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Publisher Contact
Address: Molla Gürani Mah. Kaçamak Sk.
No: 21/1 34093 İstanbul, Türkiye
Phone: +90 (530) 177 30 97 / +90 (539) 307 32 03
E-mail: info@galenos.com.tr • yayin@galenos.com.tr
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Editor in Chef

Dear readers,

With the arrival of spring, nature has begun to awaken-flowers are blooming, trees are budding, and the weather is warming, signaling renewed vitality all around us. As we approach the end of another academic year, we also look forward to the summer break-a well-deserved opportunity to rest and recharge. In the first week of June, we will come together with our loved ones to celebrate Eid al-Adha.

On this occasion, I would like to extend my sincere gratitude to the members of our editorial team-including the Managing Editors, Editorial Board, Statistics Editor, and all other contributing editors-for their dedication and valuable efforts in preparing each issue of our journal.

We also sincerely thank our esteemed reviewers, whose timely and thoughtful evaluations are essential not only for the academic development of our submitting authors but also for ensuring the punctual publication of each issue. We kindly emphasize the importance of responding to referee invitations within the designated timeframe, as peer review is a cornerstone of scholarly publishing.

On behalf of our journal, we express our heartfelt thanks to all authors who have submitted their work, our diligent referees, and our valued readers for their continued support.

The second issue of 2025 features one review article, nine original research articles, and one case report.

We wish you a healthy, happy, and peaceful season ahead and look forward to reconnecting with you in the third issue of 2025.

Best regards,

M. Ali Gülçelik, M.D., Prof.
Editor-in-Chief

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Patient knowledge and participation in preventing surgical site infections: an integrative review

Jukas Mirnoto[1,2], Andi Masyitha Irwan[3]

[1]*Hasanuddin University Faculty of Nursing, Department of Medical Surgical Nursing, Makassar, Indonesia*
[2]*Daya District General Hospital, Makassar, Indonesia*
[3]*Hasanuddin University Faculty of Nursing, Department of Gerontological Nursing, Makassar, Indonesia*

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Corresponding Author:
Andi Masyitha Irwan, PhD., RN., Hasanuddin University Faculty of Nursing, Department of Gerontological Nursing, Makassar, Indonesia
citha_ners@med.unhas.ac.id

ORCID:
orcid.org/0000-0002-4715-7668

Keywords: Surgical site infection, patient education, patient role

ABSTRACT

Awareness of health workers regarding the role of patients in decisions about surgical site infections (SSIs) is still lacking. Therefore, this study aimed to provide insight into patient knowledge and participation, and the role of health workers in involving patients in SSI prevention. Six online databases were searched for relevant studies, and this search identified ten articles. Findings highlight the importance of patient knowledge, awareness and active participation, as well as the critical role of healthcare workers in engaging and empowering patients to prevent SSIs. Therefore, adequate patient knowledge can increase patient participation in infection prevention, by educating them about the disease process and empowering them to monitor surgical wounds, use antibiotics, and make decisions related to preventing SSIs.

Introduction

Surgical site infection (SSI) is a potential complication of surgical procedures that can harm the patient. According to the Centers for Disease Control and Prevention (CDC) in the United States (US), there were around 110,800 cases of SSIs due to inpatient surgical procedures in 2015. In 2021, the CDC reported a 3% increase in the incidence of SSIs across all types of surgical procedures compared with that in the previous year (1). In Japan, nosocomial infection surveillance revealed that the incidence of SSIs in gastrointestinal surgery cases had reached 9.6% (2). Another article reported that the readmission rate within 30 days for patients with SSI was 51.94 per 100 procedures compared with an overall readmission rate of 8.19 per 100 procedures. This indicated that patients with SSI had a significantly higher risk of adverse outcomes than those without SSI (3). According to the World Health Organization (WHO), SSI is a common healthcare-associated infection (HAI) in low-and middle-income countries, affecting up to one-third of patients undergoing surgery. In high-income countries, such as Europe and the US, SSI remains the second most common type of HAI (4). Therefore, special attention should be paid to reducing post-surgery complications as part of patient safety to prevent SSIs (5).

SSIs occur in surgical sites after procedures and can range from infections in the skin to more severe infections that spread to the tissue beneath the skin, organs, or implanted material (6). The incidence of SSIs can be prevented by implementing the principles and guidelines for infection prevention from the beginning of surgery, through the intraoperative period, and into the postoperative period (4). As a healthcare professional, it is important to make every effort to prevent any possible infection incidence in a hospital setting (7).

The current SSI prevention strategies primarily focus on the role of health workers and the risk factors related to the surgical procedure (8). Although routine surveillance and standard prevention protocols have been established, active involvement of patients in the prevention of SSIs should also be considered because patient involvement can be beneficial (9). If patients do not actively participate in efforts to prevent SSIs, the risk of developing infections may increase, leading to extended hospital stays, a higher risk of death, and increased treatment costs (10). However, health workers often do not recognize the role of patients and caregivers in decision-making, including antibiotic administration, despite observational data highlighting its importance. Consequently, patients and caregivers are not routinely either involved or aware of opportunities to participate in decision-making regarding SSIs (11). Therefore, healthcare workers need to educate patients about preventing SSIs and involve them in decision-making.

Patient knowledge regarding SSI prevention includes a comprehensive understanding of preventive measures (12), proper wound care procedures (13), identification of signs of infection, and compliance with essential medical instructions to reduce the risk of SSIs (14). Good patient knowledge is expected to help patients participate in SSI prevention efforts, comply with treatment protocols, monitor their health conditions, report emerging symptoms, and collaborate with health workers in the decision-making process regarding effective preventive measures to reduce the risk of SSIs (10).

The results of previous reviews have identified that involving patients in the prevention of surgical wound infections can be effective. However, further research is needed to validate this strategy (8). A review showed that although patient education is considered an important strategy to reduce the incidence of SSI and improve patient safety, patient education regarding SSI, including hospital care, is still very low (15). In addition, another review found the lack of participation and low awareness among patients regarding the risk of infection associated with the health services they receive (16). However, none of these studies has thoroughly examined patient knowledge, participation, and the role of health workers in involving patients in SSI prevention. It is important to consider the overall picture of patient knowledge, patient participation, and the role of health workers in involving patients in preventing SSIs.

The aim of this integrative review was to provide an overview of scientific literature on patient knowledge, patient participation, and the role of health workers in involving patients in the prevention of SSIs. This review is anticipated to help patients and health workers in collaborating to prevent SSIs.

Methods

Research on patient involvement in SSI prevention has been widely conducted. This research specifically focuses on patient knowledge, patient participation, and the role of health workers, in involving patients in preventing SSIs. In this review, we specifically focused on examining:

a. Patients' knowledge about SSI prevention,

b. Patient participation in SSI prevention,

c. Role of health workers in involving patients in SSI prevention.

Search strategy

This study used Whittemore and Knafl's (17) integrative review method, which is similar to our previous studies of Cooper (18) (19-21), to increase its accuracy. Integrative reviews enable the synthesis of diverse research designs, thereby providing a comprehensive understanding of a phenomenon. To ensure the accuracy of article search, this review was conducted following the PRISMA 2020 guidelines (22).

A literature search was conducted across six databases online in December 2023. The keywords used for five of these databases (Scopus, PubMed, ClinicalKey, ProQuest, and CINAHL) were "patient knowledge," "patient participation," "patient engagement," "prevention," "reduce," "minimize," and "SSI." For the Garuda database, the keywords "patient knowledge," "patient participation," "patient involvement," "prevention," "reducing," and "SSIs" were used. Garuda is an Indonesian database recommended by the Indonesian Ministry of Education, Culture, Research and Technology.

The inclusion criteria were as follows: 1) articles published in English or Indonesian, 2) original research, 3) published within the last 10 years (between 2014 and 2023), 4) research focused on patient knowledge and patient participation in SSI prevention, and 5) studies involving research subjects aged 18 years and older. The exclusion criteria were as follows: 1) review studies, 2) studies focused on instrument development, and 3) unpublished research.

Data extraction and quality assessment

Article searching was initiated by entering keywords into the databases. The identified articles were then sorted to remove duplicates. Subsequently, articles that met the eligibility criteria were selected. Articles with full text available were carefully reviewed to see if they met the inclusion or exclusion criteria. The selected articles were then subjected to an integrative review process (Figure 1).

In integrative reviews, quality evaluation is not mandatory. However, conducting an assessment can support the interpretation of study results. Two authors assessed the selected articles to determine their appropriateness for inclusion and interpretation in the integrative review. The 10 selected studies were critically appraised for quality using an instrument created by Bowling (23). The ratings were recorded in a table using a scale of "Yes" "Not reported" and "Poor" for evaluation. The evaluation results were used to assess the quality of the selected articles (23). This quality evaluation approach was selected for its relevance in assessing both quantitative and qualitative studies. Based on the evaluation, all 10 studies were determined to be of high quality. Consequently, it was decided that the selected articles met the required quality standards for inclusion in the review (Table 1).

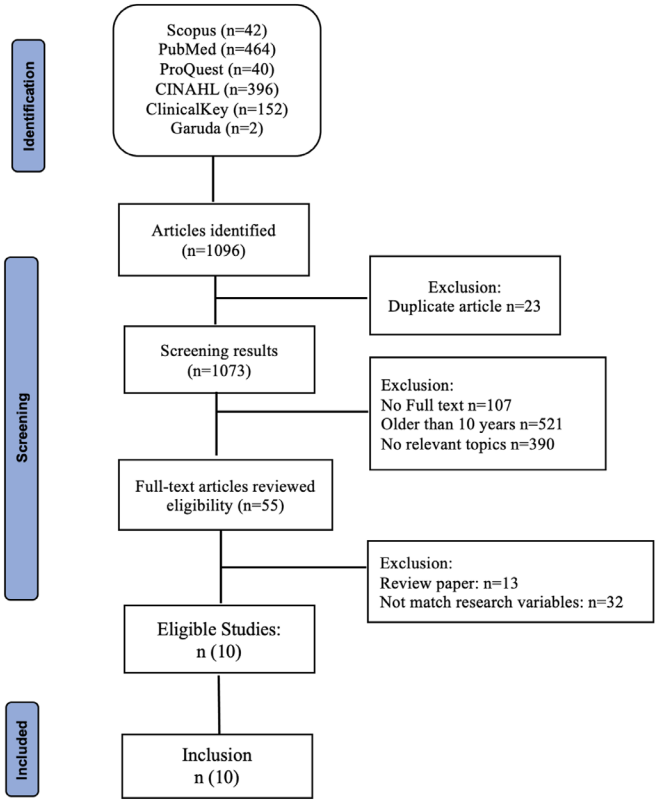

Figure 1. Prisma flow diagram

After quality evaluation, data analysis was conducted in several stages. First, the data were reduced by grouping, extracting, simplifying, and organizing the data into a framework, which was then analyzed sequentially (Table 2). Next, the data were compared and re-examined to reveal patterns, themes, and correlations. Similar data were regrouped, compared, and aligned. The final stage of data analysis involved verifying the data source to ensure its accuracy before drawing any conclusions.

Results

Ten articles were thoroughly examined and carefully synthesized to draw conclusions from research on patient knowledge, patient participation, and the role of health workers in involving patients in the prevention of SSIs. These 10 studies were conducted in various parts of the world, including the US (n=2) (13,24), Spain (n=1) (25), Nigeria (n=1) (26), Germany (n=1) (14), Brazil (n=1) (10), Japan (n=1) (27), Netherlands (n=1) (28), China (n=1) (29), South Africa (n=1) (11), and India (n=1) (11). These 10 articles comprised seven quantitative research articles and three qualitative research articles.

Table 1. Quality appraisal

Authors	Goals are clear explained	Study design explained	Appropriate research method	Adequate description, sample, and exclusion criteria	Ethics presented	Results are clearly reported	The results are in accordance with the study questions and literature	Limitations presented	Implications discussed	Value/level
Elia-Guedea et al. (25)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Oliveira et al. (10)	Yes	Not reported	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/9 High
Sanger et al. (13)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Brisibe et al. (26)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Kawabata et al. (27)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not reported	Yes	8/9 High
Yao et al. (29)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Kluytmans (28)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Mullen et al. (24)	Yes	Yes	Yes	Poor	Yes	Yes	Yes	Yes	Yes	8/9 High
Nampoothiri et al. (11)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Voigt et al. (14)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High

Table 2. Data extraction

Author	Year/ Country	Research purposes	Method	Instrument	Sample/Setting	Patient knowledge	Patient participation	The role of healthcare workers in patient involvement
Nampoothiri et al. (11)	2023/ South Africa and India	To explore the impact of patient participation, understand cultural differences in care, and discuss antibiotic use	Qualitative (grounded theory approach)	Semi-structured interview	-/Specialist adult gastrointestinal and cardiovascular and thoracic surgery at a tertiary academic referral hospital in South Africa (site A) and India (site B)	The need to understand and acknowledge patients' knowledge and expertise in their own care, the potential benefits of face-to-face educational/ counseling sessions for patient education	Antibiotic decision making	1. Encourage patient involvement 2. Provide psychosocial support 3. Education about infection prevention and control
Sanger et al. (13)	2014/USA	To investigate the experience of surgical site infection patients regarding mobile applications as a solution to the problem of identifying and managing post-surgical wound complications	Qualitative	Surveys and semi-structured interviews	13/Two affiliated teaching hospitals, including an academic medical center and a level 1 trauma center, as well as two University of Washington general surgery clinics	1. Knowledge of wound care and monitoring after discharge from hospital 2. Not receiving adequate information or education 3. The patient's inability to process and retain the information provided.	Patients are actively involved by sharing their experiences and providing input on care practices after hospital discharge	Provision of accessible communication and timely responses to patient concerns, active involvement of patients in post-discharge care
Elia-Guedea et al. (25)	2017/ Spain	To assess the effectiveness of a series of simple preventive measures in reducing the risk of infection at the surgical site of the colon and rectum	Quantitative (comparative studies)	SSI's CDC Criteria	-/BClinico Hospital Colorectal Unit Universitario Lozano Blesa in Zaragoza	-	-	Increasing awareness through information and training sessions, ensuring appropriate administration of antibiotics, fostering teamwork
Brisibe et al. (26)	2014/ Nigeria	To assess the impact of implementing infection control policies on the knowledge, attitudes and practices of health workers	Quantitative (cross-sectional)	Semi-structured questionnaire derived from WHO, CDC guidelines and similar published studies	-/Caesarean section patients at the University of Port Harcourt Teaching Hospital and Braithwaite Memorial Specialist Hospital in Port Harcourt, Nigeria	-	-	Providing personal hygiene education before and after surgery

Table 2. Data extraction

Author	Year/ Country	Research purposes	Method	Instrument	Sample/Setting	Patient knowledge	Patient participation	The role of healthcare workers in patient involvement
Voigt et al. (14)	2022/ Germany	To investigate the level of interest and need for information on infection prevention and control among patients undergoing elective total endoprosthesis	Qualitative	Structured and standardized personal interviews	425/University Hospital Gottingen in Germany	The level of patient knowledge needs to be improved, with the great need for advice and information regarding infection prevention and control	The patient participation rate in this study was 38.4%, Empowering patients in infection prevention and control, which emphasizes the need for patients to receive appropriate advice and information	Empower patients by providing appropriate advice and information, tailored to their specific needs and conditions
Oliveira et al. (10)	2023/ Brazil	To analyze the perceptions of patients and health workers regarding patient participation in SSI prevention	Quantitative (cross-sectional study)	A questionnaire with a Likert scale format that covers various domains related to patient participation in SSI prevention for both patients and health workers	123/Postoperative patients and 92 healthcare professionals/two hospitals in São Paulo, Brazil	The patient's level of knowledge is emphasized as crucial in the prevention and control of SSI with a focus on understanding their role, acquiring knowledge, and developing skills for active participation	1. Active involvement, shared responsibility	1. Active communication with patients
							2. Patient collaboration in understanding and managing the perioperative process	2. Provide education
							3. Involves shifting from a passive role to an active collaborator	3. Support for patient participation
								4. Facilitate patient empowerment through training and innovative strategies

Table 2. Data extraction

Author	Year/ Country	Research purposes	Method	Instrument	Sample/Setting	Patient knowledge	Patient participation	The role of healthcare workers in patient involvement
Kawabata et al. (27)	2023/ Japan	To assess the impact of hospital participation in the JANIS program on SSI prevention	Quantitative (retrospective before-after observational study)	JANIS program, JANIS database, and standardized model infection ratio (SIR)	157.343/Acute care hospitals in Japan	-	-	1. Educate patients 2. Involving patients in infection monitoring programs to increase patient awareness and participation
Mullen et al. (24)	2017/USA	To investigate the impact of additional perisurgical nasal decolonization involving patients and surgical and nursing staff	Quantitative	Not specifically stated. Data was taken from patient records	1,073 patients/Orthopedic and surgical treatment centers	Use of antiseptics after discharge from hospital	Patient participation was high in nasal decolonization at 95% during the 15-month trial period	1. Actively encourage and systematically record voluntary self-decolonization 2. Encourage compliance with decolonization procedures
Kluytmans (28)	2023/ Netherlands	To develop an automated surveillance system for healthcare-associated infections to reduce the risk of post-surgical disease	Quantitative (case- control, studies cross-sections al and studies observational	-	5004 patients/hospitals in the Netherlands	Historical understanding and rediscovery of the impact of nasal transmission of *S. aureus* on post-surgical infections and implementation of preventive interventions and current practices regarding decolonization	Multicenter trials, as well as being recipients of intranasal applications perioperative	-
Yao et al. (29)	2021/ China	To understand the factors that influence patient participation behavior in the prevention and control of surgical site infections (SSI) in colorectal cancer patients	Quantitative (cross-sectional studies)	Survey questionnaire	580 patients/a gastrointestinal surgical ward at a university-affiliated tertiary hospital in shongqing, China	Level of awareness and understanding of SSI-related knowledge	Revealed that participation intention had the largest total effect among the factors influencing CRC patients' participation in SSI prevention and control behavior	1. Encourage patient participation 2. Support their involvement in medical services 3. Build trust 4. Facilitate health service decision making

JANIS: The Japanese Nosocomial Infection Surveillance, SSI: Surgical Site Infection, CRC: Colorectal Cancer, ASA: American Society of Anesthesiologists, USA: United States of America, WHO: World Health Organisation

Patient knowledge about preventing surgical site infections

Among the 10 articles analyzed, 7 discussed patient knowledge in preventing infections (10,11,13,14,24,28,29). The majority of the articles indicated that patients need knowledge (11,14) and understanding of the disease (14,29), wound care process (13), and the use of antibiotics (11) to prevent SSIs. This knowledge should be provided through information and education while the patient is in the hospital and even after they have been discharged and return home.

Patient participation in preventing surgical site infections

Seven of the articles included in this study explicitly mention the need for active participation of patients in efforts to prevent SSIs (10,11,13,14,24,28,29). Active patient participation can help prevent SSIs (11,27,28). This participation includes empowering patients (14), monitoring surgical wounds (13), changing passive roles to active collaborators (10), participating in the use of antiseptics and antibiotics, and taking an active role in decision-making for infection prevention and control (11).

Role of health workers in involving patients in preventing surgical site infections

Overall, the articles analyzed provide several methods for health workers to involve patients in SSI prevention. These include providing easily accessible communication (13), providing information and education (10,11,14,25-27), empowering patients (14), encouraging patient compliance with infection prevention protocols (24), and supporting patient involvement in decision-making regarding prevention and control of SSIs (11,13,27,29).

Discussion

This integrative review aimed to provide an overview of patient knowledge, patient participation, and the role of health workers in involving patients in preventing SSIs.

Patient knowledge about preventing surgical site infections

This review discusses the importance of educating patients about their illness, wound care, and infection prevention. According to the SSI prevention guidelines from the WHO (4), patients are motivated to learn about optimal medical practices and typically adhere to recommendations from health professionals. Research indicates that the patient's knowledge about hygiene, application of prophylactic antibiotics, and postoperative wound care can contribute to SSI prevention (26). Increasing patient knowledge can facilitate the implementation of infection prevention protocols by helping patients understand healthcare workers' efforts to prevent SSIs. Therefore, it is crucial for healthcare workers to educate patients about preventing SSIs.

Patient participation in preventing surgical site infections

Most studies included in this review emphasize the need for active patient participation in efforts to prevent SSIs. This active participation involves empowering patients, monitoring surgical wounds, and collaborating with patients to prevent and control SSIs. Although several SSI prevention guidelines (1,4,30) do not specifically mention the importance of patient participation in SSI prevention, recent studies have shown that patient participation in efforts to prevent SSIs can reduce the risk of infection, accelerate patients' recovery, lower treatment costs, and improve compliance with SSI prevention measures (10). Shifting the patient's role from passive to active participant alongside healthcare workers is crucial in efforts to prevent SSIs. Therefore, healthcare workers should strive to actively involve patients in SSI prevention.

Role of health workers in involving patients in preventing surgical site infections

In this discussion, the roles of health workers in involving patients in SSI prevention is analyzed. This includes providing adequate information and education, optimal communication between patients and healthcare workers, and involving patients in decision-making regarding procedures and strategies for preventing SSIs. It was noted that various SSI prevention guidelines (1,4,30) did not mention the role of healthcare workers in involving patients in SSI prevention. However, healthcare workers play a vital role in increasing patient involvement in efforts to prevent SSIs by utilizing educational strategies, such as conveying information through video and via pamphlets, to provide knowledge to patients before and after surgery. Emphasizing the importance of educating and informing patients about the evaluation of butyrylcholinesterase levels is crucial, as these levels have been shown to be associated with the risk of developing SSIs (31). In addition, providing training to healthcare workers is crucial to ensure that patients can be actively involved in perioperative patient care (10). The role of perioperative healthcare workers, which has so far been limited to preparing patients, medical equipment, and a sterile environment to prevent SSI, can be developed into a collaborative role with patients, to reduce morbidity and mortality due to surgical complications.

Implications

To prevent SSIs, it is important for patients to have good knowledge about infection prevention. This can increase patient participation alongside health workers, in implementing efforts to prevent SSIs. Patient knowledge can be enhanced by providing information and education as well as effective means of communication with health workers. This change can shift the role of the patient from a passive to an active, increasing the patient's participation and involvement in decision-making in

efforts to prevent infection. Active patient involvement can help health workers in their efforts to prevent SSIs.

Although this review has identified heterogeneous studies, there is still a lack of original research specifically focusing on patient knowledge and participation in preventing SSIs. More related original research articles are needed to address this gap. Furthermore, this review only considered studies published in English and the Indonesian language, so there may be relevant studies published in other languages that were not included.

Conclusion

This integrative review carefully analyzed various studies that examined patient knowledge, patient participation, and the role of health workers in involving patients in preventing SSIs. This review is fundamental in providing health workers with an overview of the importance of meeting patients' needs for knowledge about preventing SSIs through optimal education and communication strategies. Adequate patient knowledge can increase patient participation in infection prevention by empowering them to monitor surgical wounds, use antibiotics, and make decisions related to preventing SSIs. Healthcare workers can help involve patients in preventing SSIs by providing access to information and education, communicating effectively, empowering patients, and providing adequate support and motivation. Success in preventing SSI will in turn accelerate patient's recovery, lower treatment costs, and improve quality of life. This understanding will then help patients and health workers in developing appropriate strategies to prevent SSIs collaboratively.

Footnotes

Authorship Contributions

Surgical and Medical Practices: J.M., A.M.I., Concept: A.M.I., Design: J.M., A.M.I., Data Collection or Processing: J.M., A.M.I., Analysis or Interpretation: J.M., A.M.I., Literature Search: J.M., Writing: J.M.

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Blind vs. hysteroscopy-guided endometrial biopsy for endometrial pathologies

Şule Atalay Mert, Ahmet Kurt, Tuğba Kınay, Burcu Gündoğdu Öztürk, Hüseyin Levent Keskin

Ankara Etlik City Hospital, Clinic of Obstetrics and Gynecology, Ankara, Türkiye

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Corresponding Author:
Şule Atalay Mert, M.D., Ankara Etlik City Hospital, Clinic of Obstetrics and Gynecology, Ankara, Türkiye
drsuleatalay@hotmail.com

ORCID:
orcid.org/0000-0002-5711-3933

Keywords: Hysteroscopy guided biopsy, blind biopsy, abnormal uterine bleeding, endometrial thickness, endometrial pathologies

ABSTRACT

Aims: The trend toward minimally invasive methods over basic classical techniques in surgical procedures is rapidly increasing. This study aimed to evaluate the sensitivity of blind biopsy (BB) vs. hysteroscopy-guided biopsy (HGB) for diagnosing malignancy in patients with endometrial pathology.

Methods: This retrospective study included patients who underwent a BB (Group BB) and HGB (Group HGB) because of persistent uterine bleeding or unaltered ultrasonography findings after the initial biopsy at a tertiary facility from October 2022 through July 2023. Patients with a known history of malignancy were excluded. The primary objectives were to compare the performance of the two procedures and calculate a cut-off of endometrial thickness (ET) for a malignancy diagnosis.

Results: The study included 150 patients (mean age: 46.20±11.26 years in Group BB and 46.98±9.77 years in Group HGB, p=0.520). The frequency of endometrial polyps was higher in group BB (61.3% vs. 35.3%, p<0.001), whereas functional endometrium was more frequent in group HGB (41.2% vs. 22%, p<0.001). Mean ET was similar in the two groups (Group BB vs. Group HGB: 11.21±4.96 mm vs. 10.31±5.63 mm, p=0.150). The cut-off of ET in predicting endometrial malignancy was 12.5 mm with a sensitivity of 75% and specificity of 74.6% [area under the curve: 0.775, 95% confidence interval: 0.615-0.935; p=0.009].

Conclusions: The presented study showed no difference between HGB and BB in identifying benign endometrial pathologies. A cut-off of 12.5 mm ET was determined to predict malignancies, though the event rate was low to perform robust calculations.

Introduction

Abnormal uterine bleeding (AUB) is the deviation from the normal menstrual cycle, encompassing changes in the frequency, amount, and duration of menstrual bleeding (1). AUB is a significant gynecological complaint, affecting approximately 30% of women of reproductive age and approximately 70% of the perimenopausal and postmenopausal periods (2). The etiology, diagnosis, and treatment of AUB often involve an endometrial biopsy (EB), a routine procedure in gynecology clinical practice. AUB significantly impairs quality of life and can be effectively treated with methods that offer practical usage advantages, such as the levonorgestrel-releasing intrauterine device. Consequently, non-invasive methods for diagnosing benign endometrial pathologies, such as endometrial polyps causing bleeding, are particularly advantageous (3).

Various methods are employed to evaluate the endometrial pathologies, including blind biopsy (BB) with vabra aspiration, Tao brush, SAP-1 brush sampler, Pipelle, Karman cannula aspiration, and hysteroscopy-guided biopsy (HGB). Endometrial aspiration for histopathological analyses is a safe, minimally invasive, and reliable office endometrial sampling (OES) procedure with minimum discomfort to the patient (4).

A hysteroscopic biopsy is preferred in conditions like endometrial polyps or fibroids because the biopsy can be performed with direct visualization (5).

Although numerous studies have compared the histopathology results of BB and HGB, their success in diagnosing malignancies and the outcomes of insufficient biopsies need to be evaluated on an individual basis (6). It remains unclear whether HGB is superior to BB in detecting endometrial diseases, endometrial cancer, and endometrial hyperplasia (EH) with or without atypia (7). Therefore, this study examined the biopsy results of BB or HGB in endometrial pathologies and their sensitivity and specificity in diagnosing a malignant disease.

Methods

Design, setting, and study population

This retrospective observational study was conducted at a tertiary gynecology clinic in Türkiye from October 2022 through July 2023. Women aged 30 years who underwent BB or HGB due to endometrial pathology were included. Patients with incomplete records or a history of malignancy, follow-up at another center, or other biopsy techniques such as only pipelle biopsy or sharp curettage were excluded. The study was conducted following the ethical principles outlined in the Declaration of Helsinki, developed by the World Medical Association and adopted in 1964. The study was approved by the Ankara Etlik City Hospital Non-Interventional Clinical Research Ethics Committee (decision number: 546, date: 27/09/2023).

The data was collected using the medical records in the hospital registry. The study hospital uses an established protocol for endometrial pathologies. Women aged 30 years or older with an endometrial pathology [endometrial polyp, postmenopausal bleeding, or postmenopausal endometrial thickness (ET) greater than 4 mm] (8-11) undergo BB with Karman cannula aspiration. HGB is performed in persistent AUB despite EB or when there is no improvement in the initial ultrasonography findings during the 2nd or 3rd-month follow-up after BB.

We divided the patients who underwent a biopsy into two groups. Group BB included patients who underwent blind BB, and Group HGB included patients who underwent HGB because of persistent AUB or no alterations in ultrasonography findings despite BB.

Biopsy procedure

All BBs were performed under local anesthesia via Karman cannula aspiration. The Pipelle was used only in postmenopausal patients or patients with a narrow internal os. All HGBs were performed using a rigid 30-degree optic, 4-mm diameter Ackerman (Eisenbahnstraße 65-67, 78604 Rietheim-Weilheim, Germany) hysteroscope. Fluid distension was achieved using an Endomat (Ackermann HysSurgiSystem, Germany) at a pressure of 150 mm Hg as part of the routine protocol.

Statistical Analysis

All analyses were performed using SPSS software for Windows (version 28.0; IBM Corp, Armonk, NY.). The Shapiro-Wilk test was used to test the normality of the data distribution. Student t-test was used to compare normally distributed variables in the two groups. Non-normally distributed variables were compared using the Chi-square test. Variables were presented as mean ± standard deviation or percentage as appropriate. A p-value of less than 0.05 was considered statistically significant.

Power analysis (G-Power 3.0.0.1) determined that a minimum of 146 cases per group was required to achieve 95% power with a 5% margin of error and an effect size of 0.42 (12).

Results

Sociodemographic findings

The study included three hundred patients. The mean age in Group BB (n=150) and Group HGB was 46.20±11.26 years and 46.98±9.77 years, respectively (p=0.520). Demographic characteristics were similar in the two groups. There were 24.7% (n=37) postmenopausal women subjects in Group BB and 29.3% (n=44) in Group HGB. There was no difference in menopause duration (11.18±7.26 months vs. 11.32±7.80 months, p=0.932) between the two groups. The body mass index (29.26±5.37 kg/m^2 vs. 29.93±4.29 kg/m^2, p=0.230) and obstetric history (gravida, parity, abortion, live children) were similar in the two groups. There was also no between-group difference in ET (11.21±4.96 mm vs. 10.31±5.63 mm, p=0.150) (Table 1).

Histopathological findings

The histopathology results showed no significant differences between the groups in the rates of non-atypical hyperplasia (AH) [2.7% (n=4) vs. 6% (n=9), p=0.156] or malignancy [4% (n=2) vs. 6% (n=8), p=0.054]. No patient was diagnosed with AH. The rate of endometrial polyp was higher in Group BB at 61.3% (n=92) compared to 35.3% (n=53) in Group HGB, with p<0.001. Additionally, functional endometrium was more common in Group HGB at 41.2% (n=61) versus 22% (n=33) in Group BB, with p<0.001 (Table 2).

