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Journal article on the Internet

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Website

Cancer-pain.org [homepage on the Internet]. New York: Association of Cancer Online Resources [updated 16 May 2002; cited 9 Jul 2002]. Available from: www.cancer-pain.org

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The Intensive Care Society of Australia and New Zealand. Mechanical ventilation strategy in ARDS: Guidelines. Int Care J Aust 1996;164:282-4.

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Drugs should be referred to by their generic names, rather than brand names.

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Original Article / Orijinal Araştırma

Long-Term Effects of COVID-19 in Hospitalized and Non-Hospitalized Pediatric Patients: A Prospective Study

Hastanede Yatan ve Yatmayan Çocuk Hastalarda COVID-19'un Uzun Dönemli Etkileri: Prospektif Bir Çalışma

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Abstract

Aim: The global COVID-19 pandemic caused by SARS-CoV-2 has led to both acute and long-term health consequences worldwide. Long COVID, characterized by persistent symptoms lasting weeks or months after recovery from the acute infection, has been increasingly reported. We aimed to evaluate long-term (i.e., symptoms persisting ≥12 weeks) effects of COVID-19 in hospitalized and non-hospitalized children in line with WHO criteria.

Material and Method: This prospective study was conducted between June 2020 and June 2021 at Sancaktepe Training and Research Hospital. A total of 60 children with PCR-confirmed COVID-19 were included. The study participants were divided into three groups: Group 1 (30 children followed up in the outpatient clinic), Group 2 (30 children hospitalized in the pediatric intensive care unit (PICU)), and Group 3 (30 children without a prior COVID-19 infection as the control group). Parents completed a questionnaire assessing symptoms persisting for ≥12 weeks after diagnosis.

Results: Group 2 experienced more symptoms both in the acute and post-acute periods. In the post-acute period, the most common symptoms were fatigue (57.9%), sleep disorders (75%), headache (60%) and anxiety (70%) which were statistically significant (p=0.001, p=0.002, p=0.043).

Conclusions: Long COVID is a significant concern for pediatric patients. Fatigue, anxiety, sleep disorders, and headache were the most frequent persistent symptoms. These findings emphasize the need for continued surveillance and targeted rehabilitation strategies to address the long-term effects of COVID-19 on children's physical and mental health.

Keywords: Child, long COVID, post-acute period, SARS-CoV-2

Öz

Amaç: SARS-CoV-2 'nin neden olduğu küresel COVID-19 pandemisi akut ve uzun vadeli sağlık sorunlarına yol açmıştır. Akut enfeksiyondan iyileştikten sonra semptomların haftalar veya aylarca devam etmesi ile karakterize olan Uzun COVID, artan şekilde bildirilmektedir. Çalışmamızda DSÖ kriterleri doğrultusunda hastaneye yatırılan ve yatırılmayan çocuklarda COVID-19'un uzun dönem (yani semptomların ≥12 hafta devam etmesi) etkilerini değerlendirmeyi amaçladık.

Gereç ve Yöntem: Bu prospektif çalışma, Haziran 2020-Haziran 2021 tarihleri arasında Sancaktepe Eğitim ve Araştırma Hastanesi'nde gerçekleştirildi. PCR ile doğrulanan COVID-19 tanısı konmuş toplam 60 çocuk dahil edildi. Çalışma katılımcıları üç gruba ayrıldı: 1. Grup (polikliniken takip edilen 30 çocuk), 2. Grup (çocuk yoğun bakım ünitesinde yatan 30 çocuk) ve 3. Grup (kontrol grubu olarak COVID-19 enfeksiyonu geçirmemiş 30 çocuk). Ebeveynler, tanıdan sonra 12 hafta boyunca devam eden semptomları değerlendiren bir anketi doldurdular.

Bulgular: Grup 2 hem akut hem de post-akut dönemlerde daha fazla semptom yaşadı. Post-akut dönemde en sık görülen semptomlar yorgunluk (%57,9), uyku bozuklukları (%75), baş ağrısı (%60) ve anksiyete (%70) idi ve bunlar istatistiksel olarak anlamlıydı (p=0,001, p=0,002, p=0,043).

Sonuçlar: Uzun COVID pediyatrik hastalar için önemli bir kaynağıdır. Yorgunluk, anksiyete, uyku bozuklukları ve baş ağrısı en sık devam eden semptomlar arasındaydı. Bu bulgular, COVID-19'un çocukların fiziksel ve zihinsel sağlıkları üzerindeki uzun vadeli etkileri ile başa çıkmak için devam eden gözetim ve hedeflenmiş rehabilitasyon stratejilerinin gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Çocuk, uzun COVID, post-akut dönem, SARS-CoV-2

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INTRODUCTION

In late 2019 and early 2020, the world faced a fatal global pandemic caused by SARS-CoV-2, which profoundly impacted and constricted our daily lives.[1] Initially, the focus was primarily on the acute symptoms of the disease. However, as time passed, it became evident that COVID-19 had long-term effects on those who contracted the disease at any age, leading to persistent symptoms following the infection. As a result, attention shifted to studying its long-term effects.[2] A broad range of persistent symptoms can significantly impair people's quality of life.[3] Recently, interest has grown in long-COVID syndrome, its pathophysiology, risk factors, consequences, and the available treatment and rehabilitation options, all of which have significant effects on daily activities, work, healthcare costs, and quality of life.[4]

According to the World Health Organization (WHO), ongoing, recurrent, or newly developed symptoms or related conditions that appear three months after the initial SARS-CoV-2 infection, with these symptoms lasting at least two months and not explained by an alternative diagnosis, are defined as long COVID or post-COVID-19 condition.[5] It has been reported that symptoms can persist for up to three years.[6] The exact underlying mechanism remains unclear.[7] A meta-analysis involving 21 studies with 80,071 children and adolescents reported the prevalence of long COVID as 25.24%.[8] Nittas et al.[9] reviewed 23 studies and 102 primary studies and found that the prevalence of long COVID in primarily non-hospitalized children was 2-3.5%. In 2023, in Turkey, Demirbuğa et al.[10] conducted a study with 116 pediatric patients and determined that post COVID-19 was 11.2%.

The aim of the present study is to evaluate the long-term (≥12 weeks post-infection) symptoms of PCR-positive COVID-19 hospitalized and non-hospitalized children according to WHO criteria for long COVID.

MATERIAL AND METHOD

Study Design

This prospective study was conducted between June 2020 and June 2021 at a tertiary hospital. The study was approved by the hospital's research and ethics committee (Date: 15.06.2022, Number: E-460596653-020) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians.

Study Population

During the study period, a total of 1.560 children had PCR-confirmed COVID-19 infection. Of these, 1.081 were followed up in our outpatient clinic, and 479 were hospitalized. Among the hospitalized children, 386 were admitted to the pediatric intensive care unit (PICU). The study sample of children with PCR-confirmed COVID-19 infection was divided into two groups: Group 1 consisted of 30 children who were followed up in the outpatient clinic, and Group 2 included 30 children who were followed up in the PICU. Additionally, a third control group (Group 3) was composed of children who had no history of symptomatic or asymptomatic COVID-19 infection with negative PCR and serology for SARS-CoV-2, no acute or chronic disease that may be confused with COVID signs and symptoms, and presented to the outpatient clinic for reasons unrelated to infection.

Children who were vaccinated for COVID-19, those with mental and/or motor developmental delays, children diagnosed with a mental illness and followed up by a child psychiatrist, and those using drugs or substances that could affect cognitive functions were excluded from the study.

For the signs and symptoms of acute period, medical records of the subjects were tracked through the electronic pediatric patient data registry and reviewed. For post-acute period the information was collected at the 12th week post-diagnosis by contacting the parents of the cases. Parents of the children in Group 3 were also contacted during the same period. The literature on long COVID was reviewed. A structured questionnaire consisting of 14 items across somatic, cognitive, and psychological domains was used, adapted from WHO, and validated for pediatric use (5). Sample size was calculated based on anticipated symptom prevalence, with 80% power and a 5% significance level. The subjects and their parents were invited to the outpatient clinic for a questionnaire, physical examination, and assessment of symptoms 12 weeks after the onset of the disease. Parents completed a questionnaire regarding symptoms experienced by their children over 12 weeks after the diagnosis of COVID-19 infection, including throat pain, shortness of breath, cough, diarrhea, nausea/vomiting, fever, weight loss, fatigue, muscle/joint pain, loss of taste or smell, anxiety, sleep disorders, and headache. The answers were recorded on a form designed for the present study. All data were collected and analyzed.

Statistical Analysis

Data obtained from the study were analyzed using statistical methods appropriate for the study's purpose. Variations within and between groups were examined over time. SPSS for Mac version 26 software was used to determine the effects. The compliance with normal distribution was assessed using visual methods (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). Descriptive statistics such as means and standard deviations were used for numerical data with a normal distribution. For normally distributed numerical data, ANOVA (post hoc Bonferroni) was used to compare groups, while for non-normally distributed data, the Kruskal-Wallis test (post hoc Mann-Whitney U test) was used. Nominal data were presented in cross-tabulations and dependent groups. Differences between independent groups were assessed using the McNemar test, Chi-Square test, and Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

In this prospective study, a total of 90 children were included. The study population consisted of 44 (48.9%) girls and 46 (51.1%) boys, with a mean age of 9.8±4.5 years. The characteristics of the groups are shown in **Table 1**.

Table 1. Demographic and Clinical Characteristics of Hospitalized and Non-Hospitalized

Variables	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	p value
Age (year), (mean±SD)	9.47±4.89	10.8±5.08	9.27±3.31	0.361
Gender (male), n (%)	17 (37)	14 (30.4)	15 (32.6)	0.733
Weight (kg), (mean±SD)	36.48±20.59	42.28±21.48	35.98±16.10	0.385
Height (cm), (mean±SD)	133.2±26.2	141.7±29	132.9±19.9	0.317

Abbreviations: SD = standard deviation

At presentation, children hospitalized in the PICU (Group 2) had significantly higher rates of shortness of breath, diarrhea, nausea/vomiting, fever, weight loss, fatigue, and muscle/joint pain compared to children who were not hospitalized (Group 1) (p=0.001, p=0.031, p=0.001, p=0.001, p=0.024, p=0.001, p=0.001). On the other hand, cough was more common in Group 1 at the onset of the disease (p=0.007). We also found that hospitalized and non-hospitalized COVID-19 patients experienced throat pain equally at presentation. In the post-acute period, fatigue was significantly higher in Group 2 (p=0.001). A comparison of the groups in terms of respiratory, gastrointestinal, musculoskeletal, and systemic symptoms is presented in **Table 2**. In the post-acute period, the most frequently reported symptoms among all participants were anxiety (11.1%; 95% CI: 4.8–20%), fatigue (21.1%; 95% CI: 13.3–31.1%), sleep disorders (13.3%; 95% CI: 6.7–21%), and headache (11.1%; 95% CI: 5.6–18.9%).

Table 2. Frequency and Distribution of Long COVID Symptoms by Group

Symptoms	Period	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	p value	Post Hoc
Throat pain, n (%)	Acute	10 (47.6)	10 (47.6)	1 (4.8)	0.007	1<2 1<3
	Post-acute	2 (33.3)	4 (66.7)	0 (0)	0.117	
Shortness of breath, n (%)	Acute	4 (19)	14 (66.7)	3 (14.3)	0.001	2>1 2>3
	Post-acute	2 (20)	5 (50)	3 (30)	0.455	
Cough, n (%)	Acute	14 (51.9)	10 (37)	3 (11.1)	0.007	1>3
	Post-acute	3 (50)	3 (50)	0 (0)	0.201	
Diarrhea, n (%)	Acute	5 (26.3)	11 (57.9)	3 (15.8)	0.031	2>1 2>3
	Post-acute	1 (20)	4 (80)	0 (0)	0.064	
Nausea/ vomiting, n (%)	Acute	8 (27.6)	17 (58.6)	4 (13.8)	0.001	2>1 2>3
	Post-acute	3 (42.9)	4 (57.1)	0 (0)	0.133	
Fever, n (%)	Acute	22 (44.9)	27 (55.1)	0 (0)	0.001	3<1 3<2
	Post-acute	0 (0)	1 (100)	0 (0)	0.364	
Weight loss, n (%)	Acute	3 (25)	8 (66.7)	1 (8.3)	0.024	2>1 2>3
	Post-acute	1 (20)	4 (20)	0 (0)	0.064	
Fatigue, n (%)	Acute	20 (43.5)	22 (47.8)	4 (8.7)	0.001	3<1 3<2
	Post-acute	8 (42.1)	11 (57.9)	0 (0)	0.001	3<1 3<2
Muscle/ joint pain, n (%)	Acute	17 (39.5)	24 (55.8)	2 (4.7)	0.001	3<1 3<2
	Post-acute	6 (35.3)	9 (52.9)	2 (11.8)	0.068	

Comparison of groups in terms of neuropsychiatric symptoms is demonstrated in **Table 3**. Group 2 (hospitalized children) experienced higher rates of anxiety both during the acute and post-acute periods compared to Group 1 (p=0.001, p=0.016). Sleep disorders were also significantly more common in Group 2 during both periods (p=0.001, p=0.02). Additionally, headache was more common in Group 2 as a persistent symptom and continued in the post-acute period (p=0.037, p=0.043). Loss of taste was the only symptom reported exclusively by infected children.

Table 3. Comparison of groups in terms of neuropsychiatric symptoms

Symptoms	Period	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	p value	Post Hoc
Loss of taste, n (%)	Acute	3 (60)	2 (40)	0 (0)	0.227	
	Post-acute	2 (100)	0 (0)	0 (0)	0.129	
Loss of smell, n (%)	Acute	4 (36.4)	6 (54.5)	1 (9.1)	0.141	
	Post-acute	2 (33.3)	3 (50)	1 (16.7)	0.585	
Anxiety, n (%)	Acute	11 (33.3)	20 (60.6)	2 (6.1)	0.001	2>1 2>3
	Post-acute	3 (30)	7 (70)	0 (0)	0.016	2>1 2>3
Sleep disorders, n (%)	Acute	8 (26.7)	20 (66.7)	2 (6.7)	0.001	2>1 2>3
	Post-acute	3 (25)	9 (75)	0 (0)	0.002	2>1 2>3
Headache, n (%)	Acute	9 (34.6)	13 (50)	4 (15.4)	0.037	2>1 2>3
	Post-acute	4 (40)	6 (60)	0 (0)	0.043	2>1 2>3

Distribution of statistically significant long COVID symptoms across three groups are summarized in **Figure 1**.

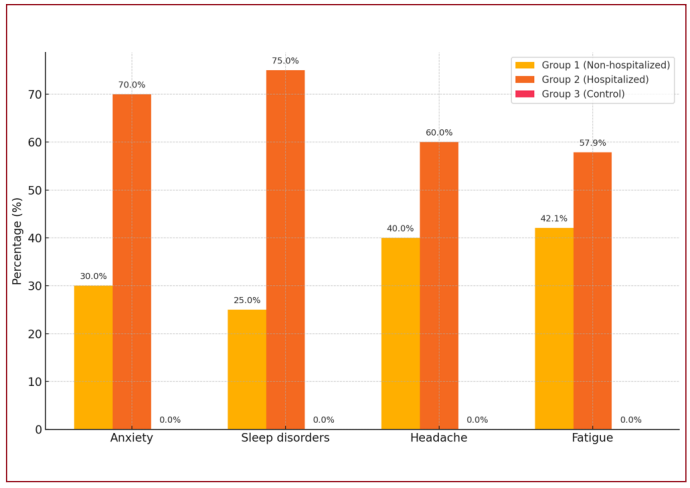

Figure 1. Distribution of statistically significant long COVID symptoms across three groups. This bar chart illustrates the percentage of participants in each group who reported various symptoms commonly associated long COVID. Group 1 (non-hospitalized patients) is shown in orange, Group 2 (hospitalized patients) in dark orange, and Group 3 (control group) in red. The hospitalized group (Group 2) showed the highest rates across all symptoms: anxiety (70.0%), sleep disorders (75.0%), headache (60.0%), and fatigue (57.9%). The non-hospitalized group (Group 1) also reported notable rates, especially for fatigue (42.1%) and headache (40.0%). In contrast, the control group (Group 3) did not report any of these symptoms.

DISCUSSION

This prospective follow-up study analyzed the symptoms of 30 hospitalized and 30 non-hospitalized PCR-confirmed COVID-19 patients, as well as 30 children previously uninfected by COVID-19. Our findings showed that children hospitalized in the PICU for COVID-19 experienced fatigue more frequently. We also found that neuropsychiatric symptoms, including anxiety, sleep disorders, and headache were more common in this group.

In February 2023, the WHO defined long COVID or Post-COVID-19 condition as symptoms lasting at least two months and occurring within three months of the acute onset of COVID-19 in children with a history of probable or confirmed SARS-CoV-2 infection.[11] The prevalence of long COVID has been reported as 25.24% by Lopez-Leon et al.[8], 20% by Bloise et al.[12], and 16.5% by Calcaterra et al.[13] While the exact pathogenic mechanism remains unclear, long COVID may result from persistent virus or viral components, tissue damage from the viral infection, autonomic and endothelial dysfunction, autoimmunity, and coagulopathy.[14-16] Vaccination against COVID-19 has been shown to reduce the risk of developing long COVID.[17,18] Previous studies have indicated that in children pre-existing diseases, female gender, and older age are associated with an increased risk of long COVID.[14,19,20] Seery et al.[2] reported cough, headache and fatigue as the most common persistent physical symptoms. On the other hand, a systematic review and meta-analyses demonstrated that compared to controls, children infected with SARS-CoV-2 experienced persistent fever, dyspnea and anosmia/ageusia.[8] A meta-analyses focusing on persistent symptoms following SARS-CoV-2 infection declared that, comparing control studies (5 studies) headache, cognitive difficulties, loss of smell, sore throat and eyes were common however, fever, cough, dyspnea, myalgia, abdominal pain, fatigue, diarrhea and dizziness were not.[19] According to a WHO report, common long COVID symptoms in children include anosmia, fatigue, loss of appetite, headache, anxiety, shortness of breath, chronic gastrointestinal symptoms, rash, food intolerances and allergies, cognitive dysfunction, sensory abnormalities, dizziness, nausea, changes in eating habits, behavioral changes, and regression of developmental delay, with fatigue, anxiety, and altered smell/anosmia being the most common.[11] In this study, we found that fatigue, anxiety, sleep disorders, and headache were more common in children who were hospitalized in the PICU and later diagnosed with long COVID.

Despite the unclear characteristics of long COVID, worldwide reports show that long COVID particularly affects the motor system so that fatigue is the most common persistent symptom at any age. Ashkenazi-Hoffnung et al.[21] conducted a prospective study with 90 children diagnosed with long COVID and showed that 71.1% of the children had fatigue as the most frequent persistent symptom. Camporesi et al.[22] prospectively followed up children previously diagnosed with SARS-CoV-2 infection at the 3rd, 6th, 12th, 18th, and 24th months following the onset of infection. They found that fatigue was the main persistent symptom, with rates of 13.1% at 3 months, 6.5% at 6 months, 3.8% at 12 months, 2.6% at 18 months, and 3.6% at 24 months post-infection onset. Similarly, a study conducted with 643 Icelandic children diagnosed with SARS-CoV-2 demonstrated that fatigue and loss of concentration were the most reported symptoms, at 22% and 23%, respectively.[23] A systematic review and meta-analysis by Lopez-Leon et al.[24], which included 47.910 patients (aged 17-87 years), reported that the three most common symptoms were fatigue (58%), headache (44%), and attention disorder (27%). Stephenson et al.[25] conducted a longitudinal cohort study in England and found that at three months after testing the top three main symptoms among test positive group were tiredness (39%), shortness of breath (23.4% and headache (23.2%). Consistent with the literature, we found that fatigue was the most common persistent symptom in both non-hospitalized and hospitalized children (42.1% and 57.9%, respectively).

Previous studies have shown that SARS-CoV-2 infection can cause neurologic manifestations and increase neurologic complications by more than 30%.[26] Moreover, Ellul et al.[27] demonstrated the presence of SARS-CoV-2 in cerebrospinal fluid in some patients, and Paniz-Mondolfi et al.[28] showed SARS-CoV-2 in frontal lobe tissue obtained during postmortem examination. According to a systematic review, the most common persistent symptoms in children and adolescents were fatigue (2-87%) and headache (3.5-80%).[29] According to a meta-analysis and systematic review from China revealed that the prevalence of neurologic symptoms were 13.51% and headache (15.88%) was third the most common symptom.[30] Similar to the literature, headache was reported as a symptom in 44% of cases by Lopez-Leon et al.[24] In our study, our findings were compatible with the literature, and one of the most frequent neuropsychiatric symptoms was headache particularly in hospitalized patients.

Sleep disturbances, including insomnia or excessive sleepiness, anxiety, depression, mood swings, and irritability are the most frequently reported psychological symptoms associated with long COVID.[8,31] According to a report, mood symptoms were found in 16.5%, and sleep disorders were present in 8.42%, as the most prevalent clinical manifestations associated with long COVID.[8] A study conducted in Italy revealed that pediatric patients with long COVID had sleeping problems (13%) and behavioral-cognitive problems (14%), including anxiety.[32] Miraglia Del Giudice et al.[33] conducted a study with 107 children to assess the impact of COVID-19 infection on behavior and sleep using two standardized questionnaires. They reported that COVID-19 significantly caused mental health issues, including behavior and sleep disorders, among children and adolescents. Furthermore, they found that adolescents were the most affected population including anxiety and depression. It is worth noting that, quarantine regimes, lock down and social distancing may

cause negative impact on children's mental health which may confuse the clinician.[34] Consistent with the literature, in the present study, we found that anxiety and sleep disorders were the most frequently reported symptoms in children hospitalized for COVID-19 infection.

Given the high frequency of fatigue, anxiety, sleep disturbances, and headache particularly in children hospitalized for COVID-19, our findings suggest that pediatric patients diagnosed with long COVID may require structured multidisciplinary follow-up care, including pediatric, psychiatric, and neurological assessments. Additionally, school reintegration programs should consider the neurocognitive and emotional challenges these children may face. Educational support, individualized learning plans, and school-based mental health services could be crucial in promoting a successful return to school and preventing long-term academic and psychosocial consequences.

This study has some limitations. Firstly, the follow-up duration was relatively short. Secondly, the study was hospital-based rather than population-based. Finally, we did not differentiate the etiology of neuropsychiatric symptoms, whether they were sequelae of COVID-19 infection or associated with pandemic-related restrictions.

CONCLUSION

This study highlights the long-term effects of COVID-19 on pediatric patients, particularly those hospitalized in the PICU. Our findings suggest that fatigue, anxiety, sleep disorders, and headache were the most prevalent persistent symptoms among hospitalized children, which were more significant compared to non-hospitalized children. These symptoms align with the broader literature on long COVID, underlining the significant impact of the disease on children's physical and mental well-being. These findings support the implementation of structured post-COVID follow-up and the incorporation of psychosocial support services for pediatric patients experiencing persistent symptoms.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Şehit Prof. Dr. İlhan Varank Training and Research Hospital Scientific Researches Ethics Committee (Date: 15.06.2022, Decision No: E-460596653-020).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

Assessment of Family Physicians' and Family Physician Assistants' Knowledge of Cystic Fibrosis Disease and Screening Tests

Aile Hekimlerinin ve Aile Hekimliği Asistanlarının Kistik Fibrozis Hastalığı ve Tarama Testi Hakkındaki Bilgi Düzeylerinin Araştırılması

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Abstract

Aim: Since January 1, 2015, our country's newborns have been screened for cystic fibrosis (CF) in primary health care services. Currently, CF is recognized as a childhood disease, yet more than 50% of patients are over the age of 18, and the median survival is 44.4 years. Therefore, family physicians play a role in managing the disease that extends beyond the neonatal period to include follow-up with adult patients. This study aimed to investigate primary care physicians' and family medicine residents' knowledge of CF and screening.

Matherial and Method: The study population consisted of family physicians and family medicine residents working in the city center of Konya. The online questionnaire included questions designed to measure the participants' sociodemographic characteristics and their level of knowledge about CF. A total of 230 volunteer physicians participated in the study.

Results: Family medicine specialists had a higher knowledge score than the other participants. The mean knowledge score on the questionnaire, which had a maximum score of 44 points, was 27.16±5.57. Family physicians demonstrated a high level of knowledge regarding screening tests and organ involvement in cystic fibrosis (CF). 95.7% of physicians knew that recurrent lung infections are a sign of CF, while 60.4% knew that regular salt use is necessary. Only 20% of participants were aware of cystic fibrosis-related diabetes.

Conclusion: Early diagnosis of cystic fibrosis (CF) is crucial for preserving lung function. Therefore, it would be beneficial for primary care physicians to receive regular training on CF diagnosis and follow-up, as well as information about CF-related complications in patients with prolonged life expectancy.

Keywords: Family medicine, cystic fibrosis, family physician

Öz

Amaç: Ülkemizde 1 Ocak 2015 tarihinden itibaren birinci basamak sağlık hizmetlerinde yenidoğanlarda kistik fibrozis (KF) tarama programı uygulanmaktadır. Günümüzde KF, medyan sağkalım süresi 44,4 yıl olan bir çocukluk çağı hastalığı olarak bilinmektedir ve hastaların %50'den fazlası 18 yaşın üzerindedir. Bu nedenle, aile hekimlerinin hastalık yönetimindeki rolü yenidoğan dönemi ile sınırlı olmayıp, yetişkin hastaların takibini de içermektedir. Bu çalışmanın amacı birinci basamak hekimlerinin ve aile hekimliği asistanlarının KF ve tarama konusundaki bilgilerini araştırmaktır.

Gereç ve Yöntem: Çalışmanın evrenini Konya il merkezinde görev yapan aile hekimleri ve aile hekimliği asistanları oluşturmuştur. Çevrimiçi anket formu, katılımcıların sosyodemografik özelliklerini ve KF hakkındaki bilgi düzeylerini ölçmek için tasarlanmış bilgi sorularını içermektedir. Çalışmaya toplam 230 gönüllü hekim dahil edilmiştir.

Bulgular: Aile hekimliği uzmanlarının bilgi puanı diğer katılımcılara göre daha yüksekti. Katılımcıların maksimum 44 puan alabileceği ankette ortalama bilgi puanı 27.16±5.57 idi. Aile hekimlerinin KF'de tarama testi ve organ tutulumu hakkında bilgi düzeyleri yüksekti. Tekrarlayan akciğer enfeksiyonlarının KF bulgusu olduğunu bilen hekimlerin oranı %95.7 iken, düzenli tuz kullanımının gerektiğini bilen hekim oranı %60.4'tü. Katılımcıların sadece %20'si kistik fibrozis ilişkili diyabet hakkında bilgi sahibiydi.

