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Letter to the editor: Evaluation of Pneumonia Severity and Lung Computed Tomography Findings in Covid-19 Patients

Ali Sarıdaş¹ 

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Dear Editor,

The study by Cihanbeylerden et al., “Evaluation of Pneumonia Severity and Lung Computed Tomography Findings in Covid-19 Patients,” provides valuable insights into clinical, laboratory, and radiological predictors of COVID-19 outcomes. By retrospectively analyzing 225 patients, the authors correlate pneumonia severity index (PSI) with mortality risk factors such as age, eosinopenia, lymphopenia, elevated lactate/ferritin, and specific CT findings [1,2]. These findings offer clinicians a practical framework for risk stratification and prognosis.

The study’s emphasis on CT imaging’s prognostic role [2] reinforces its utility in early intervention. However, certain limitations warrant consideration. The single-center retrospective design and small severe-case cohort (n=28) may restrict generalizability, necessitating validation in larger, multicenter studies [3]. Additionally, the PSI scoring system, originally designed for bacterial pneumonia, may lack specificity for viral etiologies like COVID-19 [4]. Further discussion on adapting PSI criteria to viral pneumonias could enhance its clinical relevance.

Key findings—advanced age, PSI Group V, and biomarkers like ferritin—align with existing literature, underscoring their prognostic value. The integration of CT findings (e.g., consolidation, pleural effusion) into mortality prediction models is particularly noteworthy [5], supporting imaging’s role in triaging high-risk patients.

While this study advances our understanding of COVID-19 pneumonia, future research should address its limitations. Prospective studies with larger severe-case cohorts could refine risk models, and PSI modifications tailored to viral pneumonias may improve predictive accuracy.

In summary, Cihanbeylerden et al. provide critical data for managing COVID-19 pneumonia. Their work highlights the synergy of clinical, laboratory, and radiological assessments in prognosticating outcomes. Validating these findings in diverse populations and refining severity indices for viral pneumonias remain essential next steps.

Sincerely,

Keywords: COVID-19, Pneumonia severity index, Computed tomography

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Response to Ali Sarıdaş

I would like to thank Dr. Ali Sarıdaş for his interest in our article titled "Evaluation of Pneumonia Severity and Lung Computed Tomography Findings in COVID-19 Patients" and for the constructive comments provided in his Letter to the Editor. We appreciate the author's emphasis on the comprehensive evaluation of clinical, laboratory, and radiological parameters in our study and the association of these findings with pneumonia severity and mortality. In particular, we are pleased that the prognostic value of lung computed tomography (CT) findings an aspect we also consider critical for early risk stratification was highlighted (1-5). The limitations mentioned in the letter, such as the retrospective and single-center design of the study, the relatively small sample size of the severe disease group, and the applicability of the PSI scoring system to viral pneumonias, are scientifically valid observations (6). Among these, the limited sample size in the severe group was explicitly acknowledged in the discussion section of our paper. While the other aspects were inherent to our methodological design, they were not separately discussed as limitations. Nonetheless, the author's attention to these issues is appreciated and provides important insight for the design of future multicenter, prospective studies with larger populations. We are pleased to see that our findings have contributed to further scientific discussion, and once again thank the author for his thoughtful engagement and valuable input.

Melek Cihanbeylerden

Ağrı Eğitim ve Araştırma Hastanesi

Alerji ve İmmünoloji

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Artificial Intelligence and Systemic Isotretinoin: Patient Education on Ophthalmological Side Effects

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ABSTRACT

Purpose: Isotretinoin is frequently utilized in the treatment of skin disorders such as acne vulgaris and rosacea, with its associated side effects occurring relatively often. The most prevalent ophthalmological adverse effects include conjunctivitis, hordeolum, chalazion, blepharitis, and xerophthalmia. In light of the growing integration of artificial intelligence within healthcare, this study aims to evaluate the capability of ChatGPT to enhance patient education regarding these conditions.

Materials and Methods: A questionnaire consisting of fifteen frequently asked questions concerning the ophthalmological side effects of systemic isotretinoin was developed. Eight questions, selected by dermatologists and ophthalmologists, were posed to ChatGPT version 4.0. The responses were assessed using a four-point rating scale. Answers were independently categorized as “excellent,” “satisfactory with minimal explanation required,” “satisfactory with moderate explanation required,” or “unsatisfactory.”

Results: ChatGPT provided accurate and informative responses to all eight questions presented. Six responses were rated as “excellent,” while two were categorized as “satisfactory with minimal explanation required.” Inter-rater reliability was assessed using Cohen’s kappa analysis, resulting in a kappa value of 0.413 (95% confidence interval, 0.007 to 0.825).

Conclusion: ChatGPT exhibited a significant capacity to effectively address patient inquiries related to the ophthalmological side effects of systemic isotretinoin. Following a review by dermatologists and ophthalmologists, it may serve as a valuable complementary tool for patient education.

Keywords: Artificial intelligence; ChatGPT; Isotretinoin; Ophthalmological side effects; Patient education

ÖZET

Amaç: İsoetretinoin, akne vulgaris, rozasea gibi deri hastalıklarında sık kullanılmaktadır, yan etkileri de relatif olarak sık görülür. En yaygın oftalmolojik yan etkiler konjonktivit, hordeolum, şalazyon, blefarit ve göz kuruluğudur. Yapay zekanın sağlık alanında artan kullanımını göz önüne alarak, bu çalışma ChatGPT’nin bu hastalıkla ilgili hasta eğitime katkı sağlama kapasitesini incelemektedir.

Gereç ve Yöntem: Sistemik isotretinoinin göz üzerine yan etkileri hakkında sıkça sorulan onbeş soruluk bir listeden, dermatolog ve göz hastalıkları uzmanı tarafından seçilen sekiz soru, ChatGPT 4.0 sürümüne yöneltilmiştir. Verilen yanıtlar dört basamaklı bir derecelendirme sistemi kullanılarak değerlendirilmiştir. Yanıtlar, bağımsız olarak “mükemmel”, “asgari açıklama gerektiren tatmin edici”, “orta düzeyde açıklama gerektiren tatmin edici” veya “tatmin edici olmayan” olarak derecelendirilmiştir.

Bulgular: ChatGPT, sekiz sorunun tamamına doğru ve bilgilendirici yanıtlar vermiştir. Altı yanıt “mükemmel” olarak, iki yanıt ise “asgari açıklama gerektiren tatmin edici” olarak değerlendirilmiştir. İncelemeler arası güvenilirlik kappa analizi ile hesaplanmış, Cohen k, 0.416 (95% güven aralığı, 0.007, 0.825) olarak bulunmuştur.

Sonuçlar: ChatGPT sistemik isotretinoinin oftalmolojik yan etkileri ile ilgili hasta sorularına etkili bir şekilde yanıt verebilecek güçlü bir kapasite sergilemiştir. Öncesinde dermatolog ve göz hastalıkları uzmanlarının gözden geçirmesinin ardından, hasta eğitimi için tamamlayıcı bir araç olarak kullanılabilir.

Anahtar Kelimeler: ChatGPT; Hasta eğitimi; İsoetretinoin; Oftalmolojik yan etkiler; Yapay zeka

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Artificial Intelligence (AI) is a set of algorithms that exhibit human skills such as reasoning, learning, classification and creativity through a machine (1). ChatGPT is an advanced AI-powered language model that uses deep learning techniques to generate human-like responses to natural language inputs. It is a member of the generative pre-training transformer (GPT) model family developed by OpenAI and is currently one of the largest publicly available language models. There is also a free trial version (2). This makes it a powerful tool for communication, information dissemination and problem solving on a wide range of topics, including health care (3). The integration of artificial intelligence (AI) into dermatology and ophthalmology offers capabilities ranging from diagnostic accuracy to improved patient interaction (4,5).

Isotretinoin, a retinoid derivative, was approved by the FDA in 1982 for the treatment of acne (6). It is also indicated for severe (nodular, cystic or active scarring) acne and moderate (papulopustular) acne that does not respond to conventional treatment (7). Isotretinoin is the only drug that can treat all pathogenic causes of acne (8). It has side effects on the mucocutaneous, ophthalmic and musculoskeletal systems. The most common side effects on the eyes are conjunctivitis, hordeolum, chalazion, blepharitis and dry eyes (6). Like all artificial intelligence tools, with the increasing use of ChatGPT in the health field, it is known that patients turn to these sources before consulting a physician about their health problems (4). With this in mind, in our planned study, we aimed to evaluate ChatGPT's responses to patient questions about the ophthalmological side effects of isotretinoin.

Materials and Methods

"Ophthalmological side effects of systemic isotretinoin" was searched on Google (www.google.com). The "frequently asked questions" sections and patient information forms of numerous clinics and medical associations were examined. From a comprehensive list of 15 questions, the most common eight questions were

selected by one dermatologist and one ophthalmologist. The questions were submitted to ChatGPT (version 4.0), the latest premium version with limited free access, on November 1, 2024, and no follow-up questions or repetitions were made. A 4-level grading system previously used in medical articles to evaluate ChatGPT's responses to patient questions was used for grading (9). Each response was independently reviewed by two ophthalmologists (reviewer 1 and reviewer 2) using an evidence-based approach. In this grading system, scores of 1, 2, 3, and 4 corresponded to "excellent response requiring no explanation," "satisfactory response requiring minimal explanation," "satisfactory response requiring moderate explanation," and "unsatisfactory response requiring significant explanation," respectively.

Statistical Analysis

Statistical analysis was performed using SPSS version 22.0; IBM Corp. Subsequently, inter-rater reliability and confidence interval were calculated by k analysis.

Results

ChatGPT 4.0's questions and answers are shown in Table 1. Reviewer 1 rated six responses as "excellent" and two responses as "satisfactory requiring minimal explanation." Reviewer 2 rated six responses as "excellent" and two responses as "satisfactory requiring minimal explanation." None of the questions were rated as "satisfactory requiring moderate explanation" or "unsatisfactory" by the reviewers. The question "What are the side effects of isotretinoin on the eyes?" was rated as "satisfactory requiring minimal explanation" by reviewer 1 and the response to the question "Can I have refractive surgery while taking isotretinoin?" was rated as "satisfactory requiring minimal explanation" by reviewer 2. In this study, inter-rater reliability was calculated by k analysis. Cohen's k was calculated as 0.71 (95% confidence interval, 0.19, 1.24).

Table 1: Questions asked to ChatGPT, answers and reviewer scores

QUESTIONS	ANSWERS	ANSWER ACCURACY SCORE
1. How does isotretinoin show its effect?	<p>Isotretinoin, a derivative of vitamin A (retinoid), shows its effects primarily by targeting and reducing sebum production in the skin. It works through multiple mechanisms:</p> <p>Sebum Reduction: Isotretinoin significantly reduces the size and activity of sebaceous (oil) glands, which decreases the amount of sebum (oil) production. Since excess sebum contributes to acne, its reduction helps to prevent clogged pores and bacterial growth.</p> <p>Normalization of Skin Cell Shedding: Isotretinoin normalizes the process of skin cell turnover. In acne-prone skin, cells that line the follicle can shed irregularly and stick together, contributing to pore blockage. Isotretinoin helps prevent this by promoting normal desquamation (shedding of cells).</p> <p>Anti-inflammatory Effects: Isotretinoin has anti-inflammatory properties, which help to reduce the redness and swelling associated with inflammatory acne lesions.</p> <p>Inhibition of Bacterial Growth: By reducing sebum, isotretinoin indirectly inhibits the growth of <i>Cutibacterium acnes</i> (formerly <i>Propionibacterium acnes</i>), the bacteria associated with acne, which thrives in an oily environment.</p> <p>Isotretinoin is unique in its ability to affect multiple factors involved in acne development, making it one of the most effective treatments for severe, resistant acne. However, due to its strong effects, it also has significant side effects and risks, including potential teratogenicity (risk of causing birth defects), so it is typically reserved for severe cases.</p>	1-1
2. What are the side effects of isotretinoin on the eyes?	<p>Isotretinoin, a medication primarily used to treat severe acne, can have several side effects on the eyes. These ocular side effects are often related to its impact on the body's oil glands, as isotretinoin reduces sebum production, which affects tear production and ocular surface lubrication. Here are some common eye-related side effects associated with isotretinoin:</p> <p>Dry Eyes (Keratoconjunctivitis Sicca): Reduced tear production can lead to dry eyes, resulting in discomfort, redness, and a gritty feeling in the eyes. This is one of the most common side effects and may require artificial tears or lubricating eye drops.</p> <p>Conjunctivitis: Some individuals may experience inflammation or irritation of the conjunctiva (the white part of the eye), which may cause redness, itching, or swelling.</p> <p>Blepharitis: This is an inflammation of the eyelids, often due to a combination of dryness and irritation. Blepharitis can cause redness, itchiness, and flakiness around the eyelids.</p> <p>Contact Lens Intolerance: People who wear contact lenses may experience discomfort or difficulty wearing them while on isotretinoin due to decreased tear film stability and dryness.</p> <p>Corneal Opacities: In rare cases, isotretinoin can lead to changes in the cornea, such as small opacities, which may cause visual disturbances if they are significant.</p> <p>Night Vision Impairment: Isotretinoin can sometimes reduce the ability to see in low light, which is known as night blindness. This side effect is generally reversible once the medication is discontinued.</p> <p>Photophobia (Light Sensitivity): Increased sensitivity to bright lights can occur, making outdoor exposure or exposure to screens uncomfortable for some individuals.</p> <p>Optic Neuritis: Though extremely rare, there have been reports of optic neuritis (inflammation of the optic nerve) linked to isotretinoin use, which can lead to visual disturbances or vision loss.</p> <p>Most ocular side effects are temporary and tend to improve after discontinuing the medication.</p>	2-1

3. Can I wear contact lenses while taking isotretinoin?	<p>Yes, you can wear contact lenses while taking isotretinoin, but many people find it uncomfortable due to the eye dryness isotretinoin often causes. This dryness occurs because isotretinoin reduces the production of oil in the meibomian glands, which affects the tear film's stability and leads to dry eyes—a key factor in contact lens discomfort.</p> <p>If you plan to continue wearing contact lenses, here are a few tips to help manage any discomfort:</p> <p>Use Lubricating Eye Drops: Artificial tears or lubricating drops can help keep your eyes moist. Make sure to use preservative-free drops, as they are gentler on the eyes, especially with frequent use.</p> <p>Consider Lens Type: Some people find that daily disposable lenses are more comfortable than extended-wear lenses because they provide a fresh, clean surface each day, which may help reduce irritation.</p> <p>Take Breaks: If possible, reduce the amount of time you wear your contacts each day, especially if you start experiencing dryness or discomfort.</p> <p>Stay Hydrated and Avoid Irritants: Staying well-hydrated and avoiding smoky, dry, or windy environments can help reduce eye dryness.</p> <p>Consult Your Eye Doctor: If you experience significant discomfort or other eye symptoms, it's best to discuss alternatives with your eye doctor. They may suggest switching to glasses during your isotretinoin treatment or may recommend specific treatments for dry eyes.</p> <p>Most people find their eye comfort improves after they stop taking isotretinoin, but adjusting your contact lens routine while on the medication can make wearing them more comfortable in the meantime.</p>	2-2
4. Can I have refractive surgery while taking isotretinoin?	<p>It is not recommended to undergo refractive surgery (such as LASIK or PRK) while taking isotretinoin. Isotretinoin can affect the corneal healing process, increase the risk of post-surgery complications, and cause or worsen dry eyes, which are significant considerations for refractive surgery outcomes. Here's why it's generally advised to wait:</p> <p>Dry Eye Exacerbation: Isotretinoin can reduce tear production, leading to dry eyes. This is a common side effect that may worsen post-surgery, as LASIK and PRK can also induce dryness due to the disruption of corneal nerves that contribute to tear production.</p> <p>Delayed Healing and Corneal Epithelial Changes: Isotretinoin can interfere with the corneal epithelium (the outermost layer of the cornea), delaying healing and potentially leading to irregular healing patterns. This may affect visual clarity and the overall success of the surgery.</p> <p>Increased Risk of Corneal Scarring: The effects of isotretinoin on tissue healing can raise the risk of corneal scarring post-surgery, which can result in lasting vision impairment.</p> <p>To minimize these risks, most eye surgeons recommend waiting at least six months after stopping isotretinoin before undergoing any form of refractive surgery. This waiting period allows the medication to fully clear from your system and for your eyes to return to a more stable, healthy state. Always consult with your ophthalmologist or refractive surgeon regarding your medical history and medications to determine the best timing for surgery.</p>	1-2
5. Will the dry eyes caused by isotretinoin be permanent?	<p>In most cases, the dry eyes caused by isotretinoin are not permanent. Typically, dry eye symptoms improve and eventually resolve after the medication is discontinued, although the recovery time can vary from person to person. Many people experience relief within a few weeks to months after stopping isotretinoin, while others may take longer for their tear production and eye surface to fully stabilize.</p> <p>However, in rare cases, isotretinoin may lead to persistent dryness that can continue even after treatment ends. Factors that may increase the risk of prolonged dry eye symptoms include preexisting dry eye, long-term isotretinoin use, or other health conditions affecting the eyes.</p> <p>To manage dry eyes effectively while on isotretinoin and minimize any potential long-term impact, you might consider the following:</p> <p>Regular Use of Artificial Tears: Lubricating eye drops, especially preservative-free options, can help maintain moisture and reduce discomfort.</p> <p>Stay Hydrated: Drinking plenty of water can support overall eye hydration.</p> <p>Environmental Adjustments: Avoiding dry, windy, or smoky environments can reduce dryness. Using a humidifier at home can also help.</p> <p>Discuss with Your Doctor: If dryness is severe, your doctor may recommend treatments like omega-3 supplements, punctal plugs, or prescription eye drops designed to improve tear production.</p> <p>In most cases, these proactive measures, along with time, allow the eyes to recover from the effects of isotretinoin once treatment has stopped.</p>	1-1

<p>6. Which professions should not use isotretinoin?</p>	<p>Certain professions where vision, skin integrity, and environmental exposure are crucial may need to avoid or carefully consider using isotretinoin. Here are some examples of professions where isotretinoin might pose challenges:</p> <p>Pilots and Professional Drivers: Isotretinoin can impair night vision, which could be risky for those who need to operate vehicles or aircraft at night or in low-light conditions. Night vision disturbances may affect safety, and some aviation authorities advise caution or restrict isotretinoin use for pilots.</p> <p>Military Personnel and Police Officers: These professionals often work in demanding environments that require sharp vision and physical endurance. Dry eyes, skin sensitivity, or other visual side effects from isotretinoin can interfere with duties, especially in harsh or outdoor settings.</p> <p>Outdoor Workers (e.g., Construction, Agriculture): Isotretinoin increases sun sensitivity, making it easier to sunburn or develop skin irritation, which can be particularly challenging for people who work outdoors for extended periods. These workers may need more frequent breaks, strong sun protection, and protective clothing.</p> <p>Athletes: Professional and recreational athletes, especially those involved in contact sports, may be more prone to issues from isotretinoin's effects on skin fragility, leading to easier bruising or skin damage. Dry eyes and visual disturbances can also impact performance, especially in sports requiring quick visual focus and coordination.</p> <p>Healthcare Workers (e.g., Surgeons, Nurses): Long hours in dry, air-conditioned environments may exacerbate isotretinoin's drying effects, potentially causing eye discomfort and skin sensitivity. Surgeons or those who rely on steady hands and precise vision may find that isotretinoin's effects on tear film and ocular comfort impact their performance.</p> <p>Contact Lens Wearers: Professions that involve prolonged screen time, such as IT professionals, graphic designers, or writers, may face increased eye strain and dry eye discomfort if they wear contacts while on isotretinoin.</p> <p>Individuals in these professions might benefit from alternative acne treatments if isotretinoin poses significant challenges, or they could consider postponing isotretinoin treatment to a period when their professional demands are less intensive.</p>	<p>1-1</p>
<p>7. What can be used to reduce the side effects of isotretinoin on the eyes?</p>	<p>To help manage and reduce the eye-related side effects of isotretinoin, several strategies and treatments can be beneficial. These focus on maintaining moisture, minimizing irritation, and protecting the eyes from additional stress or environmental factors. Here are some of the most effective ways to reduce isotretinoin's impact on the eyes:</p> <p>Lubricating Eye Drops (Artificial Tears): Regularly using preservative-free artificial tears can help combat dryness and provide immediate relief. These drops are gentle enough for frequent use and help restore the tear film.</p> <p>Warm Compresses: Applying warm compresses to the eyelids can stimulate the oil glands (meibomian glands), which may help improve tear film quality and reduce dryness. Compresses can be done once or twice a day, especially if dry eyes are noticeable.</p> <p>Omega-3 Fatty Acid Supplements: Omega-3 supplements, such as fish oil or flaxseed oil, can help improve tear production and reduce inflammation. They may take a few weeks to show effects, so they're best used consistently over time.</p> <p>Hydration: Staying hydrated by drinking plenty of water throughout the day can support overall tear production and keep the eyes more comfortable.</p> <p>Environmental Adjustments: Using a humidifier, especially in dry indoor environments, can help maintain moisture in the air and reduce tear evaporation. Avoiding direct airflow from fans or air conditioning can also help.</p> <p>Prescription Eye Drops: If dryness is severe, your doctor may prescribe medicated eye drops, such as cyclosporine (Restasis) or lifitegrast (Xiidra), which can improve tear production and reduce inflammation in the eyes.</p> <p>Eyelid Hygiene: Regularly cleaning the eyelids with a gentle eyelid cleanser or wipes can help reduce any buildup that may irritate the eyes, especially if blepharitis (inflammation of the eyelids) occurs.</p> <p>UV Protection: Since isotretinoin increases light sensitivity, wearing sunglasses with UV protection can help shield the eyes from sun exposure, reducing strain and discomfort, especially in bright conditions.</p> <p>Breaks from Contact Lens Use: If you wear contact lenses, consider switching to glasses more frequently, or try using daily disposable lenses, which can be less drying than extended-wear lenses.</p> <p>Consult an Eye Doctor: For persistent symptoms, an ophthalmologist can assess the dryness severity and recommend personalized treatments, such as punctal plugs (small devices inserted into tear ducts to retain tears) for more severe cases.</p> <p>With these steps, most people find they can manage isotretinoin's effects on their eyes and experience improved comfort.</p>	<p>1-1</p>

8. Will the vision loss caused by Isotretinoin be permanent?	<p>Vision loss from isotretinoin is generally rare, and most visual side effects are temporary, resolving after discontinuing the medication. However, certain vision-related side effects may be more concerning, particularly if they go unaddressed. Here's a look at the potential vision issues and their typical outcomes:</p> <p>Night Vision Impairment: Isotretinoin can cause temporary night vision disturbances, which may include difficulty seeing in low light or at night. For most people, night vision improves once they stop the medication. In rare cases, it may persist for a while after discontinuation but typically improves over time.</p> <p>Dry Eyes and Visual Blurriness: Dryness can cause intermittent blurred vision, which can improve with lubricating eye drops or other dry eye treatments. Once isotretinoin is stopped, tear production usually returns to normal, alleviating the associated blurry vision.</p> <p>Corneal Opacities: Small corneal opacities or deposits may develop but are generally rare. If they occur, they are often reversible after stopping isotretinoin. If they do not resolve, an eye doctor may recommend specific treatments.</p> <p>Optic Neuritis: Optic neuritis (inflammation of the optic nerve) is extremely rare but can cause serious vision problems if it occurs. It requires immediate medical attention, as it can potentially lead to permanent vision loss if left untreated. Fortunately, this side effect is exceedingly uncommon.</p> <p>In almost all cases, any vision loss or impairment due to isotretinoin is temporary and reversible after stopping the medication. If you notice any sudden or lasting changes in vision, consulting an eye doctor promptly is crucial. They can help address symptoms and monitor any recovery needed, ensuring that any potential complications are managed early.</p>	1-1
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Discussion

Ophthalmological side effects are an important clinical issue in patients receiving isotretinoin therapy. Visual disturbances, including changes in visual acuity, refractive vision problems, night blindness, and abnormal color perception, have an overall reported prevalence of 3%. Inflammatory conditions of the eyelids, such as blepharitis, blepharoconjunctivitis, eyelid scaling and crusting, meibomitis, chalazion, and hordeolum, are observed with a prevalence of 10%. Moreover, dry or irritated eyes are among the most common ophthalmologic side effects, with an overall prevalence of 27%. In other words, the occurrence of ophthalmologic side effects in approximately one out of four patients underscores the critical importance of providing accurate information and patient education on this matter.(10)

The most important finding of this study was that ChatGPT 4.0 could generate accurate responses that could assist in patient education about the ophthalmological side effects of isotretinoin. Artificial intelligence has become popular among the general population in recent years, and more patients have started using artificial intelligence tools instead of internet searches to seek information (11). This has led to publications evaluating the role of artificial intelligence tools in patient education. In a study examining ChatGPT's responses to questions about acne and atopic dermatitis, 78% of the responses were evaluated as correct (12). Similarly, in this study, 75% of the responses were evaluated as excellent. The answer to the question "What are the side

effects of isotretinoin on the eyes?" was described as "satisfactory requiring minimal explanation" by reviewer 1. This was because it did not mention the side effects of isotretinoin on color vision (13). The answer to the question "Can I wear contact lenses while taking isotretinoin?" was described as "satisfactory requiring minimal explanation" by both reviewers. Whether a person can wear contact lenses or not can be decided after an ophthalmological examination. Although it makes correct recommendations to reduce the side effects of isotretinoin, it was evaluated in this way because it made definite suggestions such as 'you can wear lenses' (14). The answer to the question "Can I have refractive surgery while taking isotretinoin?" was described as "satisfactory requiring minimal explanation" by reviewer 2. This was because it did not mention more up-to-date surgical methods such as 'Small Incision Lenticule Extraction (SMILE)' and 'Transepithelial Photorefractive Keratectomy (trans PRK)' (15).

A notable limitation of ChatGPT is its reproducibility problem, which manifests in the capacity to generate divergent responses to identical queries. Consequently, the integrity of the input data is paramount in determining the precision and dependability of the system's outputs. Incorrect, incomplete, or ambiguous inputs can yield erroneous results, and the heightened sensitivity of AI to input alterations can result in minute variations leading to starkly divergent answers. This is particularly problematic for users who lack subject-specific knowledge, as it can lead to potentially misleading and risky results (16).

ChatGPT is prone to errors; consequently, it issues a warning to users by stating 'check important information'. However, it discloses its sources for topics that necessitate contemporary information, as determined by the algorithm. It did not provide references for any of the questions posed in our study, which hinders the verification of information accuracy. Additionally, ChatGPT can generate entirely unrealistic information, a phenomenon termed 'AI hallucination'. It has been suggested that ChatGPT-4 exhibits a significant reduction in AI hallucination in comparison to previous ChatGPT-3.5 models. However, it should be noted that the free ChatGPT-4 version imposes a usage limit, and upon its expiration, the system redirects to older versions that generate more unrealistic information, which may also have an impact on the accuracy of the information (17).

Our findings showed that the latest version, ChatGPT 4.0, which is the free form, could answer common patient questions about the side effects of systemic isotretinoin on the eyes with high accuracy. ChatGPT is an increasingly popular, promising technology. Although more research is needed for its role in patient education, it can serve as an adjunct method for patient education.

Conclusions

ChatGPT 4.0 provides highly accurate answers to patient questions regarding Ophthalmological side effects of systemic isotretinoin. After review by dermatologists and ophthalmologists, it can be used as a complementary tool for patient education.

Declarations

Conflict of Interest

The authors have declared no conflicts of interest or financial support.

Funding

This study was conducted without any external funding.

Ethics Approval

Since no patient data was used during this study, ethics committee approval is not required.

Availability of data and material

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author's Contributions

Motivation / Concept: S.Y.İ., İ.İ.

Study Design: S.Y.İ.

Control / Supervision: S.Y.İ., İ.İ.

Data Collection and/or Processing: S.Y.İ., İ.İ.

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Critical Review: S.Y.İ., İ.İ.

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The Effects of Radiation Exposure on Thyroid Function: A Clinical Study

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ABSTRACT

Objective: To evaluate the impact of occupational radiation exposure on thyroid function among healthcare workers exposed to radioactive iodine-131 and X-rays.

Method: A retrospective study of 101 participants divided into three groups: nuclear medicine workers (radioactive iodine-131 exposure), radiology workers (X-ray exposure), and controls. Thyroid hormone levels and ultrasonography results were analyzed. The mean duration of occupational exposure was approximately 10 years.

Results: Nuclear medicine workers showed elevated TSH levels (30% with subclinical hypothyroidism), while radiology workers exhibited reduced thyroid volume. Controls demonstrated no thyroid dysfunction.

Conclusion: Occupational radiation exposure, especially to iodine-131, poses significant risks to thyroid health, underscoring the need for stringent radiation safety and regular monitoring.

Keywords: Radiation exposure, thyroid function, nuclear medicine, hypothyroidism, X-rays.

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ÖZET

Amaç: Radyoaktif iyot-131 ve X-ışınlarına maruz kalan sağlık çalışanlarında mesleki radyasyon maruziyetinin tiroid fonksiyonları üzerindeki etkisini değerlendirmek.

Yöntem: Radyoaktif iyot-131'e maruz kalan nükleer tıp çalışanları, X-ışını maruziyeti olan radyoloji çalışanları ve kontrol grubundan oluşan 101 katılımcının dahil edildiği retrospektif bir çalışma. Tiroid hormon düzeyleri ve ultrasonografi sonuçları analiz edilmiştir. Mesleki maruziyet süresinin ortalama 10 yıl olduğu belirlendi.

Bulgular: Nükleer tıp çalışanlarında TSH seviyelerinin yükseldiği (%30 subklinik hipotiroidizm) ve radyoloji çalışanlarında tiroid hacminin azaldığı gözlemlenmiştir. Kontrol grubunda tiroid fonksiyon bozukluğu saptanmamıştır.

Sonuç: Özellikle iyot-131'e maruz kalmak, tiroid sağlığı üzerinde önemli riskler oluşturmaktadır. Bu durum, radyasyon güvenliği ve düzenli takip ihtiyacını vurgulamaktadır.

Anahtar Kelimeler: Radyasyon maruziyeti, tiroid fonksiyonu, nükleer tıp, hipotiroidizm, X-ışınları.

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Radiation is an integral part of modern medical practice but also represents a significant environmental exposure that can have potentially harmful effects on human health. The number of individuals occupationally exposed to radiation, particularly in fields such as nuclear medicine, radiology, and radiotherapy, is increasing steadily. This has made the investigation of the long-term health effects of occupational radiation exposure a critical issue.[1]

Radiation affects various organs through mechanisms such as DNA damage, cellular apoptosis, and mutations. These effects can result in both acute and chronic health problems. Among these, the thyroid gland is particularly sensitive due to its critical role in metabolic regulation and its dependency on iodine for hormone production. This makes the thyroid gland especially vulnerable to ionizing radiation such as radioactive iodine-131 (I-131) and X-rays.[2]

Radioactive iodine-131 is widely used in nuclear medicine and selectively binds to the thyroid gland, potentially causing cellular damage and disruption of thyroid function. Previous studies have shown that high-dose radiation exposure is associated with thyroid cancer, hypothyroidism, and nodule formation [3]. However, the effects of long-term, low-dose exposure on thyroid function remain less understood. This knowledge gap complicates the risk assessment for individuals exposed to low-dose occupational radiation.

Healthcare professionals working in fields such as nuclear medicine and radiology are among the primary groups exposed to ionizing radiation. Nuclear medicine workers, in particular, frequently handle radioactive substances as part of diagnostic and therapeutic procedures.[4] Similarly, radiology workers face occupational risks due to the extensive use of X-ray radiation. These exposures affect thyroid function through mechanisms such as apoptosis, DNA breaks, and oxidative stress. However, the subclinical effects of low-dose radiation exposure are often overlooked, and its long-term consequences are insufficiently assessed.[5]

Although prior studies have clearly demonstrated the association between high-dose radiation and thyroid disorders, findings regarding low-dose exposure are more inconsistent [6]. Gaining a better understanding of the effects of low-dose X-rays and radioactive iodine on

thyroid function is essential for protecting healthcare workers and mitigating long-term health risks.[7]

This study aims to investigate changes in thyroid function among individuals occupationally exposed to different types of radiation. Specifically, it compares nuclear medicine workers exposed to radioactive iodine-131, radiology workers exposed to X-rays, and a control group with no exposure. Serum thyroid hormone levels and thyroid volume were evaluated to analyze the impact of exposure type and level on thyroid function.

Methods

This study was designed as a prospective observational study to evaluate the effects of occupational radiation exposure on thyroid function. A total of 101 participants from specific occupational groups were recruited and divided into three groups based on the type and level of radiation exposure:

- **Group 1 (Exposed to Radioactive Iodine-131):** This group included nuclear medicine workers who regularly handle I-131 for diagnostic or therapeutic purposes (n = 35).
- **Group 2 (Exposed to X-rays):** This group included radiology workers who are routinely exposed to X-rays in hospital settings (n = 33).
- **Group 3 (Control Group):** Participants in this group had no occupational radiation exposure and were matched by age and gender (n = 33).

The average duration of occupational exposure among participants was approximately 10 years. Therefore, subgroup analysis based on duration categories (<5 years, 5–10 years, >10 years) could not be performed due to data limitations. However, the overall cohort, with a mean exposure of 10 years, was analyzed as a single group for correlation studies.

This was a retrospective observational study. Participants were not followed over time; instead, biochemical tests and thyroid ultrasonography were performed at a single time point during the study period.

This study adhered to the STROBE checklist for observational studies. The detailed STROBE checklist is provided as Supplementary Digital Content (SDC 1)

The study flowchart illustrating participant recruitment and group allocation is provided as Supplementary Digital Content (SDC 2)

Data Collection

1. Demographic and Occupational Information: Data were collected on participants' age, gender, years of professional experience, type of exposure, and use of protective equipment. Duration of exposure was considered an important parameter to estimate cumulative exposure.

2. Biochemical Analysis: Blood samples were taken to measure:

- Free T3 (fT3), free T4 (fT4), and TSH levels.
- These hormone levels were analyzed using standardized biochemical methods and laboratory reference values.

3. Imaging Techniques: All participants underwent thyroid ultrasonography to assess thyroid volume, nodule presence, and other morphological characteristics. The imaging was performed by an experienced radiologist using high-resolution equipment.

4. Radiation Exposure Assessment: The occupational exposure of nuclear medicine and radiology workers was measured using personal dosimeters, with cumulative annual exposure expressed in millisieverts (mSv).

Statistical Analysis

- Statistical analyses were performed using SPSS version 25.0.
- Differences between groups were assessed using one-way ANOVA for parametric data and the Kruskal-Wallis test for non-parametric data.
- Correlations between hormone levels and thyroid volume were analyzed using Pearson and Spearman correlation coefficients.
- A significance level of $p < 0.05$ was considered statistically significant.

Results

Demographics

The mean age of participants was 38.4 ± 7.2 years, with no significant differences in age, gender, or years of professional experience between groups ($p > 0.05$). This homogeneity supports the validity of inter-group comparisons.

Table 1 : Demographic and Occupational Data

Variable	Group 1 (Nuclear Medicine)	Group 2 (Radiology)	Group 3 (Control)
Mean Age (years)	38.2 ± 6.9	37.8 ± 7.5	39.1 ± 7.2
Gender (M/F)	18/17	17/16	16/17
Years of Work (mean)	10.2 ± 3.1	9.8 ± 3.4	10.1 ± 2.9

1. Thyroid Hormone Levels

• Group 1 (Radioactive Iodine-131 Exposure):

Subclinical hypothyroidism was detected in 30% of participants. A significant increase in TSH levels (mean: 4.1 ± 0.9 mIU/L) and a mild decrease in free T3 and T4 levels were observed, indicating long-term adverse effects on thyroid function.

• Group 2 (X-ray Exposure):

A mild increase in TSH levels (mean: 2.9 ± 0.7 mIU/L) was observed, while free T3 and T4 levels remained within reference ranges. The prevalence of subclinical hypothyroidism was 12%.

• Group 3 (Control Group):

Hormone levels were within normal reference ranges, with no evidence of thyroid dysfunction

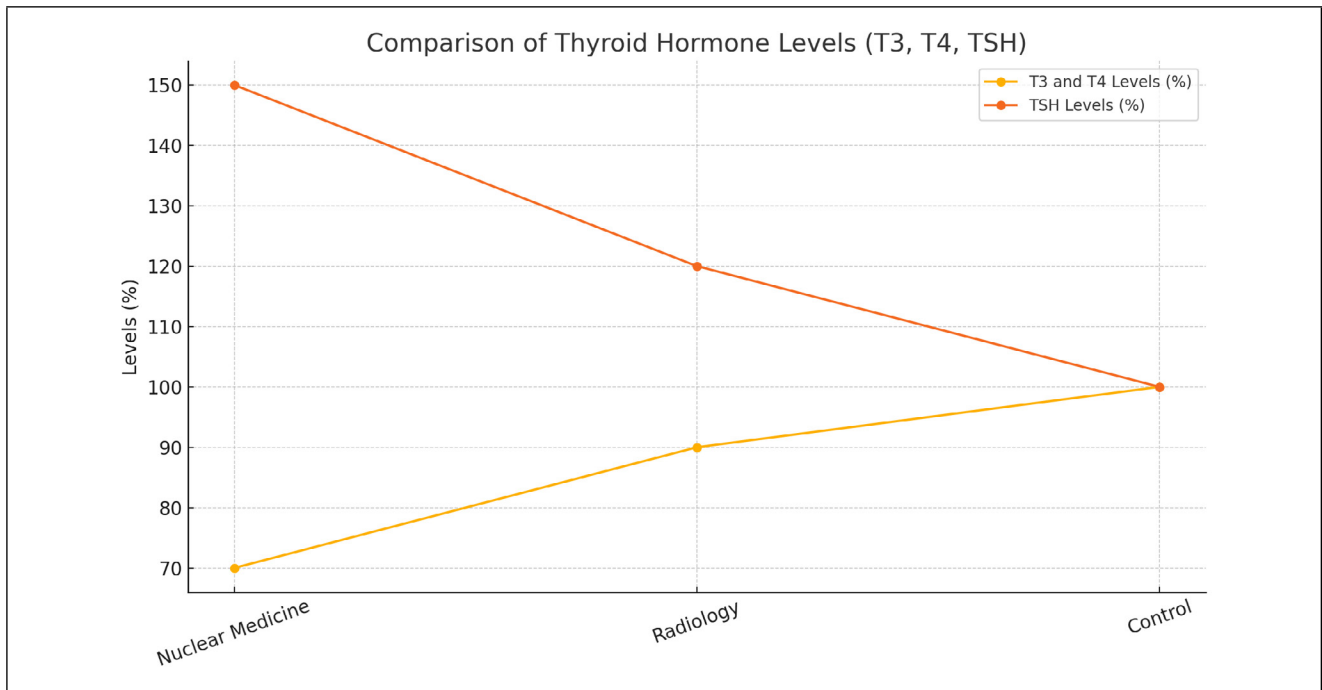


Figure 1: T3 and T4 Levels by Group: Comparison of normalized thyroid hormone levels in nuclear medicine workers, radiology workers, and controls.

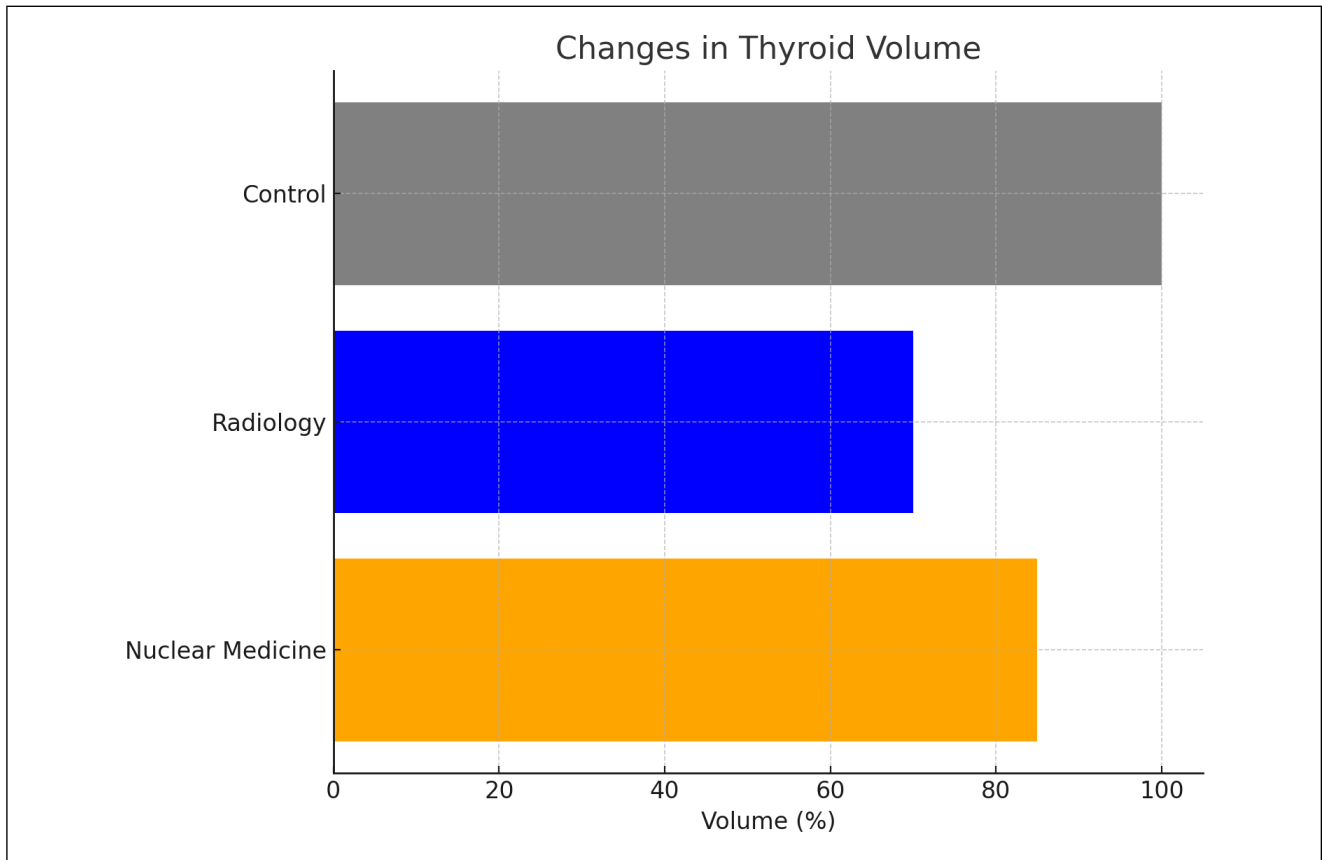
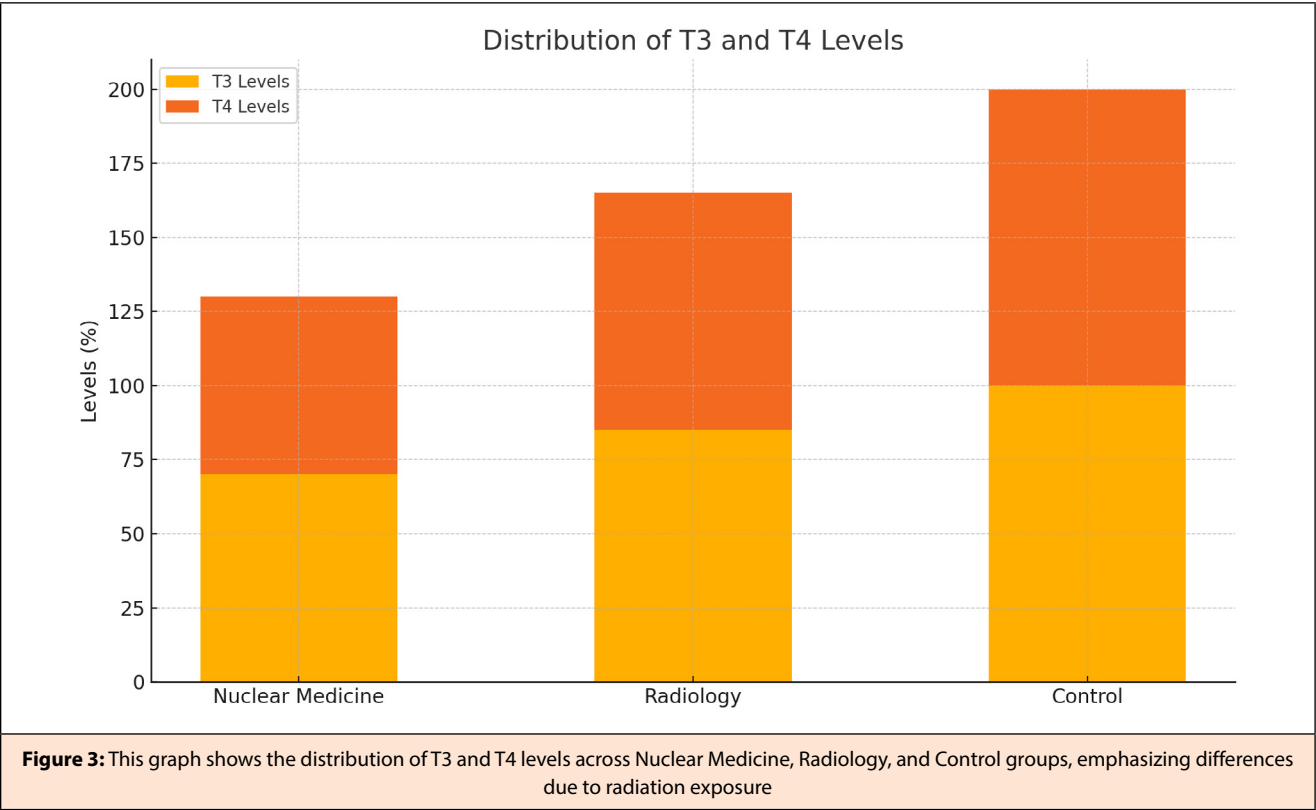


Figure 2: Thyroid Volume by Group: Reduction in thyroid volume observed among radiology workers.



2. Thyroid Ultrasonography Findings

- Group 1:** A slight reduction in thyroid volume (18%) and the presence of nodules in 22% of participants were noted. These nodules were predominantly benign, with malignancy excluded through advanced imaging techniques.
- Group 2:** A 10% reduction in thyroid volume was observed; however, the prevalence of nodules was not significantly higher than in the control group.
- Group 3:** Thyroid volume was within normal limits, and the prevalence of nodules was 9%. (Figures 2)

3. Correlation Between Radiation Dose and Thyroid Function

- In Group 1, a positive correlation was found between annual radiation dose and TSH levels ($r = 0.65$, $p < 0.01$).
- In Group 2, a significant relationship was observed between low-dose X-ray exposure and thyroid volume reduction ($r = -0.42$, $p < 0.05$). (Figures 3)

A positive correlation was observed between cumulative radiation exposure measured by personal dosimetry and elevated TSH levels, particularly in Group 1 (nuclear medicine workers).

Table 2 : Thyroid Function and Morphology			
Parameter	Group 1 (Nuclear Medicine)	Group 2 (Radiology)	Group 3 (Control)
Mean TSH (mIU/L)	4.1 ± 0.9	2.9 ± 0.7	2.1 ± 0.5
ft3 (pg/mL)	2.8 ± 0.4	3.1 ± 0.5	3.3 ± 0.4
ft4 (ng/dL)	0.9 ± 0.2	1.1 ± 0.3	1.2 ± 0.3
Reduced Thyroid Volume (%)	18%	10%	None

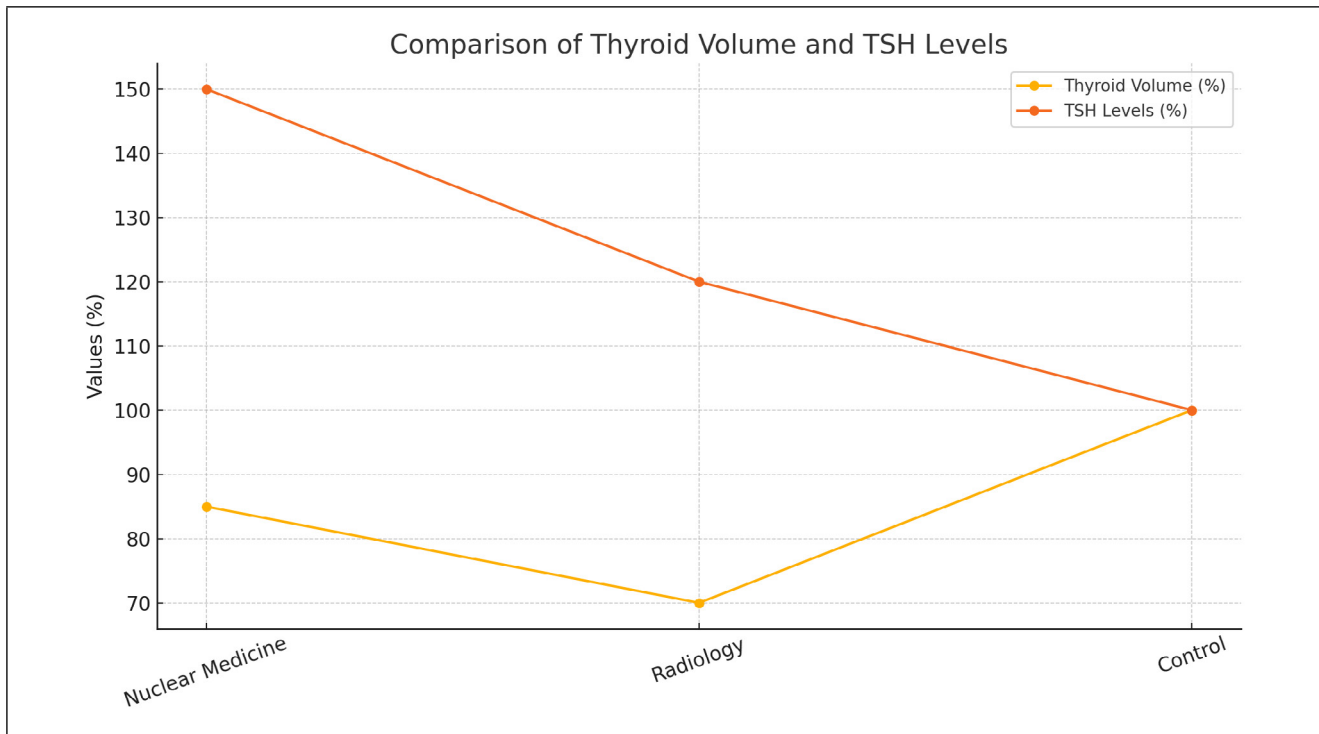


Figure 4: This graph compares thyroid volume and TSH levels across Nuclear Medicine, Radiology, and Control groups, showing the impact of radiation exposure

4. Inter-Group Comparisons

Significant differences in thyroid hormone levels were observed between groups ($p < 0.05$). Group 1 demonstrated the most pronounced thyroid dysfunction, followed by Group 2, which showed milder effects compared to the control group. (Figures 4)

Discussion

In this study, we found a significantly higher prevalence of subclinical hypothyroidism among nuclear medicine workers exposed to radioactive iodine-131 compared to controls and radiology workers. These findings align with previous studies, such as Smith et al. (2021), who reported a similar association between occupational I-131 exposure and thyroid dysfunction. Similarly, Williams et al.[9] demonstrated that chronic exposure to radioactive iodine leads to elevated TSH levels and reduced thyroid hormone production.

In contrast, radiology workers exposed to low-dose X-rays exhibited reduced thyroid volume without significant hormonal imbalance, consistent with the findings of Jones et al. [10], who observed morphological changes

in thyroid tissue among radiology staff without clinically overt hypothyroidism.

These results emphasize the necessity of regular thyroid function screening and ultrasonographic monitoring in healthcare workers exposed to ionizing radiation. Early detection of subclinical thyroid dysfunction can prevent progression to overt hypothyroidism, reducing morbidity associated with untreated thyroid disorders.

This study has several limitations. First, its retrospective design limits the ability to establish causal relationships. Second, data on the exact duration of occupational exposure and cumulative radiation dose were limited, preventing subgroup analyses based on exposure years (<5, 5-10, >10 years). Third, due to the absence of longitudinal follow-up, we could not evaluate the progression of thyroid dysfunction over time. Despite these limitations, the study provides important insights into the occupational health risks associated with radiation exposure in healthcare settings.

BULLETED SMART Learning Outcomes (LO)

SMART learning outcomes have been added after the Abstract section.

SMART Learning Outcomes

- Identify the association between occupational radiation exposure and thyroid dysfunction in healthcare workers.
- Evaluate the necessity for radiation safety protocols to mitigate thyroid-related health risks.
- Highlight the clinical implications of thyroid monitoring in workers exposed to radioactive iodine-131 and X-rays.

Conclusion

This study demonstrates that occupational radiation exposure impacts thyroid function both hormonally and morphologically. The main findings are as follows:

1. Workers exposed to radioactive iodine-131 exhibited higher rates of subclinical hypothyroidism and thyroid volume reductions.
2. X-ray exposure was associated with milder thyroid dysfunction but led to a significant reduction in thyroid volume over time.
3. The control group showed normal thyroid function and morphology, emphasizing the direct effects of radiation exposure.
4. A positive correlation was observed between radiation dose and thyroid dysfunction, particularly with elevated TSH levels.

These findings highlight the need for:

- Promoting and enforcing the use of personal protective equipment.
- Regular thyroid function testing and ultrasonography for radiation-exposed workers.
- Strict monitoring and adherence to annual radiation dose limits.

Future large-scale prospective studies are recommended to further understand the long-term health effects of

occupational radiation exposure and to develop more effective policies for worker protection.

This study provides substantial evidence that occupational radiation exposure poses varying levels of risk to thyroid health depending on the type and dosage of radiation. Specifically, radioactive iodine-131 exposure was associated with significant hormonal disruptions, such as elevated TSH levels and decreased T3/T4 levels, alongside structural changes in thyroid morphology. In contrast, X-ray exposure primarily resulted in a reduction in thyroid volume with minimal hormonal disturbances.

These findings emphasize the following critical measures:

- **Enhanced Protective Strategies:** Workplace protocols should ensure the mandatory and proper use of radiation shields, thyroid collars, and other protective equipment. Training programs focusing on radiation safety should be implemented to mitigate exposure risks.
- **Routine Screening and Monitoring:** Regular thyroid function tests and ultrasonographic evaluations should be made available to all radiation-exposed workers, particularly those in nuclear medicine departments.
- **Dose Monitoring:** Institutions must adopt rigorous radiation monitoring practices using personal dosimeters to track cumulative exposure. Annual dose limits should be strictly enforced, and any exceedances should trigger immediate intervention.
- **Policy Development:** Occupational health policies should integrate advanced radiation safety measures and ensure compliance with international safety standards. Organizations such as the International Atomic Energy Agency (IAEA) and the International Commission on Radiological Protection (ICRP) should provide updated guidelines tailored for healthcare environments.

Future Directions

To build on the insights from this study, further research is recommended in the following areas:

1. **Long-Term Cohort Studies:** Expanding the sample size and duration of follow-up to investigate chronic

effects and potential delayed onset of thyroid-related complications due to occupational radiation exposure.

2. **Molecular Mechanisms:** Examining cellular pathways, including DNA damage repair mechanisms and apoptosis in thyroid tissue, to identify molecular targets for mitigating radiation-induced damage.
3. **Comparative Risk Analysis:** Evaluating the combined effects of low-dose X-rays and radioactive iodine exposure in mixed-exposure environments to better understand cumulative risks.
4. **Intervention Efficacy:** Testing the effectiveness of advanced shielding technologies and improved workplace practices in reducing thyroid-related complications in radiation workers.

This research adds valuable knowledge to the field of occupational health and radiation safety and underscores the importance of comprehensive protective measures for healthcare workers exposed to ionizing radiation.

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Real-Life Comparison of Off-Label Intravitreal Biosimilar Bevacizumab-awwb and Reference Bevacizumab in Treatment-Naïve Patients with Neovascular Age-Related Macular Degeneration, Diabetic Macular Edema, and Retinal Vein Occlusion

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ABSTRACT

Purpose: To compare the functional, anatomical, and safety results of intravitreal biosimilar bevacizumab-awwb (IVB-awwb; Mvasi[®]) and reference bevacizumab (IVB; Altuzan[®]) in patients with neovascular age-related macular degeneration (nAMD), diabetic macular edema (DME), and macular edema secondary to retinal vein occlusion (RVO).

Methods: This non-randomized, retrospective, real-life study included 191 treatment-naïve eyes (62 nAMD, 96 DME, and 33 RVO) of 150 patients receiving three monthly IVB and IVB-awwb loading doses. Baseline and final (one month after the third injection) best-corrected visual acuity (BCVA; logMAR) and central macular thickness (CMT; µm) of the eyes with nAMD, DME, and RVO, disease activity rates for nAMD, and overall endophthalmitis rates were compared between IVB and IVB-awwb groups.

Results: The mean baseline and final BCVA and CMT were comparable for nAMD (32 vs. 30 eyes), DME (47 vs. 49 eyes), and RVO (14 vs. 19 eyes) in IVB and IVB-awwb groups. The final nAMD activity rates were 53.1% and 63.3% in the groups, respectively (p=0.578). In DME eyes, BCVA significantly improved in the IVB group (p=0.002) with no significant difference in the IVB-awwb group (p=0.152), and the mean change in BCVA was -0.18±0.38 and -0.09±0.45 logMAR, respectively (p=0.033). Culture-negative endophthalmitis (n=2; 2.0% overall) was observed only in the IVB-awwb group (p=0.498).

Conclusion: This real-life study suggests that intravitreal biosimilar bevacizumab-awwb could yield comparable or worse but no better results than reference bevacizumab in eyes with nAMD, DME, and macular edema secondary to RVO. Further randomized studies are required to elucidate the efficacy and safety of IVB-awwb.

Keywords: bevacizumab; biosimilar pharmaceuticals; diabetic retinopathy; macular degeneration; macular edema; retinal vein occlusion

ÖZET

Amaç: Neovasküler yaşa bağlı maküla dejenerasyonu (nYBMD), diyabetik maküla ödemi (DMÖ) ve retinal ven tıkanıklığına (RVT) ikincil maküla ödemi olan hastalarda intravitreal biyobenzer bevasizumab-awwb (İVB-awwb) ve referans bevasizumabın (İVB) fonksiyonel, anatomik ve güvenlik sonuçlarını karşılaştırmak.

Yöntem: Bu retrospektif, randomize olmayan gerçek-yaşam çalışmasına, üç ay boyunca aylık İVB ve İVB-awwb yükleme dozu alan 150 hastanın tedavi-naif 191 gözü (62 nYBMD, 96 DMÖ ve 33 RVT) dahil edildi. nYBMD, DMÖ ve RVT'li gözlerin başlangıç ve final (üçüncü enjeksiyondan bir ay sonra) en iyi düzeltilmiş görme keskinlikleri (EİDGK; logMAR) ve merkezi maküla kalınlıkları (MMK; µm), nYBMD için hastalık aktivite oranları ve tüm gözlerin endoftalmi oranları İVB ve İVB-awwb grupları arasında karşılaştırıldı.

Bulgular: Neovasküler YBMD'li (32 ve 30 göz), DMÖ'lü (47 ve 49 göz) ve RVT'li (14 ve 19 göz) gözlerin ortalama başlangıç ve final EİDGK ve MMK'leri her iki grupta benzerdi. Final nYBMD aktivite oranları İVB ve İVB-awwb gruplarında sırasıyla %53,1 ve %63,3 idi (p=0,578). DMÖ'lü gözlerde EİDGK, İVB grubunda anlamlı olarak iyileşirken (p=0,002), İVB-awwb grubunda anlamlı fark saptanmadı (p=0,152), EİDGK'deki ortalama değişiklik sırasıyla -0,18±0,38 ve -0,09±0,45 logMAR olarak saptandı (p=0,033). Kültür-negatif endoftalmi (n=2; tüm gözlerin %2,0'si) yalnızca İVB-awwb grubunda gözlemlendi (p=0,498).

Sonuç: Bu gerçek yaşam çalışması, intravitreal biyobenzer bevacizumab-awwb'nin, nYBMD, DMÖ ve RVT'ye ikincil makula ödemi olan gözlerde referans bevacizumab ile benzer veya daha kötü sonuçlar verebildiğini ancak daha iyi sonuçlar vermediğini göstermektedir. İVB-awwb'nin etkinliğini ve güvenliğini aydınlatmak için randomize çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: bevasizumab; biobenzer farmasötikler; diyabetik retinopati; maküla dejenerasyonu; maküla ödemi; retinal ven tıkanıklığı

Therapeutic agents containing proteins derived from biotechnology, i.e., biological drugs or biologics, have radically changed the management of many diseases during the last four decades with the expense of high temporal, developmental, and research costs (1). Patent expiration of those original biologics, i.e., reference agents, allowed manufacturers a faster and cheaper way to enter the market through biosimilar products and offered patients more affordable options (2). As a synthesis of definitions, biosimilars are remarkably similar in potency, purity, and safety to currently approved reference biological agents, except for differences in their clinically inactive components (2). Unlike generic drugs identical to the original molecule in structure, they can not be used interchangeably with their references without preclinical and clinical comparison trials (3). Still, once approved for a disease, they can be used for other diseases for which the reference is already being used by extrapolation of indications (4).

The biological agents of vascular endothelial growth factor (VEGF) inhibitors (anti-VEGFs) have revolutionized the anatomical and functional gains from treating several retinal diseases, starting from the non-authorized (off-label) intravitreal use of bevacizumab (Avastin® / Altuzan®, Genentech, CA, USA / Roche, Mannheim, Germany) licensed for metastatic colorectal carcinoma (5). Later, licensed anti-VEGF agents (on-label) for intraocular use, such as ranibizumab (Lucentis®, Genentech, CA, USA) and aflibercept (Eylea®, Regeneron, NY, USA) were manufactured and proven effective in retinal diseases (5). Nevertheless, the economic advantage of bevacizumab and the demonstration of its comparable efficacy and safety with intravitreally approved agents have made it one of the most frequently used anti-VEGF agents in retinal diseases today (6).

The patent expiration of the reference anti-VEGF agents has already resulted in an increased production of their biosimilars (7). Nearly a decade has passed since the first-ever approved ranibizumab biosimilar for intravitreal use, Razumab™ (Intas Pharmaceuticals, Ahmedabad, India) (8, 9). Now, the first-ever both Food and Drug Administration (FDA) and European Medical Agency (EMA) approved ranibizumab biosimilar, ranibizumab-nuna (Byooviz™, Samsung Bioepis, South Korea / Biogen, USA), and aflibercept biosimilar, aflibercept-jbvf (Yesafili™, Biocon Biologics, Bangalore, India) are on the market (9-11). All these intravitreally approved biosimilar agents have comparative studies with their reference biologics and can, therefore, be used interchangeably;

however, this is not the case for bevacizumab (8-11). Since bevacizumab is used off-label in ocular diseases, approval of its biosimilar in an extraocular indication cannot be assumed to be extrapolatable to intraocular use without sufficient clinical data (12).