Patients with a malignancy report

The mean age of patients with malignant biopsy results (MBR) was 65.5±3.54 years in Group BB and 52.5±13.76 years in Group HGB (p=0.035). The rate of MBR was similar in the two groups [5.3% (n=8) vs. 1.3% (n=2)], and all patients with MBR were older than 50 years.

We determined an ET cut-off of the endometrial malignancy diagnosis. Ten patients (3.33%) had a malignancy, including

Table 1. Basic characteristics

	Group BB	Group HGB	p
Age, years, mean ± SD	46.20±11.26	46.98±9.77	0.522
BMI, kg/m²	29.26±5.37	29.93±4.29	0.231
Day of the cycle, mean ± SD	11.7±3.35	12.49±3.79	0.085
Gravidity, mean ± SD	2.76±1.58	3.01±1.47	0.152
Parity, mean ± SD	2.34±1.24	2.61±1.12	0.052
Abortion, mean ± SD	0.40±0.93	0.39±0.77	0.892
Live children, mean ± SD	2.30±1.24	2.56±0.14	0.059
Endometrial thickness, mm, mean ± SD	11.21±4.96	10.31±5.63	0.145
Menopause duration, months, mean ± SD	11.18±7.26	11.32±7.80	0.812
Post-menopausal status, n (%)	44 (29.3%)	37 (24.7%)	0.363
Age of patients with MBR, years, mean ± SD	65.5±3.54 (n=2)	52.5±13.76 (n=8)	0.035

BB: Blind biopsy, HGB: Hysteroscopy-guided biopsy, BMI: Body mass index, MBR: Malignant biopsy result

Table 2. Comparison of histopathology results between the two groups

	Group BB (n=150)	Group HGB (n=150)	p
Endometrial polyp, n (%)	92/150 (61.3)	53 (35.3)	**<0.001***
Non-atypical hyperplasia, n (%)	4/150 (2.7)	9/150 (6)	0.156
Malignancy, n (%)	2/150 (1.3)	8/150 (5.3)	0.054
Functional endometrium, n (%)	40/150 (26.7)	67/150 (44.7)	**<0.001***
Myoma uteri, n (%)	12/150 (8)	13/150 (8.7)	0.835

BB: Blind biopsy, HGB: Hysteroscopy-guided biopsy

endometrial intraepithelial neoplasia and endometrial carcinoma (EC). Nevertheless, the small malignant sample (n=2) size in Group BB made it impossible to perform receiver operating characteristic (ROC) analysis. In Group HGB, ROC analysis was significant for the eight malignancy diagnoses. For the entire population, an ET cut-off of 12.5 mm demonstrated a sensitivity of 75.0% and a specificity of 74.6% in predicting malignancy [area under the curve: 0.775, 95% confidence interval (CI): 0.615-0.935; p=0.009]. The analysis could not determine a relevant cut-off in the premenopausal and postmenopausal women subgroups.

Discussion

This study showed that HGB is not superior to BB in detecting malignancies or other endometrial pathologies. Although there was no difference in malignancy and AH between Group BB and Group HGB, functional endometrial histopathology results were significantly higher in Group HGB.

There is no clear consensus on the techniques for EB to determine the etiology of AUB or increased postmenopausal ET (13). However, in recent years, there has been a growing preference for minimally invasive and cost-effective methods (13). A study comparing direct and flexible hysteroscopy sampling found no difference in the adequacy of tissue samples for diagnosing endometrial pathologies and did not demonstrate the superiority of flexible hysteroscopy (14).

Another study compared preoperative direct hysteroscopic visualization via the grasping technique with the preoperative Novac curette technique to assess the sensitivity of postoperative histopathology (15). The authors compared 121 patients who underwent preoperative blind Novac EB with 129 patients who underwent hysteroscopy. The HGB technique was successful in determining histological tumor type [diagnostic accuracy (0.922 vs. 0.890); k value (0.705 vs. 0.642)] and grade in the presence of endometrioid-type EC (K Cohen 0.354 for G1 and 0.263 for G2 (15). In the presented study, the number of patients diagnosed with MBR was low; 2 of 10 patients with a malignant pathology result were in Group BB (1.3%), and the remaining eight subjects were in Group HGB (5.3%). There was no difference between the groups regarding malignancy, while benign endometrial pathologies were more common in Group BB.

A previous study found that the sensitivity of HGB for diagnosing endometrial polyps ranged from 35.3% to 36.8% when performed at the apex and base of the lesions, while the sensitivity of BB was 29.2% (12). OES had lower diagnostic accuracy for endometrial polyps than surgical polypectomy specimens (12). Pehlivan et al. (16) found higher rates of endometrial polyp

(46.9% vs. 26.5%) and submucous fibroid (4.8% vs. 1.2%) diagnoses in women who underwent hysteroscopy compared to those who underwent probe curettage. In the presented study, endometrial polyp diagnosis was more common in Group BB. A functional endometrium finding was more frequent in Group HGB. Small endometrial polyps removed easily with BB could be the cause of our different findings from previous reports. However, we have no data about the size of endometrial polyps. Researchers need to conduct studies with more detailed data to confirm this assumption.

Various BB techniques exist in gynecology practice (17). Karman cannula aspiration is practical and yields good specimen quality (17). The microscale endometrial sampling biopsy (microscale) is a different minimally invasive technique used to obtain adequate endometrial samples for histopathology, with adequate sampling in 81.2% of subjects (18). Specimen adequacy is associated with age, menopausal status, ET, and endometrial lesion type (18). Additionally, the microscale shows strong agreement with HGB in distinguishing benign and malignant endometrial diseases (kappa 0.950, 95% CI: 0.925-0.975) (17). A study comparing post-hysterectomy AH or EC diagnoses reported a 72% specimen adequacy rate in the direct OES and HGB group (6). On the other hand, HGB improved diagnostic accuracy when preoperative OES was inadequate to determine AH or tumor type and grade. However, when OES yields a diagnosis of grade 1-2 endometrioid tumors, further HGB may provide limited benefits (6). In the current study, the specimen adequacy rate for endometrial polyps, myoma uteri, and malignancy was 73.3% (n=110) in Group BB and 55.3% (n=83) in Group HGB, with no statistically significant difference between the two groups.

In a study evaluating BB results, the most common histopathology report was normal cyclical changes, and malignant lesions were more frequent in patients over 50 (19). In the presented study, compared to the HBG group, the most common histopathology results in the BB group were endometrial polyps and normal cyclical changes. The mean age of patients in both groups diagnosed with MBR was above 50 years. Additionally, the mean age of patients with malignancy diagnosis in the BB group was significantly higher than in the HGB group.

While American College of Obstetricians and Gynecologists does not recommend biopsy for ET less than 4 mm, a thickened endometrium (>4 mm) in a postmenopausal woman with postmenopausal bleeding, detected via transvaginal ultrasonography, warrants further evaluation with endometrial sampling (9). In postmenopausal bleeding, a negative tissue biopsy following “blind” endometrial sampling is not considered a definitive endpoint. Therefore, hysteroscopy is essential to examine the endometrial cavity and rule out focal disease (9). However, studies report different cut-off values for ET. One study reported an optimal cut-off of 8 mm for detecting AH and EC in asymptomatic postmenopausal women, with a sensitivity of 84.6% and specificity of 60.9%. In the current study, the cut-off of ET related to malignant disease was 12.5 mm, with a sensitivity of 75.0% and a specificity of 74.6%. The differing results may be due to the distinct inclusion criteria implemented in the studies. The presented study included all symptomatic women and asymptomatic postmenopausal women with an ET greater than 4 mm.

As a result, many studies have focused on the differences between EB methods. However, a clear cut-off of ET has not yet been established. BB may be the first choice for an effective, non-invasive, and cost-effective EB method for non-malignant endometrial pathologies. When BB fails, HGB may be recommended. In this context, HGB may be preferred for patients over 50 years old and those with suspected malignancy.

This study has several limitations. Due to its retrospective design, maintaining consistent data quality throughout was not possible. Another limitation was the small sample size, which made it difficult to analyze outcomes with low event rates. Additionally, we were unable to compare our findings with hysterectomy results.

Conclusion

This study showed no difference between BB and HGB in detecting malignancy or other endometrial pathologies. It can be concluded that BB should be prioritized as an effective, non-invasive, and cost-effective endometrial biopsy method for non-malignant endometrial pathologies, and HGB can be recommended when BB fails. HGB may be preferred in patients aged >50 years with suspected malignancy.

Ethics

Ethics Committee Approval: The study was approved by the Ankara Etlik City Hospital Non-Interventional Clinical Research Ethics Committee (decision number: 546, date: 27/09/2023).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Ş.A.M., H.L.K., Concept: Ş.A.M., T.K., Design: T.K., B.G.Ö., Data Collection or Processing: A.K., B.G.Ö., Analysis or Interpretation: Ş.A.M., T.K., Literature Search: Ş.A.M., Writing: Ş.A.M., H.L.K.

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The prevalence and outcomes of inflammatory bowel disease among patients with cytomegalovirus disease

Zehra Karacaer[1], Cemal Bulut[1], Gonca Fidan[1], Gürkan Çelebi[2]

[1]University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Infectious Diseases and Clinical Microbiology, Ankara, Türkiye

[2]University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Gastroenterology, Ankara, Türkiye

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Corresponding Author:
Zehra Karacaer, M.D., Assoc. Prof., University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Infectious Diseases and Clinical Microbiology, Ankara, Türkiye
zehrakaracaer@yahoo.com

ORCID:
orcid.org/0000-0002-2658-4679

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ABSTRACT

Aims: Cytomegalovirus (CMV) colitis in individuals with inflammatory bowel disease (IBD) is a serious condition. The present study evaluated the prevalence and outcome of IBD-CMV colitis among patients with CMV disease.

Methods: We performed a retrospective study to evaluate the patients with IBD and CMV colitis between January 1, 2017, and December 31, 2022. We identified IBD-CMV colitis based on the presence of CMV in tissue or a polymerase chain reaction (PCR) result of ≥1000 copies/mL with no other clinical explanations. The frequency of IBD-CMV colitis, relapse rate, requirement of surgical interventions, and associated mortality were assessed.

Results: Out of 163 patients with CMV disease screened, 28 (17.2%) were diagnosed with CMV colitis and IBD [median age: 54 (19-67) years, male: 77%]. The frequency of ulcerative colitis and Crohn's disease was 93% and 7%, respectively. Most CMV PCR assays (97%) were performed using serum, whereas the remaining tests were performed using serum and tissue samples. CMV was not detected via immunohistochemistry or hematoxylin-eosin staining in any patient. Antiviral treatment was initiated in 74% of the patients and lasted a median of 20 days (6-32 days). No surgical interventions or disease-related deaths were identified.

Conclusions: This electronic medical records study showed that IBD-CMV colitis was a rare disease among patients with CMV disease and generally followed a favorable course.

Introduction

Cytomegalovirus (CMV) is a virus classified within the Betaherpesvirinae subgroup of the Herpesviridae family. It is primarily known for causing asymptomatic infections. Following primary infection, CMV can establish latency within the host and reactivate in response to various stimuli. In healthy individuals with an intact immune system, CMV does not typically cause significant complications. However, the virus can lead to multiorgan dysfunction in individuals with compromised immune systems. Additionally, CMV is associated with several diseases linked to chronic inflammation, including coronary artery disease, exacerbations of inflammatory bowel disease (IBD), multiple sclerosis, certain cancers, and immunosenescence in older people (1).

Patients with CMV infection may exhibit signs and symptoms associated with the disease. The colon is one of

the target organs affected by the CMV disease (2). CMV colitis occurs in approximately 0.05-10% of patients with active IBD. Although a definitive correlation between Crohn's disease and CMV colitis does not exist, CMV colitis is often observed in patients experiencing severe or steroid-refractory ulcerative colitis (UC) (3-6). Whether CMV is a causative factor for UC exacerbations remains to be clearly defined (7). Moreover, numerous studies have identified CMV colitis as a significant risk factor for cases of UC that do not respond to steroid treatment (8,9).

Patients diagnosed with CMV and IBD receive treatment and follow-up care. However, the available data regarding the prevalence of IBD-CMV colitis is sparse in the local context. Accordingly, this study aimed to evaluate the burden and outcomes of IBD-CMV colitis among patients experiencing CMV disease.

Methods

Study design

This study was conducted in a tertiary care hospital and retrospectively evaluated patients who presented with steroid-refractory IBD exacerbation and CMV colitis between January 1, 2017, and December 31, 2022. Patients with IBD-CMV colitis were identified from diagnoses of CMV disease in the Department of Infectious Diseases and Clinical Microbiology. The study was approved by the University of Health Sciences Türkiye, Gülhane Training and Research Hospital of Local Ethics Committee (decision no: 2022/96, date: 17.05.2023). The study protocol conforms to the Declaration of Helsinki and good clinical practice guidelines.

Inclusion and exclusion criteria

The study included female and male patients aged 18 years and older who presented to the infectious disease and clinical microbiology clinic and outpatient department with steroid-refractory IBD exacerbations. Eligible participants exhibited the following criteria: Negative blood and stool cultures, histopathological evidence of CMV, serum or tissue CMV polymerase chain reaction (PCR) ≥1000 copies/mL, and no indications of *Clostridium* difficile or *Entamoeba histolytica* infections. Patients younger than 18 years, with an identified colitis pathogen, having serum CMV PCR <1000 copies/mL, or with insufficient information in the electronic medical records were excluded.

Data collection

We used the inpatient and outpatient records to obtain data on demographic characteristics, primary diagnoses and treatments, symptoms at admission, interventions, culture results, stool analyses, serum and tissue CMV PCR levels, colonoscopy findings, and biopsy reports.

Criteria for cytomegalovirus colitis

The case definition was based on a consensus report on the diagnosis and treatment of CMV in Türkiye (10). This report recommends antiviral therapy in symptomatic patients with IBD based on a CMV PCR test or biopsy result (10). The criteria for CMV colitis used in this study were evidence of CMV in tissues (8) or detection of CMV PCR ≥1000 copies/mL in serum or tissue (11) with no other causes explaining the clinical course.

Criteria for treatment termination

The criteria for terminating the CMV colitis treatment in the clinic where the present study was performed included weekly virologic assessment by serum CMV PCR test. Treatment continued until the initial clinical symptoms and CMV viremia were resolved (12).

Prognosis assessment

A relapse was defined as a CMV colitis within 3 months after remission. Colitis beyond 3 months was regarded as a new episode and included in this study (12). CMV-associated surgery was defined as any intestinal surgical procedure conducted within 6 months of a confirmed diagnosis of CMV colitis (5). Death within six weeks after CMV colitis that could not be explained by other causes was classified as CMV-related mortality (13).

Study endpoints

The primary objective of this study was to evaluate the prevalence of IBD among patients experiencing CMV disease. For this purpose, we explored the underlying disease in patients with CMV disease. The secondary endpoints were the rates of relapse, surgical intervention, and mortality related to poor prognostic outcomes in patients with IBD and CMV colitis.

Statistical Analysis

The data were analyzed using the IBM SPSS Statistics 22.0 (SPSS Inc, Chicago, IL). The distribution of the data was evaluated using the Kolmogorov-Smirnov test. Categorical variables were presented as frequency and percentage. Continuous variables with normal distribution were presented as mean±standard deviation. Non-normally distributed variables were presented as median (minimum-maximum).

Results

Basic characteristics

We identified 163 patients diagnosed with CMV disease over 6 years. Of them, 28 (17.2%) were classified as CMV colitis in patients diagnosed with IBH. Of the patients with IBH, 93% were diagnosed with UC and 7% with Crohn's disease. The median age was 54 (19 to 67) years and 77% of the patients were male. The median time since IBD diagnosis was 3 months (1-180

months), and the median duration of IBD treatment was 2.5 months (1-180 months). The patients reported diarrhea, bloody diarrhea, and fever by 57%, 37%, and 14%, respectively.

Diagnostic management

CMV PCR assays were performed in serum by 97% and in serum and tissue samples together by 3%. The median serum CMV PCR level was 4260 copies/mL (1000-85200 copies/mL). CMV was not detected by immunohistochemistry and hematoxylin-eosin staining in any biopsy sample in which CMV PCR assay was positive.

Treatment processes

In total, 26% of the patients were not readmitted for antiviral treatment. Antiviral therapy was initiated in 74% of the patients and maintained for an average of 20 days (6-32 days). Adverse effects were noted in 38.5% of the patients, such as anemia (42%), cytopenia (30%), pancytopenia (10%), and thrombocytopenia (10%). No antiviral treatment was modified due to observed side effects.

Prognostic results

No surgical interventions, CMV-related mortality, or relapse were observed during the follow-up period. Notably, only one patient succumbed to complications of Coronavirus disease-2019.

Discussion

CMV colitis is distinguished by diarrhea, fever, and abdominal pain, with approximately 53% of cases presenting as bloody (14). Therefore, clinically differentiating between CMV colitis and IBD exacerbation is challenging. These symptoms, which can complicate clinical distinction, were frequently recorded in the present study.

There are different perspectives on the investigation of CMV colitis during IBD exacerbations. Some experts advise against routine testing for CMV replication, noting that CMV infection is relatively uncommon in active IBD cases (15,16). Maher and Nassar (17) argued that acute CMV infection is often overlooked in patients with IBD and highlighted the need to rule out this infection before initiating aggressive immunotherapy. Similarly, Weng et al. (3) emphasized the importance of routine histopathological examinations and/or CMV PCR tests in patients with refractory colitis. We systematically evaluated CMV colitis in all patients suspected of experiencing IBD exacerbation.

The prevalence of IBD among patients diagnosed with CMV disease remains uncertain. The present 6-year follow-up retrospective study showed that IBD was present in 17.2% of patients with CMV colitis. Unfortunately, this finding cannot be compared with the existing literature because no previous study specifically addressed the prevalence of underlying conditions in this patient population. These findings suggest that IBD is not a frequent underlying condition in individuals experiencing CMV colitis.

A consensus report on CMV diagnosis and treatment in Türkiye determined the definite and high-probability diagnostic criteria for CMV colitis in solid organ transplant recipients (10). The report clarified that the proposed criteria mentioned were inappropriate for use in patients with IBD because of ongoing inflammation. The study also stated that there was no recognized gold-standard diagnostic method for identifying CMV colitis in patients with IBD (10). We defined the cases in the current study using the guidance of the latest consensus report (10).

The sensitivity and specificity of molecular methods for diagnosing CMV colitis can vary significantly. Kredel et al. (18) compared serum CMV PCR, immunohistochemistry, and hematoxylin-eosin staining and found sensitivities of 1.0, 0.67, and 0.17, respectively, with specificities of 0.94 and 0.98 for the latter two methods. They recommended serum CMV PCR as the preferred diagnostic approach. Additionally, a prospective study conducted in Türkiye indicated low sensitivity but high specificity for CMV PCR in tissue and blood samples (19). The current literature revealed a lack of comprehensive information regarding the cut-off PCR level necessary for diagnosis. In the sole prospective study available, Ormeci et al. (11) proposed a 1000 copies/mL threshold for CMV PCR to diagnose CMV disease in patients with steroid-refractory IBD. Based on recent studies, a definitive diagnosis of CMV colitis can be made using tissue assays. Moreover, serum PCR can be used to exclude the disease, as was recommended in a consensus report (10). In the present study, this approach was an exclusion criterion for patients in the studied facility when a biopsy was unavailable. This proactive measure helps reduce the risk of serious complications associated with CMV colitis.

Antiviral therapy has proven beneficial for patients with steroid-refractory UC because it can significantly decrease the need for surgical intervention (8). For optimal outcomes, intravenous ganciclovir and/or oral valganciclovir should be administered for 2 to 3 weeks (8). Regarding treatment duration, intravenous ganciclovir for 2 weeks is more effective than intravenous ganciclovir for 1 week plus oral valganciclovir for 1 week (20). In the clinic where the present study was performed, intravenous ganciclovir was given priority over oral treatment in patients with IBD. Consistent with this, the patients received intravenous ganciclovir for 3 weeks on average.

CMV colitis presents a significant threat in immunosuppressed patients, exhibiting a mortality rate that varies between 35.7% and 71.4% depending on the specific characteristics of the patient population (21,22). Recent findings by Jung et al. (23) indicate that relapse occurs in approximately 10% of cases despite antiviral treatment. This phenomenon has been linked to the presence of hematological malignancies and UC. Additionally, Hendler et al. (24) demonstrated that CMV infection was associated with a 2.3-fold increase in mortality among patients

with UC, a 4.6-fold increase in mortality among individuals with Crohn's disease, and a 2.5-fold increase in colectomy in patients with UC. In the present six-year longitudinal study, we observed that CMV colitis exhibited a progressive course among patients with IBD but generally resulted in favorable outcomes. Notably, no patient required surgical intervention, and there were no relapses. Regrettably, one patient succumbed to causes unrelated to CMV or IBD.

The limitations of this study include the small sample size and the lack of biopsies in a significant number of patients. These factors may impact the generalizability of our findings and warrant careful consideration when interpreting the results.

Conclusion

The present study showed that an IBD diagnosis was rare in patients with CMV. The observed cases typically followed a positive clinical course. Prospective studies are needed to determine the true prevalence of IBD patients with CMV, along with standardization of treatment and follow-up.

Ethics

Ethics Committee Approval: The study was approved by the University of Health Sciences Türkiye, Gülhane Training and Research Hospital of Local Ethics Committee (decision no: 2022/96, date: 17.05.2023).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Z.K., C.B., G.F., G.Ç., Concept: Z.K., C.B., Design: Z.K., C.B., Data Collection or Processing: Z.K., C.B., G.F., G.Ç., Analysis or Interpretation: Z.K., C.B., Literature Search: Z.K., C.B., G.F., G.Ç., Writing: Z.K., C.B., G.F., G.Ç.

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From attachment to well-being: An examination of father-infant attachment, parental mental health, and relationship satisfaction

Necla İpar[1], Ezgi Nur Alper[2], Nuri Efe Aydın[2], Özgür Aktaş[2], Özlem Murzoğlu Kurt[3], Arzu Baygül[4]

[1]Koç University School of Medicine, Department of Pediatrics, İstanbul, Türkiye
[2]Koç University School of Medicine, İstanbul, Türkiye
[3]Marmara University Institute of Health Sciences, Social Pediatrics PhD Program, İstanbul, Türkiye
[4]Koç University School of Medicine, Department of Biostatistics, İstanbul, Türkiye

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Corresponding Author:
Necla İpar, M.D., Koç University School of Medicine, Department of Pediatrics, İstanbul, Türkiye
nipar@kuh.ku.edu.tr

ORCID:
orcid.org/0000-0002-2614-0832

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ABSTRACT

Aims: Father-infant attachment impacts children's cognitive, emotional, and social development in the early childhood. The present study examined the relationship between father-infant attachment and parental mental health, including depression and anxiety, along with relationship satisfaction and mother-infant attachment.

Methods: This cross-sectional study included parents of children aged 3 to 12 months. We administered the Edinburgh Postnatal Depression Scale (EPDS), Beck Anxiety Inventory (BAI), Couple Satisfaction Index-4, Postnatal Paternal-Infant Attachment Questionnaire (PPAQ), and Maternal Attachment Inventory (MAI) to the participants.

Results: A total of 66 father-mother dyads from İstanbul, Türkiye, participated in the study. The median age was 31.0 (25.0-39.0) years in mothers, 33.0 (26.0-47.0) years in fathers, and 8.0 (3.0-12.0) months in infants. Mothers showed significantly higher EPDS and BAI scores than fathers [9.0 (1.0-20.0) vs. 4.0 (1.0-16.0), p<0.001]. We observed a weak but significant positive correlation between the MAI score and the "affection and pride" subscale of the PPAQ score (r=0.260, p=0.035). Paternal EPDS scores positively correlated with paternal BAI (r=0.599, p<0.001), maternal EPDS (r=0.279, p=0.023), and maternal BAI (r=0.283, p=0.021) scores. Relationship satisfaction showed a negative correlation with maternal and paternal depression (r=-0.357, p=0.003, and r=-0.541, p<0.001, respectively) and anxiety (r=-0.310, p=0.011 and r=-0.374, p=0.002, respectively) scores.

Conclusions: Although we observed no direct association between father-infant attachment and parental mental health or relationship satisfaction, the weak association between mother-infant and father-infant attachment highlights the need for family-centered support. Future research is warranted to explore the complex relationships in the postpartum period to develop effective strategies.

Introduction

Parenting can be highly stressful, particularly for first-time parents, impacting both mental and physical health in the postpartum period (1). The mental status of the father and the mother can be volatile in the postpartum period, which eventually impacts family dynamics (1). Therefore, postpartum depression can be present in both women and men (1,2). The rate of depression during pregnancy and up to one year after birth was reported as 23.8% for mothers and 10.4% for fathers (3).

Postpartum depression in the father can have detrimental effects on well-being and the growth and development of the newborn. The global incidence of paternal depression ranges from 1.2% to 26%, tends to increase between 3 and 6 months after birth, and occurs later than maternal postpartum depression (2). Along with fewer symptoms experienced by the fathers, the diagnosis of paternal depression is often difficult (1). Postpartum depression correlates with low levels of co-parenting and father-infant bonding (4).

Effective parenting involves active, equal participation from both parents. Good communication, skillful co-parenting, cooperation, and support create a nurturing environment for the child's growth and development (5). Moreover, a strong, healthy romantic relationship between partners enhances a supportive parenting environment (6).

The foundation of infants' emotional security, social relationships, and cognitive development heavily depends on parental involvement (7). Father-infant attachment impacts a child's cognitive, emotional, and social development in the early years. As the strength of father-infant attachment increases, breastfeeding rates improve, cognitive delays decrease, and rates of failure to thrive diminish (8). With socio-economic advancements and evolving cultural norms, there has been a notable rise in paternal engagement in childcare, prompting growing interest in fathers' perinatal mental health, father-infant attachment, and their impact on early child development (9).

Promoting strong family ties and ensuring that children grow to their full potential physically and psychosocially during their formative years depends on the analysis of interrelated elements. While much of the existing research on parenting has predominantly focused on maternal-infant attachment, the bond between fathers and their infants has not been studied as comprehensively (1,10). The existing body of literature from various countries highlights a correlation between impaired father-infant bonding and factors such as paternal postpartum depression (4), paternal anxiety, maternal stress (11), and partnership quality during both the antenatal and postnatal periods (12). However, the limited number of studies and the diverse backgrounds of study populations across various countries make it challenging to draw definitive conclusions or establish generalizations. Moreover, actors associated with father-infant attachment have not yet been examined in many populations. Therefore, this study aimed to investigate the relationship between father-infant attachment and parental mental health, including depression and anxiety, as well as relationship satisfaction and mother-infant attachment.

Methods

Participants

The cross-sectional study included parents of children aged 3 to 12 months who sought care at the Koç University, General Pediatrics Outpatient Clinic of İstanbul, between March and August 2024. The Koç University Institutional Review Board approved the study protocol (decision no: 2023.428.IRB3.181, date: 28/12/2023), which complied with the principles outlined in the Declaration of Helsinki. We excluded parents diagnosed with neurological or psychiatric disorders, as well as children with either neurological or psychiatric disorders or chronic diseases.

Participants were selected using a non-probability sampling method. The required minimum sample size was determined to be 63 parent pairs, utilizing a 20% margin of error. Parents visiting the outpatient clinic were informed about the study, and those who consented to participate received a link to an online questionnaire on Qualtrics, delivered via phone or email. Participants provided informed consent through the online survey platform before completing the questionnaire. No incentives were offered for participation.

Data collection

The demographic questionnaire included 20 questions about children's age, gender, delivery method, feeding method, parents' age, education level, and electronic device use. Parents were asked to complete several inventories: the Edinburgh Postnatal Depression Scale (EPDS), the Beck Anxiety Inventory (BAI), and the Couples Satisfaction Index-4 (CSI-4). Fathers were asked to complete the Postnatal Paternal-Infant Attachment Questionnaire (PPAQ), while mothers were asked to complete the Maternal Attachment Inventory (MAI).

Edinburgh Postnatal Depression Scale

The EPDS, developed by Cox et al. (13) in 1987, is a self-report tool designed to assess depression in mothers. It has demonstrated reliable sensitivity and specificity for detecting depressive symptoms. EPDS is a validated tool for use in screening fathers for depression (14). The Turkish version of EPDS was validated in Turkish women by Aydin et al. (15). The EPDS consists of ten items, each rated on a four-point Likert scale from 0 to 3, with a minimum score of 0 and a maximum score of 30. In women, a score of 13 or higher is considered indicative of a risk for postpartum depression. Edmondson et al. (16) found an optimal cut-off score of 10, with a specificity

of 78.2% and a sensitivity of 89.5%. In the present study, Cronbach's alpha for the EPDS was 0.855.

Beck Anxiety Inventory

The BAI was developed by Beck et al. (17) in 1988 to assess the severity of anxiety symptoms in the previous month. It's a self-report tool that evaluates 21 symptoms, each rated on a four-point Likert scale from 0 to 3. The total score ranges from 0 to 63, with higher scores indicating greater anxiety levels. The Turkish version of BAI was validated by Ulusoy and Hisli Şahin (18), and the scale was found to be reliable and valid. In the present study, Cronbach's alpha for the BAI was 0.919.

Couple Satisfaction Index-4

The CSI-4 is an effective tool for assessing communication and satisfaction levels within romantic relationships, providing valuable insights into family dynamics (19). The CSI-4 is a self-report questionnaire that rates overall relationship satisfaction, communication quality, and marital dynamics and shows valid variance and precision. It consists of 4 items, each rated on a 6-point Likert scale from 0 to 5, with higher scores indicating better marital quality. The Turkish version of the CSI-4 was validated by Özdemir and Sağkal (20). In the present study, Cronbach's alpha for the CSI was 0.929.

Postnatal Paternal-Infant Attachment Questionnaire

Condon et al. (21) developed the PPAQ, a 19-item self-report instrument, to assess father-infant attachment. Scores range from a minimum of 19 to a maximum of 95, with higher scores indicating stronger attachment between the father and the infant. The questionnaire also yields three factors in which "patience and tolerance", "pleasure in interaction" and "affection and pride" are tested to assess variance. Interpretation of scores is based on both global and subscale measures. The Turkish version of PPAQ was validated by Güleç and Kavlak (22). In the present study, Cronbach's alpha for the PPAQ was 0.762.

Maternal Attachment Inventory

The MAI developed by Müller in 1994 is used to assess the level of maternal-infant attachment. It is a 26-item self-report questionnaire employing a 4-point Likert scale (23). The answers ranged from "almost always" to "almost never", which are 4 and 1, respectively. The total score ranges from 26 to 104, with higher scores indicating higher maternal-infant attachment. The Turkish version of the MAI was validated previously (24). In the present study, Cronbach's alpha for the MAI was 0.867.

Statistical Analysis

Data were analyzed using SPSS Statistics for Windows (version 28.0; IBM Corp, Armonk, NY). The normality of the data was assessed using the Shapiro-Wilk test. The Mann-Whitney U test was used to compare non-normal distributions. Relationships among independent categorical variables were examined using Pearson's Chi-square test or, when appropriate, the Continuity Corrected Chi-square or Fisher's Exact test. Spearman correlation analysis was employed to assess relationships between non-normally distributed variables. $P<0.05$ was considered statistically significant.