Sonuç: KF'nin erken tanısı akciğer fonksiyonlarının korunması için çok önemlidir. Bu nedenle birinci basamak hekimlerinin KF tanısı ve takibi konusunda düzenli eğitim almaları ve yaşam beklentisi uzamış KF hastalarının erişkin yaşamındaki komplikasyonlar konusunda bilgilendirilmeleri yararlı olacaktır.

Anahtar Kelimeler: Aile hekimliği, kistik fibrozis, aile hekimi

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INTRODUCTION

Cystic fibrosis (CF) is one of the most common autosomal recessive genetic disorders in Caucasians, with an incidence of one in 2500-3500 live births. The disease is caused by mutations in CFTR, a cystic fibrosis transmembrane conductance regulator gene encoding a chloride and bicarbonate channel expressed in the apical membrane of epithelial cells.[1] CF is a multisystem disease that most commonly affects the respiratory system (bronchiectasis, sinusitis), pancreas (CF-related diabetes with endocrine dysfunction, malabsorption with exocrine dysfunction), gastrointestinal system (distal bowel obstruction syndrome, biliary liver disease), and reproductive system (congenital absence of vas deferens in males, decreased fertility in females).[2,3]

CF screening is included in newborn screening programs in many countries. In our country, it has been included in the screening program of the Ministry of Health since January 1, 2015. The aim of the program is early diagnosis of the disease and initiation of treatment before clinical findings appear. In our country, Immune reactive trypsinogen (IRT) is checked in the heel blood as a screening method, the patient is recalled in case of values of 90 mmol and above and IRT is checked again in the heel blood and if it is 70 mmol and above, the screening test is considered positive and the patient is directed to sweat test.[4,5] In a patient with a positive IRT screening test, two positive sweat tests or genetic evidence of the disease is diagnostic, even if clinical findings have not yet occurred. Patients diagnosed early through the screening program have been shown to have more normal weight, height and body mass index, better pulmonary function tests and longer life expectancy.[6,7] Primary care physicians play an important role in the effective continuation of the CF screening program, which has a significant impact on quality of life and disease prognosis.

While CF was initially described as a fatal childhood disease in 1938,[8] the median projected survival has since increased to 44.4 years. Currently, more than 50% of individuals living with CF are aged 18 years or older, indicating that it is not only a childhood disease, but also a condition from which affected individuals transition into adulthood. Consequently, the role of primary care providers, such as family physicians, becomes pivotal not only during the screening program phase but also in subsequent follow-ups as patients progress through different stages of life.[9]

The objective of the present study was to assess the knowledge level of family physicians and family medicine assistants, who are in frequent contact with CF patients and newborns who constitute the screening population, regarding CF disease and screening.

MATERIAL AND METHOD

The study was carried out with the permission of Necmettin Erbakan University Pharmaceutical and Non-Medical Device Research Ethics Committee (Date: 09.07.2024, Decision No: 2024/5131). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The population of the cross-sectional and descriptive study consisted of family physicians and family physician assistants working in Türkiye, Konya city center. In the questionnaire form, in addition to questions regarding socio-demographic information such as age, year of graduation, title, etc., informational questions prepared by the researchers according to the literature were included to measure the basic level of knowledge about CF with multiple-choice questions. The online questionnaire form was shared on social media platforms used by primary care physicians in Konya a total of three times with an interval of one month. Between October 10, 2024 and December 12, 2024, the survey link was active and a total of 230 physicians voluntarily completed the survey. The identity information of the participants was kept confidential.

To assess the knowledge level of the participants about the diagnostic methods, screening test, clinical findings and treatment modalities of CF disease, 15 knowledge questions were prepared for the participants. Each correct answer by the participants was scored as 1 (one) point and the other answers were scored as 0 (zero) points. The knowledge scores for CF disease and screening test were calculated according to the answers to the information questions. Some questions had more than one correct answer. When the total knowledge scores were analyzed, the lowest score that participants could receive from the knowledge questions was zero and the highest score was 44.

Statistical Analysis

Data from the study were analyzed using the SPSS v.27 statistical program. Percentage distributions were used to examine descriptive characteristics, and measures of central tendency and prevalence (mean, standard deviation, median, etc.) of continuous variables were calculated. For further analysis, statistical significance was accepted as $p<0.05$ with a 95% confidence interval.

The Shapiro-Wilk test was used to assess the conformity of continuous variables to the normal distribution. Student t test was used to compare numerical data with two groups that fit the normal distribution, and one-way ANOVA test was used to compare more than two groups. After the ANOVA test, the Tukey test was used in the post hoc analysis to determine the group/groups from which the difference originated.

To test the agreement between continuous variables, Spearman correlation analysis was performed after assessing their conformity to the normal distribution.

RESULTS

A total of 230 volunteer family physicians and family physician assistants in the city center of Konya were part of the study.

The occupational distribution of participants is shown in **Figure 1**. The median age was 34 years (min:25; max:60). The mean time since graduation was 12.36±9.13 years (min:0; max:35). Of the participants in the residency program, 64.2% (n=86) reported receiving a pediatric rotation. Of the residents who received a pediatric rotation, 61.6% (n=53) were family medicine residents and 38.4% (n=33) were contracted family medicine residents.

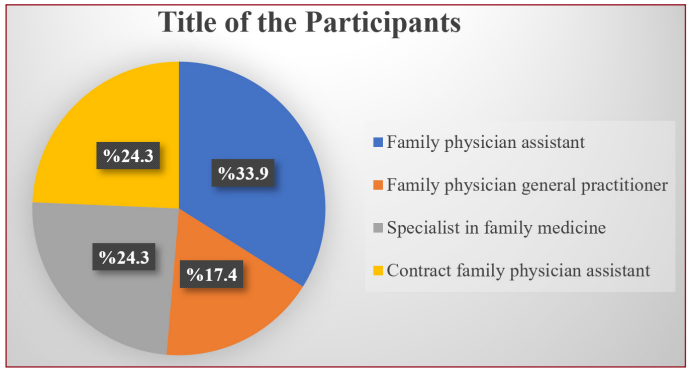

Figure 1.

The distribution of the responses of the family physicians and family physician assistants who participated in the study to the information questions about CF disease and screening test is shown in **Table 1** and **Table 2**.

When analyzing the total knowledge score, the lowest score was 13 (0.4%; n=1) and the highest score was 40 (1.7%; n=4). The mean knowledge score of the participants was 27.16±5.57 points.

There was no statistically significant difference between the title of the physician and the status of receiving education about CF, following patients diagnosed with CF and referring patients with a pre-diagnosis of CF (p>0.05). Specialists in family medicine were found to have a higher level of knowledge about CF than other physicians (general practitioner-family medicine assistant, p=0.035; general practitioner-family medicine specialist, p<0.001; general practitioner-family medicine assistant, p=0.007). The comparison of knowledge scores about CF disease and screening test according to some socio-demographic and professional background characteristics of the participants is shown in **Table 3**.

There is a weak and negative correlation between the age and length of study of the participants and their knowledge scores about CF disease and screening test (r=-0.052 and r=-0.022, respectively). However, this relationship was not statistically significant (p=0.44 and p=0.74, respectively). The correlation analysis between the age of the participating physicians and the time elapsed since graduation and their knowledge scores regarding CF disease and screening test is shown in **Table 4**.

Table 1. Distribution of responses to the questions about CF disease and screening tests (questions 1-7) by family physicians and family physician assistants who participated in the study.

1-Sample with newborn screening test for cystic fibrosis (n= 230)		
Heel prick test*	199	86.5
Sweat	30	13.1
Venous blood	1	0.4
2-Definitive diagnostic method(s) for cystic fibrosis (n=230) †		
Genetic mutation analysis *	199	86.5
Sweat test*	158	68.7
Measurement of the nasal potential difference *	46	20.0
3-Inheritance of cystic fibrosis (n= 226) ‡		
Autosomal recessive *	193	85.4
Dependent on X	12	5.3
Autosomal dominant	11	4.9
Sporadic	10	4.4
4-The system is not expected to be involved in cystic fibrosis (n=230)		
Neurological system *	216	93.9
Pancreas	10	4.4
Sweat glands	2	0.9
Respiratory system	1	0.4
Gastrointestinal system	1	0.4
5-Neonatal/infancy manifestations of cystic fibrosis (n=230) †		
Recurrent lung infection*	220	95.7
Growth retardation*	200	87.0
Wheezing*	182	79.1
Meconium ileus*	163	70.9
Diarrhea*	155	67.4
Nasal polyp	107	46.5
Skin manifestations	106	46.1
Diabetes mellitus	58	25.2
Edema*	48	20.9
Pseudo-bartter syndrome*	45	19.6
Osteoporosis	23	10.0
6-CF-suspicious microorganisms in sputum or throat cultures(n=230) †		
*P. aeroginosa**	158	68.7
K. pneumonia	107	46.5
M. cataralis	84	36.5
*S. aureus**	62	27.0
*S. maltophilia**	53	23.0
S. pneumonia	41	17.8
Respiratory syncytial virus	19	8.3
7-Gastrointestinal tract finding(s) of cystic fibrosis (n=230) †		
Meconium ileus*	174	75.7
Diarrhea*	171	74.3
Vomiting*	128	55.7
Constipation*	100	43.5
Jaundice*	95	41.3
Distal intestinal obstruction syndrome *	88	38.3
Rectal prolapse*	72	31.3

*Correct answer, †More than one option can be marked, ‡Four participants did not respond.

Tablo 2. Distribution of responses to the questions about CF disease and screening tests (questions 8-15) by family physicians and family physician assistants who participated in the study.

8-Respiratory manifestation(s) of cystic fibrosis (n=230) †		
Recurrent lung infection *	227	98.7
Wheezing*	206	89.6
Bronchiolitis *	168	73.0
Nasal polyp*	139	60.4
Sinusitis*	108	47.0
Barrel chest*	38	16.5
9-Evidence of late cystic fibrosis in patients with mild mutations (n=230)		
Infertility*	156	67.8
Nasal polyp	47	20.4
Sinusitis	20	8.7
Diarrhea	7	3.0
10-Late complication of cystic fibrosis (n=230)		
Bronchiectasis	105	45.7
Diabetes*	46	20
Clubbing	45	19.6
Osteoporosis	24	10.4
Hipersplenism	10	4.3
11-Treatment method(s) used in cystic fibrosis (n=230) †		
Pancreatic enzyme*	188	81.7
Bronchodilator*	165	71.7
Dornaz alpha*	146	63.5
Salt*	139	60.4
Multivitamin*	102	44.3
12-Sign(s) of pulmonary exacerbation in cystic fibrosis (n=230) †		
Cough, increased sputum, respiratory distress*	181	78.7
New-onset cough, shortness of breath, loss of appetite and wheezing*	148	64.3
New infiltration on chest radiography that was not present before*	141	61.3
New findings on auscultation (rales, rhonchi, etc.) *	112	48.7
Newly grown microorganism*	108	47.0
13-In cystic fibrosis, the first thing that comes to mind in the patient who receives pancreatic enzyme and presents with abdominal pain and gas (n=230)		
Inadequate enzyme intake*	159	69.1
A normal finding	48	20.9
Hunger	14	6.1
Vitamin deficiency	9	3.9
14-The organ most affected by cystic fibrosis (n=230)		
Lung*	228	99.1
Liver	2	0.9
Brain	-	-
Heart	-	-
15-Why salt is not recommended in patients with cystic fibrosis (n=230)		
They lose Na and Cl through sweat *	218	94.8
They lose Na and Cl in urine	5	2.2
They lose Na and Cl in feces	5	2.2
There is a lack of uptake	2	0.9

* Correct answer, † More than one option can be marked.

Table 3. Comparison of knowledge scores about cystic fibrosis disease and screening test according to some sociodemographic and occupational background characteristics of the participants

Feature	Knowledge Score		
	n	X̄±SS(Mean)	Test
Age			
34 years and below	115	27.49±5.71	t=0.870 p=0.385
35 years and older	110	26.84±5.50	
Time after graduation (years)			
9 years and below	118	27.15±5.72	t=-0.60 p=0.952
10 years and above	111	27.11±5.42	
Title			
Family physician assistant	78	26.88±5.13	F=7.613 p<0.001*
Family physician general practitioner	40	24.05±5.93	
Specialist in family medicine	56	29.25±4.94	
Contract family physician assistant	56	27.68±5.59	
Pediatrics rotation status of assistant physicians			
Yes	86	27.66±5.64	t=1.303 p=0.195
No	48	26.42±4.65	
Participation in any training on cystic fibrosis			
Yes	55	27.60±5.71	t=0.669 p=0.504
No	175	27.02±5.54	
Follow-up status of patients diagnosed with cystic fibrosis†			
Yes	42	28.38±5.64	t=1.681 p=0.094
No	160	26.78±5.48	
Referral of patients with a prediagnosis of cystic fibrosis‡			
Yes	48	28.25±5.36	t=1.528 p=0.128
No	166	26.87±5.54	

*Family physician general practitioner - Family physician assistant, p=0.035; Family physician general practitioner - Specialist in family medicine, p<0.001; Family physician general practitioner - Contract family physician assistant, p=0.007
†Participants who stated that they did not remember the follow-up of patients diagnosed with cystic fibrosis were excluded.
‡Participants who stated that they did not remember referring patients with a prediagnosis of cystic fibrosis were exclude

Table 4. Correlation analysis between the age and graduation period of the physicians participating in the study and their knowledge scores on CF disease and screening test

		Total Score
Age	r*	-0.052
	p	0.44
	n	225
Time after graduation	r*	-0.022
	p	0.74
	n	230

* Spearman correlation was performed due to skewed distribution.

DISCUSSION

Cystic fibrosis is a disease that is screened by primary care physicians, and the present study is one of the few studies to investigate the knowledge of primary care physicians and family medicine residents about CF. We believe that the results are important for raising awareness in primary care. It can be said that the knowledge of CF among the participating physicians is at an intermediate level. According to the National Cystic Fibrosis Registry System (NCRS) 2023 data, 336 (15.04%) of the 2234 CF patients living in Turkey were 18 years and older. The age at which patients are diagnosed

with CF can vary from 1 month to 41 years.[10] Since CF can be diagnosed at any age and patients can reach adulthood, it is important to determine the level of knowledge of family physicians about this disease. When the total knowledge score was analyzed in our study, the mean score of the participants in the knowledge questions was 27.16±5.57 points, which can be scored as high as 44 points. Accordingly, it can be said that the knowledge of the physicians participating in the present study about CF disease and screening is at a moderate level.

Since January 1, 2015, newborns in our country are screened for CF by heel-prick blood sampling. The newborn screening test is performed by measuring IRT. Babies with a positive screening test are referred to a higher center for sweat testing as soon as possible (available at: www.kistikfibrozisturkiye.org). Approximately 90% of the physicians who participated in our study were aware that heel-stick blood screening and genetic mutation analysis should be performed for definitive diagnosis. The other test that should be performed for definitive diagnosis was the sweat test, and about 70% of the physicians knew this information. These results suggest that physicians' awareness about the screening program and CF diagnostic tests is high in our country. The screening program allows infants to be diagnosed at an early stage, which makes treatment and follow-up more beneficial.

In our study, when the knowledge level of the participants about the early signs of CF was examined, almost all of the participants knew that frequent lung infections could be an early sign, while about 15% did not know that CF could cause growth retardation. In a study by Cesur et al, the frequency of CF was found to be 5.3% in children presenting to a pediatric clinic with the complaint of recurrent lung infection, while the frequency of CF was found to be 8.8% in children presenting with growth retardation.[11] In children with frequent lung infections, height and weight percentile values should be monitored in primary care clinics. If there is a growth pause, we think it may be useful to evaluate the patients for CF. The rate of those who responded nasal polyps and osteoporosis to the findings seen in the neonatal and infant periods was 46.5% and 10%, respectively. We believe that it would be appropriate to increase awareness of this issue since both findings are seen in the late period.

When renal tubular functions are normal in the presence of hyponatremia, hypochloremia, hypokalemia and metabolic alkalosis, this picture is called Pseudo-Bartter Syndrome (PBS) and can be observed especially in CF patients in infancy. In a study conducted by Eyuboglu et al. on CF patients in our country, the rate of PBS was found to be 10% and it was shown that PBS patients were diagnosed earlier.[13] Only about 20% of the physicians who participated in our study were informed about PBS. Considering the hot climate of our country and the insistence of families to dress their babies tightly, the possibility of CF patients presenting with PBS may have increased. Therefore, we think it is important to increase the awareness of PBS among primary care physicians. Infertility is an important presenting symptom of adult CF. This group of patients has rarer mutations and generally does not have pancreatic insufficiency. While 95% of male CF patients are infertile and this is related to the absence of vas deferens, fertility in female CF patients is lower compared to the normal population due to malnutrition and dark cervical mucus.[14] In our study, the awareness of infertility among the participants was found to be about 70%. We recommend a detailed history regarding CF in primary care, especially for male infertility.

The prevalence of cystic fibrosis-related diabetes (CFRD) increases markedly with age, with a prevalence of 2% in childhood, 19% in adolescence, and 40% to 50% in adulthood in people with CF.[15] CFRD is associated with increased morbidity and mortality. Adequate nutritional status is known to be critical for maintaining lung function and survival in CF. Deterioration of pulmonary and nutritional status begins 2 to 4 years before the actual diagnosis of CFRD.[16,17] In our study, only 20% of the physicians were aware that CFRD is a late complication. Because the nutritional approach to diagnosis, follow-up, and treatment of CFRD differs from that of type 1 and type 2 diabetes mellitus, there is a need for education to increase awareness of this issue among primary care physicians.

When the relationship between the age of the physicians in our study and the time elapsed since graduation and the total knowledge score on the test was examined, no statistically significant difference was found. On the other hand, the mean knowledge score of general practitioners was found to be statistically significantly lower than that of participants with other titles. Based on these results, we believe that physicians who continue or complete their specialty training in a tertiary hospital after medical school have a higher awareness of cystic fibrosis and that additional studies should be conducted to increase the knowledge level of general practitioners.

When the questions about CF treatment were analyzed in our study, 80% of the physicians knew that pancreatic enzyme was used in treatment, about 60% knew that inhaled dornase alfa and salt were used, and about 50% of the physicians knew that multivitamins were used. Awareness of the use of salt is still not at the desired level. Since CF-related PBS is common in our country, it may be useful to increase the level of physicians' knowledge about salt treatment in infants.

In Asseri's study, primary care physicians correctly answered 13.5% of the questions about CF treatment modalities.[18] In 2019, in a study conducted by Demirtaş et al. among primary care physicians in our country, the rate of physicians who knew about daily salt treatment was 23.5%, the rate of physicians who knew about inhaled dornase alfa use was 37.4%, and the rate of physicians who knew about pancreatic enzyme treatment was 34.8%.[19] We believe that the level of knowledge of our physicians about CF treatment has increased due to the increase in the number of CF centers

in the last 5 years, the fact that these patients have a longer life expectancy with new treatments, and the increase in the number of patients diagnosed through screening.

Limitations

The study has limitations in that it only included family physicians in the Konya province. The presence of a Department of Pediatric Chest Diseases in the province may have increased the physicians' level of knowledge. Studies with more participants from across the country may also be useful for determining primary care physicians' knowledge levels.

CONCLUSION

Life expectancy and quality of life have increased significantly with the increasing number of treatment options in CF. The level of knowledge of primary care physicians has also increased in recent years. We believe that the increasing number of pediatric pulmonologists in our country in recent years is also effective in this regard. Early diagnosis of CF is very important both for prevention of malnutrition and for preservation of lung function. Therefore, it would be beneficial for family physicians to be regularly trained in CF diagnosis and follow-up and informed about adult complications of CF.

Abbreviations

CF: Cystic fibrosis, **CFRD**: Cystic fibrosis-related diabetes, **CFTR**: Cystic fibrosis transmembrane conductance regulator, **IRT**: Immune reactive trypsinogen, **NCRS**: National Cystic Fibrosis Registry System, **PBS**: Pseudo-Bartter Syndrome

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Necmettin Erbakan University Pharmaceutical and Non-Medical Device Research Ethics Committee (Date: 09.07.2024, Decision No: 2024/5131).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Original Article / Orijinal Araştırma

Retrospective Analysis of Pediatric Head Trauma Patients

Pediyatrik Kafa Travması Hastalarının Retrospektif Analizi

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Abstract

Aim: The purpose of this study was to increase the amount of epidemiological data regarding pediatric head traumas and emphasize the necessity of developing trauma prevention strategies.

Material and Method: The data of a total of 135 patients aged 0-18 referred to the Neurosurgery Clinic of Muş State Hospital between November 2022 and November 2024 were included retrospectively analyzed.

Results: Eighty one (60.0%) of the patients were male, and 54 (40.0%) were female. Falling from height (38.5%) was the most frequently encountered cause of trauma. According to their initial Glasgow Coma Scale (GCS) scores, 90.4% of the patients had mild (GCS 13-15), 3.7% had moderate (GCS 9-12), and 5.9% had severe (GCS 3-8) head traumas. Visits took place in the summer months at a rate of 43.7% and outside the working hours at a rate of 57.8%. There were 6 patients who required surgical intervention, and these patients had compression fractures and intracranial hematomas.

Conclusion: It should be kept in mind that pediatric head traumas are caused by preventable factors, and a significant proportion of these traumas can be prevented through appropriate precautions. The results of this study emphasize the need to increase the amount of epidemiological data related to pediatric head traumas and develop prevention strategies.

Keywords: Pediatric trauma, head trauma, epidemiology

Öz

Amaç: Bu çalışmanın amacı, pediatrik kafa travmalarına ilişkin epidemiyolojik veri miktarını artırmak ve travma önleme stratejileri geliştirilmesinin gerekliliğini vurgulamaktır.

Gereç ve Yöntem: Kasım 2022 ile Kasım 2024 arasında Muş Devlet Hastanesi Beyin Cerrahisi Kliniği'ne sevk edilen 0-18 yaş arası toplam 135 hastanın verileri retrospektif olarak incelendi.

Bulgular: Hastaların 81'i (%60,0) erkek, 54'ü (%40,0) kadındı. Yüksekten düşme (%38,5), en sık karşılaşılan travma nedeniydi. Başvuru anındaki Glasgow Koma Skalası (GKS) değerlerine göre hastaların %90,4'ü hafif (GKS 13-15), %3,7'si orta (GKS 9-12), %5,9'u ise ağır (GKS 3-8) kafa travmasına sahipti. Başvuruların %43,7'si yaz aylarında, %57,8'i ise mesai saatleri dışında gerçekleşmişti. Cerrahî müdahale gerektiren 6 hasta vardı ve bu hastalarda kompresyon kırıkları ile intrakraniyal hematomlar mevcuttu.

Sonuç: Pediatrik kafa travmalarının önlenebilir faktörlerden kaynaklandığı ve bu travmaların önemli bir kısmının uygun önlemlerle engellenebileceği unutulmamalıdır. Bu çalışmanın sonuçları, pediatrik kafa travmalarına ilişkin epidemiyolojik verilerin artırılması ve önleme stratejileri geliştirilmesi gerekliliğini vurgulamaktadır.

Anahtar Kelimeler: Pediyatrik travma, kafa travması, epidemiyoloji

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INTRODUCTION

Pediatric head traumas (PHTs) are some of the most significant public health problems worldwide, and they are the most frequently encountered cause of morbidity and mortality in this age group.[1,2]

PHTs should be assessed separately from adult traumas and considered in the context of their own age group. There are several reasons for this, while the most important reasons include the larger head/body ratio of a child compared to an adult, the inadequate protection of intracranial structures by the thinner bone structure of a child's cranium, the mechanism of injury, and differences in long-term prognosis.[3,4] Most PHTs are caused by preventable factors, and the rates of these traumas and their subsequent complications can be minimized by taking the necessary precautions.[1] Falls from height are the most common form of injury, followed by motorized vehicle accidents.[5]

With today's technology, the diagnosis of traumas in general is made using X-ray imaging, ultrasonography, and computed tomography (CT) methods.[6] The gold standard method for the examination of PHT cases is cranial CT (CCT).[7] The Glasgow Coma Scale (GCS) is an internationally adopted scoring system that evaluates the neurological state of a patient. It has a score range of 3-15, and lower scores indicate an increased severity of trauma and a poorer neurological state.[8,9] Head traumas are examined under three categories based on the GCS scoring system: mild (GCS) 13-15), moderate (GCS 9-12), and severe (GCS 3-8).[8]

The review of the literature showed that the causes and mechanisms of head traumas show variations from country to country and even from one region to another in the same country. This once again highlights the importance of epidemiological studies on the topic. There is a very limited number of studies on PHTs in Turkey. For this reason, we aimed to share our clinical experiences and contribute to the literature by retrospectively analyzing the data of pediatric patients who were brought to our clinic with head traumas.

MATERIAL AND METHOD

After receiving the approval of the local ethics committee with the decision date 12/02/2025 and numbere 25-MOBAEK-014, The study was carried out retrospectively with 135 patients aged 0-18 years who were referred to the Neurosurgery Clinic of Muş State Hospital in Turkey between November 2022 and November 2024. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The sample included patients who were brought to the emergency service with head traumas and then referred to the Neurosurgery Clinic. The study excluded patients in the same age group who did not have head traumas and patients with head traumas who were older than 18 years old. The patients were divided into three groups at the ages of 0-2 years (infancy), 3-7 years (play age), and 8-14 years (school age). The data of all patients were reviewed in terms of age, sex, triage zone, time to first examination, cause of trauma, GCS score at the time of presenting, monitoring duration, affected cranial region, unit of initial monitoring, month of trauma, time (hours) of hospital visit, accompanying pathologies, and surgical operation requirements. The patients were also divided into three groups as follows: mild head trauma (GCS 13–15), moderate head trauma (GCS 9–12), and severe head trauma (GCS≤8). All patients were subjected to CCT scans in a neutral position, and their CCT results were recorded.

RESULTS

The patient population was found to be 60.0% (n=81) male and 40.0% (n=54) female. It was determined that the vast majority of patients (90.4%, n=122) had a GCS score between 13-15 upon admission, while 5.9% (n=8) had a GCS score of 8 or below, and 3.7% (n=5) had a GCS score between 9-12. **Tables 1-6** present the distributions of the patients based on their demographic characteristics.