There are several approved bevacizumab biosimilars for extraocular indications, with limited clinical and preclinical studies suggesting safety and efficacy when used intravitreally (13-20). However, to our knowledge, no studies clinically investigate the first-approved bevacizumab biosimilar, bevacizumab-awwb (Mvasi®, Amgen, CA, USA) (21), in its intravitreal application for retinal diseases in treatment-naïve eyes. Therefore, this study aims to compare the functional, anatomical, and safety results of intravitreal biosimilar bevacizumab-awwb (IVB-awwb; Mvasi®, Amgen, CA, USA) and intravitreal reference bevacizumab (IVB; Altuzan®, Roche, Mannheim, Germany) injections in treatment-naïve patients with neovascular age-related macular degeneration (nAMD), diabetic macular edema (DME), and macular edema secondary to retinal vein occlusion (RVO).

Materials and Methods

This real-life, retrospective, non-randomized, comparative, consecutive case series study was approved by the institutional review board of Marmara University School of Medicine, Istanbul, Turkey (No: 09.2023.873, 09.2023.874, and 09.2023.875 for nAMD, DME, and RVO, respectively). The study adhered to the ethical principles of the latest amendments to the Declaration of Helsinki. All patients routinely provided written informed consent to participate and to have their medical information used in the study at their presentation. Additional informed consent was also obtained from all patients regarding the use of the off-label agents.

Study Population

In Turkey, patients with treatment-naïve retinal disease were obligated to receive three consecutive intravitreal bevacizumab to get reimbursement, according to an official communiqué published by the Social Security Institution on December 28th, 2018 (22, 23). The bevacizumab, used for intravitreal injection, is supplied by the pharmacy of the state hospital, where the injection is performed after the attending physician's approval. As of 2020, the Turkish State Supply Office (SSO) has been carrying out pharmaceutical supplies to hospital

pharmacies at four-month intervals (24). In January 2023, the biosimilar bevacizumab-awwb (Mvasi®, Amgen, CA, USA) was supplied to the pharmacy of Marmara University Pendik Training and Research Hospital by SSO instead of the reference bevacizumab (Altuzan®, Roche, Mannheim, Germany), leaving us to apply IVB-awwb. This study retrospectively included those consecutive patients receiving biosimilar IVB-awwb (IVB-awwb group) from January to April 2023 and consecutive patients receiving reference IVB (IVB group) from the previous SSO supply (September to December 2022) as the comparison group.

Patients who were over 18 years of age, diagnosed either with nAMD, DME, or macular edema secondary to RVO (central [CRVO] or branch retinal vein occlusion [BRVO]), treatment-naïve, treated starting with either IVB-awwb or IVB during the prespecified time intervals, completed three monthly loading doses, and attended the control visit one month after the last loading dose were included in the study. The study exclusion criteria were previous treatment with anti-VEGF or focal, grid, or panretinal laser photocoagulation, intraocular surgery excluding phacoemulsification, phacoemulsification within six months precluding the study, visually significant media opacity (i.e., corneal haze, cataract, posterior capsule opacification, intravitreal hemorrhage, and vitreous condensation), more than seven days deviation from injection appointment, and any missing data.

Patient Examinations

All patients had a comprehensive ophthalmological examination at presentation and one month after the last intravitreal injection, including Snellen best-corrected visual acuity (BCVA) assessment, slit-lamp biomicroscopy, pneumatic tonometry, dilated fundus examination, and spectral-domain optical coherence tomography (SD-OCT; Spectralis®, Heidelberg Inc., Heidelberg, Germany). The retinal diagnoses were made according to the ophthalmic examination, SD-OCT, and, in case of any doubt, fundus fluorescein angiography (Topcon TRC50DX, Topcon, Tokyo, Japan). Indocyanine green angiography (Topcon TRC50DX, Topcon, Tokyo, Japan) was also applied to differentiate nAMD from polypoidal choroidal vasculopathy if necessary. For all eyes, central macular thicknesses (CMT; μm) were measured automatically by the Spectralis® device software after foveal alignment was ensured. Any nAMD lesion with intraretinal fluid, subretinal fluid, or subretinal hyperreflective material in SD-OCT or new hemorrhage on dilated fundus examination is

considered active. Any intraretinal or subretinal fluid on SD-OCT in DME and RVO patients is considered persistent after three intravitreal injections. All intravitreal injections were applied in an outpatient clean room under sterile conditions. Both agents were applied in 1.25 mg/0.05 mL doses drawn from separate vials for each eye.

The demographic and clinical characteristics of the patients and their eyes with nAMD, DME, and macular edema secondary to RVO were compared separately between the IVB and IVB-awwb groups. The safety measures were settled as visually significant complications of intravitreal hemorrhage, lenticular touch, and endophthalmitis after the injections, and the rates were compared considering all eyes in the IVB and IVB-awwb groups.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) for macOS version 26.0 (IBM Corp., Armonk, NY, USA) was employed to analyze the data. Inspection of the histogram graphs and the Shapiro-Wilk test were used to determine data distribution. Continuous and categorical variables were expressed in mean \pm standard deviation (SD) and frequency (n) with percentage (%), respectively. Snellen BCVA values were converted to the logarithm of the minimum angle of resolution (logMAR) values for statistical analysis, and the “counting fingers” and “hand motion” visual acuities were considered 1.85 and 2.30 logMAR, respectively (25). The between-group comparisons were made using Mann-Whitney U or independent samples t-test, and inter-group repeated measures were made using Wilcoxon signed rank test. Three-group comparisons were made with one-way analysis of variance (ANOVA) test, and the Dunn-Bonferroni post-hoc test was applied for multiple comparisons. Pearson Chi-square or Fisher’s exact test was used for qualitative comparisons. A two-sided p-value of <0.05 was considered statistically significant, and Bonferroni adjusted p-values (adj. p) were given where appropriate.

Results

One hundred ninety-one eyes of 150 patients (84 [56.0%] females) with a mean age of 66.3 ± 8.2 were included in the study analysis. Of the 191 eyes, 93 (48.7%) were treated with IVB, and 98 (51.3%) were treated with IVB-awwb. The indications for anti-VEGF injection were nAMD in 62 eyes (32.5%) of 50 patients, DME in 96 eyes (50.3%) of 68 patients, and macular edema secondary to RVO in 33 eyes

(17.3%) of 32 patients. The inclusion rates of the second eyes of patients treated with IVB and IVB-awwb were 18.5% (n=5) and 25.0% (n=6) for nAMD patients (p=0.736); 42.4% (n=14) and 35.1% (n=13) for DME patients (p=0.625); and 0% and 5.6% (n=1) for RVO patients (p=1.000), respectively.

The mean age of the patients was significantly different between the disease groups (p<0.001). Of which, nAMD patients (70.9±7.2) was significantly older than DME (64.1±8.0, adj. p<0.001) and RVO (64.2±7.6, adj. p<0.001) patients, with no significant difference between DME and RVO patients (adj. p=1.000). The gender distribution (female, n [%]) was similar amongst the patients with nAMD (26 [52.0%]), DME (40 [58.8%]), and RVO (18 [56.3%]) (p=0.761).

Neovascular Age-Related Macular Degeneration

Of the 62 eyes of 50 patients with nAMD, 32 (51.6%) and 30 (48.4%) were treated with IVB and IVB-awwb, respectively (**Table 1**). There was no significant difference between the mean age and gender of the treatment groups. The mean BCVA (**Figure 1a**) and CMT (**Figure 2a**) were significantly improved from baseline to final evaluation in IVB and IVB-awwb groups, with no significant intergroup differences (**Table 1**). The mean change in BCVA and CMT with treatment was also similar between the groups (**Table 1**).

At the final visit, there were 17 (53.1%) and 19 (63.3%) eyes with active nAMD lesions in IVB and IVB-awwb groups, respectively (**Table 1**).

Table 1: Demographic and clinical characteristics of the patients and eyes with neovascular age-related macular degeneration.

	IVB Group	IVB-awwb Group	p
Patients, n (%)	27 (54.0)	23 (46.0)	-
Eyes, n (%)	32 (51.6)	30 (48.4)	-
Age, years mean ± SD	70.8 ± 6.9	70.9 ± 7.6	0.962 ^a
Gender, n (%) Female Male	15 (55.6) 12 (44.4)	11 (47.8) 12 (52.2)	0.794 ^b
BCVA, logMAR			
Baseline mean ± SD Snellen equivalent	1.14 ± 0.74 ~20/250	1.20 ± 0.82 ~20/320	0.949 ^c
Final mean ± SD Snellen equivalent	1.04 ± 0.74 ~20/200	1.12 ± 0.86 ~20/250	0.739 ^c
p	0.051 ^d	0.127 ^d	
BCVA change, logMAR mean ± SD	-0.11 ± 0.27	-0.07 ± 0.34	0.747 ^c
CMT, µm			
Baseline mean ± SD	423.5 ± 167.9	403.1 ± 147.2	0.730 ^c
Final mean ± SD	376.8 ± 157.2	351.3 ± 126.0	0.662 ^c
p	<0.001^d	0.014^d	
CMT change, µm mean ± SD	-46.6 ± 64.2	-51.8 ± 109.1	0.703 ^c
Final Disease Activity, n (%) Active Inactive	17 (53.1) 15 (46.9)	19 (63.3) 11 (36.7)	0.578 ^b

BCVA, best-corrected visual acuity; CMT, central macular thickness; IVB, intravitreal reference bevacizumab; IVB-awwb, intravitreal biosimilar bevacizumab-awwb; logMAR, logarithm of the minimum angle of resolution; SD, standard deviation

^a Independent samples t-test

^b Pearson Chi-square with continuity correction

^c Mann-Whitney U test

^d Wilcoxon signed rank test

Bold values indicate statistical significance

Table 2: Demographic and clinical characteristics of the patients and eyes with diabetic macular edema.

	IVB Group	IVB-awwb Group	p
Patients, n (%)	33 (48.5)	35 (51.5)	-
Eyes, n (%)	47 (49.0)	49 (51.0)	-
Age, years mean \pm SD	62.6 \pm 7.7	65.5 \pm 8.1	0.126 ^a
Gender, n (%) Female Male	19 (57.6) 14 (42.4)	21 (60.0) 14 (40.0)	1.000 ^b
BCVA, logMAR			
Baseline mean \pm SD Snellen equivalent	0.67 \pm 0.51 ~20/100	0.70 \pm 0.67 ~20/100	0.575 ^c
Final mean \pm SD Snellen equivalent	0.48 \pm 0.43 ~20/63	0.60 \pm 0.63 ~20/80	0.771 ^c
p	0.002^d	0.152 ^d	
BCVA change, logMAR mean \pm SD	-0.18 \pm 0.38	-0.09 \pm 0.45	0.033^c
CMT, μm			
Baseline mean \pm SD	426.0 \pm 91.4	424.6 \pm 122.9	0.994 ^c
Final mean \pm SD	365.6 \pm 115.6	386.3 \pm 130.6	0.585 ^c
p	<0.001^d	<0.001^d	
CMT change, μm mean \pm SD	-60.4 \pm 125.1	-38.3 \pm 106.4	0.288 ^c
BCVA, best-corrected visual acuity; CMT, central macular thickness; IVB, intravitreal reference bevacizumab; IVB-awwb, intravitreal biosimilar bevacizumab-awwb; logMAR, logarithm of the minimum angle of resolution; SD, standard deviation ^a Independent samples t-test ^b Pearson Chi-square with continuity correction ^c Mann-Whitney U test ^d Wilcoxon signed rank test Bold values indicate statistical significance			

Diabetic Macular Edema

Among the 96 eyes (68 patients) with DME, 47 eyes (49.0%) of 33 patients were treated with IVB, and 49 eyes (51.0%) of 35 patients were treated with IVB-awwb (**Table 2**). The mean age and gender were similar, and there were no significant differences between the baseline and final BCVA and CMT of the groups (**Table 2**). The mean CMT was significantly improved with treatment

in both groups, with no significant difference in CMT change between them. The DME persistence rates were also similar amongst IVB (30 eyes; 61.2%) and IVB-awwb (26 eyes; 55.3%) groups ($p=0.795$). However, a statistically significant improvement in BCVA was observed only in the IVB group, and the degree of improvement was significantly greater compared to the IVB-awwb group (**Figures 1b and 2b**).

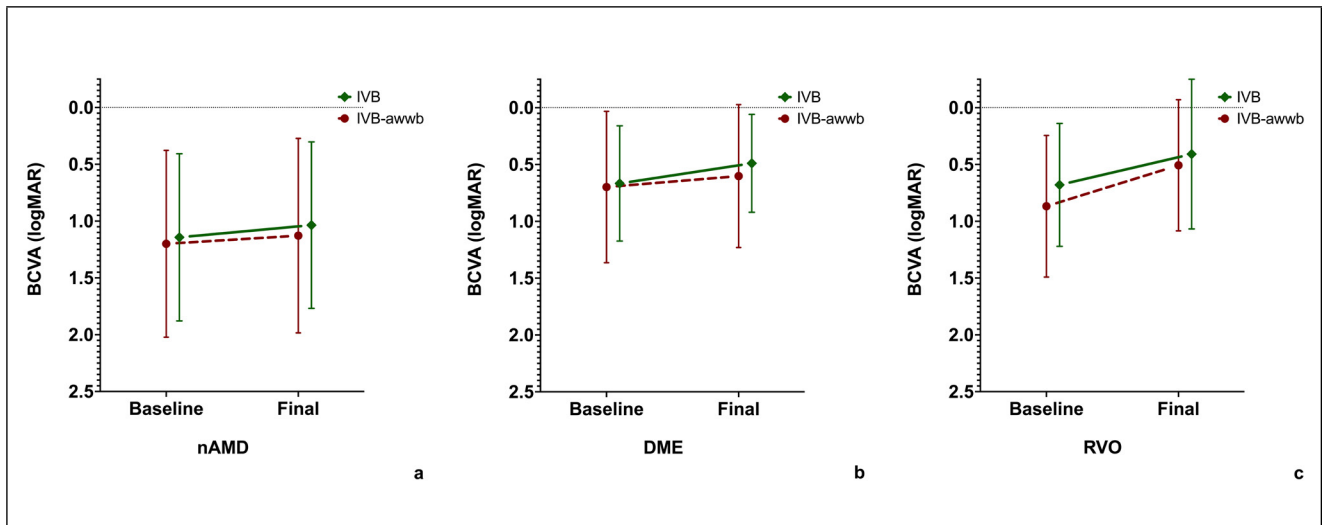


Figure 1: The line graphs of the mean baseline and final best-corrected visual acuity (BCVA) of the eyes included in the study **a.** Neovascular age-related macular degeneration (nAMD), **b.** Diabetic macular edema (DME), **c.** Macular edema secondary to retinal vein occlusion (RVO).

BCVA, best-corrected visual acuity; IVB, intravitreal reference bevacizumab; IVB-awwb, intravitreal biosimilar bevacizumab-awwb; logMAR, the logarithm of the minimum angle of resolution. Error bars indicate standard deviation.

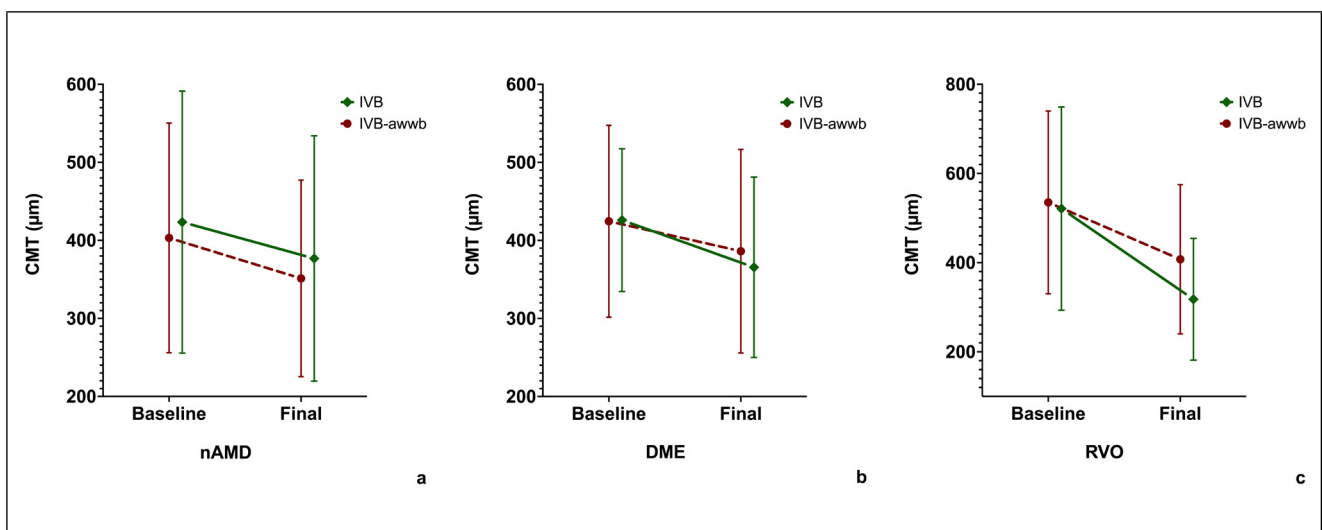


Figure 2: The line graphs of the mean baseline and final central macular thickness (CMT) of the eyes included in the study **a.** Neovascular age-related macular degeneration (nAMD), **b.** Diabetic macular edema (DME), **c.** Macular edema secondary to retinal vein occlusion (RVO).

IVB, intravitreal reference bevacizumab; IVB-awwb, intravitreal biosimilar bevacizumab-awwb. Error bars indicate standard deviation.

Retinal Vein Occlusion

There were 14 and 19 eyes of 14 and 18 patients in the IVB and IVB-awwb groups, respectively, with no significant difference in mean age and gender between the patients (**Table 3**). There were three (21.4%) and six (31.6%) eyes with central retinal vein occlusion in the IVB and IVB-awwb

groups, respectively. The mean baseline BCVA and CMT were similar and significantly improved in both groups, with no significant difference in final BCVA (**Figure 1c**) and CMT (**Figure 2c**). The macular edema persisted in 3 (21.4%) and 7 (36.8%) eyes in IVB and IVB-awwb groups, respectively ($p=0.455$). The changes in BCVA and CMT were also comparable between the two treatment groups (**Table 3**).

Table 3: Demographic and clinical characteristics of the patients and eyes with macular edema secondary to retinal vein occlusion.

	IVB Group	IVB-awwb Group	p
Patients, n (%)	14 (43.8)	18 (56.2)	-
Eyes, n (%)	14 (42.4)	19 (57.6)	-
Age, years mean \pm SD	65.4 \pm 9.1	63.2 \pm 6.3	0.441 ^a
Gender, n (%) Female Male	5 (35.7) 9 (64.3)	13 (72.2) 5 (27.8)	0.088 ^b
The type of RVO, n (%) CRVO BRVO	3 (21.4) 11 (78.6)	6 (31.6) 13 (68.4)	0.698 ^c
BCVA, logMAR			
Baseline mean \pm SD Snellen equivalent	0.68 \pm 0.53 ~20/100	0.87 \pm 0.63 ~20/160	0.322 ^d
Final mean \pm SD Snellen equivalent	0.41 \pm 0.66 ~20/50	0.51 \pm 0.58 ~20/63	0.163 ^d
p	0.023^e	0.029^e	
BCVA change, logMAR mean \pm SD	-0.27 \pm 0.38	-0.36 \pm 0.73	0.855 ^d
CMT, μm			
Baseline mean \pm SD	521.3 \pm 228.0	535.2 \pm 204.1	0.716 ^d
Final mean \pm SD	317.7 \pm 136.5	407.4 \pm 167.3	0.109 ^d
p	0.001^e	0.009^e	
CMT change, μm mean \pm SD	-203.6 \pm 166.9	-127.8 \pm 183.6	0.308 ^d

BCVA, best-corrected visual acuity; BRVO, branch retinal vein occlusion; CMT, central macular thickness; CRVO, central retinal vein occlusion; IVB, intravitreal reference bevacizumab; IVB-awwb, intravitreal biosimilar bevacizumab-awwb; logMAR, logarithm of the minimum angle of resolution; RVO, retinal vein occlusion; SD, standard deviation

^a Independent samples t-test
^b Pearson Chi-square with continuity correction
^c Fisher's exact test
^d Mann-Whitney U test
^e Wilcoxon signed rank test
Bold values indicate statistical significance

Safety

No intravitreal hemorrhage or lenticular touch was encountered during the study period. There were no cases of endophthalmitis in the overall IVB-treated eyes (n=93), but two eyes (2%) from the IVB-awwb-treated eyes (n=98) were diagnosed as endophthalmitis (p=0.498).

Both endophthalmitis patients (a 46-year-old female and a 55-year-old male) had unilateral BRVO with different intravitreal injection application dates. They presented with decreased visual acuity, ocular pain, ciliary injection,

and hypopyon three days after the third loading dose of IVB-awwb injections. Same-day vitreous tap and intravitreal antibiotic injections (1 mg/0.1 mL vancomycin and 2.25 mg/0.1 mL ceftazidime) were applied to both patients at their presentation. Their signs were completely regressed after three sessions (once every two days) of intravitreal antibiotic injections with one drop per hour of topical moxifloxacin 0.5% (Moxai*, Abdi İbrahim, İstanbul, Türkiye) and four drops a day of topical prednisolone 1%, without needing pars plana vitrectomy. Vitreous sample cultures were negative for both patients. The BCVA and CMT of both eyes were better than their first presentation at the final visit.

Discussion

This first real-life study assessing intravitreal biosimilar bevacizumab-awwb in comparison to reference bevacizumab in treatment-naïve eyes of nAMD, DME, and RVO patients showed comparable functional and anatomical results in nAMD and RVO, with significantly less BCVA improvement in bevacizumab-awwb treated DME eyes ($p=0.033$). Although not statistically significant, two cases of culture-negative endophthalmitis were also seen with IVB-awwb, suggesting a questionable sterile intraocular inflammation.

To our knowledge, the first biosimilar bevacizumab with clinical data in intravitreal use was Zybev™ (Zydus Cadila Healthcare Ltd., Ahmedabad, India) (13). In this multicenter retrospective study in India, a single intravitreal injection of 1.25 mg/ 0.05 mL Zybev™ resulted in a significant improvement of BCVA and CMT one month later without any systemic or ocular adverse events in a mixed group of DME, nAMD, and RVO. Later, Agarwal et al. (14) retrospectively evaluated the six-week results of a single injection of the same agent in various retinal diseases. The authors reported an overall significant mean BCVA and CMT improvement considering all patients, without any improvement in BCVA of Coat's disease, choroidal osteoma, and eight cases of BRVO (14). The study also reported no systemic or ocular adverse events (14). In a preclinical study, Lashay et al. (15) reported similar short-term vitreoretinal safety of single intravitreal 2.5 mg/0.1 mL Stivant™ (CinnaGen Co., Tehran, Iran) with electroretinography and histology compared to intravitreal reference bevacizumab in albino rabbits (15). Later, the same group investigated the efficacy of intravitreal 1.25 mg/0.05 mL Stivant™ in patients with nAMD (87 eyes), DME (234 eyes), and RVO-related macular edema (64 eyes) who were either treatment-naïve or without treatment for six months (16). Although CMT significantly improved after the last Stivant™ injection for all indications in this prospective case series, BCVA significantly improved only in RVO patients (16). No systemic or ocular adverse events were reported, except vitreous hemorrhage one day after the injection in a diabetic patient (16).

The ocular safety of another biosimilar bevacizumab, bevacizumab-bvzr (Zirabev®; Pfizer Inc., New York, USA), was evaluated in healthy male cynomolgus monkey eyes in 1.25 mg/0.05 mL biweekly doses of total three intravitreal injections (17). The repeat-dose intravitreal injection of Zirabev® was tolerated locally and systemically,

with an ocular safety comparable to controls (17). The first clinical study with intravitreal Zirabev® was reported in a case series of 13 injections for 12 eyes of 9 children with retinopathy of prematurity (ROP, $n=7$), macular neovascularization ($n=3$), RVO ($n=2$), and Coat's disease ($n=1$) (18). The study revealed a positive clinical response with 0.125 or 0.625 mg/0.025 mL of Zirabev® for ROP and a standard dose of 1.25 mg/0.05 mL for other diagnoses, without post-injection endophthalmitis or intraocular inflammation (18). Recently, a retrospective, single-center, interventional study from India evaluated another biosimilar bevacizumab (Bevatas®, Intas Pharmaceuticals, Ahmedabad, India) in 100 type-1 ROP and 44 aggressive ROP (AROP) eyes (19). The study demonstrated significant benefits from intravitreal 0.625 mg/0.025 mL Bevatas® monotherapy in type-1 ROP but not in AROP, with complete regression rates of 87% and 18.2%, respectively, without any ocular or systemic adverse events (19).

Most recently, a real-life study from Italy assessed the efficacy and safety of three consecutive monthly IVB-awwb (Mvasi®) in nAMD and DME patients who underwent forced substitution from IVB (Avastin®) at the pharmacy level during their maintenance phase of treat-and-extend anti-VEGF treatment (20). For the 80 eyes of 76 nAMD patients receiving a mean of 19.5 ± 11.9 (range, 3-52) IVB, mean BCVA and CMT did not significantly change after the third IVB-awwb injection (20). And the slopes of the linear correlation of CMT over time (in weeks) were similar for IVB (-0.71) and IVB-awwb (-0.98), reflecting comparable ($p=0.43$) therapeutic activity of the agents (20). The proportions of the treatment intervals reached with the treat-and-extend strategy, as well as retinal fluid score changes, were also similar between the agents (20). Similar results were obtained in 55 eyes of 33 patients with DME receiving a mean of 15.4 ± 7.6 (range, 3-36) IVB after substitution to IVB-awwb (20). The authors reported no ocular or systemic adverse events after cumulatively administering 3496 IVB-awwb injections throughout the study (20). Similarly, the changes of BCVA and CMT were comparable for our patients, except for BCVA change in DME eyes, suggesting at least equivalent efficacy of both agents. However, better improvement in BCVA with IVB in DME eyes could be explained by the fact that our patients were all treatment-naïve and might not have been influenced by the ceiling effect that previously treated eyes, which could have been reached the maximum BCVA of the eye, can get (i.e., no more available visual acuity score to gain).

Regarding safety, our study revealed two (2%) culture-negative endophthalmitis cases in RVO patients managed with local therapy without necessitating pars plana vitrectomy. The fact that the endophthalmitis cases we encountered were culture negative and the functional and anatomical results were relatively favorable increases the likelihood of these cases being sterile endophthalmitis. Yet, considering that we used antibiotics during their treatment, we cannot comment on whether our cases definitely had sterile endophthalmitis. Biosimilar molecules differ from reference agents in their quaternary structures due to biotechnological processes involved in their production through living cells and their inactive components, with even minor unintended modifications resulting in an altered efficacy and safety (2, 7). The importance of this difference regarding safety has been highlighted in the literature with cluster sterile endophthalmitis encountered with some batches of Razumab®, the first on-label intravitreal anti-VEGF biosimilar, resulting in the revision of its formulation (8). Accordingly, the American Academy of Ophthalmology published a policy statement indicating the potential difference in immunogenicity with biosimilars while used intravitreally, strongly recommending against the intravitreal use of off-label bevacizumab biosimilars in the absence of sufficient clinical studies in ophthalmological indications (12).

While interpreting the results of this study, one should consider its non-randomized retrospective design, relatively small sample size, and limited follow-up period. Another limitation is the inclusion of both eyes of eligible patients in the study, given that literature reports suggest bevacizumab injections in one eye may cause changes in the fellow eye (26). However, the inclusion of both eyes in the treatment groups did not differ significantly between the groups. Therefore, this effect is unlikely to influence the study outcomes substantially. Also, this study did not evaluate systemic factors such as hypertension or HbA1c levels, which may influence treatment outcomes in DME and RVO. Future studies should consider these variables. The strength of the study is its head-to-head comparative design in real-life conditions, providing insight into a current affair of national as well as global importance.

Conclusion

This real-life assessment of intravitreal biosimilar bevacizumab-awwb suggests comparable anatomical and functional results to its reference counterpart,

with the possibility of questionable immunogenicity to consider. Future randomized comparative studies with more extensive sample sizes may provide clinicians with more information on this subject.

Declarations

Funding

No funding was required during the conduction of this study.

Conflict of Interest

The authors have no potential proprietary or financial interests to disclose.

Ethics Approval

The study protocol was approved by the institutional review board of Marmara University School of Medicine, Istanbul, Turkey (No: 09.2023.873, 09.2023.874, and 09.2023.875).

Data Availability

The data of this study is available from the correspondence author upon reasonable request.

Authors' Contributions

MOS: Conception, design, supervision, funding, materials, data collection, processing, analysis, and interpretation, literature review, writing, and critical review; **SGK:** Conception, design, supervision, materials, data collection and interpretation, literature review, writing, and critical review; **AA:** Conception, design, supervision, data interpretation, and critical review; **DDY:** Conception, design, supervision, data interpretation, literature review, and critical review; **ÖŞ:** Conception, design, supervision, fundings, materials, data analysis and interpretation, and critical review.

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Hymenoplasty Experience: Factors Associated with Dehiscence (Hymenoplasty Complications)

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ABSTRACT

Purpose: To evaluate outcome of hymenoplasties in private clinics and investigate the factors affecting the risk of dehiscence

Method: A retrospective cross-sectional survey of Obstetrics and Gynecology specialists trained over the last five years was conducted. Specialists from private clinics completed surveys on hymenoplasties performed. Rates and types of complications were requested and factors associated with wound dehiscence in patients undergoing permanent hymenoplasty was investigated with multivariate analysis.

Results: A total of 968 patients were included. Hymenoplasty was performed for revirgination in 874 cases (90.2%), incision of the hymen for gynecological procedures in 82 (8.4%) cases and trauma in 12 cases (1.2%). Complications included wound dehiscence (26.1%), infection (1.7%), bleeding (1.7%), pain (1.5%), itching (1.4%) and dyspareunia (0.5%). The technique was permanent in 714 cases and temporary in 254 cases. Among the permanent hymenoplasty cases, multivariate logistic regression analysis showed that obesity (OR=3.1, 95%CI: 1.5-6.2, p=0.001) and tobacco use (OR=2.2, 95%CI: 1.3-3.8, p=0.003) increases the risk of dehiscence. Sedation decreased the risk of dehiscence when compared to local infiltration anesthesia (OR=0.56, 95%CI: 0.33-0.99, p=0.04). Every decrease in the polyglactin suture caliber decreased the risk of dehiscence (OR=0.22, 95%CI: 0.16-0.3, p<0.001)

This study showed that using 5.0 sutures, omitting infiltration anesthesia, and avoiding tobacco use may help decrease wound dehiscence after hymenoplasty.

Keywords: Hymenoplasty, wound dehiscence, complications, suture, surgical technique, infiltration anesthesia

ÖZET

Amaç: Bu çalışmada, özel kliniklerde gerçekleştirilen himenoplasti operasyonlarının sonuçlarını değerlendirmek ve dehisens (yarada açılma) riskini etkileyen faktörleri araştırmak amaçlanmıştır.

Yöntem: Son beş yıl içinde eğitim almış Kadın Hastalıkları ve Doğum uzmanlarına yönelik geriye dönük, kesitsel bir anket çalışması yapıldı. Özel kliniklerde çalışan uzmanlardan, gerçekleştirdikleri himenoplasti operasyonlarına ilişkin veriler toplandı. Komplikasyon oranları ve türleri sorgulandı, ayrıca kalıcı himenoplasti yapılan hastalarda yara dehisensi ile ilişkili faktörler çok değişkenli analiz ile değerlendirildi.

Bulgular: Çalışmaya toplam 968 hasta dahil edildi. Himenoplasti, 874 vakada (%90,2) bekâretin yeniden kazanılması amacıyla, 82 vakada (%8,4) jinekolojik işlemler için himen insizyonu nedeniyle ve 12 vakada (%1,2) travma sonrası gerçekleştirildi. Komplikasyonlar arasında yara dehisensi (%26,1), enfeksiyon (%1,7), kanama (%1,7), ağrı (%1,5), kaşıntı (%1,4) ve dispareuni (%0,5) yer aldı. Operasyon tekniği 714 vakada kalıcı, 254 vakada geçici olarak uygulandı. Kalıcı himenoplasti vakalarında yapılan çok değişkenli lojistik regresyon analizine göre obezite (OR=3,1, %95 GA: 1,5-6,2, p=0,001) ve tütün kullanımı (OR=2,2, %95 GA: 1,3-3,8, p=0,003) yara dehisensi riskini artırmaktadır. Sedasyon uygulaması, lokal infiltrasyon anesteziye kıyasla dehisens riskini azaltmaktadır (OR=0,56, %95 GA: 0,33-0,99, p=0,04). Kullanılan poliglaktin sütür kalınlığının azalması, dehisens riskini her seviyede düşürmüştür (OR=0,22, %95 GA: 0,16-0,3, p<0,001).

Bu çalışma, 5.0 sütür kullanımının, infiltrasyon anesteziinden kaçınmanın ve tütün kullanımının önlenmesinin, himenoplasti sonrası yara dehisensi riskini azaltmaya yardımcı olabileceğini göstermektedir.

Anahtar Kelimeler: Himenoplasti, yara dehisensi, komplikasyonlar, sütür, cerrahi teknik, infiltrasyon anestezi

Hymenoplasty may be performed to repair the hymen after injury or for cosmetic reasons. Although hymen aesthetics is legal in many countries, it remains ethically and culturally controversial and is performed as part of gynecology or plastic surgery (1,2). There was a dearth of research into hymenoplasty application techniques and management of complications in the literature. Hymenoplasty, unlike other gynecologic surgeries, involves ethical and psychological debates. The procedure aims to restore or narrow the vaginal opening (3). Furthermore, recent studies have shown that, despite the increasing popularity of hymenoplasty procedures, many clinicians lack adequate training in the techniques (4, 5).

The hymen is a thin and elastic membrane that partially covers the vaginal opening (6). If the hymenal opening measures 1 cm or less in diameter, the hymen is considered intact (7,8). The most frequently genesis type of hymen is the annular configuration, as was found in the present study (9,10). Penetrating hymen trauma, such as sexual intercourse, tampon use, or surgery, can cause deep clefts in the hymen and disrupt its integrity (11,12).

In the present study, which we intend will help fill the evidence gap, approaches to hymenoplasty, application techniques, and complications experienced by obstetricians who have an interest in cosmetic gynecology in Turkey were investigated. Moreover, clinicians' approaches to complications were evaluated.

Materials and Methods

In this cross-sectional, retrospective study, patients who underwent surgery for hymenoplasty procedures for reasons including revirgination, iatrogenic sectioning of the hymen for oocyte freezing, vaginal or uterine surgeries or biopsies, vaginal or hymenal trauma were reviewed. Data were collected by individual interviews with 41 expert clinicians from different private clinics. The data were collected by requesting the clinicians to complete a proforma datasheet for each patient. In the datasheet, information about the presence and nature of complications, concomitant surgeries or revision surgeries were included. The surgeons who performed these procedures were also questioned about their training and surgical experience. Ethical approval was obtained from the local ethics committee.

Patients were eligible for inclusion if of reproductive age (18-50 years). The demographic data, history of chronic diseases, smoking history, body mass index (BMI), surgical history, medication history, type of hymen, and additional surgical procedures performed during hymenoplasty were recorded on the datasheet.

Furthermore, information about the anesthesia method used during the surgery, suture material used, energy modality used, and the postoperative period was also included. Finally, respondents were asked about complications, if any, after hymenoplasty and/or additional surgery and treatment, and if so, what the nature of the complications were and whether any revision was performed.

Statistical analysis of the data was conducted using SPSS, version 21 (IBM Inc., Armonk, NY, USA). Continuous variables are presented as mean and standard deviation. Categorical variables are presented as numbers and percentages. Chi-square test was used to compare the distribution of categorical variables concerning the occurrence of dehiscence. Logistic regression analysis using the enter method was used to predict the occurrence of suture dehiscence among the permanent hymenoplasty cases.

Results

A total of 54 experts from different private clinics that had hands-on education with hymenoplasty since 2015 were contacted and 41 (75.9%) agreed to participate. The surgeons reported that they performed a total of 1171 hymenoplasties in the last five years and the records of 1009 (86.2%) patients were available. Of these, 968 data sheets were fully completed and so constituted the study data pool, resulting in data available on 82.7% of all hymenoplasties performed.

The mean age of the respondents was 40.6 ± 6.5 years, and the duration of their expertise ranged from 1 to 24 years. The respondents had been performing hymenoplasty surgeries for a mean of 3.4 ± 3 years, ranging from 1 to 15 years. Hymenoplasty was performed for revirgination in 874 cases (90.2%), incision of the hymen for gynecological procedures in 82 (8.4%) cases and trauma in 12 cases (1.2%).

Demographic characteristics of patients are shown in Table 1. The Goodman technique(permanent) was used in

83.7% cases and the Flap technique(temporary) in 16.3%. Out of a total of 968 cases, 253 cases (26.1%) required revision within one to three months of the initial surgery due to wound dehiscence during postoperative follow-up.

Table 1: Selected demographic and operative variables of hymenoplasty cases.

Variables	Mean	(min-max)
Age (year)	28.7±4.3	21-46
Hymen Type	n (968)	%
Annular	563	58.2
Crescentic	339	35.0
Septate	23	2.4
Cribriform and others	43	4.4
Hymenoplasty Technique		
Temporary	254	26.2
Permanent	714	73.8
Tobacco use		
Yes	392	40.5
Diabetes Mellitus		
Yes	23	2.4
Obesity (BMI>30 kg/m ²)		
Yes	138	14.3
Anesthesia Technique		
Local anesthesia	586	60.5
Sedation	382	39.5
Sutures used (polyglactin)		
2.00	115	11.9
3.00	299	30.9
4.00	391	40.4
5.00	163	16.8

Complications were observed in 68 (7%) cases, with wound dehiscence being the most common. Details are provided in Table 2. Other complications included bleeding, infection, pain, itching and dyspareunia.

Table 2: Complications of hymenoplasty.

Complications	n	%
Wound dehiscence	253	26.1
Other complications	68	7
Infections	17	1.7
Bleeding	17	1.7
Pain	15	1.5
Itching	14	1.4
Dyspareunia	5	0.5

The distribution of selected variables according to the presence of hymenoplasty dehiscence is presented in Table 3. Multivariate logistic regression analysis showed that obesity (OR=3.1, 95%CI: 1.5-6.2, p=0.001) and tobacco use (OR=2.2, 95%CI: 1.3-3.8, p=0.003) increased the risk of dehiscence. Sedation decreased the risk of dehiscence when compared to local infiltration anesthesia (OR=0.56, 95%CI: 0.33-0.99, p=0.04). Every unit decrease in the polyglactin suture caliber decreased the risk of dehiscence (OR=0.22, 95%CI: 0.16-0.3, p<0.001).

Table 3: Distribution of selected variables according to presence of dehiscence after permanent hymenoplasty.

Variable	Dehiscence (n=253) n (%)	Successful Healing (n=461) n (%)	P-value
Hymen Type			
Annular	122 (48.2)	371 (80.5)	<0.001
Crescentic	119 (47)	49 (10.6)	
Septate	12 (4.7)	11 (2.4)	
Cribriform and others	0 (0)	30 (6.5)	
Tobacco use	159 (62.8)	98 (21.3)	<0.001
Diabetes Mellitus	12 (4.7)	5 (1.1)	0.002
Obesity (BMI>30)	64 (25.3)	20 (4.3)	<0.001
Hymenoplasty technique			
Goodman	189 (74.7)	386 (83.7)	0.004
Flep	64 (25.3)	75 (16.3)	
Polyglactin Suture			
2.0	99 (39.1)	14 (3)	<0.001
3.0	117 (46.2)	82 (17.8)	
4.0	24 (9.5)	265 (57.5)	
5.0	13 (5.1)	100 (21.7)	
Anesthesia			
Local infiltration	211 (83.4)	171 (37.1)	<0.001
Sedation	42 (16.6)	290 (62.9)	

Discussion

The present study has assessed data from a large case series of hymenoplasty, including practitioners' experience and techniques, suture materials, complications encountered, and comorbidities. Significant variables were identified that were risk factors for the occurrence of possible complications. In this report, clinicians' approaches are revealed and both technical and training deficiencies are emphasized.

Following hymenoplasty, complications were observed in 68 (7%) of cases in the present study, with wound dehiscence being the most common. Some minor complications occurred, including bleeding, infection, pain, itching, and dyspareunia. Most authors have reported only minor complications. There are a few studies that have reported complications including wound dehiscence, discharge problems, stinging and mild pain, and postoperative itching (13–17). Although complications have been reported previously, no cause-effect relationship has been found for these complications.

Multivariate logistic regression analysis found that obesity significantly increased the risk ($OR=3.1$) of separation in our study. Adipocytes tend to expand in size under obese conditions. However, the vasculature does not increase proportionally, causing a delay in the rate of angiogenesis. Consequently, tissue experiences hypoxia due to insufficient blood supply due to inadequate vasculature. The resulting hypoxia may damage capillaries in the incision area, which increases the risk of infection and wound site dehiscence (18–20). Moreover, hypoxic wounds impair the synthesis of collagen, leading to defective healing (21,22). Vascular defects are also associated with defective or delayed recruitment of immune system cells to the wound (23), longer inflammatory responses and decreased secretion of mediators. Nutritional defects and micro- and macro-nutrients deficiencies in obese individuals also delay the healing process (24,25). Obesity has been associated with a greater general risk of surgical site infections (26) due to delay in wound healing, which promotes the entrance and proliferation of microorganisms.

Performing multivariate logistic regression analysis, we found that tobacco use increased the risk of opening ($OR=2.2$), similarly to obesity. Nicotine impairs proper macrophage migration and fibroblast activation, again impeding the wound healing process and also has a vasoconstrictive effect, leading to reduced wound perfusion(27).

According to our data, the dehiscence rate was higher in cases where local infiltration was used compared to sedation. We believe that high concentrations of local anesthetic can negatively affect wound healing and reduce collagen synthesis. Earlier studies have shown delayed wound healing associated with local anesthetic agents (28–30). In the present study, the dehiscence rate was significantly higher in cases where local anesthesia

was preferred compared to general anesthesia. Although there are few publications, in labiaplasty cases where general anesthesia and local anesthesia were compared, the dehiscence rate was found to be significantly higher in cases with local anesthesia(30).

Finally, our analysis also showed that using a lower caliber polyglactin suture decreased the likelihood of dehiscence ($OR=0.22$). We speculate that wound dehiscence may be prevented or much reduced by the choice of thinner sutures. Thinner sutures may be preferred to minimize tissue trauma and potential dehiscence.

It is important to note that our study has certain limitations. Data were collected by individual interviews with 41 experts from different centers. The socio-economic levels and demographic features of the patient groups are not equal between compared groups and there is no selected patient group. It was evident that the clinicians we interviewed did not keep adequate records of case information collected retrospectively. In addition, preoperative and postoperative antibiotic use was different, which may well have been one of the factors affecting complication rates. However, since we did not receive enough information, we could not comment on whether this was significant or not.

There is an ongoing discussion about the various methods and techniques used in hymenoplasty treatment. This field was not taught in the curriculum for clinician training in our experience. Several techniques and methods have been proposed for hymenoplasty, however, there is no universally accepted or standardized method for it. According to a study, only 12% of doctors feel that they have enough knowledge to perform hymen aesthetics, while another study found that more than half of doctors require additional information and training on this topic (4,5).

The absence of similar studies in the literature makes our work pioneering for future research. We believe that standardized pre-op and post-op approaches that are not currently included in training curricula should be defined and added to training books. Although not medically necessary, hymenoplasty - a type of female genital cosmetic surgery (FGCS) - is becoming increasingly popular. We believe that standardizing practices in the field of FGCS, including hymenoplasty, and integrating them into the training curriculum is necessary.

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Post-Acute Sleep Disturbances Following COVID-19 and Associated Factors: A Single-Center Study

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ABSTRACT

Purpose: The long-term effects of COVID-19 infection on survivors' mental health and its relationship with COVID-19 severity remain undetermined. We aimed to investigate the post-COVID sleep disturbances (poor sleep quality and insomnia) that persist beyond four weeks after acute COVID-19 infection and up to six months after the acute illness and the related factors.

Methods: We enrolled 188 participants 1-6 months after COVID-19 infection in this descriptive study. All participants were asked to complete a sociodemographic data form, the Beck Anxiety Scale (Beck-A), the Beck Depression Scale (Beck-D), the Pittsburgh Sleep Quality Index (PSQI), and the Insomnia Severity Index (ISI).

Results: 43.6% and 41% of participants reported experiencing poor sleep quality and insomnia, respectively. Sociodemographic factors such as marital and employment status, education level, household size, smoking, alcohol consumption, follow-up time, and comorbidities did not significantly impact sleep quality and insomnia rates. However, our results showed that higher anxiety and depression scores were associated with worse sleep quality and insomnia.

Conclusions: Our study highlights the critical situation of sleep disturbances, anxiety, and depression risk in post-COVID-19 patients. Although the first COVID-19 pandemic has ended, analyzing worldwide data about the last pandemic is crucial for preparing for potential scenarios globally.

Keywords: Anxiety, COVID-19, depression, insomnia, sleep quality

ÖZET

Amaç: COVID-19 enfeksiyonunun hayatta kalanların ruh sağlığı üzerindeki uzun vadeli sonuçları ve bunun hastalık şiddeti ile ilişkisi belirsizdir. Bu çalışmada, akut COVID-19 enfeksiyonundan dört hafta - altı ay sonrasına kadar devam eden COVID-19 sonrası uyku bozukluklarını (kötü uyku kalitesi ve uykusuzluk) ve ilgili faktörleri araştırmayı amaçladık.

Yöntem: Bu tanımlayıcı çalışmaya COVID-19 enfeksiyonundan 1-6 ay sonra, 188 katılımcı dahil edilmiştir. Tüm katılımcılardan sosyodemografik veri formu, Beck Anksiyete Ölçeği (Beck-A), Beck Depresyon Ölçeği (Beck-D), Pittsburgh Uyku Kalitesi İndeksi (PSQI) ve Uykusuzluk Şiddeti İndeksi (ISI) doldurmaları istenmiştir.

Bulgular: Katılımcıların sırasıyla %43,6'sı ve %41'i kötü uyku kalitesi ve uykusuzluk yaşadığını bildirmiştir. Medeni durum, çalışma durumu, eğitim düzeyi, hane halkı büyüklüğü, sigara kullanımı, alkol tüketimi, takip süresi ve eşlik eden hastalıklar gibi sosyodemografik faktörler uyku kalitesi ve uykusuzluk oranlarını önemli ölçüde etkilememiştir. Bununla birlikte, çalışmamızın sonuçları anksiyete ve depresyon puanlarının daha kötü uyku kalitesi ve uykusuzluk ile ilişkili olduğunu göstermiştir.

Sonuç: Çalışmamız, COVID-19 sonrası hastalarda uyku bozuklukları, anksiyete ve depresyon riskinin ne kadar önemli olduğunu vurgulamaktadır. İlk COVID-19 pandemisi sona ermiş olsa da, son pandemiyle ilgili dünya çapındaki verilerin analiz edilmesi, küresel olarak potansiyel senaryolara hazırlanmak için çok önemlidir.

Anahtar Kelimeler: Anksiyete, COVID-19, depresyon, uykusuzluk, uyku kalitesi

The novel coronavirus (SARS-CoV-2) will result in acute respiratory syndrome (COVID-19), which is associated with potentially fatal pneumonia. Studies suggest that about one-third of infected people remain asymptomatic, while 15% of symptomatic cases progress to severe, potentially fatal complications, particularly in the elderly population (1). The terms post-COVID, long COVID, or post-acute sequelae of SARS-CoV-2 refer to continuous, recurring, or new symptoms or other health problems that appear after the acute phase of SARS-CoV-2 infection (2). Neurological and psychiatric symptoms such as peripheral neuropathy, dizziness, headache, cognitive impairment, sleep disturbances, depression, and anxiety may be present in patients with post-COVID-19 syndrome (3). Alkodaymi et al. (2022) found that the most prevalent symptoms at 3 to <6 months follow-up, including fatigue, dyspnea, sleep disturbance, and concentration problems, were significantly influenced by factors such as COVID-19 disease severity, diabetes mellitus, male sex, world region, and overall study quality score (4).

A meta-analysis showed an increased risk of depression and anxiety in COVID-19 patients compared with other inpatients, highlighting the need for long-term mental health assessment (5). In a cross-sectional study, factors such as female sex, diabetes, need for oxygen or mechanical ventilation, and elevated neutrophil-to-lymphocyte ratio (NLR) were found to increase vulnerability to post-COVID-19 psychopathologies (6).

COVID-19-related sleep disorders, including sleep apnea, poor sleep quality, and insomnia, have become widespread, affecting up to 50-75% of acute COVID-19 patients and 30-35% of the general population according to Kalamara et al. (7). A meta-analysis revealed that 32.9% of individuals experienced sleep disorders after COVID-19 infection (8). These disturbances often persist even after other symptoms have resolved (9). In hospital settings, a Turkish study found that patients with poor sleep quality had extended hospital stays and higher rates of depression (10).

Research indicates that circadian disruptions following COVID-19 infection may contribute to higher rates of anxiety disorders and insomnia (11), and depression and insomnia (12). Female sex and severe/critical COVID-19 significantly increase the risk of post-COVID sleep disturbances, with no substantial impact observed based

on the duration of hospitalization (13). These findings highlight the complex interplay between COVID-19 and sleep disturbances, emphasizing the need for further investigation into their mechanisms and potential interventions. Although anxiety, depression, and sleep disturbances are frequently reported in the post-COVID period (14), the literature on their relationship is insufficient. The close link between post-COVID-19 syndrome and symptoms of depression, anxiety, and sleep disturbances highlights the need for additional research in this area and underscores the importance of assessing the depth of these interactions.

Therefore, this study was conducted to determine the post-COVID sleep disturbances (poor sleep quality and insomnia) that persist beyond four weeks after acute COVID-19 infection and up to six months after the acute illness and the related factors.

We hypothesized that hospitalization and increased anxiety and depression scores would be associated with sleep quality and that these associations would be stronger in women than men.

Material and Methods

The study included patients aged 18-65 years who applied to the COVID-19 Outpatient Clinic of Baskent University Faculty of Medicine Ankara Hospital and were diagnosed with COVID-19 from December 2020 to April 2021 (the period when the Delta variant was dominant) by using real-time PCR method in throat swab specimens. Patients with ongoing hospitalization, illiteracy, visual or hearing loss, cognitive impairment (mental retardation, dementia, etc.), or psychotic disorders (schizophrenia and other psychotic disorders) were excluded from the study. Attempts were made to contact 783 patients who met the inclusion criteria by telephone between 1 and 6 months after COVID-19 diagnosis. One hundred eighty-five patients could not be reached, and 410 did not agree to participate in the study. The 188 (24%) patients who agreed to participate in the study and gave verbal consent after being informed were included. Data were collected using Google Forms.

Participants were asked to complete a socio-demographic form, the Beck Anxiety Scale (Beck-A), the Beck Depression Scale (Beck-D), the Pittsburgh Sleep Quality Index (PSQI), and the Insomnia Severity Index (ISI).

Sociodemographic and clinical data form: Included questions on age, sex, marital status, educational level, smoking and alcohol consumption history, and chronic systemic disorders such as diabetes mellitus (DM), hypertension (HT), and cardiovascular disease (CVD). It also covered COVID-19 treatment modality (inpatient or outpatient), duration of hospital stay, and information about household and bedroom partners. The treatment modality was used to assess the severity of COVID-19.

The Pittsburgh Sleep Quality Index (Turkish version): A 7-dimension scale that evaluates sleep quality and disturbances. The PSQI consists of 24 questions, 19 of which are self-reported, and 5 are answered by a partner or roommate. Scores range from 0 to 21, with total scores over 5 indicating poor sleep quality (15).

Insomnia Severity Index (Turkish version): A self-reported, five-point Likert scale comprising seven items designed to measure the severity of insomnia symptoms. Each item is scored from 0 to 4, with total scores ranging from 0 to 28. Scores from 0 to 7 indicate clinically insignificant insomnia, 8 to 14 suggest subthreshold insomnia, 15 to 21 indicate moderate clinical insomnia, and 22 to 28 represent severe clinical insomnia (16). A total score of 10 or more is recommended as the cut-off for identifying insomnia cases in community samples (17).

Beck Depression Scale (Turkish version): The scale consists of 21 questions that patients answer based on their feelings over the past week. The cut-off score is 17, with the highest possible score being 63. Higher scores reflect more severe depressive symptoms (18).

Beck Anxiety Scale (Turkish version): The scale consists of 21 self-reported questions about the severity of anxiety symptoms. Total scores range from 0 to 63, with scores from 0-7 indicating minimal anxiety, 8-15 mild anxiety, 16-25 moderate anxiety, and 26-63 severe anxiety (19).

Statistical analyzes

The data were analyzed using SPSS 17.0 (Statistical Package for the Social Sciences, IBM). Before univariate comparisons, Kolmogorov-Smirnov test and visual tests were conducted. Sociodemographic descriptive statistics were expressed as frequencies and percentages for categorical variables and medians with interquartile ranges (IQR) for continuous variables. Univariate analyses

were performed using the Pearson chi-square test for categorical variables and the Mann-Whitney U test for continuous variables. Logistic regression was used to assess the relationship between independent variables and sleep quality (dichotomous PSQI scores) and insomnia (dichotomous ISI scores).

Results

The study involved 188 participants, with a mean age of 37 ± 12.5 years, and on average, it had been 3 months (min-max 1- 6 months) since the onset of their COVID-19 symptoms. More than half were female (55.3%) and married (55.3%). Most of them were employed (74.5%), and held at least a university degree (77.6%). Only 17% lived alone, and 46% stated that they slept alone in their bedroom. Most of them did not smoke (74.5%) or drink alcohol (68.1%). 27% had a chronic medical disease (DM, HT, etc). Twenty-two patients (11%) received inpatient treatment for COVID-19, while the remaining patients were treated as outpatients.

Only 15% of participants reported experiencing sleep problems before COVID-19. In the post-COVID period, 43,6% of participants (n=82) reported poor sleep quality according to the global PSQI scores. Univariate analysis revealed that female patients had significantly worse sleep quality than men (67.1% vs. 32.9%) ($p = 0.004$), and those who had experienced bereavement also had significantly worse sleep quality compared to those who had not (77% vs. 23%) ($p = 0.027$). Sleep quality was significantly worse in those who had poor sleep quality also before COVID-19 (73% vs. 27%) ($p = 0.002$). Factors such as marital status, employment status, education level, household size, smoking, alcohol consumption, follow-up duration, treatment modality (inpatient/outpatient treatment for COVID-19), and comorbidities did not significantly affect sleep quality. Additionally, participants with poor sleep quality had significantly higher anxiety (median (IQR) 15(10-23), 5(2-10)) and depression scores (median (IQR) 13(8-20), 3(1-9) compared to those with good sleep quality ($p < 0.001$ for both comparisons).

The sociodemographic, COVID-19-related, and clinical characteristics of the patients and the comparison of the good and poor sleepers according to these characteristics are presented in Table 1.

Table 1: Comparison of the sociodemographic, COVID-19 related and clinical characteristics of good and poor sleepers

Characteristics		Total	Good sleepers (PSQI≤5) (n:126) n (%) / median (IQR)	Poor sleepers (PSQI>5) (n:82) n (%) / median (IQR)	Chi-square /Z	p
Age (years)			39 (19)	31 (20)	-2.512	0.012^a
Sex	Male	84	57 (53.8%)	27 (32.9%)	8.129	0.004^b
	Female	104	49 (46.2%)	55 (67.1%)		
Marital Satus	Single/divorced	84	43 (40.6%)	41 (50%)	1.665	0.197 ^b
	Married	104	63 (59.4%)	41 (50%)		
Employment	Full or part time	140	82 (77.4%)	58 (70.7)	1.068	0.301 ^b
	Not employed	48	24 (22.6%)	24 (29.3)		
Households size	Alone	33	21 (19.8%)	12 (14.6%)	0.856	0.355 ^b
	Living with 2 or more	155	85 (80.2%)	70 (85.4%)		
Are you sleeping alone in your bedroom?	Alone	101	56 (52.8)	45 (54.9%)	0.078	0.780 ^b
	Not alone	87	50 (47.2%)	37 (45.1%)		
Smoking	Yes	48	22 (20.8%)	26 (31.7%)	2.917	0.088 ^b
	No	140	84 (79.2%)	56 (68.3%)		
Bereveament due to COVID	Yes	30	11 (10.4%)	19 (23.2%)	5.642	0.018^b
	No	158	95 (89.6%)	63 (76.8%)		
COVID-19 Treatment modality	Inpatient	22	14 (13.2%)	8 (9.8%)	0.533	0.465 ^b
	Outpatient	166	92 (86.8%)	74 (90.2%)		
Comorbidity	Yes	45	28 (26.4%)	17 (20.7%)	0.820	0.365 ^b
	No	143	78 (73.6%)	65 (79.3%)		
Sleep problems before COVID-19	Yes	29	9 (9.4%)	20 (27%)	9.203	0.002^b
	No	141	87 (90.6%)	54 (73%)		
Time to assement (months)		188	4 (1-6)	5 (1-6)	-0.708	0.479 ^a
Beck-D scores		188	3 (1-9)	13 (8-20)	1544	<0.001^a
Beck-A scores		188	5 (2-10)	15 (10-23)	1762.5	<0.001^a

* Poor sleep quality refers to Pittsburgh sleep quality index scores > 5 Beck-A: Beck Anxiety Scale, Beck-D: Beck Depression Scale, PSQI: Pittsburgh Sleep Quality Index

a: Mann Whitney U test, b: Pearson chi-square test

n: number, %: percent, IQR: interquartile range

According to the ISI scores, 41% of participants were identified as experiencing insomnia. Univariate analysis revealed significant differences in sex, employment status, and pre-existing sleep problems before COVID-19 between individuals with and without insomnia.

However, factors such as marital status, education level, household size, smoking, alcohol consumption, presence of comorbidities, COVID-19 treatment modality, and follow-up duration did not significantly affect insomnia.

Table 2: Comparison of the sociodemographic, COVID-19 related, and clinical characteristics of groups with and without insomnia

Characteristics		Insomnia (ISI<10) (n:111) n (%) / median (IQR)	Without insomnia (ISI≥10) (n:77) n (%) / median (IQR)	Chi-square/Z	p
Age (years)		37 (21)	33 (20)	-1.639	0.101 ^a
Sex	Male Female	58 (52.3%) 53 (47.7%)	26 (33.8%) 51 (66.2%)	6.286	0.012
Marital Status	Single/divorced Married	51 (45.9%) 60 (54.1%)	33 (42.9%) 44 (57.1%)	0.175	0.675
Employment	Full or part-time Not employed	90 (81.1%) 21 (18.9%)	50 (64.9%) 27 (35.1%)	6.234	0.013
Households size	Alone Living with 2 or more	20 (18%) 91 (82%)	13 (16.9%) 64 (83.1%)	0.040	0.841
Are you sleeping alone in your bedroom?	Alone Not alone	64 (57.7%) 47 (42.3%)	37 (48.1%) 40 (51.9%)	0.687	0.194
Smoking	Yes No	25 (22.5%) 86 (77%)	23 (29.9%) 54 (70.1%)	1.291	0.256
Alcohol consumption	Yes No	35 (31.5%) 76 (68.5%)	25 (32.5%) 52 (67.5%)	0.018	0.892
Bereavement due to COVID	Yes No	16 (14.4%) 95 (85.6%)	14 (18.2%) 63 (81.8%)	0.481	0.488
COVID-19 Treatment modality	Inpatient Outpatient	11 (9.9%) 100 (90.1%)	11 (14.3%) 66 (85.7%)	0.842	0.359
Comorbidity	Yes No	32 (28.8%) 79 (71.2%)	13 (16.9%) 64 (83.1%)	3.563	0.059
Sleep problems before COVID-19	No Yes	96 (94.1%) 6 (5.9%)	45 (66.2%) 23 (33.8%)	22.513	<0.001
Time to assesment (months)		4 (1.5-6)	5 (6-1)	-0.28	0.977 ^a
Beck-D score		4 (1-10)	12 (7-20)	-6.715	<0.001^a
Beck-A score		6 (3-11)	16 (9-24)	-6.737	<0.001^a

* Insomnia (+) refers to patients whose Insomnia Severity Index scores are ≥10 Beck-A: Beck Anxiety Scale, Beck-D: Beck Depression Scale, ISI: Insomnia Severity Index

a: Mann Whitney U test, b: Pearson chi-square test

n: number, %: percent, IQR: interquartile range

Furthermore, participants with insomnia exhibited significantly higher levels of anxiety (median (IQR) 16 (9-24)vs 6 (3-11)) and depression scores (median (IQR)

12 (7-20), 4 (1-10)) compared to those without insomnia (p <0.001 for both comparisons). Detailed results are presented in Table 2.

Table 3: Logistic regression coefficients for predicting sleep quality and insomnia

	Dependent variable poor sleep quality (PSQI score > 5)		Dependent variable insomnia (ISI score ≥ 10)	
Variable	OR (95% CI)	p	OR (95 % CI)	p
Age	0.99 (0.96-1.03)	0.805		
Sex (female)	1.12 (0.49-2.56)	0.789	1.04 (0.46-2.36)	0.923
Bereavement due to COVID (yes)	1.66 (0.55-4.99)	0.365		
Sleep problems before COVID-19 diagnose (yes)	1.25 (0.42-3.70)	0.685	4.36 (1.40-13.51)	0.011
Beck-D score	1.135 (1.06-1.21)	<0.001	1.102 (1.04-1.17)	0.001
Beck-A score	1.08 (1.02-1.14)	0.005	1.102 (1.043-1.165)	0.001

Beck-A: Beck Anxiety Scale, Beck-D: Beck Depression Scale, PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index
OR: Odds ratio, CI: confidentiality interval

Logistic regression analysis revealed that anxiety and depression scores are independent risk factors for both sleep quality and insomnia. Sleep problem before being diagnosed with COVID-19 are also independent risk factors for insomnia. Detailed results are presented in Table 3.

Discussion

This study aimed to assess sleep quality and insomnia in COVID-19 survivors up to six months after the acute illness and the factors influencing them. We found that approximately half of the patients experience sleep problems (poor sleep quality and insomnia at rates of 43.6% and 41%, respectively) after one to six months post-infection. However, only 15% of participants reported experiencing sleep problems before the onset of the COVID-19 disease.