Results

Socio-demographic characteristics

This study included 66 father-mother dyads from İstanbul, Türkiye. The median age of the mothers and fathers was 31.0 (25.0-39.0) and 33.0 (26.0-47.0) years, respectively. The median age of the infants was 8.0 (3.0-12.0) months. The infants' sex distribution was nearly equal, with 32 girls (48.5%) and 34 boys (51.5%). Table 1 shows the socio-demographic characteristics of the participants.

The median screen time for mothers was shorter than for fathers [3.0 (0.0-14.0) hours vs. 5.3 (2.0-16.0) hours, $p<0.001$]. The median PPAQ score was 76.1 (53.3-88.6) and the median MAI score was 99.0 (78.0-104.0). Table 2 shows the socio-demographic and attachment characteristics of the parents.

Assessment of parental mental health

The median EPDS score was 9.0 (1.0-20.0) for mothers and 4.0 (1.0-16.0) for fathers ($p<0.001$). The median BAI score was 8.5 (0.0-42.0) for mothers and 3.0 (0.0-47.0) for fathers ($p<0.001$). Mothers consistently had higher scores on EPDS

Table 1. Socio-demographic characteristics of the participants

Children's age, months, median (min-max)	8.0 (3.0-12.0)
Sex, n (%)	
Female	32 (48.5)
Male	34 (51.5)
Maternal age, years, median (min-max)	31.0 (25.0-39.0)
Paternal age, years, median (min-max)	33.0 (26.0-47.0)
Childbirth order, n (%)	
First	57 (86.4)
Second	9 (13.6)
Planned pregnancy, n (%)	
Yes	61 (92.4)
Method of delivery, n (%)	
Cesarean	55 (83.3)
Vaginal	11 (16.7)
Feeding method, n (%)	
Breastfeeding only	13 (19.7)
Breastfeeding+formula	5 (7.6)
Breastfeeding+complementary feeding	36 (54.5)
Formula+complementary feeding	12 (18.2)
Maternal working status, n (%)	
Yes	32 (48.5)
Paternal working status, n (%)	
Yes	66 (100)

Min-max: Minimum-maximum

across different severity levels, 7+, 9+, and 13+ than fathers (p<0.001, p<0.001, and p=0.028, respectively). Anxiety scores, as measured by the BAI, showed a similar pattern, with mothers exhibiting higher anxiety levels compared to their counterparts (p=0.002). In contrast, the CSI total score for relationship satisfaction was similar in both groups (p=0.331) (Table 3).

Correlation analyses

We observed a weak positive correlation between MAI and the "affection and pride" subscale of father-infant attachment (r=0.260, p=0.035).

Paternal EPDS scores positively correlated with paternal BAI, maternal EPDS, and maternal BAI (r=0.599, p<0.001; r=0.279, p= 0.023; and r=0.283, p=0.021, respectively). Paternal EPDS inversely correlated with paternal CSI (r=-0.541, p<0.001).

Paternal BAI scores positively correlated with maternal EPDS and maternal BAI (r=0.381, p=0.002 and r=0.258, p=0.037, respectively) and inversely correlated with paternal CSI (r=-0.374, p=0.002). Additionally, paternal CSI scores correlated positively with maternal CSI scores (r=0.295, p=0.016).

Maternal EPDS and BAI scores showed a strong positive correlation (r=0.628, p<0.001). Maternal CSI scores negatively correlated with maternal EPDS (r=-0.357, p=0.003) and maternal BAI (r=-0.310, p=0.011).

Maternal MAI scores inversely correlated with maternal EPDS and BAI scores (r=-0.257, p=0.023, and r=-0.319, p=0.009, respectively). Table 4 shows the correlations between parental attachment, depression, anxiety, and relationship satisfaction.

We observed a weak negative correlation between maternal EPDS and marital duration (r=-0.277, p=0.025). However, we observed no significant correlations between maternal EPDS, BAI, CSI, MAI, and children's age, maternal education level, screen time, or marital duration. Similarly, there were no significant correlations between paternal EPDS, BAI, CSI, PPAQ, and the child's age, paternal education level, screen time, or marital duration.

Table 2. Parents' socio-demographic and attachment characteristics

	Median (min-max)
Maternal education, years	16.0 (11.0-24.0)
Paternal education, years	16.0 (8.0-26.0)
Marital duration, years	4.0 (2.0-26.0)
Maternal screen time, hours	3.0 (0.0-14.0)
Paternal screen time, hours	5.3 (2.0-16.0)
Paternal PPAQ total score	76.1 (53.3-88.6)
PPAQ subscale 1	33.8 (16.0-40.0)
PPAQ subscale 2	27.6 (18.0-35.0)
PPAQ subscale 3	15.0 (9.6-15.0)
MAI total score	99.0 (78.0-104.0)

PPAQ: Postnatal Paternal-Infant Attachment Questionnaire, MAI: Maternal Attachment Inventory, Min-max: Minimum-maximum

Discussion

The present study evaluated father-infant attachment in the context of parental mental health, including depression, anxiety, relationship satisfaction, and mother-infant attachment. The findings revealed that mothers reported higher levels of depression and anxiety compared to fathers. No significant relationship was observed between father-infant attachment and parental mental health or relationship satisfaction. However, a weak association was found between mother-infant attachment and the "affection and pride" subscale of father-infant attachment. Additionally, mother-infant attachment was inversely correlated with maternal depression and anxiety.

Parental mental health

The postpartum period can be challenging for parents as they adapt to their evolving roles and the associated expectations, often leading to depression, irritability, and feelings of helplessness and hopelessness (1). In the present study, both EPDS scores, which assess depression, and BAI scores, which measure anxiety, were significantly higher in mothers than fathers. Notably, 18.2% of mothers and 4.5% of fathers had an EPDS score of 13 or higher, indicating a higher

Table 3. Parents' psychological characteristics

	Maternal (n=66)	Paternal (n=66)	p
EPDS total score, median (IQR)	9.0 (1.0-20.0)	4.0 (1.0-16.0)	**<0.001***
EPDS class, n (%)			
EPDS <7	16 (24.2)	43 (65.2)	**<0.001****
EPDS ≥7	50 (75.8)	23 (34.8)	
EPDS <9	29 (43.9)	51 (77.3)	**<0.001****
EPDS ≥9	37 (56.1)	15 (22.7)	
EPDS <13	54 (81.8)	63 (95.5)	**0.028****
EPDS ≥13	12 (18.2)	3 (4.5)	
BAI total score, median (min-max)	8.5 (0.0-42.0)	3.0 (0.0-47.0)	**<0.001***
BAI subscale, n (%)			
Minimal anxiety levels (0-7)	29 (43.9)	51 (77.3)	**0.002*****
Mild anxiety (8-15)	24 (36.4)	10 (15.2)	
Moderate anxiety (16-25)	8 (12.1)	3 (4.5)	
Severe anxiety (26-63)	5 (7.6)	2 (3.0)	
CSI total score, median (min-max)	17.0 (3.0-21.0)	17.0 (4.0-21.0)	0.331*

*Mann-Whitney U test, **Continuity correction, ***Chi-square tests.
EPDS: Edinburgh Postnatal Depression Scale, BAI: Beck Anxiety Inventory, CSI: Couple Satisfaction Index, IQR: Interquartile range, Min.-max.: Minimum-maximum

likelihood of clinical depression. Moderate to severe anxiety was observed in 19.7% of mothers compared to only 7.5% of fathers. Additionally, a strong correlation was found between depression and anxiety in both parents. Consistent with the present findings, a meta-analysis by Paulson and Bazemore (3) of 43 studies with a total of 28,004 participants found that the rate of depression during pregnancy and up to one year after delivery was 23.8% for mothers and 10.4% for fathers. Zheng et al. (25) assessed postpartum depression among Chinese mothers and fathers, finding that mothers exhibited higher levels of depression compared to fathers. In another work, a meta-analysis of 79 studies reported an estimated prevalence of depression among mothers between 21.8% and 37.9%, while anxiety levels ranged between 24.1% and 53.6%. In contrast, fathers exhibited an estimated prevalence of depression between 12.5% and 23.8%, with anxiety levels ranging from 8.1% to 36.3% (26). Another study reported that the maternal depression rate in high-income countries was 10-20%, while it was above 20% in low-and middle-income countries (27). The wide variation in prevalence numbers may result from assessments conducted at different time points, using different methods, and variations in population characteristics, including socio-economic backgrounds (3,27,28). Furthermore, the higher prevalence of depression in mothers compared to fathers in the present study, as well as in the literature, underscores the urgent need for targeted guidelines to support parental mental health, particularly for mothers, during this sensitive period. Disparities in maternal and paternal involvement in childcare may also contribute to maternal mental health outcomes. Future research should examine the impact of parental involvement, along with other contributing factors, to gain a comprehensive understanding of parental mental health.

Attachment

We observed a weak correlation between maternal attachment (measured by the MAI) and the “affection and pride” subscale of paternal attachment (measured by the PPAQ). Mother-infant attachment was negatively correlated with maternal depression and anxiety, whereas father-infant attachment did not show similar associations. We observed no significant relationships between maternal attachment, paternal attachment and relationship satisfaction. However, similar studies have demonstrated different results. Wells and Jeon (4) found that paternal postpartum depression was associated with lower levels of co-parenting and impaired father-infant bonding. Fathers experiencing depressive symptoms also reported higher levels of impaired attachment, feelings of rejection, anger, and anxiety related to caregiving. In addition, fathers who reported a higher quality of co-parenting experienced lower levels of impaired attachment, rejection, anger, and caregiving-related anxiety. A similar study conducted in Poland identified a strong correlation between impaired paternal bonding and factors such as paternal anxiety and maternal stress. Regression analysis revealed that two factors significantly predicted paternal bonding: Maternal-infant bonding and paternal stress (11). A review conducted in Türkiye suggested that paternal depression in the postnatal period negatively affects father-child attachment and may lead to behavioral problems, delayed

Table 4. Correlation between parental attachment, depression, anxiety and relationship satisfaction

	1	2	3	4	5	6	7	8	9	10	11	12
1. PPAQ score	1											
2. Patient and tolerance	**0.859****	1										
3. Pleasure in interaction	**0.753****	**0.399****	1									
4. Affection and pride	**0.416****	0.196	**0.253***	1								
5. MAI	0.132	0.046	0.112	**0.260***	1							
6. Paternal EPDS	0.005	-0.067	0.047	0.059	0.018	1						
7. Paternal BAI	-0.064	-0.152	0.081	-0.157	-0.140	**0.599****	1					
8. Paternal CSI	0.153	0.106	0.127	0.196	0.059	**-0.541****	**-0.374****	1				
9. Maternal EPDS	-0.096	-0.109	-0.082	-0.019	**-0.257***	**0.279***	**0.381****	-0.208	1			
10. Maternal BAI	-0.059	-0.096	-0.013	0.012	**-0.319****	**0.283***	**0.258***	-0.188	**0.628****	1		
11. Maternal CSI	0.058	0.103	0.074	0.016	0.154	-0.193	-0.020	**0.295***	**-0.357****	**-0.310***	1	
12. Child age	0.086	-0.037	0.121	0.141	0.047	0.103	0.111	-0,076	0.218	0.031	-0.140	1

*Spearman rho correlation coefficients, **Significant correlations at p<0.05, p<0.01 level, respectively.
PPAQ: Postnatal Paternal-Infant Attachment Questionnaire, MAI: Maternal Attachment Inventory, EPDS: Edinburgh Postnatal Depression Scale, BAI: Beck Anxiety Inventory, CSI: Couple Satisfaction Index

speech, hyperactivity, anxiety, and depression in the child (2). A meta-analysis of 28 articles showed a significant association between paternal depression and lower levels of positive and higher levels of negative parenting behaviors, with the positive behaviors "warmth, sensitivity, responsiveness" and negative behaviors as "hostility, intrusiveness, disengagement" (29). Knappe et al. (12) found that fathers with depressive disorders exhibited lower levels of antenatal attachment to their children. The study further emphasized that both antenatal and postnatal partnership quality, with antenatal father-to-child attachment, was positively associated with postnatal father-to-child attachment. We observed a weak association between maternal and paternal attachment to the infant. While maternal mental health was found to be associated with attachment, no association was observed between paternal mental health and attachment. The lack of association may be attributed to the small sample size or the mother's greater involvement in childcare. Future studies should involve a larger sample size across multiple centers focused on parent-infant attachment. Additionally, the present findings, along with previous research, highlight the need to focus on both mothers' and fathers' mental health to improve parent-child attachment and overall family well-being.

Relationship satisfaction

The present study found no significant difference in relationship satisfaction, as measured by the CSI, between mothers and fathers. However, a positive correlation was found between maternal and paternal relationship satisfaction, and it was found that relationship satisfaction negatively correlated with anxiety and depression for both mothers and fathers. This finding aligns with a cross-sectional study on maternal and paternal relationship dynamics, which demonstrates that dyadic satisfaction and co-parenting alliance significantly influence maternal mental health by reducing stress and depressive symptoms (30). Despite the differences between the questionnaires used, several previous studies reported similar associations. Keles et al. (6) observed that postpartum depression rates in mothers were higher in the presence of marital dissatisfaction compared to those without, underscoring the importance of relationship quality and co-parenting dynamics for maternal well-being. Not only does couple satisfaction univariately influence the mental state of parents but Knappe et al. (12) have also addressed the multivariate nature of this phenomenon. They found that partners experiencing depression exhibited reduced relationship satisfaction both prenatally and postpartum. Couples in which one partner experienced depression demonstrated lower overall satisfaction and displayed more dysfunctional interaction patterns, including poorer communication and problem-solving abilities, decreased social support, less self-disclosure and intimacy, increased negativity, and an intensified focus on physical and psychological concerns. The quality of parents' relationship and its influence on an infant's well-being are critical issues. Cox et al. (13) found that while marital satisfaction was high during pregnancy, it tended to decrease during the transition to parenthood and continued to decline throughout the child's first year. Thus, the observed natural decline in couple satisfaction during an infant's first year raises the question of how the quality of the parents' romantic relationship, as assessed by the CSI or similar questionnaires, affects the infant's well-being. Sarkadi et al. (31) suggested that positive parental bonding improves children's emotional regulation in later years. Cabrera et al. (32) further highlighted the benefits of parental engagement activities, play, and direct care, which reduce stress and improve overall mental wellness. The present findings suggest that depression and anxiety in both mothers and fathers directly impact relationship satisfaction, which may subsequently affect family dynamics and the child's well-being. Therefore, we recommend implementing interventions aimed at improving the mental health of both parents, with a particular focus on mothers. In addition, further research is needed to explore these relationships in more detail.

Several limitations of the study should be acknowledged. First, the voluntary nature of participation, along with the assessment of variables such as depression, anxiety, relationship satisfaction, and parent-child attachment through self-report questionnaires, may introduce bias, particularly because individuals experiencing depression and anxiety may have chosen not to participate. Furthermore, the study did not examine how maternal and paternal involvement in childcare may influence parental mental health, relationship satisfaction, and attachment. Finally, the cross-sectional design and relatively small sample size limit the ability to infer causal relationships between variables. The strength of the present study was the examination of the relationships between father-infant and mother-infant attachment, parental mental health, and relationship status among the same parental dyads.

Conclusion

The present study showed that depression and anxiety were associated in parents and were negatively associated with relationship satisfaction. The results highlight the impact of mental health on relationship quality. Although no direct association was found between father-infant attachment and either parental mental health or relationship satisfaction, the presence of a weak association between mother-infant and father-infant attachment highlights the importance of family-centered support. Future research is needed to further explore the complex interactions among parental mental health, attachment, and relationship satisfaction to improve family outcomes in the postpartum period.

Ethics

Ethics Committee Approval: The study was approved by the Koç University of Ethics Committee (decision no: 2023.428. IRB3.181, date: 28/12/2023).

Informed Consent: Consent form was filled out by all participants.

Footnotes

Authorship Contributions

Concept: N.İ., N.E.A., Design: N.İ., N.E.A., Data Collection or Processing: N.İ., Analysis or Interpretation: N.İ., A.B., Literature Search: N.İ., E.N.A., Ö.A., Ö.M.K., Writing: N.İ., E.N.A., Ö.A.

Conflict of Interest: One author of this article, Necla İpar, is a member of the editorial board of the Gülhane Medical Journal. However, she did not take part in any stage of the editorial decision of the manuscript. The other authors declared no conflict of interest.

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Retrospective histomorphological analysis of bone and soft tissue tumors and tumor-like lesions over 32 years in a tertiary healthcare facility

Mumini Wemimo Rasheed[1], Uchechukwu Brian Eziagu[2], Adebayo Ayoade Adekunle[3], Najeem Adedamola Idowu[4], Ismail Salisu[5], Abdullahi Abba Habib[6], Enoch Abiodun Afolayan[1]

[1]University of Ilorin Teaching Hospital, Department of Anatomic Pathology, Ilorin, Nigeria
[2]University of Uyo Teaching Hospital, Department of Histopathology, Uyo, Nigeria
[3]Ladoke Akıntola University of Technology, Department of Morbid Anatomy and Histopathology, Ogbomoso, Nigeria
[4]Ladoke Akıntola University of Technology, Department of Surgery, Ogbomoso, Nigeria
[5]Federal University Dutse Faculty of Basic Clinical Sciences, Department of Surgery, Dutse, Nigeria
[6]Federal University Dutse Faculty of Clinical Sciences, Department of Obstetrics and Gynaecology, Dutse, Nigeria

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Corresponding Author:
Mumini Wemimo Rasheed, M.D.,
University of Ilorin Teaching Hospital,
Department of Anatomic Pathology,
Ilorin, Nigeria
rasheed.wemimo@npmcn.edu.ng
muminirasheed265@gmail.com

ORCID:
orcid.org/0000-0003-4888-6325

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ABSTRACT

Aims: Clinicopathological features of bone and soft tissue tumors/tumor-like lesions have been shown to vary geographically. This study aims to analyze the clinicopathological features of bone and soft tissue lesions in Ilorin, including both neoplastic and non-neoplastic diseases derived from mesenchymal cells, thus addressing a notable data gap.

Methods: We retrospectively reviewed histopathologically diagnosed cases of bone and soft tissue lesions over thirty-two years (1985 to 2016) at the University of Ilorin Teaching Hospital, Ilorin, Nigeria. Data were extracted from pathology reports and case files.

Results: A total of 970 cases of bone and soft tissue lesions were recorded. The age distribution of the study group ranged from 0 to 81 years with a mean age of 34.5±0.5 years and the male-to-female ratio was 1:1. The lesions of adipose tissue origin constituted the most common (38.4%; 373/969) followed by blood vessels (20.6%; 200/969) and fibrous tissue lesions (18.8%; 182/969) among others. The majority of these bone and soft tissue lesions were benign 80.4%. The most common soft tissue neoplasm was lipoma (32.1%; 311/970). Fibrosarcoma was the most common malignant soft tissue neoplasm (7.8%; 76/970).

Conclusions: Adipocytic tumors were the most prevalent soft tissue lesions, with lipoma being the most frequent specific lesion. Fibrosarcoma was the predominant malignant soft tissue neoplasm, while giant cell tumor was the most commonly diagnosed bone neoplasm. Clinically, these findings highlight the necessity for heightened vigilance and tailored diagnostic strategies for these prevalent tumors in healthcare settings.

Introduction

Neoplastic and non-neoplastic disorders originating from mesenchymal cells, including fibroblasts, adipocytes, muscle cells, and osteoblasts, are responsible for bone and soft tissue tumors (STTs) as well as tumor-like lesions (1-3). Although these lesions can occur in any section of the body, soft tissue lesions are most common in the extremities (1,2,4-14). Among adult soft tissue neoplasms, fewer than 4% are soft tissue sarcomas (1,3,10,15-18), while 90% are considered benign (2,4,12-14,17-20). Compared to soft tissue neoplasms, primary bone neoplasms are less prevalent (5-9,14,17,18).

The prevalence of primary bone sarcomas as a subset of malignant neoplasms is relatively low, constituting only 0.2% of cases (5-9,17,18). Interestingly, despite their rarity, bone sarcomas exhibit variability in gender distribution, with women representing a significant proportion, comprising 46% of cases in the United Kingdom (1,17,18). This suggests that while bone sarcomas are infrequent overall, they display distinct epidemiological patterns that warrant further investigation. Malignant bone neoplasms are frequently found (1,17,18). Chondrosarcoma, osteosarcoma, and Ewing sarcoma are the most frequently occurring histological subtypes of bone sarcomas (1,5-9,16-18).

Soft tissue neoplasms are more prevalent than bone neoplasms among lesions (2,3,14,17,18,20). Soft tissue neoplasms exhibit histological categorization into benign, intermediate, and malignant subtypes, with the incidence of benign variants surpassing that of malignant ones (1,2,21-23). Malignant soft tissue neoplasms represent only 0.7% of all malignant neoplasms and account for 6.5% of malignancies in children under 15 years (1-3,5-14,16-18,20,23). Notably, lipoma emerges as the most prevalent soft tissue neoplasm, constituting nearly 50% of soft tissue neoplasms (2,12-14,20,23). Concurrently, liposarcoma claims the position of the most common soft tissue sarcoma, while osteosarcoma holds this distinction among bone sarcomas.

Bone and soft tissue neoplasms can occur throughout the body, with specific predilections. Lipoma frequently manifests in the neck, shoulder, abdomen, and thigh, whereas soft tissue sarcomas predominantly localize in the arms, legs, and abdomen (2-14,16,20). The etiology of these neoplasms remains largely elusive; however, factors such as radiation exposure, positive family history, and neurofibromatosis have been linked to their development (1,3,13,23). Crucially, the conclusive diagnosis of bone and soft tissue lesions hinges on histopathological evaluation following a biopsy. The diagnostic process is compounded by the relative rarity of primary soft and bone lesions, and the diverse array of histological subtypes, posing a significant challenge (1,2,6,8,10,12-14,20-23). Consequently, the distribution and comprehensive evaluation of these histological subtypes within our environment are particularly sparse.

Therefore, this study aimed to retrospectively analyze the clinicopathological features of bone and soft tissue lesions in Ilorin, Southwestern Nigeria. Specifically, it sought to determine the age and gender distribution, tissue of origin, histopathological subtypes, and relative frequencies of these lesions, and to compare the findings with those reported in the literature.

Methods

Study population and recruitment

This retrospective study was conducted at the Department of Histopathology, University of Ilorin Teaching Hospital, Ilorin, Nigeria, spanning 32 years from 1985 to 2016. Inclusion criteria encompassed all lesions originating from mesenchymal cells managed during the specified period, while exclusion criteria included patients with incomplete information and those with secondary bone and soft tissue neoplasms. The study was approved by the Rasheed Shekoni Federal University Teaching Hospital, Dutse Institutional Ethics Committee (decision number: RSFUTH/GEN/226/V.II, date: 28.11.23).

Variables and data collection

Original histopathological slides of the cases were retrospectively reviewed. Data collected from re-examined slides, laboratory request forms, and pathology reports included information on age, gender, tissue of origin, histopathological subtypes, and anatomical location of the lesions. In cases where original slides were unavailable, new slides were prepared from archival formalin-fixed paraffin-embedded tissue blocks. The data collection process ensured that all subjects within the study period who met the inclusion criteria were included.

Statistical Analysis

We performed all our statistical analyses using IBM SPSS Statistics® version 23.0 (IBM Corporation, 1 New Orchard Road, Armonk, New York, United States). As the study utilized a convenience sampling technique, no sample size calculation was performed, recognizing that sample size calculations are based on principles of probability sampling techniques. Descriptive statistics were used to summarize the data, and the results were presented in text, tables, and figures. A p-value of less than 0.05 was considered statistically significant.

Results

Case analysis and demographics

During the 32-year study period from 1985 to 2016, a total of 970 cases of bone and soft tissue lesions were analyzed. The age distribution of the subjects ranged from 0 to 81 years, with

a mean age of 34.5±0.5 years. The majority of the lesions were observed in individuals aged 21-30 years. The study population had an equal male-to-female ratio (M:F) of 1:1 (Table 1).

Tissue derivatives and lesion frequency

Among the seven observed bone and soft tissue derivatives, lesions of adipose soft tissue origin had the highest frequency, accounting for 38.5% (373/969) of cases, followed by blood vessels at 20.6% (200/969). The least frequent were lesions originating from bone, cartilage, and tendon sheath tissues, comprising 3.7% (36/969) of cases (Table 1).

The histopathological categories

The histopathological analysis of 969 lesions revealed that benign cases predominated (80.4%), with 2.4% classified as borderline and 17.2% as malignant, showing significant variation across tissue types. Adipose (94.9%), neural (94.6%), and vascular (96.0%) tissue derivatives were mostly benign, whereas smooth muscle tissue derivatives exhibited a notably high malignancy rate (84.0%, p=0.001). Fibrous tissue derivatives showed a diverse distribution with 46.7% benign, 12.6% borderline, and 40.7% malignant cases, emphasizing the importance of histopathological evaluation for accurate lesion categorization (Table 2).

Neoplasm types and prevalence

The most commonly diagnosed specific soft tissue neoplasm was lipoma, which accounted for 32.1% (311/970) of cases, followed by capillary haemangioma at 16.3% (158/970), and the least common was myxoma, with only 0.1% (1/970) of cases. These neoplasms were derived from adipose, blood vessels, and fibrous tissue, respectively (Table 3 and Figure 1). The study revealed that benign lesions constituted 80.4% of all cases, whereas malignant lesions made up 17.2%. Lipoma was identified as the most common benign soft tissue neoplasm, while fibrosarcoma was the most common malignant soft tissue neoplasm, accounting for 7.8% of cases. Among malignant bone neoplasms, osteosarcoma was the most frequent, constituting 1.8% (17/970) of cases; whereas giant cell tumors were the most common benign bone neoplasms, representing 2.9% (28/970) of cases (Table 3).

Table 1. Frequency distribution of derivatives/origins of bone and soft tissue lesions with respect to the sex and age of our study subjects at University of Ilorin Teaching Hospital

Derivatives	Frequency	Percentage (%)	Male n (%)	Female n (%)	M:F n	Age (years) range	Age (years) mean±SD	p-value
Adipose	373	38.4	175 (46.9)	198 (53.1)	1:23	31-40	39.0±0.8	**0.001**
Neural	56	5.8	34 (60.7)	22 (39.3)	17:11	21-30	26.1±2.5	
Smooth muscle	50	5.2	23 (46.0)	27 (54.0)	23:27	31-40	34.2±2.9	
Fibrous tissue	182	18.8	99 (54.4)	83 (45.6)	99:83	31-40	35.2±1.3	
Blood vessels	200	20.6	114 (57.0)	86 (43.0)	57:43	21-30	29.9±1.3	
Bone, cartilage, and tendon sheath	36	3.7	18 (50.0)	18 (50.0)	1:1	21-30	29.3±1.8	
Bone	73	7.5	31 (42.5)	42 (57.5)	31:42	31-40	32.1±1.9	
Total	970	100.0	494 (50.9)	476 (49.1)	1:1		34.5±0.5	

The results are significant where p<0.05 at 95% confidence interval
SD: Standard deviation, M: Male, F: Female

Table 2. Frequency distribution of the histopathological categories of our study subjects at University of Ilorin Teaching Hospital

The histopathological categories					
Derivatives	**Frequency**	**Benign n (%)**	**Borderline n (%)**	**Malignant n (%)**	**p-value**
Adipose	373	354 (94.9)	-	19 (5.1)	**0.001**
Neural	56	53 (94.6)	-	3 (5.4)	
Smooth muscle	50	8 (16.0)	-	42 (84.0)	
Fibrous tissue	182	85 (46.7)	23 (12.6)	74 (40.7)	
Blood vessels	199	191 (96.0)	-	8 (4.0)	
Bone, cartilage, and tendon sheath	36	29 (80.6)	-	7 (19.4)	
Bone	73	59 (80.8)	-	14 (19.2)	
Total	969	779 (80.4)	23 (2.4)	167 (17.2)	

The results are significant where p<0.05 at 95% confidence interval

Anatomical distribution and temporal trends

The anatomical distribution of these lesions showed that the majority were located in the trunk (254/769), followed by the head and neck region (214/769) (Table 4). The frequency of soft tissue lesions peaked in 2009, with 10.6% (103/970) of cases, and was lowest in 1989, with 0.9% (9/970) (Table 5). Throughout the study, results demonstrated statistically significant associations, with all p-values below 0.05, which indicates the robustness of the findings.

Discussion

Tumors and tumor-like lesions of bone and soft tissue origin occur across a wide age range. In this study, participants ranged in age from 0 and 81 years with a mean of 34.5±0.5 years.