Table 1.Age and sex distributions of the patients

Variables	Groups	Frequency	Percentage
Age (years)	0-2 (infancy)	63	46.7
	3-7 (play age)	35	25.9
	8-14 (school age)	24	17.8
	14 or older	13	9.6
Sex	Male	81	60.0
	Female	54	40.0

Among all groups created based on the ages of the patients, the 0-2 (infancy) age group had the highest rate(46.7%, n=63). This was followed by the 3-7 (play age) (25.9%, n=35) age group, the 8-14 (school age) (17.8%, n=24) age group, and the≥14 (9.6%, n=13) age group. **Figure 1** also shows the distributions of the patients based on their sex and age.

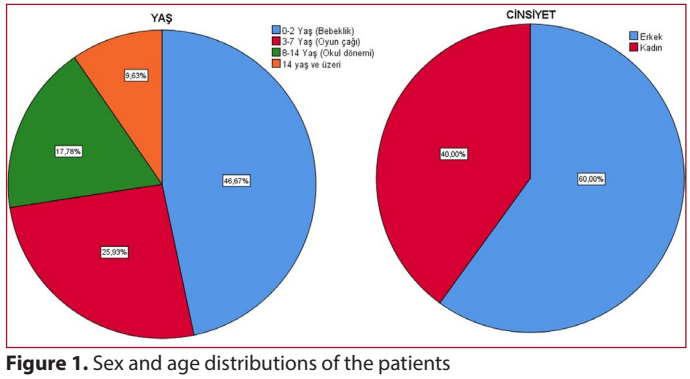

Figure 1. Sex and age distributions of the patients

Table 2.Triage information, examination times, and causes of trauma

Variables	Groups	Frequency (n)	Percentage (%)
Triage	Red zone	19	14.1
	Yellow zone	116	85.9
Time met (min) after presenting	12 or below	57	42.2
	13-25	27	20.0
	26-41	19	14.1
	42-65	17	12.6
	66 or above	15	11.1
Cause of trauma	EVTA	19	14.1
	IVTA	11	8.1
	FAI	2	1.5
	Assault	4	3.0
	At home	29	21.5
	Outside home	18	13.3
	Fall from height	52	38.5

EVTA: Extravehicular traffic accident, IVTA: Intravehicular traffic accident, FAI: fire arm injury

It was determined that most of the patients (85.9%, n=116) were assigned to the yellow zone after triage, while 14.1% (n=19) were assigned to the red zone. It was found that 42.2% (n=57) were seen within 12 minutes or less after they arrived at the hospital, 20.0% (n=27) were seen within 13-25 minutes, 14.1% (n=19) were seen within 26-41 minutes, 12.6% (n=17) were seen within 42-65 minutes, and66 minutes or more passed before 11.1% (n=15) were seen. The most frequently encountered cause of trauma was falling from height (38.5%, n=52), followed by traumas in the home environment (21.5%, n=29), EVTA (14.1%, n=19), traumas outside the home environment (13.3%, n=18), IVTA (8.1%, n=11), assault (3.0%, n=4), and FAI (1.5%, n=2).

Table 3.Initial Glasgow Coma Scale, monitoring durations, and affected regions of the patients

Variables	Groups	Frequency	Percentage
Presenting GCS	≤8	8	5.9
	9-12	5	3.7
	13-15	122	90.4
Monitoring duration (days)	1-2	69	51.1
	3-4	24	17.8
	5 or more	10	7.4
	Referred to another center	32	23.7
Affected cranial region	Frontal	50	37.0
	Frontoparietal	1	0.7
	Occipital	21	15.6
	Parietal	52	38.5
	Temporal	11	8.1

GCS: Glasgow Coma Scale

While 51.1% (n=69) of the patients were monitored for 1-2 days, 17.8% (n=24) were monitored for 3-4 days, 7.4% (n=10) were monitored for 5 days or longer, and 23.7% (n=32) were referred to another center. The most frequently affected cranial region was the frontal (37.0%, n=50) and parietal (38.5%, n=52) regions, followed by the occipital (15.6%, n=21), temporal (8.1%, n=11), and frontoparietal (0.7%, n=1) regions.

Table 4. First monitoring unit, trauma months, and hospital arrival times of the patients

Variables	Groups	Frequency (n)	Percentage (%)
First unit of monitoring	Emergency service	47	34.8
	Anesthesial CU	1	0.7
	Neurosurgery inpatient clinic	21	15.6
	Pediatric ICU	28	20.7
	General ICU	1	0.7
	ENT inpatient clinic	1	0.7
	Orthopedics inpatient clinic	4	3.0
	ICU referral	32	23.7
Trauma month	January	3	2.2
	February	5	3.7
	March	9	6.7
	April	9	6.7
	May	18	13.3
	June	22	16.3
	July	25	18.5
	August	12	8.9
	September	6	4.4
	October	9	6.7
	November	11	8.1
	December	6	4.4
Arrival time (hours)	00:00-08:00	11	8.1
	08:01-16:00	46	34.1
	16:01-00:00	78	57.8

Most of the patients were monitored for the first time in the emergency services (34.8%, n=47), followed by ICU referrals(23.7%, n=32), PICUs (20.7%, n=28), and neurosurgery inpatient clinics(15.6%, n=21). Other units of first monitoring were orthopedics inpatient clinics (3.0%, n=4) and anesthesia ICU, general ICU, and ENT inpatient clinic units (0.7%, n=1). Most traumas occurred in July (18.5%, n=25), followed by June (16.3%, n=22), May (13.3%, n=18), August (8.9%, n=12), March, April, and October (6.7%, n=9), November (8.1%, n=11), September and December (4.4%, n=6), February (3.7%, n=5), and January (2.2%, n=3). While 8.1% (n=11) of the patients were brought to the hospital at the hours of 00:00-08:00, 34.1% (n=46) were brought at 08:01-16:00, and 57.8% (n=78) were brought at 16:01-00:00. The units where the patients were monitored firth, the months of their visits, and their hours of presenting to the hospital are also presented in **Figure 2**.

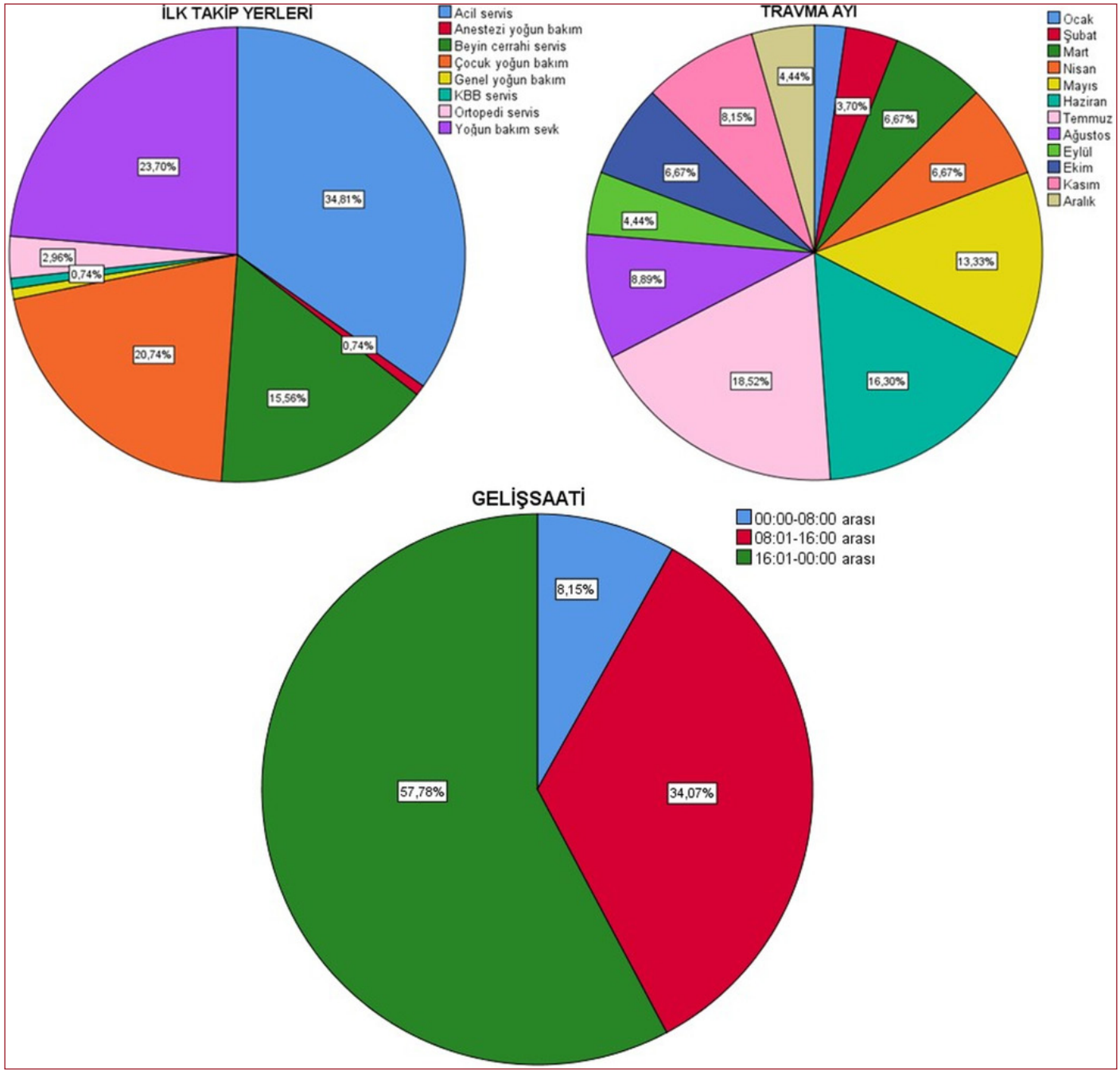

Figure 2. First monitoring unit, trauma months, and hospital arrival times

The types of traumas accompanying the head traumas of the patients the most were orbital fractures (8.1%, n=11) and extremity fractures (4.4%, n=6). While 3.7% (n=5) of the patients had mastoid fractures, 2.9% (n=4) had extremity fractures, thoracic trauma, and abdominal trauma, 2.2% (n=3) had orbital and maxillofacial fractures, 2.2% (n=3) had extremity fractures and spinal trauma, 2.2% (n=3) had sinus fractures, 1.5% (n=2) had abdominal trauma, 1.5% (n=2) had abdominal and thoracic trauma, 1.5% (n=2) had extremity fractures and abdominal trauma, 1.5% (n=2) had extremity fractures and thoracic trauma, 1.5% (n=2) had spinal trauma, 0.7% (n=1) had extremity fractures, thoracic trauma, and orbital trauma, 0.7% (n=1) had thoracic trauma, and 0.7% (n=1) had thoracic and spinal trauma.

Linear fractures were the most frequently observed pathology (30.4%, n=41) among the patients. Other pathologies included subgaleal hematomas (18.5%, n=25), compression fractures (7.4%, n=10), subdural hematomas (6.7%, n=9), linear fractures and subdural hematomas (5.9%, n=8), contusions (5.2%, n=7), linear fractures and epidural hematomas (3.7%, n=5), and contusions and traumatic subarachnoid hemorrhages (SAH) (3.7%, n=5). Less frequently encountered

pathologies were compression fractures with subdural hematomas (2.2%, n=3), linear fractures and traumatic SAH (2.2%, n=3),compression fractures and traumatic SAH (1.5%, n=2), epidural hematomas and traumatic SAH (1.5%, n=2), linear fractures, contusions, and traumatic SAH (1.5%, n=2), compression fractures and epidural hematomas (0.7%, n=1), compression fractures, epidural hematomas, and subdural hematomas (0.7%, n=1), linear fractures and contusions (0.7%, n=1), linear fractures and pneumocephalus (0.7%, n=1), linear fractures, traumatic SAH, and epidural hematomas (0.7%, n=1), subdural hematomas and traumatic SAH (0.7%, n=1), subdural hematomas, traumatic SAH, and contusions (0.7%, n=1), and traumatic SAH (0.7%, n=1).

As seen in Table 7, most of the patients (95.6%) did not require surgery. The reasons for the surgeries of the rest of the patients were compression fractures (2.2%, n=3), compression fracture, epidural hematoma, and subdural hematoma (0.7%, n=1), epidural hematoma (0.7%, n=1), and subdural hematoma (0.7%, n=1). It is seen that most of the patients were followed up without any surgical intervention, whereas those requiring surgeries mostly had compression fractures. The breakdown of the surgical procedures of the patients is displayed in **Figure 3**.

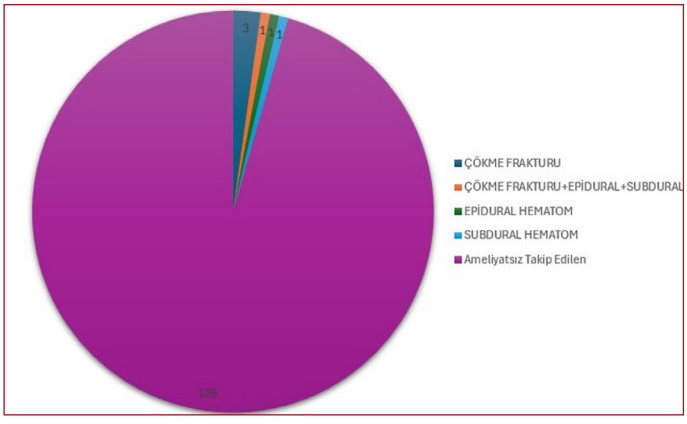

Figure 3. Surgical operations of the patients

DISCUSSION

Traumas at pediatric ages are some of the most significant public health problems and constitute the most prevalent cause of child deaths.[5,10,11] The most frequently affected body part in pediatric trauma cases is the head, and 80% of mortalities associated with multiple traumas were found to involve head traumas.[12,13] Although there has been a dramatic improvement in trauma-related brain damage rates in developed countries thanks to well-equipped and specialized ICUs, the adoption of a disciplined approach, and the minimization of preventable causes, head trauma cases continue to be a challenge in Turkey and the surrounding region for neurosurgery units despite some improvements in conditions.

One of the issues drawing attention in the literature is that falls from heights and traffic accidents, which are prominent causes of pediatric traumas, are among the causes that are preventable or minimizable with the appropriate precautions.[1,10,11,14] This prevention or minimization could only be possible by the accurate identification of the problem at its source and the development of rational solutions and recommendations for this source. Although there are several studies on this topic in general[1,15] there are not enough epidemiological studies in the region encompassing Turkey. In this study, by retrospectively analyzing the cases of 135 pediatric patients, important information was obtained about the epidemiology, etiology, and clinical outcomes of pediatric head traumas.

In our study, the 0-2 (infancy) age group constituted the higher rate of the patients (46.7%, n=63). This age group was followed by the 3-7 (play age)(25.9%, n=35), 8-14 (school age)(17.8%, n=24), and 14+ (9.6%, n=13) age groups. Male patients also constituted the majority (60.0%) of our sample. Male children were also found to have higher rates among trauma patients presenting to emergency services in the study conducted by Ceylan et al.,[16] in the study carried out on childhood accidents by Sieben et al.,[17] and in the study of injuries in the pediatric population performed by Wang et al.[18] These results were in agreement with our results. The finding of the highest rate of patients in the 0-2 age group in our study may be attributed to the fact that families in the region where our study was conducted are crowded in general, the care of infants aged 0-2 is usually shared between parents and other children in the household, and the region has a low sociocultural status. The rates of trauma cases gradually decreased in older age groups, in which children are expected to take on their own care and develop awareness.

Trauma patients who are referred to neurosurgery units from emergency services are usually assigned to the red and yellow zones after triage, and their tests, diagnoses, and treatments are completed in these zones.[19] The patients referred to us consisted of red and yellow zone patients, most of whom (85.9%) were assigned to the yellow zone. More than 50% of consultations evaluated by our unit were seen to within the first 30 minutes. The referrals of the patients from their respective zones following triage were compatible with other reports in the literature,[19] and the consulted patients were usually met within a reasonable time. The cases of the patients who could not be examined within the first 30 minutes could have been related to the cancellation of consultation after the emergency interventions of the patients or the prolongation of waiting times due to termination of access to computers after the examination of the patients by physicians who were contacted via telecommunication channels during their emergency on-call shifts and the subsequent cancellation of their consultations. The results of our study showed that the most prevalent cause of traumas was falling from a height at a rate of 38.5%. Similarly, falls from height have been reported to be the most prevalent causes of trauma in the literature.[3,13,14] Another study evaluating pediatric head trauma patients reported that motor vehicle accident-related trauma was more common.[20] However, the results were generally consistent with ours.

In our study, 90.4% of the patients were in the mild head trauma (GCS 13-15) group. This showed that pediatric head traumas in our region were usually mild cases, and the need for ICU admission was rare. According to the collected data, because the general status of the patients was good at the time of their visits, they were usually monitored at the emergency services (34.8%), and most (51.1%, n=69) were monitored for two days or less. Suresh et al. reported the rates of poor patient outcomes as 58.5% in the GCS 3-5 group, 35.2% in the GCS 6-8 group, 11.4% in the GCS 9-12 group, and 1.3% in the GCS 13-15 group.[21] In addition to this, the fact that 5.9% of the patients in our sample had severe head trauma (GCS 8 and below) demonstrated the importance of preventing mortality and morbidity through early diagnosis and appropriate treatment approaches. More than 50% of cranial fractures in pediatric patients are seen in the parietal and frontal bones, and they are mostly accompanied by contusion and hematoma.[22-24] In our sample, the most frequently seen condition was cranial fractures at a rate of 58.5% (n=79), accompanied by other parenchymal pathologies. The most frequently affected regions in our patients were the parietal (38.5%) and frontal (37.0%) regions, which were similar to those reported in the literature.

The months with the highest rates of traumas in our study were the summer months, and the busiest month for trauma cases was July (18.5%). This result may be attributed to the longer time spent by children outside in summer and their increased physical activity levels. Similarly, in the literature, the summer months have been revealed to be the period during which pediatric traumas have the highest rates.[5,10,13] During the summer months, due to school holidays, children spend more time outside, and they display higher levels of physical activity and risky behaviors. Moreover, the limited degree of supervision by families during the summer holidays in our region may be another factor raising the risk of trauma. Most patients whose cases were examined in our study were brought to the hospital at 16:01-00:00 (57.8%). Furthermore, while 8.1% (n=11) were brought at 00:01-08:00, and 34.1% (n=46) were brought at 08:01-16:00. Aydın et al. reported that 53.3% of patients presented to the emergency service at the hours of 08:00-16:00, whereas Sucu et al. stated that 45.3% of patients visited the emergency service at the hours of 12.00-18.00.[25,26] The higher rates of patients who were brought to the emergency services outside working hours in our study may be associated with the possibility that parents brought their children after they came home from work, and testing and treatment procedures at the emergency services are usually faster than those in regular outpatient clinics.

In this study, the most frequently encountered traumas accompanying the head traumas of the patients were extremity fractures, whereas the most frequent accompanying pathologies were maxillofacial injuries (**Table 5**). Işık et al.[27] provided similar results. These results highlighted the importance of a systemic examination in pediatric head trauma cases.

The number of patients examined in our study who required surgical interventions after their examinations at the emergency services was 6 (4.3%), and all these patients underwent the necessary operations (**Table 6**). The patients requiring surgery mostly had compression fractures and intracranial hematomas. It should be kept in mind that these cases require early diagnosis and intervention. The low rate of surgical intervention requirement in our study (4.3%) may be explained by the fact that there are not many elevated settlement areas that could result in relatively more severe traumas in the region, the region is not on the main traffic routes, and the city center is located far from the highway.

Table 5. Accompanying traumas of the patients

Variables	Groups	Frequency (n)	Percentage (%)
Accompanying Trauma	Abdominal Trauma	2	1.5
	Abdominal Trauma + Thoracic Trauma	2	1.5
	Extremity Fracture	6	4.4
	Extremity Fracture + Abdominal Trauma	2	1.5
	Extremity Fracture + Spinal Trauma	3	2.2
	Extremity Fracture+ Thoracic Trauma	2	1.5
	Extremity Fracture + Thoracic Trauma+ Abdominal Trauma	4	2.9
	Extremity Fracture + Thoracic Trauma+ Orbital Trauma	1	0.7
	Mastoid Fracture	5	3.7
	Orbital Fracture	11	8.1
	Orbital Fracture+ Maxillofacial Fracture	3	2.2
	Sinus Fracture	3	2.2
	Spinal Trauma	2	1.5
	Thoracic Trauma	1	0.7
	Thoracic Trauma+ Spinal Trauma	1	0.7
	Isolated Head Trauma	87	64.4

Table 6. Patient pathologies

Variables	Groups	Frequency (n)	Percentage (%)
Pathology	Compression Fracture + Subdural Hematoma	3	2.2
	Compression Fracture	10	7.4
	Compression Fracture + Epidural Hematoma	1	0.7
	Compression Fracture + Epidural Hematoma+ Subdural Hematoma	1	0.7
	Compression Fracture + Traumatic SAH	2	1.5
	Epidural Hematoma	5	3.7
	Epidural Hematoma+ Traumatic SAH	2	1.5
	Contusion	7	5.2
	Contusion + Traumatic SAH	5	3.7
	Linear Fracture	41	30.4
	Linear Fracture+ Traumatic SAH	3	2.2
	Linear Fracture+ Epidural Hematoma	5	3.7
	Linear Fracture+ Contusion	1	0.7
	Linear Fracture+ Contusion + Traumatic SAH	2	1.5
	Linear Fracture+ Pneumocephalus	1	0.7
	Linear Fracture+ Subdural Hematoma	8	5.9
	Linear Fracture+ Traumatic SAH + Epidural Hematoma	1	0.7
	Subdural Hematoma	9	6.7
	Subdural Hematoma+ Traumatic SAH	1	0.7
	Subdural Hematoma+ Traumatic SAH + Contusion	1	0.7
	Subgaleal Hematoma	25	18.5
	Traumatic SAH	1	0.7
Surgical Operation	Compression Fracture	3	2.2
	Compression Fracture+ Epidural Hematoma + Subdural Hematoma	1	0.7
	Epidural Hematoma	1	0.7
	Subdural Hematoma	1	0.7
	Follow-up without Surgery	129	95.6

SAH: Subarachnoid hematoma

Complications such as hydrocephalus and meningitis can also occur, particularly in those undergoing surgery following trauma. These complications may necessitate secondary surgery after primary surgery. It is known that ventriculoperitoneal shunt placement, particularly after hydrocephalus develops, can lead to other complications such as infection and obstruction.[28] However, due to the small number of patients undergoing surgery and the fact that patients with poor general condition are followed at advanced centers, we have not observed these complications in any of our patients.

Among the patients who were brought following traumas, none died at our hospital. The reason for this may be that because our hospital does not have a well-equipped pediatric ICU unit, patients whose general status is poor and who have low GCS scores are referred to higher-tier hospitals.

This study had certain limitations. First, this was a retrospective study. Second, the data were collected at a single center. This may limit the applicability of the results to the general population. It is recommended that future studies be performed with larger samples and multi-center designs. It is also needed to examine the long-term effects of traumas in prospective studies.

CONCLUSION

Consequently, it should be kept in mind that pediatric head traumas are caused by preventable factors, and a significant proportion of these traumas can be prevented through appropriate precautions. The results of this study emphasize the need to increase the amount of epidemiological data related to pediatric head traumas and develop prevention strategies..

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Tokat Gaziosmanpaşa University Non-Intervention Scientific Research Ethics Committee (Date: 07.01.2025, Decision No: 25-MOBAEK-014).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

Association Between Pressure Injuries and Nutritional Status in Patients Receiving Home Healthcare Patients

Evde Sağlık Hizmeti Alan Hastaların Basınç Yaralanmalarının Değerlendirilmesi ve Beslenme Durumları ile İlişkisi

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Abstract

Aim: Pressure injuries are commonly observed in home care patients. This study aimed to evaluate the presence of pressure injuries and the nutritional status of patients receiving home healthcare services, and to reveal the relationship between these two conditions.

Material and Method: A total of 81 patients with pressure injuries, followed in September 2023 by the Home Healthcare Unit of Kayseri City Training and Research Hospital, were evaluated in detail. Patients' demographic characteristics, presence of chronic diseases, and nutritional status were assessed. The Barthel Index of Activities of Daily Living and the Mini Nutritional Assessment–Short Form (MNA-SF) were applied. A p-value of <0.05 was considered statistically significant.

Results: The median age of patients with pressure injuries was 77 years (range: 15–97), and 45 (55.6%) were female. Pressure injuries were most commonly located in the sacral region (57 patients, 70.4%), with stage 2 being the most frequent (43.9%). Heel injuries were observed in 9 patients (11.1%), also predominantly stage 2 (66.7%). One patient (1.2%) had a pressure injury on the toes, which was stage 2. Sixty-two patients (76.5%) were completely dependent. According to the MNA-SF, 8 patients (9.9%) had normal nutrition, 39 (48.1%) were at risk of malnutrition, and 34 (42%) were malnourished. Malnutrition was significantly more prevalent in patients with sacral pressure injuries (p=0.043). Similarly, the risk of malnutrition was significantly higher in those with trochanteric pressure injuries (p=0.009).

Conclusion: The incidence of pressure injuries was higher in patients who were malnourished or at risk of malnutrition. In order to prevent pressure injuries in patients receiving home healthcare, early identification of malnutrition is essential. During this process, individualized diet planning and appropriate vitamin and mineral supplementation should be provided.

Keywords: Pressure injury, home health service, malnutrition, activities of daily living

Öz

Amaç: Basınç yaralanmaları evde bakım hastalarında yaygın olarak görülmektedir. Bu çalışmada evde sağlık hizmeti alan hastaların basınç yaralanması varlığını ve beslenme durumlarını değerlendirmek; bu iki durum arasındaki ilişkiyi ortaya koymak amaçlanmıştır.

Gereç ve Yöntem: Kayseri Şehir Eğitim ve Araştırma Hastanesi Evde Sağlık Hizmetleri Biriminde 2023 yılı Eylül ayında takip edilen hastalardan basınç yaralanması olan 81 hasta ayrıntılı değerlendirildi. Hastaların demografik özellikleri, kronik hastalık varlığı, beslenme şekli sorgulandı ve Barthel Günlük Yaşam aktiviteleri indeksi, Mini Nütrisyonel Değerlendirme-Kısa Form (MNA-SF) ölçekleri uygulandı. p<0,05 istatistiksel olarak anlamlı kabul edildi.