A recent meta-analysis found a pooled prevalence of sleep disturbances of 47%, similar to our study (20). In a comprehensive analysis involving 9944 participants across 36 studies, Pinzon et al. found that 32.9% experienced sleep disorders within six months of COVID-19 infection (8). Additionally, a recent meta-analysis showed that one-year post-discharge, 47.1% of 535 COVID-19 survivors had poor sleep quality (21). In a study conducted by Ahmed et al. (2021) in Egypt, it was observed that poor sleep quality, at around 65%, persisted up to 6 months after discharge

(6)—higher than our study's findings. A recent meta-analysis was found that the prevalence of post-COVID sleep disturbances significantly influenced by geographic location. Research conducted in Europe, Africa, and the Americas showed a higher prevalence of post-COVID sleep disturbances compared to studies in Asian regions, particularly Southeast Asia (21). In addition, using of different measurement tools for assessing sleep quality and insomnia at various stages of the COVID-19 pandemic may contribute to variations in the results of studies.

Furthermore, we found that notable risk factors for poor sleep quality and insomnia were psychological factors such as anxiety and depression, rather than medical characteristics like comorbidities and the severity of infection (measured by treatment modality) as well as sociodemographic features such as age, sex, marital status, household size, or employment status. While our univariate analyses revealed associations between poor sleep quality and variables such as age, sex, and bereavement, these associations lost their significance when adjusted. In terms of insomnia, a notable statistical difference was observed among groups concerning sex and employment status. However, after adjustment, only anxiety and depression scores, along with pre-COVID-19 sleep problems, remained significant predictors. In the literature, conflicting results regarding sociodemographic factors and post-COVID sleep disturbance relations have been presented.

Some studies pointed out that younger patients have a higher prevalence of post-COVID-19 sleep disturbances (9). A study from Greece discovered that women have a higher prevalence and experience more severe insomnia compared to men. However, no significant differences related to sex were observed concerning poor sleep quality (7). In their meta-analysis, Alkodaymi et al. reported that at the 3-to <6-month follow-up, sleep disorders (24%) are one of the most commonly observed psychological problems, and world region, male sex, DM comorbidity, and COVID-19 severity are identified as significant effect modifiers (4). According to the last meta-analysis by Linh et al., female sex and severe/critical acute COVID-19 were associated with a significantly higher risk of post-COVID sleep disturbances (22). Similar to our results, Ahmed et al. (2021) found no significant difference between good and poor sleepers in terms of COVID-19 severity and demographics such as age and sex (6). This discrepancy could be due to sample size limitations, population-specific characteristics, or other unmeasured variables that may have influenced the results. Additionally, it's possible that the impact of gender was mediated by other factors such as comorbidities, psychosocial stressors, or the severity of COVID-19 symptoms, which could have attenuated the observed association.

Conflicting results were found regarding comorbidities, such as DM, HT and cardiovascular diseases. However, dementia and chronic obstructive pulmonary diseases/asthma were not identified as risk factors for post-COVID sleep problems. The relationship between smoking or drinking habits and post-COVID sleep problems also showed inconsistent results (21).

A longitudinal study from Italy reported that 41% of patients exhibited poor sleep quality during both the 2nd-month and 10th-month evaluations, similar to our study. In contrast to our study, in the second-month evaluation, only inflammatory factors were identified as risk factors for poor sleep quality rather than anxiety and depression scores. However, by the ten-month evaluation, female sex, higher levels of inflammatory factors, along with elevated scores for anxiety and depression, were identified as risk factors, similar to our study (22). In a large-scale retrospective cohort study conducted with outpatient cases in the UK, female sex and comorbidities were found to be associated with long COVID. Additionally, anxiety and depression were identified as the most common accompanying comorbidities (23).

A study focusing on non-hospitalized COVID-19 survivors reported a significant correlation between depression and anxiety and the development of long-term insomnia (24). Meanwhile, a study with hospitalized COVID-19 survivors revealed that symptoms of anxiety and depression, along with poor sleep quality, fluctuated throughout the first year after recovery. Notably, this study did not identify any risk factors related to these conditions (25). A recent meta-analysis showed that mental health problems, such as anxiety, stress, and depression, were positively associated with post-COVID sleep disturbances, which aligns with our findings. The impact of hospitalization for COVID-19 on sleep problems was not statistically significant (22). Taquet et al., in their study examining the symptoms of long COVID-19, noted that anxiety and depression were more frequently observed after the first three months, with anxiety gradually increasing beyond the third month (11).

Both sleep disturbances and anxiety/depression are more frequent in women than men. That is why gender could be a confounder (26). An international COVID sleep study, which controlled for pre-pandemic insomnia, found a 46% incidence of insomnia post-COVID and a relation with depression scores. Additionally, a meta-analysis reported that the association between insomnia and long COVID is bidirectional and remained significant even after controlling for other health conditions (such as attention and memory problems, chronic fatigue, sleep apnea, depression, and anxiety) (27). Notably, insomnia tends to persist even after the resolution of other symptoms (9).

Insomnia may be linked to the persistence of chronic COVID-19 symptoms (28). A study in the USA utilizing an extensive federated electronic health record system revealed that individuals who survived COVID-19 exhibit notably elevated occurrences of psychiatric disorders, dementia, and insomnia (11).

There is a lack of research on this subject in our country. Given the variations in results reported from various parts of the world, findings from our country, situated at the crossroads of three continents, hold significance. Our study is noteworthy as it is the first to investigate the long-term effects of COVID-19 on sleep disturbances in both inpatients and outpatients in Turkey during the pre-vaccine era, when a single strain (Delta variant) was dominant.

Our study has several limitations. First, the absence of pre-COVID-19 data restricts our ability to establish a baseline for comparison of anxiety and depression. Second, there is a potential for recall bias, as information on sleep problems before COVID-19 obtained from patients' evaluations relied solely on self-administered questionnaires instead of diagnostic interviews or objective measurements. Additionally, other variables, like vaccination status and different viral variants, could influence the connection between insomnia and long COVID (29). We collected our data during a period when COVID-19 vaccinations had not yet begun in our country. The dominant strain was the Delta variant. Therefore, we can discuss a homogeneous sample in this regard. The limited generalizability of our findings is influenced by the single-center design and a relatively low participation rate. Finally, since our study has a descriptive design, there is no control group; therefore, making causal inferences is not possible. To investigate the possible effects of long-term COVID on sleep disturbances, more longitudinal studies are required.

Conclusion

Our study highlights the critical issue of sleep disturbances, anxiety and depression risk in post-COVID-19 patients. We strongly recommend a multidisciplinary approach involving psychiatrists in the post-COVID care. Although the first COVID-19 pandemic has ended, new mutations of the COVID-19 virus and future pathogens will again cause diseases that require global action. Additionally, it is evident that the geographical location of studies can influence the lasting impacts of COVID-19; thus, analyzing worldwide data about the last pandemic is crucial for preparing for potential scenarios globally. Further research is needed to understand the persistent and long-term effects of COVID-19 on sleep disturbances.

Declarations

Ethics approval and Funding

This study was approved by Baskent University Institutional Review Board (Project no: KA21/193) and supported by Baskent University Research Fund.

Conflicts of interest

The authors declare no potential conflict of interest.

Availability of data

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' contributions

Literature Search: SC, GA, BA, GAG, DD, SS, YAB, UBÇ

Protocol writing: SC, GA, BA, GAG, DD, SS, YAB, UBÇ

Data collection: BA, GAG, DD, SS, YAB, UBÇ

Statistical analysis: SC, GA

Manuscript draft writing: SC, GA

All authors contributed and have approved the final manuscript.

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Geriatric Syndromes in Polymyalgia Rheumatica: A Cross-Sectional Study

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ABSTRACT

Purpose: Polymyalgia rheumatica (PMR) is a common inflammatory disorder in the elderly. Geriatric syndromes as losses in activities of daily living, frailty, nutritional deficits and sarcopenia were conditions that become increasingly prevalent with age. Whilst PMR is a disease mostly affects geriatric population, there is a scarce data about PMR and possible accompanying geriatric syndromes. We examined prevalence of the accompanying geriatric syndromes in PMR patients and compare with age ($\pm < 5$ years) and sex matched controls.

Methods: Ten patients (8 female/2 male) diagnosed with PMR according to ACR/EULAR 2012 provisional PMR criteria and ten healthy controls were included to present study. Losses in activities of daily living was evaluated with Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs). Nutritional status were assessed with Mini-Nutritional Assessment Short Form (MNA-SF). Muscle strength evaluated with hand grip test. Patients with lowered muscle strength were labeled as probable sarcopenia according to The European Working Group on Sarcopenia in Older People (EWGSOP2) 2018.

Results: Mean hand grip strength was significantly lower in PMR patients ($p=0.04$) and probable sarcopenia was strikingly more common in patient group ($p=0.01$). Difference between the groups in terms of activities of daily living, nutritional status was non-significant.

Conclusion: Higher prevalence of sarcopenia was disclosed at immune mediated rheumatic disease patients in the previous studies. Current study indicates that PMR patients were significantly more prone to probable sarcopenia. Further efforts are needed to ameliorate the patients' care, quality of life and well-being.

ÖZET

Amaç: Polimiyalji romatika (PMR), yaşlılarda yaygın görülen bir inflamatuvar hastalıktır. Geriatrik sendromlar, günlük yaşam aktivitelerindeki kayıplar, kırılabilirlik, beslenme yetersizlikleri ve sarkopeni gibi yaşla birlikte giderek yaygınlaşan durumları içerir. PMR çoğunlukla geriatrik popülasyonu etkileyen bir hastalık olmasına rağmen, PMR ve olası eşlik eden geriatrik sendromlar hakkında sınırlı veri bulunmaktadır. Çalışmamızda, PMR hastalarında eşlik eden geriatrik sendromların prevalansını inceledik ve bu verileri yaş (± 5 yıl) ve cinsiyet açısından eşleştirilmiş sağlıklı kontrollerle karşılaştırdık.

Yöntem: ACR/EULAR 2012 PMR kriterlerine göre PMR tanısı almış on hasta (8 kadın/2 erkek) ve on sağlıklı kontrol çalışmaya dahil edildi. Günlük yaşam aktivitelerindeki kayıplar, Günlük Yaşam Aktiviteleri (ADLs) ve Enstrümantal Günlük Yaşam Aktiviteleri (IADLs) ile değerlendirildi. Beslenme durumu Mini Beslenme Değerlendirme Kısa Formu (MNA-SF) ile değerlendirildi. Kas gücü el kavrama testi ile ölçüldü. Kas gücü düşüklüğü tespit edilen hastalar, 2018 tarihli Avrupa Sarkopeni Çalışma Grubu (EWGSOP2) kriterlerine göre olası sarkopeni olarak sınıflandırıldı.

Bulgular: Ortalama el kavrama gücü PMR hastalarında anlamlı derecede daha düşüktü ($p=0.04$) ve olası sarkopeni hasta grubunda anlamlı bir şekilde daha yaygındı ($p=0.01$). Gruplar arasında günlük yaşam aktiviteleri ve beslenme durumu açısından fark anlamlı değildi.

Sonuç: Bu çalışma, PMR hastalarının olası sarkopeniye önemli ölçüde daha yatkın olduğunu göstermektedir. Hastaların bakımı, yaşam kalitesinin iyileştirilmesi için daha fazla çaba gerekmektedir.

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Polymyalgia rheumatica (PMR) is relatively common rheumatic condition in elderly population (1). The most frequent presentation is a new pain and stiffness, in the shoulders and hips with concomitant elevated acute phase reactants (2).

The hallmark of PMR is an exaggerated inflammatory response. Proinflammatory cytokines such as tumor necrosis factor- α (TNF- α), interleukin-1 beta (IL-1 β), and interleukin-6 (IL-6) are elevated in PMR patients, reflecting systemic inflammation (3). IL-6, in particular, has been identified as a critical mediator of the inflammatory process, contributing to clinical symptoms and the acute phase response (4).

PMR predominantly affects individuals over 50 with the highest incidence occurring between the ages of 70 and 80 (5). This suggesting that age-related immune changes play a crucial role. "Inflammaging," a term describing chronic low-grade inflammation associated with aging, may amplify immune dysregulation in PMR (6). This includes shifts in monocyte and macrophage function, which may contribute to tissue-specific inflammation, particularly in the synovial and periarticular structures.

As individuals get older, they are at an increased risk of developing various geriatric syndromes, such as frailty, nutritional deficiencies, functional impairments in activities of daily living (ADL), sarcopenia—conditions that can impact their overall health, functional independence, and quality of life (7).

While PMR predominantly affects older adults, limited research examines the prevalence and impact of geriatric syndromes within this population. Understanding the overlap between PMR and these syndromes could enhance clinical management and patient outcomes.

We aimed to investigate the prevalence of the accompanying geriatric syndromes in PMR patients and compare them with age (± 5 years) and sex-matched controls.

Methods

Study Participants

Potential patients were identified between December 2021 and November 2023 through an electronic medical record search of the Istanbul Research and

Training Hospital using the International Classification of Diseases-10 (ICD-10) code for polymyalgia rheumatica (M35.3). Inclusion criteria included fulfilling the 2012 EULAR/ACR Classification Criteria for PMR, having a diagnosis within the previous 12 months, and currently being treated with glucocorticoids at any dose (8). Healthy controls were randomly chosen from individuals attending routine visits at the geriatric outpatient clinic. To ensure comparability, controls were matched with PMR patients based on age (± 5 years) and sex. Exclusion criteria included a concurrent diagnosis of giant cell arteritis (GCA) or other inflammatory rheumatic diseases, as well as end-stage chronic kidney disease, chronic pulmonary disorders requiring oxygen therapy, active cancer, a history of solid organ transplantation, or HIV infection. The study was approved by the Ethical Committee of the Istanbul Research and Training Hospital (10.11.2023-307). A written consent was obtained from the participants for the present study.

Variables

Comorbid conditions were quantified by the Charlson Comorbidity Index (CCI) (9). Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) were used to evaluate losses in activities of daily living (10,11). For ADLs, a score of 6 indicates full independence, 3–5 indicates partial dependence, and 2 or below is considered dependent (10).

For IADLs, a score of 8 indicates full independence, 4–7 indicates partial dependence, and 3 or below is considered dependent (11). Mini-Nutritional Assessment Short Form was used to assess the nutritional status (12). For the MNA-SF, a score of 0–7 indicates malnutrition, 8–11 indicates a risk of malnutrition, and 12–14 reflects normal nutritional status (12). Muscle strength was evaluated with a hand grip test. Patients with lowered muscle strength were labeled as probable sarcopenia, according to definition of The European Working Group on Sarcopenia in Older People (EWGSOP2) 2018 (13). The cut-off points for the hand grip test are <27 kg for men and <16 kg for women (13).

Statistical Analysis

Statistical analyses were performed using SPSS 20.0 software (IBM Corp., Armonk, NY, USA). The Shapiro-Wilk test was applied to assess the normality of data distribution. Normally distributed continuous variables

were expressed as mean \pm standard deviation, while categorical variables were reported as median (IQR). Group comparisons were conducted using either the Student's t-test or the Mann-Whitney U test, based on the data distribution. Fisher's exact test was employed for analyzing categorical variables. A p-value of <0.05 was considered statistically significant.

Results

Thirteen patients with PMR were identified. Of the 13 eligible patients, ten subjects (8 female/2 male) accepted to participate in the present study. Age (± 5 years) and sex-matched healthy controls were randomly selected from a geriatric outpatient unit in the same hospital.

The mean age was 75 ± 7.9 years for patients and 75.7 ± 7.9 years for controls, with no significant difference between the groups ($p = 0.90$). The mean PMR duration was 12.5 ± 8.9 months in the patient group. No participant was using concomitant prednisolone in the healthy control group. The median (IQR) Charlson comorbidity index was 5 (4-6) in the patient group, whereas it was 3 (4-5) ($p=0.01$) in healthy controls. The baseline characteristics of the patients and controls are depicted in Table 1.

Table 1: Baseline characteristics of the patients and controls.

Characteristics	PMR Patients	Controls	P
Sex, (n)			
Male	2	2	0,99
Female	8	8	
Age, mean \pm SD, years	$75 \pm 7,9$	$75,7 \pm 7,9$	0,90
Prednisolone*, (n)			N/A
Ever	10	0	
Never	0	10	
PMR duration, mean \pm SD, months	$12,5 \pm 8,9$	N/A	N/A
CCI**, median (IQR)	5 (4-6)	3 (3-4)	0,01

*Prednisolone ≥ 5 mg/day more than 3 months

**Charlson Comorbidity Index

The mean ADLs and IADLs were $5,7 \pm 0,9$ and $7,4 \pm 1,5$ in the patient group, while $5,8 \pm 0,4$ and $7,1 \pm 2,1$ in the control group ($p=0,79$ and $p=0,73$, respectively). The mean MNA-SF score was higher in the patient's group ($11,4 \pm 1,8$ vs. $9,6 \pm 3,1$, respectively); however, it was not statistically significant ($p=0,22$). Mean hand grip strength

was significantly lower in PMR patients ($18,5 \pm 8,6$ vs $23,5 \pm 3,9$, respectively) ($p=0,04$). Six (%60) of the 10 PMR patients had probable sarcopenia according to muscle strength, and none in the control group ($p=0,01$). Geriatric syndromes in PMR patients and controls are depicted in Table 2.

Table 2: Geriatric syndromes in PMR patients and controls.

	PMR Patients (n=10)	Controls (n=10)	P
ADLs, mean \pm SD	$5,7 \pm 0,9$	$5,8 \pm 0,4$	0,79 ^e
IADLs, mean \pm SD	$7,4 \pm 1,5$	$7,1 \pm 2,1$	0,73 ^e
MNA-SF, mean \pm SD	$11,4 \pm 1,8$	$9,6 \pm 3,1$	0,22 ^e
Muscle strength, kg	$18,5 \pm 8,6$	$23,5 \pm 3,9$	0,04^e
Probable sarcopenia, n	6	0	0,01^h

^eMann Whitney U Test, ^hFisher's exact test, SD standard deviation, ADLs Activities of Daily Living, IADLs Instrumental Activities of Daily Living, MNA-SF Mini-Nutritional Assessment Short Form

Discussion

PMR is an inflammatory connective tissue disorder that presents with morning stiffness of the girdle muscles and B symptoms in particularly women patients over age 50 years. Since the disease is common in the geriatric population, there is scarce data regarding the prevalence and impact of accompanying geriatric syndromes such as ADL loss, frailty, nutritional deficits, and sarcopenia in this group.

In our study, we demonstrated that probable sarcopenia, one of the geriatric syndromes, was significantly more frequent in the PMR group compared to controls. As far as we know, there has yet to be a study investigating the association between PMR and sarcopenia using the EWGSOP2 criteria. Sattui et al. diagnosed sarcopenia in 26% of PMR patients (14). Their study assessed sarcopenia using the dual-energy X-ray (DXA) method. However, according to the EWGSOP2 criteria, muscle strength is now prioritized for sarcopenia diagnosis, and the condition is defined as either sarcopenia or probable sarcopenia based on muscle mass measurements.

Inflammatory cytokines (e.g., IL-6, TNF- α , IL-1 β) promote muscle protein breakdown and inhibit muscle synthesis, contributing to sarcopenia (15). Additionally, prednisolone is the mainstay treatment model for PMR management through exacerbated sarcopenia through multiple mechanisms, including increasing protein catabolism, a-inducing mitochondrial dysfunction (resulting in reduced energy production and muscle weakening), b-activating myostatin (leading to muscle mass and strength loss), and c-causing oxidative stress and inflammation (16-18). Given that both the disease itself and its treatment can impair muscle strength and mass which makes screening sarcopenia is crucial for patients with PMR.

The relationship between PMR and the Mini Nutritional Assessment-Short Form (MNA-SF) underscores the potential impact of inflammation and functional impairments commonly seen in PMR on nutritional status. Inflammation and mobility limitations can increase the risk of malnutrition and lower MNA-SF scores (19). Although MNA-SF scores were higher in the PMR group, the difference was not statistically significant, and both groups were categorized as at risk of malnutrition based on the MNA-SF. nutritional screening and management during PMR diagnosis are vital. Sarcopenia and malnutrition often create a vicious cycle that exacerbates one another. This interplay can lead to functional losses, increased dependency, and higher mortality risk in geriatric patients (20).

The Charlson Comorbidity Index (CCI) in our study was significantly higher in the PMR group. The contribution of PMR itself to the CCI score likely explains this difference.

Limitations

The limited number of participants and its single center design were the limitations of the present study.

Conclusion

In conclusion, both the disease process and its treatment contribute to sarcopenia in PMR patients. Therefore, individuals diagnosed with PMR should undergo screening for probable sarcopenia, and if identified, appropriate care should be initiated.

Given the significant overlap between PMR and these syndromes, further research is essential to understand

how these conditions interact and to guide clinicians in providing comprehensive care to improve outcomes for patients with PMR.

Declarations

Funding

This study has no external funding.

Conflicts of Interest/Competing Interests

The authors declare that they have no conflicts of interest.

Ethics Approval

The study was approved by the Ethical Committee of the Istanbul Research and Training Hospital (10.11.2023-307).

Authors' Contributions

MO and VS conceptualized and designed the study. MO organized the database, performed the statistical analysis. MO and VS wrote the first draft of the manuscript. MO edited the final version of the paper. All authors approved the final version of the manuscript.

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N/A

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Authors can share the data upon a reasonable request.

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Breastfeeding Self-Efficacy and Success in Mothers of Infants with Indirect Hyperbilirubinemia

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ABSTRACT

Purpose: This descriptive study aimed to assess the breastfeeding self-efficacy and breastfeeding success of mothers whose infants were diagnosed with indirect hyperbilirubinemia (IHB).

Methods: The research was conducted on 115 mothers whose infants were undergoing phototherapy treatment in the neonatal intensive care, postpartum, and postoperative care units of a maternity hospital in Ankara. Data were collected through face-to-face interviews. Mothers completed the Mother-Infant Identification Form and the Breastfeeding Self-Efficacy Scale (BSES); their breastfeeding processes were evaluated using the LATCH scale.

Results: The average BSES score among the 115 mothers surveyed was found as 51.79 ± 9.4 . The average of LATCH scores was 7.46 ± 1.93 . LATCH scores differed significantly by the gender of the infants, their birth weight, and the time of discharge, whereas the average BSES scores showed no significant differences across these variables.

Conclusion: The study revealed that the level of self-efficacy and breastfeeding success of mothers whose infants diagnosed with IHB was insufficient. Also, multiple factors are considered to influence the initiation and continuation of breastfeeding behaviors.

Keywords: breastfeeding self-efficacy, indirect hyperbilirubinemia, newborn, phototherapy

ÖZET

Amaç: Bu araştırma, bebeği indirekt hiperbilirubinemi (İHB) tanısı almış annelerin emzirme öz-yeterliliği ve emzirme başarısının değerlendirilmesi amacıyla tanımlayıcı olarak yapılmıştır.

Yöntemler: Araştırma, Ankara'da bir kadın doğum hastanesinde yenidoğan yoğun bakım, postpartum ve postoperatif bakım servislerinde, fototerapi tedavisi alan 115 annenin katılımıyla gerçekleştirilmiştir. Veriler, yüz yüze görüşme yöntemiyle toplanmıştır. Anneler, Anne-Bebek Tanıtım Formu ve Emzirme Öz-Yeterlilik Ölçeği'ni (EÖYÖ) doldurmuş; emzirme süreçleri LATCH ölçeği ile değerlendirilmiştir.

Bulgular: Araştırmaya katılan 115 annenin EÖYÖ puan ortalaması $51,79 \pm 9,4$, LATCH puan ortalaması ise $7,46 \pm 1,93$ olarak bulunmuştur. Bebeklerin cinsiyetine, doğum ağırlığına ve taburcu olma zamanına göre LATCH puanları ortalamaları anlamlı farklılık gösterirken, EÖYÖ puan ortalamalarının anlamlı farklılık göstermediği belirlenmiştir.

Sonuç: İHB tanısı alan bebeklerin annelerinde emzirme öz yeterliliği ve emzirme başarısının düşük düzeyde olduğu belirlenmiştir. Ayrıca, emzirme davranışlarının başlatılması ve sürdürülmesinde birden fazla faktörün etkili olduğu değerlendirilmiştir.

Anahtar Kelimeler: emzirme öz yeterliliği, indirekt hiperbilirubinemi, yenidoğan, fototerapi

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Hyperbilirubinemia is characterized by a yellowing of the skin and sclera due to elevated levels of bilirubin, caused by the catabolism of the hem fragment of the hemoglobin molecule (hemoglobin-myoglobin-cytochrome). Hyperbilirubinemia is more commonly referred to as jaundice (1,2). IHB, depending on the type of bilirubin deposited in the serum. The pathophysiological causes and potential complications differ between direct hyperbilirubinemia and IHB. While IHB in infants can be physiological and temporary, direct hyperbilirubinemia is pathological in all cases (2,3). Although there are not definitive data on the prevalence of hyperbilirubinemia in newborns in our country, a multicenter study conducted in 2018 found that 6.4% of infants had bilirubin levels greater than 25 mg/dL, 0.23% had acute bilirubin encephalopathy, and 0.2% had hearing loss (2).

The most important characteristic of indirect bilirubin deposited in serum is its ability to pass the blood-brain barrier when there is excessive deposition in the body, which may induce neurotoxic effects on the brain, and may ultimately result in the most life-threatening complication of IHB – kernicterus. Kernicterus is a complex condition that develops in infants as a result of severe IHB and is associated with serious neurological dysfunction. The definitive findings of this clinical picture mostly manifest after one year of age, and may result in permanent sequelae, such as cerebral palsy, hearing loss and intellectual disability, or even infant mortality (2,3,4).

The American Academy of Pediatrics (AAP) and the TNS underline that kernicterus, which develops due to IHB in otherwise healthy term and late-preterm infants, is a “condition that should never develop”. The exact rate of incidence of kernicterus in Türkiye or around the world is currently unknown, it has been estimated as higher than acceptable. (1,3,4). The estimated rate of incidence of kernicterus among term and late-preterm infants in North America and Europe is reported to be 0.4–2.7/100.000 and is estimated to be 100 times higher in developing countries than in developed countries (5). In order to prevent and manage the IHB and kernicterus successful breastfeeding is a one of the major precautions (3).

Previous studies which investigated the factors that affected breastfeeding behaviors among mothers reported that breastfeeding self-efficacy was the most critical factor influencing the breastfeeding process (6,7).

The breastfeeding self-efficacy concept was theorized by Dennis and Faux (6), drawing on the self-efficacy theory of Albert Bandura in which self-efficacy is defined as an individual’s feeling of efficacy to accomplish a specific task. Breastfeeding self-efficacy reflects the mothers’ emotions and opinions regarding breastfeeding, the ability to cope with the challenges encountered during this process and the level of belief that “I can do this” (6). A successful lactating process can be achieved by encouraging the mother to lactate after birth and ensuring that nurses understand the challenges faced by mothers and help generate solutions (6,7).

There are various practices in Türkiye that aim to initiate and maintain successful breastfeeding, but despite all these practices, the rate of feeding with only breastmilk during the first six months has not yet reached a sufficient level, and early initiation of additional feeding has not been prevented (9,10). According to the 2018 Türkiye Demographic and Health Survey (TDHS), only 41.7% of infants were exclusively breastfed for the first six months of their lives (8). This rate remains below the desired level for optimal infant nutrition and health.

In the present study, we aimed to evaluate breastfeeding self-efficacy and breastfeeding success among mothers whose infants are diagnosed with IHB. Highlighting mothers’ breastfeeding self-efficacy and breastfeeding success may contribute to the development of breastfeeding policies in our country.

In line with the aim of this study, the following research questions will be addressed:

Research questions:

1. Do the average BSES and LATCH scores differ according to the characteristics of mothers, including socio-demographic, obstetric, and breastfeeding factors?
2. Do the mean scores of the BSES and LATCH show a difference based on certain descriptive characteristics (gender, birth weight, percentage of weight loss after birth, time of discharge, and first feeding method) of newborns diagnosed with IHB?

Material and Methods

This descriptive study was carried out between May 2015 and May 2016 in the infant intensive care, postpartum and postoperative care clinics of one of the Women's Health Training and Research Hospital, in Ankara, Türkiye. Prior to the research, ethical approval was obtained from the relevant Institutional Review Board (IRB).

For the sample size calculation of this study, the mean and standard deviation values obtained from Küçükoğlu's (2011) study on the BSES and LATCH breastfeeding scales were used. The power analysis was performed with an expected 10% margin of error, and the required number of mothers to be included in the study was determined to be at least 115 based on a power = 0.82 and $\alpha = 0.01$ (11). The infants included in the study were selected from those with a birth weight of 2500 grams or more, born between 37-42 weeks of gestation, aged less than 10 days postnatally, and without any hematological disease, infection, or need for treatment other than physiological jaundice. Infants with any hematologic disease other than IHB, infections or concomitant disorders were excluded from the study. The mothers included in the study were those aged 18 or older, with a term baby born at 37 weeks of gestation or later, no contraindications to breastfeeding, no multiple pregnancies, and who were willing, cooperative, and open to communication. Infants with any hematologic disease other than IHB, infections or concomitant disorders were excluded from the study.

To determine the descriptive characteristics of the mothers and their infants, data were collected using a Mother-Infant description form that was prepared by the researchers based on the literature, along with BSES and LATCH breastfeeding description and evaluation scales.

BSES, originally developed as a 33-item scale by Dennis and Faux in 1999, was later shortened to a 14-item scale by Dennis in 2003 (6). The BSES Form Scale is a 5-point Likert-type scale (1 = I am not sure at all, 2 = I am not very sure, 3 = I am occasionally sure, 4 = I am sure, 5 = I am always sure), with a minimum score of 14 and a maximum score of 70. Higher scores increase in direct proportion to an individual's level of breastfeeding self-efficacy. (7).

BSES has been used by more than 400 researchers and healthcare professionals in 30 countries so far. The validity and reliability study of the Turkish scale were carried out by Tokat (2009), and the Cronbach's Alpha value was shown to be 0.86. In the present study, the Cronbach's Alpha value was found to be 0.83. The LATCH scale was developed in 1994 by Jensen, Wallace and Kelsay to help healthcare providers in the assessment of effective breastfeeding by providing a systematic and standardized method of measurement (9). The items in the LATCH breastfeeding description and evaluation scale were adapted to an Apgar scoring system. LATCH is an acronym of the items on the scale, being the five situations faced by the mother and require appropriate interventions (9). (see Figure 1).

Each criterion that makes up LATCH Breastfeeding Description and Assessment Scale is given a score of 0, 1 or 2, and breastfeeding is assessed based on the total score, calculated by adding all scores. The highest and lowest total scores that can be obtained in this scale are 10 and 0, respectively, with scores lower than 10 indicate that the mother requires support for breastfeeding. The LATCH breastfeeding description and assessment scale is not only a tool of measurement that can be used by nurses but can also be used by mothers for self-assessment. (9,10).

Assessment	Scores		
CRITERIA	0	1	2
Latch	Sleepy or reluctant; no sustained latch	Repeated attempts to latch, holds nipple only, visible suction	Grasps the breast while holding the areola in the mouth, rhythmical sucking. Lips flanged
Visible swallowing	None	Some suction	Strong expirations visible during swallowing
Type of nipple	Inverted	Flat	Everted after stimulation
Mother's comfort of breast and nipple	Engorgement, cracked, bleeding, blisters	Reddened, small blisters, decreased comfort	Soft breasts and comfortable
Position of holding the infant	Full assist	Minimal assist	No assist

Figure1: Instructions for the Assessment of LATCH Breastfeeding Description Measurement Tool

The first validity and reliability study to use the Turkish scale were performed by Demirhan in 1997 (10), who found that the Cronbach's Alpha value for the scale was 0.94. In the present study, the Cronbach's Alpha value of the scale was found to be 0.62. This lower value may be attributed to factors such as sample size, cultural differences, or the administration process of the scale, which might affect its reliability in this specific context.

Statistical Analysis

The data collected in the study were analyzed using SPSS 24. Numerical data were represented as means and standard deviations, while nominal data (demographic) were summarized as frequencies and percentages. For the analyses of numerical data, Kolmogorov-Smirnov or Saphiro Wilk tests were applied initially to check whether the variables met the parametric conditions (normal distribution). For variables meeting parametric test conditions, a T-test was used for comparisons between two groups, and a One-Way Analysis of Variance (ANOVA) was applied to compare more than two groups. For non-parametric variables, a Mann-Whitney U-test was used for two-group comparisons, while a Kruskal-Wallis H-test was

applied for comparisons among more than two groups. The reliability of the scales was investigated through Cronbach's Alpha values. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

Of the 115 infants included in the study, 58.3% were female and 41.7% were male. Among them, 10.4% had a low birth weight, while 89.6% had a normal birth weight. The mean birth weight of the infants was $3,193 \pm 461$ grams.

The differences between the birth weights and current weights of the infants were evaluated after classifying them into two groups (Table 1). The first group consisted of infants who had physiological weight loss after birth (weight loss less than 10%) and accounted for 90.4% of the study sample; while the second group consisted of infants with pathological weight loss who lost at least 10% of their birth weight. This group accounted for 9.6% of the sample. Of all the infants, 11.4% were discharged with their mothers within 24 hours of delivery, and 74.8% were initially fed with colostrum.

Table 1: Mean BSES and LATCH scores of the mothers based on descriptive characteristics of the infants (N=115)

Descriptive Characteristics	Number (n)	Percentage (%)	BSES Scores, Mean±SD	Test Value and Significance	LATCH Scores Mean±SD	Test Value and Significance
Gender						
Female	102	58.3	50.43±9.943	t=1.845	7.13±2.152	t=2.173
Male	13	41.7	53.69±8.385	p=0.068	7.92±1.485	p=0.032
Birth weight						
2,500 grams and below (Low birth weight)	12	10.4	51.58±2.667	U=609.000 p=0.934	6.50±0.417	U=383.500 p=0.030
Between 2,501 and 4,000 grams (Normal birth weight)	103	89.6	51.82±0.935		7.57±0.193	
Weight after birth (Percentage of weight lost)						
Less than 10% weight loss	104	90.4	51.96±9.556	U=401.000 p=0.860	7.42±1.987	U=274.400
10% or more weight loss	11	9.6	51.09±7.778		8.09±1.375	p=0.254
Time until discharge after delivery						
Within the first 24 hours after delivery (A)	13	11.4	48.69±3.039	KW=3.570 p=0.168	6.92±0.525	U=926.500 p=0.021
Later than 24 hours after delivery (B)	51	44.3	50.61±1.359		7.10±0.256	
Current inpatients*(C)	51	44.3	53.76±1.185		7.96±0.276**	
First mode of feeding						
Colostrum	86	74.8	53.48±1.185	t=3.458	7.74±1.777	t=2.784
Formula	29	25.2	46.79±9.500	p=0.001	6.627±2.162	p=0.006
*Mother-infant couples in 3–7th postnatal days and still being monitored at the hospital						
**Sources of difference according to Mann-Whitney U-test (Difference: B-C)						

*Mother-infant couples in 3–7th postnatal days and still being monitored at the hospital

**Sources of difference according to Mann-Whitney U-test (Difference: B-C)

Table 2: Mean BSES and LATCH scores of mothers according to their descriptive characteristics (N=115)

Descriptive Characteristics	Number (n)	Percentage (%)	BSES Scores, Mean±SD	Test Value and Significance	LATCH Scores, Mean±SD	Test Value and Significance
Mother's Age						
19-25 years	47	40.9	50.94±1.405	KW = 0.863 p=0.834	7.23±0.258	KW = 2.754 p= 0.431
26-30 years	34	29.6	51.74±1.476		7.44±0.392	
31-35 years	22	19.1	53.32±2.290		7.59±0.404	
36 years and above	12	10.4	53.36±2.288		8.17±0.441	
Education						
Primary school	51	44.3	51.43±1.277	KW = 1.169 p=0.557	7.73±0.238	KW = 2.415 p = 0.299
High school	38	33.0	51.11±1.533		7.11±0.311	
Undergraduate and graduate school	26	22.7	53.50±1.985		7.46±0.462	
Family type						
Elementary	89		53.00±0.966	U=767.000 p=0.009	7.45±0.211	U=1151.000 p=0.968
Large	26		47.65±1.858		7.50±0.348	
Type of delivery						
Normal	67	58.3	51.54±9.128	t=0.340	7.34±1.974	t = 0.769
C-section	48	41.7	52.15±9.910	p=0.734	7.63±1.886	p=0.444
Planned/unplanned status of pregnancy						
Planned	93	80.9	52.27±0.988	U=854.500	7.55±0.197	U=887.000
Unplanned	22	19.1	49.77±1.899	p=0.231	7.09±0.446	p=0.327
Number of deliveries						
Primiparous	61	53.0	49.13±9.703	t=3.359	6.84±1.908	t = 3.905
Multiparous	54	47.0	54.80±8.192	p=0.001	8.17±1.724	p=0.000
Knowledge of breastfeeding						
Informed	89	77.4	52.92±0.953	U=853.000	7.73±0.200	U= 7323.000
Uninformed	26	22.6	47.92±1.965	p=0.042	6.54±0.360	p=0.004
Efficacy of information received on breastfeeding						
Yes	68	59.1	55.04±0.969	t=4.188 p=0.000	7.82±1.892	t=2.472
No	47	40.9	47.09±1.375		6.94±1.893	p=0.015
Father's support during breastfeeding						
Supportive	103	89.6	52.40±0.914	U=402.500 p=0.048	7.63±0.184	U= 332.500
Non-supportive	12	10.4	46.58±2.732		6.00±0.564	p=0.008
Knowledge of jaundice before delivery						
Informed	58	50.4	52.48±9.162	t=0.792 p=0.430	7.60±2.017	t=0.796
Uninformed	57	49.6	51.09±9.714		7.32±1.853	p=0.428
Efficacy of information received on jaundice *(n=58)						
Yes	28	50.4	56.39±1.532	U=774.000 p=0.004	8.32±0.337	U=782.500
No	30	49.6	50.31±1.006		7.18±0.205	p=0.004
*The question was answered by mothers who were informed about jaundice						

*The question was answered by mothers who were informed about jaundice

As shown in Table 2, family type significantly influenced BSES scores, with mothers in elementary families scoring higher than those in large families (U=767.000, $p<0.05$, Table 2). However, no significant difference was observed in LATCH scores based on family type (U=1151.000, $p>0.05$, Table 2). Parity also demonstrated a significant

effect, as multiparous mothers had higher BSES ($t=3.359$, $p<0.001$, Table 2) and LATCH scores ($t=3.905$, $p<0.001$, Table 2) compared to primiparous mothers, reflecting the impact of prior breastfeeding experience on maternal self-efficacy. Mothers who were informed about breastfeeding scored significantly higher on both BSES (U=853.000,

$p < 0.05$, Table 2) and LATCH ($U = 7323.000$, $p < 0.01$, Table 2) compared to those who were uninformed. Additionally, mothers who perceived the breastfeeding information they received as effective had significantly higher BSES ($t = 4.188$, $p < 0.001$, Table 2) and LATCH scores ($t = 2.472$, $p < 0.05$, Table 2).

Support from fathers during breastfeeding was another significant factor, as supportive fathers were associated with higher BSES ($U = 402.500$, $p < 0.05$, Table 2) and LATCH scores ($U = 332.500$, $p < 0.01$, Table 2) compared to those who were non-supportive. Knowledge of jaundice before delivery did not significantly impact BSES ($t = 0.792$, $p > 0.05$, Table 2) or LATCH scores ($t = 0.796$, $p > 0.05$, Table 2). However, among mothers who were informed about jaundice, those who found the information effective had significantly higher BSES ($U = 774.000$, $p < 0.01$, Table 2) and LATCH scores ($U = 782.500$, $p < 0.01$, Table 2), suggesting that the quality of information plays a crucial role. Maternal age, education level, and type of delivery did not show significant differences in BSES or LATCH scores. Specifically, maternal age ($KW = 0.863$, $p > 0.05$ for BSES; $KW = 2.754$, $p > 0.05$ for LATCH, Table 2), education ($KW = 1.169$, $p > 0.05$ for BSES; $KW = 2.415$, $p > 0.05$ for LATCH, Table 2), and type of delivery ($t = 0.340$, $p > 0.05$ for BSES; $t = 0.769$, $p > 0.05$ for LATCH, Table 2) were not significant. Planned versus unplanned pregnancy also did not significantly affect BSES ($U = 854.500$, $p > 0.05$, Table 2) or LATCH scores ($U = 887.000$, $p > 0.05$, Table 2).

In the study, a moderate positive and significant relationship was found between the BSES and the LATCH breastfeeding assessment tool ($r = 0.531$, $p < 0.01$).

Discussion

This study found that while the mean BSES scores of mothers did not differ significantly based on the gender of their infants, a significant difference in breastfeeding success was observed ($p < 0.05$, Table 1). Aslan and Ege (2016) identified a significant relationship between infant gender and breastfeeding self-efficacy while investigating the relationship between maternal breastfeeding self-efficacy and the risk of depression (15). Similarly, Ören et al. (2023) found that infant gender had a significant effect on maternal breastfeeding attitudes. These findings suggest that factors such as the societal structure in which the study is conducted and the mother's satisfaction with the infant's gender may influence the outcomes (16). In this context, it is important for nurses

to emphasize the importance of breastfeeding without gender discrimination in both antenatal and postnatal counselling (15,16,17).

While the mean BSES scores of the mothers did not vary significantly according to the birth weight of infants in this study, a statistically significant difference was noted in breastfeeding success ($p < 0.05$, Table 1). Based on previous studies, all infants with a birth weight lower than 2.500 grams are considered to be low birth-weight infants, irrespective of the gestational week at birth. Previous studies have indicated that the mothers of infants with low birth weight experience difficulties in breastfeeding and have a high level of anxiety regarding the maintenance of breastfeeding after being discharged from the hospital. This leads mothers to be predisposed to quitting breastfeeding and switching to formula (17,20,24). Birth weight did not significantly affect BSES or LATCH scores, but low birth weight was associated with lower breastfeeding success ($p < 0.05$, Table 1). Previous studies indicate that mothers of low birth-weight infants face more challenges and anxiety, necessitating additional breastfeeding support (16,17).

Postnatal weight loss did not significantly affect BSES or LATCH scores, though mothers of infants with pathological weight loss appeared to receive higher levels of breastfeeding support during hospitalization, which may mitigate negative effects (1,2). Monitoring infant weight loss in the first postpartum week is crucial for preventing health risks (3,21).

Early discharge (<48 hours) did not significantly affect BSES scores but reduced LATCH scores ($p < 0.05$, Table 1). Literature links early discharge to increased IHB and rehospitalization rates, highlighting the importance of postnatal home visits and effective community healthcare services (3,4,5,21,22).

Mothers who fed their infants colostrum as the initial nutrient had significantly higher BSES and LATCH scores ($p < 0.05$, Table 1). Colostrum's nutritional and laxative properties are vital for infant health and IHB prevention. Supporting colostrum feeding within the first postpartum hour is critical (16,20).

Sociodemographic characteristics such as maternal age and education level did not significantly affect BSES or LATCH scores ($p > 0.05$, Table 2). However, family type significantly influenced BSES scores, with mothers

in nuclear families scoring higher ($p < 0.05$, Table 2). Extended families often rely on elder relatives' practices, suggesting the need to involve older family members in breastfeeding education (19,20).

Parity emerged as a significant factor, with multiparous mothers scoring higher on BSES and LATCH than primiparous mothers ($p < 0.05$, Table 2). Prior breastfeeding experience positively influenced current self-efficacy (7,18). Similarly, receiving adequate prenatal breastfeeding information significantly improved BSES and LATCH scores ($p < 0.05$, Table 2), emphasizing the need to enhance the quality of prenatal care.

This study demonstrates that the father's attitude towards breastfeeding significantly affected the mean BSES and LATCH scores of the mothers. Several studies in the literature have discussed the support and influence of the father regarding the issue of breastfeeding (Lee and Ip, 2008; Hunter and Cattelona, 2014; Rempel et al., 2017; Sahin and Ozyurt, 2017). In a previous study, Kong and Lee (2004) found out that mothers who were encouraged by their spouses to breastfeed would more commonly prefer to breastfeed their infants (Kong and Lee, 2004). Based on our findings and previously reported data in the literature, nurses should consider the effects of the father on the mother's breastfeeding habits during their interventions to increase breastfeeding success and to include the fathers in training consultancy programs so that they can sufficiently support their spouses.

In the present study, the mean BSES and LATCH scores of the mothers did not differ significantly depending on their level of knowledge of infant jaundice ($p > 0.050$). However, the mean BSES and LATCH scores varied significantly according to the level of satisfaction of the mothers with the information they had received ($p < 0.05$, Table 2). In their study to identify the risk factors for infant IHB, Cayonu et al. (2011) concluded that the knowledge of the community on jaundice was insufficient, and the same study reported that, although all families recognized the jaundice of their infants between the third and fourth days, they delayed visiting hospital for an average of two days and referred to a hospital on the fifth day after onset (Cayonu et al., 2011). Uslu et al. (2012) carried out a study in which they analyzed the effects of the infant jaundice and breastfeeding training given to mothers and the early monitoring of infants by outpatient clinics, on the frequency of hospitalization due to jaundice. The authors found that these training reduced the duration of

phototherapy and hospital stays in infants re-hospitalized for jaundice, and also decreased the associated costs. It is crucial that healthcare professionals who provide training and consultancy to the mothers on breastfeeding highlight the causes of IHB and the importance of breastfeeding for its prevention. Re-hospitalizations due to IHB or the continued inpatient monitoring of the infant for phototherapy may negatively affect the mother-infant relationship (Maisels and Newman, 2012; Uslu et al., 2012). The results of the present study suggest that the mothers' perception of having limited knowledge on IHB results in anxiety among these mothers, and consequently, has a negative effect on breastfeeding.

Conclusion

The present study, as a descriptive evaluation of breastfeeding self-efficacy and breastfeeding success among mothers whose infants were diagnosed with IHB, suggests that breastfeeding self-efficacy and breastfeeding success levels were insufficient among these mothers. Regular follow-up of early discharged mothers by public health nurses through home visits and the use of mobile health applications for continuous breastfeeding support during the prenatal and postnatal periods, along with including fathers in support programs, can help prevent complications and improve breastfeeding outcomes. Additionally, breastfeeding counseling programs should include topics on the prevention and management of complications related to IHB.

Declarations

Funding

This study had no external funding.

Conflicts Of Interest

The authors declare that they have no conflicts of interest.

Ethics Approval

This study was approved by the Ankara University Ethics Committee (Decision No: 2015-11/147, Date: May 7, 2015).

Availability Of Data and Material

The data for this study are available from the corresponding author upon reasonable request.

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Authors' contributions

All authors have significantly contributed to this article's preparation, thoroughly reviewed the manuscript, and approved its final version for submission.

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Information Literacy Levels of Nursing Students and Affecting Factors

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ABSTRACT

Purpose: This study aims to assess the information literacy levels of nursing students and identify the factors influencing them.

Methods: A descriptive, cross-sectional design was used, with 489 nursing students participating. Data were collected using a "Sociodemographic Information Form" and the "Information Literacy Scale."

Results: The average information literacy score was 3.87 ± 0.54 . The highest sub-dimension score was for ethical and legal regulations (4.03 ± 0.60), and the lowest was for defining the need for information (3.77 ± 0.63). The internet was the primary source of information for 56.0% of students. Computer use proficiency was the only factor significantly affecting information literacy.

Conclusion: Improving access to information resources like the internet and computers in universities could enhance nursing education. Strengthening students' computer skills is necessary to increase information literacy awareness. Nursing educators should focus on integrating evidence-based practice into the curriculum and providing relevant practical experiences.

Keywords: Nursing, nursing student, information literacy, literacy

ÖZET

Amaç: Bu çalışma hemşirelik öğrencilerinin bilgi okuryazarlığı düzeylerini değerlendirmeyi ve etkileyen faktörleri belirlemeyi amaçlamaktadır.

Yöntemler: Tanımlayıcı, kesitsel bir tasarım kullanılmış ve çalışmaya 489 hemşirelik öğrencisi katılmıştır. Veriler "Sosyodemografik Bilgi Formu" ve "Bilgi Okuryazarlığı Ölçeği" kullanılarak toplanmıştır.

Sonuçlar: Ortalama bilgi okuryazarlığı puanı 3.87 ± 0.54 'tür. En yüksek alt boyut puanı etik ve yasal düzenlemeler (4.03 ± 0.60), en düşük puan ise bilgi ihtiyacını tanımlama (3.77 ± 0.63) alt boyutuna aittir. Öğrencilerin %56,0'sı için internet birincil bilgi kaynağıdır. Bilgisayar kullanım yeterliliği bilgi okuryazarlığını anlamlı olarak etkileyen tek faktördür.

Sonuç: Üniversitelerde internet ve bilgisayar gibi bilgi kaynaklarına erişimin artırılması hemşirelik eğitimi geliştirebilir. Bilgi okuryazarlığı farkındalığını artırmak için öğrencilerin bilgisayar becerilerini güçlendirmek gereklidir. Hemşirelik eğitimcileri kanıta dayalı uygulamaları müfredata entegre etmeye ve ilgili pratik deneyimler sağlamaya odaklanmalıdır.

Anahtar Kelimeler: Hemşirelik, hemşirelik öğrencisi, bilgi okuryazarlığı, okuryazarlık

Nursing is a profession that undertakes the care of patients as a part of health services manages treatment processes, and aims to improve the general health and well-being of patients. In order to provide effective services in today's complex health environment, nurses need to be equipped with 21st century competencies (1). The report of the UNESCO World Summit on the Information Society proposes a literacy framework titled "21st Century Competencies", which includes 12 core competencies that will be needed in the society of the future (2). Information literacy is defined as a core competency among the practical competencies within the framework of 21st century competencies. The Institute of Medicine has identified five core competencies required for health professionals. These are: providing patient-centered care, working with interdisciplinary teams, using evidence-based practices, implementing quality improvement, and using informatics (3). Information literacy of nurses is recognized as one of the core competencies of nurses in this profession due to the increasing use of research findings and updating of information in health care (4). Nurses need a high level of information literacy to evaluate information retrieved from databases and combine it with evidence-based practice, therefore nurses and nursing students should acquire information literacy skills resulting in effective retrieval of records from high-quality clinical research articles (5). Lack of information literacy prevents nurses from accessing reliable evidence (5).

Information literacy is defined by the American Library Association (ALA) as "recognizing the need for information, accessing, evaluating, and using information effectively" (6). Based on this definition, information literacy skills include many steps such as asking clinical questions, developing search strategies, searching using databases and digital tools, finding the necessary information, critically evaluating the information found, referencing and applying it in the clinical field. Published by the Royal College of Nursing (RCN) in 2011, "RCN Competencies: Finding, Using and Managing Information" defines nursing information literacy competency as a comprehensive concept that includes determining why and what information is needed, searching for information, evaluating how the information meets the identified need, managing information, using information inclusively, legally, and ethically, and creating new information (7).

In modern society, where information sources are rapidly increasing, selecting the right information is more important than ever (8). Nurses use information literacy

skills to provide the best patient care by assessing the accuracy, reliability and appropriateness of health-related information. Nursing students need information literacy skills for activities such as literature review, writing research projects, and actively participating in class discussions throughout their undergraduate education. Considering the rapid development of information today, providing information literacy skills to pre-nursing students is important for the development of lifelong learning and the use of evidence-based approaches (9). Evidence-based practice is the basis of problem-solving in nursing and students can transfer these skills into clinical settings to practice after accessing the right information (10). Therefore, it is necessary for students to effectively search for information, critically evaluate it, and acquire clinical decision-making skills (11).

Healthcare settings expect nurses to solve complex patient problems, be innovative and use the best evidence as information literate professionals. A recent systemic review highlighted the need for nursing education to develop information literacy competencies (12). Nursing students may experience some difficulties in the transition from university to professional life in terms of demonstrating knowledge, accessing information and combining it with the practice environment. Failure to acquire professional competencies during undergraduate years may cause problems in nursing practices during the transition to work (13). Developing information literacy skills of nursing students before the start of the profession can help them adapt effectively (14). In the literature, learning styles, motivation and attitudes, technology use, and education levels are reported as factors affecting nursing students' information literacy (14-16). Assessing nursing students' information literacy skills is critical for developing these skills. Resources that increase information literacy to support the nursing student's ability to provide safe and effective care are recommended to be routinely integrated into the nursing curriculum (17). However, there is no curriculum to develop information literacy in the nursing undergraduate curriculum of the university where the study was conducted.

The integration of information literacy education into nursing education has mostly been achieved using the standards of nursing education associations. Understanding these standards and how faculty members' perceptions of the importance of IL skills vary with their level of education will guide the development of a companion document that librarians, in collaboration with nurse educators, can use to integrate IL education into nursing curricula at the course and program levels.

Some recent studies have shown that training nurses in information literacy is beneficial (18). There are a limited number of studies evaluating nursing students' information literacy in the literature (15). The Chinese study showed that most nursing students have a low level of information literacy, lack information awareness, and are not good at using scientific and technological developments, so they are unable to keep up with the latest research results in this professional field in a timely manner (19). The literature examining the information literacy levels of nursing students in Turkey and the factors affecting information literacy is quite limited (20). Because of this in this study, it was aimed to determine the information literacy levels of nursing students and the factors affecting them.

Materials and Methods

This study is descriptive and cross-sectional study. It was conducted face-to-face with students studying at the Nursing Department of the Faculty of Health Sciences of a university in Turkey between May 2023 and November 2023.

Sample

A total of 601 students are enrolled in the nursing program, and 489 students were selected by a random sampling method. The completion rate of the data collection form was determined as 81.36%. Eleven incomplete and incorrectly completed questionnaires were excluded from the evaluation. Inclusion criteria were nursing students in all grades who voluntarily agreed to participate in the study. Students who interrupted their education due to illness or any other reason and did not agree to participate in the study were excluded. The school where the study was conducted has a classical education model. All students participating in the study received the basic nursing education curriculum. There is no information literacy course in this curriculum. Knowledge of information literacy is partially provided in basic information technologies, research methods, evidence-based nursing and biostatistics course content.

Ethical considerations

Before starting the study, permission to use the scales was obtained via e-mail. Institutional permission from the university and ethics committee permission (dated 11.05.2023 and numbered 2023/06) from the Non-Interventional Clinical Research Ethics Committee of the university was obtained for the study. Written permission

was obtained from student nurses who agreed to participate in the study.

Data collection tools

Data collection tools consist of two parts. The first part includes the Sociodemographic Information Form and the second part includes the Information Literacy Scale.

Sociodemographic Information Form: In the form consisting of 17 questions about sociodemographic characteristics, the researchers included questions about the students' gender, age, academic average, grade, employment status, place of residence, English level, basic statistics education, personal computer ownership, computer usage level, use of ways of obtaining information, training on literature search and use, the most used method of obtaining information, whether they have received training on information literacy before and whether they want to receive training, defining information literacy and determining their goals after graduation. At the university where the study was conducted, students can receive a maximum academic score of 4.00.

Information Literacy Scale: The information literacy scale developed by Adigüzel (21) used in this study consists of 29 items and 4 factors. Defining the need for information, accessing information, using information, and ethical and legal regulations in using information. There are no reverse items in the scale. The scale questions are 5-point Likert scale ranging from very difficult (1), difficult (2), undecided (3), not difficult (4), and not difficult at all (5). The mean score equivalents of the options in the scale are: 4-5 "I have no difficulty at all", 3-3.99 "I have no difficulty", 2-2.99 "I am undecided", 1-1.99 "I have difficulty", 0-0.99 "I have great difficulty". As the score obtained from the scale increases, the level of information literacy increases. The overall Cronbach Alpha reliability coefficient of the original scale was found to be 0.928 (34) and 0.940 in the current study.

Statistical Analysis

Statistical Package for Social Sciences (SPSS), version 21.0 (SPSS Inc., Chicago, IL) was used for data analysis. Data were presented as mean, percentage, standard deviation and frequency counts. Compliance with normal distribution was evaluated by Shapiro-Wilk and Kolmogorov-Smirnov tests. Multiple regression analysis was used to determine the factors affecting the information literacy score. A significance level of 0.05 was accepted.

Results

The mean age of the students who participated in the study was 21.01 ± 2.1 and the mean academic average was 3.29 ± 0.262 . 73% of the students were female, 95.5% were not working and 61.3% lived in the city center. The English level of 51.1% of the students was intermediate,

70% did not receive basic statistics education, and 60.9% received information about literature review in the course. It was determined that 25.2% of the students did not have a computer and 64.6% of them had an intermediate level of computer use. Among the ways of obtaining information, the internet ranked first with a rate of 56% (Table 1).

Table 1: Sociodemographic datas of the nursing students (n=489)

	mean±standart deviation		
Age (year)	21,01±2,1		
Academic achievement score	3,29±0,26		
		n	%
Gender	Female	357	73.00
	Male	132	27.00
Grade	First	116	23.70
	Second	131	26.80
	Third	125	25.60
	Forth	117	23.90
Working status	No	467	95.50
	Yes	22	4.50
Residence	Providence	300	61.30
	Town	153	31.30
	Village	36	7.40
English language level	Low	250	51.10
	Moderate	225	46.00
	High	14	2.90
Basic statistics training	No	343	70.10
	Yes	146	29.90
Student activity experience status	I attended the student congress as a listener	178	36.40
	I attended in the student congress with a paper	9	1.80
	I received student project acceptance	3	0.60
	I presented at a student event	45	9.20
	Other	34	7.00
	None	220	45.00
Computer ownership status	No	123	25.20
	Yes	366	74.80
Level of computer usage	Beginner	60	12.30
	Moderate	316	64.60
	Good	113	23.10
Way to obtain information	Library/online databases	48	9.80
	Websites	274	56.00
	Expert contacts	5	1.00
	Social media	11	2.20
	Other (books, journals, articles, etc.)	151	31.00
Literature review and utilization	I was informed about this in the lesson	298	60.90
	I received online paid training outside of class	9	1.80
	I found out about it on the internet myself	62	12.70
	No training received	120	24.60
Information literacy	No	413	84.50
	Yes	76	15.50
Information literacy training willingness to receive	No	149	30.50
	Yes	340	69.50
Their goals after graduation	Working as a nurse	245	50.10
	Working in a field other than nursing	28	5.70
	Master's degree and then academia	62	12.70
	Working abroad	58	11.90
	Other (Working in another field, etc.)	96	19.60
Data are given as mean±standard deviation or n(%)			

While 44.13% of the students defined information literacy as finding the information needed and 5.47% as recognizing the need for knowledge, 29.76% could not or did not want to define information literacy. (Figure 1).

The students' total average score of information literacy was 3.87 ± 0.54 . When the sub-dimensions of the information literacy scale were examined, the dimension

of ethical and legal regulations in using information was the highest (4.03 ± 0.60) and the dimension of defining the need for information was the lowest (3.77 ± 0.63) (Table 2).

In the logistic regression analysis of the factors affecting the information literacy score, only the level of computer use was found to be a predictor of information literacy (Table 3).

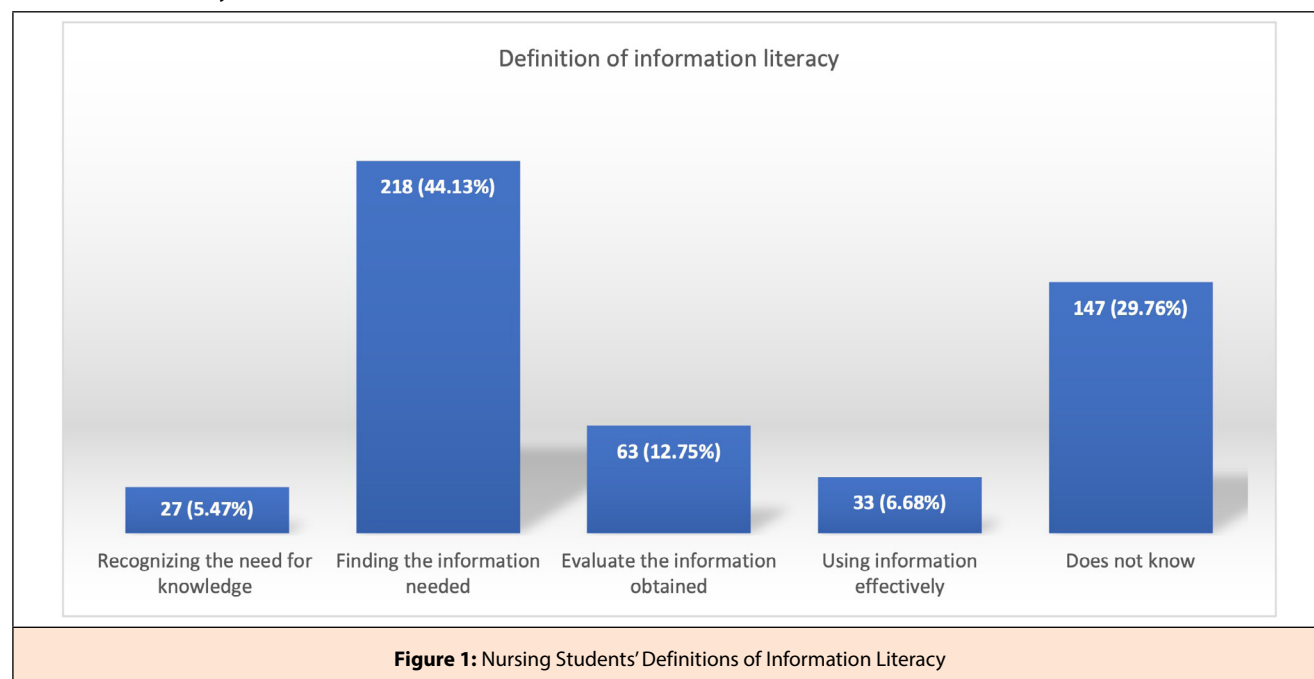


Table 2: Information Literacy Scale Score Averages of Nursing Students (n=489)

	Mean±SD
Information literacy average score	3,87±0,54
Defining the information need	3,77±0,63
Accessing information	3,86±0,57
Using knowledge	3,82±0,64
Ethical and legal regulations in using information	4,03±0,60
<i>Data are given as mean±standard</i>	

Table 3: Factors Affecting Nursing Students' Information Literacy (n=489)

Variables	UNIVARIATE	p value	MULTIVARIATE*	p value
	Coefficients (95%CI)		Coefficients (95%CI)	
Age	0.034(0.010-0.058)	0.006	0.027(-0.004-0.058)	0.089
Gender	0.055(-0.053-0.163)0.320	0.320	0.025(-0.087-0.137)	0.661
Class	0.044(-0.142-0.231)	0.641	0.020(-0.035-0.074)	0.478
Working status	0.062(-0.170-0.294)	0.601	(0.064(-0.303-0.176)	0.601
Residence	-0.036(-0.012-0.041)	0.359	0.016(-0.062-0.094)	0.685
English language level	0.064(-0.023-0.151)	0.148	0.052(-0.036-0.139)	0.244
Basic statistics education receiving status	0.124(0.019-0.228)	0.021	0.071(-0.038-0.181)	0.202
Computer ownership status	0.090(-0.021-0.201)	0.110	0.016(-0.099-0.130)	0.789
Level of computer usage	0.154(0.073-0.236)	<0.0001	0.138(0.049-0.226)	0.002
On information literacy education status	0.116(-0.017-0.248)	0.087	0.100(-0.036-0.237)	0.148
Information literacy training willingness to receive	0.077(-0.027-0.182)	0.146	0.104(-0.001-0.210)	0.052
<i>Multiple regression analysis</i>				

Discussion

In this study in which we investigated the level of information literacy among nursing students, only the level of computer use was found to be an important determinant among the factors affecting the information literacy score. To increase information literacy, it may be important to focus on developing students' skills in using computers effectively. The findings of this study draw attention to the fact that 44.13% of nursing students defined information literacy only as accessing or finding information, 5.47% were uncertain about recognizing the need for information, and 29.76% could not or did not want to define information literacy. These results show that the majority of students need a clear definition of what information literacy is and is not. Considering the rapid spread of information and similar rapid change in today's world, this result also shows that students need to strengthen their awareness of information literacy. Another important finding of the study is that among the sub-dimensions of the scale, the dimension of defining students' information needs was the lowest (3.77 ± 0.63). This shows that students have difficulty in identifying their information needs. In the study conducted by Li et al. in a 2022 study involving nursing students in China, the highest score among the sub-dimensions of information literacy was reported in the information awareness dimension (15). Considering the necessity to follow continuously updated evidence in the field of clinical practice today, it is critical for students to be informed about this issue. However, in this study, 84.5% of the students did not receive information literacy training and 51.1% evaluated their language proficiency as low. These results put students at risk of not being able to adequately develop their skills in identifying, researching, analyzing and evaluating problems in the field of nursing. In order to fully benefit from the opportunities offered through universities such as library services, free databases and trainings, students need to be aware of these opportunities. However, according to the results of this study, it is seen that the majority of students are not aware of these resources or encouragement practices are not common. Nursing students' unfamiliarity with the processes of feeling, finding, analyzing and evaluating the need for information may prevent the understanding and use of evidence-based practice in clinical skills. Research shows that nurses do not use electronic resources such as online databases frequently enough, even in a period of increased access to electronic resources. Therefore, it is important not only to access information but also to critically evaluate and apply the information (9). In

this context, the gradual and continuous provision of information literacy training during undergraduate education should aim to strengthen students' ability to access and evaluate information, as well as to gain the ability to use information effectively in clinical practice.