Table 3. Frequency distribution of specific bone and soft tissue lesions with respect to the sex and age of the study subjects at University of Ilorin Teaching Hospital

Specific lesions	Class	Frequency	Percentage (%)	Male n (%)	Female n (%)	M:F (n)	Age (years) range	Age (years) Mean±SD	p-value
Lipoma	Benign	311	32.1	144 (46.3)	167 (53.7)	1:23	31-40	39.5±0.9	**0.002**
Fibrolipoma	Benign	50	5.2	25 (50.0)	25 (50.0)	1:1	31-40	35.3±2.8	
Liposarcoma	Malignant	13	1.3	6 (46.2)	7 (53.8)	6:7	31-40	39.0±4.2	
Neurofibroma	Benign	46	4.7	30 (65.2)	16 (34.8)	15:8	21-30	24.1±2.5	
Plexiform neurofibroma	Benign	5	0.5	3 (60.0)	2 (40.0)	3:2	31-40	30.6±9.8	
Schwannoma	Benign	3	0.3	-	3 (100.0)	0:3	51-60	50.3±12.9	
Malignant peripheral nerve sheath tumor	Malignant	3	0.3	2 (66.7)	1 (33.3)	2:1	21-30	27.3±12.6	
Glomus tumour	Benign	3	0.3	1 (33.3)	2 (66.7)	1:2	31-40	30.6±9.8	
Rhabdomyosarcoma		35	3.6	18 (51.4)	17 (48.6)	18:17	21-30	28.3±3.2	
Dermatofibroma	Benign	28	2.9	16 (57.1)	12 (42.9)	4:3	21-30	29.4±3.0	
Fibroma	Benign	18	1.9	10 (55.6)	8 (44.4)	5:4	21-30	23.3±3.5	
Ossifying fibroma	Benign	3	0.3	1 (33.3)	2 (66.7)	1:2	31-40	30.3±11.8	
Fibromatosis	Benign	6	0.6	4 (66.7)	2 (33.3)	2:1	21-30	28.6±5.5	
Granular cell tumour	Benign	2	0.2	2 (100.0)	-	2:0	21-30	27.0±3.0	
Myxoma	Benign	1	0.1	1 (100.0)	-	1:0	11-20	18.0±0.0	
Fibromyxoma	Benign	4	0.4	1 (25.0)	3 (75.0)	1:3	11-20	12.0±3.4	
Dermatofibrosarcoma protuberans	Borderline	26	2.7	12 (46.2)	14 (53.8)	6:7	41-50	41.0±3.1	
Fibrosarcoma	Malignant	76	7.8	46 (60.5)	30 (39.5)	23:15	41-50	41.0±1.9	
Capillary haemangioma	Benign	158	16.3	85 (53.8)	73 (46.2)	85:73	31-40	31.1±1.5	
Lymphangioma	Benign	7	0.7	4 (57.1)	3 (42.9)	4:3	11-20	15.5±8.6	
Angiosarcoma	Malignant	4	0.4	3 (75.0)	1 (25.0)	3:1	21-30	24.7±7.3	
Giant cell tumour	Benign	28	2.9	13 (46.4)	15 (53.6)	13:15	31-40	31.0±2.2	
Osteosarcoma	Malignant	17	1.8	7 (41.2)	10 (58.8)	7:10	21-30	29.4.5±3.9	
Chondrosarcoma	Malignant	6	0.6	4 (66.7)	2 (33.3)	2:1	21-30	23.6±2.1	
Ganglion cyst	Benign	57	5.9	24 (42.1)	33 (57.9)	8:11	31-40	32.8±2.1	
Angiomyolipoma	Malignant	3	0.3	3 (100.0)	-	3:0	31-40	35.6±9.7	
Cavernous haemangioma	Benign	26	2.7	17 (65.4)	9 (34.6)	17:9	21-30	28.2±4.1	
Leiomyosarcoma	Malignant	13	1.3	4 (30.8)	9 (69.2)	4:9	41-50	50.7±4.0	
Pyogenic granuloma	Benign	18	1.9	8 (44.4)	10 (55.6)	4:5	31-40	32.1±4.1	
Total		970	100.0	494 (50.9)	476 (49.1)				

The results are significant where p<0.05 at 95% confidence interval
SD: Standard deviation, M: Male, F: Female

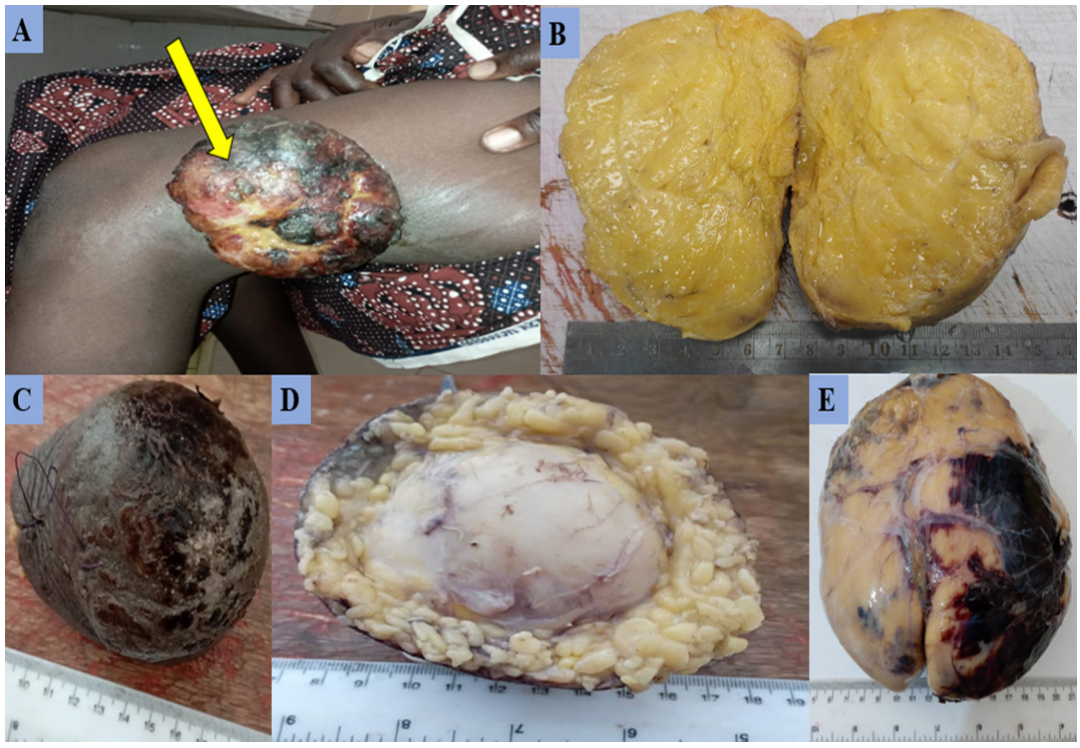

Figure 1. (A) This photograph shows an ulcerated ovoid firm multilobulated neoplasm (thick yellow arrow) with a variegated color on the lateral aspect of the lower half of the left thigh (histopathologic evaluation revealed a malignant soft tissue neoplasm consistent with angiosarcoma). (B) This photograph shows the solid homogenously yellow cut surface of a firm ovoid mass (histopathologic evaluation revealed a benign soft tissue neoplasm consistent with lipoma). (C-D) These photographs are of the same specimen; (C) shows the anterior surface while (D) shows the posterior surface. This was a skin mass, which had a patchy, scaly and ulcerated surface, weighing 550 g and measuring 10.1 x 8.3 x 5.6 cm in its longest dimensions. Its cut-section revealed a partially encapsulated firm dermal-based greyish white tumor which measured 7.5 x 5.6 x 3.9 cm in its longest dimensions and is surrounded by multilobulated fatty tissue (histopathologic evaluation revealed a benign soft tissue neoplasm consistent with dermatofibroma). (E) This photograph shows an ovoid, soft to firm, fatty specimen with subcapsular hemorrhage, weighing 1,200 g and measuring 17.4 x 16.1 x 7.4 cm in its longest dimensions. Its cut-section revealed a soft to firm, golden yellow, and multilobulated solid tissue (histopathologic evaluation revealed a benign soft tissue neoplasm consistent with lipoma).

This finding was consistent with those of other researchers who have also reported broad age ranges (2-20). In our study, STTs were commonly seen in the middle-aged group. This is similar to findings by Vhriterhire et al. (14), who reported a mean age of 43.1 years. Notably, we found that benign STTs were common in the younger population, whereas malignant STTs were more common in the fifth and sixth decades. Similarly, Singh et al. (23) reported that there was a significant correlation with age, thus implying that the frequency of malignant neoplasms increases with age.

We observed no gender predominance, with the male to female ratio 1:1. This was in contrast to Harpal et al. (2) study where the prevalence of soft tissue lesions was reported to be higher in the male gender. In studies by Vhriterhire et al (14), and Ikeri et al. (24), male-female ratios of 1:1.2 and 1:1.3, respectively, were reported. The discrepancies might be due to the sample size.

Over the study period, 28 specific neoplasms of bone and soft tissue lesions were diagnosed and they were classified into benign, intermediate, and malignant subtypes with frequencies of 80.4%, 2.4%, and 17.2%, respectively. This indicates that the majority of these lesions were benign, consistent with findings reported in the literature. Our findings were also similar to Singh et al. (23) study which showed that most of their study cases were benign mesenchymal neoplasms. This might be because neoplasms of adipose tissue origin constituted the majority of soft tissue neoplasms studied. This finding has been attributed to the relative abundance of adipose tissue in the human body (25).

In our study, the trunk was the most common site involved in the occurrence of soft tissue lesions followed by the head and neck region. Notably, benign lesions were significantly associated with the trunk and the head and neck region. In contrast, malignant soft tissue neoplasms had a predilection for the lower extremities.

Table 4. Frequency distribution of specific bone and soft tissue lesions and site of occurrences at University of Ilorin Teaching Hospital

Specific lesions	Frequency	Head and neck n (%)	Trunk n (%)	Upper extremity n (%)	Lower extremity n (%)	p-value
Lipoma	229	53 (28.4)	99 (39.0)	34 (26.8)	43 (24.7)	**0.001**
Fibrolipoma	39	15 (7.0)	14 (5.5)	2 (1.6)	8 (4.6)	
Liposarcoma	12	1 (0.5)	7 (2.8)	-	4 (2.3)	
Neurofibroma	31	6 (2.8)	14 (5.5)	2 (1.6)	9 (5.2)	
Plexiform neurofibroma	5	1 (0.5)	1 (0.4)	2 (1.6)	1 (0.6)	
Schwannoma	3	1 (0.5)	1 (0.4)	-	1 (0.6)	
Malignant peripheral nerve sheath tumor	2	-	1 (0.4)	-	1 (0.6)	
Glomus tumour	3	-	1 (0.4)	2 (1.6)	-	
Rhabdomyosarcoma	29	8 (3.7)	7 (2.8)	3 (2.4)	11 (6.3)	
Dermatofibroma	23	2 (0.9)	8 (3.1)	5 (3.9)	8 (4.6)	
Fibroma	15	7 (3.3)	6 (2.4)	1 (0.8)	1 (0.6)	
Ossifying fibroma	2	2 (0.9)	-	-	-	
Fibromatosis	5	-	4 (1.6)	-	1 (0.6)	
Granular cell tumour	2	1 (0.5)	-	1 (0.8)	-	
Myxoma	1	1 (0.5)	-	-	-	
Fibromyxoma	4	2 (0.9)	-	1 (0.8)	1 (0.6)	
Dermatofibrosarcoma protuberans	24	3 (1.4)	14 (5.5)	4 (3.1)	3 (1.7)	
Fibrosarcoma	65	4 (1.9)	33 (13.0)	2 (1.6)	26 (14.9)	
Capillary haemangioma	135	77 (36.0)	21 (8.3)	21 (16.5)	16 (9.5)	
Lymphangioma	6	3 (1.4)	1 (0.4)	-	2 (1.1)	
Angiosarcoma	4	1 (0.5)	-	1 (0.8)	2 (1.1)	
Giant cell tumour	23	-	1 (0.4)	17 (13.4)	5 (2.9)	
Osteosarcoma	15	-	1 (0.4)	1 (0.8)	13 (7.5)	
Chondrosarcoma	5	1 (0.5)	-	-	4 (2.3)	
Ganglion cyst	36	-	3 (1.2)	25 (19.7)	8 (4.6)	
Angiomyolipoma	2	-	2 (0.8)	-	-	
Cavernous haemangioma	22	15 (7.0)	5 (2.0)	1 (0.8)	1 (0.6)	
Leiomyosarcoma	10	-	8 (3.1)	-	2 (1.1)	
Pyogenic granuloma	17	10 (4.7)	2 (0.8)	2 (1.6)	3 (1.7)	
Total	769	214 (100.0)	254 (100.0)	127 (100.0)	174 (100.0)	

The results are significant where $p<0.05$ at 95% confidence interval

In our study, adipose tissue-derived lesions were the most common, constituting 38.4% of the cases, followed by vascular tissue-derived and fibroblastic tissue-derived lesions constituting 20.6% and 18.8% of the cases, respectively. These observations were consistent with the findings of the study conducted by Singh et al. (23).

Also, we found that lipoma was the most common benign soft tissue neoplasm, accounting for 32.1% of our study cases. This finding is consistent with that of Singh et al. (23), who reported lipomas in 29.3% of their cases. Furthermore, we found that liposarcoma, the malignant counterpart of lipoma, accounted for 1.3% of all soft tissue lesions studied. Our finding aligns with the results of Vhriterhire et al. (14), who reported that liposarcoma constituted 2.1% of all soft tissue lesions they studied.

Notably, the vascular tissue-derived lesions found in our study were primarily hemangioma and angiosarcoma. Hemangioma was the most common vascular tissue-derived lesion, with capillary hemangioma being the most common benign vascular neoplasm, accounting for 16.3% of the cases in our study. Our observation was in agreement with that of Singh et al. (23). Interestingly, malignant vascular tissue-derived neoplasms were rare in our study, with angiosarcoma

Table 5. Yearly fluctuation in the incidence of derivatives of bone and soft tissue lesions in University of Ilorin Teaching Hospital

Yearly fluctuation	Frequency	%	Adipose n (%)	Neural n (%)	Smooth muscle n (%)	Fibrous tissue n (%)	Blood vessels n (%)	Bone, cartilage, and tendon sheath n (%)	Bone n (%)	p-value
1985	23	2.4	7 (1.9)	-	1 (2.0)	4 (2.2)	9 (4.5)	2 (5.6)	-	**0.001**
1986	27	2.8	6 (1.6)	1 (1.8)	1 (2.0)	9 (4.9)	9 (4.5)	-	1 (1.4)	
1987	41	4.2	8 (2.1)	5 (8.9)	2 (4.0)	12 (6.6)	9 (4.5)	1 (2.8)	4 (5.5)	
1988	24	2.5	4 (1.1)	1 (1.8)	2 (4.0)	6 (3.3)	9 (4.5)	1 (2.8)	1 (1.4)	
1989	9	0.9	1 (0.3)	-	-	4 (2.2)	2 (1.0)	1 (2.8)	1 (1.4)	
1990	26	2.7	10 (2.7)	-	3 (6.0)	8 (4.4)	4 (2.0)	-	1 (1.4)	
1991	20	2.1	11 (2.9)	-	1 (2.0)	5 (2.7)	2 (1.0)	-	1 (1.4)	
1992	28	2.9	10 (2.7)	2 (3.6)	1 (2.0)	5 (2.7)	5 (2.5)	2 (5.6)	3 (4.1)	
1993	15	1.5	3 (0.8)	-	2 (4.0)	4 (2.2)	-	2 (5.6)	4 (5.5)	
1994	26	2.7	7 (1.9)	2 (3.6)	6 (12.0)	4 (2.2)	2 (1.0)	-	5 (6.8)	
1995	20	2.1	3 (0.8)	2 (3.6)	1 (2.0)	9 (4.9)	2 (1.0)	2 (5.6)	1 (1.4)	
1996	18	1.9	6 (1.6)	1 (1.8)	2 (4.0)	1 (0.5)	7 (3.5)	1 (2.8)	-	
2001	45	4.6	22 (5.9)	6 (10.7)	3 (6.0)	3 (1.6)	9 (4.5)	-	2 (2.7)	
2003	37	3.8	19 (5.1)	6 (10.7)	2 (4.0)	5 (2.7)	3 (1.5)	1 (2.8)	1 (1.4)	
2006	78	8.0	33 (8.8)	3 (5.4)	2 (4.0)	11 (6.0)	20 (10.0)	5 (13.9)	4 (5.5)	
2007	99	10.2	34 (9.1)	5 (8.9)	5 (10.0)	21 (11.5)	19 (9.5)	6 (16.7)	9 (12.3)	
2008	88	9.1	36 (9.7)	3 (5.4)	5 (10.0)	20 (11.0)	12 (6.0)	1 (2.8)	11 (15.1)	
2009	103	10.6	41 (11.0)	6 (10.7)	4 (8.0)	19 (10.4)	24 (12.0)	4 (11.1)	5 (6.8)	
2012	65	6.7	35 (9.4)	3 (5.4)	2 (4.0)	5 (2.7)	9 (4.5)	-	11 (15.1)	
2013	59	6.1	28 (7.5)	1 (1.8)	2 (4.0)	11 (6.0)	10 (5.0)	3 (8.3)	4 (5.5)	
2014	61	6.3	26 (7.0)	6 (10.7)	2 (4.0)	5(2.7)	18 (9.0)	1 (2.8)	3 (4.1)	
2016	58	6.0	23 (6.2)	3 (5.4)	1 (2.0)	11(6.0)	16(8.0)	3 (8.3)	1 (1.4)	
Total	970	100	373 (100.0)	56 (100.0)	50 (100.0)	182 (100.0)	200 (100.0)	36 (100.0)	73 (100.0)	

The results are significant where p<0.05 at 95% confidence interval

accounting for 0.4% of our study cases. Similarly, Singh et al. (23), reported two cases of angiosarcoma among 270 STTs studied.

Schwannomas, and neurofibromas were the most common benign peripheral nerve sheath tumors (PNSTs) observed in our study, and this finding is consistent with other relevant studies (4,19). The common sites for benign PNST were the trunk, followed by the head and neck region. This finding was comparable to the findings of Singh et al. (23). Interestingly, only two cases of malignant PNST were seen in the trunk and lower extremities in this study.

In our study, the neoplasms of skeletal muscle tissue-derivation were all malignant, being mainly rhabdomyosarcoma, which accounted for 3.6% of all soft tissue lesions studied. Rhabdomyosarcomas were commonly found in the lower extremities. Interestingly, our findings contrast sharply with those of Singh et al. (23), who reported that the head and neck region was the most common site for rhabdomyosarcoma occurrence.

The major malignant soft tissue neoplasm in our study was fibrosarcoma. This finding contrasts with the incidence of malignant soft tissue neoplasms in Europe, where leiomyosarcoma was found to be the most common malignant soft tissue neoplasm (17,18). Also, a similar study conducted in Thailand revealed that the most common malignant soft tissue neoplasm was unspecified sarcoma (accounting for 24% of their cases) followed by leiomyosarcoma and liposarcoma (26). Our finding is, however, in agreement with previous bone and soft tissue studies conducted in our center by Adeniji et al. (27) and Wemimo et al. (28).

In our study, the primary benign bone lesions were more common than malignant bone lesions. This finding is consistent with the results of Obalum et al. (7), and Aina et al. (6). Also, we found that the most common benign bone neoplasm was giant cell tumour, and this contrasts with the findings of some researchers who found osteochondroma as the most common benign bone neoplasm (6-9). Notably, osteosarcoma and

chondrosarcoma were the most common malignant primary bone neoplasms in our study, and this finding is consistent with results from other relevant studies (5-9).

The limitations of our study were derived from its retrospective nature in that we could not find the histopathology registers and files, for archiving pathology laboratory request forms and reports, for ten years within the study period of 1985 to 2016. The missing years were 1997 to 2000, 2002, 2004 to 2005, 2010 to 2011, and 2015. Also, we could not carry out ancillary histopathological studies of the bone and soft tissue lesions, such as immunohistochemistry, cytogenetics/karyotypic studies, and polymerase chain reaction studies, because of a lack of resources. Furthermore, the findings of our study cannot be generalized to the entire country because it is a single-center study. Thus, for further study, we would like to conduct a more robust multi-center study and include ancillary histopathological studies. Additionally, we would like to conduct both single-center and multi-center prospective bone and soft tissue studies with the inclusion of ancillary histopathological studies where all the quality control variables will be managed by the authors.

Conclusion

Our study identified seven soft tissue derivatives, with adipose tissue being the most prevalent. Lipoma emerged as the most common specific soft tissue lesion, while fibrosarcoma was the most frequent malignant soft tissue neoplasm. Among bone neoplasms, giant cell tumor was the most common. Clinically, these findings highlight the importance of focusing on diagnostic and therapeutic efforts on these prevalent tumors to improve patient outcomes.

Ethics

Ethics Committee Approval: The study was approved by the Rasheed Shekoni Federal University Teaching Hospital, Dutse Institutional Ethics Committee (decision number: RSFUTH/GEN/226/V.II, date: 28.11.23).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: U.B.E., N.A.I., I.S., A.A.H., Concept: M.W.R., E.A.A., Design: M.W.R., U.B.E., I.S., E.A.A., Data Collection or Processing: M.W.R., U.B.E., A.A.A., N.A.I., I.S., A.A.H., Analysis or Interpretation: M.W.R., U.B.E., A.A.A., A.A.H., E.A.A., Literature Search: M.W.R., U.B.E., A.A.A., N.A.I., I.S., E.A.A., Writing: M.W.R., U.B.E., A.A.A., N.A.I.

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Evaluation of pregnancy planning and contraceptive methods in patients with systemic lupus erythematosus

Özlem Karakaş[1], Dudu Çelik Tam[2], Pınar Akyüz Dağlı[3], Bahar Özdemir Ulusoy[4], Berkan Armağan[2], Şükran Erten[5]

[1]Kırıkkale University Faculty of Medicine, Department of Internal Medicine, Division of Rheumatology, Kırıkkale, Türkiye
[2]Ankara Bilkent City Hospital, Clinic of Rheumatology, Ankara, Türkiye
[3]University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Rheumatology, Ankara, Türkiye
[4]University of Health Sciences Türkiye, Ankara Gaziler Physical Therapy and Rehabilitation Training and Research Hospital, Clinic of Rheumatology, Ankara, Türkiye
[5]Ankara Yıldırım Beyazıt University Faculty of Medicine, Ankara Bilkent City Hospital, Department of Rheumatology, Ankara, Türkiye

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Corresponding Author:
Özlem Karakaş, M.D., Kırıkkale University Faculty of Medicine, Department of Internal Medicine, Division of Rheumatology, Kırıkkale, Türkiye
ozlem01us@yahoo.com

ORCID:
orcid.org/0000-0002-3031-3353

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ABSTRACT

Aims: Women's educational background plays a crucial role in family planning, chronic disease management, and treatment adherence. Chronic diseases and the use of rheumatological medications can raise various concerns, influencing family planning decisions. This study aimed to evaluate pregnancy-related status, contraceptive methods, and factors contributing to pregnancy-related concerns in female patients with systemic lupus erythematosus (SLE) and to compare these findings based on educational levels.

Methods: This cross-sectional study included women aged 18-49 diagnosed with SLE based on the 2019 European Alliance of Associations for Rheumatology/American College of Rheumatology classification criteria. Participants were eligible if they were planning a pregnancy, currently pregnant, or had a prior pregnancy history. Patients with overlapping autoimmune diseases or those unwilling to participate were excluded. The primary outcome was the assessment of pregnancy-related concerns and contraceptive methods. Data were collected through structured interviews and analyzed using statistical tests to compare groups based on educational levels.

Results: A total of 71 female patients were included, with a median age of 42 years [interquartile range (IQR): 36-48], and the majority were married (75.3%). The median disease duration was 9 years (IQR: 5-14). Only 25.0% of the patients consulted their physician before planning a pregnancy, and 37.1% used contraception. The most commonly used contraception methods were condoms (17.8%), intrauterine devices (14.5%), and oral contraceptives (4.8%). The most common concern was the belief that medications could harm the baby (32.7%). No significant differences were observed in primary outcomes when comparing educational levels ($p>0.05$).

Conclusions: This study highlights low rates of preconception counseling and contraceptive use among female SLE patients, as well as prevalent concerns regarding pregnancy-related risks.

Introduction

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease that characterized by a wide range of clinical manifestations, from mild symptoms to life-threatening organ involvement. The clinical onset of SLE in genetically predisposed individuals results from the interaction of environmental, immunological, and hormonal factors. Since the disease frequently affects women of childbearing age, fertility and pregnancy-related issues are a significant part of SLE management (1). Advances in diagnostic and therapeutic approaches have led to significant improvements in the clinical management of the disease, with enhanced survival rates among patients. With enhanced life expectancy and quality of life, individuals with SLE are expressing a growing desire to marry and have children, posing important clinical challenges for healthcare providers (2).

Hormonal changes during pregnancy can trigger SLE flare-ups. Additionally, factors such as pre-existing organ damage, autoantibodies, and treatment medications may significantly impact maternal and fetal health (3). Various clinical studies have demonstrated that pregnancy-related complications-including recurrent miscarriages, preterm birth, fetal death, congenital heart block, and intrauterine growth restriction-occur at significantly higher rates in women with SLE compared to those without the disease (4-6).

Effective pregnancy planning and management in SLE patients require a comprehensive, multi-phase approach, including preconception counseling, disease monitoring and treatment during pregnancy, management of complications, fetal monitoring, breastfeeding, postpartum follow-up, and newborn care (2). Additionally, factors such as education level and access to healthcare services also influence pregnancy decisions and treatment adherence. A study evaluating factors affecting women's access to healthcare services in Türkiye highlighted that demographic characteristics such as women's education levels, employment status, and number of children are significant determinants of healthcare accessibility (7). According to the 2023 data from the Turkish Statistical Institute, 44% of women in Türkiye have completed high school and higher education (8). Another study in Türkiye demonstrated that education level influences healthcare service utilization, with higher education levels being associated with fewer children and improved child survival rates (9).

Despite these findings, no previous studies in Türkiye have specifically examined the perspectives of women with SLE on pregnancy. This study aims to assess the pregnancy-related status of female SLE patients, their contraceptive methods, and the factors contributing to pregnancy-related concerns. Additionally, we aim to compare these findings based on the patients' educational levels to evaluate the perspectives of women with SLE-on-pregnancy.

Methods

Study design and patient selection

This study was conducted using a cross-sectional design. Female patients aged 18 and older, diagnosed with SLE and followed at the Rheumatology Clinic of Ankara Bilkent City Hospital, were evaluated. Among them, 71 patients who agreed to participate were included in the study after face-to-face interviews.

The inclusion criteria consisted of women aged 18-49 diagnosed with SLE met one or more of the following conditions: planning to become pregnant at any point in their lives, currently pregnant or having a history of pregnancy. Exclusion criteria included patients who did not meet the 2019 European Alliance of Associations for Rheumatology/American College of Rheumatology classification criteria for SLE (10), those with an additional autoimmune disease (e.g., overlap syndromes, Sjogren's syndrome, scleroderma, inflammatory myositis), individuals under 18 years old, and those unwilling to complete the survey.

The Clinical Research Ethics Committee of Ankara Bilkent City Hospital approved the study (decision number: E1-23-3567, date: 10.05.2023) and conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Data collection

Demographic and clinical data

Demographic characteristics including age, marital status, and educational level were recorded. Information regarding planned and unplanned pregnancies, preconception counseling, decision-making in pregnancy, and contraceptive methods [e.g., condom, oral contraceptives, intrauterine devices (IUDs)] was collected. The withdrawal method was not considered a form of contraception.

Assessment of pregnancy-related concerns

To assess pregnancy-related concerns among female SLE patients, all participants were asked the following eight questions:

1. Fear of being unable to care for the child,
2. Belief that rheumatologic medications would harm the baby,
3. Concern that the disease could be passed on to the baby,
4. Belief that SLE may lead to early death in the patient,
5. Doctor's opposition to pregnancy due to the rheumatologic condition,
6. Previous experiences of pregnancy loss(es),
7. Previous complications during pregnancy,
8. Fear disease flare-ups during and after pregnancy.

Given that educational level may influence pregnancy planning, patients were categorized based on their educational background. For analysis, they were divided into two groups: those with primary education or less (Group 1, n=36) and those with high school education or higher (Group 2, n=35).

Outcomes

The primary outcome was the assessment of pregnancy-related concerns, contraceptive methods, and the factors contributing to these concerns. The secondary outcome was to evaluate the perspectives of women with SLE on pregnancy by comparing these findings based on the patients' educational levels.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was evaluated using the Shapiro-Wilk test and visually through plots and histograms. Continuous variables were presented either as median (minimum-maximum) or mean±standard deviation (SD), according to normality. Categorical variables were compared between groups using the Pearson Chi-squared test. Independent-samples t and Mann-Whitney U tests were used for the comparison of continuous variables, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

Demographic characteristics

A total of 71 female patients were included, with a median age of 42 years (range: 19-69). The median disease duration was 9 years (range: 0-28). There were 20 postmenopausal patients. Among them, 15 (75.0%) were diagnosed with SLE after completing all their pregnancies. Two patients (10.0%) were diagnosed with SLE without ever having been pregnant. Of the patients, 75.3% were married, and 11.7% were divorced.

Pregnancy and contraception patterns

The median number of pregnancies was 3 (range: 0-11), with a median of 2 planned pregnancies (range: 0-8). The median number of live births was 2 (range: 0-6). When evaluating who primarily initiated the desire to become pregnant, it was found that in 60.0% of the patients, the decision to become pregnant was initiated by the patient herself, while in 11.1% of cases, the decision was initiated by the partner. In 26.7% of the patients, pregnancy was planned through a mutual decision between the patient and partner. The rate of consulting a physician to plan pregnancy was found to be 25.0%. The overall rate of contraception use was determined to be 37.1%. Among the contraceptive methods used, condoms were the most common at 17.8%, followed by IUDs at 14.5% and oral contraceptives at 4.8%. The oral contraceptives used are often preparations containing combined estradiol and progesterone.

Educational status and pregnancy outcomes

SLE patients were compared in two groups based on their educational level. Group 1 included patients with primary education or less, and Group 2 included patients with high school education or higher. Among the patients, 44.2% (n=36) had completed primary education (8 years), 26% (n=20) had completed high school, and 19.5% (n=15) were university graduates. The baseline characteristics of these two groups are presented in Table 1. Group 1 patients had a higher mean age (SD) and median [interquartile range (IQR)] disease duration compared to Group 2 [48.1 (9.3) vs. 38.3 (10.1) years, $p<0.001$, and 12 (8) vs. 8 (9) years, $p=0.01$, respectively]. In terms of marital status, 91.7% of Group 1 patients were married, compared to 64.1% of Group 2 patients ($p=0.003$). The median (IQR) number of pregnancies and the median (IQR) number of planned pregnancies was higher in Group 1 than in Group 2 [3 (1) vs. 2 (3), $p<0.001$, and 2.5 (2) vs. 1 (2), $p=0.013$, respectively]. There was no significant difference between the groups in terms of who made the decision to become pregnant. However, pregnancy initiated by the partner and family was more common in Group 1, while more patients in Group 2 made the decision independently. There were no significant differences between the groups in terms of consulting a physician before planning a pregnancy, the use of contraception, or the type of contraception used.

When evaluating the responses to the eight questions assessing the concerns of female SLE patients about pregnancy and having children, the most common concern was the belief that rheumatologic medications might harm the baby (32.7%). Other concerns included fear of a disease flare-up during and after pregnancy (20.4%), the fear of being unable to care for the child (16.3%), the concern that the disease would be passed on to the baby (16.3%), the doctor's opposition to pregnancy due to the rheumatologic condition (14.3%), previous complications during pregnancy (14.3%), the belief that the disease may lead to early death in the patient (12.2%), and previous experiences of pregnancy loss(es) (12.2%). When comparing the two educational groups, no significant differences were found regarding these concerns (Figure 1).