Bulgular: Basınç yaralanması olan hastaların yaş ortancası 77 (15-97) idi. Hastaların 45'i (%55,6) kadındı. Sakrumda 57 (%70,4) hastada basınç yaralanması vardı ve en çok görülen evre 2 (%43,9) idi. Topukta 9 (%11,1) hastada basınç yaralanması vardı ve en çok görülen evre 2 (%66,7) idi. Ayak parmaklarında 1 (%1,2) hastada basınç yaralanması vardı ve evre 2 (%100) idi. Hastaların 62 (%76,5) tam bağımlıydı. MNA-SF tarama durumuna göre normal nütrisyon 8 (%9,9), malnütrisyon riski altında 39 (%48,1), malnütrisyonlu 34 (%42) hasta bulunmaktaydı. Özellikle sakrum bölgesinde basınç yaralanması olanlarda malnütrisyon anlamlı yüksekti (p:0,043). Trokanter bölgesinde basınç yaralanması olan hastalarda da malnütrisyon riski anlamlı yüksekti (p:0,009).

Sonuç: Sonuç olarak malnütrisyon ya da malnütrisyon riski olan hastalarda basınç yaralanması görülme oranı artmıştır. Evde sağlık hizmeti alan hastalarda basınç yaralanmalarının önlenmesi için malnütrisyonun erken dönemde tespit edilmesi gereklidir. Bu süreçte, hastaların bireysel ihtiyaçlarına uygun özel diyet planlamaları yapılmalı ve gerekli vitamin-mineral takviyeleriyle desteklenmelidir.

Anahtar Kelimeler: Basınç yaralanması, evde sağlık hizmeti, malnütrisyon, günlük yaşam aktivitesi

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INTRODUCTION

The term pressure injury (PI) was formerly referred to as "decubitus ulcer" or "bed sore." In 2016, the National Pressure Ulcer Advisory Panel (NPUAP) in the United States replaced this terminology with pressure injury to better define skin and underlying tissue damage in immobile patients. The term ulcer only referred to open wounds, whereas injury includes both open and intact skin damage and emphasizes preventability. With appropriate care, up to 95% of pressure injuries are considered preventable.[1,2] Despite this high preventability, pressure injuries continue to occur at significant rates globally and in Turkey. A Turkish study reported a PI incidence of 33.5%.[3] PIs are defined as "localized damage to the skin and/or underlying tissue, typically over a bony prominence, as a result of pressure or pressure in combination with shear".[4] These injuries compromise skin integrity, increase the risk of infection, prolong hospitalization, reduce quality of life, and raise healthcare costs. The quality of care is critical in PI prevention. These injuries are frequently observed among home care patients. Factors such as poor oral intake, malnutrition, low body weight, and muscle wasting significantly increase the risk. Immobility, incontinence, and reduced muscle mass are also contributing factors.[5] Approximately 95% of PIs occur in the lower half of the body. Around 65% affect the pelvic area and 30% the lower extremities. In supine patients, the most common sites are the sacrum (53.4%), heels (14.8%), and trochanters (12.5%). These injuries are prevalent in home care settings, especially among elderly patients. Malnutrition is frequent in this group and is defined by insufficient intake of energy and protein, weight loss, and low body mass index. It impairs wound healing and increases PI risk. Anorexia, dysphagia, and reduced appetite further contribute to nutritional deficits. Studies have shown that malnourished elderly individuals are nearly twice as likely to develop pressure injuries compared to well-nourished peers.[6] Preventing and managing PIs is an important healthcare quality indicator. The U.S. Agency for Healthcare Research and Quality notes that one in eight deaths is linked to pressure injuries resulting from malnutrition. Malnutrition, worsened by chronic illness and age-related factors like tooth loss, is a major contributor to morbidity and mortality. This study aims to assess the presence of pressure injuries and nutritional status in patients receiving home healthcare and to examine the relationship between these two factors.[7]

MATERIAL AND METHOD

The institutional consent to perform the study was obtained from Kayseri Provincial Directorate of Health and the study was approved by the Ethics committee of Nuh Naci Yazgan University (Decision number: 2024/002-07 and Date: 12.02.2024). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This descriptive, cross-sectional study included all patients with a documented pressure injury who were registered with the Home Healthcare Services Unit of Kayseri City Training and Research Hospital and received care in September 2023. A total of eighty-one eligible patients were enrolled. Demographic characteristics, chronic disease history, and nutritional patterns were recorded. Pressure injuries were evaluated according to the classification system of the National Pressure Ulcer Advisory Panel (NPUAP).[8] In addition, the researchers developed a patient information form based on a review of the relevant literature. This form was supplemented with the Barthel Index of Activities of Daily Living (ADL) and the Mini Nutritional Assessment–Short Form (MNA-SF) to assess functional and nutritional status, respectively.

Barthel Index of ADL. Originally developed by Barthel et al. and later revised by Shah et al.[9], the Turkish validation was conducted by Küçükdeveci et al.[10] The scale assesses independence in ten basic daily activities (e.g., feeding, transfers, continence, mobility). Scores range from 0 (total dependence) to 100 (complete independence), categorized as total (0–20), severe (21–61), moderate (62–90), or slight (91–99) dependence, and full independence (100). MNA-SF. Revised by Kaiser et al., this six-item screening tool reliably classifies older adults as malnourished (0–7), at risk of malnutrition (8–11), or well-nourished (12–14), based on appetite, recent weight loss, mobility, acute illness or stress, neurocognitive status, and body mass index (BMI).[11,12]

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 21.0. Continuous variables were summarized as means±SD, medians, and ranges; categorical variables as counts and percentages. Normality was tested with Kolmogorov–Smirnov. Between-group comparisons used the Independent-Samples t-test for normally distributed data and the Mann–Whitney U test otherwise. In the comparison of three or more groups, One-Way ANOVA was applied for normally distributed data, while the Kruskal-Wallis test was used for data that did not follow a normal distribution. Categorical variables were compared with χ^2 tests. Pearson or Spearman correlation coefficients assessed associations between continuous variables, depending on distribution. A two-tailed $p < 0.05$ indicated statistical significance.

RESULTS

In September 2023, data from 573 patients under the care of the Home Healthcare Services Unit of Kayseri City Training and Research Hospital were reviewed. Among them, 81 (14%) were diagnosed with decubitus ulcers (DUs). The median age of these patients was 77 years (range: 15–97), and 55.6% (n=45) were female. All patients had at least one chronic illness. The most common ulcer site was the sacral region

(70.4%), with Stage 2 being the most frequent stage (43.9%). Heel ulcers were observed in 11.1%, mostly Stage 2. Other locations included the trochanteric (13.6%), scapular (3.7%), and toe (1.2%) areas. The average number of ulcers per patient was 1.39±0.58. No significant gender difference was observed in DU count (p=0.643). Most patients (76.5%) were classified as totally dependent according to the Barthel Index, with a median score of 0 (range: 0–75). Nutritional assessment using the Mini Nutritional Assessment–Short Form (MNA-SF) showed that 9.9% had normal nutrition, 48.1% were at risk of malnutrition, and 42% were malnourished (median MNA-SF: 9). Malnutrition was significantly more prevalent among patients with sacral ulcers (p=0.043) and those with trochanteric ulcers were significantly more likely to be at risk of malnutrition (p=0.009). Among malnourished patients with sacral ulcers, most had Stage 2 injuries (p=0.020). A positive correlation was found between Barthel score and MNA-SF score (p=0.007, r=0.298). While there was a weak negative correlation between Barthel score and number of DUs (p=0.102), a statistically significant negative correlation was observed between MNA-SF score and number of DUs (p=0.002, r=–0.343). Age was positively correlated with the number of DUs (p=0.042, r=0.226).

Table 1. General Data of Patients and Frequency of Pressure Injury

	Number (n)	Percentile (%)	Mean±SD/Median (min–max)
Age			77 (15–97)
Gender (F/M)	45/36	55.6/44.4	
Chronic Diseases			
Hypertension	40	49.4	
Cerebrovascular disease	32	39.5	
Diabetes	23	28.4	
Coronary artery disease	22	27.2	
PI			
PI Prevalence	81/573	14	
Number of PI per patient			1.39±0.58
PI Localization			
Sacrum	57	70.4	
Trochanter	11	13.6	
Heel	9	11.1	
Scapula	3	3.7	
Toes	1	1.2	
MNA Screening			
MNA Score			9 (1–13)
At risk of malnutrition	39	48.1	
Malnourished	34	42	
Normal	8	9.9	
Feeding Type			
Normal	39	48.1	
Oral Nutrition	31	38.3	
PEG	11	13.6	

SD: Standard Deviation; Min: minimum; Max: maximum; MNA: Mini Nutritional Assessment, PI: Pressure İnjury, PEG: Percutaneous Endoscopic Gastrostomy

Table 2: Mini Nutritional Assessment Screening Scores by Pressure İnjury Location

Region	Mean Score	Standard Deviation	p-value
Sacrum			
Yes (n=57)	9.25	2.382	0.001
No (n=24)	6.98	3.583	
Trochanter			
Yes (n=11)	9.36	1.286	0.074
No (n=70)	7.39	3.576	

Table 3: Pressure Injury Status in Sacral and Trochanteric Regions Based on Mini Nutritional Assessment Screening

Region	Nutritional Status	Normal Nutrition	At Risk of Malnutrition	Malnourished	p-value
Sacrum	Yes (n=57)	4 (7%)	24 (42.1%)	29 (50.9%)	0.035
	No (n=24)	4 (16.7%)	15 (62.5%)	5 (20.8%)	
Trochanter	Yes (n=11)	0 (0%)	10 (90.9%)	1 (9.1%)	0.009
	No (n=70)	8 (11.4%)	29 (41.4%)	33 (47.1%)	

Table 4: Correlation Matrix between Age, Number of Pressure Injuries, Barthel Score, and Mini Nutritional Assessment Screening Score

	Age	Number of Ulcers	Barthel Score	MNA Screening Score
Age	1	0.226 (p=0.042)	0.031 (p=0.786)	–0.091 (p=0.417)
Number of Ulcers		1	–0.183 (p=0.102)	–0.343 (p=0.002)
Barthel Score			1	0.298 (p=0.007)
MNA Screening Score				1

MNA: Mini Nutritional Assessment

DISCUSSION

Pressure injuries are associated with factors such as immobility, aging, malnutrition, and chronic diseases.[13] These injuries significantly reduce quality of life, increase healthcare costs, and elevate mortality. Their prevalence is particularly high among elderly individuals who are hospitalized, live in nursing homes, or receive home healthcare services.[14] Therefore, identifying the contributing factors is essential for effective preventive strategies.

In this study, the dependency level, nutritional status, and clinical characteristics of pressure injuries in individuals receiving home healthcare services were examined. Literature indicates that among those receiving home care, the total dependency rate is 37%, the rate of nutritional product use is 32%, and the pressure injury prevalence is 12%.[15] In our study, all participants had pressure injuries, and total dependency was 76.5%, which is considerably higher. This can be attributed to the specific characteristics of the study population.

Regarding ulcer characteristics, our findings are consistent with previous studies. In the study by Bergquist et al.[16], most ulcers were at Stage 1 or 2, commonly localized to the sacral and heel regions. Similarly, Özgenel et al.[17] reported sacral (43%), trochanteric (29%), and heel (8%) as the most common sites. In our study, 70.4% were sacral ulcers, and Stage 2 was the most frequent stage, confirming that the sacral region is the most vulnerable.

Nutritional status is a key factor in pressure injury development. The Pan Pacific Guideline recommends the use of the Mini Nutritional Assessment–Short Form (MNA-SF) for elderly individuals.[18] European data shows that 40% of hospitalized patients and 60% of those in nursing homes are at risk of malnutrition.[19] In a multinational study, malnutrition prevalence was 5.8% among community-dwelling elderly, 13.8% in nursing homes, and 38.7% in hospitals.[20] Similar results have been reported in Turkey.[21] Malnutrition prevalence is also notably high among patients receiving home healthcare services, largely due to advanced age, multiple comorbidities, and severe dependency. For instance, a 2023 study found that 49.7% of elderly patients under home healthcare were either malnourished or at risk of malnutrition.[22] Similarly, another 2023 study reported that 38.13% of home care patients were malnourished, while 37.81% were at risk.[23] In our study, malnutrition prevalence was 42%, and 48% were at risk, likely due to older age, high comorbidity, and severe dependency. These findings are consistent with previous studies in the literature, which have also reported high rates of malnutrition and nutritional risk among elderly patients receiving home healthcare services.

Aging is associated with an increased risk of pressure injuries, likely due to age-related skin changes, immobility, and the burden of chronic diseases.[24] In our study, all patients had at least one chronic illness, the median age was 77 years, and 76.5% were totally dependent, which may contribute to the observed frequency of pressure injuries.

While gender has not consistently shown a relationship with pressure injury development in the literature[25], our findings were in line with this, showing no statistically significant difference between male and female patients.

The relationship between functional dependency and malnutrition is well-established. Cereda et al. demonstrated that malnutrition leads to decreased activities of daily living.[26] Our study found a significant positive correlation between MNA-SF and Barthel Index scores, suggesting that better nutrition supports independence. Conversely, malnutrition causes muscle loss and functional decline, leading to increased care needs and decreased quality of life.[20,27] This bidirectional relationship underscores the need for early, combined evaluation of functional and nutritional status.[28]

Immobility is a major pressure injury risk factor. Aydın and Mucuk noted a higher risk among individuals with dependency in daily living.[29] In our study, a weak negative but non-significant correlation was found between functional status and the number of pressure injuries.

Malnutrition has been reported as an independent risk factor for pressure injuries. Alhaug et al. found that individuals with malnutrition had a 2.5-fold increased risk.[30] Similarly, Bergquist-Beringer et al. reported a strong association between malnutrition, hypoalbuminemia, and the incidence of pressure ulcers.[31] Although our findings are consistent with those in the literature, causality cannot be confirmed due to the study design.

In our study, patients with pressure injuries located in the sacral region were more frequently malnourished, while those with injuries in the trochanteric region were more often at risk of malnutrition. These findings suggest that nutritional impairment may compromise tissue integrity and predispose certain anatomical areas to ulcer development. Cereda et al. reported that inadequate nutritional status delays wound healing and increases the risk of pressure injury formation.[32] In particular, protein-energy malnutrition reduces the resistance of the skin and soft tissues to pressure, thereby facilitating ulcer formation in high-risk regions such as the sacrum and trochanter.[33] Therefore, nutritional assessment plays a critical role in establishing clinical priorities based on the location of pressure injuries in affected individuals.

This study is subject to several limitations. First, as it was conducted exclusively among patients receiving home healthcare services from a single hospital, the generalizability of the findings is inherently restricted. Second, nutritional status was assessed solely using the MNA-SF, which relies on self-reported data and may therefore introduce measurement bias. Finally, the relatively small sample size further limits the external validity and applicability of the results to broader populations.

CONCLUSION

Most patients were totally dependent, and 42% were malnourished, underscoring the importance of nutritional status as a significant risk factor for pressure injuries. Based on these findings, systematic nutritional assessment should be integrated into the routine care of home healthcare patients. Early identification of nutritional risk and timely, individualized nutritional interventions may contribute to the prevention and more effective management of pressure injuries. In this context, a multidisciplinary approach that addresses both functional and nutritional status is essential to improve patient outcomes and support quality of life.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Nuh Naci Yazgan University Ethics Committee (Date: 12.02.2024, Decision No: 2024/002-07).
Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.
Referee Evaluation Process: Externally peer-reviewed.
Conflict of Interest Statement: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.
Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

Integrating Green Building Principles Into Family Health Centers: Scenario-Based Energy Efficiency Assessment

Yeşil Bina Prensiplerinin Aile Sağlığı Merkezlerine Entegre Edilmesi: Senaryo Tabanlı Enerji Verimliliği Değerlendirmesi

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Abstract

Aim: Many developed countries around the world are developing various policies to make their health institutions and health infrastructure sustainable. This study aims to evaluate the current energy efficiency practices in hospitals in Türkiye and investigate their applicability to family health centres (FHCs).

Material and Method: The study was conducted using a mixed and qualitative design that combined existing document analysis, comparative analysis, and scenario modelling methods. It aims to develop applicable policy recommendations for both situation assessment and future planning by evaluating data obtained from healthcare institutions operating in Türkiye.

Results: Solar energy systems (photovoltaic panels), indoor LED lighting systems, and water-saving fixtures, which are identified as the fastest and easiest to implement for FHCs in green building certification, are expected to reduce the carbon emissions of the existing 8300 FHCsby approximately 45000 tons per year, saving about 20 million kWh of energy and 1,5 million cubic meters of water annually.

Conclusion: While hospitals have the potential for transformation with more advanced systems, FHCs can contribute to environmental sustainability with simpler and lower-cost strategies. It has been determined that FHCs, based on the principles of green building criteria, are quite suitable for sustainable energy use even on a micro scale. The scenarios developed indicate that the identified practices can contribute to national environmental goals and also play an important role in raising environmental awareness in society. The successful dissemination of sustainable health policies will be possible with the active involvement of FHCs in this process.

Keywords: Green building, family health centres, sustainability

Öz

Amaç: Dünyanın birçok gelişmiş ülkesi, sağlık kurumlarını, sağlık altyapılarını sürdürülebilir hale getirmek için çeşitli politikalar geliştiriyor. Bu çalışma, Türkiye'deki hastanelerdeki mevcut enerji verimliliği uygulamalarını değerlendirmeyi ve aile sağlığı merkezlerine (ASM) uygulanabilirliğini araştırmayı amaçlamaktadır.

Gereç ve Yöntem: Çalışma, mevcut belge analizi, karşılaştırmalı analiz ve senaryo modelleme yöntemlerinin bir arada kullanıldığı karma ve nitel bir tasarımla gerçekleştirilmiştir. Türkiye'de hizmet veren sağlık kurumlarından elde edilen verilerin değerlendirilerek hem durum tespiti hem de gelecek planlaması açısından uygulanabilir politika önerileri geliştirmeyi amaçlamaktadır.

Bulgular: Yeşil bina sertifikasyonunda yer alan ve ASM'ler için en hızlı ve kolay uygulanabilir olarak belirlenen güneş enerjisi sistemleri (fotovoltaik paneller), iç mekân LED aydınlatma sistemleri, su tasarrufu sağlayan armatürlerin tercih edilmesi ile birlikte halihazırda bulunan 8.300 ASM'nin karbon emisyonlarını yılda yaklaşık 45.000 ton azaltabileceği, yıllık yaklaşık 20 milyon kWh enerji ve yıllık 1,5 milyon metreküp su tasarrufu öngörülmektedir.

Sonuç: Hastaneler daha gelişmiş sistemlerle dönüşüm potansiyeline sahipken, ASM'ler daha basit ve düşük maliyetli stratejilerle çevresel sürdürülebilirliğe katkıda bulunabilirler. ASM'lerin yeşil bina kriterleri prensibiyle, mikro ölçekte bile sürdürülebilir enerji kullanımına oldukça uygun olduğu belirlenmiştir. Senaryolaştırılarak belirlenen uygulamaların ulusal çevre hedeflerine katkıda bulunabileceğini ve ayrıca toplumda çevre bilincinin artmasında önemli bir rol oynayabileceğini göstermektedir. Sürdürülebilir sağlık politikalarının başarılı bir şekilde yayılması, ASM'lerin bu süreçte aktif bir rol almasıyla mümkün olacaktır.

Anahtar Kelimeler: Yeşil bina, aile sağlığı merkezleri, sürdürülebilirlik

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INTRODUCTION

With the increasingly evident impacts of global environmental issues and climate change around the world, a new development goal and transformation have begun.[1] The importance and feasibility of using renewable energy systems, energy-efficient building designs, and waste reduction strategies to achieve environmental sustainability goals have been recognized.[2,3] Many developed countries have developed various policies to make the infrastructure of healthcare buildings more sustainable and have started to encourage healthcare institutions in this direction.

Sustainability awareness and purpose-driven practices are increasing in Türkiye, but they are progressing below expectations. A more widespread approach and mechanisms to accelerate efforts are needed, along with practical examples.[4] Due to high energy consumption and carbon footprint compared to other public buildings, the healthcare sector has structures that need to participate in this transformation.[1] Hospitals and similar healthcare facilities are open 24 hours a day, which brings with it a significant environmental burden, from waste management to water usage.[5] Re-adapting healthcare facilities with eco-friendly and sustainable building practices will holistically protect the environment and indirectly public health.

The aim of this study is to discuss the importance of adopting environmentally friendly approaches and using sustainable energy sources in the 8.300 Family Health Centres (FHCs) operating in Türkiye, according to the Ministry of Health's 2024 data.[6] By evaluating the practices implemented in the world and in Türkiye, it aims to create a roadmap to reduce the environmental impacts of FHCs.

MATERIAL AND METHOD

In this research, the analysis of existing green hospital practices in healthcare institutions in Türkiye, the evaluation of the feasibility of these practices in FHCs, and the identification of the benefits to be gained from these practices were aimed. This study used a qualitative approach that included three parts: a careful review of national and international green building standards and health policies; a comparison of the structures of hospitals and Family Health Centers (FHCs); and creating models based on real-life data about what is possible (like national energy use reports and maps showing solar energy potential). Scenario modeling was performed using Excel-based estimations derived from published technical benchmarks (e.g., solar panel yield, water savings per fixture, etc.). Since the study is based on the construction of accessible data and universal standards using scenario modelling methods, an ethics committee application was not deemed necessary by the committee.

At the first stage, the Ministry of Health regulations, the Ministry of Energy and Natural Resources regulations, the Ministry of Environment, Urbanization and Climate Change regulations, municipal regulations and the Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREAM) reports published by international certification organizations were systematically examined. The number of existing green hospitals in Türkiye, their geographical distributions, eco-friendly strategies (use of renewable energy, water efficiency, waste management, building insulation, energy monitoring systems, etc.), and certifications were determined.

In the second phase, the most commonly used structural practices of the existing green hospitals in Türkiye were compared with the structural characteristics of a typical FHC according to the Ministry of Health regulations. A comparative analysis was conducted in terms of energy consumption levels, infrastructure capacity, physical space utilization, and financial resource management . With the obtained data, it was evaluated which green building practices could be implemented in FHC.

Finally, the identified applications simulated possible green practices for FHC using the scenario modelling method. For the buildings currently in service, the environmental and energy-saving impacts of low-cost and quickly implementable interventions were estimated based on literature data. With this simulation, it was aimed to determine the potential of FHCs in terms of environmental sustainability.

RESULTS

Based on building certification criteria, a comparative analysis conducted to evaluate green building practices in hospitals and FHCs revealed that due to the intensive use of operating rooms and laboratories, hospitals have high energy consumption and require additional ventilation/ lighting systems. FHCs generally have sufficient natural lighting and ventilation due to their existing buildings, which leads to lower energy costs compared to hospitals. While hospitals aim to obtain international certifications such as LEED or BREEAM, which are more suitable for large structures, FHCs are more compatible with local or basic systems like EDGE or YeS-TR. While hospitals face challenges in green building certification processes due to complex structures and high costs, FHCs encounter limitations such as low awareness and limited local support (**Table 1**).

In the scenario modelling prepared for approximately 8.300 FHCs operating in Türkiye as of 2024, when we focus on sustainability practices, the three identified applications with low cost and high applicability are "solar energy systems (photovoltaic panels)," "LED lighting systems," and "water-saving fixtures."

Table 1. Comparative Analysis of Green Building Practices in Hospitals and Family Health Centres.

Criterion	Hospitals	Family Health Centres
Building Scale & Function	Large-scale, multifunctional, 24/7 service structures	Small-scale, basic outpatient care, usually single buildings
Energy Consumption	High – Intensive use of HVAC, ORs, laboratories	Low – Natural lighting and ventilation often sufficient
Cost of Green Transition	High – Significant investment and operational costs	Low – More affordable and accessible transformation opportunities
Certification Potential	Suitable for international standards (e.g., LEED, BREEAM)	More suited to basic or local systems (e.g., EDGE, YeS-TR)
Barriers	Technical complexity, high costs, bureaucratic procedures	Limited local support, low awareness, restricted funding
Applicable Strategies	Trigeneration, smart energy monitoring, waste heat recovery systems	Solar panels, thermal insulation, water-saving fixtures, natural air flow
Access to Incentives	Greater access to central government subsidies and public funding	Mostly reliant on local government or small-scale incentives

According to this scenario model, the installation of 3 kWp capacity rooftop photovoltaic systems for each FHC in Türkiye could generate approximately 100 million kWh of electricity annually, which is equivalent to the annual electricity consumption of about 35.000 households. It is projected that this implementation could reduce carbon emissions by approximately 45.000 tons per year. Additionally, replacing halogen or fluorescent lighting in all health centres with LED lighting systems provides an annual energy saving of approximately 20 million kWh.

Thanks to its geographical location, Türkiye has significant solar energy potential. According to the Turkish Solar Energy Potential Atlas, the annual average total sunshine duration is 2,741 hours, and the annual average total radiation value is 1,527.46 kWh/m^2. Based on the scenario, solar energy systems installed in the Southeast Anatolia region, which has the highest solar exposure, and the Black Sea region, which has the lowest solar exposure, were analysed. The Southeastern region, with approximately 1,800 kWh/m^2/year of radiation, has provided greater environmental benefits compared to the Black Sea region, which has 1,200 kWh/m^2/year of radiation. At this point, not only energy use but also the importance of location-specific planning during implementation is noteworthy (**Figure 1**).

In healthcare facilities, due to hygiene standards, water usage is the highest among public buildings. Water-saving fixtures, dual-flush toilets, and rainwater harvesting systems are the quickest and most cost-effective methods that can be implemented to reduce consumption. Gray water treatment systems are used to recycle wastewater. According to the scenario model where the use of water-saving fixtures and dual-flush toilets becomes standard in all health centres, building water usage can be reduced by approximately 35%. With this rate, an annual saving of 1.5 million cubic meters of clean water is anticipated (**Table 2**).

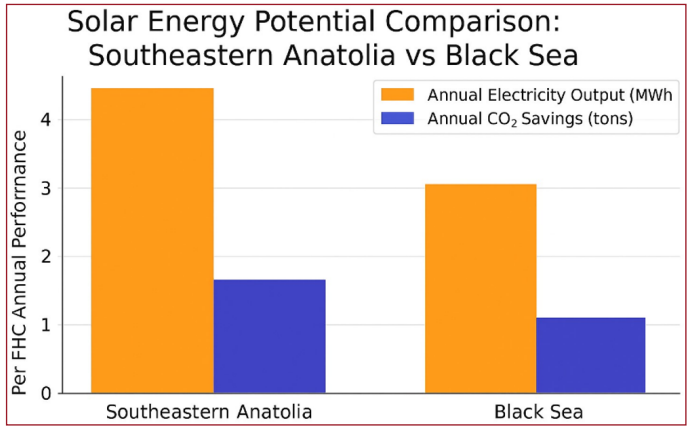

Figure 1. Solar Energy Potential Comparison.