In this study, only the level of computer use was found to predict information literacy. Soroya et al. reported that training in statistics, literature access and use, and place of birth were associated with information literacy scores (14). They evaluated medical students and reported that English language proficiency, participation in information literacy trainings, and high emotional intelligence had positive effects on information literacy. On the other hand, in Dolnicar and Podgornik's (16) study on the COVID pandemic period, it was stated that having information and communication technology devices and information and communication technology courses were not related to information literacy competence. However, in the same study, it was found that there was a significant relationship between the level of personal confidence in internet use and the level of information literacy. Similarly, in Duncan and Holtslander's study (13), it was found that there was a relationship between students' ability to use computers and lack of confidence. In this context, this study evaluated the relationship between information literacy and computer use, and it is thought that students' motivation to seek information will increase with the improvement of their computer use skills. Özkul and Kaya evaluated that 32.1% of nursing students evaluated themselves as competent in computer use (22). In the study, 64.6% of the students had moderate computer skills. In Özkul and Kaya's study, the fact that students' proficiency in computer use was low may be related to the fact that their study was conducted 15 years ago (22). Improvement in computer skills can positively affect students' motivation to seek information by increasing their self-confidence levels. It can enable students to be more active in accessing information and learning processes. Considering that most of the students in this study used the internet and computers as a way of obtaining information, the importance of these technologies in educational processes becomes even more evident. Especially with the development of the internet and new technologies, students are becoming more digitalized and tend to self-directed learning rather than traditional learning approaches (23).

In the literature, it is emphasized that nurses' effective use of computers is a prerequisite for information literacy (24). In this context, it is important to use internet and computer

facilities more effectively in nursing education to enhance students' digital skills and information literacy. The Iranian study suggests that combining traditional learning methods with e-learning methods such as the application of educational website and interactive online resources in teaching the fundamentals of nursing course can be an effective complement to the development of nursing students' clinical skills (25). Considering that the defining the information need sub-dimension was the lowest in this study, we think that it may be useful to add trainings on the use of electronic resources to the nursing curriculum. In a study conducted in Türkiye, Problem-Based Learning method was shown to have positive effects on information literacy (20). In addition to the classical education methods in the university where the study was conducted, the application of methods in which the student participates more actively in the learning process may have positive effects on issues such as access to information, evaluation of information, use and definition of information. Even digital literacy could be a useful addition to the nursing education curriculum (26).

In this study, it was determined that only 15.5% of the students received information literacy training and 60.9% were informed about literature search and its use in the courses. Although evidence-based practices are very important for nursing practice, it has been shown that a significant proportion of nurses are not ready to implement evidence-based practice due to their lack of information literacy skills in seeking and receiving information (27). This situation reveals the lack of information literacy education in nursing undergraduate programs (17). The American Association of Colleges of Nursing recommends integrating information literacy education into undergraduate and graduate education (18). The Association of College and Research Libraries (ACRL) has developed the Information Literacy Competency Standards for Nursing and encourages the integration of these standards into the curricula of nursing programs (11, 28). Individuals can obtain this information in different ways when they encounter various information and resources in their academic studies, while practicing their profession and in their personal lives (6). It is known that nursing students obtain information about clinical skills by consulting their colleagues and peers when they transition to the profession (29). Therefore, it is considered important to develop students' information literacy competencies in their professional development. Educators need to promote information literacy, which is a core nursing competency necessary to support excellence in nursing in the digital age (30). Nursing educators should

clearly identify how to support students in information literacy. To ensure that nursing education institutions educate graduates with high information literacy, they should conduct supportive curriculum update studies that raise awareness on this issue. In addition, practices such as projects, homework, and group work should be included.

Conclusions

In an environment where information sources are diversified with technology, the importance of information literacy is constantly increasing. In this study, internet and computer ranked first among the ways of obtaining information by nursing students. Only the level of computer use was found to affect information literacy. Improving computer usage skills can help improve information literacy by making it easier for nursing students to access, evaluate, synthesize and share information. In light of these findings, it is important to increase the level of information literacy awareness, and effective and safe computer use as basic competencies for the 21st century. Universities should increase access to information literacy resources such as the internet and computers, which students use most frequently to access information. In order to increase the information literacy awareness of nursing students, there is a need to strengthen their ability to access effective and safe information in computer use. Nursing educators should develop course contents that are compatible with evidence-based practice and research roles and provide practices that will enable students to practice these roles.

Declarations

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Conflict of interest statement

The authors declared that they have no competing interests.

Ethics statement

This study has been reviewed for ethics approval (dated 11.05.2023 and numbered 2023/06).

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Health Literacy, Health Status Perception, and Educational Background as Predictors of Rational Drug Use Knowledge in Individuals with Chronic Diseases

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ABSTRACT

Purpose: This study aimed to determine the predictive role of health literacy, health status perception and education status on the knowledge level of individuals with chronic diseases regarding rational drug use.

Methods: The model of the study is relationship screening and descriptive. The study group consisted of individuals with chronic diseases (n = 272) who applied to two family health centers in a province in the Western Black Sea Region between March 15 and June 3, 2021. Data were collected using the "Individual Identification Form, Health Literacy Scale and Rational Drug Use Scale". Data were analyzed using descriptive tests, Pearson correlation and hierarchical regression tests.

Results: While health literacy and health status perception variables significantly predicted the level of knowledge on rational drug use of individuals with chronic diseases, educational status was not a significant predictor.

Conclusion: As the Health Literacy levels of individuals with chronic diseases increase, the level of Rational Drug Use knowledge also increases. The knowledge levels of individuals with chronic diseases regarding rational drug use are affected by their health literacy levels and health status perception variables. Continuous awareness studies can be conducted to increase the level of knowledge of rational drug use, health literacy levels, and health status perceptions of individuals with chronic diseases.

Keywords: Drug utilization, Health literacy, Chronic disease

ÖZET

Amaç: Bu araştırmada Kronik hastalığı olan bireylerin akılcı ilaç kullanımına ilişkin bilgi düzeyi üzerinde sağlık okuryazarlığı, sağlık durumu algısı ve eğitim durumunun yordayıcı rolünün belirlenmesi amaçlandı.

Yöntemler: Bu çalışmanın modeli, ilişki tarayıcı ve tanımlayıcıdır. Çalışma grubu, 15 Mart - 3 Haziran 2021 tarihleri arasında Batı Karadeniz Bölgesi'ndeki bir ilde iki aile sağlık merkezine başvuran kronik hastalığı olan bireylerden (n = 272) oluştu. Veriler "Bireysel Tanıtım Formu, Sağlık Okuryazarlığı Ölçeği ve Akılcı İlaç Kullanım Ölçeği" kullanılarak toplandı. Veriler, tanımlayıcı testler, pearson korelasyon ve hiyerarşik regresyon testleri kullanılarak analiz edildi.

Bulgular: Kronik hastalığa sahip bireylerin akılcı ilaç kullanımı bilgi düzeylerini sağlık okuryazarlığı ve sağlık durumu algısı değişkenleri anlamlı şekilde yordamışken, eğitim durumu ise anlamlı bir yordayıcısı değildir.

Sonuç: Kronik hastalığı olan bireylerin Sağlık Okuryazarlığı düzeyleri arttıkça Akılcı İlaç Kullanımı bilgi düzeyi de artmaktadır. Kronik hastalığa sahip bireylerin akılcı ilaç kullanımı bilgi düzeyleri sağlık okuryazarlığı düzeyleri ve sağlık durumu algısı değişkenlerinden etkilenmektedir. Kronik hastalığa sahip bireylerin akılcı ilaç kullanımı bilgi düzeylerini, sağlık okuryazarlığı düzeylerini ve sağlık durumu algılarını artırmak için sürekli farkındalık çalışmaları yapılabilir.

Anahtar Kelimeler: İlaç kullanımı, sağlık okuryazarlığı, kronik hastalık

Rational drug use (RUD) is defined as patients taking medications appropriate for their clinical needs, in doses that meet their individual requirements, for an adequate duration and at the lowest cost (1). Irrational drug use by individuals has become an important public health problem. Irrational drug use leads to serious health problems such as adverse drug reactions and resistance in various diseases, especially in chronic diseases, and even death in Turkey as in the whole world (2,3). There are many factors affecting individuals' rational drug use. In this study, the predictive levels of some factors, which are thought to be the most effective factors, were investigated.

In the literature, it has been reported that rational drug use and health literacy are related and rational drug use increases as the health literacy levels of individuals increase (4). Health literacy is defined as the knowledge, motivation and competence of people to access, understand, evaluate and apply health information in order to make judgments and decisions about health services, disease prevention and health promotion in daily life (5). It is accepted that health literacy is an important factor that has an impact on health and health outcomes (6,7). Low health literacy level is an important public health problem that can affect the general health of individuals and increase their problems related to diseases (6,7), and it has been determined as a factor that significantly affects adherence to treatment in chronic diseases (8). Health literacy plays an important role in the self-management of chronic diseases, which constitute 47% of the global disease burden (9,10). Low levels of health literacy lead to conditions such as inadequacy in the management of chronic diseases, less compliance with drug treatment, irrational drug use such as not using drugs correctly or regularly, and an increase in the rate of hospitalization (7,11,12).

Health perception is also an important factor affecting individuals' rational drug use. This is because health perception is an individual's subjective assessment of his/her own health status. While some people perceive themselves as healthy despite having one or more chronic diseases, others may perceive themselves as sick even though there is no objective evidence of disease (13). Although health perception has a subjective structure, it is a concept related to rational drug use and health literacy level. In a study conducted by Özişili (2023) with adult individuals, it was found that health perception positively affected rational drug use (14). In addition, it was found that there was a relationship between rational drug use and individuals' health literacy levels, educational status

and health perceptions (3,15). In a study conducted with individuals with chronic disease, it was found that their health perception status was low, but individuals who knew the concept of rational drug use beforehand had higher health perceptions (16). In the literature, there are also studies examining the relationship between rational drug use and health literacy in individuals with chronic diseases (12,17), or examining the concepts of rational drug use and health literacy separately (16). When these studies are examined, it is seen that rational drug use and health literacy of patients are important in the management of chronic diseases. However, no study was found to examine whether the health literacy levels, health status perceptions and educational status of individuals with chronic diseases predicted their rational drug use knowledge. There is a need for different studies examining the relationship between these concepts and their predictive status. Since the concepts of rational drug use and health literacy are important concepts especially for individuals with chronic diseases, more research on these concepts is needed. Therefore, this study was conducted to determine whether the levels of health literacy, health status perceptions and educational status of individuals with chronic diseases predict their rational drug use knowledge levels.

Our research questions:

1. What is the level of HL in individuals with chronic diseases?
2. What is the level of RDU knowledge in individuals with chronic diseases?
3. Is there a relationship between HL levels and RDU knowledge levels of individuals with chronic diseases?
4. Do HL levels, health status perceptions, and educational backgrounds of individuals with chronic diseases predict their RDU knowledge levels?

Material and Methods

Study Design and Study Population/Sample

The model of the study is descriptive study based on the correlational model. The population consisted of all individuals with chronic diseases who applied to 12 family health centers in a provincial center in the Western Black Sea Region of Turkey. However, since the population was very large and broad, among the probability sampling

methods, cluster sampling method was used, and the family health centers were divided into 12 clusters, from which two clusters were selected by the drawing method (18). The sample size was determined as 266 using the Gpower 3.1 program, assuming margin of error = 0.05, power = 0.80, and a correlation value between HL and RDU of 0.17.8 Considering the possibility of data loss, the sample size was increased by five percent to reach 280 individuals. However, the study was completed with 272 individuals due to missing data in six questionnaires and outliers in two questionnaires.

Instruments

Individual Description Form: The form, created by utilizing the literature, consists of questions that question the participants' age, gender, marital status, educational status, previously diagnosed chronic diseases and their perception of health status (2,11,12).

Health Literacy Scale: The scale was developed by Sorensen et al. (2013), revised by Toçi et al. (2013), and adapted into Turkish by Aras and Bayık Temel (19). The scale was translated into Turkish as the Health Literacy Scale, and it consists of 25 items and four sub-dimensions. These include access to information, comprehension, appraisal/evaluation, and application/utilization of information. The minimum score is 25 and the maximum score is 125 for the entire scale. The scale items were graded on a five-point Likert scale ranging from "1 = I have no difficulty at all" to "5 = I am unable/incapable/unlikely." The Cronbach's alpha value of the scale was 0.92 for the total score and ranged between 0.62 and 0.79 for the sub-dimensions. Low scores indicate that the level of HL is inadequate, problematic and poor, while high scores indicate that it is adequate and very good. For this study, Cronbach's alpha value was 0.97 for the entire scale, 0.94 for the access to information sub-dimension, 0.89 for the comprehension sub-dimension, 0.92 for the appraisal/evaluation sub-dimension, and 0.89 for the application/utilization sub-dimension.

Rational Drug Use Scale: The scale was developed by Demirtaş et al. (2). The scale consists of one factor and 21 items. The total reliability of the scale was found to be 0.79. The scale was prepared on a three-point Likert-type scale, and it is scored as follows: "Yes: 2 points," "I don't know: 1 point," "No: 0 points." Some items on the scale are reverse scored. The predictive value for the scale was determined to be 34 points. The cut-off score of the scale is 34, and

higher scores indicate higher levels of knowledge. The Cronbach's alpha value of the scale was 0.77 for this study.

Data Collection

Before the data collection process, a preliminary application was made in 15 individuals with chronic diseases. No negative feedback was received from the individuals. Data were collected through face-to-face interviews lasting an average of 10-15 minutes with volunteers who had at least one chronic disease, were over the age of 18, could speak Turkish, had no communication problems, and applied to two family health centers selected by lottery between March 15 and June 3, 2021.

Ethical Considerations

Before starting the study, the necessary permissions were obtained from the Social Sciences Human Research Ethics Committee of a university in the Western Black Sea Region (dated 21.01.2020, protocol number 2020/12) and the Provincial Health Directorate. Permission was obtained from the owner for the scales. In addition, the participants were given the necessary information about the study and their verbal and written consents were obtained. The principles of the Declaration of Helsinki were followed.

Statistical Analysis

Research analyzes were conducted with the Statistical Package for the Social Sciences (SPSS 22.0). Percentage, mean-standard deviation, and minimum-maximum values, among descriptive statistics, were used for interpreting the findings. In order to understand the suitability of the data for hierarchical multiple linear regression analysis, the normality of the data set was evaluated with kurtosis and skewness values. Mahalanobis distance values were examined for outliers using a value of 16.27 for the three predictive variables. The six data identified as outliers were removed from the set, and analyses were performed with 272 data. The sample size was found to be sufficient considering the number of predictor variables. As another assumption of multiple regression analysis, the mutual independence of errors was evaluated with Durbin-Watson (1.644) and it was determined that there was no autocorrelation. Pearson correlation coefficients, Tolerance value, Variance Inflation Factor (VIF), and Condition Index (CI) values were analyzed for other assumptions. There was no multiple correlation between predictive variables (<0.80). Tolerance value was above 0.10, VIF value was below 10,

and CI value was below 30. In line with these processes, it was determined that the data were suitable for multiple linear regression analysis. Research data were analyzed by hierarchical regression analysis. In hierarchical regression, perception of health status (good = 1, intermediate and poor = 0) and educational background (high school and above = 1, middle school and below = 0) were taken as dummy variables, and HL was used as a continuous variable. The significance level in the study was taken as 0.05 (20,21).

Results

The mean age of the individuals participating in the study was 56.93 ± 14.51 , 50.0% were female, 78.7% were married, and 29.4% were primary school graduates. It was determined that 60.3% of the individuals perceived their health status as moderate, and 36.4% had hypertension (Table 1).

Table 1: Sociodemographic Variables of Individuals (n=272)		
Variable	n	%
Age $\bar{X} \pm S.D.$ = 56.93 ± 14.51 (min: 19, max: 88)		
Gender		
Female	136	50.0
Male	136	50.0
Marital Status		
Married	214	78.7
Single	58	21.3
Education		
Illiterate	15	5.5
Literate	30	11.0
Primary school	80	29.4
Secondary school	46	16.9
High school	75	27.6
University and above	26	9.6
Chronic disease diagnosed by a doctor (n=363)*		
Diabetes	122	33.6
Hypertension	132	36.4
Cardiovascular Disease	72	19.8
Asthma or COPD	13	3.6
Other (Cancer, Kidney failure, Liver, Thyroid etc)	24	6.6
Health Perception		
Good	90	33.1
Middle	164	60.3
Bad	18	6.6
* More than one answer has been given to this question. Percentages are taken from the answers given.		

The mean RDU total score of the study participants was 31.32 ± 6.54 , and the mean HL total score was 94.44 ± 21.38 . For the sub-dimensions of HL, the mean score of access to information was 19.44 ± 4.93 , the mean score of comprehension was 25.37 ± 6.97 , the mean score of appraisal/evaluation was 30.06 ± 7.29 , and the mean score of application was 19.56 ± 4.40 (Table 2).

Table 2: Average Scores of Individuals on Rational Drug Use Scale and Health Literacy Scale (n=272)

Scales and Sub-dimensions	Min-Max	$\bar{X} \pm S.D.$	MSE*
Rational Drug Use Scale Total	14-42	31.32 ± 6.54	0.40
Health Literacy Scale	25-125	94.44 ± 21.38	1.30
Health Literacy Scale Sub-dimensions			
Access to Information	5-25	19.44 ± 4.93	0.30
Understanding Information	7-35	25.37 ± 6.97	0.42
Valuation/Evaluation	8-40	30.06 ± 7.29	0.44
Practice	5-25	19.56 ± 4.40	0.27
* Mean Standard Error			

There was a moderately positive correlation between the RDU and HL ($r = 0.456$, $p < 0.001$) (Table 3).

The results of the variables that predict RDU knowledge and the relationship between variables are presented in Table 4. While the first model (HL) explained 20.8% of the variance ($R^2 = 0.208$), the second model explained 23.7% of the variance when health status perception was added ($R^2 = 0.237$), and the third model explained 24.2% of the variance when educational background was added ($R^2 = 0.242$).

Table 3: Correlation Coefficient For Rational Drug Use Scale and Health Literacy Scale

Scales	Rational Drug Use	Health Literacy
Rational Drug Use	1	0.456*
Health Literacy	0.456 ^a	1
* $p < 0.001$		

In the first model, it was determined that HL ($\beta = 0.456$) predicted RDU knowledge in a statistically significant manner ($F(1/270) = 71.073$, $p < 0.001$). HL explained RDU knowledge at a rate of 20.8%. In the second model, it was found that when HL ($\beta = 0.426$) as well as good health status perception ($\beta = 0.172$) were added to the model, RDU knowledge score of individuals increased ($F(2/269) = 41.789$, $p < 0.001$). The predictive power for these variables

was 23.7%. According to the third model in which educational background was added, it was found that HL ($\beta = 0.397$) and good health status perception ($\beta = 0.168$) were predictors of RDU knowledge ($F(3/268) = 28.526$, $p <$

0.001), but education level ($\beta = 0.077$) was not found to be a statistically significant predictor of RDU knowledge ($p > 0.05$). However, predictive power (24.2%) increased in the third model (Table 4).

Table 4. Hierarchical Multiple Regression Analysis Results for Variables Predicting Rational Drug Use

Model	B	Standart Error	β	t	R	R ²	F	df
1. Constant	18.130	1.604		11.306*	0.456	0.208	71.073*	1/270
Health Literacy	0.140	0.017	0.456	8.430*				
2. Constant	18.232	1.578		11.557*	0.487	0.237	41.789*	2/269
Health Literacy	0.130	0.017	0.426	7.862*				
Health Perception (Good=1)	2.387	0.751	0.172	3.179*				
3. Constant	18.687	1.612		11.591*	0.492	0.242	28.526*	3/268
Health Literacy	0.121	0.018	0.397	6.834*				
Health Perception (Good=1)	2.328	0.751	0.168	3.099*				
Education (High school and ve above =1)	1.034	0.778	0.077	1.328				

* $p < 0.001$

Discussion

This study investigated the levels of RDU knowledge and HL of individuals with chronic diseases, whether there is a relationship between RDU knowledge and HL, and whether the variables of HL, health perception, and educational background predict RDU knowledge of individuals with chronic diseases.

It was found that the level of RDU knowledge of individuals with chronic diseases was lower than the cut-off point specified in the scale. In a systematic review on RDU in Turkey, it was reported that the level of RDU knowledge of the population was low (22). A study conducted in Ethiopia found that almost a quarter of patients had inadequate knowledge about RDU (23). Unlike the results of this study, in study by Çifçi et al. (3) and Kaya et al. (24), it was found that individuals had adequate knowledge about RDU. Different results may be due to many variables such as individuals' education levels, the region they live in or their knowledge levels. The World Health Organization recommends educating the public to promote RDU (25).

Considering the lower and upper scores specified in the scale, it can be interpreted that the HL level is at a moderate level. In a similar study conducted in China, it was determined that 78.4% of the participants had a low HL

level (26). In a study conducted by Yasa in Ordu province with individuals over 18 years of age, it was found that the level of HL was moderate (17). In a study involving elderly individuals in Iran, more than half of the elderly were found to have insufficient HL (27). In the systematic review study conducted by Lima et al. (28), it was determined that the elderly have poor HL. In studies conducted in Turkey, it was found that elderly individuals have low HL (24,29). These results show that the HL levels of especially elderly individuals are below the desired level. This can have negative repercussions on the health and economic indicators of both individuals and countries. Therefore, all health professionals have significant responsibilities for increasing the RDU and HL levels of individuals with chronic diseases. It may be useful to realize all practices and interventions in this direction.

As the HL of individuals with chronic diseases increases, their knowledge about the RDU also increases. In a study in Turkey where meta-analysis was conducted on theses on the relationship between RDU and HL, it was determined that as the level of health literacy increases, rational drug use also increases in the same direction (4). Similarly, a positive relationship was found between HL and RDU in a study conducted on diabetic individuals (12). In a study by Abacigil et al. (11) conducted with patients aged above 18, it was found that as the level of HL increased, the level of RDU also increased. In a study conducted in Konya with individuals over the age of 18, it was determined that HL

and RDU levels were sufficient. It was stated that one of the factors affecting rational drug use is the HL levels of individuals (24). A study conducted with adults in Japan found that individuals with higher HL levels better understood the information presented in drug leaflets (30). RDU and HL are two important elements that have an impact on health improvement as well as affect and complement each other (15,24). Although the presence of many factors affecting the elements makes it difficult to understand these concepts, these concepts are of great importance in terms of health-related behaviors. For this reason, creating public service announcements, increasing drug and health knowledge levels, raising awareness about these and establishing training polyclinics may be important steps to be taken.

It was found that the RDU knowledge of individuals with chronic diseases was significantly predicted by HL in the first place and by the perception of good health status in the second place. Although education level alone did not predict RDU knowledge, it was found to increase predictive power when evaluated together with HL and good health status perception. These three variables explain 24.2% of RDU knowledge. Kaya et al. (24) reported that HL and RDU affect each other. It has been emphasized that it is important for individuals to have a high level of HL in order to follow a rational way in the stages of prescribing, distributing, selling and using drugs. There is information in the literature that RDU is closely related to education and HL levels (11). In a study by Şengül and Akyıl (16), it was found that health perception and RDU were associated, and as health perception improved, RDU knowledge level also increased. In another study, it was found that health perception affected RDU positively (14). In addition, other studies on RDU have also reported a relationship between RDU and individuals' HL levels, educational backgrounds and health perceptions (3,15). As can be understood from the results of the studies, RDU, HL, education level, and health status perception are concepts that mutually affect each other, and their levels can be changed with various interventions. For this reason, education and interventions to change the levels of these concepts in individuals with chronic diseases become even more important. It is especially important to explain medical information on RDU and HL to older individuals in a clear and simple language so that it is fully comprehensible. In addition, providing trainings on HL and RDU in combination at all levels of education starting from the basic education level can ensure that individuals become aware of these conditions from an early age, become more conscious, and have better health perception. This can prevent individuals from developing chronic diseases at an early age.

Chronic diseases play an important role in the global burden of disease. Preventive and rehabilitative activities for chronic diseases are very important in reducing this burden. In this regard, all healthcare professionals, especially nurses, who are the backbone of the healthcare system, have a responsibility. Measuring the rational drug use behaviors and health literacy skills of individuals with chronic diseases, determining the factors affecting them, and then implementing nursing interventions to improve these behaviors and skills will make important contributions to the more effective management of chronic diseases.

Conclusion

In conclusion, as HL level increases, the level of RDU knowledge also increases in individuals with chronic diseases. RDU knowledge levels of individuals with chronic diseases are affected by the variables of HL level and health status perception. In line with these results, trainings, seminars and awareness-raising activities can be conducted for individuals with chronic diseases to increase their HL and RDU knowledge levels at the same time. In addition, trainings such as disease management and recognition of symptoms and side effects can improve their health status perceptions. Further studies can be planned with larger sample groups including different factors that are believed to be predictors of RDU knowledge of individuals with chronic diseases.

Limitations

The study has limitations. The results can be generalized to individuals with chronic diseases who presented to the family health centers where the study was conducted. In addition, self-report scales were used in this study, and the answers only reflect the reality to the extent of the interest and concentration levels of the individuals in the study group. However, explaining the findings using advanced statistical analyses is a strength of the study.

Declarations

Authors Disclosure (Conflict of Interest) Statement

The author does not declare any conflict of interest.

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Ethics Approval

Ethical approval (Date/Number: 2020/12) was obtained from the ethical committee of a university.

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Nurse's Opinion: Can Pet Therapy Be Used in the Treatment and Care of Chronic Diseases?

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ABSTRACT

Purpose: Animal-assisted therapies are used to alleviate disease-related symptoms and are delivered independently by nurses. The aim of this study was to assess nurses' opinions on the use of pet therapy in the treatment and care of chronic diseases.

Methods: Data were collected through face-to-face interviews between October 2021 and April 2022. A total of 167 nurses were reached. The data collection used the Socio-demographic Characteristics Questionnaire, Views on Care of People with Chronic Diseases Questionnaire, Views on Use of Pet Therapy Questionnaire and Preferences on Use of Pet Therapy Questionnaire. A descriptive study design was used in adherence to the STROBE checklist.

Results: We found that the nurses had not heard of pet therapy, wanted to use incorporate it into their practices through training and indicated that it could done with live animals, especially for disadvantaged groups. It was also evident that they felt that animal-assisted therapy applications would provide psychosocial support to patients.

Conclusion: Given that pet therapy is considered to have positive effects in disease management, it is believed to be important for nurses as it can contribute to patient care processes.

Keywords: chronic diseases, nursing care, pet therapy

ÖZET

Giriş: Kronik hastalıklar, yaşam tarzı değişiklikleriyle yönetilebilir olsa da, bireyler, aileler ve toplum için yıkıcı sonuçlar doğurabilir, sağlık sistemleri üzerinde büyük bir yük oluşturabilir. Pet terapiler, hastalıkla ilgili semptomları hafifletmek için kullanılmakta ve hemşireler tarafından bağımsız olarak uygulanabilmektedir. Bu çalışmanın amacı, hemşirelerin kronik hastalıkların tedavi ve bakımında pet terapinin kullanımına ilişkin görüşlerini değerlendirmektir.

Yöntem: Veriler Ekim 2021-Nisan 2022 tarihleri arasında yüz yüze görüşmeler yoluyla toplanmıştır. Toplam 167 hemşireye ulaşılmıştır. Verilerin toplanmasında literatür doğrultusunda hazırlanan Sosyo-demografik Özellikler Anketi, Kronik Hastalığı Olan Bireylerin Bakımına İlişkin Görüşler Anketi, Pet Terapi Kullanımına İlişkin Görüşler Anketi ve Pet Terapi Kullanımına İlişkin Tercihler Anketi kullanılmıştır. STROBE kontrol listesine uygun olarak tanımlayıcı bir çalışma tasarımı kullanılmıştır.

Bulgular: Hemşirelerin pet terpiyi duymadıklarını, eğitim yoluyla uygulamalarına dahil etmek istediklerini ve özellikle dezavantajlı gruplar için canlı hayvanlarla yapılabileceğini belirttikleri belirlendi. Ayrıca, hayvan destekli terapi uygulamalarının hastalara psikososyal destek sağlayacağını düşündükleri ve hemşirelik bakımına pet terapileri dahil etmenin, mesleki görünürlüğü ve gücü artıracağını da düşündükleri tespit edildi.

Sonuç: Pet terapisinin hastalık yönetiminde olumlu etkileri olduğu düşünüldüğünde, hasta bakım süreçlerine katkı sağlayabileceği için hemşireler açısından önemli olduğu düşünülmektedir.

Anahtar Kelimeler: kronik hastalık, hemşirelik bakımı, pet terapi

Chronic diseases, also known as non-communicable diseases, occur with a combination of genetic, physiological, environmental and behavioral factors, which are long-term, usually progress slowly, where pharmacological treatment is insufficient (1). With chronic diseases, it is important to provide periodic monitoring and support to stop the progression of the disease, improve self-care, and maximize the function and responsibility of the person (2).

Chronic diseases are responsible for almost 74% of all deaths worldwide according to the World Health Organisation (WHO) data for September 2022. Moreover, 77% of these deaths are in countries with low- and middle-income levels. Although people from all age groups, regions and countries are affected by chronic diseases, the increase in chronic diseases is caused by factors such as tobacco use, physical inactivity, excessive alcohol use and unhealthy diet (1).

Although chronic diseases can be controlled and prevented through lifestyle changes, they cause devastating health consequences for the individual, family and society and place a burden health systems (2). The burden associated with chronic diseases makes the prevention and control of these diseases a necessity for the 21st century. WHO emphasizes the importance of an evidence-based approach for international action in the diagnosis, follow-up, surveillance, prevention and control of chronic diseases to reduce the burden (1).

The aim of evidence-based nursing care is to strengthen individuals' coping with psychological, social and physiological changes and to increase their adaptation to the disease. At the same time, this care requires nurses to provide up-to-date and effective interventions and to evaluate the effectiveness of these intervention programs (3). Although there are many methods to support individuals with chronic diseases in terms of bio-psycho-social aspects, one of these methods is pet therapies based on human-animal interaction. Pet therapy has been included in the Nursing Interventions Classification (NIC) under the name "Animal Assisted Therapy" since 2004(4).

The results of the studies in the literature reveal that pet therapy is one of the effective methods to reduce anxiety and stress levels in the treatment and care of individuals with chronic diseases(5-7). Studies on pet therapy have shown that the presence of animals improves the individual's emotional expression, communication and self-care competencies(5), strengthens the immune system(8), helps in the treatment and maintenance

of chronic muscle nervous system diseases, provides treatment and rehabilitation of different motor disorders(5), regulates the cardiovascular system(6), alleviates pain and reduces pain-related insomnia(9), improves health perception(6).

Although published studies indicate the use of pet therapies in caring for people with chronic diseases, there are two experimental studies(7,10) and one descriptive master's thesis(11) that assess healthcare professionals' views on this topic in our country. Additionally, a descriptive study aiming to evaluate the perspective of other experts on this subject has been identified (12). Intervention studies have investigated the effects of pet therapies on pain during insulin administration in children with diabetes and the effects of pet therapies on stress and social anxiety levels in physically disabled children, and the studies yielded positive results(7,10).

The use of pet therapy, one of the nursing interventions, as a supportive measure in treatment and care centers in the world and in our country is very limited. We believe that it is important to assess our colleagues' awareness of this issue in order to actively use pet therapy, in the context of care and practice. The study will evaluate the opinions of nurses working with people with chronic diseases in order to expand the use of pet therapy and to determine the level of awareness of nurses regarding the use of animals in the care of these patients. This study was conducted to evaluate nurses' views on the use of pet therapy in the treatment and care of chronic diseases.

Materials and Methods

Design

This is a descriptive study.

Recruitment and participants

The study data were collected face-to-face by contacting nurses working in Istanbul. Snowball sampling method was used to collect the data. The study was carried out with 167 nurses working in the internal medicine wards of hospitals where chronic patients were hospitalised and who volunteered to participate in the study. 97 people who had not been working in the clinic for at least 6 months and did not have the title of nurse were excluded from the study. 39 nurses refused to participate in the study for various reasons (work intensity, shift end time, etc.).

Data collection

The study data were collected face-to-face between October and April 2021. The data collection consisted of a socio-demographic characteristics information form prepared in line with the literature, a form about their views on caring for a person with chronic disease, a form for determining the views on the use of pet therapy, and a form questioning their preferences for pet therapy application.

Statistical Analysis

The data obtained from the research were analysed using SPSS 23.0 package program. Descriptive statistics such as frequency distribution, mean, standard deviation were used to describe the sample in the evaluation of the data.

Ethical consideration

Consent was obtained from the ethics committee

of the university before starting data collection (09.28.2021/8480). The purpose of the study was explained to the participants who met the inclusion criteria, and their verbal and written consent was obtained. The Declaration of Helsinki was adhered to throughout the study.

Results

Sociodemographic characteristics of nurses

The mean age of the nurses was 26.34 ± 5.99 years, 85.6% were female, 50.3% had a bachelor's degree or higher, 67.1% were single, the mean duration of their employment was 5.33 ± 5.56 years, 50.3% did not have an animal with which they interacted in the past or present, 22.2% of those who interacted had birds, the mean duration of animal care was 4.48 ± 4.04 years, 85% stated that they generally loved their animals. (Table 1).

Table 1: Nurses' views on caring for individuals with chronic diseases (n=167)

Age (X \pm SD) (Min-Max) (26.34 \pm 5.99) (18-56)		
	n	%
Gender		
Female	143	85.6
Male	24	14.4
Education		
High school	33	19.8
Under graduate (2 years)	50	29.9
Bachelor's degree or higher	84	50.3
Marital status		
Married	55	32.9
Single	112	67.1
Employment duration (X \pm SD) (Min-Max)(5.33 \pm 5.56)(1-35) Year		
Is there an animal you interact with/have taken care of in the past or present?		
Yes	83	49.7
No	84	50.3
Which animal/animals?*		
Cat	35	21
Bird	37	22.2
Fish	30	18
Dog	24	14.4
Other	12	7.2
Animal care duration (X \pm SD) (Min-Max) (4.48 \pm 4.04) (1-21) Year		
Your thoughts on animals in generally?		
I love them	142	85
I'm afraid of them	13	7.8
It doesn't matter if they exist or not.	12	7.2

In the internal medicine clinic, 45.5% of the nurses stated that the group to which they provided the most care was adults (55.7%), female (40.1%), and patients with internal medicine diseases (35.3%). 94.6% of the nurses found it correct to apply pharmacological and psychosocial interventions together for the care and treatment of individuals with chronic diseases, 88%

preferred psychosocial interventions when caring for their patients, 71.9% stated that they had difficulty from time to time while caring for patients, 67.7% stated that they had difficulty in meeting the characteristics and care needs of chronic disease, and 95.2% stated that they provided training to facilitate the patient's coping with the disease (Table 2).

Table 2: Determination of nurses' opinions on the use of pet therapy		
Age (X±SD) (Min-Max) (26.34±5.99) (18-56)		
	n	%
Currently working clinic		
Family health center	14	8.4
Pediatric	13	7.8
Infection disease	12	7.2
Physical therapy and rehabilitation	3	1.8
Internal medicine	76	45.5
Other	49	29.3
Which patient group are you most interested in?*		
Female	67	40.1
Child	43	25.7
Adults	93	55.7
Older people	55	32.9
Neurologic patient	40	24
Psychiatric patient	18	10.8
With alcohol substance use disorder	21	12.6
Internal medicine clinic	59	35.3
Respiratory diseases	50	29.9
Oncologic diseases	24	14.4
Opinions about care and treatment methods of individuals with chronic diseases		
Only pharmacological or only psychosocial intervention is effective.	9	5.4
Pharmacological and psychosocial interventions should be applied together.	158	94.6
Preferred interventions when caring for patients*		
Psychosocial interventions	147	88
Physical interventions	136	81.4
Non-pharmacologic interventions	37	22.2
Supporting human-animal interaction	14	8.4
Do you have difficulties in caring for patients?		
Yes, I'm difficulting.	22	13.2
I have difficulty from time to time	120	71.9
No, I'm not difficulting.	25	15
Reasons for difficulty in caring for patients*		
High need for care	147	88
Reasons attached to the nurse himself/herself	113	67.7
From physical working conditions	39	23.4
To make it easier for the patient to cope with the disease*		
Educating	159	95.2
I support psychosocially	115	68.9
I support the regulation of physical conditions	13	7.8
<i>*More than one option is marked.</i>		

59.9% of the nurses stated that they had not heard of animal assisted practice/pet therapy before, 47.9% of those who had heard of it had heard about it from the news, 52.1% stated that pet therapy could not be applied in our country, 78.4% stated that it could not be applied in the institution where they work, 91% thought that it

could be applied to patients in childhood, 79% stated that it could be applied in disadvantaged groups, 93.4% stated that it could be applied in health institutions and organizations and 73.1% stated that it could be applied in psychiatry clinics (Table 3).

Table 3: Determination of nurses' opinions on the use of pet therapy

Age (X±SD) (Min-Max) (26.34±5.99) (18-56)		
	n	%
Have you heard of animal-assisted practice/pet therapy before?		
Yes	67	40.1
No	100	59.9
If yes, where did you get this information?		
News	32	47.9
Social media	26	40.1
Literature	9	12
Can pet therapy be applied in our country?		
Yes	80	47.9
No	87	52.1
Can pet therapy be applied in your institution?		
Yes	36	21.6
No	131	78.4
In which developmental stages can pet therapy be applied? *		
Childhood	152	91
Adult	133	79.6
Older people	132	79
In which patient groups can pet therapy be applied?		
Healthy individuals	78	46.7
Disadvantages groups	132	79
Individuals who have/will undergo a surgical operation	36	21.6
Individuals with chronic diseases	102	61.1
In which institutions can pet therapy be applied in our country?		
Health institutions and organizations	156	93.4
Institutions that care for disadvantaged groups	135	80.3
Units related to legal processes	28	16.8
Schools	90	53.9
In which clinics can pet therapy be applied?		
Oncology clinics	83	49.7
Pediatrics clinics	96	57.5
Surgical clinics	54	32.3
Psychiatry clinics	122	73.1
Internal medicine clinics	65	38.9
Pain management clinics	79	47.3
Sleep disorders clinics	86	51.5
* More than one option is marked.		

74.9% of the nurses stated that if they were to apply pet therapy, they would prefer live animals, 77.8% would prefer cats, 95.2% stated that applying pet therapy would have positive psychosocial effects, 91.6% thought that

pet therapies could be applied as a nursing intervention in people with chronic diseases, and 79% stated that they wanted to apply pet therapy after receiving the necessary training (Table 4).

Table 4: Nurses' preferences for the application of the pet therapy

Age (X±SD) (Min-Max) (26.34±5.99) (18-56)		
	n	%
What kind of animals would the pet prefer if she/he was going to practice therapy? Live animals Stuffed animals Robotics (NAO-Humanoid robot) Robotics animals (PARO-pet robot) Stories about animals	125 47 19 15 44	74.9 28.1 11.4 9 26.3
Which animal would you prefer to use? * Cat Dog Bird Fish Rabbit Hamster Farm animals Other	130 122 123 117 80 44 40 39	77.8 73.1 73.7 70.1 47.9 26.3 24 23.4
What kind of effects can the application of pet therapies have on the individual?* Supports personal development. Positive psychosocial effects. Positively affects the individual physically. It supports the interaction between the individual and the health professional. It increases the motivation of the employees. Negative psychosocial effects.	156 159 155 129 136 100	93.4 95.2 92.8 77.2 81.4 59.9
Your opinion on the applicability of pet therapy as a nursing intervention in patients with chronic disease It can be applied by nurses. Nurses may be insufficient in terms of both quantitative and qualitative aspects.	153 14	91.6 8.4
Would you like to apply pet therapy as a nursing intervention in patients with chronic disease?* I would like to apply after receiving the necessary training. I would like to apply it with a professional who knows the subject. I don't think nurses should do it.	132 124 65	79 74.3 38.9
* More than one option is marked.		

30.6% of nurses believe that implementing pet therapy in nursing practice would enhance the professional scope and visibility of the nursing profession, while 32.2% think it

would increase professional strength. Therefore, they have expresses a willingness to implement pet therapy as a nursing intervention in their practice areas ($p=0.000$) (Table 5).

Table 5: The relationship between the desire for the implementation of pet therapy and its potential effects

Do they think that nurses should implement it?							
	Yes		No		Partially		χ2
	n	%	n	%	n	%	
It increases the visibility of nursing							
Yes	51	30,6	2	1,2	4	2,4	0.000
No	29	17,3	12	7,1	8	4,8	
Partially	35	21,0	5	3,0	21	12,6	
It increases professional strenght							
Yes	54	32,2	1	0,6	2	1,2	0.000
No	17	10,2	15	9,0	17	10,2	
Partially	31	18,6	3	1,8	27	16,2	

Discussion

In this study, which was conducted to determine the awareness of caregivers caring for chronic patients on the use of pet therapy, we believe that several important findings were obtained. We found that due to the nature of the disease and the increased need for care, caregivers find it difficult to care for chronic patients and provide training to support them. Another important finding was that although most nurses had never heard of pet therapy, they indicated that it can be used with live animals and that they would like to use pet therapy after receiving training. It was also clear that nurses felt that animal-assisted therapies would provide psychosocial support to the patient when treating chronic diseases.

Pet therapies are used by nurses in the treatment and care of chronic diseases(13).A study conducted in the United Kingdom to determine nurses' views of pet ownership found that most participants had been employed for 3 to 5 years, were 40 years old or younger, and were full-time working women(13,14).A pilot study comparing various parameters between nurses with and without a pet reported that most participants were female, married, had an average age of 40.28 years and had been employed in the health sector for an average of 18.31 years (15). The majority of the sample in this study consisted of single, middle-aged females with university degrees and an

average length of employment of 5.33 ± 5.56 years, and these characteristics were similar to those of nurses in human-animal interaction studies reported in the literature.

Almost half of the nurses who participated in our study reported that they had pets in the past or currently and that they generally liked animals. In a pilot study conducted to determine the potential benefits of human-animal interaction between nurses with and without pets, it was reported that slightly more than half of the nurses had pets(15). In this context, it can be said that the sample is similar. It was hypothesized that the fact that the majority of nurses also have a pet in their daily lives could be an important facilitating factor in increasing the predisposition to and willingness to practice animal-assisted therapy practices in nursing and in practice. Additionally, the literature indicates that nurses who are younger and have a higher level of education tend to have a more positive attitude towards innovative approaches(16). The participants in this study were young on average(26.34 ± 5.99 years) and had a high level of education (50.3% had a bachelor's degree or higher). The fact that the majority of the nurse population in our study is young and has a bachelor's degree or higher level of education explains their willingness to implement pet therapy, an innovative approach, as a therapeutic intervention.

From past to present, various ties have been established between humans and animals, and animals have been included in artistic materials, religions, fairy tales, mythologies, and academic studies (17,18). Animals are frequently included in various stories in literature. For example, while various animals such as cats and birds appear in Djoha(17), there is a relationship between stereotypes and identities related to animals in children's storybooks. In these sources, cats and birds are identified with the female gender, while cats, birds and fish are grouped as animals suitable for urban life (18). Again, King(2007) emphasized the different characteristics of animals in human-animal interactions within the scope of health promotion(19). In our study, we determined that most of the nurses who kept animals kept cats, birds and fish and observed that the animals kept by the nurses were compatible with the animals identified with the female gender in the literature. The reason for this may be related to the fact that most of the sample consists of nurses of female gender. In addition, nurses fed animals referred to in the literature as urban pets.

There are studies examining nurses' opinions about pet therapies that reveal the benefits of human-animal interaction. It is understood that the nurses in these studies are paediatric(14), veterinary nurses(13) and health professionals in general(20). We found that most of the nurses worked in internal medicine wards and cared for adults. Although the study refers to nurses, it differs from the literature in that the nurses in our study predominantly care for adult patients and work in internal medicine.

Having a chronic disease brings many negative emotions such as coping with the symptoms of the disease, the limitations of the treatment, and concerns about the future. These negative emotions reduce the quality of life by affecting the cognitive, physical, and social life of the individual(21). Problems related to the disease not only challenge the patient but also the nurses who care for the patient. As it is understood from the literature, it is necessary to address the patient in a multidimensional way and contribute to improving the quality of life. It is thought that the nurses participating in this study also had difficulty in caring for their patients for similar reasons. Findings from a study examining the views and opinions of nurses regarding pet therapy indicate that pediatric nurses working with pets experience greater personal satisfaction at work, reduced burnout, express more positive feelings about their work, have higher job satisfaction, and experience less work-related depression

compared to the control group of nurses working under standard conditions without pets(22). Considering that pet therapy has positive effects on both patients and practitioners, it is thought that implementing pet therapy could be effective in enhancing the mental well-being of nurses who have significant responsibilities and face challenges in the treatment and care of chronic diseases.

Nurses face different problems while caring for chronic patients and pharmacological and non-pharmacological approaches are used to cope with these problems(23). Almost all of the nurses in our study found it correct to apply pharmacological and psychosocial interventions together in individuals with chronic diseases and preferred psychosocial interventions while caring for patients. While focusing on pharmacological treatment of patients as a student, non-pharmacological approaches are used more and more as experience and knowledge are gained. A study conducted with nurses caring for palliative care patients found that nurses mostly focus on self-care practices, symptom management and improving quality of life(24). The opinions of the nurses participating in the study were similar to those reported by the literature.

Nurses provided training to empower their chronic patients. In chronic diseases, not only the patient but also the patient's relatives should be included in care. Education is used to help patients and their relatives cope with the symptoms of chronic diseases and to support the patient's self-care. Education is one of the most effective methods of coping with the disease, although it can be provided in different ways, such as face-to-face, internet-based or written materials(25).

There are studies in literature examining the knowledge and opinions of nurses regarding pet therapy(11,26). In a study conducted in Turkey, it was stated that 15.7% of the participants (nurses, doctors, patients, and relatives) heard about animal-assisted applications and 2.2% of them applied it(26). It was found that 40.1% of the nurses participating in this study had heard of pet therapy practices. Pet therapies that can be applied by nurses can be applied in hospitals, nursing homes, nursing homes or through home visits(27). Nurses who implement pet therapy programs can take part in the intervention team(16) or can do this alone(7). Therefore, the underlying reason why a higher proportion of people heard of pet therapy practices in this study may be that only the nurse group was included. Since pet therapy or animal-assisted

practices are non-pharmacological methods, the nurse group is more familiar with this practice.

Most of the nurses participating in our study stated that they had not heard of pet therapy but wanted to learn about it, and that if it was to be applied, it could be applied in children and disadvantaged groups. In a pilot study conducted to evaluate the possible benefits of human-animal interaction in nurses, it was stated that the interaction has psychological benefits and can be applied even in a busy clinic(15). In a study conducted with nurses and parents of children in an oncology clinic, it was reported that dog-assisted therapy can contribute to alleviating psychological distress in children and parents, facilitating their adaptation to the therapeutic process, and improving their well-being during their hospital stay(14). Again, it has been reported that animal-assisted applications have positive results in pain management in paediatric patients (28). In another study, it was reported that animal-assisted practices had positive effects and reduced aggressive behaviors in chronic psychiatric patients(29). Studies on animal-assisted practices are generally carried out with disadvantaged and child groups. The opinions of nurses were similar to those reported by the literature.

In our study, the majority of participants also indicated that using pet therapy as a nursing intervention would increase the visibility and strength of nursing. Being powerful is part of being professional and maintaining a professional image. The study indicates a positive relationship between nurses' empowerment and quality of care, good patient outcomes, patient satisfaction, and job satisfaction (30). The willingness of participants to use pet therapy as a therapeutic intervention in their care and practices to enhance professional visibility and empowerment is considered an important finding both professionally and in terms of care quality.

Limitations

The number of nurses participating in the study(n=167) was relatively low; participation could have been higher. Unfortunately, as is the case worldwide, nurses in Türkiye also face high workloads. As a result, the participation of nurses was lower than desired. Therefore, the results may not represent the general situation in Türkiye. Another limitation is that the data for the research were collected using a data collection form created by the researchers based on the literature. Using a scale with established

validity and reliability could have strengthened the study. On the other hand, 19 questions were asked to measure nurses' perceptions specific to pet therapy in the care of chronic patients. Thus, it is believed that this approach provided an opportunity to view the topic from a broader perspective. Nevertheless, it is advisable to use scales with established validity and reliability in future studies.

Conclusions

The results of this study revealed that nurses had difficulty in caring for chronic patients, provided training to help patients cope with their illnesses, had not heard of pet therapy and wanted to apply it after receiving training, and thought that it could be applied with live animals, especially in disadvantaged groups. They thought that pet therapy applications would support patients psychosocially. It has been determined that nurses consider pet therapy to be an effective intervention in increasing professional visibility and empowerment.

Declarations

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Conflict of Interest Statement

None.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

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Exploring Awareness and Attitudes Towards Smoking Among Pregnant Women and Healthcare Professionals: A Qualitative Study

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ABSTRACT

Purpose: Smoking during pregnancy or exposure to secondhand smoke can impact fetal development and child health. Moreover, the smoking habits of healthcare professionals (HCP) not only jeopardize their own well-being but also undermine anti-smoking efforts' credibility. The aim of this study was to investigate the awareness and attitudes of pregnant women and HCP about smoking.

Methods: The study conducted four focus group interviews involving 34 pregnant women and two focus group interviews with 17 HCP. Data collection was carried out through face-to-face interviews with audio recordings, utilizing researcher-developed forms comprising of the mother's information form and semi-structured questions. Content analysis of the research data was performed using MAXQDA-24.

Results: Findings revealed that both pregnant women and HCP were exposed to secondhand smoke within their homes (40% vs 17.6%, respectively) often disregarding areas like the kitchen, balcony, or less frequented rooms as part of the indoor environment. Many emphasized the detrimental impact of smoking in the presence of children, highlighting its potential to influence children to adopt the habit. Additionally, it was stated that educational videos on smoking's dangers to child health motivated pregnant women to quit smoking.

Conclusion: The study highlights a significant gap in awareness among both pregnant women and HCPs regarding the risks of secondhand and thirdhand smoke exposure. Despite HCPs' knowledge of the harms of smoking, the presence of exposure suggest that more effective interventions are needed. To address this gap, pregnant women should receive targeted education from informed HCPs who fully understand the risks associated with smoking, particularly in the home environment.

Keywords: Child health, secondhand tobacco smoke, smoking, thirdhand tobacco smoke

ÖZET

Amaç: Gebelikte sigara içilmesi veya ortamdaki sigara dumanının solunması fetüsün gelişmesini ve çocuk sağlığını etkileyebilmektedir. Sağlık çalışanlarının sigara kullanması; öncelikle kendi sağlıklarını tehdit etmesinin yanı sıra sigara kullanımına karşı yürütülen mücadelenin güvenilirliğini de azaltmaktadır. Bu çalışmanın amacı, gebelerin ve sağlık personelinin sigara içme konusundaki farkındalık ve tutumların araştırılmasıdır.

Yöntem: Araştırmada 34 gebe ile 4 odak grup görüşmesi, bu gebelerin başvurduğu diğer birimlerde görevli 17 sağlık personeli ile 2 odak grup görüşmesi yapıldı. Araştırma verileri araştırmacılar tarafından geliştirilen anket formu, yarı yapılandırılmış sorular ile yüz yüze görüşme ile ses kaydına alınarak toplanmıştır. Araştırma verilerinin içerik analizinde MAXQDA-24 kullanılmıştır.

Bulgular: Bulgular, hem hamile kadınların hem de sağlık çalışanlarının evlerinde pasif içiciliğe maruz kaldıklarını (sırası ile %40, %17.6) ve genellikle mutfak, balkon veya daha az kullanılan odalar gibi alanları kapalı ortamın bir parçası olarak görmediklerini ortaya koymuştur. Katılımcılar, çocukların yanında sigara içmenin zararlı etkilerini vurgulayarak, çocukları bu alışkanlığı edinme konusunda etkileme potansiyelinin altını çizmiştir. Ayrıca, sigaranın çocuk sağlığı üzerindeki tehlikelerine ilişkin eğitici videoların hamile kadınları sigarayı bırakma konusunda motive ettiği bildirilmiştir.

Sonuç: Çalışma, hem hamile kadınlar hem de sağlık çalışanları arasında, ikinci el ve üçüncü el duman maruziyeti ile ilgili önemli bir farkındalık eksikliğini vurgulamaktadır. Sağlık çalışanlarının sigaranın zararları hakkında bilgi sahibi olmalarına rağmen, temas varlığı daha etkili müdahalelere ihtiyaç duyulduğunu göstermektedir. Bu eksikliği gidermek için, gebeler, özellikle ev ortamındaki sigara içmenin risklerini tam olarak anlayan eğitilmiş sağlık çalışanlarından planlı eğitim alınmalıdır.

Anahtar Kelimeler: Çocuk sağlığı, ikinci el tütün dumanı, sigara, üçüncü el tütün dumanı

Smoking which cause severe illnesses and functional impairments, and ultimately death in smokers and those around them, while also reducing their quality of life, stands as a major public health issue due to the significant economic and emotional burdens it places on families and communities (1).

Despite causing over 8 million deaths annually, tobacco use continues to persist widely (2). According to the Turkish Health Survey 2022 data, the prevalence of daily tobacco product use among individuals aged 15 and older in Türkiye has increased to 28.3% (3). Despite awareness of all known risks associated with tobacco use, maternal smoking during pregnancy remains a global health concern (4). Additionally, exposure to secondhand smoke is as detrimental as active smoking (2,5). One form of this exposure, secondhand smoke (passive smoking), is the smoke emitted from burning tobacco products like cigarettes, cigars, or pipes, as well as the exhaled breath of a smoker (6). Thirdhand smoke, on the other hand, refers to the residual smoke particles from burned tobacco products that react with surfaces such as furniture, clothing, and walls, becoming re-emitted and potentially inhalable (7).

Maternal smoking during pregnancy or exposure to secondhand smoke not only affects the mother's health but also constitutes a leading cause of adverse health outcomes for the unborn child (e.g., stillbirth, preterm birth, low birth weight, cleft lip, asthma, sudden infant death syndrome, and metabolic disorders) (5,8). Smoking during pregnancy is prevalent both worldwide and in Türkiye (8,9).

The role of healthcare professionals is pivotal as they serve as community role models and are crucial in informing and deterring pregnant women from smoking or exposure to smoking-related risks (9). Their smoking status and exposures also shape their approaches (10). It's worth noting that healthcare professionals' smoking not only endangers their own health but also undermines efforts against smoking (11). Studies indicate a troubling rise in smoking rates among healthcare professionals both nationally and internationally (1,12-15).

We hypothesize that both pregnant women and healthcare professionals who smoke or are exposed to smoke will demonstrate a lack of awareness regarding the

adverse effects of smoking on child health. Additionally, we predict that healthcare professionals' smoking habits and exposures will influence their approaches to informing and deterring pregnant women from smoking.

The aim of this study was to investigate the awareness and attitudes of pregnant women attending antenatal classes, as well as healthcare professionals working in the units visited by these pregnant women, regarding smoking.

Material And Method

The qualitative study was conducted between February and June 2023 in pregnant women and healthcare professional from two centers in Şanlıurfa, Turkey.

All participants voluntarily agreed to take part in the study and provided informed consent. Only pregnant women attending prenatal classes at Şanlıurfa Training and Research Hospital and Viranşehir State Hospital were included in the study. Only healthcare professionals working in units visited by the pregnant women were included in the study. Pregnant healthcare professionals were included in the healthcare professional group to provide a unique perspective, as they represent both the professional knowledge of healthcare providers and the lived experience of pregnancy. Their dual role allows for a more comprehensive understanding of attitudes and awareness about smoking during pregnancy.

To conduct the research, institutional permission was obtained from Şanlıurfa Training and Research Hospital and Şanlıurfa Viranşehir State Hospital, along with written approval from the University Clinical Research Ethics Committee. After obtaining these approvals, informed consent was obtained from all participants who agreed to take part in the study.

In qualitative research literature, it is recommended that the sample size should not be so small as to preclude saturation, and for phenomenological studies, conducting interviews with up to 10 individuals is suggested (16). In line with this information, 4 focus group interviews were conducted with a total of 34 pregnant women who attended antenatal classes at Şanlıurfa Training and Research Hospital and Viranşehir State Hospital. Additionally, 17 healthcare professionals working in other units visited by these pregnant women participated in 2

focus group interviews. Saturation was achieved after a total of 6 interviews conducted at both centers.

Inclusion Criteria: Pregnant women were eligible to participate if they agreed to take part in the study and were regularly attending and continuing their follow-up at the pregnancy school. Healthcare professionals were included if they agreed to participate and had direct interactions with pregnant women during the treatment or care process.

Exclusion Criteria: Individuals who refused or were unwilling to participate in the study were excluded.

Data Collection Instruments

In this study, the researchers used the mother information form and the semi-structured questions for both pregnant women and for health personnel (Table 1). The study form was developed by the researchers. The questions were refined in accordance with existing literature (1, 8, 9, 10-12) to ensure they were relevant and aligned with the study's objectives. To ensure its clarity and appropriateness, the questions were tested with five pregnant women and healthcare professionals. Based on their feedback, adjustments were made to improve the clarity of the questions.

The Mother and Health Personnel Information Forms included sociodemographic questions such as age, occupation, marital status, and number of children. The Semi-Structured Forms for both groups contained open-ended questions regarding participants' views on smoking and tobacco use, smoking status within the home, and opinions on the effects of cigarette smoke on children's present and future health.

Data were collected through face-to-face interviews conducted by the researchers, during which audio recordings were made. Participants were informed at the beginning of the interviews that the conversations would be recorded. Suitable environments were provided to ensure that the interviews were conducted under healthy conditions, with privacy ensured for both the interviewer and the participating pregnant women and healthcare professionals.

Table 1: Interview guide

Table 1: Interview guide	
Sociodemographic characteristics	
Age, gender, job, marital status, number of children, education status, family form, caregiver for the child	
Interview Questions	
1. Do you smoke cigarettes?	
2. What are your views on smoking and tobacco use?	
3. What is the status of smoking and tobacco use at home?	
4. What are your views on the effects of cigarette smoke on children's present and future?	

Data Analysis

The audio recordings were transcribed verbatim and analyzed using a traditional content analysis approach, wherein categories and codes were generated by the researchers. The transcripts were repeatedly read to ensure accurate coding and categorization. The collected data were analyzed using thematic analysis. MAXQDA-24 software was utilized for content analysis. Interview statements were reported in alignment with the identified categories and codes, and participant anonymity was maintained, with quotations presented as excerpts from the discussions. For triangulation, multiple sources of data, including interviews with both pregnant women and healthcare professionals, were triangulated to enhance the validity and reliability of the findings.

Results

The mean age of the pregnant women who participated in the study was 26.3 ± 4.1 years, while that of the healthcare professionals was 30.6 ± 5.0 years. Among the pregnant women, 35.3% were literate, and 85.3% identified as housewives. Additionally, 35.3% of the husbands had graduated from secondary school, and 38.3% were self-employed. Furthermore, 17.6% of the pregnant women lived in extended families, and 76.5% reported receiving help from their mothers in childcare. On average, the pregnant women had 2.55 ± 1.54 children.

A total of 34 pregnant women were interviewed in two centres. It was determined that four of the interviewed pregnant women continued to smoke while three quit smoking due to pregnancy. All pregnant smokers acknowledged the harmful effects of smoking on child health. Thirty pregnant women believed smoking was harmful to children's health, one believed it was harmful to pregnant women, and four stated it was harmful to everyone, including themselves.

A total of 17 healthcare professionals, including 1 doctor, 3 nurses, 1 psychologist, 1 dietician and 11 midwives, working in units where pregnant women were admitted in two centres were interviewed. Four of the healthcare professionals were male. All of the healthcare professional stated that they did not smoke. 70.6% of the healthcare professionals were married, with an average of 2.0 ± 1.0 children.