Discussion

In the study, 60% of female patients with SLE expressed the desire to become pregnant. The rate of consulting a physician to plan pregnancy before conception was 25.0%, and the rate of contraception use was 37.1%. When stratified by educational level, no significant differences were observed in terms of who initiated the desire for pregnancy, consultation rates for preconception planning, or contraception use. Regarding

Table 1. Comparison of demographic and pregnancy characteristics in systemic lupus erythematosus patients based on educational level

	Primary education or below, n=36	High school or above, n=35	p-value
Age, years, mean±SD	48.1±9.3	38.3±10.1	**<0.001**
Disease duration, years, median (IQR)	12 (8)	8 (9)	**0.010**
Marital status, n (%) - Married - Divorced - Single	 33 (91.7) 3 (8.3) 0	 22 (63.0) 5 (14.2) 8 (22.8)	**0.003**
Number of pregnancies, median (IQR)	3 (1)	2 (3)	**<0.001**
Number of planned pregnancies, median (IQR)	2.5 (2)	1 (2)	**0.013**
Who decided on the pregnancy, n (%) - Patient - Partner - Joint decision (patient and partner) - Family	 13 (36.1) 4 (11.1) 6 (16.6) 1 (2.7)	 14 (40.0) 1 (2.8) 6 (17.2) 0	 0.501
Planned pregnancy with consultation from physician before pregnancy, n (%)	6 (16.6)	6 (17.2)	0.738
Use of any contraceptive method, n (%)	11 (30.5)	12 (34.3)	0.394

SD: Standard deviation, IQR: Interquartile range

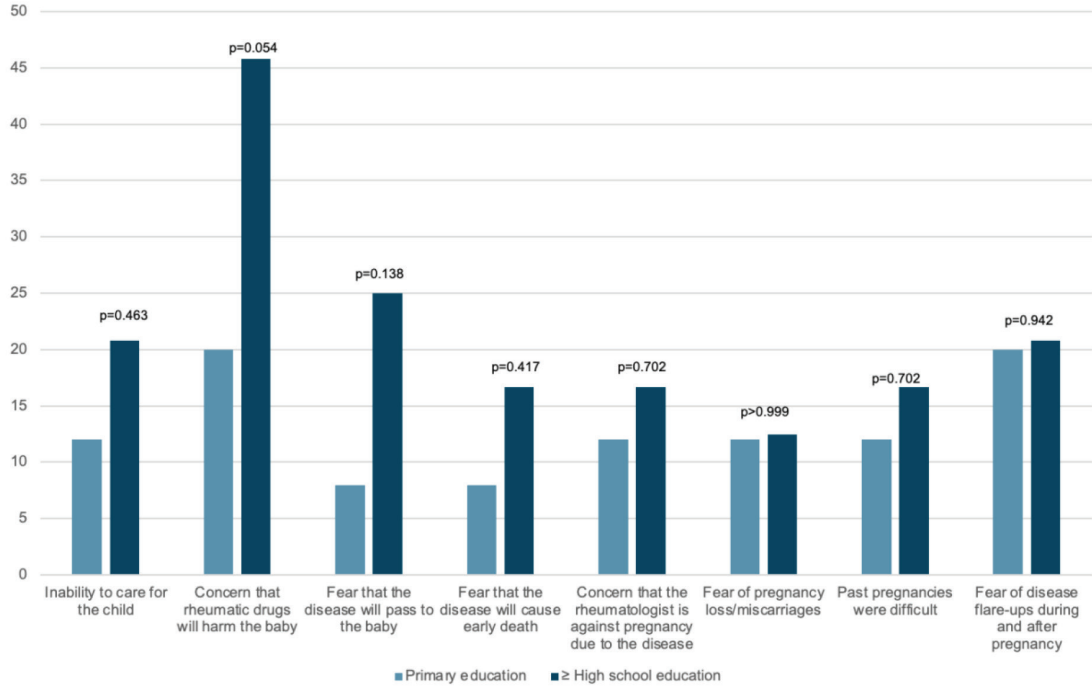

Figure 1. Comparison of the reasons that negatively affect pregnancy desire in women with systemic lupus erythematosus according to educational status

pregnancy-related concerns, more than one-third of the patients expressed worry about the potential teratogenic effects of rheumatologic medications, and one-fifth were concerned about disease flare-ups during or after pregnancy.

As SLE commonly affects women of reproductive age, it is crucial that patients receive proper information about pregnancy planning and disease management before, during, and after pregnancy. However, there is limited research on this topic both in our country and globally. In our study, we found that 60% of women with SLE made the decision to become pregnant themselves. Upon reviewing the literature, we could not find any study that specifically evaluated the role of family or partner influence versus personal decision-making regarding pregnancy in SLE patients. Studies have shown that SLE patients tend to

have smaller families with fewer children (11,12). In this study, the median number of live births was two. Education can influence family relationships and decisions about childbirth. Higher education and longer schooling often lead to later marriages, delayed childbearing, and smaller family sizes (13,14). In the study, we observed that patients with lower education levels had more children; however, these patients were, on average, 10 years older than those with higher education levels, making direct comparisons challenging.

Despite the importance of pregnancy timing for SLE patients, there has been a lack of focus on contraceptive counseling and recommendations, leading to the underuse of effective contraceptive methods in this patient population (12). In the study, 37.1% of patients used some form of contraception. A separate study conducted in Türkiye with 113 SLE patients found that 20.3% of patients did not use any contraceptive method (15). The most commonly used contraceptive method among our patients was condoms (17.8%). A similar study in the literature also showed that condoms were the most preferred contraceptive method among SLE patients (16). SLE patients, especially during periods of high disease activity, should receive contraceptive counseling to prevent unplanned pregnancies and manage teratogenic drug use. IUDs can be recommended to all patients unless there is a gynecological contraindication. The safety of combined (estrogen plus progestin) and progestin-only contraceptives has been demonstrated in randomized controlled trials for SLE patients who are negative for antiphospholipid antibodies (aPL) (17). However, combined hormonal contraceptives should not be recommended for women whose tests were positive for aPL antibodies. Progestin-only methods (e.g., pills, subcutaneous depot injections) may be suitable for these women, though their use should be evaluated in light of the associated thrombosis risk. Estrogen therapy may be considered for the management of persistent gynecological issues that cannot be managed otherwise. While copper IUDs can be used in all patients, levonorgestrel-releasing IUDs should be considered only if the benefits (e.g., reducing menstrual bleeding in patients who are using an anticoagulant) outweigh the risks of thrombosis. In our study, only one patient reported using a hormonal IUD.

Preconception pregnancy planning is critically important for both maternal and fetal health in women with SLE (18,19). Family planning should be discussed as early as possible after the diagnosis of the disease. This approach allows most women to have healthy and successful pregnancies while ensuring timely measures are taken to reduce the risks of adverse maternal and/or fetal outcomes (18). The best pregnancy outcome will be achieved in patients who are in remission for 6 months before conception (20). Patients at high risk due to disease flare-ups should postpone pregnancy until the disease is well-controlled (21).

Given that pregnancy rates among SLE patients have increased in recent years, healthcare providers must pay greater attention to pregnancy management (19). A study reveals that the majority of SLE patients received preconception counseling in a non-multidisciplinary approach, and 16% of those ultimately decided not to pursue pregnancy (22). Another study from the United States revealed that over 60% of women with any rheumatologic disease did not receive documented pregnancy planning counseling (23). While there are no similar studies specifically focused on SLE, we found that only 25% of our patients consulted their physician for pre-pregnancy planning, and there were no differences between education levels in this regard. Based on the results of our study, family planning should be regularly addressed as part of the management of SLE, beginning as early as possible, ideally shortly after diagnosis, through a multidisciplinary approach.

The disease course and treatment modalities required for SLE can affect patients' personal relationships and decisions about having children. Factors that may influence patients' concerns about pregnancy and childbearing include disease activity, the belief that medications used during the disease course may harm the pregnancy process or baby, recurrent pregnancy losses, and previous pregnancy complications (1,24). One-third of childless women with SLE attribute their lack of children to the disease (22). The responses to the questions we asked our patients are consistent with the concerns reported in the literature. The most common concerns were that rheumatologic medications could harm the baby and that the disease might flare up during or after pregnancy. There were no statistically significant differences between education groups regarding any of the questions. However, the concern that rheumatologic medications could harm the baby, approaching statistical significance ($p=0.054$), was more common among those with higher education levels. This suggests that increasing the level of education may bring different concerns to the fore.

There are several limitations of this study. The most significant factors are a small sample size and the lack of assessment of disease activity, organ damage, or treatment regimens. Additionally, the study was conducted at a single center, which may limit the representation of different socioeconomic groups compared to multicenter studies involving university and private hospitals.

Assessing risk factors for adverse maternal and fetal outcomes in pregnant women with SLE is crucial for preconception counseling and the implementation of appropriate preventive strategies and patient-specific monitoring plans during pregnancy.

Conclusion

This study found that the desire for pregnancy was mostly initiated by the patients themselves. However, the

rates of preconception counseling and contraceptive use were low. There were no significant differences between education groups in these aspects. Providing information about pregnancy to SLE patients as early as possible after diagnosis may increase the use of effective contraception and lead to more planned pregnancies. Additionally, educating patients about the rheumatologic medications used during pregnancy and breastfeeding and discussing the risk of disease flare-ups were among the key concerns raised by our patients. Increasing awareness and providing family planning information to SLE patients, particularly through rheumatology and gynecology specialists, should be a priority in the preconception period.

Ethics

Ethics Committee Approval: The Clinical Research Ethics Committee of Ankara Bilkent City Hospital approved the study (decision number: E1-23-3567, date: 10.05.2023).

Informed Consent: Consent form was filled out by all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: B.A., Ş.E., Concept: Ö.K., P.A.D., B.A., Design: Ö.K., D.Ç.T., B.A., Data Collection or Processing: Ö.K., B.Ö.U., Analysis or Interpretation: B.A., Ş.E., Literature Search: D.Ç.T., B.Ö.U., Ş.E., Writing: Ö.K., P.A.D.

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Effect of examination findings on forensic report results in traumatic cutaneous-subcutaneous tissue injuries: a retrospective study

Hüseyin Balandız[1], Duran Güralp Çelik[1], Burak Kaya[2], Halit Canberk Aydoğan[3], Sait Özsoy[1], Alperen Selvi[1]

[1]University of Health Sciences Türkiye, Gülhane Faculty of Medicine, Department of Forensic Medicine, Ankara, Türkiye
[2]Artvin Branch of the Council of Forensic Medicine, Artvin, Türkiye
[3]Ordu University Training and Research Hospital, Ordu, Türkiye

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Corresponding Author:
Hüseyin Balandız, M.D., University of Health Sciences Türkiye, Gülhane Faculty of Medicine, Department of Forensic Medicine, Ankara, Türkiye
huseyinbalandiz@gmail.com

ORCID:
orcid.org/0000-0002-8619-8550

Keywords: Soft tissue injuries, examination findings, forensic report

ABSTRACT

Aims: Accurate recording of the findings obtained during the first examination of forensic cases is of great importance for the forensic reports to be prepared afterwards. The aim of this study was to determine whether there is a difference between the initial and final examination of cutaneous injuries after trauma, and how this difference affects the result of the forensic report.

Methods: The study was designed as a retrospective analysis based on forensic reports prepared between January 1, 2020, and July 20, 2024, at the Department of Forensic Medicine, Gülhane Training and Research Hospital, University of Health Sciences, Türkiye. A total of 1,221 cases with cutaneous-subcutaneous traumatic tissue injuries were eligible for inclusion in the study.

Results: Of the 1,221 cases, 84.1% were male and the mean age was 36.7 years. 51.9% (n=634) of the injuries were “NOT MILD enough to be resolved with simple medical intervention”, and the injury was considered to be a facial fixed scar in 3.3% of cases. In 239 of the 365 cases re-examined some discrepancies in lesion size were found; the size of the lesions was smaller than indicated in the medical records in 65.9%, while it was larger in 34.1% of these cases. These differences in lesion size were found to change the outcome of the forensic report in 28 cases ($\chi^2 = 617.24$, $p<0.001$).

Conclusions: Our study revealed that the majority of physicians inaccurately reported the wound sizes of forensic cases, either as larger or smaller than they actually were. Since this situation will change the outcome of the forensic report and impact the judgment process, victimization will be inevitable. In order not to cause any victimisation in forensic cases, physicians should prepare a report using metric measuring instruments for the dimensions of cutaneous lesions in physical examination.

Introduction

Trauma is defined as physical or psychological harm to a person. Physical trauma includes cases such as assault, stabbing, traffic accidents, falls, burns, torture, sexual offences, neglect, and abuse. Each of these is a forensic case (1). The section on intentional injury offences in the Turkish Penal Code (TPC) (2) stipulates some penalties for those who intentionally harm a person’s body. In order to make a judgement regarding these penalties, a forensic report is needed. In forensic medicine practice, these forensic reports have two stages:

first, the "General Forensic Examination Report" prepared by the physician who first saw the patient; second, the forensic report indicating the last condition of the patient, which is usually prepared by forensic medicine specialists and is used in legal proceedings. The injury weights in all these forensic reports should be organized using "Guidelines for the Evaluation of Injury Crimes Defined in the TPC in Terms of Forensic Medicine" (3).

Since the emergency departments of hospitals are the first center where forensic cases are presented, the obligation to report forensic cases and the responsibility for preparing forensic reports falls largely on emergency physicians. A physician who encounters a forensic case should definitely prepare a forensic report after performing medical intervention on the patient. In these forensic reports, which are organised under the name of "General Forensic Examination Form" the entire physical examination of the patient should be written down and the results of the examinations and consultations should be prepared completely (4).

Cases in which forensic medicine specialists are requested by the judicial authorities to prepare a forensic report in accordance with Articles 86-87 of the TPC (2) can be submitted both through the relevant file and by outpatient application to forensic medicine polyclinics. The findings of the initial examination of the forensic case in the emergency department and the final examination performed by the forensic medicine specialist are important in preparing a forensic report.

One of the major problems faced by forensic medicine experts is the lack of medical documentation in cases where a forensic report is requested, and the discrepancies between the initial and final examination findings due to the initial findings not being properly recorded. These disputes may have a direct impact on the outcome of the forensic report and result in individuals losing their legal rights.

The aim of this study is to analyse the differences between the initial examination findings documented in general forensic examination reports and the final examination findings recorded in forensic medicine outpatient clinics in forensic cases with cutaneous-subcutaneous injuries. In addition, it is investigated whether these differences affect the outcome of forensic reports.

Methods

Study design and patient selection

The study was designed as a retrospective analysis based on forensic reports prepared between January 1, 2020, and July 20, 2024, at the Department of Forensic Medicine, Gülhane Training and Research Hospital, University of Health Sciences, Türkiye. A total of 7,167 forensic reports were analysed. A total of 1221 patients with post-traumatic cutaneous and subcutaneous tissue injuries were eligible for inclusion in the study. Only the initial examination findings of patients with more than one admission [evaluation of fixed facial scar (FFS), evaluation of sensory-organ dysfunction or loss of function, etc.] were included in the study. This study was conducted with the approval of the University of Health Sciences Türkiye, Gülhane Scientific Research Ethics Committee (decision number: 2024-587, date: 10.12.2024).

Data collection and data assessment

The study evaluated parameters such as age, gender, origin of the incident, lesion size, whether the injury was mild enough to be treated with simple medical intervention (SMI), whether it was a fixed scar on the face, the differences in lesion size between the previous medical documents relating to the incident and our own examination, and whether these differences affected the outcome of the forensic report.

The classification criteria for the size of trauma-related cutaneous-subcutaneous lesions were determined according to the data specified in Table 2 (traumatic changes involving cutaneous-subcutaneous-muscular tissue) of the "Guidelines for the Evaluation of Injury Crimes Defined in the TPC in Terms of Forensic Medicine (Association of Forensic Medicine Specialists, June 2019)" (3).

According to the guidelines for the evaluation of injury crimes defined in the TPC in terms of forensic medicine, Table 2, which presents Traumatic Changes Involving Cutaneous-Subcutaneous-Muscular Tissue is provided blow (3):

<5 cm as a single lesion in the scalp and facial area, <10 cm in total, <10 cm as single lesion in other parts of the body, in total <20 cm cutaneous-subcutaneous injuries	MILD
≥5 cm as a single lesion in the scalp and facial area, ≥10 cm in total, ≥10 cm as a single lesion in other parts of the body, in total ≥20 cutaneous-subcutaneous injuries	NOT MILD

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean or median (minimum–maximum), while categorical variables were presented as number and percentage. The Shapiro-Wilk test was used to assess the normality of continuous variables, while the Chi-square and Binomial tests were applied to evaluate categorical data and proportions, respectively. A p-value of <0.05 was considered statistically significant.

Results

Of the 1221 patients with trauma-related cutaneous and subcutaneous tissue injuries, 84.1% (n=1027) were male, 15.9% (n=194) were female, and the mean age was 36.7 years (±16.2) (Figure 1).

It was found that 29.9% (n=365) of the cases were examined in our forensic medicine outpatient clinic, while 70.1% (n=856) received a forensic report via case files. Injuries occurred most frequently in March with a rate of 11.5% (n=141) and least frequently in August with a rate of 2.3% (n=28) (Figure 1).

When the cases were analysed according to the origin of the injury, it was determined that the most common causes of injury were assaults (n=455, 37.3%), traffic accidents (n=343, 28.1%), and penetrating stab wounds (n=341, 27.9%). The origin of the injuries is shown in Figure 2.

When the cutaneous-subcutaneous wound characteristics of all cases were evaluated [according to the article "Traumatic changes involving the cutaneous-subcutaneous-muscular tissue, Table 2, (shown in methods section)" in the guideline for the evaluation of injury crimes defined in the Turkish penal code in terms of forensic medicine];

a. 7.7% (n=94) of the cases had a cutaneous-subcutaneous lesion ≥5 cm as a single lesion on the scalp and face,

b. 43.6% of the cases (n=532) had cutaneous-subcutaneous lesions of less than 10 cm in total on the scalp and face,

c. 5.8% of the cases (n=70) had cutaneous-subcutaneous lesions of ≥10 cm in total on the scalp and face,

d. 1.4% of the cases (n=17) had ≥10 cm cutaneous-subcutaneous lesions as a single lesion in other parts of the body (no lesion on the face and scalp),

e. 39.5% of the cases (n=482) had cutaneous-subcutaneous lesions less than 20 cm in total on the whole body,

f. 2.1% of the cases (n=26) had cutaneous-subcutaneous lesions of ≥20 cm in total distributed over the whole body.

In 3.3% (n=41) of all cases (n=1221), the injury was considered to be a FFS. The frequency of facial fixed scars according to lesion size and location is shown in Table 1.

It was found that 51.9% (n=634) of the injuries were "NOT MILD enough to be resolved with SMI" and 48.1% (n=587) were "MILD enough to be resolved with SMI".

A comparison of the initial examination findings (general forensic examination report and/or patient epicrisis notes) and the final examination findings of 365 patients who were examined in our forensic polyclinic and received a forensic report revealed that in 126 (34.5%) cases, there was no difference in lesion size, whereas in 239 (65.5%) cases, there was a difference in lesion size ($p<0.001$). The mean time elapsed between the first presentation to the emergency department (date of the incident) and the forensic medicine outpatient clinic examination, of the 365 cases was 48.4 days [minimum (min.) 0, maximum (max.) 522].

In 158 (65.9%) of 239 patients with a difference in lesion size, the lesion detected at the last examination was smaller than the lesion detected at the first examination in the previous medical records, and in 81 (34.1%) patients, the lesion detected at the last examination was larger than the lesion detected at the first examination ($p<0.001$). A statistically significant association was found between the direction of lesion size change (increase or decrease) and the alteration in the forensic report outcome ($\chi^2=619.37$, df = 4, $p<0.001$), as well as between the lesion size change category (increase, decrease, or none) and forensic classification outcome ($\chi^2=617.24$, df=6, $p<0.001$) (Figure 3).

In 9.4% (n=15) of 158 cases in which the final examination at our forensic medicine outpatient clinic revealed lesions smaller in size than the initial examination findings recorded in the patient's medical records, it was found that the measurement result at the final examination had a direct effect on the forensic report result and the forensic report result changed from "NOT MILD enough to be resolved with simple medical intervention" to "MILD enough to be resolved with simple medical intervention" ($p<0.001$). The median time interval between the initial emergency department

Table 1. Distribution of facial fixed scars according to lesion size and location

	FFS (+)	FFS (-)	Total
≥5 cm cutaneous-subcutaneous lesion as a single lesion on the scalp and face	11 (11.7)	83 (88.3)	**94 (100)**
Cutaneous-subcutaneous lesions under 10 cm in total on the scalp and face	11 (2)	521 (98)	**532 (100)**
Cutaneous-subcutaneous lesions ≥10 cm in total on the scalp and face	13 (18.5)	57 (81.5)	**70 (100)**
Cutaneous-subcutaneous lesions less than 20 cm in total on the body	4 (0.8)	478 (99.2)	**482 (100)**
Cutaneous-subcutaneous lesions ≥20 cm in total on the body	2 (7.6)	24 (92.4)	**26 (100)**
No lesions on the face and scalp	-	-	**17**
Total	**41 (3.3)**	**1163 (96.7)**	**1221 (100)**

Data are presented as n (%).
FFS: Fixed facial scar

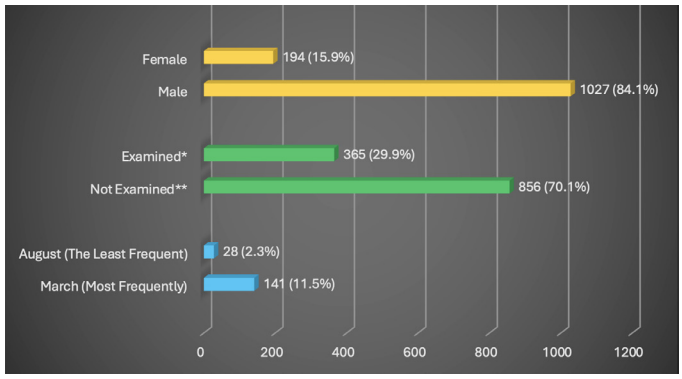

Figure 1. Gender of the cases, whether the cases were examined in our polyclinic or not, and the most and least frequent month of incidents.
*The cases were examined in our Forensic Medicine outpatient polyclinic.
**The cases were not examined, the forensic reports were prepared through the case files

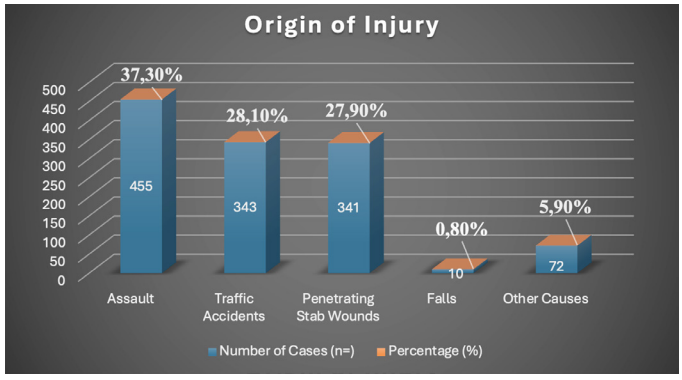

Figure 2. The origin of the injuries

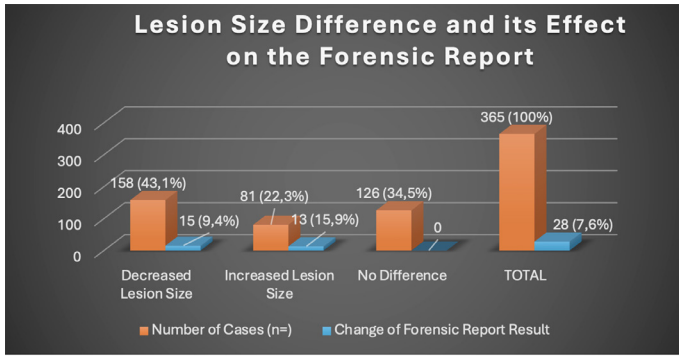

Figure 3. The difference between the lesion sizes in the final examination and the initial examination findings reported in the medical records and the effect of this difference on the forensic report result. A statistically significant association was observed between lesion size change direction and change in forensic report outcome (Chi-square test, χ^2=619.37, df=4, p<0.001).

examination and the forensic medicine outpatient clinic examination for these 15 cases was 8.0 days.

In 15.9% (n=13) of the 81 cases where the lesion size measured at our final examination was larger than that reported in the patient's initial medical records, the measurement result was found to have a direct impact on the outcome of the forensic report, and the report result of "MILD enough to be resolved with simple medical intervention" was changed to "NOT MILD enough to be resolved with simple medical intervention" (p<0.001) (Figure 3). The median interval between the first examination in the emergency department and the last examination in our outpatient clinic of these 13 cases was 5.0 days. In 7.6% (n=28) of the 365 cases we examined, the difference between the examination results was found to have changed the outcome of the forensic report (χ^2=617.24, df = 6, p<0.001) (Figure 3).

Discussion

The present study revealed that the majority of patients with trauma-related cutaneous-subcutaneous injuries had lesions located on the face, and in approximately half of the cases, these injuries were NOT MILD enough to be resolved with a SMI. In addition, it was determined that in the majority of the patients examined by the Department of Forensic Medicine, the lesions were different in size from those stated in the initial examination of the patient (65.9% smaller, 34.1% larger). This lesion size difference had a direct effect on the result of the forensic report in some cases, leading to changes in the report. In light of all these findings, it was revealed that the majority of physicians who examined forensic cases recorded the lesions with approximate methods and without measuring them clearly.

Articles 86 and 87 of the TPC cover the details of the proceedings related to intentional injury offences. Article 86 states that "A person who intentionally inflicts pain on the body of another person or causes impairment of health or perception shall be sentenced to imprisonment from one year to three years" and "If the effect of the act of intentional injury on the person is mild enough to be resolved with a SMI, upon the complaint of the victim, imprisonment from four months to one year or a judicial fine shall be imposed" (2).

Therefore, forensic examination is of great importance for the accurate description of the lesions and the correct measurement of their dimensions in the preparation of a strict forensic report according to Articles 86-87 of the TPC. Since the wound size is important in cutaneous-subcutaneous injuries according to the TPC, if the clinician reports the wound size as smaller than the actual wound size, the offender may be sentenced to a lesser penalty, whereas if the wound size is reported as larger than the actual wound size, the offender may be sentenced to a higher penalty than he/she should receive. During the examination, care should be taken to remove all clothing and to examine the entire body, including the palms of the hands, the soles of the feet, and the mucous membranes of the mouth. During the examination, the location and detailed characteristics (length, width, depth, colour, etc.) of each wound should be specified, metric measuring instruments should be used, and photographs should be taken if possible (5).

In their study, Turla et al. (6) found that 30.5% of the forensic reports prepared in emergency departments did not include

the presence or absence of external traumatic lesions, and in almost half of the cases where external lesions were described, the lesion descriptions were not as detailed as they should be in forensic reports. In our study, we found that in 65.5%, (n=239) of the 365 cases we examined, there was a difference between the lesion sizes measured in the general forensic examination form and the lesion sizes measured in our own examination.

A reduction in wound size during and as a result of wound healing is an expected finding (7). The median time between the first presentation to the emergency department and the forensic medicine polyclinic examination of the 365 cases was 11.5 days.

However, in a significant number of our cases (n=81, 22.3%), the fact that the lesion was found to be larger than initially recorded cannot be explained by this reasoning. Considering the workload, the high number of patients, and the fact that the first priority of emergency physicians is to save lives, emergency physicians tend to give an estimated measurement instead of measuring the lesions with a ruler. However, it should not be forgotten that patients may lose their legal rights for this very reason (8).

In the guidelines for the evaluation of injury crimes defined in the Turkish criminal code in terms of forensic medicine; “Injuries involving the scalp and facial area ≥5 cm as a single lesion, ≥10 cm in total, ≥10 cm as a single lesion in other parts of the body, ≥10 cm as a single lesion, ≥20 cm in total, involving the cutaneous-subcutaneous injuries are NOT MILD enough to be solved with SMI” (3). Lesion size is particularly important for lesions on the face and scalp, and small errors in measurement can lead to a change in the forensic report. In the measurements we made in our study, we found that in 7.6% (n=28) of the 365 cases examined, the difference in lesion size was large enough to change the outcome of the forensic report. In addition, this change in the forensic report outcome was statistically associated with both the direction of the lesion size change and the lesion size change status.

In 53.3% (n=15) of the 28 cases where the forensic report result was changed, it was found that the lesion sizes recorded in the medical documents from the initial examination were actually smaller, as a result of the examination carried out in our forensic medicine polyclinic. Therefore, while the results of the first forensic report issued through the file of these cases were “NOT MILD enough to be resolved with SMI”, it had to be changed to “MILD enough to be resolved with SMI” as a result of the forensic medicine polyclinic examination.

Wound healing is a dynamic process consisting of four continuous, overlapping and precisely programmed phases. In adult humans, optimal wound healing involves the following events: rapid haemostasis, appropriate inflammation, mesenchymal cell differentiation, proliferation, and migration of mesenchymal cells to the wound site, appropriate angiogenesis, rapid re-epithelialization (re-growth of epithelial tissue over the wound surface), and appropriate synthesis, cross-linking, and orientation of collagen to provide strength to the healing tissue (9). In general, several local and systemic factors can affect wound healing. Oxygenation, infection, foreign bodies and venous insufficiency are some of the local factors that influence wound healing, while age and sex, sex hormones, stress, ischaemic diseases such as diabetes, hereditary healing disorders, obesity, alcoholism, smoking and diet are some of the systemic factors that influence wound healing (10).

Due to the specific cutaneous structure and blood vessel density of this region in maxillofacial injuries, healing of cutaneous-subcutaneous injuries and shrinkage of the wound are expected outcomes. In addition, factors like the presence of infection and receipt of treatment during the wound healing process are also important. The effect of the healing process on wound tissue shrinkage may appear to contradict our findings. In cases where the size of the lesion decreased and changes occurred as a result of the forensic report, the average time between the initial and final examinations was 8.0 days. This shows that most of these inconsistencies occurred despite the relatively short follow-up period.

In addition, an injury deep enough to involve cutaneous-subcutaneous tissue, even as it begins to heal and decrease in size, is expected to show some discolouration compared to uninjured cutaneous tissue. It is therefore easy to distinguish between a healed injury and uninjured cutaneous tissue on final examination, especially in the first month; and a detailed examination of the scar tissue can give an idea of the original wound size.

Therefore, in the cases where we found a decrease in wound size, both that the majority of the cases were examined in the early period (first 15 days) and that there was a significant change in colour between the injured and uninjured cutaneous tissue suggest that the wounds were described without metric measurements in the emergency departments rather than in the healing phase of the injury. In cases where changes were made to the forensic report because the final lesion size was larger than initially recorded, the median time between emergency department and forensic medical examinations was 5.0 days. This is further evidence that these inconsistencies are not solely due to long-term wound changes, but rather to initial recording errors.

Similarly, in 46.7% (n=13) of the 28 cases, the lesion sizes reported in the medical records were found to be larger during the examination performed in our outpatient clinic. In these cases, while the results of the first forensic report issued through the case file were “MILD enough to be resolved with SMI”, they had to be changed to “NOT MILD enough to be resolved with SMI” as a result of the forensic medicine polyclinic examination.

There is no study in the literature that examines the impact of forensic findings on the outcome of the forensic report in a

way comparable to our study. The situation mentioned in the previous paragraphs may lead to the loss of rights for the victim or the perpetrator in both criminal and compensation cases, and may result in a person receiving less or more punishment.

A study conducted by Şener et al. (11) aimed to determine the incompletely defined wound sizes in forensic reports issued in primary health care institutions and emergency departments. They reported that there were difficulties in the preparation of reports in 93 cases because it was not specified whether cutaneous-subcutaneous tissue and muscle tissue injuries were present. We believe that incomplete information about wound depth in some of the reports we examined during the archive search phase of our study and errors such as defining a sharp object wound as a laceration may lead to similar difficulties in report writing.

In our study, cases considered to be FFSs represented 3.3% (n=41) of all cases. Güven et al. (12) found this rate to be 2.6% in their study. In a study by Kürkçü et al. (13), the rate of facial fixed scars was found to be significantly increased in lesions with scar lengths greater than 2 cm. This significant finding between the size of a lesion within the limits of the face and its potential to cause a facial fixed scar emphasizes the importance of accurate measurement of lesion size.