DISCUSSION

Public buildings in Türkiye are undergoing a significant transformation through eco-friendly strategies and sustainability certifications. This transformation has begun with practices such as energy efficiency, water conservation, waste management, and building insulation. Energy efficiency and waste monitoring systems are the most rapidly implementable fundamental strategies adopted by green hospitals to ensure environmental sustainability. Although green building practices are particularly noteworthy in newly constructed health campuses, according to current data in Türkiye, 20 green hospitals have been identified, and there is no clear information on the number of hospitals in the application process.

Table 2. Quantitative Estimations for Environmental Impact of Sustainable Practices in FHCs

Parameter	Assumptions / Inputs	Calculation	Estimated Outcome
Annual Electricity Generation via Photovoltaic Systems	3 kWp per FHC Avg. output ≈ 12,000 kWh/year/FHC 8,300 FHCs	12,000 kWh × 8,300	~99.6 million kWh/year
Carbon Emission Factor	0.45 kg CO_2/kWh (Türkiye average)	99.6 million kWh × 0.45 kg CO_2/kWh	~45,000 tons CO_2/year
Electricity Savings via LED Lighting	Old lighting: 3,000 kWh/year/FHC Savings rate: ~80% 8,300 FHCs	2,400 kWh × 8,300	~20 million kWh/year
Water Savings via Efficient Fixtures	Avg. baseline: 54 m^3/month/FHC Reduction: ~35% 8,300 FHCs	54 × 12 × 0.35 × 8,300	~1.5 million m^3/year
Regional Solar Potential	Southeast Anatolia: 1,800 kWh/m^2/year Black Sea Region: 1,200 kWh/m^2/year	Higher solar yield in southeastern regions by up to 50%	Location-specific optimization possible

Nowadays, LED lighting systems, energy analysers, and automation systems are used to reduce the energy consumption of buildings. The basis of these systems is to monitor energy usage, keep it to a minimum, and increase efficiency. In some hospitals, technologies such as trigeneration systems are used to produce electricity from waste heat, thereby increasing energy efficiency. In waste management, comprehensive waste management plans are implemented with the aim of recycling service process waste, with the target of recycling 75% of the waste.

TS EN ISO 50001 Energy Management System aims to establish and continuously improve energy management systems in practices. According to the regulations published by the Ministry of Energy, green hospitals in Türkiye are expected to document their environmental sustainability through various certification systems.

To minimize energy loss, the use of high-insulation glass, which is among the criteria for green hospitals, is also recommended. Additionally, the construction chemicals used indoors should meet international standards for Volatile Organic Compounds (VOCs) to reduce environmental and health hazards. LEED certifies buildings that meet energy and environmental design criteria; the Bursa Integrated Health Campus is the only healthcare facility in Türkiye to receive LEED Gold certification. YeS-TR evaluates energy use, water and waste management, and indoor environmental quality, offering four certification levels: pass, good, very good, and national excellence. Finally, it is an honorary title of "Environmentally Friendly Hospital" awarded by the Association of Environmental Organizations, but it is not an official certification. In Istanbul, Private Türkiye Hospital has received this title.

While developed countries generally implement sustainable healthcare service structures through new buildings, in countries like Türkiye where healthcare services are provided intensively and continuously, transforming existing facilities is a more realistic and feasible approach.[2,7] FHCs are ideal pilot areas for sustainability practices due to their integration into the community and simple administrative structures.

According to the literature, green healthcare institutions play a critical role not only in environmental protection but also in raising public awareness.[3,5,8] Considering the daily patient visits and close community ties of FHCs, the environmental solutions implemented here can influence individual behaviour change and raise awareness in the surrounding households.

Some limitations are anticipated in practice. The scarcity of financial resources hinders new initiatives. Therefore, the development of incentive mechanisms will be effective. In the practices implemented in developed countries, it has been observed that tools such as public-private partnerships offered to some small healthcare institutions or green certificate awards have been effective.[9,10] In Türkiye, similar models can be expanded with energy incentives and infrastructure grants or sponsorships from municipalities.

Additionally, it is very important to raise awareness and educate FHC staff about sustainability. Healthcare professionals who internalize eco-friendly practices can help establish sustainable behaviour patterns in patient care.[4,11]

The scenario analyses in this study show that eco-friendly practices such as energy efficiency (solar panels, LED lighting), water conservation (hardware systems), and waste management can be easily implemented in FHCs with low-cost transformations and can yield significant benefits.

Agyekum and colleagues (2021) address green building practices differently for hospitals and family health centers. Hospitals are large, multifunctional facilities that operate 24/7. Despite having significant potential for sustainable transformation due to high energy consumption, complex infrastructure, and large carbon footprints, they face obstacles such as high costs and complicated technical requirements. Hospitals are encouraged to pursue international certifications such as LEED and BREEAM for corporate prestige and access to public funding.[12,13] Through comparative analysis, it is shown that the high-cost technologies used in green hospitals (for example, greywater recycling or geothermal heating systems) are not feasible for FHCs in the short term due to infrastructure and financial constraints. Therefore, this study focuses on low-cost, feasible energy and water efficiency solutions. This approach aligns better with the existing FHC infrastructure and appears more practical for sustainable health policies.

Similar to McGain & Naylor's findings (2014) on rapid payback periods for basic green strategies in primary care settings, our scenario also supports the feasibility of LED and water-saving fixtures as first-step interventions. On the other hand, health centres, which are generally single-story and have lower energy needs, are quite suitable for the implementation of simple and cost-effective sustainable solutions such as natural ventilation, insulation, solar panels, and grey water systems. However, limited support from local authorities, weak technical capacity, and low awareness hinder the widespread implementation of these practices.[14]

With this research, it was aimed to emphasize that the principle of sustainability should not be limited to large hospitals but should be spread throughout the entire healthcare system. FHCs can be the most accessible and effective connection with the community in this transformation. These practices can reduce the environmental footprint while providing economic savings, thereby helping to lessen the overall financial burden on the healthcare system.[15] Additionally, symbolically promoting the environmental identity of FHCs can raise public environmental awareness. However, mere awareness and education may not be sufficient to achieve this transformation. New regulations by policymakers to integrate environmental criteria into the accreditation of healthcare facilities would be beneficial. Although pilot implementations have started globally and locally, similar studies should be presented to policymakers since these implementations have not yet been on the agenda of FHCs.[16]

This study examines the possibilities and limitations of expanding environmental sustainability practices in FHCs in Türkiye and reveals the potential for integrating the green hospital concept into primary healthcare services. The findings have revealed that even small-scale interventions can provide significant environmental and economic benefits.

CONCLUSION

Hospitals and family health centers have different priorities and implementation challenges regarding green building practices. While hospitals have a complex structure, health centers can contribute to environmental sustainability through low-cost strategies thanks to their simpler structure. The findings of the study indicate that FHCs can contribute to environmentally sustainable development goals through the use of sustainable energy and play an important role in raising public environmental awareness. The successful dissemination of sustainable health policies will be possible with the active participation of family health centres in this process. This study expands on existing literature by providing a practical scenario-based roadmap tailored to the Turkish primary care infrastructure, which has not been previously addressed in this context. Micro-scale actions will form the foundation for macro-scale environmental transformations in healthcare services.

ETHICAL DECLARATIONS

Ethics Committee Approval: Since our research includes a scenario-based qualitative analysis, it is a research that does not require ethics committee approval.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

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Original Article / Orijinal Araştırma

Perianal Infectious Dermatitis in Children

Çocuklarda Perianal Enfeksiyöz Dermatit

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Abstract

Aim: This study aimed to evaluate the clinical characteristics, microbiological findings, and treatment outcomes of pediatric patients diagnosed with perianal infectious dermatitis (PID), with the goal of enhancing clinical awareness and minimizing diagnostic delays in pediatric practice.

Material and Method: We retrospectively reviewed pediatric patients aged 0-18 years diagnosed with PID at a pediatric infectious diseases clinic. Demographic data, clinical symptoms, and culture results were analyzed. Diagnosis was based on clinical presentation and positive cultures from perianal lesions.

Results: Nine pediatric patients (mean age: 5.3 years, 8 boys, 1 girl) were diagnosed with PID. The most common symptoms were anal itching and painful defecation. Physical examination showed well-demarcated erythema in the perianal region. *Streptococcus pyogenes* was isolated in 7 patients, *Streptococcus agalactiae* in 1 patient, and both *S. pyogenes* and *Staphylococcus aureus* in 1 patient. All patients were treated with oral amoxicillin, leading to full recovery without complications.

Conclusion: This study highlights the importance of recognizing PID in pediatric patients presenting with perianal erythema, which can prevent unnecessary interventions and complications when appropriately diagnosed and treated.

Keywords: Perianal infectious dermatitis, *Streptococcus pyogenes*, children

Öz

Amaç: Bu çalışma, perianal enfeksiyöz dermatit (PED) tanısı alan çocuk hastaların klinik özelliklerini, mikrobiyolojik bulgularını ve tedavi sonuçlarını değerlendirmeyi; ayrıca bu hastalığın klinik farkındalığını artırarak yanlış tanı oranını azaltmayı amaçlamaktadır.

Gereç ve Yöntem: Bu çalışmada, çocuk enfeksiyon hastalıkları kliniğinde 0–18 yaş arası PED tanısı alan hastalar retrospektif olarak incelendi. Hastaların demografik özellikleri, klinik bulguları ve mikrobiyolojik kültür sonuçları değerlendirildi. Tanı, karakteristik klinik bulgular ve perianal lezyonlardan elde edilen pozitif kültür sonuçlarına dayanarak konuldu.

Bulgular: Çalışmaya dahil edilen toplam dokuz hastaya (ortalama yaş: 5,3 yıl; 8 erkek, 1 kız) PED tanısı konuldu. En sık gözlenen semptomlar anal kaşıntı ve ağrılı dışkılama idi. Fizik muayenede tüm hastalarda belirgin sınırlara sahip perianal eritem tespit edildi. Mikrobiyolojik incelemelerde, 7 hastadan *Streptococcus pyogenes*, 1 hastadan *Streptococcus agalactiae* ve 1 hastadan hem *S. pyogenes* hem de *Staphylococcus aureus* izole edildi. Tüm hastalara oral amoksisilin tedavisi uygulandı ve tamamında komplikasyon gelişmeksizin tam iyileşme sağlandı.

Sonuç: Bu çalışma, perianal eritem ile başvuran çocuk hastalarda PED'in doğru şekilde tanınmasının önemini vurgulamaktadır. Zamanında ve uygun şekilde tanı konulduğunda gereksiz müdahaleler ve olası komplikasyonlar önlenebilmektedir.

Anahtar Kelimeler: Perianal enfeksiyöz dermatit, *Streptococcus pyogenes*, çocuk

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INTRODUCTION

Perianal infectious dermatitis (PID) is a superficial infection of the perianal skin, most commonly caused by group A beta-hemolytic streptococci (GABHS). Although the exact incidence is unknown, estimates range from 1 in 2000 to 1 in 218 cases, with a higher prevalence in boys (70%).[1-3]

When GABHS is the identified or suspected pathogen, it is generally referred to as perianal streptococcal dermatitis. Rarely, it may be associated with streptococcal tonsillitis.[2] The infection can also be caused by *Staphylococcus aureus*.[3] Clinical manifestations typically include anal itching (78-100%), rectal pain (50%), painful defecation (50%), and bloody streaks in the stool (20-35%). Systemic symptoms such as fever and malaise are uncommon. The classic presentation is a bright red, sharply demarcated rash surrounding the anus.[1-4] In the acute period (<6 weeks), the rash is tender, bright, and moist. A white pseudomembrane may also be observed in this period. As the rash becomes chronic, painful anal fissures, dried mucoid exudate, or psoriasiform plaques may form.[3]

The diagnosis of perianal infectious dermatitis is based on detecting the pathogen in culture of the lesion in a clinically suspected case. GABHS are frequently identified as the cause. The differential diagnosis includes diaper dermatitis, candidiasis, seborrheic dermatitis, psoriasis, sexual abuse, local trauma, and pinworms.[2-4] Perianal infectious dermatitis can spread within households, especially when family members bathe together or use the same water.[3] A 10-day course of treatment with penicillin or amoxicillin is recommended and results in rapid clinical improvement.[1-4] Recurrence is reported in 39% of cases, which is probably related to family transmission.[5]

Despite its typical clinical features, many clinicians are still unable to recognize PID. Delays in diagnosis and treatment lead to worsening of complaints and results in problems such as constipation and anal fissures. This case series presents the clinical features of pediatric patients diagnosed and treated for PID in our clinic, to raise awareness among clinicians.

MATERIAL AND METHOD

The study was carried out with the permission of Ankara Training and Research Hospital Ethics Committee (Date: 11.01.2024, Decision No: E25-459). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This retrospective study included pediatric patients aged 0–18 years who were diagnosed with perianal infectious dermatitis at the pediatric infectious diseases outpatient clinic. Demographic and clinical data were retrospectively collected from medical records. In our study, PID was clinically suspected based on symptoms such as anal itching, anal pain, painful defecation, rectal bleeding, and constipation, accompanied by physical examination findings including well-demarcated perianal erythema, tenderness, and inflammation.

The diagnosis was confirmed based on clinical findings and positive culture results from samples obtained from perianal lesions.[6] Patients with incomplete medical records, missing microbiological data, or those lost to follow-up were excluded from the study.

RESULTS

The demographic and clinical characteristics of the patients are summarized in **Table 1**. The mean age was 5.3±1.47 years, with eight boys and one girl. Only one patient had an upper respiratory tract infection in the past month, and one had recurrent symptoms after previous treatment for PID. Most patients were referred from pediatrics or pediatric gastroenterology departments for persistent anorectal dermatitis. The most common symptoms were anal itching and painful defecation. Physical examinations revealed well-demarcated exudative erythema in the perianal region (**Figure 1**). Based on the treatments previously administered, five patients were initially managed for presumed bacterial skin infections, five for fungal infections, and six for diaper dermatitis. Anal lesion swab cultures identified *S. pyogenes* in seven patients, *S. agalactiae* in one, and both *S. pyogenes* and *S. aureus* in one patient. All patients received oral amoxicillin (50 mg/kg/day) for 10 days, resulting in complete resolution without complications.

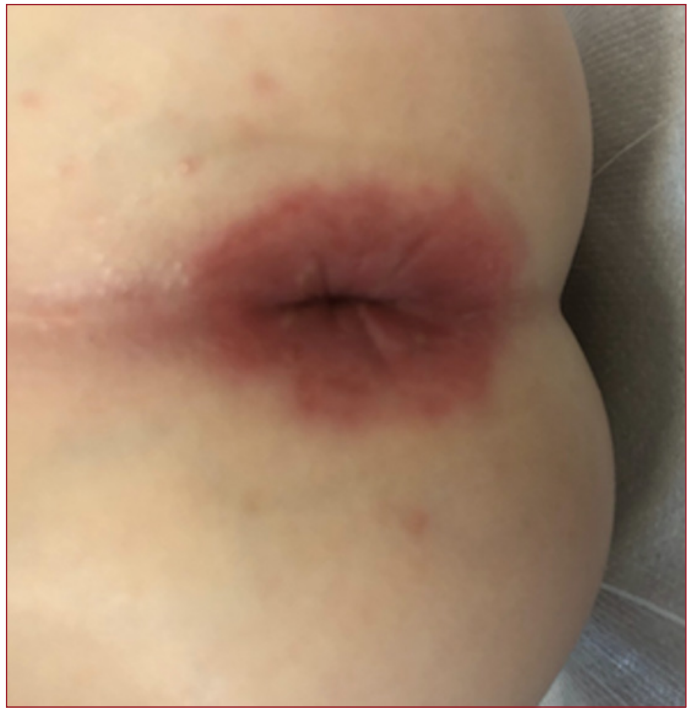

Figure 1. Well-demarcated erythema in perianal infectious dermatitis

Table 1. Demographic and clinical characteristics of the patients

No.	Age (years)/ Gender	Anal itching	Painful defecation	Bloody stool	Constipation	Symptom duration	Previous treatments	Pathogen (culture)	Treatment
1	2 years 10 months/M	+	+	+	+	1.5 months	Analgesic cream	*S. pyogenes*	Amoxicillin
2	4 years 11 months/M	+	-	-	+	6 months	Antifungal cream Zinc cream Antibiotic cream Steroid cream Herbal cream	*S. pyogenes*	Amoxicillin
3	6 years 3 months /M	+	+	+	+	2 years	Anti-inflammatory cream Cicatrizing cream	*S. pyogenes* *S. aureus*	Amoxicillin
4	5 years 2 months/M	+	-	+	-	3 weeks	Anti-inflammatory cream Antifungal cream Antibiotic cream	*S. pyogenes*	Amoxicillin
5	6 years 5 months/M	+	-	-	-	1 month	Antibiotic cream Antifungal cream Moisturizing cream	*S. pyogenes*	Amoxicillin
6	5 years 9 months/F	-	+	-	+	1 week	Anti-inflammatory cream Antibiotic cream	*S. agalactiae*	Amoxicillin
7	5 years 9 months /M	+	+	+	-	2 weeks	Analgesic cream Antibiotic cream	*S. pyogenes*	Amoxicillin
8	3 years 5 months/M	+	+	-	-	1 week	Antifungal cream	*S. pyogenes*	Amoxicillin
9	7 years 6 months/M	+	-	-	-	2 months	Antifungal cream	*S. pyogenes*	Amoxicillin

DISCUSSION

In this case series, we evaluated nine pediatric patients diagnosed with PID. Most presented with typical symptoms such as anal itching and painful defecation. *Streptococcus pyogenes* was the most commonly identified pathogen, and all patients showed full recovery following oral amoxicillin therapy. These results highlight the need to consider PID in children with persistent perianal complaints.

Perianal infectious dermatitis is a superficial infection of the perianal skin characterized by distinct clinical features. However, due to frequent misdiagnosis and lack of clinical awareness, its true incidence in the pediatric population remains uncertain, resulting in lower-than-expected detection rates.[7]

Perianal infectious dermatitis presents with symptoms such as well-demarcated exudative erythema in the anal region and associated itching, anal pain, constipation, painful defecation, and bloody stool can be observed.[2] It usually occurs between the ages of 6 months and 10 years and is more common in males. Reasons for the higher frequency in this age group include perianal-oral digital contact, different hygiene habits, and microbial colonization of the perineum. Consistent with the literature, the mean age of the patients was 5.3 years, and only one patient was female. Anal itching and painful defecation were the most commonly reported symptoms, in accordance with previous studies.

The differential diagnosis of perianal infectious dermatitis is wide. Patients can present with symptoms that have persisted for years and may even be unnecessarily exposed to invasive procedures such as colonoscopy or retroscopy.[2,8] Misdiagnosis can result in inappropriate treatments, including topical antifungals, corticosteroids, or antihelminthic agents, which may obscure the characteristic clinical findings and exacerbate the condition.[8] The diagnosis is usually delayed for weeks or months and can sometimes take over a year.[9,10] In our case series, many topical treatments were tried before diagnosis, and the duration of symptoms ranged from 1 week to 2 years.

The causative pathogen must be isolated in culture to confirm the diagnosis. Cultures usually yield *S. pyogenes*, with *S. aureus* and streptococci other than *S. pyogenes* observed less frequently.[11] In our case series, *S. pyogenes*, *S. agalactiae*, and both *S. pyogenes* and *S. aureus* were isolated in anal swab cultures of the 7 patients.

Most patients undergo 10 days of oral penicillin therapy for dermatitis and other symptoms. However, a recurrence rate of up to 39% has been reported. Other treatments include amoxicillin, clindamycin phosphate, erythromycin, and topical 2% mupirocin.[8] Although penicillin is generally recommended as the primary choice of treatment for *S. pyogenes* infection, amoxicillin is better tolerated in the pediatric population due to the taste and the wide dose range. All the patients in our study received amoxicillin therapy.

The primary complication of PID is prolonged discomfort due to delayed diagnosis and treatment. Though rare, complications such as proctitis and abscess formation have been reported.[12] Polat et al. recently reported two pediatric cases complicated by bacteremia, emphasizing the need for early diagnosis and effective antimicrobial therapy to avoid systemic spread.[13] However, no complications were observed in any of the patients in our case series.

CONCLUSION

This study highlights that perianal infectious dermatitis is a recognizable and treatable condition in children with persistent perianal symptoms. Clinical suspicion, supported by physical examination and culture, enables timely diagnosis. Early recognition and appropriate antibiotic therapy ensure full recovery and help avoid unnecessary treatments and diagnostic procedures.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Ankara Training and Research Hospital Ethics Committee (Date: 11.01.2024, Decision No: E25-459).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article / Orijinal Araştırma

The Use of Mobile Health Applications in Midwifery and Nursing: A Systematic Review of Theses

Mobil Sağlık Uygulamalarının Ebelik ve Hemşirelik Alanındaki Kullanımı: Tezler Üzerine Sistematik Bir Derleme

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Abstract

Aim: This study systematically reviews postgraduate theses conducted in Turkey between 2020 and 2025 that investigated the use of mobile health (mHealth) applications in the fields of midwifery and nursing.

Material and Method: Designed as a retrospective, cross-sectional, and descriptive review, the study examined theses obtained from the National Thesis Center of the Council of Higher Education using the keywords "mobile health," "mobile application," and "digital health." A total of 45 eligible theses (34 doctoral and 11 master's), available in full-text and meeting predefined inclusion criteria, were analyzed. Of these, 5 were descriptive and 40 were quasi-experimental or randomized controlled trials. The data were thematically categorized according to health domains.

Results: Six main thematic areas were identified: maternal and infant health (n=12), chronic disease management (n=15), cancer care and chemotherapy (n=7), caregiver support and education (n=3), mobile health literacy and usage (n=4), and mental health and psychosocial adaptation (n=3). The findings revealed that mobile health applications significantly contributed to improvements in self-care, treatment adherence, symptom management, and quality of life. Particularly in nursing, these technologies were frequently used for chronic disease management and telehealth services. In midwifery, mobile apps supported antenatal care, postpartum follow-up, and breastfeeding counseling. Despite their benefits, challenges such as data security concerns, technological literacy, and user engagement were noted.

Conclusion: This review underscores the growing academic and clinical interest in mobile health applications in nursing and midwifery. These tools hold promise for enhancing patient care, supporting healthcare professionals, and facilitating digital transformation in health systems. Future efforts should focus on user-centered design, integration into clinical workflows, and long-term impact evaluation through robust methodologies.

Keywords: Mobile health, mobile applications, midwifery, nursing, digital health, systematic review

Öz

Amaç: Bu çalışma, Turkiye'de 2020-2025 yılları arasında ebelik ve hemşirelik alanlarında yapılmış, mobil sağlık (m-sağlık) uygulamalarının kullanımını konu alan lisansüstü tezleri sistematik olarak incelemeyi amaçlamaktadır.

Gereç ve Yöntem: Retrospektif, kesitsel ve tanımlayıcı tasarıma sahip olan bu sistematik derleme, Yükseköğretim Kurulu Ulusal Tez Merkezi veri tabanında "mobil sağlık", "mobil uygulama" ve "dijital sağlık" anahtar kelimeleri kullanılarak gerçekleştirilmiştir. Belirlenen dahil etme kriterlerine uyan ve tam metnine erişilebilen toplam 45 tez (34 doktora, 11 yüksek lisans) değerlendirmeye alınmıştır. Tezlerin 5'i tanımlayıcı, 40'ı ise yarı deneysel ya da randomize kontrollü deneysel tasarıma sahiptir. Veriler sağlık alanlarına göre tematik olarak sınıflandırılmıştır.

Bulgular: İncelenen tezler altı ana temada gruplandırılmıştır: Anne ve bebek sağlığı (n=12), kronik hastalık yönetimi (n=15), kanser bakımı ve kemoterapi süreci (n=7), bakım veren desteği ve eğitimi (n=3), mobil sağlık okuryazarlığı ve kullanım durumu (n=4), ruh sağlığı ve psiko-sosyal uyum (n=3). Mobil sağlık uygulamalarının öz bakım, tedaviye uyum, semptom yönetimi ve yaşam kalitesini artırmada etkili olduğu saptanmıştır. Hemşirelik alanında uygulamalar genellikle kronik hastalık yönetimi ve tele-sağlık hizmetleri kapsamında kullanılırken; ebelik alanında gebelik izlemi, doğum sonrası takip ve emzirme danışmanlığı gibi hizmetleri desteklemiştir. Bununla birlikte, veri güvenliği, kullanıcı uyumu ve teknik sınırlılıklar gibi çeşitli zorluklara da işaret edilmiştir.

Sonuç: Bu derleme, mobil sağlık uygulamalarına yönelik artan akademik ve klinik ilgiyi ortaya koymakta ve bu teknolojilerin hemşirelik ve ebelik uygulamalarında hasta bakımını güçlendirmede önemli bir araç olduğunu göstermektedir. Gelecekte, kullanıcı odaklı tasarımların geliştirilmesi, klinik uygulamalara entegrasyonun sağlanması ve uzun vadeli etkilerin güçlü yöntemlerle değerlendirilmesi önerilmektedir.

Anahtar Kelimeler: Mobil sağlık, mobil uygulamalar, ebelik, hemşirelik, dijital sağlık, sistematik derleme

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INTRODUCTION

In the digital age, the internet is widely used as a means of communication.[1] In Turkey, the use of mobile devices is increasing each year.[2] According to the Turkish Statistical Institute (TÜİK) Household Information Technologies (IT) Research, the percentage of individuals aged 16–74 using the internet increased from 87.1% in 2023 to 88.8% in 2024. In 2024, internet usage was observed at 92.2% among men and 85.4% among women.[3] As medical information is now frequently searched online, global interest in mobile health applications has increased.[1,4]

By providing portable and readily accessible health information, mobile technology has the potential to improve healthcare standards, increase public awareness, enhance personal health, and deliver timely disease alerts.[5] In addition, these applications contribute to reducing hospital stays, alleviating pressure on healthcare systems, and offering cost-effective, widely accessible solutions—particularly in resource-limited settings.[4,6,7] Furthermore, they enhance access to healthcare services for individuals facing geographical or systemic barriers.[8]

A meta-analysis revealed that Turkey, with a 63% usage rate, ranks among the top countries using mobile health applications.[9] Therefore, the reliability, quality, and applicability of health information used in mobile health applications is of great importance.[1] Although research on mobile applications for women's health in Turkey is limited, the growing popularity of mobile health applications is expected to influence the Turkish market. Thus, there is a need for mobile applications tailored to midwifery care to ensure holistic service delivery.[2]

The growing use of mobile health applications directly affects the professions of midwifery and nursing by reducing workload, supporting chronic disease management, and improving communication between healthcare professionals and patients in remote areas. To improve care quality and strengthen the scientific foundation of both professions, it is crucial that technological innovations are integrated into clinical and educational practices.[2,10]

Therefore, this systematic review aims to examine postgraduate theses conducted in Türkiye that focus on mobile health applications related to midwifery and nursing. The objective is to identify research trends, thematic focuses, and methodological patterns within these studies. This review was carried out in accordance with the PRISMA 2020 guidelines and structured using the PICOS framework to ensure methodological transparency and rigor.[11, 12]

MATERIAL AND METHOD

Study Design

This study employed a retrospective, cross-sectional, and descriptive design. The systematic review process was carried out in accordance with the PRISMA 2020 guidelines to ensure methodological transparency and rigor. The review protocol was not pre-registered.