There were 14 statements about smoking during pregnancy, 57 statements about household exposure to cigarette smoke, 36 statements about negative effects on health, 14 statements about being disturbed by smoke, 19 statements about being against smoking and 10 statements about normalisation of smoking for the child. The findings obtained from the participants were divided into three themes

Theme 1. The effects of smoking on children

Most of the pregnant women (P) and healthcare professional who participated in the research emphasized the detrimental effects of smoking on child health. Specifically, they expressed concerns about the potential for respiratory distress, as noted by participants P21 and P28. One pregnant woman (P30) attributed her decision to quit smoking to a video she watched illustrating the negative consequences of smoking. Similarly, another participant (P25) mentioned that witnessing her other child develop bronchitis, attributed to cigarette smoke by the doctor, motivated her to stop smoking around her child. Additionally, a pregnant woman (P7) shared her experience of losing her baby during a previous pregnancy, which led her to abstain from smoking during her current pregnancy. Healthcare professionals echoed similar sentiments, expressing their belief that smoking would adversely affect children's lungs and have long-term negative implications for their health, as mentioned by participants P22 and P26.

Furthermore, both pregnant women and healthcare professionals voiced concerns about the potential influence of exposure to smokers on children's future smoking behavior. They emphasized the risk that children who witness smoking may be more inclined to start smoking themselves later in life.

Negative effect

P7: *It's very harmful to children. I was smoking during my other pregnancy. My baby died at 5 months.*

P21: *I think smoking deteriorates the lungs. I've heard it corrodes them. And I think there'll be respiratory distress.*

P25: *Smoking is harmful to children now and later in life. My little son had bronchitis. The doctor said it was caused by cigarette smoke. That's why I don't smoke around him.*

P28: *The child can't breathe. It ruins a child with bronchitis. Smoking is not a good thing. If you put a kid with bronchitis in a smoking environment, he/she'll end up in intensive care.*

P30: *I smoke once in a while. My sister posted a video on the internet about the harm to the baby. I haven't smoked since I saw it.*

HCP12: *Smoking is bad for health. It affects the baby's lungs and blood circulation. It is a poison. It can cause disability and other diseases in the future.*

HCP14: *It is necessary to keep it away from children. Because their alveoli are very small. They are not able to handle this smoke.*

The act of emulating cigarette smoking

P23: *Since the child sees smoking, he/she wants to start in the future, it feels normal.*

P29: *The children are getting used to it. Because the father smokes, the child also wants to smoking.*

HCP1: *Since children are exposed to cigarettes, they become enamoured of smoking and their addiction increases.*

HCP2: *I don't smoke. My husband does. He smokes on the balcony. When a child sees his own father, he imitates and envies him.*

Theme 2. Contact with smoking

The study found that 12 pregnant women (40%) did not smoke themselves but were exposed to secondhand smoke at home, primarily due to their spouses or other household members.

Among the 18 pregnant women who smoke and have household exposure to cigarette smoke, they mentioned using areas such as balconies and kitchens where other family members are not present for smoking.

All healthcare professionals stated that they do not smoke, while three healthcare professionals mentioned that their spouses smoke indoors or on the balcony.

Both pregnant women and healthcare professionals who participated in the study expressed the belief that passive smoking has negative effects. It was determined that there is household exposure to cigarette smoke among the pregnant women and healthcare professionals participating in the study, and there is a perception that smoking in areas such as the kitchen or balcony eliminates the effects of smoking (P1, P23, P25, HP3, HP8).

Passive smoking / Secondhand smoke

P4: *I don't use it, my husband does. He smokes on the balcony. Non-smokers are more affected by smoking, it's harmful.*

P27: *It harms the child's lungs as they grow up. Even if they don't smoke, sitting next to someone who does affects them negatively due to the bad smell.*

HCP10: *Smoking should not be allowed in the presence of children. Passive smoking also has many harmful effects.*

HCP16: *Both cigarettes and tobacco are extremely harmful to the body. They have the same raw material. They affect the lungs to the extent of destroying them. Not only the smoker but also passive smoking is a dangerous situation. Even someone who doesn't smoke but is around someone who does is in danger as if they were smoking themselves. It is harmful for indoor use. Whether adult or child, this situation poses a high risk..*

Household exposure to cigarette smoke

P1: *My husband smokes a lot. He smokes inside the house too. It's poisoning the children. My children get bronchitis, I*

tell my husband not to smoke. He keeps smoking. I tell him to quit smoking, but he doesn't.

P23: *I'm strongly against it. I don't even allow it around me. If a guest comes to the house, they go to the balcony to smoke.*

P25: *I smoke. My husband smokes. We smoke at home too. When the children are inside, we either go to the balcony or the kitchen.*

HCP3: *I don't use it. My husband does. It should definitely not be used. My husband doesn't smoke around us. He smokes on the balcony. But even the smell is bothersome.*

HCP8: *Neither my husband nor I smoke. When guests come over, they smoke on the balcony. We are not with him/her at that moment.*

Theme 3. Pregnant women's smoking habits

Among the interviewed pregnant women, four continued smoking, one smoked during pregnancy but quit after watching a video about the negative effects of smoking (P30), and two stopped smoking after learning they were pregnant. One of these pregnant women mentioned smoking during a previous pregnancy but quit after losing her baby during pregnancy (P7). Another pregnant woman mentioned stopping smoking during pregnancy because of the harm it could cause to the children's health (P10). All pregnant women who smoked stated that smoking is harmful to child health.

Healthcare professionals participating in the study expressed that smoking by pregnant women is akin to committing a crime against the child and also has negative effects on the mother's health (HCP14).

One pregnant woman mentioned smoking to eat the cigarette ash and not being able to tell her husband because of fear (P5). One pregnant woman who smoked mentioned continuing to smoke out of habit but expressed a desire to quit (P14).

Negative impact

P10: *My husband and I used to smoke. But I don't smoke now. I don't smoke around the child. It harms the child.*

P16: *Pregnant women especially should not smoke because it's harmful.*

HCP2: *Pregnant women here also smoke. We warn them but they continue to smoke. It's very harmful for the children's health too.*

HCP14: *Even the name 'cigarette' is frightening. It causes permanent damage to the lungs. I can't believe pregnant women smoke. It's murder for the baby.*

HCP16: *Smoking during pregnancy can lead to hereditary diseases in babies. According to researches, if the mother uses alcohol and cigarettes during pregnancy, the possibility of anxiety and depression in babies increases. This shows that it is important for women not to smoke during pregnancy.*

Habituation

P5: *I smoke. Not a lot, actually, I eat the ash. I'm scared because my husband is around, I can't tell the doctor. My husband gets mad at me for smoking.*

P14: *It's a bad thing, but I use it. It should be kept out of the house as much as possible. We don't use it at home either. It also harms children. It affects their breathing. I want to quit, but I can't.*

P28: *I hate it, even the smell of it. It harms both life and property. Despite warning people around me, they continue. Once you start, you can't quit. Hopefully, I never smoke.*

Discussion

All healthcare professionals participating in the research stated that they did not smoke, while it was determined that among the pregnant women, some continued smoking while others stopped smoking due to pregnancy. Reasons for quitting smoking included watching videos about the harms of smoking, previous negative experiences, and concerns about the negative impact on the unborn baby. Based on these findings, it is believed that education and videos provided to pregnant women about quitting smoking would be effective. Additionally, the research revealed that both pregnant women and healthcare professionals are knowledgeable about the harms of smoking. Similar studies in the literature have found that the rate of smoking among pregnant women is low (8,17).

Similar to previous research findings, the study also observed a tendency among women to quit smoking during pregnancy. However, there are still pregnant women who continue to smoke. In light of these findings, as

quitting smoking during pregnancy may not be promptly achieved, it is crucial to initiate this struggle in a planned manner during the pre-pregnancy period and prioritize women's inclusion in smoking cessation programs. Within these programs, different approaches at both individual level (counseling, behavioral support therapy, text messaging, financial incentives, pharmacotherapy, etc.) and societal level (smoking bans, increasing social stigma, taxation, etc.) have been found to be beneficial (5,18-20). Quitting smoking after learning about pregnancy may be considered a delayed decision due to nearly completed organogenesis. Similar studies have also found that smoking behavior is common among women planning pregnancy and is often discontinued after pregnancy confirmation (21,22). Therefore, expanding preconception care services and considering smoking and passive exposure to smoke within this context are crucial for child health.

The study determined that 12 pregnant women (40%) do not smoke themselves but are exposed to secondhand smoke at home, while 3 healthcare professionals (17.6%) reported similar exposure. In a study conducted in Türkiye, in 2020, it was found that 50% of pregnant women were exposed to passive smoke at home (22). A similar study in China, involving a total of 15,682 pregnant women, found that non-smoking pregnant women (48.2%) were exposed to secondhand and thirdhand smoke (23). In a study comparing exposure to secondhand and thirdhand smoke, no difference was found in the levels of cotinine, a nicotine metabolite and an objective measure of passive smoking, between individuals exposed to both types of smoke. Both types of exposure lead to similar negative health outcomes.

Exposure to secondhand and/or thirdhand smoke can cause emotional, structural, or behavioral problems, as well as respiratory diseases in infants and children in later stages of life (24-26). In a study by İnci et al. aimed at determining the negative effects of environmental tobacco smoke exposure on child health under the age of five, the rate of household smokers was found to be 70.3%, and the rate of smoking mothers was 50%. According to the same study, one-third of the children of smokers were considered passive smokers based on the examination of urine cotinine/creatinine ratios, and the presence of smokers in the household and an increase in the number of cigarettes smoked per day were found to increase the frequency of acute respiratory tract infections (26).

According to the Turkey Global Youth Tobacco Survey 2017 data, approximately half of the children aged 13-15

are exposed to tobacco smoke at home (27). Babies and children living in these households are exposed to both secondhand smoke and its inevitable consequence, thirdhand smoke, from birth to adulthood. The only way to eliminate this situation is to prohibit smoking in homes (28). Babies, children, and pregnant women are particularly vulnerable to exposure to secondhand and thirdhand smoke, so they should be protected from tobacco smoke.

In the study, it was determined that pregnant women and healthcare professionals are exposed to secondhand smoke at home. Pregnant women and healthcare professionals stated that in order to protect non-smokers and children at home, smoking is confined to balconies, gardens, or rooms where no one else is present. According to this finding, participants do not consider these areas as part of the home environment and are not aware of the potential effects of tobacco smoke exposure. Furthermore, while not smoking in enclosed areas of the home prevents exposure to secondhand tobacco smoke, smoking in outdoor areas poses a risk of exposure to thirdhand tobacco smoke. While some of the pregnant women and healthcare professionals participating in the study showed caution regarding secondhand smoke, none of the participants expressed awareness of the negative consequences of thirdhand smoke. Studies in the literature have similarly found that smoking occurs indoors, in rooms, on balconies-terraces, where children are present (21,23,29).

The Turkey Baby, Child, Adolescent Follow-up Protocols guide stated that counseling on smoking should be provided to young people, and families should be educated about ensuring that babies do not have direct and indirect contact (smoking in another room, close contact with a smoker) with tobacco smoke (30).

Strengths and Limitations

As a limitation, data collection relied on self-reported information from participants, which might introduce bias or inaccuracies in responses. However, the study included perspectives from both pregnant women and healthcare professionals, enriching the analysis and interpretation of the findings. The study focused on passive smoke exposure among pregnant women and healthcare professionals, addressing an important public health concern. Qualitative data collection methods, such as interviews, allowed for in-depth exploration of attitudes, behaviors, and perceptions related to smoking and secondhand smoke exposure. The study provided

insights into potential areas for intervention, such as preconception care services and smoking cessation programs, to mitigate the harmful effects of tobacco smoke exposure.

Conclusion

According to the findings of this study, it was determined that the majority of pregnant women and healthcare professionals lack awareness of the negative effects of secondhand and thirdhand smoke exposure. Additionally, the finding that some pregnant women continue smoking during pregnancy and only quit upon learning of their pregnancy can lead to significant issues concerning child health. In order to eliminate the impact of smoking and exposure to secondhand and thirdhand smoke, it is imperative for healthcare professionals with a high level of awareness regarding the negative effects of smoking to provide education to pregnant women.

Furthermore, these educational efforts should extend to include spouses and other individuals living in the household. Increasing the awareness of healthcare professionals about the harms of smoking on pregnant women and child health may also have an indirect effect on the society they come into contact with. This study is expected to raise awareness about the harms of smoking, secondhand and thirdhand smoke exposure among pregnant women, healthcare personnel and the public.

Declarations

Declarations of Interest

The authors declare no conflict of interest.

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Conflict of Interest

The author declared that there is no conflict of interest

Ethical Approval

The study was conducted with the permission of the Harran University Clinical Research Ethics Committee (Protocol no: 2023/03/17).

Availability of Data And Material

Available.

Authors' Contributions

Concept- HYSA, BG, SSY; Design- HYSA, BG, SSY; Supervision- SSY; Resources- HYSA, BG; Materials- HYSA, BG; Data Collection and/or Processing- HYSA, BG; Analysis and/or Interpretation- HYSA, BG, SSY; Literature Search- HYSA; Writing Manuscript- HYSA; Critical Review- HYSA, BG, SSY.

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Fear of COVID-19 and Depression in Pregnant Women and New Mothers: A Cross-Sectional Study

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ABSTRACT

Purpose: The objective of this study was to assess the levels of COVID-19 fear and depression among pregnant women and new mothers.

Methods: The study is of a cross-sectional design. The study sample consisted of pregnant women and new mothers, aged 18 years or older, who had given birth within the past year and resided in a province in the Eastern Black Sea region (n = 259). Data were collected using a personal information form, the COVID-19 Fear Scale, and the Patient Health Questionnaire-9 (PHQ-9).

Results: Women's COVID-19 Fear Scale score mean was 15.28 ± 6.42 and their PHQ-9 mean score was 9.27 ± 5.31 . Multiple linear regression analysis showed that the variables of PHQ-9 ($p=0.000$), educational background ($p=0.029$), occupational status ($p=0.0015$) and socioeconomic status ($p=0.012$) were statistically significant predictors of COVID-19 fear. All variables were found to explain the variance in COVID-19 Fear Scale scores to 16% ($R^2= 0.164$).

Conclusion: The women in this study appeared to have a moderate level of COVID-19 fear. PHQ-9, educational background, occupational status, and socioeconomic status were predictors of women's COVID-19 fear. The pandemic period, which is a public health emergency, affects not only the physical health but also the psychological health of pregnant and post-partum women, a particularly vulnerable group. It is very important for midwives and nurses to effectively screen pregnant and post-partum women, particularly vulnerable group, for symptoms of depression and fear, and to provide them with accurate and up-to-date information to protect and improve their health.

Keywords: Depression, Fear of COVID-19, PHQ-9, Postpartum, Pregnant

ÖZET

Amaç: Bu çalışmanın amacı gebeler ve doğum yapan annelerde COVID-19 korku ve depresyon düzeylerini değerlendirmektir.

Method: Çalışma kesitsel tiptedir. Çalışmanın örneklemini, Doğu Karadeniz bölgesindeki bir ilde ikamet eden, 18 yaş ve üzeri gebe ve son bir yıl içinde yeni doğum yapmış anneler oluşturmuştur. Veriler kişisel bilgi formu, COVID-19 Korku Ölçeği ve Hasta Sağlık Anketi-9 (PHQ-9) kullanılarak toplanmıştır.

Bulgular: Kadınların COVID-19 Korkusu Ölçeği puan ortalaması $15,28 \pm 6,42$ ve PHQ-9 ortalama puanı $9,27 \pm 5,31$ idi. Çoklu doğrusal regresyon analizi, PHQ-9 ($p=0.000$), eğitim durumu ($p=0.029$), mesleki durum ($p=0.0015$) ve sosyoekonomik durum ($p=0.012$) değişkenlerinin COVID-19 korkusunun istatistiksel olarak anlamlı yordayıcıları olduğunu göstermiştir. Tüm değişkenlerin COVID-19 Korkusu Ölçeği puanlarındaki varyansı %16 ($R^2= 0.164$) ile açıkladığı bulunmuştur.

Sonuç: Bu çalışmadaki kadınların COVID-19'a karşı orta düzeyde korkuya sahip oldukları görülmüştür. PHQ-9, eğitim durumu, mesleki durum ve sosyoekonomik durum, kadınların COVID-19 korkusunun yordayıcılarıydı. Bir halk sağlığı acil durumu olan pandemi dönemi, özellikle savunmasız bir grup olan hamilelerin ve yeni annelerin sadece fiziksel sağlığını değil aynı zamanda psikolojik sağlığını da etkilemektedir. Ebe ve hemşirelerin özellikle savunmasız bir grup olan gebeleri ve yeni anneleri depresyon ve korku belirtileri açısından etkin bir şekilde taramaları, sağlıklarını korumaları ve iyileştirmeleri için onlara doğru ve güncel bilgiler vermeleri çok önemlidir.

Anahtar Kelimeler: Depresyon, COVID-19 korkusu, PHQ-9, Postpartum, Gebe.

C OVID-19 first emerged in China and was declared a pandemic on March 11, 2019. Identified as a significant public health issue by the World Health Organization (WHO), COVID-19 has had a negative impact on the health of many people, potentially leading to death (1). Globally, the COVID-19 pandemic has disrupted healthcare systems, affecting physical and mental health, with significant psychological consequences reported across different populations, including pregnant women (2). The diseases and deaths caused by COVID-19 broadcasted on media, TV and press organs has taken a toll on many people psychologically (3). Moreover, with the closure of schools, workplaces and social spaces in the fight against the pandemic came social isolation, which led to negative psychological outcomes such as fear and depression (2).

The data available in the literature on complications caused by COVID-19 in pregnant women and newborns are limited. As the effects of COVID-19 infection on pregnancy remain unknown, pregnant women, new mothers and newborns are considered to be at high risk for COVID-19 (4, 5). Women's immune system is suppressed during pregnancy. This makes them more prone to COVID-19, which causes especially pregnant women and also women who are nearing or have recently given birth to experience greater fear and anxiety (6, 7). Pregnant women feel fear and anxiety not only for their own health but are worried about their unborn baby as well (8). It has been reported in the literature that pregnant women experience high levels of anxiety and that their COVID-19 fear is considerably correlated with depression (9, 10). In a study by Fan et al. (2021) conducted on pregnant and new mothers in China and Hong Kong, most of the participants reported that the thought of COVID-19 made them feel scared and anxious. The same study also reported that postpartum depression had increased with the outbreak of the COVID-19 pandemic (4). In a qualitative study investigating the experiences of pregnant women during the COVID-19 pandemic in Turkey, women reported that disruptions and limitations in the provision of health services had aggravated their fears about peripartum (prenatal, natal and postpartum) care. Further, it was pointed out that the restrictions and lockdowns brought by the COVID-19 pandemic affected the social support systems of pregnant women, causing

an increase in their anxiety (5). In Turkey, health policies introduced during the pandemic, such as restrictions on healthcare access and limited interaction with healthcare professionals, significantly impacted pregnant women's psychological well-being (5,6). Studies show that the psychological health of pregnant women has been greatly affected during the pandemic and that they experience at least one psychological problem such as depression, anxiety, and stress in addition to COVID-19 fear (4, 11).

Psychological evaluation of pregnant women and postpartum women in an international public health crisis is crucial (12). It is stated that in a pandemic, the psychological health of people is not emphasized as much as their physical health and the psychological consequences will persist in the long run (13). In this sense, it is of utmost importance that midwives and nurses conduct effective screenings for depression and fear symptoms and convey accurate and up-to-date information about COVID-19 in order to protect and improve women's psychological health in the peripartum period (4). Previous studies have put forth that studies should be conducted to examine the causes of anxiety and fear in women who were pregnant or gave birth during the pandemic (4, 14). Studies on pregnant women and new mothers will constitute a key component in actions to be taken to mitigate the adverse mental health consequences of a possible large-scale future pandemic and justify the preparedness that needs to be established for the provision of reliable healthcare services (4, 11). It is believed that determining the situation in different cultures will contribute to the literature. Against this background, this study aimed to investigate the levels of COVID-19-related fear and depression in pregnant women and new mothers aged 18 years or older, living in a province located in the the Eastern Black Sea (EBS) region.

Material and Methods

Study Design: This study was conducted using a cross-sectional design.

Setting and Participants: The study was carried out in a province in the EBS region. Researchers gathered the data through face-to-face interviews in family health centers between April and July 2022. Data collection

took an average of 15 minutes per participant. The study population consisted of pregnant women and new mothers, who gave birth in the last 1 year, aged 18 years or older, living in a province located in Turkey (N = 1922). Sample size was calculated by G*Power 3.1, which resulted in a minimum sample size of 198 persons with power = 0.80, alpha = 0.05, and d = 0.35 (4). The sample consisted of 259 women who had command of the Turkish language and consented to take part in the research.

Data Collection Tools: The researchers gathered the data by means of personal information form, COVID-19 Fear Scale and Patient Health Questionnaire-9 (PHQ-9).

Personal-information form: The researchers designed the personal-information form after conducting a thorough review of pertinent literature (4). The form consisted of 11 items about the participants' socio-demographic characteristics such as educational background and age as well as certain characteristics related to COVID-19.

COVID-19 Fear Scale: This scale was developed by Ahorsu, et al. (15) and its Turkish validity and reliability were tested by Bakioglu, et al. (16). The scale has a Cronbach's Alpha coefficient of 0.82. In our study, the scale has a Cronbach's Alpha coefficient of 0.89. Fear of COVID-19 Scale is a 5-point Likert scale and it consists of 7 items, none of which are reversed. The total score derived from all items on the scale indicates the extent of COVID-19-related fear experienced by the individual. Scores on the scale range from 7 to 35, with a higher score signifying a greater level of fear associated with COVID-19.

Patient Health Questionnaire-9 (PHQ-9): This questionnaire was developed by Kroenke, et al. (17) for the purpose of depression screening and its Turkish validity and reliability was tested by Sari, et al. (18). The scale has a Cronbach's Alpha coefficient of 0.84. In our study, the scale has a Cronbach's Alpha coefficient of 0.86. PHQ-9 is a 4-point Likert scale and it consists of 9 items. It assesses how often a patient has been bothered by depressive symptoms over the last two weeks. The scores that can be obtained on the scale are between 0 and 27. Scores ranging from 1 to 4 indicate 'very minimal' symptoms, 5 to 9 represent 'mild' symptoms, 10 to 14 indicate 'moderate'

symptoms, 15 to 19 suggest 'moderate to severe' symptoms, and scores between 20 and 27 indicate 'severe' symptoms of depression. Respondents with PHQ-9 ≥ 10 are considered to be in depression (17). The last item on the questionnaire is not included in the total score.

Ethical Considerations: Ethics committee approval (15.03.2022/Decision no:49-04) and institutional approval prior to the study. Participants were briefed about the study in compliance with the Declaration of Helsinki, and their consent was obtained through an Informed Consent Form. Only individuals who volunteered were included in the study.

Statistical Analysis: We conducted the data analysis using IBM SPSS version 25. The level of statistical significance was accepted as $p < 0.05$. Normal distribution of data was assessed using measures of skewness and kurtosis. Descriptive statistics including mean, standard deviation, range, frequency, and percentage were employed. Parametric tests such as the Independent Samples Test and One-Way ANOVA were utilized for data analysis. Multiple linear regression analysis (enter method) was carried out to identify predictors of COVID-19 fear. Prior to conducting the multiple linear regression analysis, multicollinearity and data normality were assessed.

Results

Mean age of the women participating in this research was 29.23 ± 4.61 (min=18, max=45). Some of the women's characteristics and a comparison of their Fear of COVID-19 Scale and PHQ-9 scores are given in Table 1.

A statistically significant difference was found between fear of COVID-19 and occupational status ($p=0.022$), received mental health support ($p=0.046$), and vaccinated against COVID-19 ($p=0.013$).

PHQ-9 showed a statistically significant difference between place of residence ($p=0.003$), received mental health support ($p=0.001$), vaccinated against COVID-19 ($p=0.042$) and lost a relative to COVID-19 ($p=0.043$).

Table 1: Some of the women's characteristics and a comparison of their fear of COVID-19 scale and PHQ-9 scores (n = 259)

	n (%)	Fear of COVID-19 Scale Mean \pm SD (Min-Max)	PHQ-9 Mean \pm SD (Min-Max)
Education			
Primary/Secondary School	73 (28.2)	15.69 \pm 6.36 (7-33)	9.68 \pm 6.02 (0-26)
High School	79 (30.5)	14.70 \pm 6.58 (7-28)	9.16 \pm 5.89 (0-27)
University or higher	107 (41.3)	15.42 \pm 6.36 (7-34)	9.07 \pm 4.26 (0-20)
Test p		0.491 0.612**	0.309 0.734**
Place of residence			
Rural	74 (28.6)	15.51 \pm 6.00 (7-27)	11.10 \pm 6.55 (0-27)
Urban	185 (71.4)	15.18 \pm 6.59 (7-34)	8.54 \pm 4.54 (0-24)
Test p		0.367 0.714*	3.088 0.003*
Occupational status			
Works	84 (32.4)	16.59 \pm 6.37 (7-34)	9.60 \pm 4.85 (0-23)
Does not work	175 (67.6)	14.65 \pm 6.36 (7-33)	9.11 \pm 5.52 (0-27)
Test p		2.300 0.022*	0.699 0.485*
Socioeconomic status			
Income less than expenses	81 (31.3)	13.91 \pm 5.88 (7-29)	10.03 \pm 5.10 (0-24)
Income equal to expenses	135 (52.1)	15.91 \pm 6.82 (7-34)	9.17 \pm 5.59 (0-27)
Income greater than expenses	43 (16.6)	15.88 \pm 5.79 (7-33)	8.13 \pm 4.62 (0-23)
Test p		2.712 0.068**	1.852 0.159**
Chronic disease			
Yes	240 (92.7)	15.09 \pm 6.37 (7-34)	9.26 \pm 5.06 (0-27)
No	19 (7.3)	17.68 \pm 6.66 (7-29)	9.36 \pm 7.97 (0-26)
Test p		-1.700 0.090*	-0.055 0.957*
Received mental health support			
Yes	19 (7.3)	18.10 \pm 7.54 (7-29)	13.94 \pm 5.08 (3-23)
No	240 (92.7)	15.05 \pm 6.28 (7-34)	8.90 \pm 5.15 (0-27)
Test p		2.003 0.046*	4.106 0.001*
History of COVID-19 infection			
Yes	112 (43.2)	15.95 \pm 6.58 (7-34)	9.20 \pm 5.14 (0-24)
No	147 (56.8)	14.76 \pm 6.26 (7-29)	9.32 \pm 5.45 (0-27)
Test p		1.477 0.141*	-0.182 0.856*
Vaccinated against COVID-19			
Yes	184 (71.0)	15.86 \pm 6.65 (7-34)	9.70 \pm 5.40 (0-27)
No	75 (29.0)	13.84 \pm 5.57 (7-29)	8.22 \pm 4.96 (0-21)
Test p		2.506 0.013*	2.039 0.042*
Lost a relative to COVID-19			
Yes	26 (10.0)	17.53 \pm 6.26 (7-29)	11.26 \pm 4.35 (3-20)
No	233 (90.0)	15.03 \pm 6.40 (7-34)	9.05 \pm 5.36 (0-27)
Test p		1.899 0.059*	2.032 0.043*

* T-test in independent groups

** One Way ANOVA

Abbreviations: PHQ-9, Patient Health Questionnaire-9.

Respondents with PHQ-9 \geq 10 are considered to be in depression. In this study, 40.9% (n=106) of the women were depressed. 39% (n=62) of pregnant women and 44% (n=44) of postpartum women were depressed (data

not shown). The women's Fear of COVID-19 Scale mean score was 15.28 \pm 6.42 and their PHQ-9 mean score was 9.27 \pm 5.31 (Table 2).

Table 2: Fear of COVID-19 scale and PHQ-9 mean scores (n = 259)

	Pregnant (n = 159)	Postpartum (n = 100)	Total	Test <i>p</i>
	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	Mean ± SD (Min-Max)	
Fear of COVID-19 Scale	15.16 ± 6.33 (7-34)	15.46 ± 6.58 (7-29)	15.28 ± 6.42 (7-34)	-0.354 0.724*
PHQ-9	9.01 ± 5.24 (0-27)	9.68 ± 5.41 (0-24)	9.27 ± 5.31 (0-27)	-0.975 0.330*

* T-test in independent groups
Abbreviations: PHQ-9, Patient Health Questionnaire-9.

Table 3. Factors predicting women's fear of COVID-19

Independent Variable	Unstandardized Coefficients		Standardized Coefficients	t	p	95.0% CI	
	B	SE	β			Lower Bound	Upper Bound
(Constant)	13.841	3.508		3.946	0.000	6.932	20.750
PHQ-9	0.289	0.077	0.239	3.730	0.000*	0.136	0.441
Age	-0.040	0.090	-0.028	-0.439	0.661	-0.217	0.138
Status (ref: Postpartum)							
Pregnant	-0.085	0.873	-0.006	-0.097	0.922	-1.804	1.634
Education (ref: Primary/Secondary School)							
High School	-1.850	1.058	-0.133	-1.749	0.081	-3.934	0.233
University or higher	-2.607	1.190	-0.200	-2.190	0.029*	-4.951	-0.263
Place of residence (ref: Rural)							
Urban	-0.505	0.956	-0.036	-0.529	0.598	-2.389	1.378
Occupational status (ref: Does not work)							
Works	2.608	1.060	0.191	2.459	0.015*	0.519	4.697
Socioeconomic status (ref: Income less than expenses)							
Income equal to expenses	2.348	0.927	0.183	2.532	0.012*	0.522	4.174
Income greater than expenses	2.324	1.246	0.135	1.865	0.063	-0.131	4.779
Chronic disease (ref: Yes)							
No	-2.317	1.478	-0.094	-1.567	0.118	-5.228	0.595
Received mental health support (ref: No)							
Yes	0.908	1.547	0.037	0.587	0.558	-2.138	3.955
History of COVID-19 infection (ref: No)							
Yes	0.629	0.797	0.049	0.789	0.431	-0.941	2.200
Vaccinated against COVID-19 (ref: No)							
Yes	1.682	0.876	0.119	1.920	0.056	-0.044	3.409
Lost a relative to COVID-19 (ref: No)							
Yes	1.306	1.306	0.061	1.000	0.318	-1.266	3.878

Dependent variable: Fear of COVID-19

Abbreviations: CI, confidence interval; SE, standard error; β, standardized regression coefficient; PHQ-9, Patient Health Questionnaire-9; ref, reference.

Notes: Durbin-Watson = 1.906; F = 3.427, *p* < 0.001; R = 0.405; R² = 0.164; Adjusted R² = 0.116; * = *p* < 0.05

The authors also examined the correlation between the Fear of COVID-19 Scale and PHQ-9 scores of women participating in the study. According to the results of Pearson's correlation test, a low level of positive linear correlation was found ($r=0.27$, $p=0.0001$). The higher the fear of COVID-19, the more severe the depression.

Table 3 provides an analysis of the variables/factors affecting women's fear of COVID-19. Multiple linear regression analysis was performed to predict fear of COVID-19 on the basis of these variables. Based on analysis results, it was determined that the model created was statistically significant ($F=3.427$, $p<0.001$). From among the variables included in the model, PHQ-9, educational

background, occupational status and socioeconomic status were found to be statistically significant predictors of fear of COVID-19 ($p < 0.05$). All variables were found to explain the variance in Fear of COVID-19 Scale scores to 16% ($R^2 = 0.164$).

Discussion

It is known that feelings of uncertainty and fear are common in any public health emergency (12). Likewise, the COVID-19 pandemic has caused especially pregnant women and new mothers to experience more fear (6, 7). This study was conducted to determine fear of COVID-19 and depression in pregnant women and new mothers. The objective of this study was to determine the levels of COVID-19 related fear and depression in pregnant women and new mothers.

Our study results showed that women experienced moderate fear of COVID-19 (Table 2), which supports the results of previous studies indicating that pregnant and/or new mothers experienced moderate fear of COVID-19 (4, 10, 14). As the effects of COVID-19 on pregnancy remain unknown, pregnant women and new mothers are considered to be at high risk for COVID-19 (4, 5). Women's immune system is suppressed during pregnancy. This makes them more prone to COVID-19, which can cause pregnant women and women who are nearing or have recently given birth to experience greater stress, anxiety and fear (6, 7).

Our study revealed a positive linear relationship between fear of COVID-19 and depression. The higher the fear of COVID-19, the more severe the depression. This result shows parallelism with the results of previous studies in the literature (4, 9). Times marked by uncertainty such as a pandemic can cause people to experience negative psychological issues such as depression and fear (2).

After performing a multiple regression analysis in our study to identify the variables that predict fear of COVID-19, the findings revealed that the variables predicting fear of COVID-19, it was found that the variables of PHQ-9 score, educational background, occupational status and socioeconomic status of women were statistically significant predictors of fear of COVID-19 ($F = 3.427$, $p < 0.001$). All variables were found to explain the variance in Fear of COVID-19 Scale scores to 16% ($R^2 = 0.164$).

Examining the variables that emerged as statistically significant predictors of fear of COVID-19 according to the regression analysis results, it became evident that the "PHQ-9" variable ranked first in the order of significance, suggesting that the more severe depression in women, the greater their fear of COVID-19. The research conducted by Fan, et al. (4) conducted on women is similar to our study in this regard. Further, our study results showed that approximately half of the women (40.9%) were depressed. It can be seen that the rate of depression found in our study is higher than the generally accepted pre-pandemic prevalence for perinatal depression of up to 20% (19, 20). When we look at previous studies in the literature, it is seen that the rate of depression in pregnant women and new mothers during the COVID-19 pandemic was found to range between 17.2% and 58.0% (4, 21-23). As the effects of COVID-19 on pregnancy remain unknown, pregnant women and new mothers are considered to be at high risk for COVID-19 (4, 5). The COVID-19 pandemic impacts not only physical health but also psychological well-being (2, 3). It has been observed that the psychological problems in pregnant and/or new mothers have increased with the outbreak of COVID-19 (9, 13, 23-25). The pandemic has led people to experience negative psychological issues such as depression and fear (2).

The variable ranking second in the order of significance was "educational background". Our study showed that the higher the education level of women, the lower their COVID-19 fear. In contrast to our study result, a study conducted during the pandemic period showed that the higher the level of education of pregnant women, the more severe their anxiety (26). This being said, studies show in general that pregnant women with a high education level experience less psychological problems such as fear and anxiety (24, 27-28). This discrepancy may be due to various factors such as cultural context, sources of information, or personal coping mechanisms. It is stated that low education level may cause fear as it can make it harder for individuals to inform themselves about COVID-19 and to understand how and to what extent this infection may affect their health (28). The more knowledge an individual has about COVID-19, the lower their fear of COVID-19, suggesting that education and knowledge are key to a healthier society (27).

The variable identified as the third most significant in terms of importance was "occupational status". Working women have more COVID-19 fear. Previous studies have shown that pregnant women working during the pandemic were more likely to experience psychological problems (12,

29). Fear is a common occurrence in times of uncertainty, such as a pandemic (12). It is believed that having to leave their homes where they feel safe, worrying about getting infected with COVID-19 and the financial stress caused by the pandemic create fear in working women (12, 29, 30).

It is known that along with the physiological effects, socioeconomic effects are another cause of fear of COVID-19 (27). The variable that ranked fourth in the order of significance according to our study was "socioeconomic status". According to our study results, women whose income was equal to expenses experienced more fear of COVID-19 than those whose income was less than expenses. Whilst it is known that the pandemic has had more negative effects on pregnant women, especially on those with low income (24), a study revealed that middle-income pregnant women were more likely to experience psychological problems (12). In their study, Wu, et al. (12) stated that women whose income was equal to expenses were at a greater risk due to the economic hardships and increasing unemployment caused by the pandemic.

This study has various limitations. The results of this research are limited to pregnant women and new mothers living in the province where the research was conducted. Due to the reliance on self-reported data from participants and the utilization of a cross-sectional study design, the research findings only reflect the circumstances at the time of data collection.

In summary, it was observed that the women involved in this study experienced a moderate level of COVID-19 fear. PHQ-9, educational background, occupational status, and socioeconomic status were predictors of and explained women's COVID-19 fear.

The pandemic period, a public health emergency, impacts not only physical health but also psychological well-being of pregnant women and new mothers, who are a particularly vulnerable group. In this context, it is very important for midwives and nurses to effectively screen women, who are at a particularly high risk, for depression and fear symptoms and provide them with accurate and up-to-date information in order to protect and improve their health. It is recommended that longitudinal studies on pregnant women and new mothers be conducted with a view to providing reliable healthcare services and ensuring preparedness against possible large-scale pandemics that may occur in the future.

Declarations

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Conflict of interest statement

The authors report there are no competing interests to declare.

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Data Availability Statement

The data can be obtained from the correspondent author by e-mail.

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Determination of Knowledge Levels of Mothers on Infant Nutrition and Use of Herbal Products

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ABSTRACT

Purpose: Infancy nutrition is important for the smooth growth and development of the baby. In this period, the importance of breast milk and alternative treatment methods are more oriented to complaints such as sleep, gas/bloating and fever in infants. This study was conducted to determine the knowledge, attitudes and practices of mothers with babies aged 0-2 years living in Karabük province about infant nutrition and the use of herbs in the problems they encounter.

Methods: The study included 121 volunteer mothers with infants aged 0–2 years living in Karabük. A questionnaire consisting of 35 questions related to sociodemographic characteristics, infant nutrition, and the use of herbal products was used. Percentage and frequency distributions were utilized to analyze the data, and Student's t-test and ANOVA were applied to evaluate the parameters that showed normal distribution.

Results: In the study, it was determined that 37.2% of the infants were exclusively breastfed for the first 6 months, 40.5% had a total breastfeeding duration of 7-12 months, 53.7% started complementary feeding after the 6th month, 62% of the mothers preferred medical treatment, 19.8% preferred herbal treatment and 18.2% preferred both treatment methods. It was observed that there was a statistical relationship between sociodemographic characteristics such as education level, age range, number of children in the family, BMI of the mother, duration of breastfeeding and herbal product use ($p<0.05$).

Conclusions: There is a need for more comprehensive and prospective studies on breastfeeding, breast milk and herbal products in the community.

Keywords: Infant feeding, herbal use, breastfeeding, breast milk

ÖZET

Amaç: Bebeklik döneminde beslenme, bebeğin sorunsuz büyümesi ve gelişmesi için önemlidir. Bu dönemde anne sütünün önemi ve alternatif tedavi yöntemleri daha çok bebeklerde uyku, gaz/şişkinlik ve ateş gibi şikayetlere yöneliktir. Bu çalışma Karabük ilinde yaşayan 0-2 yaş arası bebeği olan annelerin bebek beslenmesi ve karşılaştıkları sorunlarda bitkilerin kullanımı ile ilgili bilgi, tutum ve uygulamalarını belirlemek amacıyla yapılmıştır.

Yöntem: Çalışmaya Karabük'te 0-2 yaş arası bebeği olan 121 gönüllü anne dahil edilmiştir. Katılımcılardan sosyodemografik özellikler, bebek beslenmesi ve bitkisel ürün kullanımı ile ilgili 35 soru içeren bir anket doldurmaları istendi. Verilerin analizinde yüzde ve frekans dağılımları, normal dağılıma sahip parametrelerin değerlendirilmesinde ise Student t testi ve ANOVA kullanılmıştır.

Bulgular: Çalışmada bebeklerin %37,2'sinin ilk 6 ay sadece anne sütü ile beslendiği, %40,5'inin toplam emzirme süresinin 7-12 ay olduğu, %53,7'sinin 6. aydan sonra tamamlayıcı beslenmeye başladığı, annelerin %62'sinin medikal tedaviyi, %19,8'inin bitkisel tedaviyi, %18,2'sinin ise her iki tedavi yöntemini tercih ettiği belirlenmiştir. Eğitim düzeyi, yaş aralığı, ailedeki çocuk sayısı, annenin VKİ'si gibi sosyodemografik özellikler ile emzirme süresi ve bitkisel ürün kullanımı arasında istatistiksel bir ilişki olduğu görülmüştür ($p<0.05$).

Sonuç: Toplumda emzirme, anne sütü ve bitkisel ürünler konusunda daha kapsamlı ve ileriye dönük çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Bebek beslenmesi, bitkisel ürün kullanımı, emzirme, anne sütü

Nutrition is important in all periods from birth to the end of life. This importance increases during infancy, the period of the fastest growth and development, which forms the basis of a healthy life. Conditions that arise due to nutritional deficiencies in infants aged 0-3 years are an important cause of mortality in that age group. Educating and raising awareness of parents about infant and child nutrition is very important for raising healthy generations (1,2).

Infancy is the period of the fastest growth. The World Health Organization and the United Nations International Children's Emergency Fund (UNICEF) recommend that every infant should be exclusively breastfed for the first 6 months after birth and that breastfeeding should be continued with complementary foods after the first 6 months until at least two years of age (3). In Turkey, the rates of exclusive breastfeeding for 6 months in 2008, 2013 and 2018 were reported as 40.4%, 30% and 41%, respectively (4). In the world, the rate of exclusive breastfeeding for the first 6 months is 38% and it is aimed to increase the rate of exclusive breastfeeding for the first 6 months to over 50% by 2030 (5,6). The first years of life are critical for establishing long-term nutritional patterns that support healthy growth. WHO recommends starting complementary feeding after the 6th month of life, while the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) recommends starting complementary feeding no earlier than the 17th week and no later than the 26th week (3,7).

Adequate and balanced nutrition is known to reduce the risk of infections in infants. In infant feeding, factors such as family, social-cultural factors, economy, digital technology, disease conditions in the baby can affect the baby's eating habits. During this period, mothers often face problems such as sleep, gas/bloating and fever in their babies. In complaints such as sleep, gas/bloating and fever, the mother pays more attention to the baby's nutrition and uses alternative treatment methods. Thousands of years ago, humans recognized the therapeutic power of plants and used plants to live healthy (8,9).

In recent years, it has gained importance to consume natural foods and foods instead of using drugs to find solutions to Free Radicals (SR) and various diseases that negatively affect people's health (10,11). It is known that many plants have been used for medicinal purposes since ancient times in the world. The earliest information on medicinal plants and their use in history comes from Chinese, Egyptian and Greek history, and it is known that some drugs were produced and exported in Anatolia during the Hittite period. Today, it is reported that the number of

plants used in the world is around 20,000, 4000 of them are widely used and about 400 of them are traded (12). Throughout human history, many diseases have been and are being treated by using plants. According to World Health Organization (WHO) data, 80% of the world population is treated with herbal medicines (13).

Generally, studies on herbs have been conducted on adults; however, there are no studies in the literature on which herbs mothers use for themselves, which herbal alternative treatment methods are preferred for health problems encountered in infants such as milk enhancer, sedative, respiratory tract infections. This study was conducted to determine the knowledge and practices of mothers with infants aged 0-2 years about infant nutrition, the importance of breastfeeding and the use of herbs by mothers.

Methods

Research Place, Time and Sample Selection

The research was conducted in the baby library in Karabük Zübeyde Hanım Provincial Public Library. The sample of the study consisted of 121 mothers with children between the ages of 0-2, who did not have problems in speaking and understanding Turkish. The number of volunteers participating in the study was determined according to the results of Power analysis (Type I error: 0.05, type II error: 0.20 and the power of the study was accepted as 0.80 and above). The individuals constituting the study group were included in the study after their informed consent was obtained by explaining the purpose and benefits of the study and their roles in the study, paying attention to the principle of volunteerism.

Data Collection

A questionnaire form consisting of multiple-choice and open-ended questions was applied to determine the demographic and personal characteristics of the women who would participate in the study. The questionnaire form included 35 questions about the sociodemographic characteristics of the study group, the mother's knowledge about infant feeding, the infant's disease status and the evaluation of herbal product use. Mothers with infants aged 0-2 years, who were able to understand and speak Turkish, who voluntarily agreed to participate in the study, and mothers who used herbal products in the last 6 months were included in the study. Mothers with chronic diseases, those with premature infants and those who completed the questionnaire incompletely were excluded from the study. In addition, mothers who received

pharmacological treatment during gestation were not included in the study.

Ethics committee approval dated 06/05/2024 (Decision No: 2024/05/ 51) was obtained from Karabük University, Social and Human Sciences Research Ethics Committee for the study. Before the study, the participants were informed about the study and voluntary individuals who agreed to participate in the study were included in the study by signing the "Informed Consent Form". The study was conducted in accordance with the principles of the Declaration of Helsinki. Participant confidentiality and data protection measures are detailed in order to increase ethical transparency. All data of the participants were anonymised and their personal information was stored in an encrypted database. Mothers participating in the study were informed about the possible risks of herbal products. In particular, explanations were made about the safety problems, possible side effects and drug interactions of herbal products and they were advised to consult health professionals. This information process was emphasised in the interviews conducted both before and after the survey.

Data Analysis

The suitability of the data for normal distribution was evaluated by Kolmogorov-Smirnov test. Student t-test

was used for normally distributed variables and Mann-Whitney U test was used for non-normally distributed variables. ANOVA test was preferred for intergroup comparisons because the means of three or more groups were compared. Chi-square test was used to evaluate the relationship between categorical data. For example, a significant relationship was found between herbal product use and education level ($\chi^2 = 9.21$, $p = 0.002$). Logistic regression analysis was applied for the dependent variable of herbal product use (yes/no). Maternal age ($p = 0.03$), educational level ($p = 0.01$) and socioeconomic status ($p = 0.02$) were found to be significant predictors.

Results

It was found that 71.9% of the mothers who participated in the study were between the ages of 25-34, 69.4% had an educational level of university or higher, 45.5% were civil servants, 92.6% lived in nuclear families, and 65.3% had 2 children. The mean age of the mothers was 35.15 ± 2.45 years (years), mean body weight was 69.0 ± 4.80 kg, mean height was 160.7 ± 6.65 cm, mean BMI was 26.9 ± 2.20 kg/m², 5.8% were underweight, 64.5% were normal, 25.6% were overweight and 4.1% were obese according to BMI class. The mean age of the babies was 21 ± 2.2 months, mean body weight was 11.5 ± 2.1 , mean height was 87.7 ± 2.65 cm, mean birth weight was 3.15 ± 0.60 kg, and mean birth length was 50.2 ± 2.45 cm (Table 1).

Table 1: Distribution of sociodemographic and anthropometric characteristics of mothers and infants

	n	%		n	%
Age			Anthropometric Characteristics of the Mother		
<18	5	4.1	BMI class		
18-24	25	20.7	<18.5 kg/m ² (underweight)	7	5,8
25-34	87	71.9	18.5-24.9 kg/m ² (normal)	78	64,5
35-44	4	3.3	25.0-29.9 kg/m ² (overweight)	31	25,6
Mother's education level			≥ 30 kg/m ² (obese)	5	4,1
Primary education	2	1.7			
High school and equivalent	35	28.9			
University and above	84	69.4			
Mother's occupation					
Housewife	25	20.7	Maternal BMI (kg/m ²)	26.9 \pm 2.20	
Officer	55	45.5	Age of mother (years)	35.15 \pm 2.45	
Academician	8	6.6	Maternal body weight (kg)	69.0 \pm 4.80	
Private sector	33	27.3	Maternal height (cm)	160.7 \pm 6.65	
Family type			Anthropometric Characteristics of the Child		
Nuclear family	112	92.6	Child's age (months)	21 \pm 2.2	
Extended family	9	7.4	Child's body weight (kg)	11.5 \pm 2.1	
Number of children in the family			Child's height (cm)	87.7 \pm 2.65	
1 child	33	27.3	Child's birth weight (kg)	3.15 \pm 0.60	
2 children	79	65.3	Child's birth height (cm)	50.2 \pm 2.45	
3 children	9	7.4			
Child gender					
Girl	73	60.3			
Male	48	39.7			

When information on infant feeding was examined in the study, it was found that 42.1% received breast milk and formula, 37.2% received only breast milk, 40.5% had a total breastfeeding period between 7-12 months, 43.8% had a bottle feeding period between 7-12 months, 53.7% started complementary feeding after the 6th month, and

86.8% received breast milk at night. Among the mothers, 53.7% thought that their babies were fed normally, 58.7% received information about breast milk and 53.7% received information about complementary feeding from healthcare professionals (Table 2).

Table 2: Distribution of information on infant feeding

	n	%		n	%
Type of infant feeding (First 6 months)			Mother's views on the baby's nutrition		
Breast milk only	45	37.2	Underfed	30	24.8
Only formula	11	9.1	Normal nutrition	65	53.7
Breast milk and formula	51	42.1	Overfeeding	26	21.5
Breast milk and complementary feeding	9	7.4	Breastfeeding status of the child at night		
Formula and complementary feeding	5	4.1	Yes	105	86.8
Total duration of breastfeeding of the child			No.	16	13.2
0-6 months	16	13.2	Source of information about breastfeeding		
7-12 months	49	40.5	Health workers	71	58.7
12-18 months	36	29.8	Relatives and Environment	5	4.1
>18 months	20	16.5	Written and visual media	45	37.2
Duration of bottle feeding (months)			Source of information on complementary nutrition		
0-6 months	35	28.9	Health workers	65	53.7
7-12 months	53	43.8	Relatives and Environment	12	9.9
>12 months	33	27.3	Written and visual media	44	36.4
Time to start complementary feeding					
<6 months	56	46.3			
≥6 months	65	53.7			

It was determined that 62% of the mothers preferred medical treatment, 19.8% preferred herbal treatment and 18.2% preferred both treatment methods. It was found that 38.8% of the babies had gas and bloating problems, 71.9% used herbal products in their babies, and 37.2% of them bought herbal products from the internet.

It was found that 48.8% of the mothers did not use herbal teas as milk enhancers, and those who preferred herbal teas frequently used galactagogue (33.9%), dill, malt

products (12.4%), and milk enhancer mixture teas (5%). It was found that 78.5% of the mothers did not use herbal products for insomnia/sedative, while those who preferred to use herbal products used chamomile (13.2%), jasmine (6.6%), St. John's wort (1.7%). It was found that 43% of the mothers used cumin and 37.2% used fennel for gas, bloating and constipation, 29.8% used a mixture of herbal products and 4.1% used olive oil, and 100% did not use herbal products for fever (Table 3).

Table 3: Evaluation of herbal product use in case of infant's illness

	n	%		n	%
Common Problems in Infants			Herbal Product Use as Milk Booster (Mother)		
Gas, Bloating	47	38.8	Not in use	59	48.8
Sleep	25	20.7	Galaktagog etc.	41	33.9
Fire	22	18.2	Dill, malt products	15	12.4
None of them	27	22.3	Milk-boosting blended teas	6	5.0
First Choice in Infant Illness			Insomnia / Herbal Product Use as a Sedative (Mother)		
Medical treatment	75	62.0	Not in use	95	78.5
Herbal treatment	24	19.8	Daisy	16	13.2
Both	22	18.2	St. John's Wort	2	1.7
First Choice in Individual Disease			Jasmine	8	6.6
Medical treatment	67	55.4	Gas Bloating Herbal Product Use in Constipation (Mom)		
Herbal treatment	19	15.7	Not in use	17	14.0
None of them	13	10.7	Linden	5	4.1
Both	22	18.2	Aniseed	2	1.7
Presence of Herbal Products Used in Infants			Fennel	45	37.2
Yes	87	71.9	Cumin	52	43.0
No.	34	28.1	Insomnia / Herbal Product Use as a Sedative (Baby)		
Place of Purchase of Herbal Products			Not in use	105	86.8
Pharmacy	18	14.9	Herbal product mixtures	16	13.2
Aktar	25	20.7	Gas Bloating Herbal Product Use in Constipation (Baby)		
Internet	45	37.2	Not in use	80	66.1
Market, market, etc.	21	17.4	Olive Oil	5	4.1
Own Collection	11	9.1	Herbal product mixtures	36	29.8
			Herbal Product Use in High Fever		
			Yes	0	0
			No.	121	100

A statistically significant relationship was found between the educational level of the mothers and the presence of herbal products used in infants, and it was found that the use of herbal products increased as the educational level increased ($p = 0.043$, OR = 1.75, 95% GA: 1.12–2.74). Herbal product use was more prevalent among mothers with a university degree ($p = 0.01$, Cohen's $d = 0.65$), indicating a moderate effect size. There was no statistically significant relationship between the gender of the baby and the use of herbal products ($p > 0.05$). A statistically significant relationship was found between the age of the

mother and the presence of herbal products ($p < 0.05$). as the age range increased, the use of herbal products increased. There was no statistically significant relationship between the mother's occupation and herbal product use ($p > 0.05$). A statistically significant relationship was found between the number of children in the family and herbal product use ($p < 0.05$). It was found that herbal product use increased in families with two children. A statistically highly significant relationship was found between the mother's BMI classification and herbal product use. Herbal product use was higher in mothers with normal BMI ($p =$

0.02, OR = 2.10, 95% CI: 1.25-3.45). There was a significant difference in herbal product use between overweight and normal weight mothers ($p = 0.035$, Cohen's $d = 0.48$), indicating a small to moderate effect. There was no statistically significant relationship between the type of nutrition of the infant in the first 6 months and herbal product use

($p > 0.05$). A statistically significant association was found between breastfeeding duration and herbal product use ($p = 0.038$, OR = 1.60, 95% CI: 1.05-2.45). Mothers breastfeeding longer than 18 months had a higher rate of herbal product use ($p < 0.01$, Cohen's $d = 0.72$), indicating a strong effect (Table 4).

Table 4: Anova and t test results of herbal products used in infants and mother's sociodemographic characteristics

		Presence of Herbal Products Used in Infants		p
		Yes	No.	
Age		n	n	p=0.043
	<18	2	3	
	18-24	17	8	
	25-34	66	21	
	35-44	2	2	
Mother's education level	Primary education	2	0	p=0.05
	High school and equivalent	30	5	
	University and above	55	29	
Mother's occupation	Housewife	20	5	p=0.386
	Officer	34	21	
	Academician	6	2	
	Private sector	27	6	
Baby gender	Girl	54	19	p=0.105
	Male	33	15	
Number of children in the family	1 child	14	19	p=0.000
	2 children	66	13	
	3 children	7	2	
Maternal BMI classification	<18.5 kg/m ²	5	2	p=0.000
	18.5-24.9 kg/m ²	53	25	
	25.0-29.9 kg/m ²	25	6	
	≥30 kg/m ²	4	1	
Type of infant feeding (first 6 months)	Breast milk only	33	12	p=0.214
	Only formula	5	6	
	Breast milk and formula	39	12	
	Breast milk and complementary feeding	5	4	
	Formula and complementary feeding	5	0	
Total duration of breastfeeding of the child	0-6 months	14	2	p=0.038
	7-12 months	40	9	
	12-18 months	23	13	
	>18 months	10	10	

Maternal education level (OR = 2.15, $p = 0.01$), socioeconomic status (OR = 1.85, $p = 0.03$) and health literacy (OR = 1.45, $p = 0.02$) significantly affected herbal product use. Regression analysis showed that there was a positive relationship between mother's education level and herbal product use ($\beta = 0.27$, $p = 0.004$), indicating that the probability of use increased with increasing education.

Increasing the number of children in the family was found to be an important factor affecting herbal product use (OR = 1.75, $p = 0.005$, 95% CI: 1.20-2.55). Herbal product use was higher in mothers with two or more children ($\beta = 0.35$, $p = 0.001$). No significant association was found with herbal product use in mothers with high BMI (≥ 25 kg/m²) ($p = 0.210$).

Table 5: Multivariate Logistic Regression Analysis of Factors Affecting Herbal Product Use

Variable	B (Beta Coefficient)	Standard Error (SE)	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Maternal Education (University and above)	0.765	0.295	2.15	1.25 – 3.68	0.010*
Maternal Age (≥ 30 years)	0.430	0.210	1.54	1.02 – 2.32	0.040*
Socioeconomic Status (Medium/High)	0.615	0.278	1.85	1.12 – 3.05	0.030*
Number of Children (≥ 2 children)	0.560	0.180	1.75	1.20 – 2.55	0.005**
Breastfeeding Duration (> 12 months)	0.320	0.150	1.38	1.05 – 1.95	0.045*
Maternal BMI (≥ 25 kg/m ²)	-0.270	0.190	0.76	0.51 – 1.14	0.210

* $p < 0.05$, statistically significant. ** $p < 0.01$, highly significant.

Discussion

This study was conducted to determine the level of mothers with babies aged 0-2 years of breast milk, the time of switching to complementary feeding and the use of herbs in the problems they encounter in their babies. The data obtained in this study are important in terms of raising awareness of mothers in terms of eliminating their lack of knowledge and changing wrong attitudes and behaviors.

Breast milk is the most suitable food for infants because its content varies according to the needs of the newborn, it has protective properties against infections, it meets the physiological and psychosocial needs of the infant alone for the first 4-6 months and it is economical. In Turkey, especially primary health care institutions and health workers are the most appropriate source to meet the information needs of mothers on breastfeeding and infant nutrition (5). In a study conducted with 536 participants in Turkey, the rate of infants who received exclusive breastfeeding for the first 6 months was 44.5%, while it was 24.9% in the United States (14,15). WHO reported the rate of exclusive breastfeeding in the first 6 months as 44% in the world (3). In studies, it has been found that the source of information about breast milk and complementary feeding is often health personnel (16-18). In this study, 37.2% of the mothers who were exclusively breastfed for the first 6 months and 53.7% of the mothers who started complementary feeding after the 6th month were

found to be 37.2% and it was observed that the mothers received information about infant feeding mainly from healthcare professionals. The duration of breastfeeding is below the rates in the world and in our country. This may be due to the small number of participants and the ineffectiveness of the trainings given to mothers within the scope of breast milk promotion and baby-friendly health facilities program.

There are studies in the literature on giving extras such as herbal products and galactagogues to breastfeeding mothers through changing pharmaceutical, nutritional and behavioral strategies in breast milk production (19,20). In a study conducted with 1294 adult women in the USA, 57.5% of the participants reported using galactagogues, 27.7% herbal supplements, and 1.4% medication to increase breast milk (21). In a study conducted with 1876 people in Australia, it was determined that 19% of the participants used galactagogue-containing products; the use of such products was significantly higher in women who gave birth prematurely, gave birth by cesarean section, thought that milk production was low and applied to a lactation consultant (20). Herbal products such as chamomile, pasiflora, valerian, jasmine, which are known for their insomnia and sedative effects, are also frequently used in the literature (22,23). In this study, it was observed that mothers frequently used galactagogue, dill, malt products, milk-enhancing mixture teas as milk enhancers; those who preferred herbal products for insomnia/sedatives frequently used chamomile, jasmine, St. John's wort;

those who preferred herbal products for gas, bloating and constipation frequently used cumin, fennel, herbal product mixture in the baby and olive oil. It can be said that the products used are in parallel with the herbal products in the literature.

Herbal treatments are shaped by traditional and cultural beliefs in many societies. Most mothers have a traditional belief that herbal products are harmless and natural (24). However, scientific data do not always support these beliefs. For example, there are conflicting findings about the effectiveness of galactagogues used by mothers as milk enhancers (25). While some studies claim that these herbs can increase milk production, others have not shown any significant effect (26). Recent systematic reviews and meta-analyses suggest that herbal products may provide favourable effects in some situations, but these effects are often supported by limited evidence (24,27). For example, although herbs such as fennel and cumin have been suggested to alleviate flatulence problems, there is insufficient evidence for their long-term effects (28). In addition, some studies have reported that herbal products only show a placebo effect (29).

Although the efficacy of many herbal therapies is not yet fully scientifically proven, their use in the treatment of illness or to reduce symptoms is rapidly increasing worldwide. In a study conducted in Australia with 810 women (n=354 pregnant; n=456 breastfeeding), it was reported that most of the women used herbal supplements and felt that they were useful in protecting and improving their health and that of their babies, but that they preferred the medicines prescribed by doctors/pharmacists when they were ill (24). In a meta-analysis study conducted in Indonesia, it was reported that breastfeeding mothers with higher education level, working life and normal weight had better health literacy; they were often active in seeking additional health methods and were more prone to use herbal products (28). In this study, it was determined that mothers primarily preferred medical treatment and then herbal treatment as treatment methods. It was found that babies frequently had gas and bloating problems, 71.9% of the mothers used herbal products in their babies, and frequently bought herbal products from the internet. There was a statistical relationship between sociodemographic characteristics such as education level, age range, number of children in the family, BMI of the mother, duration of breastfeeding and herbal product use.

This study assessed mothers' tendencies towards the use of herbal products in their infants and the potential benefits and risks of such use. It was observed that mothers' trust in herbal products is supported by cultural and traditional beliefs, but scientific evidence does not always confirm these beliefs. It is of great importance that health professionals raise awareness among mothers about the safe use of herbal products and promote evidence-based breastfeeding practices. Future more comprehensive and longitudinal studies will provide a clearer picture of the long-term effects of herbal products on infant health. This study has some limitations. Firstly, since the study has a cross-sectional design, it is not possible to establish a cause-effect relationship. In addition, the sample was limited to mothers living in Karabük province and the generalisability of the results to a wider population is limited. Long-term effects related to the use of herbal products could not be evaluated. In future studies, the effects of herbal products on infant health should be examined more comprehensively by conducting longitudinal studies with larger samples.

Conclusion

This study assessed breastfeeding women's knowledge and beliefs about breast milk, breastfeeding and herbal products. Findings suggest that scientific evidence on the efficacy and safety of herbal products is limited, but mothers have high confidence in these products. This may delay seeking professional health care and negatively affect effective breastfeeding. Health professionals should raise awareness of mothers about the safe use of herbal products, provide counselling based on scientific data and adopt a supportive approach to the difficulties encountered during breastfeeding. In addition, awareness-raising trainings and information campaigns on breastfeeding and complementary nutrition should be organised within the scope of public health interventions.

Declarations

Funding

No financial support was received for this research.

Conflict of Interest

There is no conflict of interest between the authors of the study.

Ethics approval

Ethics committee approval dated 06/05/2024 (Decision No: 2024/05/ 51) was obtained from Karabük University, Social and Human Sciences Research Ethics Committee for the study.

Author Contributions

ŞC and BE performed the research, analyzed the data, and wrote the paper; HDG conceived of and designed the overall study.

Availability of data and materials

All data have been presented here. Material may be available upon request.

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Determining the awareness of university students regarding carbon footprint

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ABSTRACT

Purpose: This study aimed to examine the behaviors of university students regarding their carbon footprint in their daily lives in the areas of home, shopping, transportation and food consumption.

Methods: This cross-sectional descriptive study was conducted at Yozgat Bozok University in the Spring Semester of the 2022-2023 Academic Year. The sample of the study consisted of 164 students studying at the Faculty of Health Sciences, Engineering and Communication at Yozgat Bozok University in the spring semester of the 2022-2023 academic year. The data for the study were obtained through a personal information form and a carbon footprint awareness survey administered online. Numbers and percentages were used in the analysis of demographic data, and the Chi-Square test was used in comparative analyses. The significance level in statistical tests was accepted as $p < 0.05$.