This study has several limitations. The biggest limitation of the study is the acceptance of the accuracy and completeness of the available medical records. In addition, the time intervals between the initial and final examinations cannot be standardised or estimated. Furthermore, since the general forensic examination reports were prepared in emergency departments, lesion measurements were mostly made by estimation without the use of metric instruments, which likely leads to inconsistencies in the medical records.

Conclusion

This study highlights the discrepancies between initial and final forensic examinations in cases of cutaneous-subcutaneous tissue injuries and their impact on forensic report outcomes. The most frequent reason for these discrepancies appears to be the lack of detailed and standardized documentation during the initial emergency department evaluations. The high workload in emergency settings may lead to estimations rather than precise measurements, potentially resulting in discrepancies that can affect judicial outcomes. Our results underscore the necessity for standardized forensic documentation practices, including the systematic use of metric measuring instruments and photographic evidence.

Additionally, we propose a revision of the forensic injury classification criteria outlined in the TPC. The current classification, which differentiates injury severity based on a single-lesion threshold, (≥5 cm for the face and ≥10 cm for other body parts) may not adequately reflect the actual impact of multiple smaller injuries. Our suggestion for this problem, which is frequently encountered in forensic medical practice, is that it would be more appropriate to remove the phrases “≥5 cm as a single lesion” and “≥10 cm as a single lesion” from the guideline. Instead, use the guideline criterion of “≥10 cm of injury involving the scalp and facial area” and “≥20 cm of cutaneous-subcutaneous injury involving the cutaneous-subcutaneous area in other parts of the body” for a more comprehensive and fair assessment.

Ethics

Ethics Committee Approval: This study was conducted with the approval of the University of Health Sciences Türkiye, Gülhane Scientific Research Ethics Committee (decision number: 2024-587, date: 10.12.2024).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S., Concept: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S., Design: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S., Data Collection or Processing: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S., Analysis or Interpretation: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S., Literature Search: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S., Writing: H.B., D.G.Ç., B.K., H.C.A., S.Ö., A.S.

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Is food insecurity higher among pregnant women in rural areas of Indonesia?

Azrimaidaliza Azrimaidaliza[1], Resmiati Resmiati[1], Gina Fajria Islami[1], Ulya Uti Fasrini[2], Annisa Dwi Apriliani[1]

[1]Universitas Andalas Faculty of Public Health, Department of Nutrition, Kota Padang, Indonesia
[2]Universitas Andalas Faculty of Medicine, Department of Medical Education, Kota Padang, Indonesia

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Corresponding Author:
Azrimaidaliza Azrimaidaliza, M.D., Universitas Andalas Faculty of Public Health, Department of Nutrition, Kota Padang, Indonesia
azrimaidaliza@ph.unand.ac.id

ORCID:
orcid.org/0000-0002-9020-7851

Keywords: Food insecurity, Indonesia, pregnant women, rural area

ABSTRACT

Aims: This study aimed to provide valuable insights to inform targeted interventions to alleviate food insecurity and improve maternal and fetal health outcomes, particularly in Indonesia.

Methods: This cross-sectional study was conducted in rural West Sumatra, Indonesia, and investigated food security among 103 randomly selected pregnant women from Pesisir Selatan District. Participants were selected based on residency and consent, while those with severe illness or communication limitations were excluded. Data were collected using the validated Household Food Insecurity Access Scale. Statistical analysis, including Chi-square tests and logistic regression, was used to explore associations.

Results: The study included 103 pregnant women, with a mean age of 25.22±3.35 years, ranging from 19 to 40 years. Results indicated a high prevalence of food insecurity (62.1%) among participants. Initial bivariate analysis showed a significant association between food insecurity and low maternal nutrition knowledge [odds ratio (OR): 6.378; 95% confidence interval (CI): 2.638-15.418; p≤0.001]. In the multivariate analysis, adjusted for maternal occupation and socioeconomic status, the association remained significant with p-values of 0.014 and <0.001, respectively. Multiple logistic regression revealed significant associations between food insecurity and maternal unemployment (OR: 9.147; 95% CI: 1.559-53.665; p=0.014) and low socioeconomic status (OR: 29.603; 95% CI: 8.800-99.584; p<0.001).

Conclusions: These findings highlight the strong impact of unemployment and low socioeconomic status on food insecurity among pregnant women in rural West Sumatra. While maternal nutrition knowledge initially showed a significant relationship, its influence diminished in the context of other factors.

Introduction

Food security, defined as universal access to sufficient, nutritious meals for a healthy lifestyle, is imperative to combating undernutrition (1). Recent global trends have shown a concerning rise in moderate to severe food insecurity, with prevalence reaching 29.6% and persisting at this elevated level from 2019 to 2020. Despite a slight decrease in severe food insecurity from 11.7% to 11.3% between 2021 and 2022, the overall figures remain higher than pre-pandemic levels, which were below 11.7% (2). While Indonesia showed signs of improvement in food security according to the 2022 Global Food Security Index, the country still grapples with persistently low levels compared to previous years (3).

Pregnant women are especially susceptible to the effects of not having enough nutritious food. The Food and Agriculture Organization and various studies consistently highlight that women, especially in lower-income countries and rural areas, face a higher risk of food insecurity compared to men (1,4-6). Inadequate food intake during pregnancy can exacerbate complications such as maternal morbidity, mental health issues, and fetal problems like intrauterine growth retardation and low birth weight (7-12). Previous research identified various factors contributing to household food insecurity, encompassing health risks, food accessibility, and socioeconomic factors (13). Studies have extensively explored determinants of food security across different populations and regions in Indonesia, examining factors like age, gender, education, and socioeconomic status (14). These studies reveal a complex array of determinants influencing food security. Building on this knowledge, the current study sought to explore the specific determinants of food security among pregnant women in rural areas of Western Indonesia. The aim was to provide insights that could inform targeted interventions to alleviate food insecurity and improve maternal and fetal health outcomes in Indonesia.

Methods

Research design and respondents

This cross-sectional study focused on pregnant women living in rural Pesisir Selatan District, West Sumatra, Indonesia, particularly in the Basa Ampek Balai Subdistrict under the Tapan Public Health Center's jurisdiction.

A sample size of pregnant women was determined using the Lemeshow formulation for observational research on two population proportions, where Z=1.96 and d=0.05 (15). This formula was chosen to ensure a desired level of precision in estimating the proportions of interest within the population. The value of Z=1.96 corresponds to a 95% confidence level, indicating confidence that the actual population parameter lies within the computed interval. The margin of error (d=0.05) signified the desired precision level, indicating the maximum allowable deviation from the true proportion. By using these parameters, the study aimed to achieve reliable estimates of population proportions while maintaining statistical confidence in the findings.

$$n = \frac{Z_{1-\alpha/2^2} P(1-P)N}{d^2(N-1) + Z^2 P(1-P)}$$

$$n = \frac{1.96^2 \times 0.577\ (1-0.577) \times 141}{0.05^2(141-1) + 1.96^2\ \times\ 0.577\ (1-0.577)}$$

$$n = 103$$

The sample obtained using this formula consisted of 103 pregnant women who were selected through random sampling. Participants who consented to the study after receiving thorough explanations and signing informed consent forms were included. Exclusion criteria included individuals who were sick, making it difficult to communicate, those who needed more rest, and respondents who refused to be interviewed or were not at the location. Exclusion criteria in this study applied to those suffering from serious illness and being unable to communicate effectively. Illness status was assessed through initial observations by enumerators and self-reported symptoms from respondents. Evaluating participants' communication abilities involved direct observations by enumerators to gauge their comprehension and responses to basic instructions or study-related questions. The study also excluded respondents who refused to be interviewed or were not present at the location.

Data collection

Enumerators received training on how to interview participants and complete research questionnaires. Trained enumerators, under the direct supervision of two researchers, collected both secondary and primary data for this study. Secondary data were obtained from agency reports, including the prevalence of nutritional problems in pregnant women and the population of pregnant women in the research location. Primary data were obtained from a validated and standardized questionnaire, namely the Household Food Insecurity Access Scale (HFIAS) from the Food and Nutrition Technical Assistance (16). The validation test was carried out using the gamma correlation test by examining the p-value and correlation coefficient (r) obtained. The higher the correlation value obtained (the closer it was to 1), the better the validity of the measuring instrument.

The assessment of food security in this study was conducted using a questionnaire tool called the HFIAS. It consisted of nine questions aimed at gauging the frequency and severity of food insecurity experienced by families over the past four weeks. Respondents indicated whether certain conditions had occurred during this period with a "yes" or "no" response. To further assess the severity of food insecurity, Likert scale questions were used with response options of never (0), rarely (1 or 2 times), sometimes (3-10 times), and often (>10 times). Scores were then calculated based on these responses, ranging from 0 to 27, to determine the level of food insecurity. Based on the total scores, households were categorized into four levels: food secure (0 scores), mildly food insecure (1-5 scores), moderately food insecure (6-13 scores), and severely food insecure (14-27 scores). For analytical purposes, food security status was dichotomized into "secure" (no occurrence of any conditions) and "not secure" (at least one positive response to the nine items), facilitating the identification of predictors of food security (16-18).

Pregnant women's characteristics, encompassing age, gestational age, nutrition knowledge, education level,

maternal employment status, and socioeconomic status, were systematically collected using a structured, standardized, and validated questionnaire. Education level was classified as “low” (completion of junior high school or below) or “high” (completion of senior high school or above) (19). Maternal employment status was dichotomized into “unemployment”, for those who did not work or solely engaged in household duties, and “employment” for those with an occupation (20,21).

Socioeconomic status was determined using a structured socioeconomic assessment tool. The cut-off categorization, which used about 80% of the total scores, was modified from previous studies. This tool categorized socioeconomic status into “low” (total score <19) and “high” (total score ≥19) based on various indicators, including educational level (1 = less than middle school, 2 = less than high school, 3 = graduated with a diploma or a degree), income (1 = less than Rp. 600.000, 2 = Rp. 600.000-1.200.000, 3 = more than Rp. 1.200.000), occupation (1 = not working, 2 = trader, 3 = civil servant or private employee), housing quality (1 = not permanent, 2 = semi-permanent, 3 = permanent), ownership status (1 = renting, 2 = contract/rent, 3 = own), number of children (1 = more than 4 people, 2 = 2-3 people, 3 = 1 person), wealth items such as gold, television, and refrigerator (1 = 1 type, 2 = 2 types, 3 = 3 types or more), and sources of drinking water (1 = well water, 2 = well water and tap water, 3 = tap water) (22,23).

In terms of nutrition knowledge, participants were assessed through a series of 16 questions covering topics such as nutritious foods, their importance for bodily health, the consequences of inadequate nutrition, and strategies for preventing undernutrition during pregnancy. Respondents were allowed to select multiple answers for each question. The total score, based on correct responses, was 50 points. Nutrition knowledge status was categorized as “low” (scores <70%) or “high” (scores ≥70%) (24,25).

Before data collection, participants had been briefed on the study’s objectives and potential risks, after which they provided consent by signing an informed consent form. Additionally, approval was secured from the school principal. The procedures of the study were approved by the Ethics Committee of the Faculty of Public Health of Universitas Andalas (decision number: 10/UN16.12/KEP-FKM/2023, date: 30.05.2023).

In addition, permission letters to conduct research in the Tapan Community Health Center area were obtained from the relevant health agencies and local government authorities. These permission letters explicitly provided access to the support necessary for the smooth implementation of the research. This support included coordination with local health staff, access to necessary health records, and the use of health center facilities for data collection activities. Such comprehensive permits ensured that the research was compliant with local regulations and with the necessary institutional support.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). The analysis included univariate, bivariate, and multivariate techniques. Chi-square tests were used to examine the relationships between independent and dependent variables. Simple and multiple logistic regression models were used to determine the key factors influencing food security among pregnant women. Variables with a p-value of less than 0.5 in the bivariate analysis were included in the multivariable analysis. Independent predictors of anemia were identified using odds ratios (OR) greater than 1 with 95% confidence intervals (CI).

Results

The study included 103 pregnant women with a mean age of 25.22±3.35 years; they had a gestational age of 5.49±1.82 months, or second trimester. In general, respondents had an educational background above junior high school (95.1%), were housewives (85.4%), and had low socioeconomic status (55.3%) (Table 1).

The analysis of data from a cohort of pregnant women residing in rural areas of Western Sumatra indicated a notable prevalence of food insecurity, with 62.1% of participants affected. Using the HFIAS, researchers observed that the majority of respondents (93.2%) reported minimal concerns regarding household food sufficiency (Table 2).

Regarding demographic variables, a significant proportion (66.7%) of pregnant women aged 19 to 29 years experienced food insecurity, although the statistical association between age and food security status was not significant (OR: 1.778; 95% CI: 0.768-4.114; p=0.177). Additionally, a substantial segment

Table 1. Demographic characteristics

Demographic characteristics	**Mean±SD**
Pregnant women’s age (years)	25.22±3.35
Gestational age (months)	5.49±1.82
Variable	**n (%)**
Nutrition knowledge	
Low	64 (62.1)
High	39 (37.9)
Education level	
Low	5 (4.9)
High	98 (95.1)
Maternal employment status	
Unemployment	88 (85.4)
Employment	15 (14.6)
Socio-economic status	
Low	57 (55.3)
High	46 (44.7)

SD: Standard deviation

(78.1%) exhibited low levels of nutrition knowledge, with a statistically significant correlation observed between low levels of nutrition knowledge and food insecurity (OR: 6.378; 95% CI: 2.638-15.418; p<0.001).

While educational attainment did not exhibit a statistically significant association with food insecurity, mothers who were unemployed or homemakers were more predisposed to household food insecurity (69.3%) compared to their employed counterparts. Notably, a significant association was identified between maternal employment and food insecurity among pregnant women (OR: 9.037; 95% CI: 2.357-34.645; p<0.001). Furthermore, lower socioeconomic status was strongly correlated with heightened rates of food insecurity (91.2%) compared to those with higher socioeconomic standing, a relationship deemed statistically significant (OR: 29.467; 95% CI: 9.526-91.153; p<0.001) (Table 3).

Subsequent multiple logistic regression analysis revealed (Table 4) that both maternal unemployment status (OR: 9.147; 95% CI: 1.559-53.665; p=0.014) and low socioeconomic status (OR: 29.603; 95% CI: 8.800-99.584; p<0.001) emerged as risk factors against food insecurity among pregnant women.

Table 2. Prevalence and indicators of food insecurity of pregnant women in rural areas of Western Sumatera

Food security category	**n**	**%**
Food secure	39	37.9
Food insecure	64	62.1
Household hunger scale indicators in the past 4 weeks	**Yes n (%)**	**No n (%)**
Worry about household would not have enough food	7 (6.8)	96 (93.2)
Pregnant woman or household member was unable to eat the foods you preferred because of a lack of resources	30 (29.1)	73 (70.9)
Pregnant woman or household member had to eat a limited variety of foods due to a lack of resources	36 (35.0)	67 (65.0)
Pregnant woman or household member had to eat foods they did not want because they couldn't obtain other types of food	47 (45.6)	56 (54.4)
Pregnant woman or household member had to eat smaller meals than needed due to a shortage of food	103 (100.0)	0 (0.0)
A pregnant woman or other household member had to reduce daily meals because of insufficient food	103 (100.0)	0 (0.0)
There were times when the household had no food due to a lack of resources	103 (100.0)	0 (0.0)
Pregnant woman or household member slept hungry at night because there was not enough food	103 (100.0)	0 (0.0)
Did you or any household member go all day and night without eating anything due to a lack of food?	103 (100.0)	0 (0.0)

Table 3. Characteristics and other factors of pregnant women with food security

Independent variables	**Food security status**		**p-value**
	Insecure n (%)	**Secure n (%)**	
Pregnant woman's age			
19-29 years	46 (66.7)	23 (33.3)	0.177
30-40 years	18 (52.9)	16 (47.1)	
Nutrition knowledge			
Low	50 (78.1)	14 (21.9)	**<0.001**
High	14 (35.9)	25 (64.1)	
Education level			
Low	5 (100.0)	0 (0.0)	-
High	59 (60.2)	39 (39.8)	
Maternal employment status			
Unemployment	61 (69.3)	27 (30.7)	**<0.001**
Employment	3 (20.0)	12 (80.0)	
Socio-economic status			
Low	52 (91.2)	5 (8.8)	**<0.001**
High	12 (26.1)	34 (73.9)	

*Statistical test: Chi-square test

Table 4. Determinants of food insecurity of pregnant women in rural areas of Western Indonesia

Variables	Simple logistic regression		Multiple logistic regression	
	OR (95%CI)	p-value	OR (95%CI)	p-value
Pregnant woman's age	1.601 (0.180-14.234)	0.673	-	-
Nutrition knowledge	2.227 (0.700-7.081)	0.175	-	-
Education level	88651145.28 (0.000-)	0.999	-	-
Maternal employment status	6.693 (1.112-40.270)	**0.038**	9.147 (1.559-53.665)	**0.014**
Socio-economic status	22.063 (6.367-76.450)	**<0.001**	29.603 (8.800-99.584)	**<0.001**

*Statistical test: Simple logistic regression and multiple logistic regression, OR: Odds ratio, CI: Confidence interval

Discussion

The findings of this study corroborated earlier research, indicating a high incidence of food insecurity among pregnant women in rural areas. A significant relationship was also observed between maternal nutrition knowledge and food security, with well-informed mothers tending to provide better nutrition for their families. Comparable studies conducted in Semarang District, Indonesia, and rural Bangladesh reported similarly elevated rates of household food insecurity, indicating a consistent regional trend (26,27). Conversely, a lower prevalence was noted in Iran, albeit within an urban context. Significantly, the coronavirus disease of 2019 pandemic worsened global food insecurity, as evidenced by a meta-analysis showing a high prevalence of food insecurity (28,29). A study referenced in this research underscored the detrimental effects of food insecurity on the quality of life of pregnant women (30).

The observed disparities in food insecurity percentages could be attributed to variances in geographical location, methodologies, sample sizes, and measurements employed across studies. Nonetheless, common determinants emerged, including socioeconomic factors such as low income, unemployment, and limited access to food markets and transportation (31,32).

Dietary patterns also played a role, with food-secure pregnant women displaying higher consumption of animal proteins, while their food-insecure counterparts relied more heavily on vegetables (33). A wealth of research demonstrated a robust link between food insecurity and malnutrition among women of reproductive age, including pregnant women (34,35). A study conducted in Central Tapanuli Regency, Indonesia, identified a significant connection between household food security and energy and protein intake during pregnancy, which affected maternal weight gain and birth outcomes (36,37).

Furthermore, economic constraints often led to restrictive feeding practices, limiting dietary variety and nutritional adequacy (38,39). In line with earlier studies, maternal education level was identified as a critical factor, with lower educational attainment being associated with a higher risk of food insecurity among pregnant women (40,41). Additionally, maternal employment and household socioeconomic status were recognized as key risk factors, supporting existing literature, which indicated that socioeconomic and environmental factors influenced food insecurity (42-44). According to the findings of this study, increasing income levels were essential for attaining household food security.

The research results indicated that the level of nutritional knowledge acted as a mediating factor in the relationship between maternal employment and socioeconomic status, and food insecurity. Mothers who had good nutritional knowledge prepared more balanced food and were able to understand the nutritional adequacy of pregnancy as recommended (45). Even if a mother had a high socioeconomic background, having low levels of nutritional knowledge made it difficult for her to provide nutritious food for her family. This was supported by the current study, which showed that more than half of the mothers had low levels of nutritional knowledge. Research conducted by Mousa TY and Dardas LA in 2023 found that nutritional knowledge was linked to food security ($p<0.05$). This was because individuals who possessed good nutritional knowledge were motivated to apply the acquired information by providing a healthy food supply, engaging in better food shopping practices, and improving health and nutrition-related behavior (46-48).

Despite these insights, the cross-sectional nature of the study limited its ability to establish causal relationships between predictors and food insecurity. Additionally, the generalizability of the findings was confined to pregnant women with similar rural characteristics, but the study did not specifically address other health conditions of pregnant women in rural areas. Furthermore, the study did not distinguish the effect of financial resources on food insecurity apart from employment status. Future research endeavors are warranted to explore and compare determinants

of food security across urban and rural settings and informing targeted interventions to alleviate malnutrition among pregnant women and children.

Conclusion

The study findings highlighted the crucial influence of maternal unemployment and low socioeconomic status as primary determinants of food insecurity among pregnant women in rural areas of West Sumatra Province. Notably, nutrition knowledge emerged as a mediating factor in the relationship between maternal employment, socioeconomic status, and food security. Consequently, integrating nutrition education initiatives into health center activities holds promise for enhancing maternal knowledge and fostering improved nutrition practices within households. Moving forward, there is a pressing need for further research employing robust study designs to elucidate causal associations and guide targeted interventions aimed at tackling food insecurity within this vulnerable population.

Ethics

Ethics Committee Approval: The procedures of the study were approved by the Ethics Committee of the Faculty of Public Health of Universitas Andalas (decision number: 10/UN16.12/KEP-FKM/2023, date: 30.05.2023).

Informed Consent: Consent form was filled out by all participants.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: A.A., R.R., G.F.I., U.U.F., A.D.A., Concept: A.A., Design: A.A., G.F.I., Data Collection or Processing: G.F.I., Analysis or Interpretation: A.A., Literature Search: A.A., R.R., U.U.F., Writing: A.A., R.R., U.U.F., A.D.A.

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Postural habits and postural awareness in spinal pain, spinal function, and quality of life in resident physicians

Elzem Bolkan Günaydın

Ufuk University Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Ankara, Türkiye

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Corresponding Author:
Elzem Bolkan Günaydın, M.D.,
Ufuk University Faculty of Medicine, Department of Physical Medicine and Rehabilitation, Ankara, Türkiye
elzembolkan@yahoo.com

ORCID:
orcid.org/0000-0002-4000-6947

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ABSTRACT

Aims: Evaluation of postural habits and awareness scale (PHAS), Spinal Functional Index (SFI), and Nottingham Health Profile (NHP) scores, and spinal pain presence (location, intensity, and duration) in resident physicians.

Methods: This cross-sectional study was conducted on resident physicians. Whether participants experienced spinal pain, location (neck, back, low-back), as well as the duration, were recorded. They were asked to mark pain intensity at rest and during movement, in spinal pain areas on a 0-10 cm visual analog scale (VAS). Afterwards, the PHAS, SFI, and NHP questionnaires were applied.

Results: A total of 72 resident physicians were included (mean age: 27.81±3.98 years); 41 (56.9%) were female. In the neck pain group, the PHAS-stance habits and awareness (SHA) score was moderately negatively correlated with neck pain duration (r=-0.44, p=0.006) and low to moderately positively correlated with the SFI score (r=0.33, p=0.05). The PHAS-ergonomic awareness (EA) score showed a moderate negative correlation with neck pain intensity-movement VAS (r=-0.39, p=0.02). In the back pain group, PHAS-SHA (r=0.52, p=0.004) and PHAS-postural habit (PH) scores (r=0.37, p=0.05) were positively correlated with SFI score at moderate and low moderate levels. In the low-back pain group, PHAS-PH (r=-0.47, p=0.006) and PHAS-EA (r=-0.45, p=0.01) were negatively and moderately correlated to VAS for pain intensity during movement. PHAS-positional awareness score correlated moderately positively with SFI score (r=0.41, p=0.02). PHAS-SHA correlated moderately negatively with pain intensity-movement VAS (r=-0.40, p=0.02), and low to moderately positively with SFI (r=0.37, p=0.04).

Conclusions: Poor PH and awareness are associated with more severe and prolonged spinal pain, worse spinal function, and poorer quality of life.

Introduction

Postural control, whether in static or dynamic settings, is a fundamental necessity for executing daily activities (1). Posture denotes the alignment and positioning of the limbs, spine, and head, and any imbalance in this alignment, positioning, or weight distribution may lead to postural asymmetry. Postural asymmetry may contribute to hyperactivity and tightness in one muscle group, while generating elongation and weakening in the opposing muscles, resulting in muscle imbalance that imposes excessive load on the joints and skeletal system during movement, hence inducing discomfort (2). In this sense, good posture is the alignment that exerts minimal stress on each joint. Poor posture entails improper alignment of body segments, resulting in heightened stress on joints (3) and may induce musculoskeletal pain (2).

Postural awareness (PA), a crucial aspect of recognizing the difference between good and poor posture, has recently acquired prominence in the health sciences. PA emphasizes an

individual's capacity to recognize postural alterations in everyday life (3). Body posture can be affected by multiple factors, including physical, physiological, emotional, and environmental influences. Daily and behavioral habits are frequently developed that may neglect healthy body positioning, resulting in postural changes, as these habits significantly influence posture (3,4). Poor postural practices can alter muscle tone and body alignment, ultimately leading to detrimental posture patterns and overall body asymmetry. To avert musculoskeletal impairments linked to poor posture, it is essential to understand optimal ergonomics. PA is essential for sustaining healthy postural habits (PHs) in daily life. Additionally, individual PH influences the degree of PA, necessitating assessments that incorporate these habits to inform health science professionals about treatment options and lifestyle modifications (3).

Alterations in posture are frequently seen as a risk factor for the development of spine pain (2). Low back pain is a prevalent condition linked to postural imbalance. Spinal postural assessment is crucial in understanding low back pain, as incorrect postural behavior frequently serves as a risk factor for low back pain and lumbar injury. Suboptimal posture elevates mechanical strain in the lower back, adversely impacting spinal alignment and flexibility; persistent poor posture may be associated with chronic nonspecific low back pain. Lumbar discomfort and injury can consequently exacerbate postural issues, including diminished muscle strength, inadequate stability of the deep core muscles, prolonged maintenance of static positions, and reduced muscle flexibility (5). This has resulted in the belief that upholding proper posture and movement in daily tasks is essential for the prevention and treatment of low back pain (2).

Postural abnormalities, particularly forward head posture resulting from excessive neck flexion, are a significant risk factor for neck pain (6,7). Maintaining a pronounced flexion angle of the neck while labor increases the weight of the head, imposing additional strain on the spine and resulting in alterations to ligaments, tendons, and muscles, which may eventually induce permanent postural changes, namely forward head posture (7). The literature underscores the need for postural rehabilitation in managing chronic neck pain (6).

The research have investigated the correlation between inadequate posture and spinal pain across several occupational categories (8-11). Physicians frequently suffer from spine pain due to many postural factors, including demanding work schedules, shift patterns, and prolonged periods spent seated or standing in a static position (11,12). There are studies in the literature on musculoskeletal problems caused by poor posture among physicians across medical specialties and the positive effects of ergonomic principles on these problems. Recent data support the idea that work-related musculoskeletal pain often begins during residency (11,13,14). Since it is known that persistent poor posture is also an important factor contributing to the chronicity of spinal pain, evaluating the PA and habits of resident physicians at the beginning of their professional lives and providing training will help prevent musculoskeletal problems related to their profession This precaution is especially valuable in avoiding chronic spine-related issues tied to their profession (5). The objective of the study is to assess the PHs and awareness scale (PHAS), Spinal Functional Index (SFI), and Nottingham Health Profile (NHP) scores, and spinal pain presence (location, intensity, and duration) in resident physicians.

Methods

Study design and participants

This cross-sectional, observational study was conducted between February 2023 and April 2023 at Ufuk University, Ankara, Türkiye. The study included 72 volunteer participants aged between 20 and 50 years, all of whom were working as resident physicians. Of the participants, 35 (48.6%) were resident physicians in internal medicine departments and 37 (51.4%) were resident physicians in surgical medicine departments. All resident physicians had a daytime work schedule between 08:00-17:00, and in addition, worked night shifts from 17:00-08:00 for 8 days a month-they were exempt from daytime work after the night shift. Participants with a history of previous trauma or surgery that could cause pain or postural disorders in the spine and known systemic, neurological, psychiatric, infectious, inflammatory, rheumatic, tumoral, or degenerative diseases were excluded from the study. The study was approved by the Ufuk University of Non-interventional Clinical Research Evaluation Ethics Committee (decision number: 23.01.12.01/01, date: 24.01.2023) and written informed consent were obtained. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data collection and instruments

Participants' age, gender, height, and weight, accompanying diseases, whether there is spinal pain, if there is spinal pain, the pain area (neck, back, low-back), and the duration of pain in the relevant area were recorded. Additionally, whether there is a regular exercise habit and if so, the frequency, and whether regular posture exercises are performed and if so, the frequency, were recorded. Participants were asked to mark their average pain intensity on a 0-10 cm visual analog scale (0 = no pain, 10 = most unbearable pain) at rest and with movements related to the spine or requiring spinal support in daily life activities (walking, personal care, work life, etc.) in the areas of spinal pain (15). Participants were then asked to answer questions on the PHAS (3), SFI (16), and NHP (17) questionnaires. It took an average of 30 minutes for each participant to fill out the data collection form and the questionnaires.

Postural habits and awareness scale

It is a five-point Likert-type scale (1 = I completely disagree, 5 = I completely agree) developed to evaluate PHs and posture awareness, which consists of 7 items on PHs and 12 items on PA (3). The scale includes two main scores-PH and PA and four sub-scores: stance habits and awareness (SHA), awareness of factors that impair stance, positional awareness (POA) and ergonomic awareness (EA). Based on the included items, the sub-scores can be interpreted as four different aspects of posture-related awareness and habits. Higher scores on the scale indicate better PHs and awareness levels. The scale developed by Bayar et al. (3) in 2022 underwent a Turkish validity and reliability study. The reliability of the Turkish version of the PA Scale was found to be sufficient (total α value=0.854, factor 1=0.886, factor 2=0.777), and was confirmed with a test-retest conducted two weeks apart (r=0.831). In our study sample, we observed that the scale was easily understandable and applicable.

Spinal Functional Index

It is a 25-item questionnaire developed to evaluate the functions of the spine as a whole. If the statements in the items fully apply to the participant, they give 1 point; if they partially apply, they give half a point; and if the statements do not describe them, they leave the relevant item blank. The total score of the survey is calculated by adding the scores obtained from the items. The percentage score is then determined by calculating four times the total score and subtracting this result from 100. Higher percentile scores indicate better functionality. The scale was developed by Gabel et al. (18) in 2013, and its Turkish validity and reliability study was conducted by Tonga et al. (16) in 2015.

Nottingham Health Profile

It is a scale consisting of a total of 38 questions that evaluates the quality of life. Each question is answered with yes or no. The first part of the questionnaire evaluates, in patients, six subsections: sleep status, energy level, emotional status, social isolation status, physical mobility, and pain. In the second part, it is evaluated whether there are any problems at work, at home, in social activities, and interpersonal relationships. Sub-scores for each section and scores for the first and second sections are calculated by summing the scores of the items answered "yes" (19). Higher scores indicate poorer quality of life (19). The Turkish validity and reliability study was conducted by 17. Kücükdeveci et al. (17) in 2000.

Statistical Analysis

In determining the sample size in the study, power analysis was performed using Gpower 3.1.9.4 software. It was found that a total minimum of 71 patients was sufficient in our analysis according to the effect size standardized by Cohen (with effect size=0.40, α=0.05 for 95% power).