Search Strategy

The literature search was conducted in April 2025 using the National Thesis Center of the Council of Higher Education of Turkey (YÖK Ulusal Tez Merkezi) database. The search included the keywords: "mobile health", "mobile application", and "digital health", both in English and Turkish. Boolean operators (AND/OR) were used to combine search terms.

Inclusion Criteria

- Theses written in Turkish
- Master's or doctoral level
- Full-text available
- Published between 2020 and April 2025
- Related to midwifery or nursing fields
- Involving use or evaluation of mobile health applications

Exclusion Criteria

- Studies not involving mobile or digital health applications
- Abstract-only records or inaccessible full-texts
- Other disciplines outside midwifery/nursing

Eligibility Framework: PICOS

The inclusion strategy was structured using the PICOS framework:

Component		Description
P	(Population)	Midwives, nurses, students, caregivers, or patients
I	(Intervention)	Use of mobile health (mHealth) or mobile applications
C	(Comparison)	Not applicable
O	(Outcomes)	Educational effectiveness, clinical improvement, self-care, adherence
S	(Study type)	Descriptive, quasi-experimental, RCT, or methodological studies

Selection Process

The selection process included screening of thesis titles and abstracts, followed by full-text review. A total of 45 theses were included: 11 master's and 34 doctoral theses. Of these, 5 were descriptive studies and 40 were either quasi-experimental or randomized controlled trials (RCTs). The selection process is illustrated in the PRISMA flow diagram (**Figure 1**).

Data Extraction

A structured data extraction form was created in Microsoft Excel. The following information was collected from each thesis:

- Thesis title
- Author
- University and department
- Year of publication
- Degree (master's or doctoral)
- Study aim and methodology
- Population/sample size
- Mobile health application used
- Outcomes and key findings
- Conclusion

Data extraction was conducted independently by three reviewers. Disagreements were resolved through discussion or with input from a fourth reviewer.

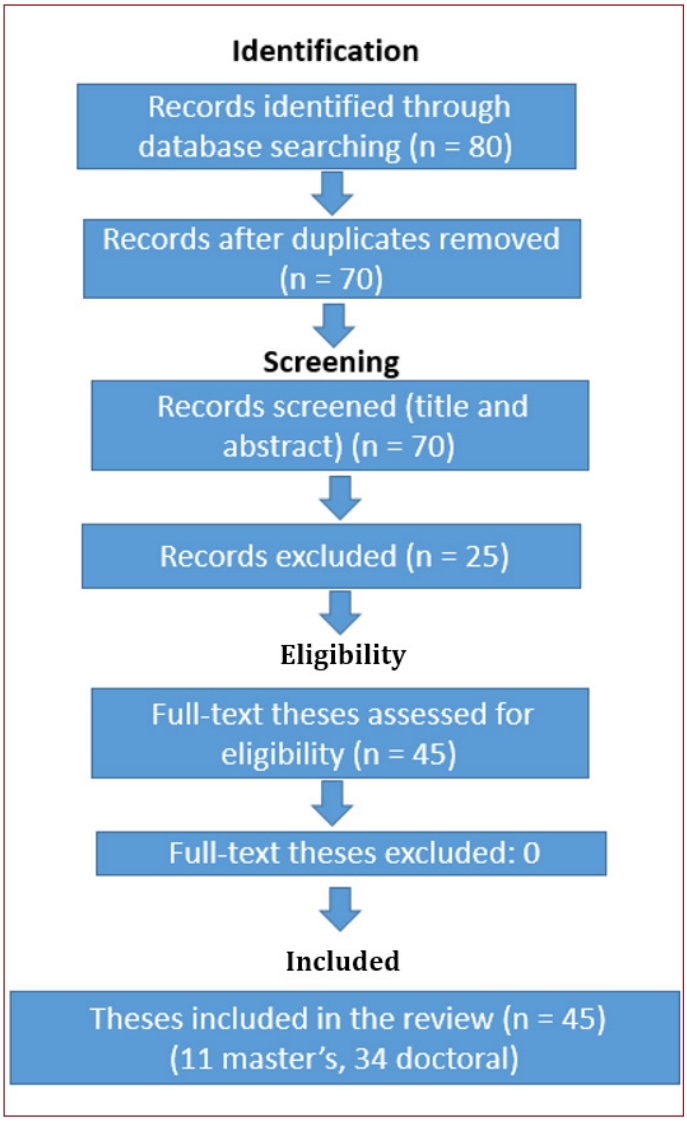

Figure 1. PRISMA Flow Diagram

Data Synthesis and Thematic Categorization

To enhance analytical clarity, all included theses were thematically grouped based on their health domain and research focus. Six thematic categories were identified:

1. Maternal and Infant Health
2. Chronic Disease Management
3. Cancer Care and Chemotherapy
4. Caregiver Support and Education
5. Mobile Health Literacy and Usage
6. Mental Health and Psychosocial Adaptation

Each thesis was assigned to a primary theme, and findings were synthesized accordingly. Within each theme, narrative summaries and representative examples were presented, supported by thematic tables that include thesis title, author, methodology, sample, and key outcomes. Quantitative summaries such as theme-wise thesis counts and distribution by academic degree (master's/doctoral) were also provided.

Quality Assessment

A formal quality appraisal tool was not applied, as the objective of this review was to map and categorize existing postgraduate research rather than conduct a meta-analysis. However, methodological classifications (e.g., descriptive, quasi-experimental, RCT) were reported to provide an overview of scientific rigor.

Ethical Considerations

Ethical approval was not required for this study since all data were collected from a publicly accessible database: https://tez.yok.gov.tr.

RESULTS

In this review, a total of 44 theses were analyzed, including 27 doctoral and 17 master's theses. The largest number of theses focused on chronic disease management (15 theses), followed by maternal and infant health (12 theses). Cancer care and chemotherapy symptom management included 7 theses. Fewer theses were related to caregiver support and education (3), mobile health literacy and usage (4), and mental health and psychosocial adaptation (3). The distribution of doctoral and master's theses varied by theme, with chronic disease management and maternal health featuring more doctoral theses, while mobile health literacy had a higher proportion of master's theses (**Table 1**).

Table 1. Thematic Distribution of Theses by Degree Type

Theme / Health Domain	Total Number of Theses	Number of Doctoral Theses	Number of Master's Theses
Maternal and Infant Health	12	7	5
Chronic Disease Management	15	10	5
Cancer Care and Chemotherapy	7	5	2
Caregiver Support and Education	3	2	1
Mobile Health Literacy & Usage	4	1	3
Mental Health and Psychosocial Adaptation	3	2	1
Total	44	27	17

A total of 12 theses focused on maternal and infant health, covering topics such as breastfeeding support, postpartum adjustment, and care for premature infants. These studies predominantly used randomized controlled trials and highlighted the positive impact of mobile health applications on breastfeeding self-efficacy, maternal attachment, and postpartum physical symptoms. For example, Topkara (2024) found that a breastfeeding support app significantly improved self-efficacy, while Yenice (2023) reported increased maternal attachment and infant care skills through mobile interventions. These findings underscore the potential of mobile health technologies to enhance maternal and infant health outcomes (**Table 2**).

Table 2. Theses Related to the Theme of Maternal and Infant Health

Thesis Title	Author (Year)	Objective	Method	Findings	Conclusion
Development of Breastfeeding Supportive Mobile Application: Effect on Breastfeeding Self-Efficacy	Topkara (2024) PhD[13]	To determine the effect of a breastfeeding support app on breastfeeding self-efficacy	RCT, n=86	Breastfeeding self-efficacy significantly increased	Mobile app effectively increased breastfeeding self-efficacy
The Effect of Nursing Care on Postpartum Adjustment through Mobile Health Application	Şat (2021) MSc[14]	To evaluate the effect of nursing care via mobile app on postpartum adjustment	RCT, n=62	Positive impact on postpartum adjustment	Mobile application found effective for postpartum adjustment
The Effect of Mobile Application Developed for Home Care of Premature Infants on Maternal Attachment	Yenice (2023) PhD[15]	To assess the effect of a mobile app on maternal attachment and infant care	RCT, n=48	Increased maternal attachment and parental self-efficacy	Mobile intervention enhanced maternal-infant bonding
The Effect of Postpartum Nursing Care and E-Mobile Education on Postpartum Physical Symptoms	Karaçay Yıkar (2022) MSc[16]	To determine effect on postpartum physical symptoms and breastfeeding self-efficacy	RCT, n=75	Reduced physical symptoms and increased breastfeeding self-efficacy	Mobile education and nursing care beneficial postpartum
Development of a Mobile Application Based Breastfeeding Education Program and Evaluation of Its Effectiveness	Acar (2022) MSc[17]	To develop and test a breastfeeding education app	RCT, n=73	Positive impact on exclusive breastfeeding	App contributed to breastfeeding success
The Effect of Education Given to Mothers Through Mobile Application Program on Their Attitudes and Skills Towards Rational Drug Use	İnan (2023) MSc[18]	To assess the effect of mobile education on mothers' attitudes and skills	Experimental, n=140	Significant increase in attitudes and skills	Education via app effective for rational drug use
The Effect of Yoga Practiced Online and with an App on Birth Outcomes	Eroğlu (2022) MSc[19]	To evaluate yoga's effect on birth outcomes via app	RCT, n=74	Increased birth satisfaction, newborn weight, and Apgar scores	Yoga app increased positive birth outcomes
The Effect of Education Given to Women Who Underwent Breast Surgery with Mobile Application on Supportive Care Needs and Quality of Life	Balcı (2023) MSc[20]	To evaluate mobile education impact on supportive care and QoL	RCT, n=81	Decreased care needs, improved QoL	Mobile app improved care and QoL
The Effect of Mobile Application Developed for Gynecologic Cancer Patients Receiving Chemotherapy on Physical and Psychosocial Adaptation	Vardar (2023) MSc[21]	To determine app effect on physical and psychosocial adaptation	RCT, n=64	Increased physical, social, psychological adaptation	Mobile app effective for cancer patients
The Effect of Interactive Nurse Support Program Developed with Mobile Application on Patient Outcomes in Breast Cancer Patients Receiving Chemotherapy During Covid-19	Özdemir (2024) PhD[22]	To evaluate interactive nurse support via app on breast cancer patients	RCT, n=100	Decreased anxiety; improved QoL and social support	Mobile app effective during pandemic care
The Effect of Mobile Application for Medication Reminder on Treatment Adherence in Women with Breast Cancer Receiving Hormone Therapy	Budaycı (2023) MSc[23]	To assess effect of medication reminder app on adherence	Quasi-experimental, n=52	Significant increase in treatment adherence	App improved medication compliance
The Effect of Mobile Application Developed for Caregivers of Patients with Percutaneous Endoscopic Gastrostomy on Caregivers' Knowledge, Skills and Care Burden	Akyüz (2024) MSc[24]	To evaluate impact on caregivers' knowledge, skills, and burden	RCT, n=27	Increased skills; reduced care burden	Mobile app recommended for caregiver support

Fifteen theses investigated chronic disease management, including diabetes, COPD, hypertension, and multiple sclerosis. Most studies employed randomized controlled trials to evaluate mobile health applications aimed at improving self-care, treatment adherence, symptom management, and quality of life. For instance, Şahin (2021) demonstrated increased self-care behaviors among type 2 diabetes patients using a mobile app, and Özdemir (2023) reported significant improvements in self-efficacy and disease management in COPD patients. These results indicate that mobile health tools can effectively support chronic disease patients in managing their conditions (**Table 3**).

Seven theses examined mobile health interventions in cancer care, focusing on medication adherence, symptom management, and psychosocial support for patients undergoing chemotherapy. Several randomized controlled studies revealed that mobile applications enhanced treatment compliance and reduced symptoms in breast and colorectal cancer patients.[23,28] Additionally, awareness-raising applications for cervical cancer demonstrated significant increases in patient knowledge.[39] These findings highlight the role of digital health solutions in improving oncology care and patient outcomes (**Table 4**).

Three theses addressed mobile health applications designed to support caregivers, especially those caring for patients with gastrostomy or tracheostomy. Studies showed that mobile and simulation-based education increased caregivers' knowledge and skills while reducing care burden and anxiety levels.[24,42] These results emphasize the value of tailored digital interventions in empowering caregivers and improving patient care quality (**Table 5**).

Table 3. Theses Related to the Theme of Chronic Disease Management

Thesis Title	Author (Year)	Objective	Method	Findings	Conclusion
The Effect of Using Smart My Diabetes Mobile Health Application on Self-Care of Individuals with Type 2 Diabetes	Şahin (2021) MSc[25]	To evaluate impact of mobile app on self-care in type 2 diabetes patients	Quasi-experimental, n=68	Significant increase in self-care behaviors	Mobile app positively affected self-care
The Effect of Mobile Application Developed for Individuals with Multiple Sclerosis on Symptom Management and Quality of Life	Üstündağ (2021) PhD[26]	To assess app impact on symptom management and QoL	Mixed/RCT, n=63	90.3% found app useful; QoL improved	Mobile app effective for MS symptom management
The Effect of Education via Mobile Phone on DASH Diet Adherence, QoL, Mindfulness and Stress in Hypertensive Individuals	Meşhur (2023) PhD[27]	To determine effect on diet adherence, QoL, mindfulness, stress	RCT, n=134	QoL and mindfulness increased; stress decreased	Mobile education recommended
The Effect of a Mobile Application Developed for COPD Patients on Self-Efficacy and Disease Management	Özdemir (2023) PhD[28]	To evaluate effect on self-efficacy and disease management	RCT, n=40	Significant improvements in self-efficacy and disease control	Mobile app effective for COPD management
Exercise Programs via Mobile App on QoL and Dyspnea in COPD Patients	Kaya (2021) PhD[29]	To assess app-based exercise impact on QoL and dyspnea	RCT, n=76	QoL improved; symptoms decreased	Mobile exercise programs recommended
Investigation of the Effect of a Mobile Application Developed for Individuals with Type 2 Diabetes Using Insulin on Insulin Use Perception and Self-Management	Döner (2024) PhD[30]	To assess impact on insulin perception and self-management	RCT, n=88	Increased knowledge, self-management; reduced negative attitudes	Educational tool for diabetes management
The Effect of Mobile Application Developed for Patients Using Oral Anticancer Drugs in Cancer Treatment on Drug Compliance and Symptoms	Eşer (2020) PhD[31]	To determine effect on medication adherence and symptoms	RCT, n=77	Positive effects on adherence and symptom reduction	Mobile app recommended
The Effect of Mobile Application for Medication Reminder in Breast Cancer Patients Receiving Hormone Therapy	Budaycı (2023) MSc[23]	To evaluate medication reminder app on adherence	Quasi-experimental, n=52	Significant increase in compliance	App improved treatment adherence
Development of a Mobile Application for Patients with Liver Cirrhosis and the Effect of Application on Activity Level, Self-Efficacy and Quality of Life	Çelik (2023) PhD[32]	To assess app effectiveness in liver cirrhosis patients	Methodological + RCT, n=52	Increased activity level, self-efficacy, QoL	Effective mobile health practice
The Effect of Mobile Health Application Supported Education on Lower Urinary System Symptoms and Quality of Life in Children with Voiding Disorders	Çinkir (2023) MSc[33]	To determine educational impact via mobile app	RCT, n=99	Symptom relief and QoL improved	Mobile education recommended
Determination of Community's E-Health Literacy and Use of Mobile Health Applications	Kiral (2022) MSc[34]	To assess e-health literacy and app use	Descriptive, n=1028	Positive correlation between literacy and app use	Need to increase mobile health literacy
The Effect of Mobile Application Based on Omaha System on Physical, Psychosocial, Cognitive Symptoms and QoL in Covid-19 Patients	Torun (2023) MSc[35]	To evaluate app effect on symptoms and QoL in Covid-19 patients	RCT, n=60	Improvement in physical and depressive symptoms	App recommended for Covid-19 care
The Effect of Mobile Application Supported Education and Counseling on Healthy Lifestyle Behaviors of Women with Gestational Diabetes	Karakoç (2023) MSc[36]	To determine effect on healthy lifestyle	RCT, n=52	Improved healthy behaviors	Mobile education effective
Comparison of the Effect of Education Booklet and Mobile Application Used in Discharge Education for Coronary Artery Bypass Graft Surgery on Patients' Discharge Readiness and Self-Efficacy	Şahan (2022) MSc[37]	To compare mobile app and booklet education	Quasi-experimental, n=66	No significant difference between groups	Mobile app highly recommended
Development of a Mobile Health (M-Health) Literacy Scale	Karadayı (2022) MSc[38]	To develop a valid and reliable m-health literacy scale	Methodological, n=448	31 items, 4-factor scale	Reliable and valid tool in Turkey

Table 4. Cancer Care and Chemotherapy Symptom Management

Thesis Title	Author (Year)	Objective	Method	Findings	Conclusion
The Effect of Medication Reminder Mobile Application on Treatment Adherence in Women with Breast Cancer Receiving Adjuvant Hormone Therapy	Budaycı (2023) MSc[23]	To evaluate effect of medication reminder app on treatment adherence	Quasi-experimental, n=52	Treatment adherence increased significantly	Mobile app improved treatment compliance
The Effect of Interactive Nurse Support Program Developed with Mobile Application on Patient Outcomes in Breast Cancer Patients Receiving Chemotherapy During Covid-19 Pandemic	Özdemir (2024) PhD[28]	To determine effect of app on patient outcomes during chemotherapy	RCT, n=100	Anxiety decreased; QoL and social support improved	Mobile application effective in patient support
The Effect of Interactive Nurse Support Developed with Mobile Application Program on Patient Outcomes in Colorectal Cancer Patients Receiving Chemotherapy During Covid-19	Ağdemir (2024) PhD[40]	To evaluate impact of interactive nurse support app on patient outcomes	RCT, experimental n=40, control n=44	Social support and symptom management improved; anxiety decreased	Mobile app enhanced care during chemotherapy
Evaluation of the Effectiveness of Mobile Health Application Developed for Cervical Cancer Awareness	Tunaman (2024) PhD[39]	To assess impact on cervical cancer awareness	RCT, n=48	Significant increase in patient awareness	Mobile app effective in cancer prevention education
The Effect of Education Given to Women Who Underwent Breast Surgery with Mobile Application on Supportive Care Needs and Quality of Life	Balcı (2023) PhD[20]	To evaluate effect of mobile education on supportive care needs and QoL	RCT, experimental n=41, control n=40	Supportive care needs decreased; QoL improved	Mobile app effective in postoperative care
The Effect of Mobile Application Developed for Patients Using Oral Anticancer Drugs in Cancer Treatment on Drug Compliance and Symptoms	Eşer (2020) PhD[31]	To assess effect on medication adherence and symptom control	RCT, experimental n=38, control n=39	Positive effect on adherence and symptom relief	Mobile app recommended for oncology care
The Effect of Education Given with Mobile Application on Supportive Care Needs, Distress and Quality of Life in Hematopoietic Stem Cell Transplant Patients	Başcı (2023) MSc[47]	To determine effect on supportive care needs, distress, and QoL	RCT, n=36	No significant difference in distress and QoL	Mobile app impact limited but supportive

Table 5. Caregiver Support and Education

Thesis Title	Author (Year)	Objective	Method	Findings	Conclusion
The Effect of Mobile Application Developed for Caregivers of Patients with Percutaneous Endoscopic Gastrostomy on Caregivers' Knowledge, Skills and Care Burden	Akyüz (2024) PhD[24]	To evaluate effect on caregivers' knowledge, skills, and care burden	RCT, n=27	Increased skills, reduced care burden	Mobile app recommended for caregiver support
Evaluation of the Effectiveness of Simulation Model and Mobile Application in Teaching Tracheal Aspiration Practice to Caregivers of Patients with Tracheostomy	Alakan (2024) MSc[42]	To determine effectiveness on caregivers' knowledge and skills	Experimental, n=66	Simulation most effective; mobile app also effective	Simulation and mobile education improve caregiver skills
Development of a Mobile Application for the Care of Children with Gastrostomy and the Effect of Application on Gastrostomy Complications, Parents' Care Burden, Self-Efficacy and Anxiety Level	Ergezen (2024) PhD[43]	To assess effect on complications, care burden, self-efficacy and anxiety of parents	RCT, n=60	Decreased care burden and anxiety, increased self-efficacy	Mobile app useful for parent education and support

Four theses focused on e-health literacy and the acceptance and use of mobile health applications among various populations, including healthcare workers and university students. The development of valid and reliable scales measuring mobile health literacy was a notable contribution.[38] Other descriptive studies highlighted the correlation between e-health literacy and mobile app usage, underscoring the need for educational strategies to enhance digital health competencies.[6,34] These findings suggest that improving health literacy is crucial for the effective adoption of mobile health Technologies (**Table 6**).

Three theses explored the effects of mobile health applications on psychosocial outcomes such as cognitive awareness, anxiety, and quality of life. Randomized controlled trials indicated positive impacts of mobile interventions on reducing anxiety and depressive symptoms among patients undergoing infertility treatment and COVID-19.[35,45] However, one study reported limited effects on distress and quality of life in hematopoietic stem cell transplant patients.[41] Overall, these findings point to the potential benefits as well as challenges of mobile health applications in mental health contexts (**Table 7**).

Table 6. Mobile Health Literacy & Usage

Thesis Title	Author (Year)	Objective	Method	Findings	Conclusion
Development of Mobile Health (M-Health) Literacy Scale	Karadayi (2022) PhD[38]	To develop a valid and reliable scale to measure mobile health literacy	Methodological, n=448	31 items, 4-factor scale	Scale is reliable and valid in Turkey
Determination of Community's E-Health Literacy and Use of Mobile Health Applications	Kiral (2022) MSc[34]	To assess e-health literacy and mobile app perception in community	Descriptive, n=1028	Positive correlation between literacy and app use	Need to increase mobile health and literacy
Healthcare Workers' Use of Mobile Health Applications and Acceptance of Mobile Applications	Reel (2023) MSc[6]	To determine usage and acceptance of mobile apps among healthcare workers	Descriptive, n=1580	50% personal, 25% professional use	Training and incentives needed
Development of a Mobile Application Based on Psychological Well-Being of University Students	Demirezen (2023) MSc[44]	To evaluate effectiveness and usability of a mobile health app for university students	Descriptive, n=32	Positive user satisfaction	Application open for improvement

Table 7. Mental Health and Psychosocial Adaptation

Thesis Title	Author (Year)	Objective	Method	Findings	Conclusion
The Effect of Cognitive Awareness-Based Nursing Support with Mobile Application on Psychosocial Status of Women Undergoing Infertility Treatment	İnam (2022) PhD[45]	To determine effect on psychosocial status during infertility treatment	RCT, n=34	Positive effect on cognitive awareness, treatment compliance, anxiety	Mobile app contributed positively to treatment process
The Effect of Mobile Health Application Based on Omaha System on Physical, Psychosocial, Cognitive Symptoms and Quality of Life in Covid-19 Patients	Torun (2023) MSc[35]	To determine effects on physical, psychosocial, cognitive symptoms and QoL	RCT, n=60	Effective on physical symptoms, depressive symptoms, and QoL	Recommended to test in different age groups and long-term monitoring
The Effect of Education Given with Mobile Application on Supportive Care Needs, Distress and Quality of Life in Hematopoietic Stem Cell Transplant Patients	Başcı (2023) MSc[41]	To determine impact on supportive care needs, distress, and QoL	RCT, n=36	No significant differences in distress and QoL	Mobile app had limited impact

DISCUSSION

This systematic review comprehensively analyzed postgraduate theses completed in Turkey between 2020 and 2024 on the use of mobile health applications in midwifery and nursing. The findings demonstrate that mobile health technologies are effectively utilized in clinical, educational, and counseling services in these disciplines, reflecting how digital health technologies are reshaping interactions between healthcare professionals and individuals.[46,47]

Thematic Grouping of Findings

The majority of theses concentrated on two main health domains: maternal and infant health and chronic disease management. Twelve theses focused on maternal and infant health, investigating topics such as breastfeeding support, postpartum adjustment, and care for premature infants. These studies primarily used randomized controlled trials (RCTs) and highlighted significant improvements in breastfeeding self-efficacy, maternal attachment, and postpartum physical symptoms through mobile health applications.[13,15,16,25] The positive effects reported align with international evidence suggesting that digital interventions can empower mothers and improve early child care outcomes.[48]

Fifteen theses examined chronic disease management, including diabetes, COPD, hypertension, and multiple sclerosis. Most utilized RCT designs to evaluate mobile apps aimed at enhancing self-care, treatment adherence, symptom management, and quality of life. For example, Şahin (2021) showed increased self-care behaviors among type 2 diabetes patients using a mobile application, while Özdemir (2023) demonstrated improvements in self-efficacy and disease management among COPD patients.[25,49] These findings confirm the global trend of leveraging mobile health tools to support chronic illness management, especially in resource-constrained settings.[50]

Other thematic areas included cancer care (7 theses), caregiver support (3 theses), e-health literacy (4 theses), and psychosocial outcomes (3 theses). Studies in oncology emphasized medication adherence, symptom control, and psychosocial support during chemotherapy, highlighting the potential of mobile applications to improve patient outcomes and awareness.[21,23,28,40] Caregiver-focused interventions showed that mobile and simulation-based training can effectively enhance knowledge and reduce burden and anxiety.[24,42] Research on e-health literacy stressed the importance of digital competence in adopting mobile health solutions, advocating for education and training to bridge existing gaps.[6,38] Lastly, theses addressing psychosocial outcomes reported mixed results, with some indicating anxiety reduction and cognitive benefits, while others found limited impact, underscoring the complexity of digital mental health interventions.[16,35,45]

Trends and Institutional Distribution

The chronological distribution of theses reveals a notable increase in academic interest, especially from 2022 onwards, coinciding with the COVID-19 pandemic, which accelerated the adoption of digital health solutions worldwide.[48,50] The

predominance of doctoral theses (34) over master's theses (11) reflects a robust academic commitment to advancing mobile health technologies in Turkey, highlighting their potential influence on health policies and practices.[46,47]

Geographically, research activities were concentrated in universities such as Istanbul University (7 theses), Ege University (5), and Akdeniz University (4), indicating that institutional infrastructure and expertise significantly influence mobile health research productivity.[6] The overwhelming majority of studies were conducted within nursing departments (41 theses) compared to midwifery (4 theses), suggesting that mobile health integration is more established in nursing education and practice. In midwifery, applications were mainly limited to prenatal care and breastfeeding support, signaling a need for broader research across the midwifery care continuum.[13,14]

Comparison with International Literature

Internationally, the use of mobile health applications in nursing and midwifery has been widely documented for enhancing patient education, chronic disease management, and psychosocial support.[48,50] The findings from Turkish theses parallel global evidence, reinforcing the effectiveness of mobile interventions in improving self-efficacy, treatment adherence, and quality of life.[16,25,49] However, challenges such as standardization of outcome measures and long-term sustainability remain shared concerns. The Turkish context adds value by highlighting the role of digital health in a middle-income country facing unique demographic and infrastructural challenges, underscoring the importance of culturally adapted and accessible Technologies.[6,34]

Implications for Policy, Practice, and Education

The review indicates substantial potential for mobile health technologies to enhance healthcare delivery in Turkey. Policymakers should consider facilitating digital infrastructure expansion and integrating mobile health tools into public health programs to reach wider populations, especially in underserved areas.[46,47] Healthcare providers require ongoing training to increase digital literacy and effectively implement these technologies in clinical practice.[6,24]

Educational institutions should embed mobile health competencies into nursing and midwifery curricula, preparing future professionals to leverage digital tools for improved patient outcomes.[26,38] Moreover, continuous professional development programs can support current practitioners in adapting to evolving digital landscapes.[51]

Limitations and Future Directions

This review is limited by its focus on theses from Turkish universities, which may not capture unpublished studies or international research. The variability in study designs, sample sizes, and measured outcomes also complicates direct comparisons. Future research should aim to include longitudinal studies and cost-effectiveness analyses to better understand the long-term impacts and scalability of mobile health interventions.[32,41]

Furthermore, expanding research in midwifery and mental health applications, along with greater standardization of evaluation tools, will strengthen evidence bases and guide best practices in digital health.[14,45]

CONCLUSION

This systematic review offers a comprehensive overview of postgraduate theses conducted in Turkey between 2020 and 2024, focusing on the use of mobile health applications in nursing and midwifery. The review highlights that mobile health technologies are increasingly integrated into healthcare research, with maternal and infant health as well as chronic disease management emerging as the most studied and impactful areas. These themes reflect the high relevance of mobile health applications in improving self-care, treatment adherence, symptom management, and psychosocial outcomes.[13,15,25,47]

Key gaps identified include the relatively limited research in midwifery compared to nursing, particularly beyond prenatal and breastfeeding support, and the need for more standardized outcome measures to facilitate cross-study comparisons. Additionally, while mobile health literacy and caregiver support have gained attention, these areas require further expansion to maximize the benefits of digital health interventions.[6,24,38,42]

Recommendations

For Future Research:

- Expand studies in midwifery, especially in domains such as labor, postpartum mental health, and reproductive health education.
- Conduct long-term and cost-effectiveness evaluations of mobile health applications.
- Standardize outcome measures to improve comparability and meta-analytic opportunities.