Findings: According to the research results, it was determined that female students and students studying in the field of social sciences had a more positive tendency in terms of carbon footprint awareness, while health sciences students exhibited a more negative tendency.

Conclusion: As a result of the research, it is recommended that studies be carried out to develop students' environmental awareness, especially to increase their awareness about carbon footprint.

Keywords: Carbon footprint, awareness, students, environment.

ÖZET

Amaç: Bu araştırma, üniversite öğrencilerinin günlük yaşamlarında ev, alışveriş, ulaşım ve gıda tüketimi alanlarındaki karbon ayak iziyle ilgili davranışlarını incelemeyi amaçlamıştır.

Gereç ve Yöntem: Kesitsel tanımlayıcı tipteki bu araştırma, 2022-2023 akademik yılı bahar döneminde Yozgat Bozok Üniversitesi'nde yapılmıştır. Araştırmanın örneklemi, 2022-2023 akademik yılı bahar döneminde Yozgat Bozok Üniversitesi sağlık bilimleri, mühendislik ve iletişim fakültesinde öğrenim gören 164 öğrenciden oluşmuştur. Araştırmanın verileri, online olarak uygulanan, kişisel bilgi formu ve karbon ayak izi farkındalık anketi ile elde edilmiştir. Demografik verilerin analizinde sayı ve yüzdeler, karşılaştırmalı analizlerde ise Ki-Kare testi kullanıldı. İstatistiksel testlerde anlamlılık düzeyi $p < 0,05$ olarak kabul edildi.

Bulgular: Araştırma sonuçlarına göre, kadın öğrencilerin ve sosyal bilimler alanında öğrenim gören öğrencilerin karbon ayak izi farkındalığı açısından daha olumlu bir eğilime sahip olduğu, sağlık bilimleri öğrencilerinin ise daha olumsuz bir eğilim sergilediği belirlenmiştir.

Sonuç: Araştırma sonucunda, öğrencilerin çevre bilincinin geliştirilmesi, özellikle karbon ayak izi konusunda farkındalıklarının artırılması için çalışmalar yapılması önerilmektedir.

Anahtar kelimeler: Karbon ayak izi, karbon ayak izi farkındalığı, üniversite öğrencisi, çevre.

Factors such as urbanization, population growth, developing technologies, industry and the development of the industrial sector also bring environmental pollution problems to the agenda. It is known that environmental pollution is an important problem that threatens the whole world today and that the environmental resources with which people interact are not unlimited (1-3).

Carbon footprint assessments are carried out to determine the effects of human activities on the environment, such as how much nature is used, how resources are consumed, etc. There are multiple definitions of carbon footprint in the literature. Carbon footprint is defined as the biological productive area needed to limit carbon dioxide (CO₂) released into the atmosphere as a result of human activities (4). Carbon footprint constitutes the majority of the ecological footprints left behind as a result of production and consumption activities. The amount of people's share in global warming and the amount of carbon produced as a result of production and consumption in activities such as eating, drinking, transportation and heating also determine the carbon footprint value. Carbon footprint also expresses the proportion of greenhouse gases released into nature from a person, an institution or any product in the general total (5,6).

Due to the increasing population, consumption habits are increasing and harming the environment. In this context, carbon footprint calculations are made to draw attention to the different dimensions of ecological destruction in order to raise environmental awareness. For this reason, each individual in the society needs to review their individual consumption in order to contribute to the use of existing natural resources for today's needs, also defined as sustainability, but also to protect the resources for future generations and to create a safe and livable environment (7-11).

At the United Nations Conference on Environment and Development, it was stated that the two most important target groups for raising awareness on environmental issues are women and youth (12).

It is believed that determining the carbon footprint awareness of the young group, university students, will significantly contribute to their understanding of this concept, making them more aware of their environmental impact. This awareness can help eliminate or reduce negative approaches toward the environment, while reinforcing positive ones. In our country, studies on carbon footprint awareness and related trends among university students are limited (13-16).

This research aimed to examine the carbon footprint-related behaviors of university students in daily life in the areas of home, shopping, transportation and food consumption.

Material and Methods

Study Design: The research was conducted at Yozgat Bozok University in the Spring Term of the 2022-2023 Academic Year between April and June.

This study, which was conducted to examine the carbon footprint-related behaviors of university students, is descriptive and cross-sectional.

Study Population: During the spring semester of 2022-2023, there were 22,400 students studying at Yozgat University. A G Power analysis was conducted to determine the sample size for the research. According to the results of the research, which identified the awareness of Turkish consumers regarding their carbon footprint as part of the "Brands For Good" collective brand movement initiated by the Sustainable Brands (SB) global community in Turkey, it was found that 36% of the participants correctly identified their carbon footprint (17). In determining the sample size, this criterion was taken into account, and with an expected frequency of 36%, a margin of error of 5%, a confidence level of 95%, and a design effect of 3, the sample size was calculated to be 111. Three faculties representing health, social, and natural sciences were selected: the Faculty of Communication for social sciences, the Faculty of Engineering for natural sciences, and the Faculty of Health Sciences for health sciences. Accordingly, the sample size

was weighted by the number of students in each faculty, and the minimum number of students to be reached from each faculty was determined as follows: 42 students from the Faculty of Engineering, 61 students from the Faculty of Health Sciences, and 61 students from the Faculty of Communication. The research was completed with a total of 164 students.

Data Collection: The data of the research was obtained through “Personal Information Form” and “Carbon Footprint Survey”. The personal information form includes questions regarding the students’ age, gender and department of study. For the carbon footprint survey, a survey of 25 questions was prepared as a result of the literature review conducted by the researchers(13-17). The survey questions were sent to two academics who are experts in their fields and who contributed independently to the research and as a result of the feedback given, the survey questions were revised and a survey form with 14 questions was created regarding 4 areas: home, shopping, transportation and food consumption. The survey was prepared via Google form and conducted online. Before starting the survey, information about the study and a consent tab for participation in the study were added. This section asked for consent to participate in the study. Students in the relevant departments were reached through the administrators of the departments they were studying in..

Data Analysis: SPSS 21 statistical analysis package program was used to evaluate the data. Numbers and percentages were used in the analysis of demographic data, and the Chi-Square test was used in comparative analyses. In statistical tests, the significance level was accepted as $p < 0.05$.

Ethics Approval And Consent To Participate: Ethical approval for the research was received from Erzincan Binali Yıldırım University Human Research Health and Sports Sciences ethics committee dated 29/06/2022 and numbered E-88012460-050.01.04-184034. Permission was obtained from the administrators of the relevant departments (Faculty of Communication, Engineering and Health Sciences) within Yozgat Bozok University for

the research, and the participants were included in the research after accepting the informed consent text about the research in the online survey form. The principles of the Declaration of Helsinki were followed throughout the research.

Results

The students participating in the study were at least 18 and at most 22 years old, the average age was 19.1 ± 0.8 , and 76.8% were female. 37.2% of the students were studying health, 32.7% were studying social sciences, and 25.6% were studying science.

The rate of students who completely turned off electrical appliances after use was 29.3%, the rate of those who turned off lights when leaving the room was 84.8%, the rate of those who left devices such as phones and computers on charge for a long time was 47.6%, the rate of those who turned off electrical appliances etc. when they were not at home for a long time was 52.4%, and the rate of those who recycled items such as metal, plastic, glass or paper at home was 6.7%. The rate of those who mostly shop at a market close to where they live was 65.9%, the rate of those who pay attention to whether it is environmentally friendly when buying electrical appliances was 33.5%, the rate of those who pay attention to whether it is environmentally friendly when buying clothing, textiles and shoes, etc. was 31.7%, the rate of those who walk or bike to school was 67.1% and the rate of those who take an average of 3 or more flights per year was 7.9%. The rate of students who mostly consume red meat is 61.0%, the rate of those who mostly consume seasonal foods is 66.5%, the rate of those who mostly throw away leftover food is 45.1%, and the rate of students who say they recycle food packaging waste is 58.5%.

Table 1 shows the distribution of results regarding home, shopping, food and transportation.

Table 1: Frequency distribution of students' behaviors related to carbon footprint			
Variables	Response	n	%
Turning off electrical devices like TV, computer, etc., after use	Yes	48	29.3
	Sometimes	64	39.0
	No	52	31.7
Turning off lights when leaving the room	Yes	139	84.8
	Sometimes	16	9.8
	No	9	5.5
Leaving devices like phones and computers charging for a long time	Yes	78	47.6
	Sometimes	64	39.0
	No	22	13.4
Turning off heating systems like boilers when not home for a long time	Yes	86	52.4
	Sometimes	52	31.7
	No	26	15.9
Recycling items like metal, plastic, glass, or paper	Yes	11	6.7
	Sometimes	98	59.8
	No	55	33.5
Mainly shopping from	Local market	108	65.9
	Distant shopping mall	17	10.4
	Online market	39	23.8
Paying attention to whether electrical appliances are eco-friendly when buying	Yes	55	33.5
	Sometimes	73	44.5
	No	36	22.0
Paying attention to whether clothing, textiles, and shoes, etc., are eco-friendly when buying	Yes	52	31.7
	Sometimes	79	48.2
	No	33	20.1
Mode of transportation to school	Private car	6	3.7
	Shuttle bus	48	29.3
	Bicycle/Walking	110	67.1
Number of average airplane trips in a year	0	137	83.5
	1-2	14	8.5
	3+	13	7.9
General diet	Mostly vegetables and fruits	43	26.2
	Mostly red meat	100	61.0
	Equal amounts	21	12.8
Consuming foods in their season	Yes	109	66.5
	Sometimes	52	31.7
	No	3	1.8
Throwing away leftover food	Yes	74	45.1
	Sometimes	68	41.5
	No	22	13.4
Recycling food packaging waste	Yes	96	58.5
	Sometimes	51	31.1
	No	17	10.4
The average travel time by bus or shuttle in a week	At least 30 min	80	48.8
	30-60 min	44	26.9
	60+ min	40	24.4

87.7% of those who said "I sometimes pay attention to whether they are environmentally friendly or not" when purchasing electrical appliances in the shopping area were female students, and this rate is significantly higher than that of the male gender. Again, in the shopping area, clothing, textiles and shoes etc. 78.8% of those who said "yes, I pay attention to whether it is environmentally friendly or not" when purchasing were female students, and this rate is significantly higher than that of males.

100.0% of those who answered "sometimes" to the question of recycling food packaging waste in the field of food were female students, and this rate is significantly higher than that of male students.

There is no significant difference in comparison by gender with other questions regarding carbon footprint in all areas.

Table 2 shows the comparison of students' carbon footprint-related behaviors by gender.

Table 2: Comparison of students' behaviors related to carbon footprint by gender						
Variables		Male		Female		x ² * p
	Responses	n	%	n	%	
Turning off electrical devices like TV, computer, etc., after use	Yes	10	20.8	38	79.2	0,619 0,734
	Sometimes	14	21.9	50	78.1	
	No	14	26.9	38	73.1	
Turning off lights when leaving the room	Yes	35	25.2	104	74.8	2,893 0,235
	Sometimes	1	6.3	15	93.8	
	No	2	22.2	7	77.8	
Leaving devices like phones and computers charging for a long time	Yes	22	28.2	56	71.8	2,121 0,346
	Sometimes	12	18.8	52	81.3	
	No	4	18.2	18	81.8	
Turning off heating systems like boilers when not home for a long time	Yes	20	23.3	66	76.7	0,001 1,000
	Sometimes	12	23,1	40	76,9	
	No	6	23.1	20	76.9	
Recycling items like metal, plastic, glass, or paper	Yes	3	27.3	8	72.7	0,432 0,806
	Sometimes	21	21.4	77	78.6	
	No	14	25.5	41	74.5	
Mainly shopping from	Local market	24	22.2	84	77.8	3,748 0,154
	Distant shopping mall	7	41.2	10	58.8	
	Online market	7	17.9	32	82.1	
Paying attention to whether electrical appliances are eco-friendly when buying	Yes	23	41.8	32	58.2	16,419 0,000
	Sometimes	9	12.3	64	87.7	
	No	6	16.7	30	83.3	
Paying attention to whether clothing, textiles, and shoes, etc., are eco-friendly when buying	Yes	11	21.2	41	78.8	6,100 0,000
	Sometimes	24	30.4	55	69.6	
	No	3	23.2	30	76.8	
Mode of transportation to school	Private car	3	50.0	3	50.0	4,737 0,094
	Shuttle bus	7	14.6	41	85.4	
	Bicycle/Walking	28	25.5	82	74.5	
Number of average airplane trips in a year	0	28	20.4	109	79.6	10,094 0,006
	1-2	8	57.1	6	42.9	
	3+	2	15.4	11	84.6	
General diet	Mostly vegetables and fruits	9	20.9	34	79.1	1,502 0,472
	Mostly red meat	26	26.0	74	74.0	
	Equal amounts	3	14.3	18	85.7	
Consuming foods in their season	Yes	21	19.3	88	80.7	5,063 0,080
	Sometimes	15	28.8	37	71.2	
	No	2	66.7	1	33.3	
Throwing away leftover food	Yes	20	27.0	54	73.0	1,248 0,536
	Sometimes	13	19.1	55	80.9	
	No	5	22.7	17	77.3	
Recycling food packaging waste	Yes	31	32.3	65	67.7	22,963 0,000
	Sometimes	0	0.0	51	100.0	
	No	7	41.2	10	58.8	
Data are presented in numbers and percentages. Chi square test was used in comparisons.						

In the shopping area, 64.1% of the students who shopped at the virtual market were students studying in the science department and there was a significant difference compared to other departments. 41.8% of those who stated that they pay attention to whether they are environmentally friendly when purchasing electrical appliances were students studying in social sciences, and this rate is significantly higher than other departments. 100% of those who said no to the question of consuming seasonal foods were students

studying in health sciences, and there is a significant difference compared to other departments. 62.7% of those who answered yes to the question of throwing away leftover food were students studying in health sciences, and there is a significant difference compared to other departments. 58.3% of those who stated that they recycled food packaging waste in the field of food were students studying in social sciences, and there is a significant difference compared to other departments.

Table 3 shows the comparison of students' carbon footprint-related behaviors according to the department they study in.

Table 3: Comparison of students' behaviors related to carbon footprint by departments								
Variables n		Health		Science		Social		
		%	n	%	n	%	χ^2 p	
Turning off electrical devices like TV, computer, etc., after use	Yes	21	43.8	13	27.1	14	29.2	4,772 0,312
	Sometimes	23	35.9	19	29.7	22	34.4	
	No	17	32.7	10	19.2	25	48.1	
Turning off lights when leaving the room	Yes	52	37.4	34	24.5	53	38.1	4,822 0,306
	Sometimes	7	43.8	3	18.8	6	37.5	
	No	2	22.2	5	55.6	2	22.2	
Leaving devices like phones and computers charging for a long time	Yes	32	41.0	21	26.9	25	32.1	8,940 0,063
	Sometimes	18	28.1	14	21.9	32	50.0	
	No	11	50.0	7	31.8	4	18.2	
Turning off heating systems like boilers when not home for a long time	Yes	37	43.0	18	20.9	31	36.0	5,714 0,022
	Sometimes	19	36.5	14	26.9	19	36.5	
	No	5	19.2	10	38.5	11	42.3	
Recycling items like metal, plastic, glass, or paper	Yes	6	54.5	2	18.2	3	27.3	4,949 0,293
	Sometimes	30	30.6	27	27.6	41	41.8	
	No	25	45.5	13	23.6	17	30.9	
Mainly shopping from	Local market	54	50.0	28	25.9	26	24.1	20,503 0,000
	Distant shopping mall	1	5.9	8	47.1	8	47.1	
	Online market	6	15.4	25	64.1	8	20.5	
Paying attention to whether electrical appliances are eco-friendly when buying	Yes	14	25.5	18	32.7	23	41.8	17,758 0,000
	Sometimes	32	43.8	24	32.9	17	23.3	
	No	15	41.7	19	52.8	2	5.6	
Paying attention to whether clothing, textiles, and shoes, etc., are eco-friendly when buying	Yes	25	48.1	16	30.8	11	21.2	5,051 0,282
	Sometimes	25	31.6	34	43.0	20	25.3	
	No	11	33.3	11	33.3	11	33.3	
Mode of transportation to school	Private car	3	50.0	1	16.7	2	33.3	0,609 0,962
	Shuttle bus	18	37.5	13	27.1	17	35.4	
	Bicycle/Walking	40	36.4	28	25.5	42	38.2	
Number of average airplane trips in a year	0	46	33.6	36	26.3	55	40.1	4,5475 0,334
	1-2	8	57.1	4	28.6	2	14.3	
	3+	7	53.8	2	15.4	4	30.8	
General diet	Mostly vegetables and fruits	18	41.9	13	30.2	12	27.9	5,992 0,200
	Mostly red meat	38	38.0	37	37.0	25	25.0	
	Equal amounts	5	23.8	11	52.4	5	23.8	
Consuming foods in their season	Yes	49	45.0	36	33.0	24	22.0	3,274 0,513
	Sometimes	9	17.3	25	48.1	18	34.6	
	No	3	100	0	0.0	0	0.0	
Recycling food packaging waste	Yes	24	25.0	39	40.6	33	34.4	16,719 0,002
	Sometimes	32	62.7	16	31.4	3	5.9	
	No	5	29.4	6	35.3	6	35.3	
Throwing away leftover food	Yes	25	33.8	30	40.5	19	25.7	25,104 0,000
	Sometimes	20	29.4	10	14.7	38	55.9	
	No	16	72.7	2	9.0	4	18.3	
The average travel time by bus or shuttle in a week	At least 30 min.	36	45.0	19	23.8	25	31.3	13,659 0,000
	30-60 min.	12	27.3	12	27.3	20	45.5	
	60+ min	13	32.5	11	27.5	16	40.0	
Data are presented in numbers and percentages. Chi square test was used in comparisons.								

Discussion

The students participating in the study were at least 18 and at most 22 years old, the average age was 19.1 ± 0.8 , and 76.8% were female. 37.2% of the students were studying health, 32.7% were studying social sciences, and 25.6% were studying science.

In our research, more than half of the students (66.5%) stated that they consume seasonal foods. In a study conducted with university students, it was determined that the tendency to consume organic food was low (1). We think that this result obtained from our research is due to the fact that students know that consuming foods in season is a healthier and more environmentally friendly behavior, and that products sold in season are more affordable.

In our research, more than half of the students stated that they preferred a red meat-based diet (61.0%). Studies have shown that the majority of students consume red meat at a rate of 87.1% and 92.4% (11,18). Again, in the literature, studies conducted with university students have shown an increase in meat consumption (19). Our research revealed similar results to the literature in terms of red meat consumption. It suggests that the majority of students' tendency to consume red meat may be due to the fact that they frequently consume ready-made foods, especially fast food.

In our research, 29.3% of the students stated that they turned off electrical devices completely after use, and 31.7% stated that they sometimes turned them off. Again, the rate of those who turn off the lights when they leave the room was determined as 84.8%, the rate of those who leave their devices such as phones and computers on charge for a long time was determined as 47.6%, and the rate of those who turn off the lights when they are not at home for a long time was determined as 52.4%. In a study, more than half of the students stated that they turned off the combi boiler when they were not at home, did not leave the refrigerator door open for a long time, etc. results have been obtained (1). At this point, considering the common features of these questions in our research, they reveal behavioral patterns that indicate both environmental protection and economic savings. This result we obtained from our research may be due not only to students' environmentally friendly behavior but also to their thriftiness.

The percentage of students in our study who stated that they recycle household items such as metal, plastic, glass or paper was quite low (6.7%). Similar to our study, in Birand's (13) study examining ecological footprint tendencies and environmentally friendly behaviors, it was determined that the participants did not exhibit positive tendencies regarding recycling. Again, it was determined that more than half of the students participating in different studies did not pay attention to recycling and that the students were not active in recycling activities (20,21). Our research suggests that the reason why students do not exhibit a positive approach to recycling at the expected level is due to the fact that they do not have sufficient knowledge about recycling. In our research, 33.5% of the students buy electrical equipment, 31.7% buy clothing, textiles and shoes, etc. and they stated that when purchasing, they pay attention to whether it is environmentally friendly or not.

In Aslan et al. study on university students, students did not have sufficient knowledge about green marketing activities and were undecided about purchasing green products (22). In Koçoğlu et al. study, it was found that students receiving tourism education had a large It has been determined that the majority of them contribute to the protection of the environment by purchasing environmentally friendly products (23). This result obtained from our research suggests that students may not have sufficient awareness about purchasing environmentally friendly products, and that economic concerns may be prioritized in their product purchasing preferences. In our research, electrical appliances, clothing, textiles and shoes, etc. it has been determined that more than half of those who pay attention to whether it is environmentally friendly when purchasing and who express positive behavior in terms of recycling food packaging waste are female students, and that female students differ significantly from male students in all of these areas.

In a study conducted on carbon footprint among university students, it was found that female students had lower carbon footprints than males (24), and in another study (1), it was found that the average carbon footprint of women in food, energy and waste areas was significantly higher than the average of men, and that the ecological footprint of women was significantly higher than that of men in food, energy and waste areas.

It has been determined that awareness of environmental issues is higher than men, and women have a more positive environmental approach than men (1).

Environmental behaviors do not include a positive or negative judgment and represent the actions of individuals regarding the environment. Individuals' environmental behaviors can be environmentally friendly behaviors or the exact opposite. Environmentally friendly behaviors, on the other hand, refer to behaviors that individuals exhibit that will cause the least possible harm to nature (25). The term pro-environment or environmentally sensitive behaviors, which are used instead of environmentally friendly behavior, refers to behaviors that individuals exhibit in order to contribute to environmental sustainability. Examples of these include behaviors such as choosing recyclable products and taking them to recycling points, preventing unnecessary energy and water consumption, and supporting public opinion formation by participating in environmental awareness activities(26).Our research result supports the literature. The reason why female students have more positive approaches to environmental awareness and ecological footprint awareness is that in our society with a traditional family structure, women's primary duties are related to the home, especially food, waste, shopping, etc. We think this is related to daily activities.

It was determined that the rate of students who stated that they recycle food packaging waste and pay attention to whether they are environmentally friendly when purchasing electrical appliances is significantly higher among students studying in social sciences compared to other departments. This result obtained from the research may be due to the fact that the subjects included in the courses taught in the field of social sciences are effective in gaining positive behaviors regarding environmental education.

100% of those who said no to the question of consuming seasonal foods were students studying in health sciences, and there was a significant difference compared to other departments. 62.7% of those who answered yes to the question of throwing away leftover food were students studying in health sciences, and there was a significant difference compared to other departments. In Keleş et al. study (14), it was determined that food was the most effective in ecological footprint results, and in another study, it was determined that the highest carbon footprint values were in medical faculty students (24). Our research result supports the literature.

Conclusion

According to the results of the research, it was determined that female students and students studying in social sciences had a more positive tendency in terms of carbon footprint awareness, while students studying in health sciences had a more negative tendency. In line with the results obtained from the research, it is recommended that studies be conducted to increase the awareness of university students about environmental awareness in general and carbon footprint in particular.

Study limitations

The fact that the research was conducted with students at a single university is a limitation of our research.

Declarations

Funding

This study was not financially supported by any person or institution.

Conflict of interest

The authors declare that there is no conflict of interests

Ethics approval

Ethical approval for the research was received from Erzincan Binali Yıldırım University Human Research Health and Sports Sciences ethics committee dated 29/06/2022 and numbered E-88012460-050.01.04-184034.

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Availability of data and material

The datasets utilized and analyzed in this study are not publicly accessible due to privacy concerns regarding participant information. However, they can be obtained from the corresponding author upon reasonable request.

Authors' contributions

SG and TP conceived and designed the study. SG and TP were responsible for study implementation, data collection, and data management. SG and TP wrote the first draft of the report. Both authors contributed to, and approved, the final manuscript.

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Investigating the Usage of Motion Verbs in Parkinson's Disease

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ABSTRACT

Purpose: This study aimed to determine the quantity of motion verbs in Parkinson's Disease (PD) and their potential correlation with other parameters.

Methods: In this study, 20 participants diagnosed with Parkinson's disease (mean age 68.45±10.5; 14 males; 6 females) were included. They were recruited at the Maltepe University Hospital, Faculty of Medicine, Department of Neurology. Montreal Cognitive Assessment (MoCA), the pear film, and animated short videos were used as data collection tools.

Results: Among the participants, 60% were in the early stages of PD, and 40% were in the advanced stages, with educational backgrounds ranging from primary school to university. Statistical analysis showed no significant differences in the usage of verbs, motion verbs, and participles across PD stages, gender, or education levels ($p > 0.05$).

Conclusion: In this study, no significant difference was found in the use of motion verbs among individuals with PD. The literature suggests that motion verb impairments in PD patients are typically attributed to deficits in executive functions, and that motor cortex atrophy does not contribute to these impairments. As a result, there remains no consensus regarding the precise nature of language deficits in Parkinson's disease.

Keywords: Motion verbs; Parkinson's Disease; discourse.

ÖZET

Amaç: Bu çalışmanın amacı Parkinson Hastalığında (PH) hareket eylemlerinin niceliğini ve diğer parametrelerin hareket eylemleriyle potansiyel korelasyonunu belirlemektir.

Yöntemler: Bu çalışmaya, Parkinson hastalığı tanısı almış 20 katılımcı (ortalama yaş 68,45±10,5; 14 erkek; 6 kadın) dahil edilmiştir. Katılımcılar Maltepe Üniversitesi Tıp Fakültesi Nöroloji Anabilim Dalı'nda alınmıştır. Veri toplama aracı olarak Montreal Bilişsel Değerlendirme Ölçeği (MoCA), armut filmi ve hareketli kısa videolardan oluşan anlatılar kullanılmıştır.

Bulgular: Katılımcıların %60'ı PH erken evresinde, %40'ı ise ileri evresinde olup, eğitim düzeyleri ilkokuldan üniversiteye kadar çeşitlilik göstermiştir. Yapılan istatistiksel analizler, eylem, devinim eylemleri, eylemsi kullanımı açısından PH evreleri, cinsiyet ve eğitim düzeyleri arasında anlamlı bir fark olmadığını göstermiştir ($p > 0.05$).

Sonuç: Bu çalışmada, PH'li bireylerin devinim eylemlerinin kullanımında belirgin bir fark bulunamamıştır. Literatürde, PH hastalarında devinim eylem bozukluklarının genellikle yürütücü fonksiyonlardaki eksikliklerden kaynaklandığı ve motor korteks atrofisinin bu bozukluklara yol açmadığı ileri sürülmektedir. Sonuç olarak, Parkinson hastalarında dil bozukluklarının doğası hakkında net bir görüş birliği sağlanamamıştır.

Anahtar Kelimeler: Devinim eylemleri; Parkinson Hastalığı; anlatı.

Parkinson's disease (PD) is a chronic and progressive disorder marked by non-motor symptoms and linked to the degeneration of dopaminergic neurons in the substantia nigra (SN) (1). Risk factors include old age, genetic alterations, familial tendency, and chemical exposure (2). Both hereditary and environmental variables are thought to contribute to PD (3). The global prevalence of PD escalates with age, attaining 1903 cases per 100,000 for those over 80 years old (4). Parkinsonism syndromes arise from several etiological reasons, with idiopathic Parkinson's disease being the predominant kind, constituting around 80%, and its precise origin remains unidentified (5). The clinical manifestations of PD generally encompass both motor and non-motor symptoms, such as bradykinesia, rigidity, tremors, and a kyphotic posture. Repetitive motor actions become challenging in individuals due to stiffness and bradykinesia in their skeletal muscles (6). A substantial majority of persons with PD experience cognitive impairment, potentially impacting their thinking, reasoning, memory, language, and voice perception capabilities. When these challenges intensify to the extent of affecting daily functions, it is referred to as Parkinson's disease dementia (PDD) (7). In addition to prevalent mechanical speech abnormalities in PD patients, including dysarthria and hypophonia, deficits in morphosyntactic, semantic, and figurative language understanding have also been documented (8). Numerous studies have shown that PD, which impacts motor functions, also results in deficits in motor-related language. While linguistic impairments in PD are believed to arise from cognitive dysfunction, research indicates that such impairments can manifest irrespective of cognitive factors (9). Verb-specific impairments and the processing of motion-related words in patients with neurologically impaired motor reasoning skills are correlated with neural activity in brain regions associated with motor planning and execution involved presenting an action-naming task to PD patients to evaluate the accuracy of the motor-related semantic content of various verbs. The study revealed that PD had inferior performance on images with high motor content in comparison to those with low motor association. The performance of PD patients was negatively influenced by the degree of motor-related semantic content linked to each verb, providing significant insights into the relevance of brain regions involved in the planning and execution of movements for retrieving motor-related semantic content (10).

The identification of semantic-based verb deficits in Parkinson's disease remains a subject of debate. Herrera et

al. (10) reported that individuals with Parkinson's disease demonstrated greater difficulty in naming action verbs associated with high motor content compared to those with low motor content.

Deficits in verb processing have been identified through verb generation tasks. In a study by Peran et al. (11), individuals with Parkinson's disease were presented with either a verb or a noun and were asked to generate a semantically related verb and noun for each stimulus. Compared to the control group, PD participants demonstrated significant impairments in verb generation, regardless of whether the cue was a noun or a verb. In contrast, their performance in generating nouns was comparable to that of the controls. These findings suggest that verb deficits in Parkinson's disease are, at least in part, attributable to disruptions at the semantic level.

Motion events, a fundamental concept in cognitive linguistics, describe situations involving movement or location changes, often structured through elements such as figure (the moving entity), ground (the reference object), path (trajectory), and manner (the way motion occurs) (12). For instance, in the sentence "*The bird flew over the mountain*," 'the bird' is the figure, 'the mountain' is the ground, 'flew' encodes the manner of motion, and 'over' represents the path. These events are intricately tied to motion verbs, which encode the dynamic aspects of motion in language. The encoding of motion varies across languages, with satellite-framed languages like English often expressing the manner of motion in the verb and the path in additional elements, as seen in "*He ran into the building*," where *ran* indicates the manner and *into* marks the path. In contrast, verb-framed languages like Turkish predominantly encode path within the verb and use adjuncts to indicate manner, as in "*Adam köprüden koşarak geçti*" ("The man passed under the bridge by running"). This linguistic diversity not only influences how motion is conceptualized and described but also highlights the cognitive demands of processing motion verbs, which require the integration of motor, sensory, and linguistic information.

In the context of Parkinson's disease (PD), motion verbs hold particular significance due to the motor and cognitive impairments associated with the disorder. PD affects the neural mechanisms involved in motor planning and execution, which are crucial for retrieving and processing motion-related semantic content. By investigating motion verbs in PD, researchers can gain valuable insights

into the interplay between motor and linguistic systems, potentially informing both linguistic theory and clinical interventions.

Numerous research in the literature examine motion verbs, and Bertella et al. (13) found that patients with Parkinson's disease exhibited comparatively worse performance in naming action images relative to naming objects. Researchers found that Parkinson's patients had comparatively worse performance in action word creation, naming of action pictures, and verbal fluency compared to nouns (14). In the current study, the production of motion verbs in Turkish speaking PD was assessed by a new evaluation tool. This tool was used to assess motion verbs in Turkish (15). Our objective was to determine the amount of motion verbs produced in PD and the potential association with other parameters.

Materials and Methods

This is a cross-sectional descriptive study and it was aimed to determine the motion verb usage of Turkish speaking patients with PD. Ethical approval was acquired from Biruni University Clinical Studies Ethical Approval Center (Ethical approval number: 2015-KAEK-80-23-34).

Participants

In order to evaluate motion verbs, the research recruited 20 participants with PD (mean of age 68.45 ± 10.5 ; 14 men; 6 women). Participants' demographic information was presented in Table 1. The following variables were taken into account: age, gender, education level, Parkinson's disease diagnosis age, time since diagnosis, Parkinson's stage, and MoCA values. All participants were recruited at the Maltepe University Hospital, Faculty of Medicine, Neurology. All of the participants were diagnosed by one of the researchers of this study.

Table 1: Demographic Information

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Age		68,45±10,5	
Gender	Women	6	30%
	Men	14	70%
Age of Diagnosis		61,1±11,84	
Time passed since diagnosis		7,35±5,47	
PD Stage	Early	12	60%
	Late	8	40%
Stage	Tek	5	25%
	Çift	7	35%
	Postural	4	20%
	İleri	2	10%
	Tekerlek	2	10%
Education	Primary School	8	40%
	Middle School	1	5%
	High School	4	20%
	University	7	35%
MoCA	19,6±4,73		

The inclusion criteria were as follows:

- Diagnosed with Parkinson's disease,
- Being capable of completing the test,
- Aged between 30 and 85 years.

The exclusion criteria were as follows:

- Presence of secondary neurological disorders aside from Parkinson's disease
- Having a history of epilepsy, or concurrent severe psychiatric disorders.

Data Collection Tools

Demographic information on age, gender, occupation, co-occurring diseases, medications, and genetic family history was gathered from patients through a voluntary consent form, an informed consent form, and a demographic information form.

The Montreal Cognitive Assessment (MoCA): MoCA is a questionnaire designed to evaluate various cognitive functions and moderate cognitive impairment (16). The test's validity and reliability have been confirmed, with tested subcategories encompassing cognitive functions including memory, concentration, recall, language, abstract reasoning, orientation, computation, visuoconstructional skills, and executive functions. The highest attainable score on the test is 30, with scores of 21 or above signifying the absence of mild cognitive impairment (17). Our study employed the MoCA to evaluate cognitive impairment in persons with Parkinson's disease and to analyze their language performance in conjunction with other cognitive abilities.

Participants were presented with a brief film called The Pear film including a 5-minute narrative and were thereafter requested to recount the storyline and their interpretations upon its conclusion. Participants with Parkinson's disease were instructed to characterize the content of 35 animated videos (15). All narrations were recorded, transcribed, and evaluated to identify the verbs and all motion-related verbs utilized by each patient, which were subsequently reported in the study results.

The Pear Film (Movie Narration Task): The Pear Film, created by a team of scholars led by Prof. Wallace Chafe at the University of California, Berkeley, was designed to gather linguistic data from diverse languages worldwide (18). This silent movie, containing only natural background sounds and no dialogue, serves as a versatile elicitation tool applicable to any language. It was produced to explore how participants narrate and encode motion events in their language. In brief, the movie depicts a man harvesting pears, which are partially stolen by a boy riding a bike toward a pear tree. Along the way, the boy encounters a group of children and has some adventures with them. Meanwhile, the farmer eventually realizes his pears are missing, and the film concludes with this discovery. The purpose of this task is to examine how motion events are expressed in Turkish PD patients, focusing on the use of verbs in their narrations and to identify patterns in how participants encode spatial relations, especially via verbs and verbal expressions.

Assessment procedure: Participants watched the film individually and were asked to describe the movie. They provided verbal descriptions thereafter. The narratives were transcribed and analyzed for the production of motion verbs.

Short Animated Videos (Monitoring-Narration Task): This task is based on the 'Motion Verb Stimulus' developed by Bohnemeyer and Levinson (19) in the Language and Cognition research group at the Max Planck Institute for Psycholinguistics. It was designed to elicit linguistic descriptions of motion events by comparing them with other animations in the same set. The task features 35 brief (4-seconds each) 3D animations that are straightforward, easily replayable, and can be presented in different sequences for contrastive analysis. Each clip depicted dynamic scenes requiring participants to describe the motion of objects or figures. The purpose of this task was to complement the findings from the Pear Film by exploring participants' linguistic strategies in a controlled setting with distinct and focused motion events. It also aimed to observe consistency or variation in the encoding of motion events across different contexts and stimuli. An example of the videos researchers used were shown in Figure 1.

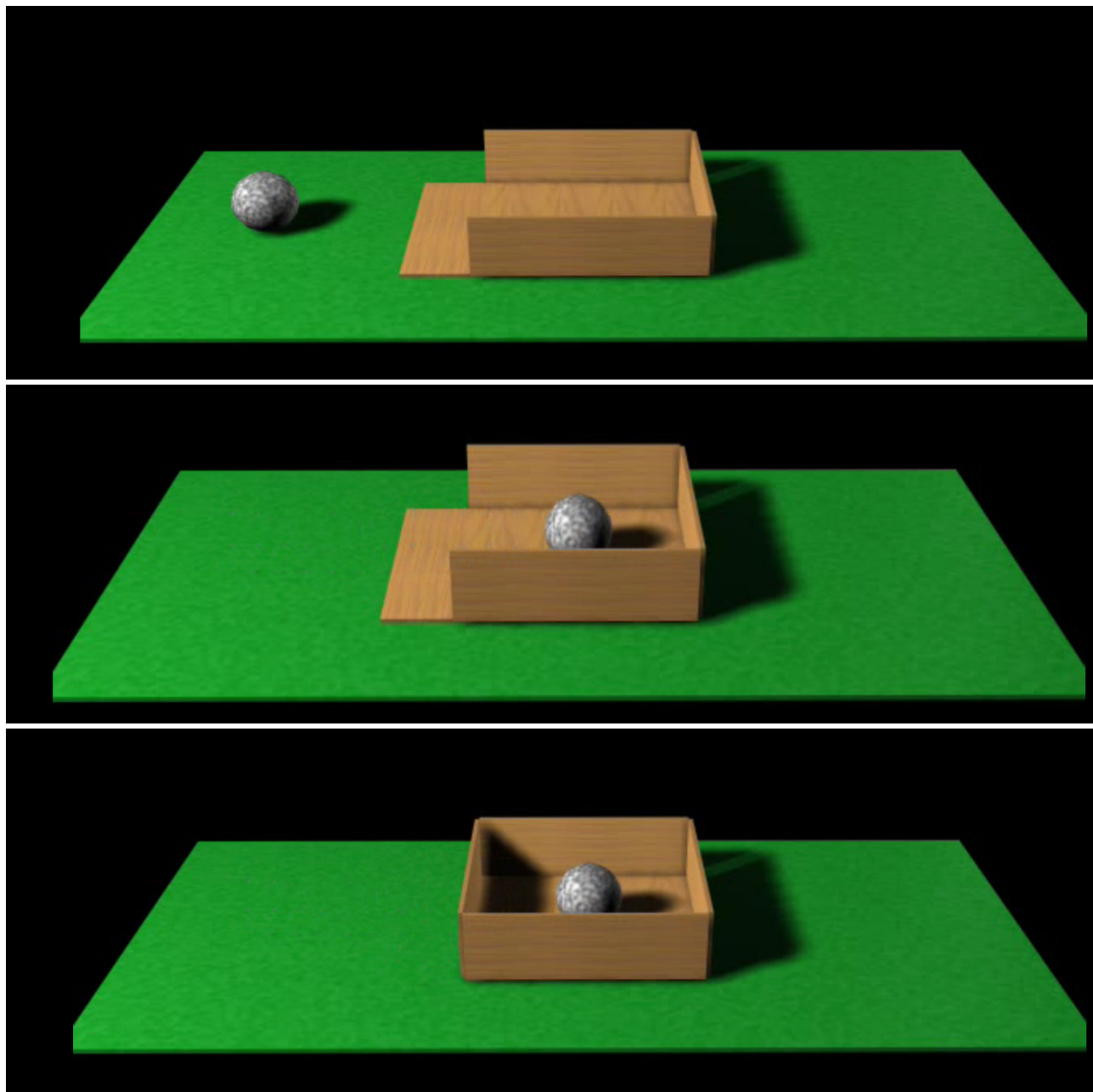


Figure 1: Excerpts from the video 5.

Assessment procedure: Participants viewed each animated clip and described what they saw. Their descriptions were recorded, transcribed, and analyzed for linguistic features similar to the Pear Film.

Results

The study included 6 female participants (30%) and 14 male participants (70%). The mean age of the participants

was 68.45 ± 10.5 years. The average age at Parkinson's disease (PD) diagnosis was 61.1 ± 11.84 years, and the mean duration since diagnosis was 7.35 ± 5.47 years. The stages of Parkinson's disease among the participants, categorized as early or advanced stages, are detailed in Table 1. Twelve participants (60%) were in the early stages of PD, while 8 participants (40%) were in the advanced stages.

When analyzed by PD stages, 5 participants (25%) were in stage 1, 7 participants (35%) in stage 2, 4 participants (20%) in stage 3, 2 participants (10%) in stage 4, and 2 participants (10%) in stage 5. The educational levels of the participants were as follows: 8 primary school graduates

(40%), 1 middle school graduate (5%), 4 high school graduates (20%), and 7 university graduates (35%). The mean Montreal Cognitive Assessment (MoCA) score of the participants was 19.6 ± 4.73 .

Table 2: Mean values, max and minimum scores.

	Mean (S.D)	Max	Min
Verb Number	14,80±5,19	8,00	24,00
Motion Number	7,75±3,47	0,00	14,00
Participle	2,8±2,85	0,00	10,00
Short Story Participle	9,95±10,04	0,00	38,00
Short Story Motion	28,6±3,69	20,00	35,00
Ratio	0,52±0,21	0,00	0,80

The usage of verbs, motion verbs and participles in short stories, as well as all ratios, mean values, and maximum-minimum scores, are presented in Table 2. The mean number of all verbs used was 14.80 ± 5.19 (max: 24, min: 8). The mean number of all motion verbs used was 7.75 ± 3.47 (max: 14, min: 0), while the mean number of all

participles was 2.8 ± 2.85 (max: 10, min: 0). In the short story narration, the mean number of participles used was 9.95 ± 10.04 (max: 38, min: 0), while the mean number of motion verbs used was 28.6 ± 3.69 (max: 35, min: 20). The overall group comparison ratio was 0.52 ± 0.21 (max: 0.8, min: 0), as detailed in Table 2.

Table 3: Variables Based on PD stage

Variable	Stage	N	Mean Rank	Summary of Ranks	U	p
Ratio	Early	12	10,17	122,00	44,000	,792
	Late	8	11,00	88,00		
Number of Verbs	Early	12	10,21	122,50	44,500	,792
	Late	8	10,94	87,50		
Number of Motion	Early	12	9,96	119,50	41,500	,624
	Late	8	11,31	119,50		
Participle	Early	12	12,17	146,00	28,000	,135
	Late	8	8,00	64,00		
Short Story Participle	Early	12	11,71	140,50	33,500	,270
	Late	8	8,69	69,50		
Short Story Motion	Early	12	9,46	113,50	35,500	,343
	Late	8	12,06	96,50		

The variables related to PD stages are outlined in Table 3. In participants with early-stage and advanced-stage PD, no significant correlation was observed in the ratios between the two groups ($p = 0.792$). When the total number of verbs used was examined, a value of $p = 0.792$ was obtained for the early stage. For motion verbs,

the early-stage value was $p = 0.624$, while the value for verbals was $p = 0.135$. The total number of verbals used in the short story narration by early-stage PD participants was $p = 0.270$, while the statistical ratio for motion verbs in the same narration was $p = 0.343$.

Table 4: Variables Based on Gender

Variable	Gender	N	Mean Rank	KruskalWallis	Sig.
Verb Number	Women	6	10,67	,007	0,934
	Men	14	10,43		
Motion Number	Women	6	12,17	,688	0,407
	Men	14	9,79		
Participle	Women	6	11,58	,297	0,585
	Men	14	10,04		
Short Story Participle	Women	6	7,17	2,746	0,098
	Men	14	11,93		
Short Story Motion	Women	6	10,92	,043	0,835
	Men	14	10,32		

Gender-related variables are presented in Table 4. The analysis of total verb usage ($p = 0.934$), motion verb usage ($p = 0.407$), and verbal usage ($p = 0.585$) revealed similar changes across groups, with no significant differences

in the overall statistics ($p > 0.05$). When examining the number of verbals ($p = 0.098$) and motion verbs ($p = 0.835$) used in short story narration, no significant differences were found between the two groups ($p > 0.05$).

Table 5: Variables Based on Education

Variable	Education	N	Mean Rank	KruskalWallis	Sig.
Verb Number	Primary	8	10,50	1,328	0,722
	Middle	1	17,00		
	High School	4	9,88		
	University	7	9,93		
Motion Number	Primary	8	11,38	1,357	0,716
	Middle	1	15,00		
	High School	4	10,63		
	University	7	8,79		
Participle	Primary	8	9,63	5,469	0,140
	Middle	1	19,00		
	High School	4	6,25		
	University	7	12,71		
Short Story Participle	Primary	8	9,31	1,969	0,579
	Middle	1	9,50		
	High School	4	8,75		
	University	7	13,00		
Short Story Motion	Primary	8	10,94	,138	0,987
	Middle	1	11,00		
	High School	4	10,63		
	University	7	9,86		

Education-related variables are detailed in Table 5. Among middle school graduates, the use of all verbs, motion verbs, and participles showed significant differences within the group compared to primary school, high school, and university graduates. However, these results were not statistically significant overall ($p > 0.05$). In short story narration, the number of verbs used was more significantly different within the university graduate group, while the number of motion verbs used was more significant within the middle school graduate group. However, these results were not statistically significant overall, and no superiority was observed between the groups ($p > 0.05$).

Discussion

The clinical signs of Parkinson's disease typically include both motor and non-motor symptoms, such as bradykinesia, rigidity, tremors, and a kyphotic posture. Repetitive motor acts become difficult for individuals due to rigidity and bradykinesia in their skeletal muscles (6). A significant majority of individuals with Parkinson's disease exhibit cognitive impairment, which may affect their thinking, reasoning, memory, language, and speech perception abilities (7). Verb-specific impairments and the processing of motion-related lexicon in patients with compromised motor reasoning abilities correlate with neural activity in brain regions linked to motor planning and execution, as assessed through an action-naming task administered to Parkinson's Disease patients to evaluate the precision of the motor-related semantic content of diverse verbs. The current study examined the usage of motion verbs in PD patients.

The correlation between action and the motor system is an intensively researched field of interest (20; 21). Research findings from neuromodulation, neuroimaging, and behavioral paradigms (both interference and facilitation) in healthy adults have prompted several scholars to assert that the motor system plays a role in the representation of physical action concepts (22; 23; 24). Researchers have utilized Parkinson's Disease (PD) as a model to investigate the disruption of the motor and language systems in relation to action concepts and verb processing (10; 25).

Deficits have been identified through verb generating activities. In Peran et al. (11), participants with Parkinson's Disease were presented with a verb or a noun and created a semantically relevant verb and noun for each stimulus. In comparison to controls, participants with Parkinson's disease exhibited deficits in verb generation

tasks, irrespective of whether the cue was a noun or a verb. Conversely, the performance of PD participants in producing nouns was comparable to that of the control group. This study indicates that verb deficits in Parkinson's disease partially stem from disturbances at the semantic level.

In both Herrera et al. (10) and Bocanegra et al. (25), participants with Parkinson's Disease exhibited greater impairment in naming action verbs with high motor content (e.g., dig) than those with low motor content (e.g., sleep). This finding indicates that persons with Parkinson's disease, even without identifiable cognitive impairment, are attuned to distinctions in movement features among action verbs. These investigations have been employed to validate grounded cognition theories. Nonetheless, the discovery of semantic-based verb deficits in Parkinson's Disease is controversial.

In our study, we were not able to find out a difference between the number of verbs and the number of motion verbs. Several studies have shown that verb impairments in Parkinson's Disease (PD) stem from deficits in executive function (26; 27) and contend that the absence of significant motor cortex atrophy renders it improbable that PD verb deficits are attributable to compromised motor schema representations (28). Consequently, ambiguity persists concerning the precise nature of PD word impairments.

Conclusion

Employing linguistic resources for the analysis of motion events is advantageous, and through experiments involving content abundant in motion, novel insights were revealed, highlighting the utilization of path and manner verbs in Turkish to articulate motion structures, further reinforced by subordinate clauses and case markers (15). The assessment utilized in this study was insufficient in capturing the challenges faced by Parkinson's disease patients in producing motion verbs. Therefore, it is crucial to develop a novel measurement instrument specifically designed to evaluate and characterize these difficulties in PD patients.

Limitations

This research has numerous limitations which must be noted. The sample size of the patient subgroups, particularly at varying levels of PD, was somewhat small.

Additionally, a control group was not included to form normative data. Furthermore, as the illness advances, further research should assess how the patients' language skills and neuroanatomical alterations correlate by using alternative assessment tools. Because this assessment method might be complicated for the target population.

Declarations

Authors Disclosure (Conflict of Interest) Statement

The authors do not declare any conflict of interest

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Ethics Approval

Ethical approval (2015-KAEK-80-23-34) was obtained from the ethical committee of Biruni University.

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The Role of Family: Effects on Adolescents' Body Image and Eating Attitudes

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ABSTRACT

Purpose: Adolescence is a critical period of physical, cognitive, and emotional changes, during which body image and eating attitudes are shaped. This study examines the relationship between family-related factors, body image, and eating attitudes among adolescents.

Methods: A cross-sectional study was conducted with 300 adolescents (133 girls, 167 boys) from three high schools in Bayburt, Türkiye. The data was obtained by researchers in classes under the supervision of teachers. Body image was assessed using the Body Cathexis and Self Scale, and eating attitudes were evaluated with the Eating Attitudes Test-26 (EAT-26). Family-related characteristics, including family type, parental education, and occupation, were collected through a structured questionnaire. Data analysis was performed using the SPSS package program (version 22.0).

Results: The mean Body Cathexis and Self Scale score was significantly higher in boys than girls ($p<0.05$), indicating more positive body image perception. EAT-26 scores showed that 19% of adolescents were at risk for disordered eating, with no significant gender differences ($p>0.05$). Family type ($p=0.009$), maternal mortality ($p=0.004$), and paternal occupation ($p=0.035$) were significantly associated with eating attitudes, whereas no significant relationship was found between family-related factors and body image ($p>0.05$).

Conclusion: Family structure and socioeconomic status influence adolescent eating attitudes, while body image appears less affected by family-related factors. Interventions targeting adolescent health should address family-based support, particularly for those experiencing maternal loss, and promote body image awareness programs, especially among girls. Future research should explore cultural and psychosocial influences on adolescent health behaviors.

Keywords: Adolescent; Body image; Disordered eating behaviour; Family.

ÖZET

Amaç: Ergenlik dönemi, beden imajı ve yeme tutumlarının şekillendiği fiziksel, bilişsel ve duygusal değişimlerin yaşandığı kritik bir dönemdir. Bu çalışma, ergenlerde aile ile ilişkili faktörler, beden imajı ve yeme tutumları arasındaki ilişkiyi incelemektedir.

Yöntem: Bayburt'taki üç lisede öğrenim gören 300 adolesan (133 kız, 167 erkek) ile kesitsel bir çalışma yürütülmüştür. Veriler araştırmacılar tarafından öğretmenlerin gözetiminde sınıflarda toplanmıştır. Beden imajı Vücut Algısı Ölçeği (VÄÖ), yeme tutumları ise Yeme Tutum Testi-26 (YTT-26) ile değerlendirilmiştir. Aile tipi, ebeveyn eğitimi ve mesleği gibi aile ile ilgili özellikler yapılandırılmış bir anket aracılığıyla toplanmıştır. Veri analizi SPSS paket (versiyon 22.0) programı kullanılarak yapılmıştır.

Bulgular: Ortalama VÄÖ puanı erkeklerde kızlara göre anlamlı olarak daha yüksektir ($p<0.05$) ve bu durum erkeklerde daha olumlu beden imajı algısına işaret etmektedir. YTT-26 puanı adolesanların %19'unun düzensiz yeme riski altında olduğunu ve cinsiyetler arasında anlamlı bir fark olmadığını göstermiştir ($p>0.05$). Aile tipi ($p=0.009$), anne ölüm oranı ($p=0.004$) ve baba mesleği ($p=0.035$) yeme tutumu ile anlamlı şekilde ilişkiliyken, aile ile ilgili faktörler ve beden imajı arasında anlamlı bir ilişki bulunmamıştır ($p>0.05$).

Sonuç: Aile yapısı ve sosyoekonomik durum ergenlerin yeme tutumlarını etkilerken, beden imajı aile ile ilgili faktörlerden daha az etkileniyor gibi görünmektedir. Ergen sağlığını hedefleyen müdahaleler, özellikle anne kaybı yaşayanlar için aile temelli desteği ele almalı ve özellikle kızlar arasında beden imajı farkındalık programlarını teşvik etmelidir. Gelecekteki araştırmalar ergenlerin sağlık davranışları üzerindeki kültürel ve psikososyal etkileri araştırmalıdır.

Anahtar Kelimeler: Adolesan; Aile; Beden imajı; Bozulmuş yeme davranışı.

Adolescence is a transition period in which physical, cognitive, emotional, and psychosocial changes occur, and the adulthood of an individual is shaped during that period (1). Along with these significant changes, body image, which expresses an individual's perceptions, thoughts and feelings about the appearance of their own body, is reformed under the influence of several factors such as physical appearance, social environment, personal experiences and cultural influences (2, 3). However, the evaluation of adolescents' body image might result in a misperception of their own body rather than its actual size and shape. Thus, dysfunctional evaluations of body image can affect eating attitudes and might cause disordered eating behaviour.

Body image dissatisfaction that develops during adolescence is associated with health factors such as depression, self-esteem and impaired eating behaviours (4-6). Similarly, eating attitudes, which include beliefs and behaviours about food and eating, change significantly during this period and are influenced by the complex interaction of individual, family and environmental factors (7, 8). Understanding the factors influencing these structures is important for identifying at-risk populations and implementing effective interventions since body image dissatisfaction and eating attitudes are critical in influencing adolescents' health behaviours. If the necessary measures cannot be taken, these disordered behaviours can negatively impact the quality of life by leading to insecurity in social relationships, social isolation and reduced participation in daily activities (9, 10).

Recent studies have intensely examined the role of family-related factors in shaping adolescents' body image and eating attitudes. As a result, family structure, parental education, and occupational status are considered the most important determinants that may contribute to developing health-related behaviours in adolescents (11, 12). Particularly, constituents of family structure, such as family type, parental loss and parents' socio-economic status, may influence adolescents' coping mechanisms, self-esteem, and eating behaviours. It has also been shown that negative comments and attitudes about the body in the family can lead to malnutrition during this period (13). Nevertheless, the results of the studies that examined family-related factors in the literature have been found to be inconsistent since the diversity of norms, expectations, and ideals regarding body image and eating attitudes are different in societies (11-13). These differences can especially lead to inconsistencies in the results of cross-cultural studies. Therefore, more research is required on how family structure, parental characteristics, and environmental factors are influenced in different cultural contexts.

Since cultural or demographic differences play an important role in forming body image and eating attitudes in adolescents, this study examined the relationship between family factors on adolescent body image and eating attitudes. The study findings will contribute to strategies that can be developed for school-based educational programmes, community health interventions, psychological support services, and cultural and socio-economic context-specific policies to promote all aspects of healthy development and prevent the onset of eating disorders in adolescents.

Material and Methods

Participants and Procedure

This cross-sectional study was conducted in Bayburt (Türkiye) with 300 adolescents (133 girls and 167 boys) in grades 9 to 12. Three government high schools in the city centre of Bayburt were chosen to apply the questionnaires. Participants approved a participant information statement, consent form, and questionnaires, followed by the approval of the Research Ethics Committee of Bayburt University (Ethical Approval number 320, date 09.10.2023). Participants were appointed according to the availability of the class in each school, and parental consent forms were conveyed to parents through students two days prior to data collection. If the parent approved the consent form, the adolescent consent form and questionnaires were supplied to the adolescents, and the participants filled out the forms. The data was obtained by researchers in classes under the supervision of teachers. Survey completion took 50 minutes with a maximum of 30 students per class. Furthermore, this study performed a power analysis with the G Power program to determine the sample size. The sample size was determined to be 264 with 95% power.

Measures

General information and familial characteristics were obtained by applying a personal information questionnaire, which researchers prepared. In this questionnaire, some background information such as age, weight, height, family type, the occupation of parents, and the education level of parents were obtained. In the study, Body mass Index (BMI) for age z score was obtained using the WHO Antro Plus application from height and body weight measurements. BMI classification used for according to the World Health Organization as follows.

Overweight: $>+1SD$ (equivalent to BMI 25 kg/m² at 19 years)

Obesity: $>+2SD$ (equivalent to BMI 30 kg/m² at 19 years)

Thinness: $<-2SD$

Severe thinness: $<-3SD$

Body image was measured using Body Cathexis and Self Scale. The Turkish validity and reliability of the scale was conducted (14, 15). This scale consists of 40 clauses aimed to measure the satisfaction of the different parts of the body. Respondents indicate the extent to which they are satisfied with their body parts using a 5-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied). Scores range between 40 to 200, and the cut-off point was determined as 135; scores <135 indicate lower dysfunctional body image.

The eating attitude was determined by the Eating Attitude Test 26 (EAT 26), which was revised from the original 40-item questionnaire. The Turkish validity and reliability of the scale was conducted (16, 17). This test consists of 26 items and three subscales, which are personal information (A, seven items), eating habits (B, 26 items), and eating behaviour (C, 5 items). Scale items are evaluated using the 6-point Likert-type scaling method (1=never, 2=rarely, 3=sometimes, 4=often, 5=usually, 6=always). The total score is achieved by counting the scores as follows: scores from 1 to 3 are recoded as 0, 4 is recoded as 1, 5 as 2, and 6 is recoded as 3. Total scores range from 0 to 78, and scores >20 indicate the eating attitude's deterioration.

Statistical analysis

The statistical analysis was carried out using the SPSS package program (version 22.0). The conformity of the variables to the normal distribution was examined using analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). The mean and standard deviation, and distribution range were calculated by descriptive analysis. Pearson's correlation analysis was used to find the correlation between the variables. P value below 0.05 was considered statistically significant.

Results

The study included 300 adolescents, 133 (44.3%) girls and 167 (55.7%) boys. The mean BMI of the adolescents participating in the study was 21.3 ± 3.4 kg/m², and the majority of participants had a BMI for age in the normal range (66.0%). The mean number of siblings of the adolescents was 3.3 ± 1.5 , and most had nuclear families (80.0%). The mother of 4 adolescents and the father of 8 adolescents were dead. Most mothers had completed primary education (36.6%), and most fathers had

completed secondary education (33.9%). The majority of mothers were housewives (83.4%) and the majority of fathers were self-employed (41.8%) (Table 1).

Table 1: General and Family-related Characteristics of Adolescents

General and Familial Characteristics	n (%)
Gender	
Girl	133 (44.3)
Boy	167 (55.7)
Total	300 (100)
Age	
13-14 years	47 (15.7)
15-16 years	166 (55.3)
17-18 years	87 (29.0)
BMI (kg/m²) (Mean \pmSD)	21.3 ± 3.4
BMI for age	
Severe thinness	7 (2.3)
Thinness	39 (13.0)
Normal	198 (66.0)
Overweight	45 (15.0)
Obesity	11 (3.7)
Family type	
Nuclear family	240 (80.0)
Extended family	49 (16.3)
Fragmented family	11 (3.7)
Number of siblings (Mean \pmSD)	3.3 ± 1.5
Mother information	
Dead	4 (1.3)
Alive	296 (98.7)
Mother's education level (n=296)	
Illiterate	7 (2.4)
Literate	10 (3.4)
Primary school graduate	108 (36.6)
Middle school graduate	68 (22.9)
High school graduate	64 (21.6)
University graduate	39 (13.1)
Mother's profession (n=296)	
Housewife	247 (83.4)
Public Officer	27 (9.2)
Laborer	11 (3.7)
Self-employment	11 (3.7)
Father information	
Dead	8 (2.7)
Alive	292 (97.3)
Father's education level (n=292)	
Illiterate	3 (1.1)
Literate	10 (3.4)
Primary school graduate	57 (19.5)
Middle school graduate	56 (19.2)
High school graduate	99 (33.9)
University graduate	67 (22.9)
Father's profession (n=292)	
Unemployed	8 (2.7)
Public Officer	88 (30.1)
Laborer	74 (25.3)
Self-employment	122 (41.8)

The mean of Body Cathexis and Self Scale Total Score was 154.9 ± 23.5 , and the statistical difference between boys and girls is significant ($p < 0.05$). According to the EAT-26 survey, 19.0% of adolescents had a score of 20 or above, and the score from this survey between girls and boys was not found to be statistically significant ($p > 0.05$) (Table 2).

The relationship between family-related factors and adolescents' eating attitudes is shown in Table 3. A statistically significant difference was found between family type ($p = 0.009$), maternal mortality status ($p = 0.004$), father's occupation ($p = 0.035$), and adolescents' eating attitude type. No significant difference was found between other family-related factors and eating attitudes ($p > 0.05$).

Table 2: Body Image and Eating Attitudes of Adolescents

	Gender		Total (n=300)	p
	Girls (n=133)	Boys (n=167)		
Body Cathexis and Self Scale Total Score (Mean \pm SD)	148.8 \pm 23.3	159.8 \pm 22.5	154.9 \pm 23.5	$p < 0.01^*$
Eating Attitudes Test (EAT-26) (Median (Min-max))	10.0 (0.0-58.0)	9.0(0.0-57.0)	9.0 (0.0-58.0)	0.52**
Eating Attitudes Test (EAT-26)	n (%)	n (%)	n (%)	
Normal	136 (43.6)	137 (56.4)	243 (81.0)	0.68***
Anorexia Nervosa	27 (47.4)	30 (52.6)	57 (19.0)	

Independent T test; **Mann Whitney U Test; * Chi-Square Test (Likelihood)
The significance level was considered as $p < 0.05$*

Table 3.: Comparison of Family-related Factors with Eating Attitudes

Family-related Factors	Eating Attitudes Test (EAT-26)			p*
	Normal	Anorexia Nervosa	Total	
Family type	n(%)	n(%)	n(%)	
Nuclear family	202 (84.2)	38(15.8)	240 (100)	0.009
Extended family	32 (65.3)	17 (34.7)	49 (100)	
Fragmented family	9 (81.8)	2 (18.2)	11 (100)	
Number of siblings (Median (min-max))	3.0 (1.0-12.0)	3.0(1.0-11.0)	3.0 (1.0-12.0)	0.51
Mother Information	n(%)	n(%)	n(%)	
Dead	1 (25.0)	3 (75.0)	4 (100)	0.004
Alive	242 (81.8)	54 (18.2)	296 (100)	
Mother's education level (n=296)				
Illiterate	6 (85.7)	1 (14.3)	7 (100)	0.12
Literate	8 (80.0)	2 (20.0)	10 (100)	
Primary school graduate	94 (87.0)	14 (13.0)	108 (100)	
Middle school graduate	48 (70.6)	20 (29.4)	68 (100)	
High school graduate	52 (81.3)	12 (18.7)	64 (100)	
University graduate	34 (87.2)	5 (12.8)	39 (100)	
Mother's profession (n=296)				
Housewife	203 (83.2)	44 (17.8)	247 (100)	0.88
Public Officer	22 (81.5)	5 (18.5)	27 (100)	
Laborer	8 (72.7)	3 (27.3)	11 (100)	
Self-employment	9 (81.8)	2 (18.2)	11(100)	
Father Information				
Dead	6 (75.0)	2 (25.0)	8(100)	0.66
Alive	237 (81.2)	55 (18.8)	292 (100)	
Father's education level (n=292)				
Illiterate	3 (100)	0 (0)	3(100)	0.38
Literate	9 (90.0)	1(10.0)	10 (100)	
Primary school graduate	51 (89.5)	6 (10.5)	57 (100)	
Middle school graduate	44 (78.6)	12 (21.4)	56 (100)	
High school graduate	76 (76.8)	23 (23.2)	99 (100)	
University graduate	54 (80.6)	13 (19.4)	67 (100)	
Father's profession (n=292)				
Unemployed	5 (62.5)	3 (37.5)	8 (100)	0.035
Public Officer	64 (72.7)	24 (27.3)	88 (100)	
Laborer	63 (85.1)	11 (14.9)	74 (100)	
Self-employment	105 (86.1)	17 (13.9)	122 (100)	

** Chi-Square Test (Pearson)
The significance level was considered as $p < 0.05$*

The relationship between family-related factors and adolescents' body image is shown in Table 4. No significant

difference was found between family-related factors and eating attitudes ($p>0.05$).