Statistical analyses were performed using SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA). The conformity of numerical variables to normal distribution was examined visually (histogram and probability plots) and with analytical methods (Kolmogorov-Smirnov tests/Shapiro-Wilk tests), and the homogeneity of variances was examined using the Levene test. In descriptive statistics, numerical variables were expressed as mean and standard deviation, and categorical variables were expressed as numbers and percentages. In comparisons of numerical data between groups, the Mann-Whitney U test was used. The Chi-square test was used to compare categorical data between groups. In examining the relationships between variables, Pearson correlation analysis (two-tailed) was used for variables that both conformed to a normal distribution, and Spearman's test (two-tailed) was used for variables at least one of which did not conform to a normal distribution (correlation coefficient: 0.75 to 1.00 indicates an excellent correlation; 0.70 to 0.75 indicates a very good correlation; 0.60 to 0.70 indicates a good correlation; 0.40 to 0.60 indicates a moderate correlation; 0.30 to 0.40 indicates a low-moderate correlation; 0.05 to 0.30 indicates low or insignificant correlation). The statistical significance level for the analyses was set at $p \leq 0.05$.

Results

A total of 72 resident physicians were included in the study (mean age: 27.81±3.98 years), of whom 41 (56.9%) were female. Descriptive statistics for the study variables are presented in Table 1.

In the group without any spinal pain, the SFI score was significantly higher [94 (50-100)/87 (24-100), p=0.02], and NHP-pain [0 (0-29.44)/19.45 (0-46.49), p<0.001], NHP-energy [0 (0-100)/30.40 (0-100), p=0.02], NHP part 1 total [35.87 (0-278.94)/101.74 (0-342.31), p=0.02], and NHP part 2 total [0 (0-1)/0 (0-4), p=0.02] scores were significantly lower compared to the group with spinal pain. No significant differences were observed between the groups in other study variables.

The comparison results of the study variables between the group with neck pain and the group without any spinal pain are presented in Table 2. NHP-pain (p<0.001); NHP-energy (p=0.01); NHP part 1 total (p=0.03); NHP part 2 total (p=0.04) scores, were significantly higher, while height (p=0.04) and SFI score (p=0.01) were significantly lower in the group with neck pain compared to those without any spinal pain.

The comparison results of the study variables between the groups with back pain and the groups without any spinal pain are presented in Table 3. In the group with back pain, age (p=0.04), NHP-pain (p<0.001), NHP-physical activity (p=0.02), NHP-energy (p=0.002), NHP part 1 total (p=0.006), NHP part 2 total (p=0.005) scores were significantly higher, while frequency

Table 1. Descriptive statistics of study variables (n=72)

Variables	Values
Age, year[+]	27.81±3.98 (24-44)
Gender, n (%)	
Female	41 (56.9)
Male	31 (43.1)
Height, cm[+]	170.54±9.4 (150-187)
Weight, kg[+]	69.66±16.74 (43-125)
BMI, kg/cm^{2+}	23.71±3.98 (16.14-37.74)
Presence of systemic disease, n (%)	
No	60 (83.3)
Yes	12 (16.7)
Presence of any spine pain, n (%)	
No	24 (33.3)
Yes	48 (66.7)
Presence of neck pain, n (%)	
No	35 (48.6)
Yes	37 (51.4)
Neck pain duration, month[+]	11.38±27.79 (0-180)
VAS-neck pain intensity at movement, cm[+]	2.17±2.57 (0-9)
VAS-neck pain intensity at rest, cm[+]	1.41±2.01 (0-7)
Presence of back pain, n (%)	
No	43 (59.7)
Yes	29 (40.3)
Back pain duration-month[+]	5.35±11.92 (0-60)
VAS-back pain intensity at movement, cm[+]	1.7±2.29 (0-8)
VAS-back pain intensity at rest, cm[+]	0.96±1.64 (0-6)
Presence of low back pain, n (%)	
No	40 (55.6)
Yes	32 (44.4)
Low back pain duration, month[+]	9.40±21.23 (0-120)
VAS-low back pain intensity at movement, cm[+]	1.72±2.32 (0-9)
VAS-low back pain intensity at rest, cm[+]	1.01±1.7 (0-6)
Regular exercise habit, n (%)	
No	43 (59.7)
Yes	29 (40.3)
Frequency of exercise, n/wk[+]	1.06±1.42 (0-5)
Regular posture exercise habit, n (%)	
No	57 (79.2)
Yes	15 (20.8)
Frequency of posture exercise, n/wk[+]	0.49±1.06 (0-5)
Postural habit score[+]	18.78±5.26 (8-35)
Postural awareness score[+]	38.99±3.72 (30-50)
Stance habits and awareness sub-score[+]	22.51±4.62 (14-34)
Awareness of factors that impair stance sub-score[+]	15.40±2.47 (10-20)
Positional awareness sub-score[+]	11.93±2.82 (7-20)
Ergonomic awareness sub-score[+]	7.96±2.72 (3-15)
Spinal Functional Index score[+]	84.6±15.88 (24-100)

Table 1. Continued

Variables	Values
NHP part 1 scores+	
Pain	13.28±15.01 (0-46.49)
Emotional reactions	20.68±24.47 (0-82.31)
Sleep	17.26±24.39 (0-87.43)
Social isolation	10.74±19.75 (0-84.03)
Physical activity	8.50±13.78 (0-88.80)
Energy	29.43±38.15 (0-100)
Total	98.53±92.44 (0-342.31)
NHP part 2 total score+	0.47±0.99 (0-4)

+Data are expressed as mean±standard deviation (minimum-maximum)
BMI: Body mass index,VAS: Visual analog scale, NHP, Nottingham Health Profile

Table 2. Comparison of study variables according to the presence of neck pain

Variables	Group with neck pain (n=37)	Group without any spinal pain (n=24)	p
Age, year+	29 (24-44)	26.5 (24-33)	0.06
Gender, n (%)			
Female	26 (70.3)	11 (45.8)	0.06
Male	11 (29.7)	13 (54.2)	
Height, cm+	164 (150-186)	174.5 (160-187)	**0.04***
Weight, kg+	60 (43-125)	70 (45-105)	0.29
BMI, kg/cm^{2}+	22.60 (17.22-37.74)	23.26 (16.14-30.68)	0.95
Presence of systemic disease, n (%)			
No	28 (75.7)	22 (91.7)	0.18
Yes	9 (24.3)	2 (8.3)	
Regular exercise habit, n (%)			
No	23 (62.2)	12 (50)	0.35
Yes	14 (37.8)	12 (50)	
Frequency of exercise, n/wk+	0 (0-4)	1 (0-5)	0.20
Regular posture exercise habit, n (%)			
No	29 (78.4)	19 (79.2)	0.94
Yes	8 (21.6)	5 (20.8)	
Frequency of posture exercise, n/wk+	0 (0-3)	0 (0-5)	0.93
Postural habit score+	17 (8-35)	19.5 (12-29)	0.07
Postural awareness score+	39 (30-50)	38.5 (32-44)	0.42
Stance habits and awareness sub-score+	20 (14-34)	23 (16-30)	0.25
Awareness of factors that impair stance sub-score+	16 (10-20)	16 (10-20)	0.57
Positional awareness sub-score+	12 (8-20)	12 (7-19)	0.54
Ergonomic awareness sub-score+	8 (3-15)	8.5 (4-15)	0.29
Spinal Functional Index score+	88 (24-100)	94 (50-100)	**0.01***
NHP part 1 scores+			
Pain	19.45 (0-46.49)	0 (0-29.44)	**<0.001***
Emotional reactions	15.55 (0-80.77)	3.54 (0-82.31)	0.40
Sleep	12.57 (0-87.43)	0 (0-87.43)	0.26
Social isolation	0 (0-58.63)	0 (0-61.50)	0.56
Physical activity	11.2 (0-88.80)	0 (0-43.29)	0.12
Energy	39.2 (0-100)	0 (0-100)	**0.01***
Total	107.45 (0-342.31)	35.87 (0-278.94)	**0.03***
NHP part 2 total score+	0 (0-4)	0 (0-1)	**0.04***

*Statistical significance level p≤0.05
+Data are expressed as median (minimum-maximum)
BMI: Body mass index, NHP: Nottingham Health Profile

of exercise (p=0.04) and SFI score (p=0.01) were significantly lower, compared to the group without any spinal pain.

The comparison results of the study variables, between the groups with low back pain and those without any spinal pain, are presented in Table 4. NHP-pain (p<0.001), NHP-energy (p=0.04), NHP part 1 total (p=0.03), and NHP part 2 total (p=0.01) scores were significantly higher, while the SFI score (p=0.007) was significantly lower in the group with low back pain compared to the group without any spinal pain.

The results of the correlation analysis to evaluate the relationships between the PHAS scores and pain-related variables are presented in Table 5. In the group with neck pain, a moderate negative correlation was observed between PHAS-SHA score and neck pain duration (r=-0.44, p=0.006). A low-to-moderate negative correlation was observed between PHAS-EA score and neck pain severity-VAS movement value (r=-0.39, p=0.02). A low-to-moderate positive correlation was observed between PHAS-SHA score and SFI score (r=0.33, p=0.05).

In the group with back pain, a moderate positive correlation was observed between the PHAS-SHA score and the SFI score (r=0.52, p=0.004), and a low to moderate positive correlation

Table 3. Comparison of study variables according to the presence of back pain

Variables	Group with back pain (n=29)	Group without any spinal pain (n=24)	p
Age, year⁺	29 (24-44)	26.5 (24-33)	**0.04***
Gender, n (%) Female Male	 19 (65.5) 10 (34.5)	 11 (45.8) 13 (54.2)	 0.15
Height, cm⁺	168 (150-185)	174.5 (160-187)	0.08
Weight, kg⁺	65 (43-125)	70 (45-105)	0.80
BMI, kg/cm²⁺	24.84 (17.22-37.74)	23.26 (16.14-30.68)	0.30
Presence of systemic disease, n (%) No Yes	 24 (82.8) 5 (17.2)	 22 (91.7) 2 (8.3)	 0.44
Regular exercise habit, n (%) No Yes	 20 (69) 9 (31)	 12 (50) 12 (50)	 0.16
Frequency of exercise, n/wk⁺	0 (0-3)	1 (0-5)	**0.04***
Regular posture exercise habit, n (%) No Yes	 24 (82.8) 5 (17.2)	 19 (79.2) 5 (20.8)	 1
Frequency of posture exercise, n/wk⁺	0 (0-2)	0 (0-5)	0.56
Postural habit score⁺	17 (8-29)	19.50 (12-29)	0.10
Postural awareness score⁺	39 (30-46)	38.5 (32-44)	0.89
Stance habits and awareness sub-score⁺	20 (14-31)	23 (16-30)	0.33
Awareness of factors that impair stance sub-score⁺	16 (10-20)	16 (10-20)	0.76
Positional awareness sub-score⁺	11 (8-17)	12 (7-19)	0.91
Ergonomic awareness sub-score⁺	8 (3-12)	8.5 (4-15)	0.40
Spinal Functional Index score⁺	84 (24-100)	94 (50-100)	**0.005***
NHP part 1 scores⁺ Pain Emotional reactions Sleep Social isolation Physical activity Energy Total	 20.18 (0-46.49) 16.84 (0-78.83) 12.57 (0-77.63) 0 (0-84.03) 11.2 (0-42.83) 60.8 (0-100) 109.42 (0-295.43)	 0 (0-29.44) 3.54 (0-82.31) 0 (0-87.43) 0 (0-61.5) 0 (0-43.39) 0 (0-100) 35.87 (0-278.94)	 **<0.001*** 0.30 0.48 0.94 **0.02*** **0.002*** **0.006***
NHP part 2 total score⁺	0 (0-4)	0 (0-1)	**0.005***

*Statistical significance level p≤0.05
⁺Data are expressed as median (minimum-maximum)
BMI: Body mass index, NHP: Nottingham Health Profile

Table 4. Comparison of study variables according to the presence of low back pain

Variables	Group with low back pain (n=32)	Group without any spinal pain (n=24)	p
Age, year+	27 (24-35)	26.5 (24-33)	0.26
Gender, n (%) Female Male	 18 (56.2) 14 (43.8)	 11 (45.8) 13 (54.2)	0.44
Height, cm+	172.5 (154-185)	174.5 (160-187)	0.41
Weight, kg+	70.5 (43-125)	70 (45-105)	0.88
BMI, kg/cm^{2}+	23.41 (17.22-37.74)	23.26 (16.14-30.68)	0.64
Presence of systemic disease, n (%) No Yes	 25 (78.1) 7 (21.9)	 22 (91.7) 2 (8.3)	0.27
Regular exercise habit, n (%) No Yes	 20 (62.5) 12 (37.5)	 12 (50) 12 (50)	0.35
Frequency of exercise, n/wk+	0 (0-4)	1 (0-5)	0.11
Regular posture exercise habit, n (%) No Yes	 27 (84.4) 5 (15.6)	 19 (79.2) 5 (20.8)	0.73
Frequency of posture exercise, n/wk+	0 (0-2)	0 (0-5)	0.46
Postural habit score+	18 (8-35)	19.5 (12-29)	0.41
Postural awareness score+	40 (32-50)	38.5 (32-44)	0.21
Stance habits and awareness sub-score+	21.5 (14-34)	23 (16-30)	0.51
Awareness of factors that impair stance sub-score+	16 (11-20)	16 (10-20)	0.43
Positional awareness sub-score+	12 (7-20)	12 (7-19)	0.54
Ergonomic awareness sub-score+	8 (3-15)	8.5 (4-15)	0.96
Spinal Functional Index score+	84 (24-100)	94 (50-100)	**0.007***
NHP part 1 scores+ Pain Emotional reactions Sleep Social isolation Physical activity Energy Total	 19.82 (0-46.49) 11.86 (0-80.77) 0 (0-77.63) 0 (0-84.03) 11.2 (0-42.83) 24 (0-100) 102.72 (0-342.31)	 0 (0-29.44) 3.54 (0-82.31) 0 (0-87.43) 0 (0-61.5) 0 (0-43.39) 0 (0-100) 35.87 (0-278.94)	 **<0.001*** 0.69 0.59 0.95 0.06 **0.04*** **0.03***
NHP part 2 total score+	0 (0-4)	0 (0-1)	**0.01***

*Statistical significance level p≤0.05
+Data are expressed as median (minimum-maximum)
BMI: Body mass index, NHP: Nottingham Health Profile

was observed between the PHAS-PH score and the SFI score (r=0.37, p=0.05).

In the group with low back pain, a moderate negative correlation was observed between the PHAS-PH score and back pain severity-VAS movement (r=-0.47, p=0.006) and between the PHAS-EA score and back pain severity-VAS movement (r=-0.45, p=0.01). A moderate positive correlation was found between the PHAS-POA score and the SFI score (r=0.41, p=0.02). Additionally, a moderate negative correlation was noted between the PHAS-SHA score and back pain severity-VAS movement (r=-0.40, p=0.02), and a low to moderate positive correlation was observed between the PHAS-SHA score and the SFI score (r=0.37, p=0.04).

Discussion

In this study, we observed that in the group with neck pain, the PHAS-SHA score was related to neck pain duration and SFI score, and the PHAS-EA score was related to the movement-related VAS value for neck pain severity. In the group with back pain, PHAS-SHA and PHAS-PH scores were associated with

Table 5. Correlations between postural habits and awareness scale scores and pain-related variables

	Neck pain duration	Neck pain intensity-VAS movement	Neck pain intesity-VAS rest	Back pain duration	Back pain intensity-VAS movement	Back pain intesity-VAS rest	Low back pain duration	Low back pain intensity-VAS movement	Low back pain intesity-VAS rest
PHAS-PH	r=-0.24 p=0.16	r=-0.27 p=0.11	r=-0.21 p=0.21	r=-0.18 p=0.36	r=-0.10 p=0.61	r=-0.04 p=0.85	r=-0.05 p=0.79	**r=-0.47 p=0.006****	r=-0.18 p=0.34
PHAS-PA	r=-0.17 p=0.33	r=-0.08 p=0.65	r=-0.07 p=0.70	r=0.02 p=0.93	r=0.17 p=0.37	r=-0.03 p=0.87	r=0.11 p=0.55	r=-0.29 p=0.10	r=0.06 p=0.73
PHAS-SHA	**r=-0.44 p=0.006****	r=-0.16 p=0.35	r=-0.18 p=0.29	r=0.05 p=0.78	r=0.13 p=0.52	r=-0.14 p=0.49	r=-0.14 p=0.45	**r=-0.40 p=0.02***	r=-0.14 p=0.44
PHAS-AFIS	r=0.18 p=0.28	r=0.09 p=0.59	r=0.08 p=0.66	r=0.28 p=0.15	r=0.23 p=0.23	r=-0.05 p=0.82	r=-0.02 p=0.91	r=0.02 p=0.90	r=0.12 p=0.53
PHAS-POA	r=-0.10 p=0.55	r=-0.16 p=0.36	r=-0.08 p=0.65	r=-0.11 p=0.57	r=0.03 p=0.88	r=-0.002 p=0.99	r=0.10 p=0.59	r=-0.18 p=0.32	r=0.09 p=0.61
PHAS-EA	r=-0.09 p=0.58	**r=-0.39 p=0.02***	r=-0.32 p=0.05	r=-0.16 p=0.41	r=-0.11 p=0.55	r=-0.04 p=0.84	r=0.27 p=0.13	**r=-0.45 p=0.01****	r=-0.17 p=0.34

*The statistical significance level of the correlation is p≤0.05 (two-tailed)
**The statistical significance level of the correlation is p≤0.01 (two-tailed)
VAS: Visual analog scale, PHAS: Postural habits and awareness scale, PH: Postural habit score, PA: Postural awareness score, SHA: Stance habits and awareness score, AFIS: Awareness of factors that impair stance subscore, POA: Positional awareness subscore, EA: Ergonomic awareness subscore

the SFI score. In the group with low back pain, we observed that the PHAS-PH score and PHAS-EA score were related to the low back pain severity-movement VAS value; the PHAS-POA score was related to the SFI score; and the PHAS-SHA score was related to the low back pain severity-movement VAS value and SFI score.

It is known that postural problems are an important triggering factor in the emergence and chronicity of many musculoskeletal problems, especially spinal pain (3). Consistent with this information, our study also found that components related to PHs and awareness were effective on spinal pain, chronicity, and functionality. Similar to our study, many studies in the literature evaluating the effects of postural factors on musculoskeletal pain report that PHs are effective on musculoskeletal pain and dysfunction (8-11). In this context, spinal problems and their relationship with poor posture are among the most researched and reported problems (2,5-7,11,20-27). In a meta-analysis conducted by Sugavanam et al. (2) in 2024, where they evaluated the effects of postural asymmetry in low back pain and examined 46 studies, it was reported that increased pelvic tilt, increased pelvic incidence, decreased lumbar lordosis, and sacral slope were commonly observed postural abnormalities in patients with low back pain. In their study evaluating the relationship between low back pain and spinal postural assessment, Du et al. (5) reported that the most frequently reported abnormalities in low back pain due to poor posture were lumbar lordosis, sway-back, round back, flat back, and scoliosis. In the meta-analysis conducted by Mahmoud et al. (7) in 2019, which examined 15 studies evaluating the relationships between neck pain and forward neck posture, it was reported that the most common postural disorder associated with neck pain was forward neck posture, and that neck pain assessment criteria were correlated with an increase in forward neck posture. In their systematic review published in 2019, Hesby et al. (21) examined 36 studies evaluating the relationships between electronic measurements based on posture and neck movements and neck pain. They reported decreased active joint range of motion and speed of movement, along with correct positioning of the head in patients with neck pain.

On the other hand, the presence of pain is an important factor that disrupts optimal postural control. This two-way relationship between posture and pain is an important risk factor for pain to become chronic (1). In our study, the two-way relationship observed in the correlation analyses between various components of PHs and awareness and the severity and duration of pain in the spine is consistent with the aforementioned information. Therefore, a person's awareness of good and bad posture and the ability to maintain appropriate PHs during daily life activities are an important factor in preventing this vicious circle (3). There are many studies reporting that postural education and postural rehabilitation have positive effects on posture awareness, PHs, and chronic low back and neck pain (6,24-26,28). In our study, it was observed that the exercise frequency was significantly lower in those with back pain compared to the group without back pain. However, the same situation was not observed in the groups with neck pain and low back pain. It was observed that the frequency of posture exercises did not change according to the pain status. We think that this situation, which seems to be different from what is generally reported in the literature, is due to the low exercise habits in both the pain and non-pain groups.

It has been reported in the literature that posture abnormalities, especially due to occupational conditions, are associated with musculoskeletal problems-low back and neck pain-in many occupational groups. Ergonomic ergonomic and postural training and rehabilitation have a positive effect on pain, functionality, and quality of life (8-11). It is known that musculoskeletal complaints are quite common among physicians and resident physicians (12). Many studies in various branches of medicine report that musculoskeletal problems are detected quite frequently (29-31). These problems can lead to negative consequences such as lower work efficiency, burnout, decreased job satisfaction, absenteeism, and early retirement (11,14,32). In our study, we observed that spinal pain was quite common among resident physicians, consistent with the literature.

We observed that resident physicians' PA and PHs were generally suboptimal, and that this situation had a negative effect on spinal pain and function. Good PHs are directly related to good ergonomic knowledge. Studies have shown that the areas where occupational pain is most frequently described by doctors are the low back and neck regions, which are directly related to posture (29,30). Ergonomic risk, which is an important cause of musculoskeletal pain among doctors, is a concept that is often overlooked in education (11,30). The most frequently emphasized risk factors are postural risks such as repetitive movements, excessive movements, working in a non-neutral static body position, standing, and neck flexion for long periods (11,29,31). Many studies have investigated various interventions to deal with poor ergonomics. These include preoperative planning aimed at reducing surgical time, breaks during surgery, the use of anti-fatigue standing mats or wearable posture correction sensors, and stretching and other exercises during surgery. These approaches appear to be effective but require further study. Beyond all approaches, posture and ergonomic training, which is a simpler and more accessible approach, remains underexplored (11).

It is reported in the literature that musculoskeletal complaints in doctors often begin during their residency training (11,14,30). In some studies, pain prevalence rates of up to 90% have been reported in resident physicians (11,30). Resident physicians typically work longer hours than attending physicians, have less time for recovery, and are subject to ergonomic risks similar to those of attending physicians. Additionally, resident physicians tend to adopt occupational postures based on observation of their mentors and personal preference rather than ergonomic principles (30).

The residency period is an ideal time to teach the concepts of proper work ergonomics (14). Given that resident physicians continue to develop their PHs and ergonomic practice skills throughout their residency training, there is an opportunity to correct poor habits through early intervention (11). In their study conducted in 2023, Gold et al. (11) reported that some of the resident physicians were trained in ergonomic principles and positions during otologic microscopic surgery while others were not and that those who received training adopted better lumbar posture. Interestingly, this study found that teaching ergonomic principles to senior resident physicians did not make a significant difference in posture. These findings suggest that younger resident physicians who have not yet developed their natural surgical posture may be more likely to change their procedural habits. This emphasize es the importance of early teaching and intervention.

On the other hand, witnessed both in practice and reported in the literature that most medical branches do not provide formal or informal ergonomics training in their residency training programs (29-31,33). Numerous surveys have revealed that most respondents report having little or no prior training in ergonomic principles (11,30). This suggests that resident physicians do not have access to evidence-based ergonomics training that could reduce their risk of experiencing work-related musculoskeletal disorders throughout their careers (29)

This information indicates that, as we did in our study, one of the first steps to be taken in preventing posture-related spine problems is to question the habits and awareness of maintaining correct posture. In this perspective, monitoring and training with posture feedback via photographs, electronic sensors, or tele-rehabilitation methods as part of postural rehabilitation are applications that have been shown to be beneficial in the literature (34-36). The success of posture and ergonomics training programs can most practically be defined by the increase in the individual's knowledge and awareness regarding their own posture habits and the benefits perceived. Apart from this, serial photographs and video reviews will further increase this awareness (29).

Strengths and limitations of the study

The primary contribution of our study to the literature is that the PHAS, a new questionnaire providing easy inquiry about PHs and awareness, is a low-cost method. This scale, which has not been used in the literature before, was utilized to confirm the relationships between spine pain, functionality, and scale parameters, in accordance with existing literature. Another contribution is that it emphasizes that even among doctors, who are the direct managers of health, poor PA and habits that can lead to spinal problems are quite common. There are few studies using objective data to analyze PHs in physicians and even fewer studies investigating the PHs of resident physicians. Our study contributes to the literature in this respect. Limitations of our study include the inability to assess changes in parameters related to study variables after postural rehabilitation and training due to the cross-sectional nature of the study and the relatively small sample size. We believe that prospective studies

with larger samples will contribute significantly to the literature on the subject and that strategies that will increase PA in clinical practice will become one of the cornerstones in the prevention and treatment of spine problems.

We believe that training programs, such as lectures and workshops on posture, ergonomics, or musculoskeletal problems, should be included in resident education programs, as these problems may be encountered by resident physicians during their specialization programs at medical schools. Although it is difficult to conduct studies that evaluate posture, ergonomics, and related musculoskeletal problems in the long term, such studies will make important contributions to the literature and clinical practice.

Conclusion

Poor PHs and poor PA are associated with more severe and prolonged spinal pain, worse spinal function, and poorer quality of life. This supports the important role of postural education in the prevention and management of spinal problems.

Ethics

Ethics Committee Approval: The study was approved by the Ufuk University of Non-interventional Clinical Research Evaluation Ethics Committee (decision number: 23.01.12.01/01, date: 24.01.2023).

Informed Consent: Consent form was filled out by all participants.

Footnotes

Conflict of Interest: The author declared no conflict of interest.

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Radiological factors causing anterior knee pain after intramedullary nailing of tibial shaft fractures

Mustafa Aydın[1], Ömer Levent Karadamar[1], Enes Keleş[1], Begüm Aslantaş Kaplan[2], Ali Aydilek[1], Erkan Sabri Ertaş[1]

[1]University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Orthopedics and Traumatology, Ankara, Türkiye
[2]University of Health Sciences Türkiye, Erbaa State Hospital, Clinic of Orthopedics and Traumatology, Tokat, Türkiye

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Corresponding Author:
Mustafa Aydın M.D., University of Health Sciences Türkiye, Gülhane Training and Research Hospital, Clinic of Orthopedics and Traumatology, Ankara, Türkiye
mustafaaydin5528@gmail.com

ORCID:
orcid.org/0000-0002-9066-4606

Keywords: Tibial shaft fracture, intramedullary nailing, anterior knee pain, mechanical axis deviation

ABSTRACT

Aims: Intramedullary nailing (IMN) is the most common method for treating tibial shaft fractures. Though the procedure preserves the soft tissue envelope around the fracture and enables weight-bearing on the affected limb, chronic anterior knee pain may still occur. The aim of this study was to evaluate radiological factors of anterior knee pain in patients undergoing tibial IMN.

Methods: Patients were retrospectively analyzed as part of the study. The distance from the proximal tip of the nail to the tibial plateau in the sagittal plane, the distance from the tip of the nail to the anterior tibial cortex, the distance from the nail entry point to the tibial mechanical axis in the anteroposterior (AP) plane, the Caton-Deschamps index, the Insall-Salvati index, and the visual analog scale (VAS) scores were evaluated.

Results: The study included 147 patients [age, mean±standard deviation (SD): 37.51±14.61 years; 99 (67.4%) male].The mean postoperative 12th month VAS pain score was 4.56±2.52. No significant correlation was found between VAS scores and factors such as the distance from the proximal tip of the nail to the tibial plateau in the sagittal plane, the distance from the tip of the nail to the anterior tibial cortex, Caton-Deschamps index, or Insall-Salvati index ($p>0.05$). However, a significantly positive correlation was observed between the distance from the nail entry point to the tibial mechanical axis in the AP plane, and VAS score ($r=0.701$, $p=0.001$).

Conclusions: Our study results indicated that when the entry point of the nail deviated further from the tibial mechanical axis, as evaluated at 12 months postoperatively, the VAS score of the patients increased. Ensuring that the nail entry point is accurately positioned within the designated safe zone is critical.

Introduction

Tibial shaft fractures (TSFs) are among the most common long bone fractures (1). They are often the result of high-energy trauma, such as falls from a height, sports injuries or motor vehicle accidents (2). Tibial fractures represent the most frequent open long bone fractures, accounting for more than 15% of cases (3,4). These injuries can lead to permanent sequelae, such as malalignment and limb shortening, even after treatment (2,5). Epidemiological studies have estimated an incidence ranging from 8.1 to 37.0 cases per 100,000 person-years (3).

Intramedullary nailing (IMN) is widely utilized in the treatment of TSFs. This technique offers certain advantages,

such as preserving the soft tissue envelope around the fracture and enabling early weight-bearing on the affected limb (3,6). However, chronic anterior knee pain remains the most frequent complication after IMN (7). The nail entry point in the tibia is of critical importance due to its potential to damage surrounding tissues (8). Structures within the knee joint, including the medial meniscus, anterior intermeniscal ligament, lateral tibial plateau, and transverse ligament, are at risk during nailing in a cadaveric study by Tornetta et al. (8), the safe zone for nail entry was defined as extending up to 4.4 mm lateral to the midline of the tibial plateau and having a width of 12.6 to 22.9 mm. Entry outside this region can cause trauma to the patellar tendon and fat pad in the proximal tibia, potentially leading to persistent anterior knee pain (9).

Anterior knee pain remains one of the most frequent complications after IMN for TSFs, which could impair patient mobility, daily functioning, and overall quality of life. Previous studies have reported persistent anterior knee pain even after nail removal, suggesting underlying chronic structural or biomechanical changes (10). Patients with anterior knee pain may exhibit a thin and disorganized patellar tendon, reactive synovitis, and fat pad calcification (11).

Although anterior knee pain usually occurs a few months after surgery, the exact relationship between nail position, entry point, and pain remains to be elucidated (12). The objective of this study was to identify and analyze radiological factors contributing to anterior knee pain following IMN in patients with TSFs. Specifically, in the present study, we aimed to investigate whether variations in nail entry point positioning and radiological parameters correlated with postoperative anterior knee pain severity.

Methods

Study design and study population

This single-center, retrospective study was conducted at the department of orthopedics and traumatology of a tertiary care center between November 2016 and January 2023. Patients who underwent IMN for TSF in our clinic and were followed for at least one year were evaluated for study eligibility. Inclusion criteria were as follows: age between 18 and 90 years; having undergone IMN due to TSF; having anteroposterior (AP) and lateral X-ray images of the knee; having no anterior knee pain before surgery. Exclusion criteria included age <18 years, undergoing previous knee joint surgery, not having undergone reaming during nailing procedures, having congenital deformities of the knee and surrounding areas, fractures extending to the level of the knee or ankle joint, advanced degenerative arthritis, requiring nail removal due to early postoperative infection, and incomplete follow-up data. A flowchart illustrating patient selection, along with the number of patients excluded according to these specific criteria and the final cohort of 147 patients included in the analysis, is presented in Figure 1.