For Policy and Practice:

- Promote policies that facilitate the integration of mobile health technologies in clinical and community healthcare settings.
- Support digital infrastructure development and equitable access to mobile health tools across diverse populations.
- Encourage healthcare providers' training in digital competencies to enhance the effectiveness of mobile health interventions.

For Educational Programs:

- Incorporate digital health literacy and mobile health application training into nursing and midwifery curricula.
- Develop continuous professional development programs focusing on emerging digital health Technologies.

In summary, this review underscores the growing scientific and practical significance of mobile health applications in nursing and midwifery in Turkey, providing a foundation for advancing research, policy, and education to harness the full potential of digital health for improving healthcare outcomes.

ETHICAL DECLARATIONS

Ethics Committee Approval: Ethical approval was not required as this study is a literature review.

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

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Case Report / Olgu sunumu

Winged Scapula and Mild Weakness in a Patient with SYNE2 Mutation-Associated Myopathy

SYNE2 Mutasyonu ile ilişkili Miyopatili Bir Hastada Kanat Skapula ve Hafif Güçsüzlük

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Abstract

Emery-Dreifuss muscular dystrophy (EDMD) is a rare disease characterized by scapulo-humero-peroneal muscle weakness, joint contractures, and cardiomyopathy. EDMD5 is an uncommon subtype caused by SYNE2 gene mutations. A 49-year-old male presented with lifelong difficulty running and rising from a squat. Examination revealed mild proximal lower limb weakness and bilateral winged scapula with left-sided predominance. Electromyography showed motor unit action potentials of reduced amplitude and short duration. Muscle biopsy indicated fiber atrophy with preserved staining for key muscular proteins. The findings in this case illustrate that clinical severity in EDMD5 may vary among individuals, as shown by the presence of mild weakness and a winged scapula.

Keywords: Emery-Dreifuss muscular dystrophy, EDMD5, myopathy, SYNE2 mutation, winged scapula

Öz

Emery-Dreifuss musküler distrofi (EDMD), skapulo-humero-peroneal kas güçsüzlüğü, eklem kontraktürleri ve kardiyomiyopati ile karakterize nadir bir hastalıktır. EDMD5, SYNE2 gen mutasyonlarına bağlı olarak gelişen nadir bir alt tiptir. Kırk dokuz yaşındaki erkek hasta, yaşamı boyunca koşma ve çömelme pozisyonundan kalkmada güçlük öyküsü ile başvurdu. Muayenede, proksimal alt ekstremite kaslarında hafif güçsüzlük ve sol tarafta belirgin olmak üzere bilateral kanat skapula saptandı. Elektromiyografide amplitüdü küçülmüş ve süresi kısa motor ünite aksiyon potansiyelleri gözlendi. Kas biyopsisinde temel kas proteinlerine yönelik boyanmanın korunduğu, ancak lif atrofisinin mevcut olduğu görüldü. Bu olguda gözlenen hafif güçsüzlük ve kanat skapula bulguları, EDMD5'te klinik şiddetin bireyler arasında değişkenlik gösterebileceğini ortaya koymaktadır.

Anahtar Kelimeler: Emery-Dreifuss musküler distrofi, EDMD5, miyopati, SYNE2 mutasyonu, kanat skapula

INTRODUCTION

Emery-Dreifuss muscular dystrophy (EDMD) is less common than Duchenne and Becker muscular dystrophies and is typically characterized by weakness in the scapulo-humero-peroneal muscles, cardiomyopathy, and contractures of the extremities.[1,2] Mutations in the EDMD gene, encoding emerin, and the LMNA gene, encoding lamin A/C, are responsible for the most prevalent subtypes of EDMD: EDMD1 and EDMD2, respectively.[1,2] Other genes such as SYNE1 and SYNE2, which encode nesprin-1 and nesprin-2, have also been implicated in rare EDMD subtypes. EDMD5, one of the rare subtypes of EDMD, has been reported in only a limited number of cases, which hampers the full characterization of its clinical features.[1-3] This report describes a patient with EDMD5, a rare subtype of Emery-Dreifuss muscular dystrophy caused by a SYNE2 mutation.

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CASE

A 49-year-old male presented to the neurology clinic with lifelong difficulties in running and rising from a squatting position. His medical history was unremarkable, and he was not taking any medications. While his family history revealed no significant findings, his parents were consanguineous, being third-degree relatives. On examination, he exhibited mild proximal weakness in the lower extremities and bilateral winged scapula, more prominent on the left side (**Figure 1A**). Muscle strength was assessed using the Medical Research Council scale. Strength in bilateral shoulder abduction and elbow flexion was graded as 4, and proximal strength in the proximal lower limb muscles was also 4 bilaterally. Strength in all other muscle group was normal. No joint limitations were observed. Sensory examination and deep tendon reflexes were within normal limits. Serum alanine aminotransferase, aspartate aminotransferase, and creatine kinase levels were 45 U/L, 68 U/L, and 346 U/L, respectively. Nerve conduction studies of the median, posterior tibial, and sural nerves yielded normal results. Needle electromyography showed no positive sharp waves, fibrillation potentials, or myotonic discharges in the left biceps brachii and deltoid muscles. However, motor unit action potentials in these muscles exhibited reduced amplitude and short duration (**Figure 1B**).

The muscle biopsy of the right biceps brachii revealed muscle fiber atrophy, with normal staining for dystrophin, emerin, dysferlin, and sarcoglycans. Genetic analysis identified a heterozygous variant in the SYNE2 gene (NM_182914.2: c.1074G>T;p.Glu358Asp), which was also detected in his father but not in his mother. One month prior to his neurology clinic visit, the patient was hospitalized with widespread pain, weakness, and dyspnea, symptoms that were most likely attributed to pneumonia. Electrocardiography (ECG), Holter ECG, echocardiography, and coronary angiography performed during his hospitalization showed normal results. His symptoms resolved within two weeks with symptomatic treatment alone. The patient gave written consent for the presentation of this case.

DISCUSSION

EDMD is a myopathy characterized by progressive muscle weakness, particularly affecting the scapulohumeral muscles in the upper extremities and the peroneal muscles in the lower extremities. It may be accompanied by cardiomyopathy, cardiac arrhythmias, or joint contractures.[1,2] The diagnosis is based on clinical features, electrodiagnostic studies including needle electromyography, and genetic testing. The presence of heart diseases such as cardiac arrhythmias in patients with EDMD highlights the importance of timely diagnosis and close follow-up of the disease.

EDMD has several subtypes based on the underlying genetic mutations. Mutations in genes such as LMNA, EMD, SYNE1, and SYNE2 have been implicated in EDMD and related myopathies.[1-4] The SYNE1 and SYNE2 genes encode nesprin-1 and nesprin-2, respectively.[1,2] EDMD4 and EDMD5 can develop in SYNE1 and SYNE2 mutations, respectively.[1-3] Weakness in these EDMD subtypes can vary from mild weakness to severe weakness.[1-3] In this present case, there was mild weakness in the proximal lower extremities. As in this present case, it was reported that no contractures were observed in EDMD5 compared to EDMD4.[1,2] Furthermore, mutations in the SYNE2 gene may play a role in the pathogenesis of EDME by impairing the mechanical connection between the nuclear envelope and the cytoskeleton.[5] Heterozygous missense variants identified

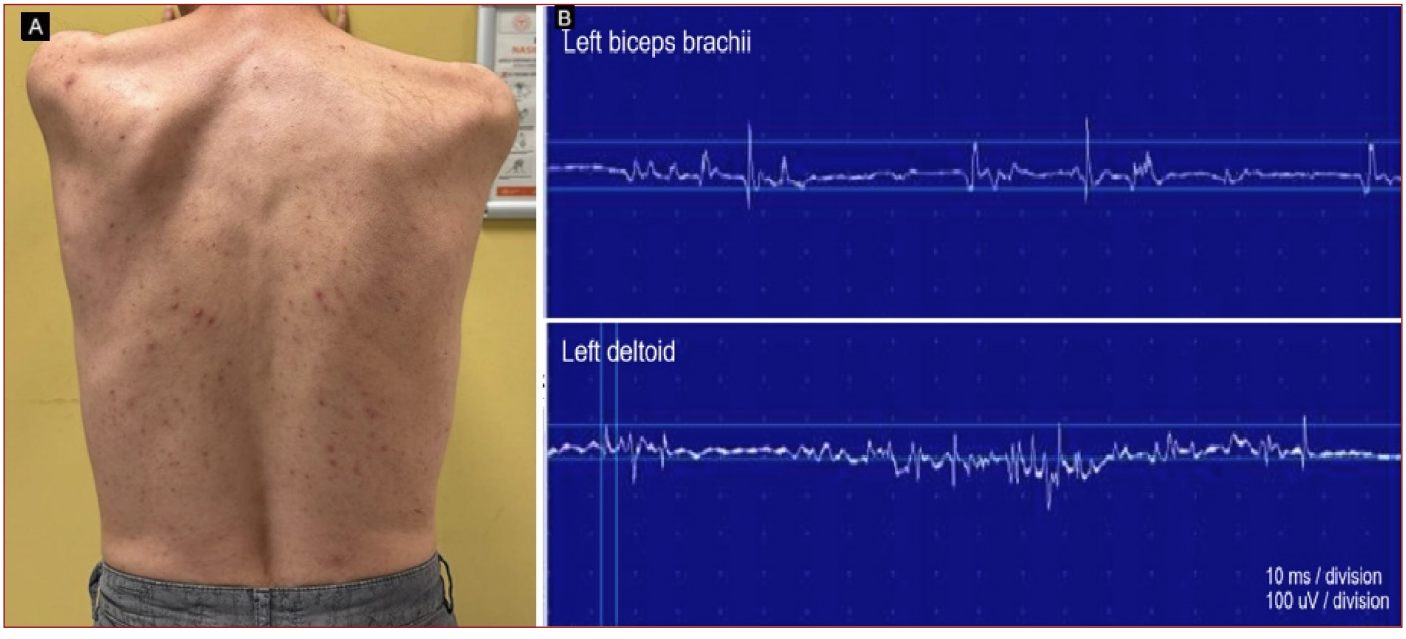

Figure 1. (A) Bilateral winged scapula with left-sided predominance **(B)** Myopathic motor unit action potentials in biceps brachii and deltoid muscles.

in patients with EDMD or EDME-like phenotypes have been associated with abnormal nuclear morphology and disrupted interactions among emerin, nesprin, and lamin proteins.[5] Taken together, these findings may help explain the mild clinical presentation observed in our patient.

Muscle weakness in EDMD primarily affects the scapular and humeral muscles, leading to winged scapula.[1,2] While winged scapula typically presents symmetrically in most myopathies, asymmetric involvement may be seen in certain hereditary myopathies, such as facioscapulohumeral dystrophy.[6] In the present case, although the winged scapula was bilateral, it was more prominent on the left side. Therefore, clinicians should be aware that hereditary myopathies with asymmetric features, although rare, may occur. In addition, this case did not show joint contractures or severe muscle weakness, findings often reported in other EDMD subtypes. This supports the view that EDMD has a broad clinical spectrum.

Life-threatening complications can occur in EDMD.[1,2,4] Cardiac involvement such as cardiomyopathy, arrhythmias, or heart failure has been reported, particularly in EDMD5.[1,2,4] However, no cardiac pathology was detected in the present case. Respiratory muscle weakness has been observed in animal models lacking SYNE1 and SYNE2, suggesting the potential role of these genes in motor innervation and respiratory function.[7] The episode of dyspnea and generalized weakness in our patient may support this association. In patients with EDMD5, intercurrent infections such as pneumonia may predispose to episodes of dyspnea and diffuse muscle weakness.

CONCLUSION

This case highlights that the presence of mild weakness and a winged scapula in this patient reflects the variability in the severity of muscle involvement among individuals with EDMD5. Additionally, this case suggests that some EDMD subtypes may present with mild clinical features in the absence of cardiac involvement or joint contractures.

ETHICAL DECLARATIONS

Informed Consent: The patient signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Case Report / Olgu sunumu

Chilaiditi Syndrome in a Pediatric Patient: An Undiagnosed Case in Recurrent Respiratory Symptoms

Pediatrik Bir Hastada Chilaiditi Sendromu: Tekrarlayan Solunum Semptomlarında Tanı Konulamayan Bir Olgu

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Abstract

Chilaiditi Syndrome is a rare anatomical condition characterized by the interposition of the bowel between the liver and diaphragm, often presenting with non-specific respiratory and gastrointestinal symptoms. This report aims to highlight the diagnostic challenges of Chilaiditi Syndrome in pediatric patients and emphasize the importance of radiographic evaluation in cases of recurrent, unexplained symptoms. We present a 5-year-old male patient with recurrent respiratory and abdominal symptoms who had been treated for extended periods with diagnoses of asthma, allergic rhinitis, and pneumonia. Despite receiving bronchodilators, corticosteroids, antihistamines, and antibiotics, the patient's symptoms persisted. Comprehensive imaging studies, including chest and abdominal radiographs and ultrasonography, were performed to identify potential anatomical abnormalities. Although rare, Chilaiditi syndrome should be considered in the differential diagnosis of children presenting with recurrent and unexplained respiratory or abdominal symptoms. Radiological assessment plays a critical role in achieving accurate diagnosis and preventing unnecessary treatments. This case underscores the importance of raising clinical awareness and not overlooking rare anatomical conditions in the pediatric population.

Keywords: Chilaiditi syndrome, Aerophagia, Asthma, Recurrent respiratory symptoms, Pneumonia

Öz

Chilaiditi Sendromu, bağırsakların karaciğer ile diyafram arasında yer değiştirmesiyle karakterize edilen nadir bir anatomik durumdur ve sıklıkla özgül olmayan solunum ve gastrointestinal semptomlarla kendini gösterir. Bu olgu, pediatrik hastalarda Chilaiditi Sendromu'nun tanısal zorluklarını vurgulamayı ve tekrarlayan, açıklanamayan semptomlarda radyolojik değerlendirmenin önemini ortaya koymayı amaçlamaktadır. Olgu: Bu yazıda, tekrarlayan solunum ve karın semptomları nedeniyle astım, alerjik rinit ve pnömoni tanıları alarak üzün süre tedavi almış 5 yaşındaki erkek bir hasta sunulmuştur. Bronkodilatör, kortikosteroid, antihistaminik ve antibiyotik tedavileri alan hastanın bu tedavilere rağmen semptomları devam etmiştir. Potansiyel anatomik anormallikleri belirlemek amacıyla göğüs ve karın röntgenleri ile ultrason dahil detaylı görüntüleme çalışmaları yapılmıştır. Tartışma/Sonuç: Chilaiditi Sendromu nadir görülse de, tekrarlayan ve açıklanamayan solunum veya abdominal semptomları olan çocuklarda mutlaka ayırıcı tanıda düşünülmelidir. Radyolojik değerlendirme tanıya ulaşmada kritik öneme sahiptir ve gereksiz tedavilerin önlenmesine yardımcı olur. Bu vaka, pediatrik hastalarda klinik farkındalığın artırılmasının ve nadir anatomik durumların göz ardı edilmemesinin önemini ortaya koymaktadır.

Anahtar Kelimeler: Chilaiditi sendromu, aerofaji, astım, tekrarlayan respiratuvar semptomlar, pnömoni

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INTRODUCTION

Recurrent respiratory and asthma-like symptoms in children are commonly attributed to infectious, viral, or allergic etiologies, often leading to corresponding treatments.[1] However, underlying anatomical anomalies, such as Chilaiditi Syndrome, may contribute to respiratory and gastrointestinal symptoms.

Chilaiditi Syndrome, a rare condition involving interposition of the bowel, typically the transverse colon, between the liver and diaphragm, has an estimated global morbidity rate of 0.025% - 0.28%.[2] First described by Demetrius Chilaiditi in 1910, this condition is often under-recognized.[3] Lack of awareness often leads to misdiagnosis and delayed care. Early radiographic evaluation in such cases can reduce the misuse of antibiotics and corticosteroids, minimizing unnecessary treatments. We present a case of a pediatric patient whose recurrent respiratory complaints were ultimately attributed to Chilaiditi Syndrome, emphasizing the importance of imaging in the diagnostic process and the need to maintain a broad differential diagnosis for recurrent respiratory symptoms.

CASE REPORT

A 5-year-old male presented with recurrent episodes of nasal congestion, wheezing, non-productive cough, and intermittently abdominal discomfort that persisted for several months. The initial onset of symptoms began around the age of 3, occurring intermittently. However, approximately 7 months prior to presentation, his symptoms significantly worsened, with increased abdominal distension, persistent wheezing, and shortness of breath, particularly during exertion. He was previously diagnosed with allergic rhinitis and asthma and treated with salbutamol, deflazacort, and montelukast. Skin prick tests for allergy were negative.

He was born via cesarean with a birth weight of 3300 gram. breastfeded until 18 months, with no comorbidities or family consanguinity.

Upon presentation, the patient had temperature of 36°C, and his pulse oxygen saturation, measured by pulse oximetry, was 98%. He had nasal congestion and respiratory symptoms. Physical examination revealed mild expiratory wheezing and normal breath sounds without rales or crackles. The respiratory rate was within normal limits. Abdominal examination showed slight distension in the right side of the abdomen, with vague and intermittent discomfort on deep palpation in the right upper quadrant. Bowel sounds were normal, and there was no guarding, rebound, or organomegaly. Blood tests showed no abnormality.

A respiratory function test was performed in our clinic and found to be normal (**Figure 1**). A chest X-ray and direct abdominal X-ray (**Figure 2**) previously performed revealed a characteristic finding of Chilaiditi Syndrome: the intestines were displaced to the right side of the abdomen, with visible gas in the right abdominal region between the liver and diaphragm. This condition was observed consistently in repeated previous radiographic images. The initial X-ray showed colonic gas on both the right and left sides, with a particular emphasis on the presence beneath the right diaphragm, which necessitated further evaluation with Doppler and standard ultrasound to rule out congenital bowel malformations and confirm the diagnosis. These were reported as normal by the pediatric radiologist. Based on the patient's clinical presentation and radiographic findings, a diagnosis of Chilaiditi Syndrome was confirmed.

The patient was advised to avoid aerophagia, refrain from consuming liquid meals before bedtime, and discontinue the intake of carbonated beverages. At the three-month follow-up, no additional clinical findings were observed within the gas suggesting that it is within the bowel and not free.

Ethical approval for this case report was obtained from the Yüksek İhtisas University Health Sciences Research Ethics Committee (Decision No: 289, Date: 19.02.2025). This study was conducted in accordance with the ethical standards of the Declaration of Helsinki.

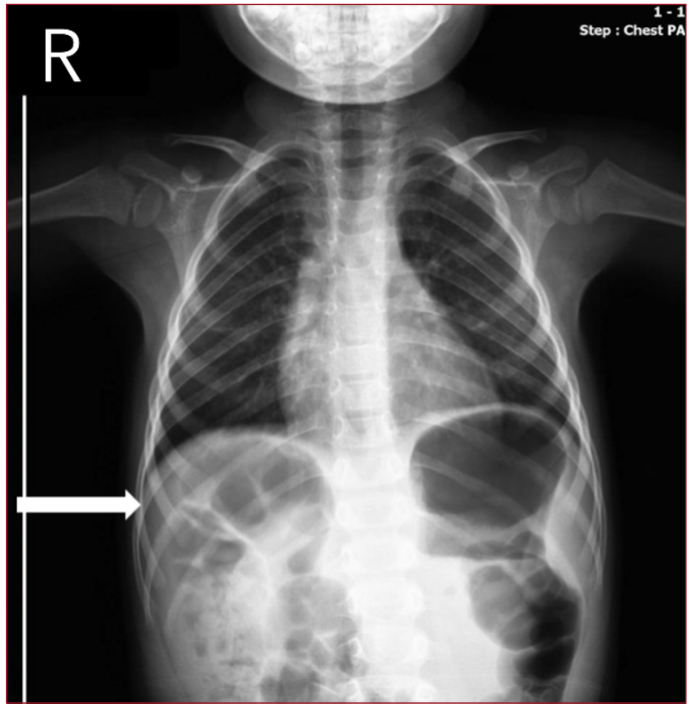
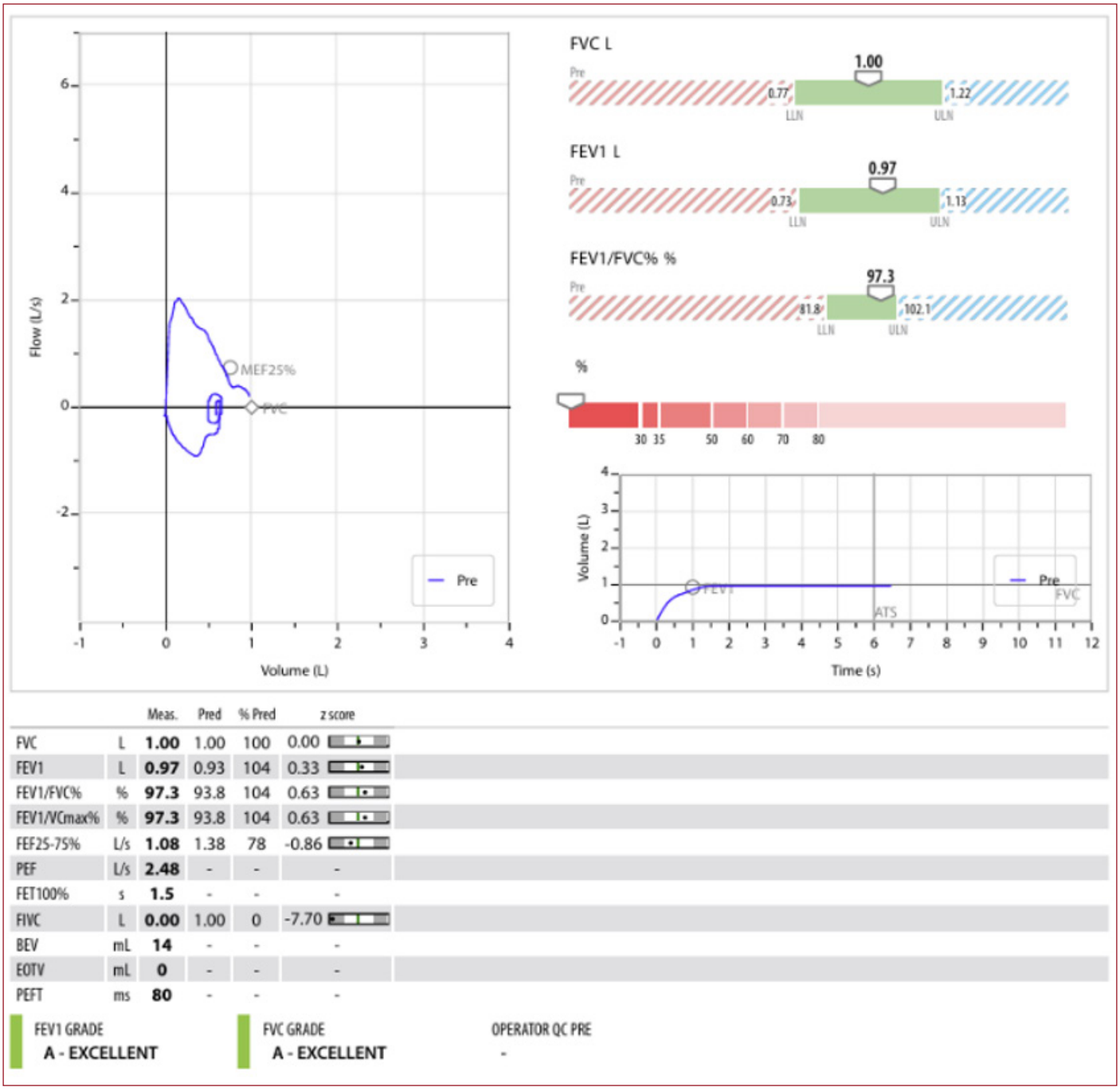


Figure 2. Arrow on X-ray highlights gas between the liver and diaphragm and haustra

DISCUSSION

Chilaiditi Syndrome can be asymptomatic or may be accompanied by a variety of symptoms, including respiratory and gastrointestinal complaints. These symptoms can often be mistaken for more common conditions. The lack of awareness about Chilaiditi Syndrome and the tendency to focus on more prevalent diagnoses frequently lead to misdiagnosis and unnecessary treatments.[4] Chilaiditi Syndrome is not covered in major pediatric texts like the Nelson Textbook, highlighting an awareness gap.