Table 4. Comparison of Family-related Factors with Body Image

Table 4. Comparison of Family-related Factors with Body Image		
Family-related Factors	Body Cathexis and Self Scale Total Score (Mean±SD)	p*
Family type		
Nuclear family	155.4±23.1	0.51
Extended family	154.4±24.7	
Fragmented family	147.1±27.1	
Number of siblings		
r	-0.044	
p**	0.22	
Mother Information		
Dead	154.8±23.3	0.41
Alive	164.5±38.1	
Mother's education level (n=296)		
Illiterate	158.4±17.8	0.97
Literate	154.8±29.7	
Primary school graduate	154.7±24.1	
Middle school graduate	157.0±23.6	
High school graduate	153.9±23.3	
University graduate	153.1±22.3	
Mother's profession (n=296)		
Housewife	155.0±23.9	0.69
Public Officer	157.7±21.8	
Laborer	146.8±14.2	
Self-employment	153.4±26.6	
Father Information		
Dead	154.6±23.4	0.20
Alive	167.2±25.5	
Father's education level (n=292)		
Illiterate	173.3±28.2	0.14
Literate	162.6±23.5	
Primary school graduate	152.1±22.3	
Middle school graduate	157.7±22.2	
High school graduate	153.6±25.9	
University graduate	155.0±21.4	
Father's profession(n=292)		
Unemployed	159.1±27.3	0.93
Public Officer	155.6±23.4	
Laborer	154.5±24.8	
Self-employment	154.3±22.6	
* One-Way Anova Test. **Pearson Correlation Test		

* One-Way Anova Test, **Pearson Correlation Test

Discussion

This study investigated adolescents' body image and eating attitudes and examined their associations with family-related factors. The results obtained from this study provided critical insights into these factors and their role in affecting adolescent health. It is known that a homogeneous distribution of the gender group in the sample is important for addressing gender-specific health needs. This study included a relatively balanced gender

distribution, which ensures the reflection of the results for both genders.

Given the potential for physiological, social, and psychological development to vary in adolescents, the sample comprised individuals in adolescence's early and middle stages. The reason for conducting the research in this age group is that the adolescent period, which is a transition period, is important for body image and eating attitudes (2,7). Focusing on early and middle adolescence

aims to provide a comprehensive understanding of developmental conditions and related factors during this transitional period. The mean BMI was 21.3 ± 3.4 kg/m², and the majority of the participants had BMI for age classified as normal. However, a significant proportion of adolescents were overweight, obese, underweight, and severely underweight. These results indicate the double burden of malnutrition in adolescents. These findings are also important for plans and policies that may be developed to control adolescent body weight and are a public health concern.

The majority of adolescents come from nuclear families, which is in line with the widespread use of the nuclear family structure in Türkiye with modernisation (18). The mean sibling number was determined as 3.3 ± 1.5 . It is thought that the number of siblings may be effective in shaping the economic and psychological problems experienced during this period by influencing factors such as the distribution of family resources, parental interest, and support structures. Studies have indicated that the number of siblings in a household can significantly affect adolescents' economic and psychological experiences by affecting parental attention, financial resource allocation, and emotional support. Furthermore, an increase in the number of siblings can lead to decreased parental support, such as time, money, and emotional energy, and potentially affect children's cognitive and emotional development, limiting access to nutritious foods and creating competition for parental attention, thus increasing stress levels among adolescents (19, 20). Fragmented families accounted for a small percentage, which may warrant further investigation into their impact on adolescent well-being.

Regarding parents' education status, the results correlate with the education level of Türkiye. In parallel with the increasing level of education in Türkiye as a result of national policies, the literacy rate in the sample is also found to be high, with a significant proportion of fathers and mothers having a university degree (21). Regarding occupation, the majority of mothers are housewives (83.4%), whereas fathers work in different professions such as self-employment or public officer (30.1%). This situation emphasises the traditional gender roles in society and shows that they contribute to the family income with different budgets. Concerning the parents' educational and professional profiles, it can be seen that the sample has a mixed socio-economic profile.

The study assessed body image and eating attitudes using the Body Cathexis and Self Scale and EAT-26. When the Body Cathexis and Self Scale Total scores were analysed by gender, it was found that boys had more positive body image than girls ($p < 0.05$). The literature suggests that girls are exposed to more social and cultural pressures (22, 23). Therefore, this situation is thought to affect adolescent girls' satisfaction with their body image. In contrast, no significant gender-related difference was observed for EAT-26 scores ($p > 0.05$). It was found that 19% of adolescents were at risk of anorexia nervosa, and there was no significant difference between genders. This finding emphasises the importance of addressing the eating attitudes of both genders in adolescents. However, in terms of gender, there is no difference in the EAT-26 score, and the significant differences in body image together suggest that although body dissatisfaction is more common in girls, this does not necessarily translate into higher rates of eating disorders compared to boys. This difference may reflect differences in coping mechanisms or social influences between the genders.

The study investigated the relationship between family-related factors and eating attitudes. The results revealed that family type, mother's mortality status, and father's profession were significantly related to eating attitudes. In contrast, other factors such as number of siblings, parental education level, and mother's profession were not significantly related. The statistical significance between family type and eating behaviour suggests that adolescents with large and fragmented families may have more unhealthy eating attitudes than those with nuclear families ($p = 0.009$). It is thought that adolescents' dietary habits, eating attitudes, and behaviours may deteriorate with the stressful environment and reduced parental support that may result from disrupting family integrity (11, 12). Similar to the literature, statistical significance was found between maternal mortality status and EAT-26 in this study ($p = 0.004$). It is believed that mothers have an important role in developing and maintaining healthy eating behaviours in their children. The literature has reported that maternal loss during adolescence can be a stressor that can trigger maladaptive coping mechanisms, including disordered eating behaviours, and is associated with an increased risk of developing depression, anxiety, and subsequent eating disorders (11, 12). The death of a mother can be a potential cause of an eating disorder. Therefore, psychosocial interventions are important to improve health-related factors in adolescents experiencing maternal loss.

It is worth noting that family-related factors have a multifaceted relationship with adolescents' eating attitudes. Previous studies pointed out that economic or emotional stress associated with parents' occupational status might affect adolescents' mental health and, consequently, their eating attitudes (24, 25). Similarly, parents' marital status, unemployment status, and duration of employment were found to be associated with the risk of suicidal ideation in children (26, 27). Another finding of this study is that there is a significant relationship between the father's occupation and eating attitudes. The prevalence of eating disorders was found to be higher among adolescents whose fathers were unemployed ($p=0.035$). On the contrary, no significant relationship was found between parental education level or the mother's occupation and adolescents' eating attitudes ($p>0.05$). These results reveal that in Turkish society, where a patriarchal social pattern is often observed, the effect of family structure on eating attitudes is more likely affected by the father's leadership role in the family, and this forms a strong family dynamic and economic basis. Therefore, family-based interventions aimed at promoting an optimal home environment in the community are thought to be important in the prevention of eating disorders in adolescents.

On the other hand, in terms of body image, the study's results indicated no statistically significant association between family-related factors and body image ($p > 0.05$). The lack of significant differences between family types ($p = 0.51$) suggests that structural differences in families, such as being part of a nuclear, extended, or fragmented family, do not play a critical role in shaping adolescents' perceptions of their bodies. Similarly, no significant correlation was observed between the number of siblings and body image ($r=-0.044$, $p=0.22$). Furthermore, no significant difference was found between parents' occupation and education level and adolescents' body image ($p > 0.05$). These findings suggest that qualitative aspects (e.g. family and sibling relationships) should be examined when assessing adolescent body image rather than quantitative data (e.g. family size or number of siblings). Moreover, although parental socioeconomic or educational factors are not determinants of adolescents' body image, according to results from this study, various influences still may primarily affect body image. Recent studies have shown that many conditions, such as social media, family pressure, social pressure, and depression, affect body image during adolescence (5, 28). Notably, there were no significant differences ($p > 0.05$) related to parental death status in the study. This finding suggests

that psychosocial effects due to parental loss may not translate directly into measurable differences in body image scores. It emphasises the limited role of family-related factors in adolescents' body image formation. It is suggested that plans and policies concerning body image that can be implemented may need to consider external influences, such as social media usage and peer relationships, rather than just considering family variables. Future research should investigate other psychosocial and cultural factors better to understand the complex development of body image during adolescence.

Limitations

There are some limitations to the study that need to be considered. Firstly, this study is a cross-sectional study. More large-scale longitudinal studies are needed to investigate the causal relationships of the findings. Furthermore, the study's cross-sectional nature may limit the generalisability of findings to other populations or regions. This study did not comprehensively examine other potential influences, such as peer relationships, media exposure, or mental health status on body image and eating attitudes, so these factors also need to be included in future research.

Conclusion

In conclusion, the study's results suggest that programmes should be developed to promote positive body image, especially among girl adolescents. In addition to this, considering the role of family in the development of adolescents, family-based studies should focus on healthy home environments that may reduce the risk of poor eating habits. Likewise, psychological and nutritional plans and interventions should also be planned to prevent eating disorders in adolescents who have experienced parental loss (especially the loss of the mother). On the other hand, the results showed that socioeconomic indicators such as parental occupation and education are important for studies of healthy eating behaviours in adolescents. Future studies are needed to explore these factors in the development of adolescents. Furthermore, this study designates the need for education and support programmes on adolescents' body image and healthy eating attitudes. Future research should also investigate the underlying factors, such as differences in cultural influences, peer dynamics, and social media use in the development of adolescent health.

Declarations

This manuscript has not previously been published elsewhere.

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Conflicts of interest

The authors declare that they have no conflict of interest.

Ethics approval

The study protocol obtained ethical approval from the Research Ethics Committee of Bayburt University (Ethical Approval number 320, date 09.10.2023).

Availability of data and material

The authors confirm that study data can be accessed if needed.

Authors' contributions

Conceptualization: ÖE, TE, AŞ

Data curation: ÖE, TE, AŞ

Formal analysis: ÖE

Funding acquisition: TE, AŞ

Methodology: ÖE, TE, AŞ

Project administration: TE, AŞ

Visualization: ÖE, TE, AŞ

Writing – original draft: ÖE, TE, AŞ

Writing – review & editing: ÖE, TE, AŞ

All authors reviewed, revised, and approved the final manuscript and made important intellectual contributions.

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Evaluation of Health System Performance with MULTIMOORA Method: OECD Countries

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ABSTRACT

Purpose: The aim of this study is to compare the health system performances of OECD countries in the light of certain health and socio-economic indicators and to make country performance rankings with the MULTIMOORA method.

Methods: Firstly, health and socio-economic indicators were determined for the performance evaluation comparisons of the countries through literature review. The data of the indicators were obtained from reliable databases and analysed by MULTIMOORA method, which is one of the multi-criteria decision-making methods.

Results: According to the results of the analyses, the countries with the highest health system performance among 38 OECD countries are Japan, Sweden, Norway, Denmark and Germany, while the countries with the lowest performance are Latvia, Costa Rica, Türkiye, Mexico and Colombia, respectively.

Conclusion: As a result, in countries with high health system performance, access, quality and comprehensiveness of health services are ensured. Per capita expenditures for the health system are quite high. In countries with low performance, the limited resources allocated to the health system cause the service coverage index to remain low. High out-of-pocket expenditures drive especially low-income groups away from health services. In this context, low-performing countries need to improve their health systems by learning from the health systems of high-performing countries and developing strategies to overcome existing deficiencies.

Keywords: Health System, Performance Evaluation, Management, Multi-Criteria Decision Making, OECD.

ÖZET

Amaç: Bu çalışmanın amacı, OECD ülkelerinin sağlık sistemi performanslarını belirli sağlık ve sosyo-ekonomik göstergeler ışığında karşılaştırarak MULTIMOORA yöntemi ile ülke performans sıralamalarını yapmaktır.

Metot: Öncelikle literatür taraması ile ülkelerin performans değerlendirme karşılaştırmalarının yapılabilmesi için sağlık ve sosyo-ekonomik göstergeler belirlenmiştir. Göstergelere ait veriler güvenilir veri tabanlarından elde edilerek; çok kriterli karar verme yöntemlerinden biri olan MULTIMOORA yöntemi ile analiz edilmiştir.

Bulgular: Analiz sonuçlarına göre 38 OECD ülkesi arasından sağlık sistemi performansı en yüksek olan ülkeler sırasıyla; Japonya, İsveç, Norveç, Danimarka ve Almanya olur iken; performansı en düşük olan ülkeler ise sırasıyla; Letonya, Kosta Rika, Türkiye, Meksika ve Kolombiya olarak tespit edilmiştir.

Sonuç: Sonuç olarak, sağlık sistemi performansı yüksek olan ülkelere sağlık hizmetlerine erişim, kalite ve kapsamlılık sağlanmıştır. Sağlık sistemi için yapılan kişi başına düşen harcamalar oldukça yüksektir. Performansı düşük olan ülkelere ise sağlık sistemine ayrılan kaynakların kısıtlı olması, hizmet kapsamı endeksinin düşük kalmasına neden olmaktadır. Cepten yapılan harcamaların yüksekliği, özellikle düşük gelir gruplarını sağlık hizmetlerinden uzaklaştırmaktadır. Bu bağlamda, düşük performanslı ülkelerin, yüksek performanslı ülke sağlık sistemlerinden öğrenim sağlayarak ve mevcut eksikliklerini giderecek stratejiler geliştirerek sağlık sistemlerini iyileştirmesi gerekmektedir.

Anahtar Kelimeler: Sağlık Sistemi, Performans Değerlendirme, Yönetim, Çok Kriterli Karar Verme, OECD.

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Evaluating health system performance is a critical process for improving the quality, accessibility and efficiency of health services. Performance measurements enable policy makers and managers to make data-driven decisions, which in turn enables more effective strategies for the delivery of health services (1). Indeed, evaluating health system performance against internationally comparable indicators allows countries to monitor progress, improve reforms and increase accountability within their health systems (2). The ability to analyze health system performance internationally by conducting broad assessments covering a variety of indicators also encourages collaboration and information sharing among countries. Such comparisons can stimulate efforts to improve the design and delivery of health services (3). Health system performance evaluations also play an important role in supporting evidence-based management and decision-making processes. Indeed, these evaluations create awareness of the efficiency and effectiveness of health service financing, resource allocation and service delivery, allowing policy makers to make evidence-based and rational choices to optimize health system performance (4).

Health systems are inherently complex and multidimensional structures. Therefore, it is insufficient to reduce performance measures to a single criterion and evaluate them accordingly. A comprehensive perspective through specific metrics is necessary to understand and evaluate the differences in health systems. Indeed, indicators included in studies in the literature provide a comprehensive framework for evaluating health outcomes, resource allocation, and the overall efficiency of health systems. Higher life expectancy is often associated with better access to health services, quality of care, and public health initiatives and supports (5). On the other hand, high maternal mortality rates may also be an indication of failures in health service delivery, including inadequate prenatal and postnatal care (6). Beyaztaş et al. (7) stated that infant mortality rate is an important indicator in determining the health levels of countries in international comparisons. Similarly, under-5 mortality rate is expressed as a valuable criterion in evaluating health system performance, as it is sensitive to changes in health policies and interventions (8). High out-of-pocket spending leads to inequalities in access to health services, disproportionately affecting low-income populations (9). On the other hand, it has been stated that countries with higher service coverage tend to have better health outcomes, including lower mortality rates among vulnerable populations (10). In

addition, countries with high income inequality generally experience worse health outcomes, and it has been emphasized that socioeconomic factors and health system performance are interconnected (11). Indeed, MULTIMOORA allows objective ranking of countries' health performance by considering multiple criteria. In this context, the aim of the study is to compare the health system performances of Organization for Economic Development and Cooperation (OECD) countries in light of certain health and socioeconomic indicators and to rank country performances using the Multi-Objective Optimization by Ratio Analysis plus Full Multiplicative Form (MULTIMOORA) method. This study is one of the rare studies that evaluates the health system performance of OECD countries using the MULTIMOORA method. Unlike the analyses generally conducted using methods such as TOPSIS and DEA in the literature, the holistic decision-making method used in this study provides more robust decision support by combining proportional, reference point and multiplier analyses.

Material and Methods

1.1. Design of the Study

This study was designed as a cross-sectional, quantitative and comparative research aiming to compare the health system performances of OECD countries in terms of certain indicators.

1.2. Data Collection

As a result of the literature review, life expectancy at birth, maternal mortality ratio, infant mortality rate, under-5 mortality rate, health expenditures to GDP ratio, out-of-pocket health expenditures ratio in total health expenditures, service coverage index and income inequality coefficient indicators were determined in order to compare the performance of country health systems. To ensure a balanced assessment, both outcome-based (e.g. mortality rates) and resource-based (e.g. healthcare expenditure) measures are included. Data on the indicators were obtained from reliable international databases such as OECD, World Health Organization (WHO) and World Bank (WB) for 38 OECD countries. The data collection phase was carried out by taking into account the latest available data of the countries for the relevant indicator. Details on the data are shown in Table 1.

Table 1: Health and Socio-economic Indicators and Data Sources Used in the Study

Indicator Name / Year	Indicator Code	Desirable Value	Data Source
Life Expectance at Birth (per year) (2023)	LEB	Max	OECD Data Explorer (12)
Maternal Mortality Ratio (per 100 000 live births) (2022)	MMR	Min	OECD Data Explorer (12)
Infant Mortality Rate (per 1000 live births) (2023)	IMR	Min	OECD Data Explorer (12)
Under-five mortality rate (per 1000 live births) (2022)	UFMR	Min	World Bank, Gender Data Portal (13)
Health expenditure (% of GDP) (2023)	HE	Max	OECD Data Explorer (12)
Out-of-pocket health expenditure (% of total expenditure on health) (2023)	OOP	Min	World Bank, DataBank (14)
Service Coverage Index (2023)	UHC	Max	WHO Data (15)
Income inequality (2022)	GINI	Min	OECD Data Explorer (12)

1.3. Analysis of Data

MULTIMOORA method, one of the multi-criteria decision-making methods, was used to evaluate the health system performance of OECD countries. MOORA (Multi-Objective Optimization by Ratio Analysis) method was developed by Brauers and Zavadskas in 2006 (16). MULTIMOORA method is an extension and improvement of MOORA method. It increases the consistency and accuracy in decision-making processes (17). In this study, the MULTIMOORA method was chosen to compare health system performances. This is because the method offers a more holistic and objective approach than common multi-criteria decision-making (MCDM) methods such as TOPSIS, VIKOR or AHP (17). Unlike methods that rely heavily on normalization sensitivity (e.g. TOPSIS) or subjective pairwise comparisons (e.g. AHP), MULTIMOORA combines ratio analysis, reference point assessment and full multiplicative form in a comprehensive framework (18). This hybrid approach reduces the influence of data scale and minimizes subjective bias, making it highly suitable for international comparisons based on objective health indicators. The stages of the method can be expressed as follows (19);

1. A “decision matrix” consisting of columns representing performance criteria and rows representing alternative decision units is prepared.
2. The “normalization” process is performed by dividing the criterion value of each alternative by the square root of the sum of the squares of each alternative value. This vector normalization method allows criteria measured at different scales to be integrated within a single framework. In fact, this guarantees

comparability between different indicators such as mortality rates, financial ratios and index scores by converting all values into dimensionless units.

3. “Ratio analysis” is applied by subtracting the minimum objective values collected from the maximum objective values collected with the table values formed by the normalized values. Benefit criteria (e.g., life expectancy, UHC) are added, and cost criteria (e.g., mortality rates, OOP spending) are subtracted after normalization. Countries are ranked based on the resulting composite scores.
4. The maximum points for the objective to be maximized and the minimum points for the objectives to be minimized, which are the maximal objective reference points, are determined. The distances to these determined points are found and converted into a matrix. In this way, the “reference point approach” is applied. For each criterion, the best value is identified as a reference point. The Euclidean distance of each alternative to this ideal point is calculated, and countries with smaller distances are preferred.
5. The values and meanings of the objectives are expressed as products and the “full multiplication form approach” is applied. The product of the criteria to be maximized is divided by the product of the criteria to be minimized.
6. The rankings made as a result of the ratio analysis, reference point and full multiplication form of the MULTIMOORA method are evaluated collectively according to their dominance.

Results

Current data on health and socio-economic indicators are obtained from reliable international databases such as WHO, WB and OECD and are shown in Table 2. The weight of each indicator is assumed to be 12.5% and kept equal. The main reason for the equal weights of the indicators is

that the health system performance is multidimensional and no weighting has been made between the indicators by national and international organizations. However, it is accepted that alternative weightings such as AHP and DEMATEL can be adopted in future studies by taking expert opinions for each indicator.

Table 2. Raw Data for Health and Socio-economic Indicators across 38 OECD Countries

Country	LEB (2023)	MMR (2022)	IMR (2023)	UFMR (2022)	HE (2023)	OOP (2023)	UHC (2023)	GINI (2022)
Australia	83,2	2,00	3,20	3,80	9,74	15,3	87	0,32
Austria	81,6	3,60	2,40	3,20	10,9	15,9	85	0,29
Belgium	82,5	7,90	2,90	3,70	10,9	20,0	86	0,25
Canada	81,6	8,50	4,70	4,90	11,2	14,8	91	0,30
Chile	81,4	18,9	6,80	6,30	10,0	35,4	82	0,45
Colombia	76,9	83,2	16,5	12,4	7,69	14,3	80	0,55
Costa Rica	81,0	15,0	9,50	7,70	7,02	22,4	81	0,47
Czechia	80,0	4,00	2,30	2,60	8,54	14,2	84	0,25
Denmark	81,9	1,60	2,40	3,50	9,44	13,0	82	0,27
Estonia	78,8	0,01	2,30	1,90	7,55	23,1	79	0,32
Finland	81,7	8,90	2,00	2,30	10,1	16,1	86	0,27
France	83,1	7,60	3,90	4,10	11,5	8,92	85	0,30
Germany	80,7	4,10	3,20	3,60	11,7	10,7	88	0,30
Greece	81,6	5,90	3,10	3,90	8,37	33,5	77	0,31
Hungary	76,9	7,90	3,60	4,00	6,36	24,2	79	0,29
Iceland	82,6	3,30	3,30	2,60	8,99	13,6	89	0,25
Ireland	82,6	1,60	3,30	3,10	6,56	10,6	83	0,29
Israel	82,8	1,10	2,80	3,40	7,62	20,2	85	0,34
Italy	83,8	2,50	2,30	2,60	8,44	22,7	84	0,32
Japan	84,1	4,30	1,80	2,30	11,0	10,9	83	0,34
Korea	82,7	8,40	2,30	2,80	9,88	28,7	89	0,32
Latvia	75,9	31,6	2,40	3,20	7,77	30,7	75	0,34
Lithuania	77,3	0,01	3,00	3,50	7,30	31,8	75	0,36
Luxembourg	83,4	0,01	3,10	2,70	5,78	8,67	83	0,30
Mexico	75,3	38,2	13,3	12,8	5,72	39,0	75	0,40
Netherlands	82,0	3,0	3,10	3,90	10,1	10,0	85	0,28
New Zealand	82,0	13,2	4,60	4,60	10,9	11,6	85	0,32
Norway	82,6	1,90	1,90	2,20	9,25	14,0	87	0,26
Poland	78,6	2,00	3,80	4,40	6,98	18,8	82	0,27
Portugal	82,4	8,80	2,50	3,20	10,0	29,6	88	0,33
Slovak Republic	78,1	3,80	5,40	5,90	8,63	19,2	82	0,23
Slovenia	82,0	5,50	2,50	2,30	9,41	12,4	84	0,24
Spain	84,0	3,30	2,60	3,00	9,62	19,1	85	0,32
Sweden	83,4	4,80	1,80	2,50	10,9	12,8	85	0,29
Switzerland	84,2	1,20	3,20	4,00	11,9	21,5	86	0,31
Türkiye	77,3	12,6	9,10	9,60	4,20	19,4	76	0,43
United Kingdom	80,9	5,50	4,00	4,10	10,8	13,2	88	0,37
United States	76,4	32,9	5,40	6,30	16,6	11,1	86	0,40

The equation calculations related to the method were made via Microsoft Excel; ratio analysis, reference point, full multiplicative form and MULTIMOORA rankings were

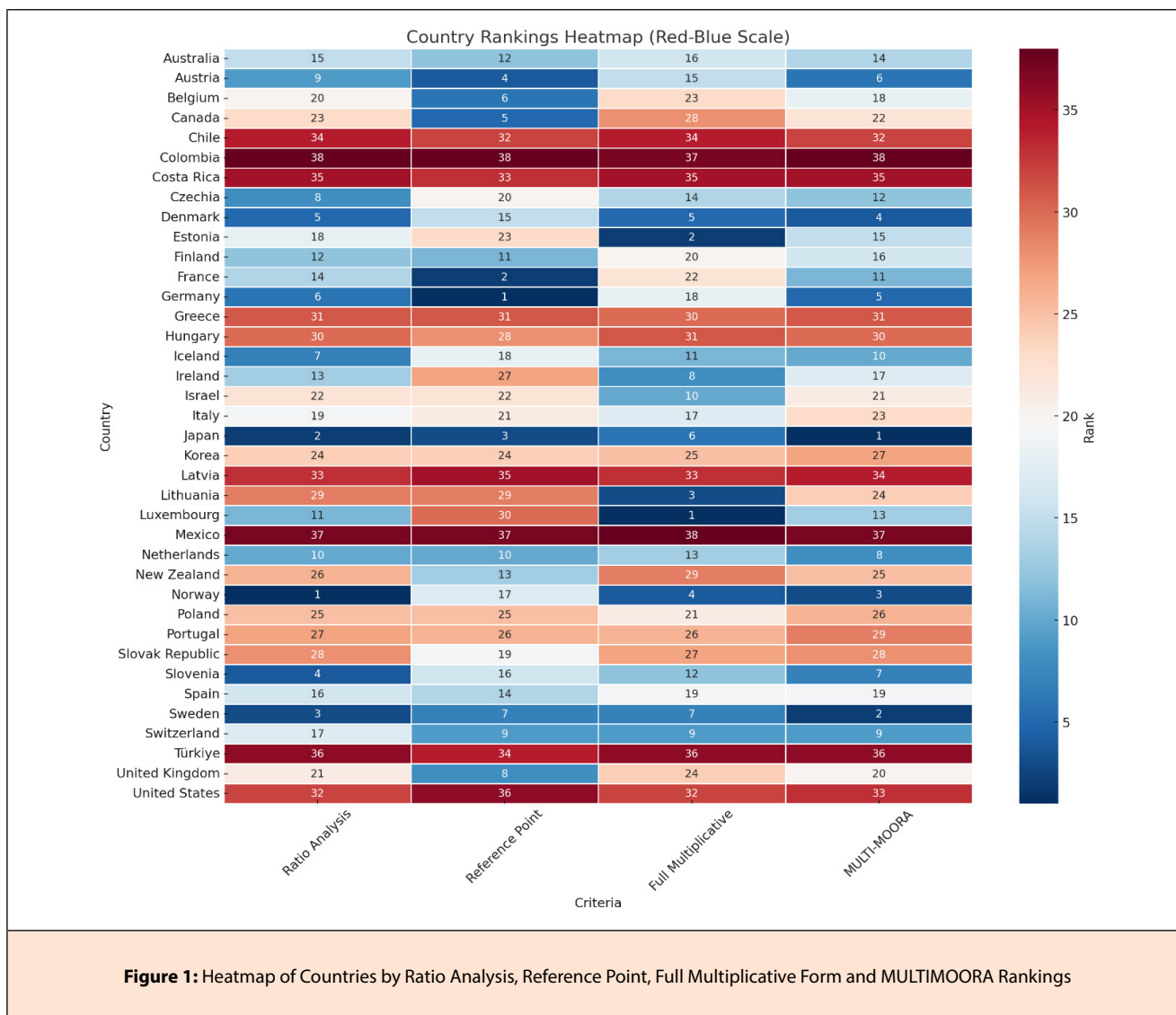
obtained as in Table 3. The board count method was applied to obtain the MULTIMOORA rankings.

Table 3: Country Rankings Based on Ratio Analysis, Reference Point, Full Multiplicative Form, and Final MULTIMOORA Aggregated Score

Country	Ratio Analysis	Rank	Reference Point	Rank	Full Multiplicative Form	Rank	MULTI-MOORA
Australia	-0,0198	15	0,1185	12	38094,34	16	14
Austria	0,0350	9	0,0979	4	38592,66	15	6
Belgium	-0,0481	20	0,0986	6	11664,73	23	18
Canada	-0,1195	23	0,0980	5	6116,43	28	22
Chile	-0,6010	34	0,2133	32	333,71	34	32
Colombia	-1,6247	38	0,7550	38	22,60	37	38
Costa Rica	-0,6590	35	0,2426	33	253,78	35	35
Czechia	0,0389	8	0,1392	20	43153,33	14	12
Denmark	0,0442	5	0,1238	15	86460,40	5	4
Estonia	-0,0376	18	0,1560	23	9273852,05	2	15
Finland	0,0211	12	0,1124	11	25170,06	20	16
France	-0,0137	14	0,0870	2	16277,02	22	11
Germany	0,0436	6	0,0835	1	34889,77	18	5
Greece	-0,2454	31	0,1980	31	4455,21	30	31
Hungary	-0,2379	30	0,1764	28	3047,33	31	30
Iceland	0,0409	7	0,1315	18	43721,65	11	10
Ireland	-0,0064	13	0,1730	27	57871,92	8	17
Israel	-0,0793	22	0,1548	22	46964,41	10	21
Italy	-0,0431	19	0,1408	21	35090,00	17	23
Japan	0,0942	2	0,0956	3	75037,09	6	1
Korea	-0,1219	24	0,1602	24	9223,17	25	27
Latvia	-0,4491	33	0,2862	35	1116,88	33	34
Lithuania	-0,2154	29	0,1844	29	2251205,56	3	24
Luxembourg	0,0252	11	0,1863	30	1192726,79	1	13
Mexico	-1,2987	37	0,3623	37	20,335	38	37
Netherlands	0,0283	10	0,1120	10	43181,74	13	8
New Zealand	-0,1517	26	0,1190	13	4609,56	29	25
Norway	0,1023	1	0,1269	17	145348,15	4	3
Poland	-0,1288	25	0,1657	25	16936,245	21	26
Portugal	-0,1559	27	0,1670	26	6707,70	26	29
Slovak Republic	-0,1992	28	0,1376	19	6701,91	27	28
Slovenia	0,0652	4	0,1243	16	43340,46	12	7
Spain	-0,0206	16	0,1207	14	28180,85	19	19
Sweden	0,0911	3	0,0987	7	61404,36	7	2
Switzerland	-0,0282	17	0,1028	9	53477,39	9	9
Türkiye	-0,7062	36	0,2516	34	172,71	36	36
United Kingdom	-0,0767	21	0,0991	8	11333,79	24	20
United States	-0,3533	32	0,2980	36	1425,92	32	33

According to the analysis results, countries can be summarized in three groups in line with the study indicators for health system performance: best performance (ranks 1-13), medium performance (ranks 14-25) and low performance (ranks 26-38). Among the OECD countries, the countries with the highest health system performance were identified as Japan, Sweden, Norway, Denmark and Germany, respectively. On the

other hand, the countries with the lowest performance were identified as Latvia, Costa Rica, Türkiye, Mexico and Colombia, respectively. In addition, Figure 1 provides a heatmap of countries according to their ratio analysis, reference point, full multiplicative form and MULTIMOORA rankings. Lower rankings (better performances) are shown in blue tones, and higher rankings (worse performances) are shown in red tones.



Conclusion

This study examined the health system performance of OECD countries. Member countries were compared in terms of a number of variables related to health and socio-economic indicators. The countries with the highest health system performance were identified as Japan, Sweden, Norway, Denmark and Germany, respectively. In fact, access to health services, quality and comprehensiveness

were provided in these countries. The high ratio of health expenditures to GDP supports the effectiveness and comprehensiveness of health services in these countries. As a result of the data analysis, it was observed that some countries exhibited relatively low performance despite high health expenditures or, on the contrary, achieved better results with low health expenditures. Although this study uses the health expenditure-to-GDP ratio as a useful measure, it is important to recognize that higher

expenditures alone do not automatically translate into better health system performance. For example, the United States, despite being at the top of the list in health expenditures per capita, fell behind in overall system performance. This situation shows that not only the amount of expenditure, but also how the expenditures are directed and the efficiency in the system are important. Similarly, it is remarkable in terms of system efficiency that some countries perform better with relatively limited budgets. It is also acknowledged that the three indicators used in the study (maternal mortality ratio (MMR), infant mortality ratio (IMR) and under-5 mortality ratio (UFMR) are thematically linked to components in the service coverage index (UHC), particularly in the area of reproductive, maternal, newborn and child health. This conceptual overlap may raise concerns about potential multicollinearity or indicator redundancy. However, each of these mortality indicators was intentionally retained to capture nuanced differences in outcomes across countries that are not fully reflected in the composite UHC score. Furthermore, the MULTIMOORA method is robust to such overlaps because it does not rely on regression-based assumptions.

A successful health system has been built thanks to stable health policies spanning many years. In countries such as Sweden and Norway, health services are financed by public resources and provided to all citizens equally. While healthy living is encouraged in Japan, early diagnosis is widespread thanks to screening programs and public health policies in countries such as Denmark. The COVID-19 pandemic significantly challenged the resilience and responsiveness of health systems across the globe. While this study does not specifically focus on pandemic-related dynamics, the performance rankings may partially reflect the post-pandemic health system responses, as some of the most recent data used (e.g., from 2022 and 2023) capture recovery trends. Countries such as Japan, Sweden, and Norway ranked among the top performers were noted for their effective crisis management and continuity of care during the pandemic, which may have contributed to their sustained performance levels. Conversely, countries struggling with fragmented service delivery or inequitable access may have experienced amplified vulnerabilities. When the literature is examined, there are various studies supporting these views.

Klumpp et al. (20) stated in their study that countries such as Japan and Germany, which allocate a large share to health expenditures, showed superior performance during the pandemic and that this was due to their

high general health system performance. Yüksel (21) also emphasized in his study comparing health system performances in OECD countries that higher performance was achieved in countries such as Sweden and Norway, where the public share allocated to health was higher. Tchouaket et al. (22) emphasized in their studies that countries such as Denmark and Germany have high health system performance by emphasizing that resource use efficiency is also effective in addition to health outcomes. Blümel et al. (23) emphasized in their study that the performance of the Norwegian health system is high compared to other countries as a result of health infrastructure investments, patient satisfaction and good health outcomes. Nilbert et al. (24) emphasized that Denmark focused on primary health care and preventive services, resulting in lower hospitalization rates and better management of chronic diseases, emphasizing the high health system performance. Johansson et al. (25) stated that Scandinavian countries, especially Sweden and Norway, have high health system performance in line with the implementation of evidence-based interventions that improve health outcomes by determining best practices.

On the other hand, the countries with the lowest performance were found to be Colombia, Mexico, Türkiye, Costa Rica and Latvia. The limited resources allocated to the health system in these countries cause the service coverage index to remain low. High out-of-pocket expenditures alienate especially low-income groups from health services. In addition, with a high income inequality coefficient, the problem of equity in access to health services arises in countries. When the literature is examined, Gavurová et al. (26) emphasized in their study that despite the increase in health expenditures, Latvia continues to have difficulties in terms of health system efficiency and ranks low among OECD countries. Rotar et al. (27) stated in their study that Colombia's health system performance is low due to problems such as administrative inefficiencies and the lack of comprehensive health policies that address the needs of vulnerable populations. Scheffler and Arnold (28) also stated in their study that there are significant barriers that limit the effectiveness and efficiency of Colombia's health system, indicating that its performance lags behind other OECD countries. Anwar et al. (29) reported that Mexico's health expenditures are low relative to its GDP and lag behind the performance of other OECD countries. Bilsel and Davutyan (30) also stated that Türkiye is among the lowest performing countries in the OECD in terms of indicators such as life expectancy at birth, infant mortality rate and the share of health expenditures in GDP.

As a result, in this study, health system performances were evaluated with health and socio-economic indicators. In this context, low-performing countries need to improve their health systems by making comparisons with high-performing countries' health systems and developing strategies to eliminate their current deficiencies. The indicators used in the study provide a snapshot of the current situation. In fact, the development speed and trends of health systems over time have not been taken into account. Therefore, it should be taken into account that some countries classified as low-performing may be in a faster recovery process compared to other countries with rapid structural reforms. This situation reveals that contextual and temporal dimensions should be taken into account as much as absolute values when classifying and evaluating. There are also some limitations to the indicators chosen. For example, more abstract aspects of service provision, such as geographic availability, health literacy, or cultural norms, could not be taken into account. Furthermore, equal weighting of indicators may limit the analysis in cases where some aspects of the system (such as maternal and child health) are more important than others. These limitations provide a compelling basis for further research. The MULTIMOORA method, which is applied to shed light on future studies, is a method that can be applied not only in measuring health system performances but also in other group decision-making problems involving personal judgments. This applied method can be improved by integrating with other MCDM methods (such as AHP, DEMATEL, ANP, SWARA, BWM).

Declarations

Funding

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Conflict of Interest

None declared.

Ethics approval

The ethical and scientific suitability of the research was approved by the Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee with the decision numbered E-10840098-202.3.02-5390, dated 05/09/2024.

Availability of data and material

All materials used in this study are detailed within the manuscript, and additional information can be requested from the corresponding author.

Authors' contributions

The author solely conceived, designed, and executed the research, including data analysis and manuscript preparation.

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Assessment of Environmental Sustainability Practices in Healthcare Facilities by Employing Fuzzy-AHP

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ABSTRACT

Background/Purpose: This study primarily aims to identify and rank the criteria employed in assessing practices that promote environmental sustainability in healthcare facilities, grounded in their relative significance and weighted contributions.

Methods: The criteria determined within the scope of evaluation of environmental sustainability practices were analyzed with Fuzzy-AHP (Analytical Hierarchy Process), which is one of the Multi-Criteria Decision-Making Techniques. In this context, the opinions of 5 participants who were experts in the fields of health management, environment and air conditioning, public health and real estate evaluation were received.

Results: The most important criterion used to evaluate applications to increase environmental sustainability in healthcare facilities is "Energy Efficiency" with a normalized weight score of 37.3%. It is followed by "Waste Reduction and Environmental Impact" (22.8%) and "Cost Effectiveness" (12.2%), respectively. In this direction, the first 3 criteria represent an important part with a weight score of 72.3%. "Technological Compliance" was determined as the least important criterion with a weight of 3.8%.

Conclusion: As a result, the complementary structure of these criteria increases the effectiveness of environmental sustainability strategies in healthcare facilities and makes significant contributions to sustainable healthcare service delivery. Therefore, healthcare facility managers' prioritization of these criteria in their selection processes regarding environmental sustainability practices will strengthen the environmental performance of the facilities while also supporting their financial sustainability.

Keywords: AHP, Fuzzy logic, Environmental sustainability, Healthcare facilities

ÖZET

Amaç: Bu çalışmanın amacı, sağlık tesislerinde çevresel sürdürülebilirliğin artırılmasına yönelik uygulamaların değerlendirilmesinde kullanılan kriterleri görece önemleri temeleninde önceliklendirmektir.

Yöntemler: Çevresel sürdürülebilirlik uygulamalarının değerlendirilmesi kapsamında belirlenen kriterler Çok Kriterli Karar Verme Tekniklerinden biri olan Bulanık-AHS (Analitik Hiyerarşi Süreci) ile analiz edilmiştir. Bu kapsamda sağlık yönetimi, çevre ve iklimlendirme, halk sağlığı ve gayrimenkul değerlendirme alanında uzman 5 katılımcının görüşleri alınmıştır.

Bulgular: Sağlık tesislerinde çevresel sürdürülebilirliği artırmaya yönelik uygulamaların değerlendirilmesi için kullanılan en önemli kriter %37,3 normalize ağırlık puanı ile "Enerji Verimliliği" dir. Sonrasında, sırasıyla, "Atık Azaltma ve Çevresel Etki" (%22,8) ve "Maliyet Etkinlik" (%12,2) yer almaktadır. Bu doğrultuda ilk 3 kriter %72,3 ağırlık puanı ile önemli bir parçayı ifade etmektedir. "Teknolojik Uygunluk" ise %3,8 ağırlık ile en az önemli kriter olarak tespit edilmiştir.

Sonuç: Kriterlerin birbirini tamamlayıcı yapısı, sağlık tesislerinde çevresel sürdürülebilirlik stratejilerinin etkinliğini artırmakta ve sürdürülebilir sağlık hizmet sunumuna da önemli katkılar sağlamaktadır. Dolayısıyla, sağlık tesisleri yöneticilerinin çevresel sürdürülebilirlik uygulamalarıyla ilgili seçim süreçlerinde öncelikli olarak bu kriterleri dikkate alması, tesislerin çevresel performansını güçlendirirken, finansal sürdürülebilirliklerini de destekleyecektir.

Anahtar Kelimeler: AHS, Bulanık mantık, Çevresel sürdürülebilirlik, Sağlık tesisleri

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Environmental sustainability has an increasing importance in the health sector today. Health facilities create significant environmental impacts through activities such as energy consumption, water use and waste management (1). Diminishing these impacts not only contributes to the protection of the environment but also to reducing operating costs and increasing the awareness of social responsibility (2). In the healthcare sector, which provides uninterrupted service 7/24 with its labour and technology intensity, implementing sustainability principles and carrying out prioritization studies to determine sustainability strategies that will provide competitive advantage make an important contribution (3). Integrating energy efficiency to hospital design have positive results in the long term (4); processes that require energy consumption such as heating, ventilation, air conditioning and lighting (5); consumption of large amounts of water with the use of equipment and devices (6); ambulance transportation, which contribute to carbon emissions, and hospital transfers of workers and users within public and private transportation (7).

The fossil fuel dependency significantly increases healthcare energy demand and CO₂ emissions. Healthcare facilities are among the largest consumers of energy. Mainly, hospitals, due to their building design and operational needs, are particularly responsible for environmental pollution. Hospitals located in warmer climates generally consume more electricity, while hospitals located in colder climates consume more fuel (8). Managing energy means reducing the energy consumed and the costs incurred, while maintaining quality and minimising environmental impact. Effective energy management is crucial not only for economic sustainability but also for environmental goals, as continuous operation of systems such as heating and ventilation further increases energy consumption (9).

Hospitals are known to consume large amounts of energy and water, in addition hazardous and non-hazardous waste, and use many different materials. However, the “green” approach to healthcare has emerged due to limited resources, inadequate waste management facilities, lack of staff training in the handling of hazardous materials, and insufficient incentives for the use of renewable energy. The green hospital concept aims at promoting efficient use of energy, water and materials, avoiding waste and implementing green building design. however, obstacles such as high investment costs, lack of information and awareness, cultural and administrative

resistance and technological infrastructure problems are encountered in the transition process to this concept (10).

It is shown that studies on sustainable healthcare services mainly focus on five main topics: energy efficiency and building design (10,11), renewable energy systems costs (8,12), minimizing environmental impacts (13,14), determining sustainability criteria (15, 16) and increasing awareness levels of managers (17-19). Studies have also focused on issues such as reducing energy costs of green hospital applications, the impact of innovation and learning perspective on sustainability, and the integration of social, economic and environmental dimensions. Sustainable healthcare services stand out as an important area in terms of environmental and economic sustainability in the healthcare sector.

The objective of this study is to ascertain the relative weight and importance levels of the criteria employed for the assessment of practices aimed at enhancing environmental sustainability in healthcare facilities. Therefore, the objective is to make environmentally focused decisions in an appropriate and objective manner, considering a range of criteria.

Material and Method

2.1. Participants

The criteria were evaluated by 5 experts in the fields of health management, environment and air conditioning, public health and real estate evaluation (Table 1).

Table 1: Participants (decision makers) characteristics				
Decision Makers	Specialization	Education	Position	Experience
DM1	Health Management	PhD	Prof.	15 years
DM2	Health Management	PhD	Assoc. Prof.	10 years
DM3	Environment and Climate	Master	Engineer	8 years
DM4	Public Health	PhD	Assoc. Prof.	11 years
DM5	Real Estate Assessment	PhD	Prof.	13 years

2.2. Identifying to criteria

In the study, data were analyzed using Fuzzy Analytical Hierarchy Process (Fuzzy-AHP) one of the multicriteria decision making techniques. AHP expresses the intuitions of decision makers in the form of crisp data based on the two-way comparisons of the criteria. It is a powerful tool for solving complex decision problems. It solves problems by

transforming into hierarchical structures through pairwise comparisons. In fact, this study aimed to make a weight and importance ranking based on 8 criteria determined in line with expert opinions and included in the literature for the evaluation of environmental sustainability practices. In this direction, the criteria and their explanations are expressed in Table 2.

Table 2: Criteria and Explanations to be Used in the Study

#	Abbreviation	Criteria	Explanation
1	CR	Corporate Reputation	Meeting ecological responsibility and increasing its reliability and prestige in the eyes of society
2	CE	Cost Effectiveness	The total cost of the application and the financial savings it provides over time.
3	EE	Energy Efficiency	The scope to which the application reduces energy usage.
4	LC	Legal Compliance	The application's adherence to local, national, and international environmental protection laws.
5	PSS	Patient and Staff Safety	The impact of the application on patient and employee safety.
6	SI	Societal Impact	The impact of the practice on society, i.e. its contribution to local communities and public health.
7	TC	Technological Compliance	Compliance with regulatory standards by adopting advanced environmentally friendly solutions
8	WRE	Waste Reduction and Environmental Impact	Contribution to reducing waste, increasing the recycling rate and safely disposing of hazardous waste.
Reference: 10-19			

The weights and importance levels of the criteria were determined by making the relevant calculations of the Fuzzy-AHP method via Microsoft 365 Excel.

2.3. Fuzzy-AHP

Fuzzy-AHP is an extension of AHP that incorporates fuzzy logic to address the uncertainties and ambiguities inherent in decision-making processes. Conventional AHP often struggles with the uncertainty of human judgment, especially when decision makers are asked to provide precise numerical values for their preferences. Fuzzy-AHP alleviates this problem by allowing decision makers to express their preferences using linguistic terms, which are then converted into fuzzy numbers, typically triangular or trapezoidal, to represent the uncertainty in their judgments (19-21).

Fuzzy-AHP usually involves several stages. The first stage is the creation of a hierarchical structure that decomposes the decision problem into a set of criteria and sub-criteria. This hierarchical model is important because it organizes the decision-making process into manageable

components and facilitates a clearer analysis of the relationships between different criteria (19, 22).

The second stage involves collecting pairwise comparison data from decision makers, where decision makers evaluate the relative importance of each criterion over others. These terms are then converted into fuzzy numbers to form a fuzzy pairwise comparison matrix (20, 23).

The third stage is the synthesis of the fuzzy pairwise comparison matrix to derive fuzzy priority weights for each criterion. It involves applying fuzzy arithmetic operations to collect a set of fuzzy comparisons that reflect the preferences of decision makers (22).

The fourth stage is the fuzzification process, in which fuzzy priority weights are converted into crisp data to facilitate the ranking of alternatives. Common methods for fuzzification include the centroid method or the average of maximums (21). In this study, Chang's method was used for fuzzy pairwise comparisons of criteria. The analysis developed by Chang (24) provides a more meaningful and flexible comparison opportunity by using pairwise comparison matrices and triangular fuzzy numbers.

The final stage involves analysis of the results, where clear priority weights are used to rank the alternatives according to defined criteria. This ranking helps decision makers to determine the most appropriate option among the alternatives considered.

In Fuzzy-AHP, decision makers receive linguistic terms and pairwise comparisons on a scale of 1-9. Then, the pairwise comparisons of the decision makers are converted into triangular fuzzy numbers as shown in Table 3.

Table 3: Triangular fuzzy scales				
Linguistic term	Abbreviation	Relative Importance	Fuzzy scales	Inverse fuzzy scales
Equal	E	1	1,1,1	(1/1, 1/1, 1/1)
Moderate	MS	3	2,3,4	(1/4, 1/3, 1/2)
Strong	S	5	4,5,6	(1/6, 1/5, 1/4)
Very Strong	VS	7	6,7,8	(1/8, 1/7, 1/6)
Extremely Strong	ES	9	9,9,9	(1/9, 1/9, 1/9)
Intermediate Values	IV	2;4;6;8	1,2,3;3,4,5;5,6,7;7,8,9	(1/3, 1/2, 1; 1/5, 1/4, 1/3; 1/7, 1/6, 1/5; 1/9, 1/8, 1/7)

Results

The determined criteria were evaluated by experts and comparison matrices containing the opinions of decision

makers were obtained. For instance, the decision matrix illustrates the perception of DM1, is shown in Table 4.

Table 4: Pairwise comparison matrix of determinants (DM1)								
	EE	WRE	CE	PSS	LC	SI	CR	TC
EE	E	MS	S	VS	MS	S	VS	ES
WRE		E	MS	S	MS	S	VS	S
CE			E	MS	E	MS	S	S
PSS				E	MS	S	VS	MS
LC					E	MS	S	MS
SI						E	MS	E
CR							E	MS
TC								E

The degrees of importance for each criterion comparison in the decision matrices were combined with the opinions of the other 4 decision makers and expressed as fuzzy numbers in Table 3, and an integrated fuzzy decision matrix containing the common opinions of 5 experts was

created. In the integrated fuzzy decision matrix, triangular fuzzy numbers were calculated for each criterion comparison. Finally, the fuzzy weights, averages and normalized relative weights of the criteria were calculated. In Table 5, the final importance weights are presented.

Table 5. Fuzzy AHP Average and Normalization Weights				
#	Criteria	Weight (Avarage)	Weight (Normalized)	Rank
EE	Energy Efficiency	0,3927	0,3727	1
WRE	Waste Reduction and Environmental Impact	0,2398	0,2276	2
CE	Cost Effectiveness	0,1281	0,1216	3
PSS	Patient and Staff Safety	0,0736	0,0865	4
LC	Legal Compliance	0,0911	0,0699	5
SI	Societal Impact	0,0432	0,0421	6
CR	Corporate Reputation	0,0444	0,0410	7
TC	Technological Compliance	0,0404	0,0383	8

According to Table 7, the most important criterion used to evaluate practices to increase environmental sustainability in healthcare facilities is "Energy Efficiency" with a normalized weight score of 37.3%. Then, "Waste Reduction and Environmental Impact" (22.8%) and "Cost Effectiveness" (12.2%) come next. In this direction, the first 3 criteria represent a significant majority with a weight score of 72.3%. "Technological Compliance" was determined as the least important criterion with a weight of 3.8%.

Discussion

This study revealed that the most crucial criteria used to evaluate practices to increase environmental sustainability in healthcare facilities are energy efficiency, waste reduction, environmental impact and cost effectiveness, respectively.

There are different studies indicating that the energy efficiency criterion has the highest importance (37.3%). Similarly, Çakmak Barsbay (8) emphasized that energy expenditures are an important expenditure item in the healthcare sector and significantly affect sustainability. Mcgain et al. (25), who discussed the impact of energy resources on the ecological footprint of healthcare services, emphasized that energy efficiency is vital for reducing environmental pollutants and promoting sustainability.

The second crucial criterion (22.8%) is waste reduction and environmental impact. In the literature, Mehra and Sharma (26) emphasized that strategies such as innovation and waste reduction will guide sustainability goals by using multi-criteria decision-making methods. Castro de Fátima et al. (27) developed 52 criteria under environmental, socio-cultural, economic, technical and regional opportunity dimensions in their study where they applied the AHP method and stated that environmental criteria were of the highest importance. In addition, the World Health Organization (28) estimates that 15% to 25% of healthcare waste is hazardous, which shows the importance of the process of evaluating the necessary practices to ensure environmental sustainability.

The third critical criterion (12.2%) is cost-effectiveness. Indeed, in the literature; Zadeh et al. (29) emphasize the need for cost-effective criteria to create sustainable healthcare environments by reducing costs on the one hand and supporting health and healing missions on

the other. Zuhri (30) emphasized that the concept of environmental sustainability is closely linked to the efficient use of resources, which can lead to significant cost savings.

Conclusion

The complementary structure of the criteria increases the effectiveness of environmental sustainability strategies in healthcare facilities and makes significant contributions to the provision of sustainable healthcare services. Therefore, healthcare facility managers should prioritize these criteria in their selection processes regarding environmental sustainability practices, which will strengthen the environmental performance of the facilities and support their financial sustainability. The detailed recommendations as below;

Energy-efficient applications such as the commissioning of building automation systems, LED lighting, smart HVAC systems, trigeneration systems and renewable energy sources (solar, wind) significantly reduce operating costs.

Reducing medical, chemical and plastic waste, establishing appropriate waste management procedures, programs that encourage recycling and reuse of materials, and supplying environmentally friendly products (e.g. biodegradable packaging, reusable tools) contribute to reducing environmental impact.

Cost effectiveness, on the other hand, provides significant savings in the long term thanks to the high return potential of investments made in sustainable practices, and also brings economic advantages by offering the opportunity to benefit from financial incentives and supports.

Declarations

Conflict of Interest

The authors have declared no conflict of interest.

Ethics Approval

Istanbul Medipol University Non-Interventional Ethics Committee decided that this study was approved (Date: 16/10/2024, Decision No: 956, Number: E-10840098-2023.02-6359). The study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants.

Availability of Data and Material

All data have been presented here. Material may be available upon request.

Authors' Contributions

EG performed the research, analysed the data, and wrote the paper also he conceived of and designed the overall study.

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The Relationship Between Hopelessness Level and Occupational Competence and Value and Time Management in University Students- A Cross-Sectional Study

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ABSTRACT

Purpose: The aim of the study is to determine the level of hopelessness of university students and to investigate the relationship between this level of hopelessness and students' occupational competence and value and time management levels.

Methods: The study was conducted with university students aged 18-25 years. After obtaining demographic information, hopelessness was assessed using the Beck Hopelessness Scale (BHS), occupation status using the Occupational Self Assessment (OSA), and time management using the Time Management Inventory (TMI).

Results: A total of 366 healthy university students participated in the study. The mean score on the BHS was 5.37 ± 4.57 (mild level). According to BHS, it was found that there was a statistically significant difference between severe hopelessness and minimal and mild hopelessness, and also between moderate hopelessness and mild and minimal hopelessness in the occupational competence sub-item of the OSA ($X^2=39.186$, $p=0.001$). In addition, according to the TMI, there was a statistically significant difference between those with severe hopelessness and those with minimal and mild hopelessness in the time planning sub-heading ($X^2=22.542$, $p=0.001$). In the time attitudes sub-heading, it was determined that the difference stemmed from those with severe hopelessness and those with minimal hopelessness ($X^2=38.960$, $p=0.001$). The results of the multiple linear regression analysis indicated that hopelessness level, time planning and time management total score variables were statistically significant predictors of students' occupational competence levels.

Conclusion: The level of hopelessness and time management in university students clearly affects their occupational performance and time management.

Keywords: Students, occupational status, time management

ÖZET

Amaç: Çalışmanın amacı üniversite öğrencilerin umutsuzluk düzeylerini belirlemek ve bu umutsuzluk düzeyinin öğrencilerin okupasyonel yeterlilik ve önem ile zaman yönetimi düzeyleriyle ilişkisini araştırmaktır.

Yöntemler: Çalışma 18-25 yaş arası üniversite öğrencisi ile gerçekleştirildi. Bireylerin demografik bilgileri sorgulandıktan sonra umutsuzluk düzeyleri Beck Umutsuzluk Ölçeği (BUÖ) ile, okupasyonel düzeyleri Aktivite Öz Değerlendirme Ölçeği (AÖDÖ) ile ve zaman yönetimleri Zaman Yönetimi Envanteri (ZYE) ile değerlendirildi.

Bulgular: Çalışmaya toplam 366 sağlıklı üniversite öğrencisi katıldı. BUÖ değerlendirmesinde ortalama puanları $5,37 \pm 4,57$ (hafif düzey) olarak belirlendi. BUÖ'ne göre AÖDÖ'nin okupasyonel yeterlilik alt başlığında şiddetli umutsuzluk ile minimal ve hafif umutsuzluk arasında ve ayrıca orta düzeyde umutsuzluk ile hafif ve minimal umutsuzluk arasında istatistiksel olarak anlamlı fark olduğu bulundu ($X^2=39.186$, $p=0.001$). Ayrıca ZYE'ne göre ise zaman planlaması alt başlığında şiddetli umutsuzluk yaşayanlar ile minimal ve hafif umutsuzluk yaşayanlar arasında istatistiksel olarak anlamlı fark olduğu görüldü ($X^2=22.542$, $p=0.001$). Zaman tutumları alt başlığında ise farkın umutsuzluk düzeyi şiddetli olanlar ile minimal düzeyde olanlardan kaynaklandığı belirlendi ($X^2=38.960$, $p=0.001$). Yapılan çoklu doğrusal regresyon analizine göre de umutsuzluk düzeyi, zaman planlaması ve zaman yönetimi toplam puanı değişkenlerinin öğrencilerin okupasyonel yeterlilik düzeyleri için istatistiksel olarak anlamlı yordayıcıları olduğu saptandı.

Sonuç: Üniversite öğrencilerindeki umutsuz düzeyinin ve zaman yönetiminin öğrencilerin okupasyonel performanslarını ve zaman yönetimlerini etkilediği açıkça görülmektedir.

Anahtar Kelimeler: Öğrenciler, okupasyonel durum, zaman yönetimi.

The undergraduate education period represents a sensitive and pivotal stage in an individual's life (1). The acquisition of a university education represents a significant opportunity for individuals to enhance their qualifications and become more qualified members of society (2,3). Nevertheless, as is the case with all young adults, university students must adapt to psychological and psychosocial changes and overcome societal and academic expectations in order to prepare for their professional careers (4). Furthermore, during this period, students may experience a range of anxiety-inducing factors, including concerns about their future roles in life beyond the completion of their university education, the management of various responsibilities, and difficulties in securing employment (1,5). Studies in the literature show that mental health problems such as depression and anxiety are increasing among university students for a variety of reasons (2,5,6).

Mental disorders such as hopelessness and depression are positively associated with loneliness, isolation and lack of social support as well as decreased self-confidence and self-esteem. All these symptoms negatively affect the occupational performance of individuals (7,8). In other words, personal and environmental factors, including the individual's motivation, roles, habits, health status, performance capacity and limitations, affect the individual's occupational participation. Difficulties or problems encountered by the individual during occupational participation are called occupational participation limitations (9). According to the Model of Human Occupation (MOHO), which is one of the occupational therapy models, occupational competence is defined as the degree to which a person can maintain his/her occupational performance. The concept of occupational value is expressed as the individual's perception of which of the occupational performances is important for him/her (10). Occupational self-efficacy, on the other hand, includes the individual's sense of personal competence and satisfaction with the occupation (11).

Also, university students need to create a balance between their daily occupational performance and academic success (12). The key factor for leading a successful life is effective time management in which it is very important to plan the time that everyone has equally. Time management is defined as the organization of one's

time to achieve effective work (13). Time management is important for academic success and it is desirable that every student has the ability to manage their time, which includes prioritizing occupational performance in line with their goals (12). However, lack of time can be challenging and overwhelming. The lack of effective time management, organization and study skills can lead to a sense of distress and dissatisfaction amongst students (14).

A review of the literature shows that there are many studies on levels of hopelessness among university students (2-6). In these studies, it can be seen that the hopelessness of the university students about the future and the effects of this hopelessness in different areas are also being studied. This study differs from similar studies in that it investigated the relationship between university students' hopelessness level and occupational performance and time management. The aim of this study was to determine the level of hopelessness in university students aged 18-25 years and to investigate the relationship between this level of hopelessness and students' time management, occupational competence and value.

Material and Methods

Subjects

The research is cross-sectional. The study was conducted with university students aged between 18 and 25 years. Participants were selected by simple random sampling method. All students who did not have communication problems and who volunteered to participate in the study were included in the study. The exclusion criteria were those with communication problems and those who did not volunteer to participate in the study. Students were asked to sign the consent forms before the application of the questionnaires in the study. Data were collected online using Google Forms. Post hoc power analysis was performed for the sample size of the study.

This study was approved by the decision of Çankırı Karatekin Scientific Research and Publication Ethics Committee dated 29.03.2023, meeting number 06 and verification code f9dc856abf044ba4. The study was conducted based on the Declaration of Helsinki.

Assessment Tools

Firstly, the participants were asked to provide information regarding their age, height, weight, smoking habits and alcohol consumption.

Subsequently, the level of hopelessness was evaluated using the **Beck Hopelessness Scale (BHS)**. The Beck Hopelessness Scale is a psychometric instrument designed to assess an individual's sense of hopelessness. It is intended to measure feelings such as despair, unhappiness and pessimism that are commonly experienced by people. The scale comprises 20 items. In scoring, for questions 1,3,5,6,8,10,13,15,19; yes=0, no=1 and for questions 2,4,7,9,11,12,14,16,17,18,20; yes=1, no=0. Consequently, the following levels of hopelessness were identified: 0-3 indicates minimal, 4-8 indicates mild, 9-14 indicates moderate, and 15 and above indicates severe. The Turkish validity and reliability study of the scale was conducted by Durak et al (15).

In the study, the occupation levels of the individuals were evaluated using the **Occupational Self Assessment (OSA)**. OSA is a scale comprising 21 questions and three sections. Each section is divided into two subsections. In the scale, firstly, the degree of difficulty of the person while performing the occupation is assessed, and in the second section, the value of this occupation for the person is questioned. Each section is scored separately on a 4-point Likert scale. The initial 11 questions of the test pertain to skills, the subsequent 10 questions relate to habits, and the concluding 10 questions concern the individual's desires. A high score on the scale indicates increased occupational competence and value. The scale was developed by Baron et al. and Turkish validity and reliability study was conducted by Pekçetin et al (16).