Written informed consent was obtained from the patients for all diagnostic and therapeutic procedures. The study was approved by the Scientific Research Ethics Committee of Gülhane, University of Health Sciences of Türkiye (decision number: 2024-537, date: 10/12/2024). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical technique

The surgeries were performed by five different surgeons, including the authors of the study. All patients underwent IMN via transtendinous approach under regional anesthesia. An incision of 3 to 5 cm was made along the midline of the patellar tendon. The entry portal was created immediately behind the patellar tendon, on the bone. The knee was positioned in 20 to 30° of flexion. Fluoroscopy was used to ensure the position of the entry point. Accuracy in nail placement was ensured through several standardized procedural steps. Specifically, surgeons employed anatomical landmarks such as the medial aspect of the lateral tibial eminence on the AP view and a point proximal to the anterior articular margin on the lateral view to guide nail insertion. Careful attention was paid to maintaining knee flexion between 20° and 30° throughout insertion to reduce variability. The primary surgeon confirmed the accurate position of the entry point fluoroscopically before proceeding

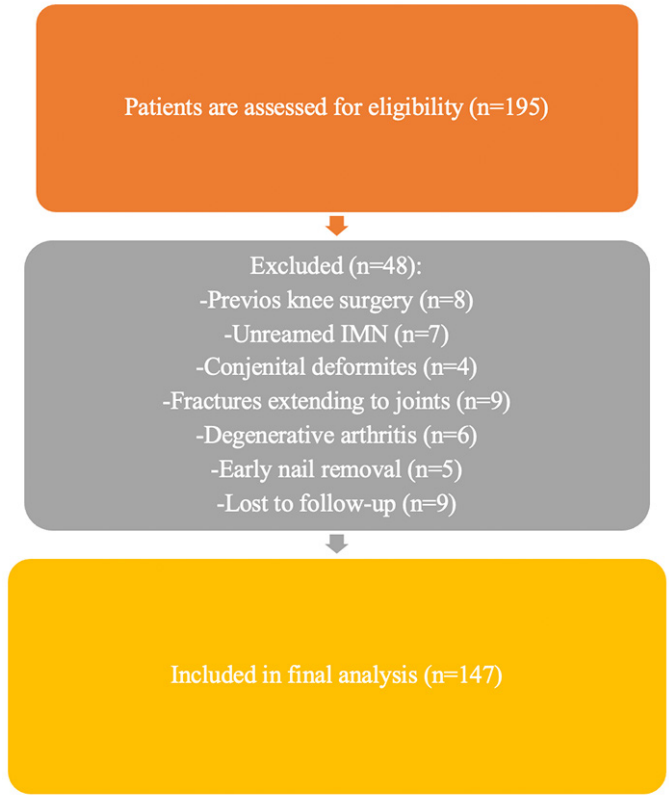

Figure 1. Flowchart of the patient selection process
IMN: Intramedullary nailing

with intramedullary reaming and nail fixation. The fracture was then reduced, reamed, and the nail inserted with proximal and distal locking screws.

Data collection and data assessment

Demographic characteristics of the patients, including age, sex, and body mass index (BMI), and postoperative and follow-up data were recorded. Postoperative AP and lateral radiographs of the tibia, routinely taken immediately after surgery and at 12 months, were evaluated. Visual analog scale (VAS) scores were noted at 12 months after surgery (0 = excellent, 10 = unbearable pain).

Fracture classification was performed using the Arbeitsgemeinschaft fur Osteosynthesefragen (AO) criteria based on routine preoperative radiographs. The patients were classified into nine subgroups (42A1, 42A2, 42A3, 42B1, 42B2, 42B3, 42C1, 42C2, 42C3). Postoperative radiographs were assessed to measure distance from the proximal tip of the nail to the tibial plateau in the sagittal plane (measured as the distance between a transverse line drawn through the tibial plateau and one through the proximal nail tip, calibrated based on nail diameter) (Figure 2), the distance from the tip of the nail to the anterior tibial cortex (measured as the distance between a line drawn along the anterior tibial cortex and the nail's anterior tip, calibrated by nail diameter), and the distance from the nail entry point to the tibial mechanical axis in the AP plane (measured as the distance between the proximal mid-point of the nail and the mechanical axis, calibrated by nail diameter). In addition, patellar morphology, Caton-Deschamps index, and Insall-Salvati index were evaluated to investigate their relationship with chronic anterior knee pain.

Radiographic imaging was standardized by maintaining a distance of 110 cm between the X-ray tube and the table.

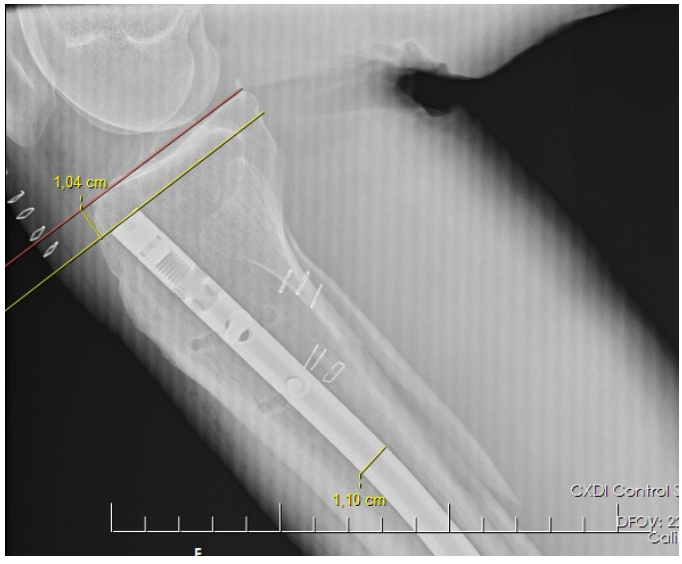

Figure 2. Radiographic measurement of the distance from the proximal tip of the nail to the tibial plateau in the sagittal plane

Nail diameter was identified from surgical records, and all measurements were calibrated accordingly. No plaster or splint was applied in the postoperative period. Partial weight-bearing on the operated side was allowed for the first 12 weeks postoperatively, with full weight-bearing allowed thereafter. All patients underwent the same physiotherapy protocols for muscle rehabilitation during hospitalization.

Statistical Analysis

Statistical analysis was performed using SPSS for Windows version 20.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean±standard deviation or median (minimum-maximum), while categorical variables were presented in number and frequency. The Kolmogorov-Smirnov test was used to assess the normality of data distribution. The independent samples t-test was used to analyze parametric data, while the Mann-Whitney U test was used to analyze non-parametric data between the groups. The Spearman correlation analysis was performed to identify potential relationships between continuous variables and VAS scores (13). A p-value of <0.05 was considered statistically significant.

Results

The study population comprised 147 patients (99 males, 48 females), with a mean age of 37.51±14.61 years (range: 18-79 years). The mean BMI was 27.47±2.39 kg/m^2, indicating a generally overweight cohort. According to the AO fracture classification, the most frequent fracture subtype encountered was type 42A1, affecting 42 patients (28.6%). Other fracture types included 42A2, 42A3, 42B, and 42C, demonstrating a diverse representation of fracture patterns typical of high-energy trauma scenarios (Table 1). The mean VAS pain score was 4.56±2.52. The mean distance from the proximal tip of the nail to the tibial plateau in the sagittal plane was 1.28±0.73 mm, the mean distance from the tip of the nail to the anterior tibial cortex was 0.48±0.32 mm, and the mean distance from the nail entry point to the tibial mechanical axis in the AP plane was 0.21±17 mm. The mean patellar morphology index was 1.49±0.15, the mean Caton-Deschamps index was 1.50±0.44, and the mean Insall-Salvati index was 0.75±0.25 (Table 2).

Correlation analysis results are presented in Table 3. No significant correlation was found between VAS scores and factors such as sex, age, BMI, AO fracture classification, the distance from the proximal tip of the nail to the tibial plateau in the sagittal plane, the distance from the tip of the nail to the anterior tibial cortex, the Caton-Deschamps index, and the Insall-Salvati index ($p>0.05$). However, a significant positive correlation was found between the distance from the nail entry point to the tibial mechanical axis in the AP plane and VAS scores ($r=0.701$, $p=0.001$) (Figure 3), indicating that as this distance increased, the VAS scores also increased.

Table 1. Demographic and clinical characteristics of patients (n=147)

Variable	Value
Age, years, mean±SD	37.51±14.61
BMI, kg/m^2, mean±SD	27.47±2.39
Sex, n (%)	
Female, n (%)	48 (32.7)
Male, n (%)	99 (67.3)
AO Fracture Classification, n (%)	
A1	42 (28.6)
A2	21 (14.3)
A3	27 (18.4)
B1	15 (10.2)
B2	13 (8.8)
B3	3 (2.0)
C2	9 (6.1)
C3	17 (11.6)

BMI: Body mass index, SD: Standard deviation, AO: Arbeitsgemeinschaft fur Osteosynthesefragen

Table 2. Radiological measurements and VAS scores of patients

Variable	Value
Distance from the proximal tip of the nail to the tibial plateau in the sagittal plane	1.28±0.73
Distance from the tip of the nail to the anterior tibial cortex	0.48±0.32
Distance from the nail entry point to the tibial mechanical axis in the anteroposterior plane	0.21±0.17
Patellar morphology index	1.49±0.15
Caton-Deschamps index	1.50±0.44
Insall-Salvati index	0.75±0.25
VAS	4.56±2.52

Data are given in mean±SD, unless otherwise stated
VAS: Visual analog scale, SD: Standard deviation

Discussion

IMN is considered the primary treatment option for adult patients with TSFs. Anterior knee pain is one of the most common complications of IMN. Although numerous studies have been conducted on this subject, the exact cause of anterior knee pain has not been fully elucidated. In a study, Toivanen et al. (7) reported that anterior knee pain persisted even after nail removal. In another study, tension increased at the proximal nail entry site of the tibia during standing, walking, and kneeling, and this tension did not resolve after nail removal, significantly contributing to loss of productivity (14). In the present study, we evaluated the radiological factors contributing to the development of anterior knee pain following IMN in patients with TSFs. Our study results showed that there was no significant correlation between VAS scores and the other variables, except for distance from the nail entry point to the tibial mechanical

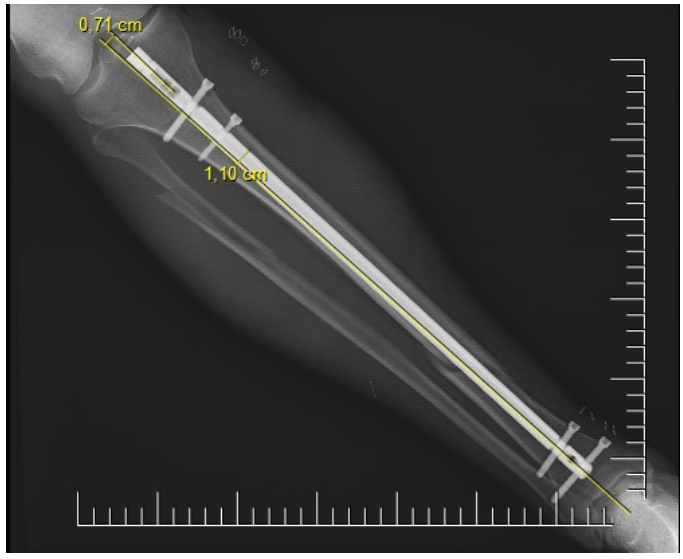

Figure 3. Radiographic measurement of the distance from the nail entry point to the tibial mechanical axis in the AP plane
AP: Anteroposterior

Table 3. Correlation analysis results

	VAS	
Variable	**r***	**p**
Age	0.011	0.894
BMI	-0.017	0.842
AO Fracture Classification	0.103	0.216
Distance from the proximal tip of the nail to the tibial plateau in the sagittal plane	-0.111	0.182
Distance from the tip of the nail to the anterior tibial cortex	-0.118	0.154
Distance from the nail entry point to the tibial mechanical axis in the anteroposterior plane	0.701	**<0.001**
Patellar morphology index	-0.022	0.789
Caton-Deschamps index	-0.028	0.740
Insall-Salvati index	-0.045	0.584

*Spearman correlation coefficient
VAS: Visual analog scale, BMI: Body mass index, AO: Arbeitsgemeinschaft fur Osteosynthesefragen

axis in the AP plane. This finding suggests that as the distance from the nail entry point to the tibial mechanical axis in the AP plane increases, the VAS scores also increase, which probably impairs patients' quality of life.

Some previous studies have suggested a potential link between age and anterior knee pain, emphasizing increased mobilization in younger individuals (15). However, in our study, there was no significant association between age and anterior knee pain, which can probably be attributed to the variability in pain perception, biomechanical differences, and discrepancy in the level of coping mechanisms among patients according to age.

Considering the surgical approaches during IMN, Toivanen et al. (7) found no significant difference in the pain scores between the paratendinous approach and the transtendinous approach. Previous studies examining the anatomy of the patellar tendon have shown that, while evaluating the Insall-Salvati and Caton-Deschamps indices, the transtendinous approach results in shortening of the patellar tendon compared to the intact knee (11). However, another study demonstrated thinning of the patellar tendon, although this was not associated with anterior knee pain (16). In our study, the patellar tendon approach was performed using transtendinous approach and, consistent with the literature, we observed no significant correlation between the Insall-Salvati and Caton-Deschamps indices and anterior knee pain.

Safe zones for the nail insertion site have been identified in previous studies, and these zones are described as the medial surface of the lateral tibial eminence on the AP view, and just proximal to the anterior articular margin on the lateral view (9,17). In surgeries performed by surgeons with less than five years of experience, the development of multiple entry points has been shown to lead to intra-articular damage, which is a cause of anterior knee pain (18). The nail insertion site may increase the risk of meniscal root tears, cause sequelae, and even lead to rapid cartilage degeneration and early arthritis, which can result in anterior knee pain, particularly in patients with smaller tibias (19,20). Intra-articular structures, such as the meniscus, anterior cruciate ligament, and articular cartilage, are at risk during tibial nailing. In the cadaveric series of Tornetta et al. (8), 20% of the specimens showed intraarticular structural damage and 30% showed damage to the meniscus and surrounding tissues. In a case report by Ellman et al. (9), magnetic resonance imaging (MRI) revealed medial meniscus damage, and the meniscus root was displaced from its anatomical footprint due to the nail placement. We also believe that the nail insertion site significantly contributes to this anterior knee pain. In the current study, we observed that as the distance from the nail entry point to the tibial mechanical axis in the AP plane increased, the VAS scores of the patients also increased. This finding suggests that pain may increase due to damage, particularly in the anterior horn of the meniscus. In addition, we examined the distance from the proximal tip of the nail to the tibial plateau in the sagittal plane and the distance from the tip of the nail to the anterior tibial cortex; however, we found no significant correlation in terms of anterior knee pain. Similarly, in their study including 33 patients, Turkmen et al. (12) evaluated changes in patellar tendon length after tibial IMN using a transtendinous approach and found no significant correlation between the anterior tibial cortex and anterior knee pain.

This study has several limitations. Firstly, the retrospective, single-center design inherently introduces potential biases, including incomplete data collection and patient selection bias, which may limit the generalizability of results. Secondly, multiple surgeons with varying levels of expertise performed the procedures, potentially influencing consistency and accuracy in nail positioning and patient outcomes. In addition, the study lacks inter-and intra-observer reliability analysis. Although all measurements were conducted by experienced professionals using standardized techniques, the absence of formal reproducibility testing may affect the reliability of the results. Thirdly, surgeries were conducted exclusively via a transtendinous approach, limiting the ability to compare outcomes with alternative surgical methods. Furthermore, detailed intra-articular imaging, such as MRI or arthroscopy, was not routinely performed; thus, subtle intra-articular injuries that could substantially affect postoperative pain outcomes may not have been identified. Finally, the absence of quality-of-life assessments restricts a comprehensive understanding of the true impact of anterior knee pain on patient functionality and well-being.

Conclusion

Anterior knee pain is the most common complication after IMN in TSF patients, negatively impacting quality of life and knee function. Our study found no significant correlation between pain and factors such as sex, age, BMI, AO classification, or radiographic measurements. However, increased deviation of the nail entry point from the tibial mechanical axis was associated with higher VAS scores, underscoring the importance of precise entry point placement. Further research is needed to better understand the contributing factors to anterior knee pain in these cases.

Ethics

Ethics Committee Approval: The study was approved by the Scientific Research Ethics Committee of Gülhane, University of Health Sciences of Türkiye (decision number: 2024-537, date: 10/12/2024).

Informed Consent: Consent form was filled out by all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.A., Concept: M.A., E.K., Design: M.A., Ö.L.K., Data Collection or Processing: E.K., A.A., Analysis or Interpretation: Ö.L.K., E.S.E., Literature Search: B.A.K., E.S.E., Writing: M.A., B.A.K.

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Burkholderia gladioli bacteremia in a patient with chronic obstructive pulmonary disease: An unusual clinical scenario

Asem Ali Ashraf, Vimal Kumar Karnaker, Vinitha Thachil

Nitte (Deemed to be University), K.S. Hegde Medical Academy, Department of Microbiology, Mangalore, India

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Corresponding Author:
Asem Ali Ashraf, M.D., Asst. Prof, Nitte (Deemed to be University), K.S. Hegde Medical Academy, Department of Microbiology, Mangalore, India
asemali611@gmail.com

ORCID:
orcid.org/0000-0002-1028-0224

Keywords: Antimicrobial resistance, bacteremia, *Burkholderia gladioli*, COPD, MALDI-ToF

ABSTRACT

Burkholderia gladioli (B. gladioli), once recognized as a plant pathogen, is increasingly linked to infections in immunocompromised patients. We report a case of *B. gladioli* bacteremia in a 57-year-old male with chronic obstructive pulmonary disease and diabetes mellitus. He presented with fever, dyspnea, and cough. A chest X-ray revealed a left lower zone consolidation. Blood cultures identified *B. gladioli* using matrix-assisted laser desorption ionization-time of flight and VITEK 2 automated identification systems. The isolate was sensitive to piperacillin-tazobactam and trimethoprim-sulfamethoxazole, leading to complete recovery. This case highlights the emerging role of *B. gladioli* as an opportunistic pathogen and the importance of early diagnosis and treatment.

Introduction

Burkholderia spp. are a genus of gram-negative, aerobic bacteria found in water, soil, and plants, comprising over 60 species. Burkholderia gladioli *(B. gladioli)*, initially identified as a plant pathogen (1), was recognized as a human pathogen in 1995 (2). Though rare, it is now considered an opportunistic pathogen, particularly in individuals with cystic fibrosis, chronic granulomatous disease, or immunocompromised states (1). It has been linked to respiratory tract colonization and, less commonly, systemic infections. This case report highlights the unusual isolation of *B. gladioli* from blood samples, emphasizing its emerging clinical significance. Elderly and immunocompromised patients, especially those with underlying conditions like chronic obstructive pulmonary disease (COPD), are at increased risk. Prompt identification and appropriate antimicrobial therapy are crucial for management, underscoring the need for greater awareness among clinicians about this evolving pathogen.

Case Presentation

A 57-year-old man was admitted to the emergency department with progressive breathlessness for three days, productive cough for two days, and low-grade fever in the last 24 hours. His medical history was remarkable for type 2 diabetes

mellitus and COPD which had been managed with intermittent prednisolone. His breathlessness was of sudden onset and severe at rest, accompanied by wheezing, especially at night and early morning. The cough was scanty, mucoid, and non-bloody.

On his physical examination, the patient was alert and oriented. Arterial blood pressure was 110/80 mmHg, pulse rate was 110/min, body temperature was 99 °F, respiratory rate was 37 breaths/min, and SpO_2 was 90% with no supplement. Auscultation revealed bilateral suprascapular crepitations and diffuse rhonchi. Grade 1 clubbing was also detected. A chest X-ray showed left lower zone consolidation (Figure 1A). *B. gladioli* was isolated from blood cultures, and sputum culture showed normal oropharyngeal flora. Table 1 summarizes the laboratory findings.

The patient received piperacillin-tazobactam (4.5 g three times daily for 10 days) and oral trimethoprim-sulfamethoxazole (TMP-SMZ) (160/800 mg twice daily for five days), along with supportive care including bronchodilators, antacids, and steroids. The treatment was well-tolerated, with no adverse effects reported.

Microbiological evaluation

Blood samples were collected under sterile conditions and cultured in a BacT/ALERT® aerobic culture media bottle (bioMérieux, France). A bottle flagged as positive from the BacT/ALERT system prompted a subculture onto 5% sheep blood agar and MacConkey agar (HiMedia, Mumbai, India) using the streak plate method, followed by incubation at 37 °C for 24 to 48 hours.

Gram staining revealed rod-shaped, gram-negative bacilli (Figure 2A). Growth on 5% sheep blood agar showed round, moist, non-hemolytic colonies (Figure 2B). On MacConkey agar, pale, irregular, non-lactose fermenting colonies were observed (Figure 2C). Both catalase and oxidase tests returned positive results. Biochemical testing further indicated that arginine was not dehydrolyzed, and neither lysine nor ornithine was decarboxylated.

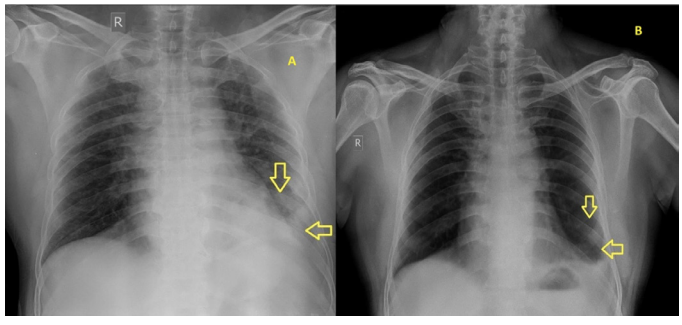

Figure 1. (A) Chest X-ray showed left lower zone consolidation. (B) Follow-up chest X-rays revealed resolution of the left lower zone consolidation and pulmonary infiltrates

The isolated bacteria were identified as *B. gladioli* with 99% probability using the VITEK 2 compact system with the gram-negative identification card (bioMérieux, Marcy L'Etoile, France) and the matrix-assisted laser desorption/ionization-time of flight (MALDI-ToF) system (bioMérieux, France).

Antibiotic susceptibility testing was performed using the automated turbidimetric VITEK 2 system (bioMérieux, France). The susceptibility cards were inoculated, and the minimum inhibitory concentrations in µg/mL were interpreted based on Clinical and Laboratory Standards Institute guidelines (3). The antibiotic susceptibility profile of the isolated bacteria showed resistance to aztreonam (≥64) but sensitivity to amoxicillin-clavulanate (≤2), piperacillin/tazobactam (≤4), ceftazidime (8), cefoperazone/sulbactam (≤8), cefepime (8), imipenem (≤0.5), meropenem (1), amikacin (≤1), gentamicin (≤1), ciprofloxacin (0.5), levofloxacin (1), minocycline (2), and TMP-SMZ (≤20).

The patient demonstrated significant clinical improvement within one week of antibiotic therapy, which included intravenous piperacillin-tazobactam (4.5 g every eight hours for 10 days) and oral TMP-SMZ (160/800 mg twice daily for five days). Symptoms such as cough and fever subsided, and laboratory results normalized, including a decrease in leukocyte count (9,184 cells/mm^3), erythrocyte sedimentation rate (13 mm/hr), and C-reactive protein (0.3 mg/L), indicating the resolution of infection and inflammation. Liver enzyme levels also returned to normal [serum glutamic-oxaloacetic transaminase (SGOT): 27 U/L, serum glutamic-pyruvate transaminase (SGPT): 31 U/L]. Follow-up chest X-rays revealed resolution of the left lower zone consolidation and pulmonary infiltrates (Figure 1B). Repeat blood cultures showed no growth. After a 12-day hospital stay, the patient was discharged in a stable condition. On subsequent follow-up visits, he reported no recurrence of breathlessness, fever, or cough.

Discussion

B. gladioli is primarily a plant pathogen but has been rarely linked to human infections. Infections in healthy individuals, typically neutralized by human serum or complement factors, are exceptionally rare (2,4). Most cases occur in individuals with underlying conditions such as diabetes, acquired immunodeficiency syndrome, cystic fibrosis, chronic granulomatous disease, or organ transplant recipients (2,5). The present report involves a patient with a history of pneumonia, commonly associated with *B. gladioli* infections, highlighting its role as an opportunistic pathogen.

The limited evidence on *B. gladioli* and its antibiotic resistance highlights the potential for complicated clinical outcomes. Reported complications include pneumonia, mediastinal abscess, bacteremia, osteomyelitis, maxillary sinusitis, and early neonatal or nosocomial sepsis. Notably, no evidence of person-to-person transmission has been documented (5).

Table 1. Blood parameters recorded during admission day

Tests	Observed value	Unit	Reference range	Inference
Hemoglobin	11.8	g/dL	13.0-17.0	Low
Total leucocyte count	23.350	cells/mm^3	4000.0-10000.0	Raised
Neutrophils	83.9	%	40.0-80.0	Raised
Lymphocytes	8.9	%	20.0-40.0	Low
Monocytes	7	%	2.0-10.0	Normal
Erythrocyte sedimentation rate	22	mm/hr	0.0-14.0	Raised
Platelet count	200.000	cells/mm^3	1.5x10^5-4.1x10^5	Normal
A/G ratio	1.36		1.0-2.1	Normal
Bilirubin total	0.72	mg/dL	0.2-1.3	Normal
Bilirubin, direct	0.25	mg/dL	0.0-0.4	Normal
Bilirubin, indirect	0.47	mg/dL	0.0-0.75	Normal
SGOT	77	U/L	5.0-30.0	Raised
SGPT	68	U/L	4.0-36.0	Raised
Alkaline phosphatase	60	U/L	38.0-126.0	Normal
Blood urea	53	mg/dL	16.6-48.5	Raised
Creatinine	1.4	mg/dL	0.7-1.4	Normal

SGOT: Serum glutamic-oxaloacetic transaminase, SGPT: Serum glutamic-pyruvate transaminase

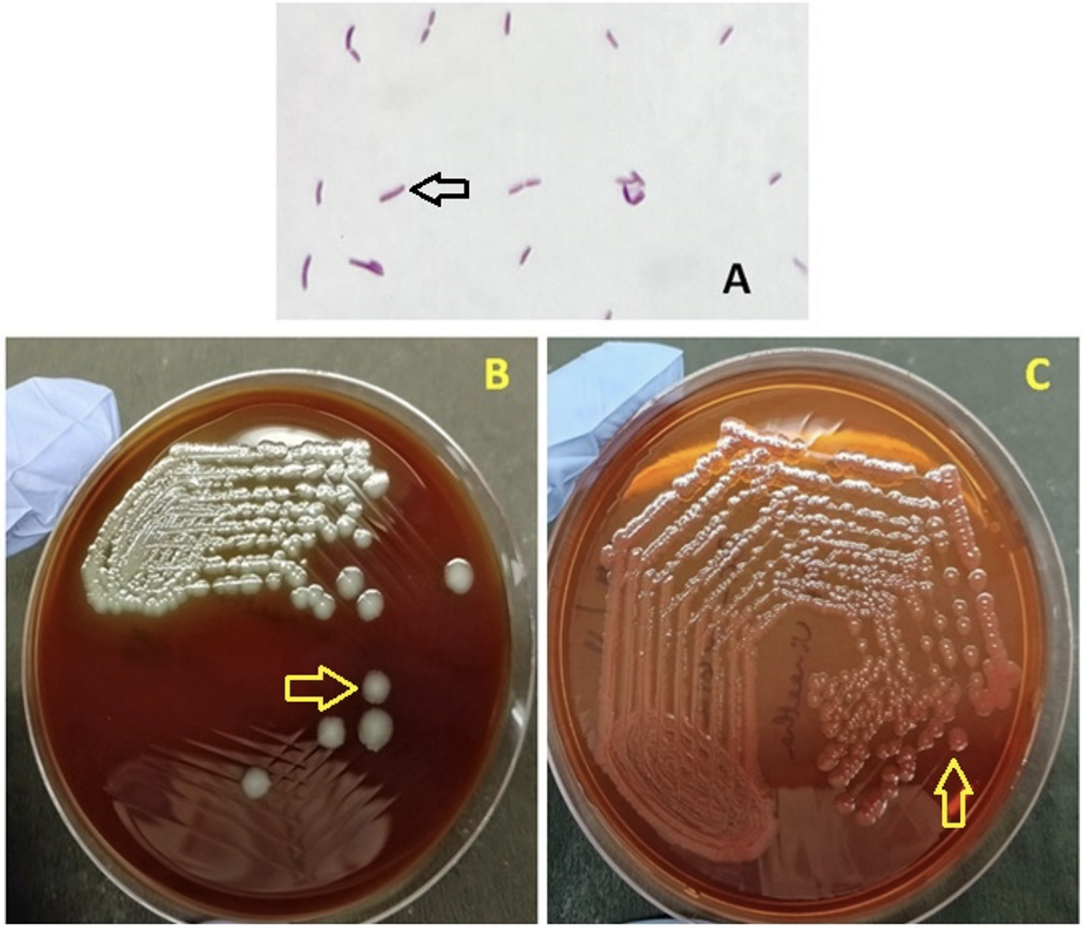

Figure 2. (A) Gram staining revealed rod-shaped, gram-negative bacilli. (B) Growth on 5% sheep blood agar showed round, moist, non-hemolytic colonies. (C) On MacConkey agar, pale, irregular, non-lactose fermenting colonies were observed

B. gladioli is underreported due to its fastidious nature and lack of standardized identification methods (4). Accurate identification is critical for effective treatment. Our laboratory addressed these challenges by utilizing an integrated approach that combines an automated microbial identification system, MALDI-ToF, and the VITEK 2 compact system, ensuring reliable and timely pathogen detection.

Treating *B. gladioli* infections can be challenging due to various antibiotic resistance mechanisms, including beta-lactamase production, plasmid-mediated resistance, and biofilm formation (6). In our case, the bacterium was not multidrug-resistant, and the patient responded well to a combination of piperacillin-tazobactam and TMP-SMZ.

Patients with *B. gladioli* infections have been treated with regimens like meropenem and TMP-SMZ, with favorable outcomes. However, discrepancies between in vitro sensitivity and in vivo effectiveness, and host-pathogen complexities can lead to treatment failure. Quon et al. (7) reported cases of clinical deterioration or death despite TMP-SMZ and meropenem therapy. Other authors suggested levofloxacin, cefazolin, and gentamicin as potential options (2). Treatment decisions should consider clinical presentation, underlying conditions, and susceptibility profile rather than relying solely on specific antibiotics to optimize the outcomes.

Conclusion

The present case report adds to the existing literature on *B. gladioli* isolated from blood samples in immunocompromised elderly patients, highlighting its emerging role as an opportunistic pathogen. It also emphasizes the importance of timely identification and management to optimize patient outcomes.

Ethics

Informed Consent: Consent was granted by the patient's next of kin.

Footnotes

Authorship Contributions

Consept: A.A.A., V.K.K., Design: A.A.A., V.K.K., Data Collection or Processing: A.A.A., V.T., Analysis or Interpretation: A.A.A., V.K.K., V.T., Literature Search: A.A.A., V.K.K., V.T., Writing: A.A.A., V.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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