		Meas.	Pred	% Pred	z score
FVC	L	**1.00**	1.00	100	0.00
FEV1	L	**0.97**	0.93	104	0.33
FEV1/FVC%	%	**97.3**	93.8	104	0.63
FEV1/VCmax%	%	**97.3**	93.8	104	0.63
FEF25-75%	L/s	**1.08**	1.38	78	-0.86
PEF	L/s	**2.48**	-	-	-
FET100%	s	**1.5**	-	-	-
FIVC	L	**0.00**	1.00	0	-7.70
BEV	mL	**14**	-	-	-
EOTV	mL	**0**	-	-	-
PEFT	ms	**80**	-	-	-

FEV1 GRADE
A - EXCELLENT

FVC GRADE
A - EXCELLENT

OPERATOR QC PRE
-

Figure 1. Respiratory Function Test showing normal results.

Though its pathophysiology is unknown, Chilaiditi Syndrome may result from congenital or acquired factors. Colonic tension seen in Chilaiditi Syndrome, caused by air aerophagia, is shown as one of the most important causes in children.[5] This can be observed in children sucking empty baby bottles.[6] Infants and young children have smaller airways, which require minimal obstruction to produce respiratory symptoms.[7] In this case, the patient presented with recurrent respiratory symptoms from around age 3, initially diagnosed as allergic rhinitis and asthma. Despite treatment, symptoms worsened over the last 7 months, prompting further investigation. Allergy tests were negative, and there was no relevant family history. Persistent symptoms and abdominal discomfort led to the diagnosis of Chilaiditi Syndrome. A Radiographic imaging is essential in the diagnosis of Chilaiditi Syndrome.[8] For a definitive diagnosis, specific radiological criteria must be met. These include displacement of the right hemidiaphragm superiorly above the liver due to the interposition of the intestine, the presence of a pseudo-pneumoperitoneum caused by air within the bowel, and the positioning of the superior margin of the liver below the level of the left hemidiaphragm.[9] These findings distinguish

Chilaiditi Syndrome from conditions like pneumonia. In our case, there was a delay of one year in establishing the diagnosis. This highlights the importance of accurate radiographic interpretation.

While typically manageable, unrecognized cases can lead to serious complications such as bowel obstruction, volvulus, ischemia, and respiratory distress.[10] Similar cases in the literature emphasize the value of early and accurate diagnosis. Conservative treatment in the pediatric age is always preferable.[8] In our case, the patient was advised to avoid aerophagia, refrain from consuming liquid meals before bedtime, and discontinue the intake of carbonated beverages, which aligns with this non-invasive approach.

CONCLUSION

Chilaiditi Syndrome, though rare, should be included in the differential diagnosis of pediatric patients presenting with recurrent, unexplained respiratory or abdominal symptoms, particularly when conventional treatments are ineffective. The role of radiographic imaging is critical for early diagnosis, which can prevent inappropriate treatment and minimize the risk of complications. Physicians should maintain awareness of this condition and consider imaging as a diagnostic tool when clinical presentations do not align with more common diagnoses. Early recognition and accurate diagnosis through imaging can lead to improved management, reduce unneeded treatments, and promote better patient care.

ETHICAL DECLARATIONS

Informed Consent: The patient signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Review / Derleme

A Comprehensive Review of Paternal Causes of Recurrent Pregnancy Loss

Tekrarlayan Gebelik Kayıplarının Paternal Nedenlerine Kapsamlı Bir Bakış

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Abstract

Approximately 5% of couples attempting to reproduce face the challenge of recurrent pregnancy loss. Sadly, more than 50% of those couples will have their case remain unexplained. This can be problematic when families are trying to conceive. Past research mainly focused on maternal causes of recurrent pregnancy loss. A shift in research towards investigating paternal etiologies has revealed more causes of recurrent pregnancy loss. New research has shown how paternal age, physical health, lifestyle habits, sperm characteristics, metabolic disorders, inflammatory disorders, and clotting disorders all influence pregnancy outcomes. The purpose of this paper is to provide a review of the past twenty years of literature investigating the underexplored paternal causes of recurrent pregnancy loss.

Keywords: Pregnancy outcome, male fertility, reproductive medicine, spermatozoa, pregnancy complication

Öz

Çocuk sahibi olma çabası içindeki çiftlerin yaklaşık %5'i tekrarlayan gebelik kaybı (TGK) sorunu ile karşılaşmaktadır. Ne yazık ki bu çiftlerin %50'sinden fazlasında neden açıklanamamaktadır. Bu durum, çocuk sahibi olmaya çalışan aileler için ciddi bir sorun teşkil etmektedir. Geçmişte yapılan araştırmalar büyük ölçüde TGK'nın maternal (anneye ait) nedenlerine odaklanmıştır. Ancak son dönemde paternal (babaya ait) etiyolojilerin araştırılmasına yönelik yönelim, TGK'nın daha fazla nedenini ortaya çıkarmıştır. Güncel araştırmalar; baba yaşının, fiziksel sağlığın, yaşam tarzı alışkanlıklarının, sperm özelliklerinin, metabolik bozuklukların, inflamatuar hastalıkların ve pıhtılaşma bozukluklarının gebelik sonuçlarını etkilediğini göstermiştir. Bu derleme çalışmasının amacı, son yirmi yılda yapılan literatürün gözden geçirilmesiyle, yeterince araştırılmamış olan TGK'nın paternal nedenlerine dikkat çekmektir.

Anahtar Kelimeler: Gebelik sonucu, erkek doğurganlığı, üreme tıbbı, spermatozoa, gebelik komplikasyonu

INTRODUCTION

Spontaneous miscarriage is a worrisome yet common event for couples trying to conceive. Every year, there are more than 20 million occurrences of spontaneous miscarriage.[1] A portion of those couples who unexpectedly lose their fetus will try again to conceive. Those who experience a second spontaneous miscarriage make up 1-5% of annual miscarriages.[2] 75% of those couples who experience recurrent pregnancy loss (RPL) have their cases remain unexplained.[3] Concrete facts and research looking into unexplained recurrent pregnancy loss is tricky for researchers due to the varying definitions of RPL. Even guidelines addressing treatment for recurrent pregnancy loss provide different suggestions due to the varying definitions found in national guidelines such as the American Society for Reproductive Medicine (ASRM), the European Society of Human Reproduction and Embryology (ESHRE), and the Royal College of Obstetricians and Gynecologists (RCOG).[4] When defining recurrent pregnancy loss, the main definition must include a standard definition for pregnancy, how long the pregnancy has to last to be considered a loss, a standard definition for recurrence, and a standard definition for consecutive losses. Despite a lack of a standardized definition, past research into causes of recurrent pregnancy loss mainly focused on maternal causes.

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The history of research with recurrent pregnancy loss has mostly been focused on maternal factors until recently. The research conducted in the past has found numerous maternal etiologies for recurrent pregnancy loss. Despite that, there are still 50 to 75% of the cases worldwide that remain unexplained.[3] Research looking into maternal etiologies of recurrent pregnancy loss has found increased maternal age, autoimmune disorders, uterine abnormalities, endocrine abnormalities, maternal microbiome, genetic anomalies, vitamin deficiencies, and maternal lifestyle factors as all contributors to recurrent pregnancy loss.[5] A widely known fact is as a mother increases in age, the riskier the outcome of her pregnancy will be. Outcomes can include spontaneous miscarriage or health defects in the newborn baby. Certain mothers have autoimmune disorders that prevent them from carrying their baby to full term. Research into mothers with Antiphospholipid Syndrome (acquired thrombophilia) or inherited thrombophilia has shown how common it is for mothers with this disorder to experience RPL.[6] Thrombophilia, a blood disorder that can be inherited or acquired (antiphospholipid syndrome) is seen to cause blood to abnormally clot. Uterine abnormalities such as congenital anatomic structural defects, acquired anatomical abnormalities and endometriosis are maternal etiologies proven to lead to RPL. A mother's endocrine system can also play a role in experiencing recurrent pregnancy loss. Research has shown endocrine disorders such as Polycystic Ovary Syndrome (PCOS), thyroid disorders, and prolactin disorders have continuously led to miscarriages.[7] Chromosomal abnormalities of the parents make up 50% - 60% of early pregnancy loss.[8] Research on Vitamin D deficiency and how it could possibly be a risk factor for RPL remains inconclusive.[9] Fairly new research for maternal etiologies of recurrent pregnancy loss have been looking into the mother's microbiome. The environment of the endometrial, gut, and vaginal biome has all shown results in how they could contribute to couples experiencing RPL.[10] While past research focused primarily on maternal risk factors, recent research has started to investigate paternal causes of recurrent pregnancy loss.

Past research heavily focused on maternal causes as sole contributors to recurrent pregnancy loss. This perspective overlooked the significant role paternal factors may have played. Research focused on paternal causes increased after recommendations from the ESHRE.[2] Past research has referenced sperm DNA fragmentation and chromosomal abnormalities as paternal causes for RPL.[11] New research has found evidence that other paternal factors such as lifestyle, metabolic syndromes, and genetic markers may play a significant role in recurrent pregnancy loss. Research into etiologies of recurrent miscarriage has always been very nuanced and multifaceted with an interconnectedness of genetic, environmental, and biological factors. The purpose of this review is to explore the underrecognized male causes of unexplained recurrent pregnancy loss based on literature from the past two decades.

Age and Unhealthy Lifestyle

It is a long-proven fact, that the older a woman is when pregnant, the higher the chances her pregnancy will result in miscarriage. The increased age leads to a decline in egg quality, changes in uterine conditions, along with a higher risk of other health complications.[12] Recent research has now shown an older father could also impact the success of a pregnancy. A meta-analysis study that evaluated the effect of paternal age on pregnancy outcomes, showed fathers between 40-44 years of age had a 23% greater chance of spontaneous miscarriage before 20 weeks compared to younger counterparts.[13] If the father was older than 45 the risk of spontaneous miscarriage increased by 43% for before 20 weeks and 74% for 13 weeks gestation. A study with over 1,900 male participants clearly indicated the association between increased paternal age and RPL with those paternal ages averaging to 35 vs 32 years old.[14] The relationship between increased paternal age and pregnancy success may be due to sperm DNA integrity. As numerous research articles emphasize the effect of paternal age on pregnancy outcomes, there is also abundant research that shows the effect of older paternal age on sperm DNA quality.[11,15,16] It's important that clinicians understand the research shows higher paternal age has significant risks when families are trying to conceive successfully and experience unexplained recurrent pregnancy loss. As research shows, paternal age greatly impacts RPL, it is also important to notice how paternal lifestyle habits further contribute to pregnancy outcomes.

A parent's healthy lifestyle habits are important for preventing the risk of spontaneous miscarriage. Research has shown how a mother's lifestyle habits such as obesity, excessive alcohol, caffeine, and tobacco intake increase the risk of the pregnancy ending spontaneously.[9] New research literature is still controversial on the lifestyle habits of the father and how it might impact RPL. There are research articles that state there has been no association between a father's alcohol intake, tobacco intake, and BMI on pregnancy outcomes.[17] There has also been recent research that states how a father's obesity has a negative association with recurrent spontaneous miscarriage.[18] Paternal obesity, alcohol consumption, and tobacco intake all have research supporting a negative association with RPL.[19,20] New research discusses how these habits in a father's life can negatively impact pregnancy outcomes through DNA fragmentation and Reactive Oxygen Species (ROS) generation.[21] As the research has shown, a father's age and lifestyle habits may be a topic discussed or reviewed when clinicians are determining the cause of a patient's RPL. In addition to paternal age and lifestyle habits, research has shown paternal health and specific diseases are associated with spontaneous miscarriage.

Metabolic Syndromes

Paternal etiologies of recurrent pregnancy loss are as multifaceted as maternal etiologies. As mentioned previously, research shows how an older paternal age during efforts to conceive can lead to compromised sperm DNA quality.

This shows that there is an interconnected nature between paternal etiologies of RPL. A father's lifestyle habits are major influences on his physical health which can lead to poor pregnancy outcomes. Physical health syndromes such as obesity, diabetes, hypertension, and hyperlipidemia are all metabolic syndromes negatively associated with RPL. A case-control study analyzed over a million pregnancy cases in the United States of America to see if there was any correlation between paternal metabolic syndromes and pregnancy outcomes. The data showed a higher chance of pregnancy loss with the more metabolic disorders a father had. For example, the risk of pregnancy loss progressively increased by 10%, 15%, and 19% in cases where fathers exhibited one, two, or three metabolic conditions, respectively, compared to pregnancies involving healthy fathers.[22] While research has shown compounded metabolic disorders, such as obesity, hypertension, and diabetes collectively influence pregnancy outcomes their individual effects appear to be specific to the syndrome.

A comprehensive review that analyzed over 115,000 fathers found that men with obesity were more likely to be infertile and had a 10% chance overall of their pregnancy being non-viable.[23] While there is research that states compounded metabolic syndromes of the father negatively impact pregnancy outcomes, recent research suggests that individual syndromes are not significant enough to negatively impact pregnancy outcomes. A cohort study that investigated the chance of successful pregnancy in fathers with diabetes mellitus found that of the 990 male participants with diabetes mellitus, there was no statistical significance seen of a negative impact on pregnancy outcomes.[24] Similarly, there is minimal research examining how paternal hypertension alone can negatively influence pregnancy outcomes. These research findings emphasize the interplay of paternal etiologies with how a father's age and lifestyle habits influence his health which then influences his sperm quality and ultimately his pregnancy outcomes. The changes in sperm cell quality could influence placental function and leading to a greater risk of pregnancy loss.[11] Advancing research on paternal health and its impact on pregnancy outcomes is important to consider and will be further discussed with inflammatory and clotting disorders.

Clotting and Inflammatory Disorders

Autoimmune diseases are conditions where the body's immune system is overly active and starts attacking itself. New research is diving into paternal factors of pregnancy loss and has started investigating the effects of fathers with Inflammatory Bowel Diseases such as Ulcerative Colitis or Crohn's Disease and pregnancy outcomes. A study using information from the Danish Assisted Reproduction Registry found that for fathers with ulcerative colitis, the likelihood of a successful pregnancy was significantly similar to fathers without the disorder. In fathers with Crohn's disease compared to fathers without, the chances of a successful pregnancy were 20% less.[25] The study also showed fathers with ulcerative colitis have a slightly better chance of a successful pregnancy, but fathers diagnosed with Crohn's disease have lower chances meaning they may be at a higher risk of losing the baby early. Due to research finding an association between inflammatory bowel disorders having a negative impact on RPL, there's been emerging research that has investigated the effects of inflammatory bowel disorder medications and their potential impact on semen parameters and pregnancy outcomes. A study that included over 25,000 fathers with inflammatory bowel disorders found that there were no significant associations between a father's intake of inflammatory bowel disorder medications and sperm quality or adverse pregnancy outcomes.[26] Emerging research in this field highlights the significance of considering paternal factors in etiologies of RPL. The increased risk of early pregnancy loss associated with fathers diagnosed with Crohn's disease could be attributed to past cases of unexplained RPL or cases previously attributed solely to maternal etiologies. In addition to inflammatory bowel disorders, recent research has uncovered the effect a father's blood disorder can have on successful pregnancy outcomes.

Thrombophilia is a blood disorder that causes blood in the circulatory system to be more likely to clot. This disorder can be inherited from the mother or father due to mutations in the genes Factor V Leiden and Prothrombin G20210A. Mutations in these two specific genes lead to higher risks of recurrent pregnancy loss because they directly lead to increased thrombosis.[3] Research into pregnant women with inherited thrombophilia has shown they have higher risks of experiencing RPL.[27] Past research was controversial on whether inherited thrombophilia would impact a pregnancy so screenings and treatments for mothers with this disorder were not recommended.[8] Updated research now also focuses on the inherited disorder through the father. A study that did a comparative analysis of inherited paternal thrombophilia in Argentinian males, found couples with the father having the Factor V Leiden mutation had a risk of RPL that was six times higher when compared to a control group.[28] Research looking into acquired parental thrombophilia (antiphospholipid syndrome) rather than inherited found that more than 5% of those couples experienced RPL.[9] In addition to Factor v Leiden and prothrombin genetic mutations, the ANXA5 gene also impacts normal blood clotting. Numerous research studies into paternal and maternal carriage of the haplotype have shown the negative contribution of the ANXA5 gene mutation to increasing thrombophilia and RPL.[29,30] Research has shown how mutations in the MTHFR gene impacts blood clotting and leads to hyperhomocysteinemia. Evidence shows when fathers have this condition the risk of miscarriage increases more than 6-fold.[31.32] In addition to blood clotting disorders and inflammatory disorders of the father impacting successful pregnancy outcomes, physical and functional characteristics of sperm have vast amounts of research showing similar pregnancy outcomes.

Characteristics of Sperm

In the past, research conclusions conflicted on the impact of sperm and semen characteristics on successful pregnancy outcomes.[13,33] However, more recent research has solidified the critical role these characteristics have. Sperm quality, decrease in sperm motility, and abnormal sperm head research have all displayed a negative association with successful pregnancies.[34] These results showcase the importance of assessing sperm and semen parameters before couples try to conceive. Numerous studies have shown that semen volume, sperm movement, shape, and concentration negatively impact RPL.[17] Past research that looked into sperm parameters found that pregnancies with abnormal sperm morphology, and sperm motility were all factors that impacted recurrent pregnancy losses.[35] These findings help shed light on the multifaceted interplay of paternal etiologies and how they can impact unexplained recurrent pregnancy loss cases. In addition to sperm morphology and motility, ROS in sperm have shown influence on successful pregnancies.

An important functional sperm characteristic that can negatively impact a pregnancy is the production of ROS in sperm and semen. ROS in semen are unstable oxygen-carrying molecules with different roles such as aiding in sperm motility, activation, and egg fertilization.[36] Research has shown how the secondary effect of ROS leads to DNA damage thus negatively affecting pregnancy outcomes.[34] The generation of ROS is influenced by external factors including lifestyle habits and a father's environment. Specific lifestyle habits including environmental toxins exposure, alcohol consumption, and smoking have been shown to be associated with an increase in the generation of ROS which leads to complications in sperm quality and function.[21] With research investigating the associations between abnormal sperm parameters and oxidative stress, these studies emphasize the importance of addressing paternal health in cases of unexplained recurrent pregnancy loss. They also stress the need for lifestyle interventions and environmental modifications in fathers to reduce oxidative stress and improve sperm quality. The interplay between paternal etiologies in RPL is further supported by an abundance of research displaying how a father's lifestyle habits influence sperm genetic markers which in turn affects pregnancy outcomes.

Genetic Markers

Outside of maternal factors, genetic and molecular markers in sperm have a significant influence on pregnancy outcomes. DNA fragmentation, chromosome abnormalities, chromosome deletions, and proteins all have been shown to play a role in RPL. DNA fragmentation, the breaking of DNA strands, is an extensively studied marker that has shown a negative association with RPL. A study has investigated sperm elemental composition in young fathers versus older fathers and its association with sperm quality. The findings revealed older men showed that older men had increased concentrations of calcium, copper, and zinc in sperm with elevated levels of zinc and calcium contributing to DNA fragmentation.[37] As seen throughout all paternal factors of recurrent pregnancy loss there is a connection they all have with one another. Research has shown that a father's lifestyle habits such as smoking, alcohol, and environmental toxins all have been found to contribute to sperm DNA fragmentation.[21] Research over time and across various races (Asians, Africans, Europeans) has consistently found that DNA fragmentation is linked to RPL.[17,38] In addition to DNA fragmentation, genetic mutations of specific genes have shown to negatively impact pregnancy outcomes. A study that used bioinformatic tools to investigate the HPA2 gene and its effects on recurrent pregnancy loss found numerous harmful mutations linked to recurrent pregnancy loss.[39] Sperm DNA fragmentation, specific genetic mutations, and other epigenetic factors have all shown to influence RPL.

Paternal epigenetic factors have also been shown to influence recurrent pregnancy loss. Recent research investigated paternal epigenetic factors such as DNA methylation through pyrosequencing to see any effects of RPL.[40] The results of the study found a decrease in sperm methylation associated with RPL. DNA fragmentation, DNA methylation patterns, and mutations in genes have all shown how sperm quality can contribute to recurrent miscarriage. Genetic abnormalities, such as balanced translocations, are an established cause of pregnancy loss but account only for 3% of couples who experience RPL.[11] Existing research is controversial about the negative effects of Y chromosome microdeletions on RPL.[41] Proteins found in sperm have a vital role in fertilization. Research into proteomics has found deviations in these sperm proteins have a negative impact on recurrent pregnancy loss. Specifically, in research conducted that compared the protein in sperm of those who experience RPL to a comparison group, the sperm had notable differences in 36 proteins.[42] New research is diving into sperm transcriptomics - which looks at coding and non-coding regions of RNA.[34] Alterations in coding RNA and non-coding RNA can serve as molecular markers for recurrent pregnancy loss. It is important to emphasize the influence each paternal factor has on each other because research has shown a father's age and lifestyle habits affect sperm quality which then affects important biological processes. Paternal age has been shown to impact various cellular mechanisms, such as ROS production, genetic alterations, chromosomal anomalies, deletions on the Y chromosome, elongation of telomeres, centromeric disruptions, shifts in epigenetic modifications, and irregularities in microRNA activity.[16] Given the importance of these genetic markers, this is a signifier for clinicians to evaluate and discuss with patients who might be predisposed to RPL or experiencing unexplained pregnancy loss. Genetic markers, sperm characteristics, and paternal health all contribute to pregnancy outcomes. This emphasizes the importance of including paternal evaluations in the discussion when clinicians are reviewing diagnoses and treatment plans.

Treatment and Diagnosis

Past diagnosis guidelines for RPL focused primarily on maternal etiology. With emerging research diving into how paternal factors can contribute to pregnancy loss, clinicians should follow the data and evaluate the father's all-around health when planning to conceive. Diagnosing RPL will require a comprehensive approach due to the multifaceted nature of the problem. As seen, paternal genetics and environment all influence pregnancy outcomes. With the significant influence sperm has on successful pregnancies, the first diagnostic tool would be sperm analysis. With a sperm analysis, all sperm characteristics such as sperm concentration, structure, and DNA integrity can be analyzed. Research has shown how abnormal characteristics in these features are linked to pregnancy loss.[34,35] Additionally, paternal genetic testing would reveal abnormalities in DNA, chromosomes, or specific genes known to contribute to RPL. Epigenetic testing could be a potential diagnostic tool as it would examine DNA methylation patterns that could potentially impact pregnancy outcomes.[40] It is important for a father to do a thorough review of his lifestyle habits, including alcohol consumption, smoking, and lack of exercise because research has shown their influence on sperm quality and pregnancy success. With all these diagnostic tools combined, in addition to diagnostic measures for maternal health, clinicians and patients can better understand the role of paternal factors in recurrent pregnancy outcomes and coordinate treatment plans accordingly.

Treatment for paternal etiologies of RPL would focus on targeting issues in sperm quality and overall paternal health. For cases of DNA fragmentation in sperm, antioxidants such as vitamin C have been suggested to reduce oxidative stress.[43] And for men with identified chromosomal abnormalities and chromosome microdeletions, assisted reproductive technologies can be considered. Lifestyle modifications are crucial in treatment plans. This includes smoking cessation, reducing alcohol consumption, and avoiding environmental toxins all in an effort to improve sperm health. In specific cases, where paternal age is a factor, the most likely option is to use sperm from a younger age as an option. Overall, treatment strategies should be personalized towards the patient and incorporate medical treatments in addition to paternal lifestyle changes to optimize chances of fertility and successful pregnancy outcomes.

Future Directions

A significant 75% of recurrent pregnancy loss cases remain unexplained despite extensive past research.[3] Future studies should continue to look into paternal etiologies contributing to recurrent pregnancy loss. Researchers can continue to investigate paternal etiologies such as paternally inherited and acquired thrombophilia, the role of sperm proteomics, and sperm transcriptomics. This research can solidify or challenge the current literature. More research should be conducted on paternal lifestyle factors such as obesity, alcohol intake, and smoking, as these can influence reproductive health. Lastly, examining the impact of other paternal autoimmune and metabolic disorders on recurrent pregnancy loss could add to the existing literature on paternal causes of recurrent pregnancy loss. By following these future research recommendations, treatment therapies for recurrent pregnancy loss can be improved and better predictive models of recurrent pregnancy loss can be created. As seen with the 2022 ESHRE guidelines, current research on paternal lifestyle factors and sperm DNA quality provides results that update treatment guidelines.[44]

CONCLUSION

The issue of recurrent pregnancy loss is multifaceted and complex. A majority of cases remain unexplained. A shift in focus from maternal etiologies to paternal etiologies have revealed new causes of recurrent pregnancy loss. New research has focused on paternal factors such as age, thrombophilic disorders, metabolic disorders, lifestyle, and sperm characteristics. This review's purpose was to gain knowledge from the findings of the last twenty years of research focusing on male risk factors associated with unexplained recurrent pregnancy loss. Although there is still a need for additional research, the current literature provides guidelines to improve pregnancy success in couples experiencing unexplained recurrent pregnancy loss.

ETHICAL DECLARATIONS

Informed Consent: All patients signed the free and informed consent form.
Referee Evaluation Process: Externally peer-reviewed.
Conflict of Interest Statement: The authors have no conflicts of interest to declare.
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