Finally, the **Time Management Inventory (TMI)** was employed to assess the time management abilities of university students. The time planning questionnaire is an inventory that evaluates how individuals utilise and manage their time. It assesses how they think and live, rather than how they aspire to be. The Time Management Inventory is not a test; the responses are not categorised as 'true' or 'false'. The questions are designed to define the individual in question. The inventory comprises three categories and 27 questions. The first category,

Time Planning, encompasses short- and long-term planning, with 16 questions. The second category, Time Attitudes, comprises seven questions. The third category, Time Wasters, comprises four questions. Responses are provided on a five-point Likert scale, with options including "always," "often," "sometimes," "rarely," and "never." The internal consistency reliability coefficient of the questionnaire was found to be .87. A Turkish validity and reliability study was conducted by Alay et al (17).

Statistical Analysis

A post hoc power analysis was conducted using G*Power version 3.1.9.2 (Heinrich-Heine-Universität Düsseldorf) to determine the required sample size. The minimum sample size was calculated to be 314 participants (effect size: 0.152; probability alpha error: 0.05; power: 0.80; and number of predictors: 5).

The study data were analysed using IBM Statistics SPSS v26.0 (SPSS Inc., Armonk, NY, USA). The Kolmogorov-Smirnov test was employed to ascertain whether the data were normally distributed. Mean, standard deviation, number and percentage values were provided as supplementary statistics. The Kruskal-Wallis test was employed to evaluate the difference between the groups, while the Spearman correlation test was employed for correlation analysis. The correlation analysis results were evaluated according to the absolute value of the correlation coefficient (r). The correlation coefficient was evaluated as exhibiting a very weak relationship ($0.00 \leq r \leq 0.25$), a weak relationship ($0.26 \leq r \leq 0.49$), a moderate relationship ($0.50 \leq r \leq 0.69$), a high relationship ($0.70 \leq r \leq 0.89$) and a very high relationship ($0.90 \leq r \leq 1.00$) (18). The lowest significance levels were set at 0.05 and 0.001.

Results

A total of 366 healthy university students aged between 18 and 25 years, the majority of whom were female (76%), participated in the study. The mean age of the participants was 21.46 ± 2.93 years, and the mean body mass index was 22.74 ± 4.49 . It was determined that very few of the students smoked cigarettes (%24) and used alcohol (%17). Table 1 presents the demographic characteristics of the participants.

Table 1: Sociodemographic characteristics of the individuals

N=366		n (%)	x±SD
Age (year)			21.46±2.93
Height (m)			1.66±0.09
Weight (kg)			63.54±14.36
Body Mass Index (BMI) (kg/m ²)			22.74±4.49
Gender	Female	277(76)	
	Male	89 (24)	
Smoking Status	Smokers	89 (24)	
	Not Smokers	277(76)	
Alcohol	Using	62 (17)	
	Not Use	304 (83)	

The mean score of the participants in the BHS evaluation was 5.37 ± 4.57 . In addition, according to the BHS, it was found that the majority of the participants had minimal hopelessness (40.98%) and mild hopelessness (36.33%).

The results of the participants' OSA indicated that the mean score for the occupational competence sub-parameter was 57.51 ± 15.19 , while the mean score

for the occupational value sub-parameter was 56.33 ± 16.89 .

The mean scores of the participants were found to be 50.57 ± 14.49 in the time planning sub-heading, 22.46 ± 5.03 in the time attitudes sub-heading, 12.09 ± 3.78 in the time wasters sub-heading and 80.2 ± 26.32 in the total score, as indicated in Table 2.

Table 2: Individuals' Hopelessness, Occupational Competence and Value and Time Management Levels

		n (%)	x±SD
Beck Hopelessness Scale	Minimal	150 (40.98)	5.73±4.57
	Mild	133 (36.33)	
	Moderate	58 (15.84)	
	Severe	25 (6.83)	
Occupational Self Assessment	Occupational Competence		57.51±15.19
	Occupational Value		56.33±16.89
Time Management Inventory	Time Planning		50.57±14.49
	Time Attitudes		22.46±5.03
	Time Wasters		12.09±3.78
	Total Score		80.20±26.32

According to the hopelessness levels of the students in the BHS, the differences according to the OSA were examined. As the hopelessness levels of the students increased, it was seen that there was a decrease in both sub-headings of the OSA scores. The difference of this decrease according to the level of hopelessness was found to be statistically significant in the occupational competence sub-heading ($X^2=39,186$, $p=0,001$), but not statistically significant in the occupational value sub-parameter of the OSA ($X^2=6,556$, $p=0,087$).

In the study in which time management was divided into time planning, time attitudes and time wasters and total score, when we compared the individuals according

to their levels of hopelessness, it was seen that time management decreased as the hopelessness levels of the individuals increased in the sub-headings of time planning ($X^2=22.542$, $p=0.001$), time attitudes ($X^2=38.960$, $p=0.001$) and especially in the total score of time management ($X^2=38.273$, $p=0.001$). In the sub-heading of time wasters, which represents a negative expression in terms of meaning, there was no difference according to the hopelessness levels of the individuals, but it was observed that the level of hopelessness was lower in individuals with severe hopelessness compared to other levels of hopelessness ($X^2=3.713$, $p=0.294$). All data are shown in Table 3.

Table 3: Differences in Occupational Competence, Value and Time Management According to Hopelessness Levels

		Beck Hopelessness Scale				Kruskall Wallis Test		
		Minimal (1)	Mild (2)	Moderate (3)	Severe (4)	X ²	p	Post Hoc
Occupational Self Assessment	Occupational Competence	61.12±15.92	57.72±13.02	51.64±16.23	45.63±12.49	39.186	0.001	4<1 4<2 3<1 3<2
	Occupational Value	58.80±16.84	55.50±17.04	54.16±15.48	49.77±21.42	6.556	0.087	
Time Management Inventory	Time Planning	53.40±13.80	49.86±14.45	48.26±15.56	39.63±13.74	22.542	0.001	4<1 4<2
	Time Attitudes	23.85±5.04	21.93±4.80	21.02±5.46	18.90±4.30	38.960	0.001	4<1 4<2 3<1 2<1
	Time Wasters	12.35±4.14	11.74±3.84	12.32±3.33	11.13±2.74	3.713	0.294	
	Total Score	89.64±17.84	78.52±25.56	77.27±26.76	63.68±24.14	38.273	0.001	2<1 3<1 4<1 4<2 4<3

Kruskall Wallis Test, $p<0.05$; $p<0.001$

In the correlation analysis results of the study, it was concluded that the BHS was negatively and weakly correlated with the occupational competence part of the OSA, the time wasters, time attitudes and total score time management ($r = -0.278$ - 0.368 ; $p<0.001$) negatively and very weakly correlated with the second part of the OSA, namely the occupational value part ($r = -0.155$; $p<0.001$). There was a positive and weak statistically significant

relationship between the occupational competence part of the OSA and time planning, time attitudes and total score time management ($r = 0.210$ - 0.394 ; $p<0.001$). Again, there was a very weak and positive correlation between the occupational value sub-parameter of OSA and time planning, time attitudes and time management total score ($r = 0.149$; $p<0.001$). All data are summarized in Table 4.

Table 4: The Relationship Between Age, Hopelessness Level, Occupational Competence, Value and Time Management

N=366	Beck Hopelessness Scale r (p)	Occupational Competence r (p)	Occupational Value r (p)	Time Planning r (p)	Time Attitudes r (p)	Time Wasters r (p)	Time Management Inventory r (p)
Age	-.030 (.580)	.029 (.598)	.010 (.857)	.060 (.240)	.083 (.126)	-.065 (.236)	0.602 (.245)
Beck Hopelessness Scale		-.368 (.000)**	-.155 (.005)**	-.278 (.000)**	-.348 (.000)**	-.100 (.064)	-.333 (.001)**
Occupational Competence			.394 (.000)**	.255 (.000)**	.210 (.000)**	.018 (.739)	.255 (.001)**
Occupational Value				.149 (.007)**	.149 (.007)**	.099 (.073)	.164 (.003)**
Time Planning					.430 (.000)**	.060 (.269)	.931 (.001)**
Time Attitudes						.218 (.000)**	.614 (.001)**
Time Wasters							.281 (.001)**

Spearman Korelasyon Testi, * $p<0.05$; ** $p<0.001$

In the study, a multiple linear regression analysis was conducted to predict occupational competence levels based on variables including hopelessness level, time planning, time attitudes, time wasters and time management total score. The results of the analysis indicated that the model was statistically significant

($F(4,319) = 12.125, p < 0.001$). The model identified three variables, namely hopelessness level, time planning and time management total score, as statistically significant predictors of students' occupational competences ($p < 0.05$). The results are shown in Table 5.

Table 5: Predictors of Occupational Competence

Occupational Competence	B	%95 CI for B		SE B	β	R2	$\Delta R1$	t	p
		Lower Bound	Upper Bound						
Model						.13	.12		
Constant	50.063	41.066	59.060	4.573					
Beck Hopelessness Scale	-.868	-1.238	-.498	.188	-.255			-4.613	.001*
Time Planning	.175	.046	.303	.065	.166			2.674	.008*
Time Attitudes	.113	-.291	.517	.205	.037			0.548	.584
Time Wasters	.089	-.367	.544	.232	.022			1.383	.702
Time Management Inventory	.175	.046	.303	.065	.218			2.674	.008*
Durbin-Watson = 2.191 $F = 12.125, p < 0.001 R = 0.363, R^2 = 0.132, Adjusted R^2 = 0.121^* = p < 0.05$									

Discussion

The study examined the relationship between the level of hopelessness, occupational competence and value and time management in university students. It was found that the level of hopelessness in university students was at a mild level and was related to students' occupational competences, time planning and time attitudes. The most striking result of the study is that hopelessness level, time planning and time management total score variables are statistically significant predictors of occupational competence level.

Hopelessness can be defined as an individual's expectations of negative events and outcomes for themselves and for the future (19). This state of despondency may result in the individual being unable to fulfil the expectations placed upon them by themselves and society (19). It is possible that university students may have to cope with a number of challenging situations, including academic tasks, assessments, social life, university life and adaptation to the environment (20). Such circumstances have a detrimental impact on the mental health of the affected individuals, leading to feelings of hopelessness (19). In the studies conducted with university students in the literature, it was found that students had mild to moderate levels of hopelessness (4,5,19). The results of the present study indicate that

the majority of students exhibit minimal or mild levels of hopelessness. In comparison to previous literature, the current findings suggest that students' self-perceptions and future outlooks are generally positive, with minimal indications of hopelessness.

The term 'occupational performance' is defined as comprising all occupations that individuals aspire to undertake, are obliged to perform and are expected to complete. This encompasses not only work but also self-care, productivity and leisure time (21). In their study examining the relationship between occupation, health and well-being, Law et al. concluded that occupational performance significantly affects human health and well-being (22). Similarly, Kielhofner emphasised the importance of occupational performance and its impact on health, suggesting that participation in meaningful activities can lead to well-being (23,24).

In contrast, a state of hopelessness has a detrimental impact on an individual's occupational performance. This is because hopelessness prevents the individual from reaching their goal. It can also lead to feelings of unhappiness, pessimism, malaise, ineffective stress management, burnout and depression (4). The results of the present study indicate that there are differences in occupational competence between individuals with high levels of hopelessness and individuals with lower levels of

hopelessness. This result is consistent with the literature, which states that hopelessness affects individuals in this manner (4,22-24). However, the study found no difference between the students participating in the study in the occupational value parameter according to the level of hopelessness. This result is thought to be due to the fact that the concept of occupational value is a complex and subjective concept (25). However, an analysis of the correlation table reveals a correlation between both the occupational competence and occupational value sub-parameters and the level of hopelessness. Furthermore, the finding that the level of hopelessness was identified as a predictor of occupational competence in the study indicates that the results of the study are consistent with those reported in the literature (4,22-24).

Time management can be defined as a form of self-management and control of events, offering individuals the opportunity to structure and control activities (26). Effective time management is associated with enhanced performance in occupations (27). In their study, Alay et al. demonstrated that individuals who employed time management strategies experienced a reduction in stress levels, an increase in productivity, and a greater likelihood of achieving their goals (17). Similarly, a lack of effective time management can result in suboptimal academic performance and psychological distress, particularly among university students (28). In another study, Uysal et al. examined the relationship between life satisfaction and time management in nursing students. As a result of the study, they concluded that there was a significant relationship between the time wasters, time management total score and life satisfaction (29).

The results of the study are consistent with those of previous time management evaluations in the literature. Another evaluation in the study revealed that time planning, time attitudes and time management total score were related to the competence and value of occupational performance, with the exception of the sub-heading of time wasters (19,27). Furthermore, the results of the multiple linear regression analysis indicated that the time planning section and time management total score were a significant predictor of the occupational competence level. These findings are an expected result according to time management studies in the literature (19,27-29).

The limitations of the study include the fact that the number of university students targeted in the study could

not be reached, and that the number of female and male students was not equal in the students reached.

Conclusion

The results of the study indicate that although the levels of hopelessness among university students were relatively mild, there is a clear association between levels of hopelessness and time and occupational management. Consequently, it is proposed that in order to reduce the levels of hopelessness among university students, the factors that contribute to these levels should be investigated and students should be supported in the teaching and implementation of strategies to cope with these factors.

Declarations

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Conflicts of interest/Competing interests

The Authors declare that there is no conflict of interest.

Ethics approval

This study was approved by the decision of Çankırı Karatekin University Scientific Research and Publication Ethics Committee dated 29.03.2023, meeting number 06 and verification code f9dc856abf044ba4. The study was conducted based on the Declaration of Helsinki.

Availability of data and material

Data can be shared if requested.

Author Contributions (Roles)

Conceived and designed the experiments: NŞ, TBF, RB, BS, FNG, AA, HA, MÇ, MBA; **Performed the experiments:** NŞ, TBF, RB, BS, FNG, AA, HA, MÇ, MBA; **Analyzed the data:** NŞ; **Contributed reagents/ materials/ analysis tools:** NŞ, TBF, RB, BS, FNG, AA, HA, MÇ, MBA; **Wrote the manuscript:** NŞ, TBF, RB, BS, FNG, AA, HA, MÇ, MBA, MD; **Final edit of paper:** NŞ.

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Clinical Validation of a Custom Wearable Patch for Accurate and Comfortable Vital Sign Monitoring in Pediatric Patients

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ABSTRACT

Background/Purpose: Measuring vital signs in pediatric patients requires special consideration and adaptation due to varying anatomy and wide age range. In addition, children's anxiety, uncooperativeness, and high activity levels further complicate measurements, necessitating devices and algorithms designed to minimize the inaccuracies and discomfort. In this work, the performance of a custom wearable patch mounted on the mid-sternum was validated in uncontrolled settings on a cohort including 84 pediatric patients.

Methods: Three-minute-long electrocardiogram (ECG), seismocardiogram (SCG) and photoplethysmogram (PPG) signals were acquired using the custom patch. First, pre-processing and signal smoothing algorithms were employed to suppress the out-of-band and motion noise. Two different tasks were then studied: (i) Heart rate (HR) and respiration rate were derived from the ECG, PPG and SCG signals individually. During HR derivation from the SCG, a novel Teager-energy-based HR estimation algorithm was proposed. (ii) Clinical relevance of the SCG signals was shown through mapping the SCG characteristics to body mass index (BMI) and blood pressure values.

Results: While the best HR estimation was achieved through the PPG-infrared signal with an absolute error of 2.2 ± 2.1 bpm, the best respiration estimation was achieved with PPG-Red signal with an error of 2.6 ± 2.2 breaths/min. On the other hand, regression models resulted in a minimum of 85% confidence interval, revealing that the SCG characteristics indeed have salient correlation with the BMI and blood pressure values.

Conclusion: Overall, the proposed patch and corresponding algorithms could potentially be leveraged for measuring vital signs from pediatric patients in clinical settings by minimizing the inaccuracies and discomfort encountered.

Keywords: Biomedical signal processing; Hemodynamic parameters; Wearable systems; Electrocardiogram; Seismocardiogram; Photoplethysmogram

ÖZET

Amaç: Pediatrik hastalarda yaşamsal parametrelerin ölçülmesi, değişken anatomi ve geniş yaş aralığı nedeniyle özel dikkat ve adaptasyon gerektirmektedir. Buna ek olarak, çocukların anksiyetesi, yeterince işbirliği yapmaması ve yüksek aktivite seviyeleri ölçümleri daha da karmaşık hale getirmektedir. Bu nedenle hataları ve kullanıcı rahatsızlığını en aza indirmek için tasarlanmış cihazlara ve algoritmalara büyük bir ihtiyaç vardır. Bu çalışmada, 84 pediatrik hastayı içeren bir kohort üzerinde, kontrolsüz ortamlarda, orta sternuma yerleştirilen özel bir giyilebilir yamanın performansı valide edilmiştir.

Yöntem: Yama kullanılarak üç dakikalık elektrokardiyogram (EKG), sismokardiyogram (SCG) ve fotopletizmogram (PPG) sinyalleri kaydedilmiştir. İlk olarak, bant dışı ve hareket gürültüsünü bastırmak için ön işleme ve sinyal yumuşatma algoritmaları kullanılmıştır. Ardından iki farklı analiz üzerinde çalışılmıştır: (i) Nabız ve solunum hızı, EKG, PPG ve SCG sinyallerinden ayrı ayrı türetilmiştir. SCG'den nabız türetme sırasında, yeni bir Teager-enerji tabanlı HR tahmin algoritması önerilmiştir. (ii) SCG sinyallerinin klinikte kullanılabilirliği, SCG özelliklerinin vücut kitle indeksi (BMI) ve kan basıncı değerleriyle eşleştirilmesiyle değerlendirilmiştir.

Bulgular: En iyi nabız tahmini 2.2 ± 2.1 bpm mutlak hata ile PPG-kızılötesi sinyali ile elde edilirken, en iyi solunum tahmini 2.6 ± 2.2 nefes/dak hata ile PPG-Kırmızı sinyalden elde edilmiştir. Öte yandan, regresyon modelleri minimum %85 güven aralığıyla sonuçlanmış ve SCG özelliklerinin BMI ve kan basıncı değerleri ile belirgin bir korelasyona sahip olduğunu ortaya koymuştur.

Sonuç: Önerilen yama ve ilgili algoritmalar, klinik ortamlarda karşılaşılan yanlışlıkları ve rahatsızlıkları en aza indirerek pediatrik hastaların yaşamsal belirtilerini ölçmek için potansiyel olarak kullanılabilir.

Anahtar Kelimeler: Biyomedikal sinyal işleme; Hemodinamik parametreler; Giyilebilir sistemler; Elektrokardiyogram; Sismokardiyogram; Fotopletizmogram

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Each year, pediatric clinics around the world admit millions of young patients, encompassing a diverse spectrum of medical needs and conditions. Based on the National Health Interview Survey reported by the Centers for Disease Control and Prevention, 95.0% of the children had a visit with a health care professional in 2023 (1). The clinical assessments during these visits often involve assessing vital signs like heart rate, respiration, blood pressure, and temperature, along with heart, lung, and vascular evaluations. Such assessments support accurate diagnosis, monitor treatment, and help ensure the well-being of pediatric patients globally (2, 3).

Measuring vital signs in pediatric patients presents unique challenges, as devices designed for adults may not be suitable for children's smaller size, wider age range (from newborns to adolescents) and anatomical features (4). Indeed, pediatric devices tend to be less advanced and available compared to adult devices, often trailing by up to around 10 years in technological development (5). Second, children may be anxious or uncooperative during vital sign assessments, introducing motion artifacts and affecting the reliability of readings (2). It has been found that 91% of children reported fear related to medical procedures, with 28% associating clinical exams with pain and 29% being scared of nursing activities (6). Thus, devices and algorithms for pediatric population should be designed in a way that the discomfort and inaccuracies are minimized.

Physiological signals like the electrocardiogram (ECG), seismocardiogram (SCG) and photoplethsmogram (PPG) are essential in wearables, as they directly originate from the underlying physiology. The ECG assesses the heart's electrical activity, while the SCG detects vibrations originating from heart contractions, with peaks and valleys reflecting cardiac events like aortic opening (AO), mitral closing (MC), etc. (7). Recent studies have utilized the SCG signal for various applications, ranging from estimating hemodynamic parameters to assessing valvular heart diseases (8-13). Finally, the PPG detects changes in light absorption caused by variations in arterial blood volume during the cardiac cycle. Analyzing PPG provides insights into blood oxygen levels, blood pressure, and vascular resistance (14-16). Thus, integrating physiological signals into wearable devices is a major advancement in

healthcare, enhancing preventive care and supporting better health outcomes worldwide (17).

In this work, *for the first time*, the performance of a custom wearable patch was investigated in *uncontrolled settings* on a cohort including 84 pediatric patients visiting Koc University Hospital. The study involved the continuous acquisition of 3-minute-long ECG, tri-axial SCG and PPG (red and infra-red) signals. After pre-processing, heart rate (HR) and respiration rate were calculated using novel signal processing pipelines. Clinical relevance was assessed by performing regression analyses that mapped SCG features to body mass index (BMI) and blood pressure values.

Material and Methods

In this work, we adapted our previously developed custom wearable patch and, *for the first time*, validated its clinical performance in uncontrolled settings on a cohort including 84 pediatric patients visiting Koc University Hospital from March to April 2024. Figure 1 shows the patch's hardware layers and attachment locations.

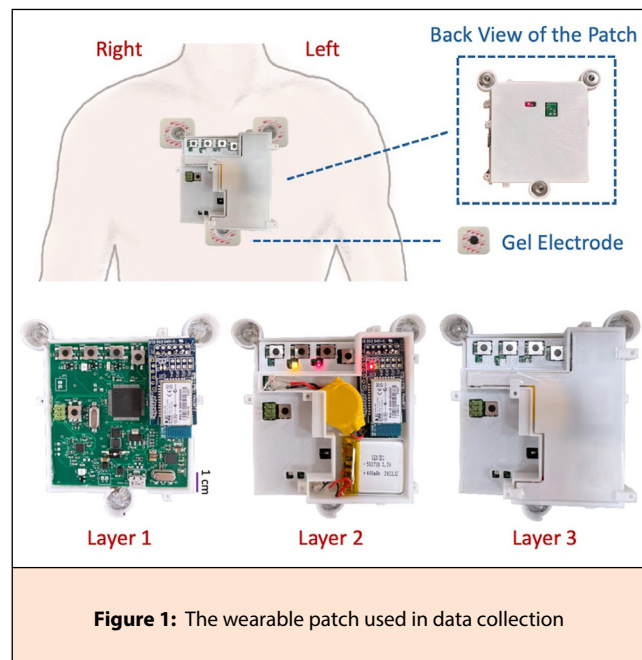


Figure 1: The wearable patch used in data collection

2.1 Custom Hardware

The SCG and PPG were acquired using an ADXL355 accelerometer (at 500 Hz) and a MAX30102 sensor (at 200

Hz), respectively. The ECG was recorded with an AD8232 analog front-end integrated circuit, through three gel electrodes to form Einthoven's triangle. Skin temperature was measured using an LMT70A sensor. The ECG and temperature were sampled at 500 Hz and 25 Hz with 10-bit resolution. As the microcontroller, ATMEGA2560 was used. Data was written to a file on a microSD card, with file naming controlled by the DS3231 real-time clock. The system ran on a 400 mAh Lithium-Polymer battery, charged via an LTC4062 charger, with hardware interrupts for optimized power management. The hardware and firmware specifications are detailed in (18).

2.2 Data Collection Protocol

The study was conducted under a protocol approved by the Koc University Institutional Review Board (2023.408. IRB2.089) and all parents/guardians have provided their written consent. 84 children were participated in the study. Before data collection, the baseline values for the body temperature, oxygen saturation (SpO₂), heart rate (HR), and systolic and diastolic blood pressures (SBP and DBP) were measured. The demographics and baseline hemodynamic parameters are presented in Table I.

Table 1: Subject demographics (mean \pm std)		
Age (years)	Weight (kg)	Height (cm)
9.1 \pm 4.3	33.9 \pm 18.3	131.4 \pm 26.3
BMI (kg/m ²)	Gender	Chronic Disease
18.1 \pm 3.9	50.0 % Female	26.6 % Yes
	50.0 % Male	71.4 % No
Heart Rate (bpm)	Temperature (Celsius)	SpO ₂ (%)
103.8 \pm 22.7	37.0 \pm 0.6	96.7 \pm 3.6
Respiration Rate (breaths/min)	Systolic BP (mmHg)	Diastolic BP (mmHg)
23.4 \pm 4.1	109.4 \pm 14.0	74.4 \pm 12.5

Data collection took place in a room in pediatric clinic without specific environmental restrictions, as factors like sound, humidity, and lighting did not impact the signals. The patch was placed on the mid-sternum using three gel electrodes, and to minimize motion artifacts, subjects sat still in a relaxed state for three minutes. The ECG, SCG and PPG signals were acquired continuously with sampling rates of 500, 500 and 200 Hz, respectively. The start and end moments of the three-minute period were determined by gently tapping on the patch, generating two distinct peaks on the SCG signals. The challenges regarding the clinical implementation are covered in the Discussion section.

Analyses were conducted on the entire dataset, followed by sub-group analyses based on:

- *Age groups*: Pre-school ($y < 6$, $n = 20$, 4.2 ± 1.3), Elementary-school ($6 \leq y < 11$, $n = 37$, 8.0 ± 1.2), Middle-school ($11 \leq y < 14$, $n = 8$, 11.3 ± 0.7), and High-school ($14 \leq y \leq 18$, $n = 19$, 15.7 ± 1.3).
- *Gender*: 42 subjects each for female and male groups.
- *Chronic disease status*: 24 subjects with chronic disease and 60 without

2.3 Signal Pre-Processing

After data collection, signal processing pipelines for estimating hemodynamic parameters were developed (Figure 2(a)). The signals were filtered with Kaiser window FIR bandpass filters to reduce noise while maintaining signal integrity. To calculate the heart rate, cut-off frequencies of 1-15 Hz for PPG, 0.5-40 Hz for ECG, and 1-40 Hz for SCG were used as per the literature (19, 20). Figure 3 shows representative four-second segments of filtered ECG, SCG, and PPG signals from one subject.

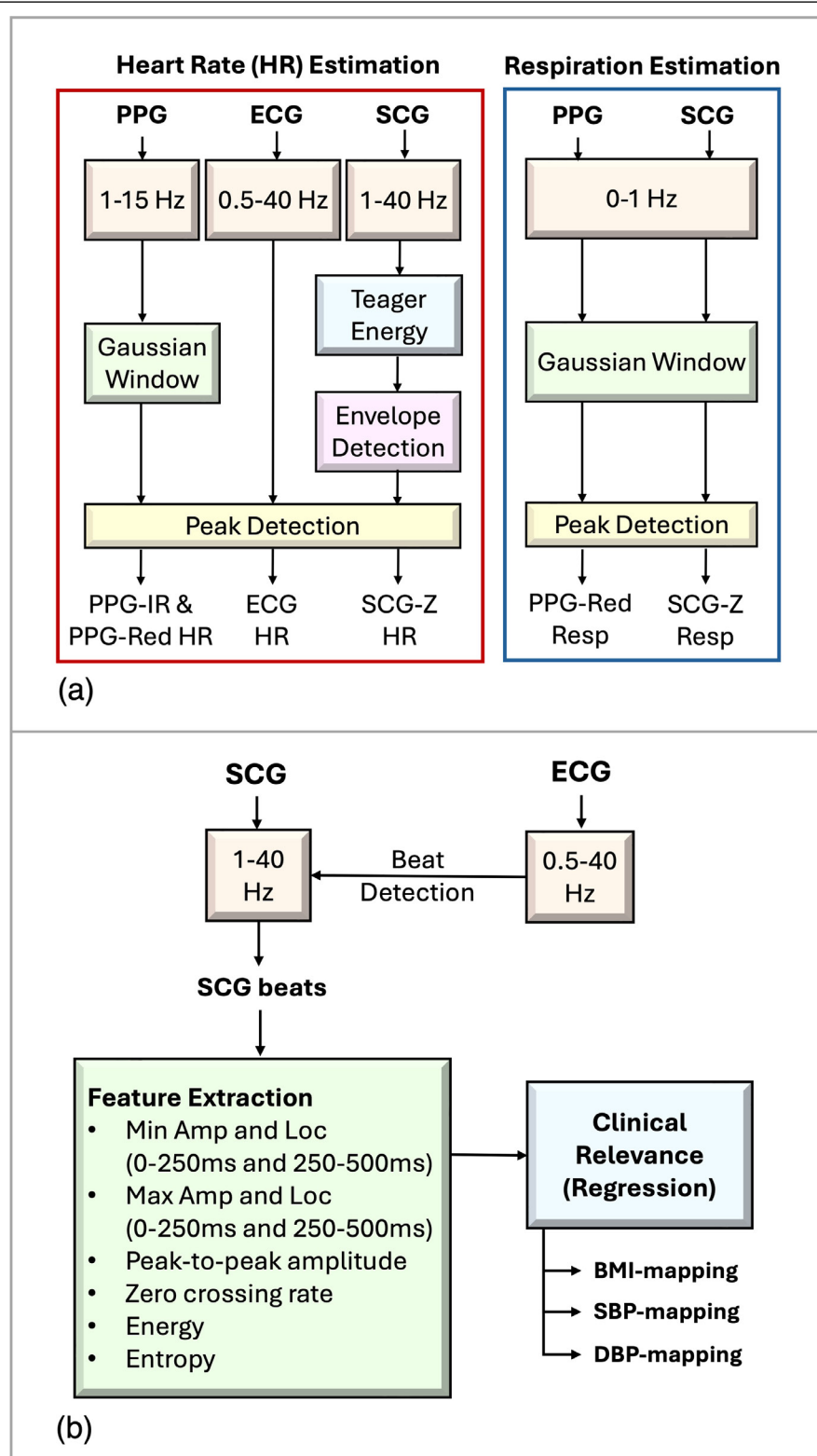


Figure 2: (a) Pre-processing and signal processing pipelines for the estimation of hemodynamic parameters

(b) Pre-processing and signal processing pipelines for the clinical relevance assessment tasks,

Min: minimum, Max: maximum, Amp: amplitude, Loc: location, BMI: body mass index, SBP: systolic blood pressure, DBP: diastolic blood pressure

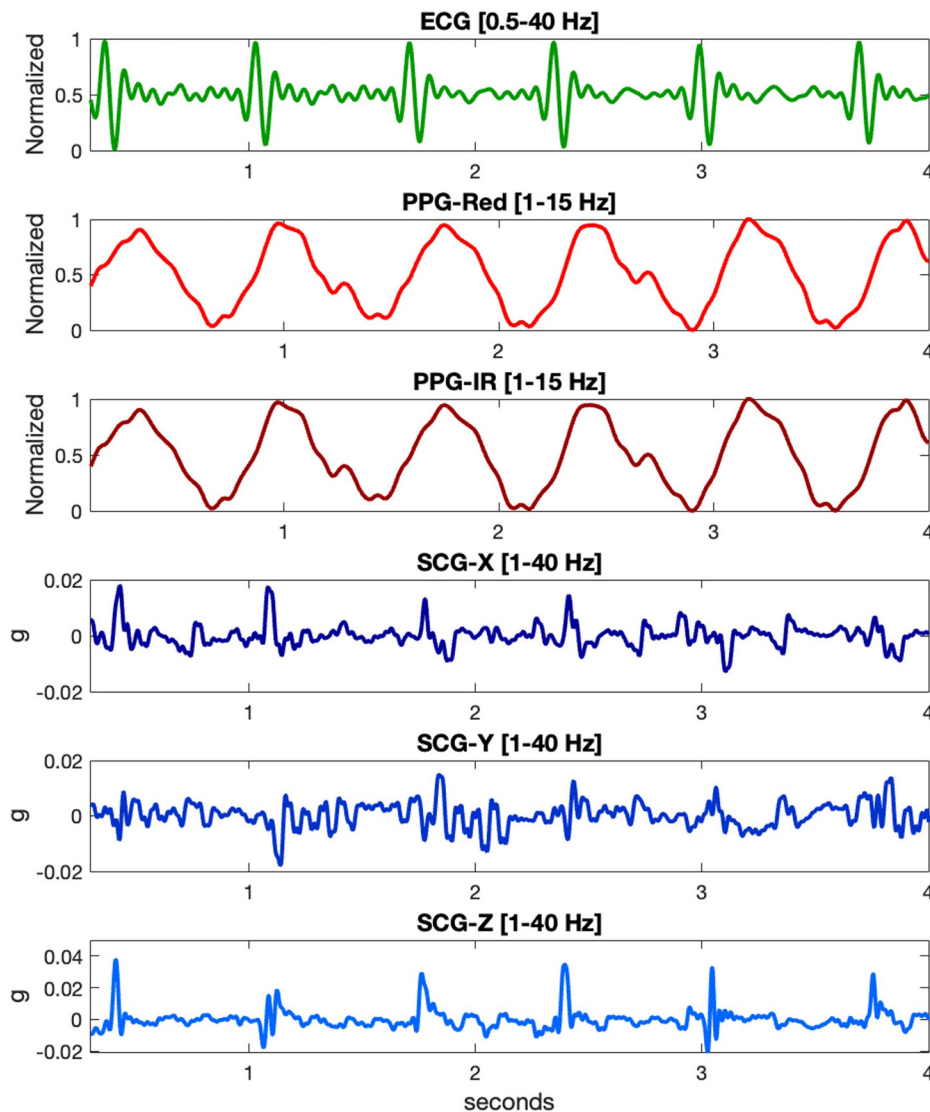


Figure 3: Four-second long segments of the collected signals

On the other hand, the frequencies below 1 Hz represent the respiration information corresponding to the respiration-induced chest movements (21). Hence, while extracting respiratory information from the SCG and PPG signals, the original raw signals were filtered using an upper cut-off frequency as 1 Hz. The PPG and SCG signals were then Gaussian filtered to remove the motion artifacts for ease of peak detection. The Gaussian window was applied to the signal, averaging the points to smooth high-frequency noise while retaining signal characteristics. The Gaussian window and width factor (α) values were determined heuristically to ensure that the signals were not over-smoothed (losing fiducial points) or under-smoothed (having redundant fluctuations). For the PPG

and SCG signals, the window size and width factor pairs were selected as (25, 2.3) and (250, 2.3), respectively, in alignment with the corresponding sampling rates.

2.4 Estimation Hemodynamic Parameters

2.4.1 Estimation of Heart Rate from ECG and PPG Signals

To compute the HR values from the collected signals, the following steps were implemented:

1. As the reference values, the baseline HR measurements acquired prior to data collection were used.

1. For the ECG-based computation, the filtered signal (0.5-40 Hz) was first normalized. Then, the R-peaks were detected with a simple peak detection algorithm (minimum peak height: 0.6, minimum peak distance: 0.33 of the sampling rate). The consecutive R-peak intervals formed an RR difference vector, which was used to calculate heart rate (HR) in beats per minute (bpm) using Equation 1.
2. For the PPG-based computation, the time intervals between the consecutive peaks on the filtered (1-15 Hz) and Gaussian-windowed red and infrared PPG signals were computed, and stored as a PP difference vector, similar to the ECG case.
3. Equations 2 and 3 were used to calculate the mean absolute error (MAE) and percentage error, where 'actual' refers to the reference HR values and 'calculated' refers to the HR values derived from the ECG, PPG-red, and PPG-infrared signals (F_s : sampling rate, std : standard deviation).

$$HR = \frac{60 \cdot F_s}{\text{mean}(RR)} \quad (1)$$

$$MAE = |\text{actual} - \text{calculated}| \quad (2)$$

$$\% \text{ error} = \frac{|\text{actual} - \text{calculated}|}{\text{actual}} * 100 \quad (3)$$

2.4.2 Teager-Operator-based Heart Rate Estimation from SCG Signals

The Teager energy operator, derived from the energy of an oscillator, detects instantaneous changes in signals, such as amplitude variations, frequency shifts, or discontinuities (22). In our previous work, the Teager operator was leveraged to locate the clicks in the joint sound signals acquired from the children with juvenile idiopathic arthritis (23). When an SCG signal is considered, detecting the aortic opening (AO) points using a simple peak detection algorithm can be challenging as (i) there are additional neighboring peaks representing mitral closing (MC) and aortic closing (AC) moments, and (ii) there are added noise due to motion artifacts and signal variability, which make AO points more subtle. Hence, we hypothesized that the Teager energy operator could accurately locate AO points, even when simple peak detection algorithms fail.

For any discrete-time signal x , the Teager energy at time n is calculated using the three consecutive samples of the signal as in Equation 4.

$$\Psi_{TE}[n] = x[n]^2 - x[n+1]x[n-1] \quad (4)$$

In this work, the Teager energy of the filtered SCG-Z signal (1-40 Hz) was calculated (Equation 4). The upper envelope of the Teager operator was then generated to emphasize significant peaks representing the AO points. The time intervals between consecutive spikes were computed, and their mean value was used to calculate the HR (Equation 1). Error calculations were done using Equations 2 and 3.

2.4.3 Estimation of Respiration

To calculate the respiration rate, two different approaches (SCG-Z-based and PPG-Red-based) were used. PPG-Red was chosen over PPG-IR, as it is less prone to motion artifacts due to relatively lower wavelength. As previously explained, both signals were filtered between 0-1 Hz and smoothed with a Gaussian window. Peak-to-peak intervals were then calculated, with the peak-valley transitions corresponding to exhalation-inhalation cycles, where each peak-to-peak duration represents a full respiration cycle. The resulting peak-to-peak vector was then used in an equation similar to Equation 1, and respiration rate in breaths/min was calculated. The errors were again calculated using Equations 2 and 3.

2.4.4 Investigating the Clinical Relevance of SCG

The clinical relevance of SCG signal characteristics was assessed by correlating them with physiological parameters (Figure 2(b)). The R-peaks from the ECG (0.5-40 Hz) were leveraged to divide the SCG-Z (1-40 Hz) into individual beats, each truncated to the minimum R-R interval length. A total of 13,603 SCG-Z beats from 84 subjects were analyzed, extracting 12 temporal features per beat (24): the minimum and maximum amplitudes and corresponding locations within the systolic (0-250ms) and diastolic (250-500ms) portions, peak-to-peak amplitude, energy, entropy and zero-crossing rate. Three XGBoost regression models were trained to map the SCG characteristics to body mass index (BMI), systolic blood pressure (SBP), and diastolic blood pressure (DBP), with performances validated using 5-fold cross-validation and assessed by mean absolute percentage error (MAPE).

Results

3.1 Estimation of Heart Rate from ECG and PPG Signals

The absolute and percentage errors for ECG and PPG-based calculations were presented in Table 2, and

the boxplots for absolute errors are shown in Figure 4. While the ECG-derived resulted in an absolute and percentage errors of 4.9 ± 6.7 bpm and 4.7 ± 6.8 %, respectively; these values were 2.5 ± 2.4 bpm and 2.3 ± 1.9 % for the PPG-Red, and 2.2 ± 2.1 bpm and 2.1 ± 1.9 % for the PPG-IR.

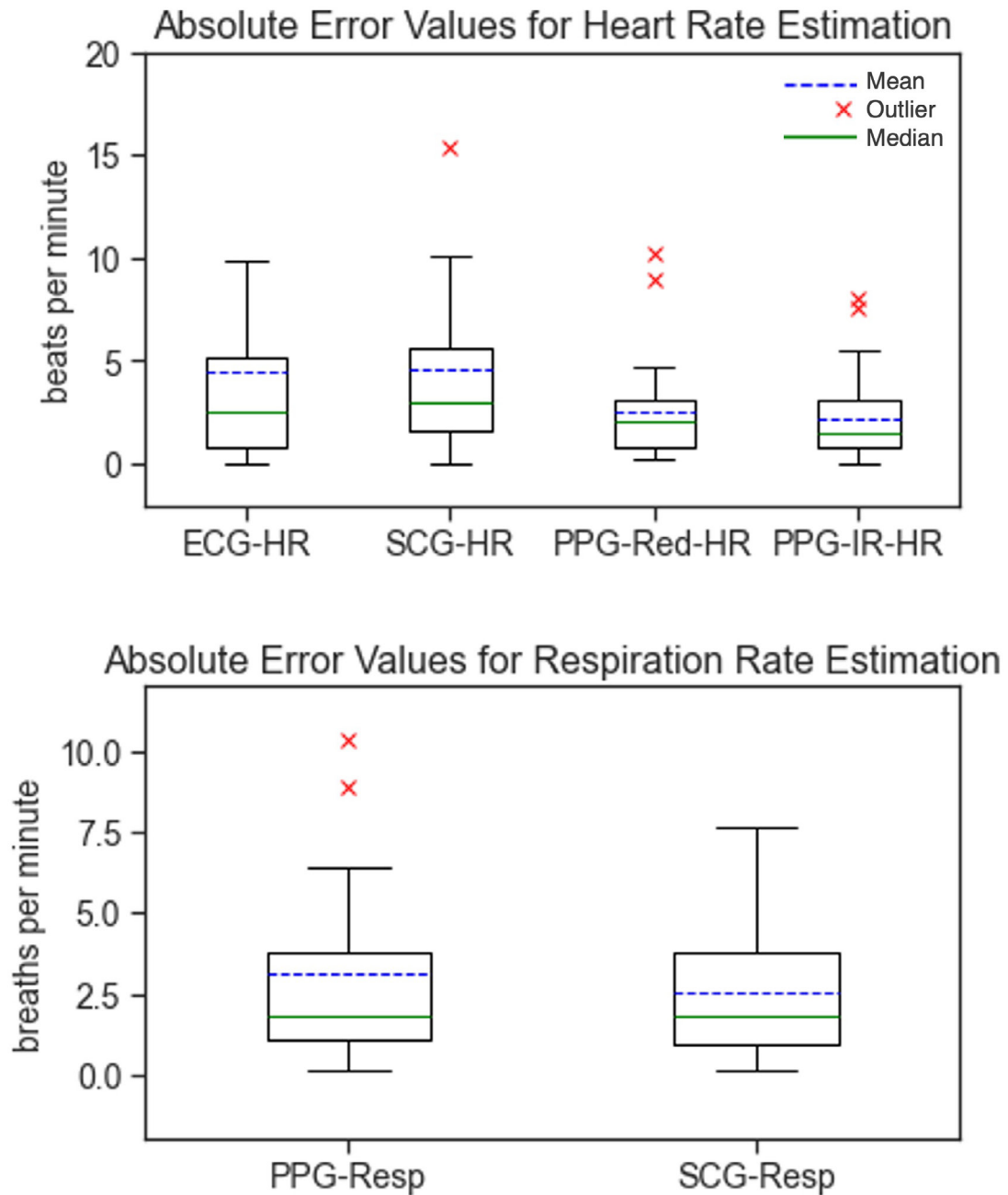


Figure 4: Box plots representing the absolute error values for heart rate and respiration rate estimation tasks.

3.2 Teager-Operator-based Heart Rate Estimation from SCG Signals

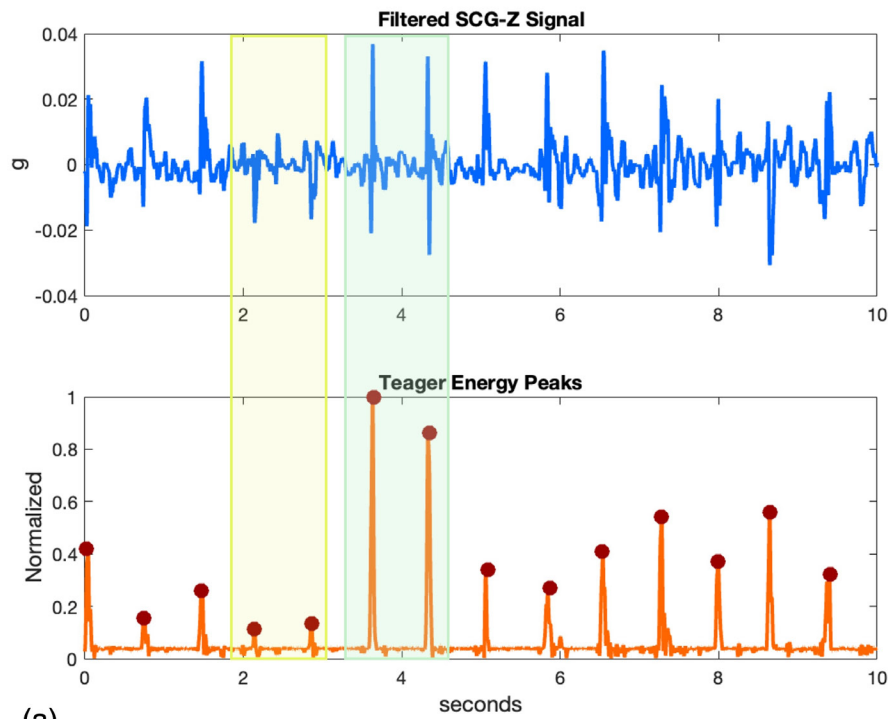
Figure 5(a) shows a 10-second SCG signal and its Teager energy plot. While some SCG segments (green box) were clean enough for accurate peak detection, others (yellow box) contained motion noise. Direct peak detection in the noisy regions would thus be unreliable, but the Teager operator successfully identified the AO peaks in these areas, allowing for accurate HR computation. Our algorithm yielded absolute and percentage errors of 4.6 ± 5.4 bpm and 4.4 ± 6.0 %, respectively (Table 2). This result was indeed comparable to the one obtained from ECG and suggests a confidence interval of at least 95%. The corresponding boxplots for absolute errors are shown in Figure 4.

3.3 Estimation of Respiration

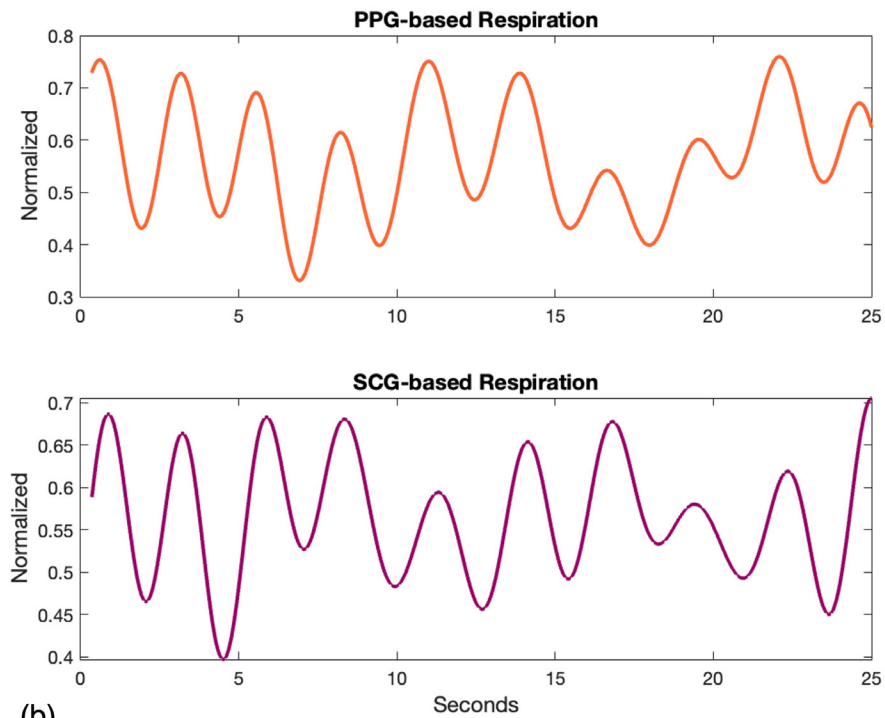
To derive the respiration information, an SCG-Z-based and PPG-Red-based derivation pipelines were used and compared. Sample five-second-long segments from the resulting signals are presented in Figure 5(b). As seen, the oscillation patterns are the same with a slight variance in the amplitude values. This was expected as the sensors are located in different regions on the patch. The estimated respiration rates are presented in Table 2. While the respiration rate estimated from PPG-Red resulted in an absolute error and percentage error of 2.6 ± 2.2 breaths/min and 11.5 ± 10.3 %; these results were 3.1 ± 3.2 breaths/min and 12.9 ± 11.1 % for the SCG-Z-based derivation.

Table 2: Estimated Cardiovascular Parameters (mean \pm std) and results for the regression tasks

	Absolute Error	Percentage Error
ECG HR	4.9 ± 6.7 bpm	4.7 ± 6.8 %
PPG-Red HR	2.5 ± 2.4 bpm	2.3 ± 1.9 %
PPG-IR HR	2.2 ± 2.1 bpm	2.1 ± 1.9 %
SCG HR	4.6 ± 5.4 bpm	4.4 ± 6.0 %
PPG-Red Respiration	2.6 ± 2.2 breaths/min	11.5 ± 10.3 %
SCG-Z Respiration	3.1 ± 3.2 breaths/min	12.9 ± 11.1 %
Clinical Relevance (Regression Task)		
	5-fold Train MAPE	5-Fold Test MAPE
BMI-mapping	11.3% error (88.7% confidence)	14.4% error (85.6% confidence)
SBP-mapping	9.7% error (90.3% confidence)	11.5% error (88.5% confidence)
DBP-mapping	9.2% error (90.8% confidence)	11.1% error (88.9% confidence)



(a)



(b)

Figure 5: (a) Teager energy operator of a 10-second long SCG segment and detected beats, (b) Five-second long respiration signals derived from SCG and PPG signals

3.4 Investigating the Clinical Relevance of SCG

For the BMI-, SBP- and DBP-mapping tasks, the train and test MAPE pairs were (11.3%, 14.4%), (9.7%, 11.5%) and (9.2%, 11.1%), respectively (Table 2). Overall, all models resulted in a minimum of 85% confidence interval, revealing that the SCG characteristics indeed have salient correlation with the BMI, SBP and DBP values.

Sub-group results revealed a general decrease in error rates for both heart rate and respiration rate measurements as age increases (Table 3). When the effect of gender was investigated, male patients showed relatively lower errors in heart rate estimation and regression tasks, while females exhibited lower errors in respiration rate analysis (Table 4). On the other hand, for all analyses, patients with chronic disease resulted in lower errors compared to the ones not having.

Table 3: Sub-group Analysis for Different Age Groups (mean \pm std)

Pre-School (y < 6)		Heart Rate			
		ECG	SCG	PPG-Red	PPG-IR
	Abs err	8.1 ± 10.1 bpm	7.3 ± 8.4 bpm	5.1 ± 4.3 bpm	3.3 ± 3.4 bpm
	% error	7.7 ± 11.0 %	6.6 ± 9.1 %	3.9 ± 3.1 %	2.8 ± 2.7 %
Elem-School (6 ≤ y < 11)	Abs err	4.6 ± 6.2 bpm	4.0 ± 4.5 bpm	1.7 ± 1.3 bpm	1.4 ± 1.0 bpm
	% error	4.2 ± 5.6 %	3.8 ± 4.2 %	1.6 ± 1.1 %	1.3 ± 0.9 %
Mid-School (11 ≤ y < 14)	Abs err	3.6 ± 2.9 bpm	4.7 ± 3.3 bpm	3.2 ± 1.4 bpm	5.9 ± 2.9 bpm
	% error	3.5 ± 2.8 %	4.3 ± 3.2 %	3.0 ± 1.9 %	5.5 ± 3.4 %
High-School (14 ≤ y ≤ 18)	Abs err	2.9 ± 3.1 bpm	3.3 ± 4.3 bpm	2.1 ± 1.3 bpm	2.3 ± 1.2 bpm
	% error	3.3 ± 4.3 %	3.9 ± 6.8 %	2.3 ± 1.7 %	2.5 ± 1.6 %
Pre-School (y < 6)		Respiration Rate			
		SCG		PPG	
	Abs err	5.0 ± 3.0 breath/min		7.3 ± 4.8 breath/min	
	% error	19.3 ± 11.5 %		26.4 ± 14.8 %	
Elem-School (6 ≤ y < 11)	Abs err	2.1 ± 1.7 breath/min		2.2 ± 1.6 breath/min	
	% error	10.1 ± 10.2 %		10.1 ± 7.4 %	
Mid-School (11 ≤ y < 14)	Abs err	3.4 ± 2.7 breath/min		2.7 ± 1.4 breath/min	
	% error	17.4 ± 12.8 %		14.1 ± 6.4 %	
High-School (14 ≤ y ≤ 18)	Abs err	1.3 ± 0.7 breath/min		2.0 ± 2.6 breath/min	
	% error	5.7 ± 3.2 %		8.4 ± 10.8 %	
Pre-School (y < 6)		Clinical Relevance (Regression Task) – 5 fold			
		SBP	DBP	BMI	
	Train Mape	4.8 ± 0.6 %	9.2 ± 1.2 %	4.9 ± 0.1 %	
	Test Mape	6.5 ± 0.5 %	11.9 ± 0.8 %	6.8 ± 0.5 %	
Elem-School (6 ≤ y < 11)	Train Mape	6.2 ± 0.5 %	7.9 ± 0.1 %	9.1 ± 0.1 %	
	Test Mape	7.9 ± 0.3 %	10.4 ± 0.5 %	12.0 ± 0.5 %	
Mid-School (11 ≤ y < 14)	Train Mape	4.6 ± 0.4 %	3.9 ± 0.1 %	4.4 ± 0.1 %	
	Test Mape	5.4 ± 0.2 %	5.5 ± 0.6 %	6.1 ± 0.3 %	
High-School (14 ≤ y ≤ 18)	Train Mape	3.9 ± 0.1%	4.9 ± 0.1 %	8.4 ± 0.1 %	
	Test Mape	5.3 ± 0.3 %	6.4 ± 0.2 %	11.3 ± 0.5 %	

Table 4: Sub-group Analysis for Different Genders and Chronic Disease Conditions (mean \pm std)

GENDER-BASED GROUPING		Heart Rate			
		ECG	SCG	PPG-Red	PPG-IR
Female	Abs err	5.2 ± 6.7 bpm	5.2 ± 5.4 bpm	3.0 ± 2.9 bpm	2.3 ± 2.0 bpm
	% error	5.4 ± 7.7 %	5.4 ± 6.9 %	2.6 ± 2.1 %	2.3 ± 2.1 %
Male	Abs err	4.5 ± 6.6 bpm	3.9 ± 5.5 bpm	1.9 ± 1.4 bpm	2.2 ± 2.1 bpm
	% error	4.0 ± 5.7 %	3.3 ± 4.7 %	1.9 ± 1.5 %	1.9 ± 1.6 %
DISEASE-BASED GROUPING		Heart Rate			
		ECG	SCG	PPG-Red	PPG-IR
Chronic Disease	Abs err	2.7 ± 2.6 bpm	3.2 ± 3.7 bpm	1.3 ± 1.2 bpm	1.7 ± 1.2 bpm
	% error	2.8 ± 3.6 %	3.6 ± 5.7 %	1.3 ± 1.3 %	1.6 ± 1.1 %
NO Chronic Disease	Abs err	5.9 ± 7.6 bpm	5.2 ± 6.0 bpm	2.8 ± 2.5 bpm	2.4 ± 2.2 bpm
	% error	5.6 ± 7.7 %	4.8 ± 6.1%	2.5 ± 1.9 %	2.2 ± 2.1 %
GENDER-BASED GROUPING		Respiration Rate			
		SCG	PPG		
Female	Abs err	2.5 ± 2.4 breath/min	2.9 ± 3.1 breath/min		
	% error	11.6 ± 12.1 %	12.2 ± 11.1 %		
Male	Abs err	2.6 ± 2.1 breath/min	3.4 ± 3.3 breath/min		
	% error	11.4 ± 8.3 %	13.9 ± 11.0 %		
DISEASE-BASED GROUPING		Respiration Rate			
		SCG	PPG		
Chronic Disease	Abs err	1.9 ± 2.3 breath/min	0.2 ± 0.1 breath/min		
	% error	10.7 ± 15.1 %	4.3 ± 4.5 %		
NO Chronic Disease	Abs err	2.7 ± 2.2 breath/min	3.7 ± 3.3 breath/min		
	% error	11.7 ± 9.0 %	15.3 ± 11.2 %		
GENDER-BASED GROUPING		Clinical Relevance (Regression Task) – 5 fold			
		SBP	DBP	BMI	
Female	Train Mape	9.5 ± 0.4 %	8.4 ± 0.1 %	10.4 ± 0.1 %	
	Test Mape	11.2 ± 0.3 %	11.1 ± 0.3 %	13.9 ± 0.5 %	
Male	Train Mape	7.5 ± 0.7 %	6.1 ± 0.1 %	9.9 ± 0.1 %	
	Test Mape	9.4 ± 0.2 %	8.3 ± 0.2 %	12.9 ± 0.3 %	
DISEASE-BASED GROUPING		Clinical Relevance (Regression Task) – 5 fold			
		SBP	DBP	BMI	
Chronic Disease	Train Mape	5.9 ± 0.1 %	7.1 ± 0.1 %	10.5 ± 0.1%	
	Test Mape	8.1 ± 0.3 %	9.5 ± 0.5 %	12.4 ± 5.7 %	
NO Chronic Disease	Train Mape	10.2 ± 0.2 %	9.1 ± 0.1 %	10.5 ± 0.1%	
	Test Mape	12.1 ± 1.7 %	11.1 ± 0.4 %	13.6 ± 0.4 %	

Discussion

PPG-derived HR trials resulted in lower errors than ECG-derived HR, contrary to the expectations. This may be due to two factors: (i) The ECG signal quality was compromised by motion and contact loss between the skin and electrodes, as children often get nervous and sweat in clinical settings. (ii) PPG signals were smoothed with a Gaussian window, reducing oscillations and noise while preserving key peaks, making peak detection more accurate.

On the other hand, deriving HR from SCG has always been challenging due to the noise from movement and complex waveform. Additionally, it contains multiple neighbouring

peaks corresponding to various cardiac phases, making AO point identification difficult. Our proposed approach's superior performance has been compared with the common methods in the literature as well (Table 5). These methods were including direct peak detection, template matching with correlation computation (25) and wavelet decomposition (26). Among these, the closest results were obtained when wavelet decomposition was used, whereas template matching and direct peak detection suffered from inaccuracies due to motion-related variation in the SCG morphology. Hence, given SCG's common use in wearable systems, this Teager-based method can enhance vital parameter monitoring while reducing computational and hardware demands.

Table 5: Comparison with the literature for the SCG-based HR methods

METHOD		Absolute Error	% Error
Direct Peak Detection	Without envelope	6.4 ± 6.2 bpm	6.1 ± 6.2 %
	With envelope	5.9 ± 7.1 bpm	5.8 ± 7.4 %
Template Matching with Correlation Computation (25)		16.1 ± 14.9 bpm	17.3 ± 19.7 %
Wavelet Decomposition (26)	Without envelope	5.6 ± 7.2 bpm	5.7 ± 7.7 %
	With envelope	5.5 ± 7.1 bpm	5.5 ± 7.5 %
Teager Energy Operator	Without envelope	5.8 ± 7.4 bpm	5.6 ± 7.9 %
	With envelope	4.6 ± 5.4 bpm	4.4 ± 6.0 %

In respiration derivation, both SCG- and PPG-based methods showed similar performance, with the PPG-Red method slightly outperforming SCG-Z. The 3-breath error could be attributed to signal quality, but another factor might be the reliability of the reference measurement. The reference respiration rate was determined using manual breath counting rather than a digital tool, which could have introduced inaccuracies that were reflected in the algorithm's output.

The clinical relevance of SCG was also observable in the BMI and blood pressure mapping models.

The transmission of vibrations from the heart to the accelerometer is influenced by various tissues such as bone, muscle, fat, and skin, whose composition and thickness vary across individuals (27). These anatomical differences impact SCG characteristics, which were observed in our BMI estimation results in parallel. Similarly, the SBP and DBP estimation tasks resulted in satisfactory performance. As previously explained, the

peaks and valleys of the SCG signal represent cardiac valve movements, similar to the blood pressure waveform where the valleys mark aortic valve opening (diastolic pressure) and the dicrotic notch corresponds to aortic valve closure. Literature demonstrates that time differences between fiducial points in the ECG, SCG, and PPG signals can be used in pulse arrival time (PAT) and pulse transit time (PTT)-based blood pressure estimation (28-30). However, these approaches require two different signals to derive the blood pressure values. On the other hand, in our work, we showed that the SCG signal features could directly be mapped to blood pressure values, without requiring any additional signals. This might potentially contribute to alleviate the computational or hardware-related needs.

When sub-groups results were investigated, PPG methods showed lower errors across all age groups in all tasks. For SBP, DBP, and BMI analyses, older children (middle and high school) exhibited lower error rates, suggesting more stable measurements. When gender results were investigated, anatomical differences, particularly the

higher fat-to-muscle ratio in females, affect patch placement and signal quality in HR estimation, though this anatomical variation may improve respiration rate accuracy by enhancing chest expansion detection. Lastly, patients with chronic diseases exhibit significantly lower errors across all measurement methods compared to those without chronic conditions, suggesting more coherent signals and improved model performance, likely due to more consistent physiological responses.

Limitations and Challenges

The study was limited by the relatively small sample size and imbalance across age sub-groups, which may affect the generalizability across and comparability within specific demographic categories. Future work should focus on validating the system with larger, more diverse datasets, including subjects with varying clinical conditions and demographics. Additionally, incorporating longitudinal data could offer insights into the system's long-term effectiveness across different pediatric populations.

A key challenge for clinical implementation is ensuring data accuracy and reliability. Factors such as device placement, sensor quality, and patient movement can lead to inconsistent readings. Children's nervousness can result in sweating and excessive motion, causing electrode contact loss, affecting data quality and creating intra- and inter-subject variability. Additionally, some children and parents expressed concerns about the wearable patch's unfamiliarity and potential long-term effects, which may hinder acceptance and implementation. Addressing these concerns requires targeted education and reassurance to improve user confidence and adherence.

Conclusion

In this study, the performance of our custom wearable patch was evaluated in uncontrolled settings with 84 pediatric patients at Koc University Hospital. The first part involved computing hemodynamic parameters such as heart rate and respiration rate from ECG, PPG, and SCG signals. The second part assessed the clinical relevance by using regression analyses to correlate SCG characteristics with BMI, DBP and SBP. Future work will focus on refining the algorithms and validating the patch's effectiveness in disease monitoring and treatment.

Declarations

Funding

This work was supported by the Scientific and Technological Research Council of Turkey (Grant Number: 121E133).

Conflicts of interest/Competing interest

The authors do not have any conflict of interest or competing interest to disclose.

Ethics Approval

The study was conducted under a protocol approved by the Koc University Institutional Review Board (2023.408. IRB2.089) and all parents/guardians have provided their written consent.

Availability of data and material

The data is not publicly available due to ethical reasons.

Authors contributions

B.S.: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing – original draft, Writing – review and editing, Visualization, Funding acquisition

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