e-ISSN: 3023-655X

# Ankyra Medical Journal

Volume: 5 Issue: 1 Year: 2026


MHA
MEDIHEALTH ACADEMY

# EDITOR-IN-CHIEF



# ASSOCIATE EDITORS-IN-CHIEF



# EDITORIAL BOARD

## ENGLISH LANGUAGE EDITOR

**Mohammad Bilal ALSAVAF, MD**

*Department of Otorhinolaryngology, Faculty of Medicine, Ohio State University, OH, USA*

## STATISTICS EDITOR

**Assist. Prof. Maruf GÖĞEBAKAN**

*Department of Maritime Business and Administration, Maritime Faculty, Onyedi Eylül University, Balıkesir, Turkiye*

## LAYOUT EDITOR

**Hatice AKYIL**

*Biologist, MediHealth Academy Publishing, Ankara, Turkiye*

Ankyra
Medical Journal

# Contents

Volume: 5 Issue: 1 Year: 2026

## ORIGINAL ARTICLES



## REVIEW



## CASE REPORT



## RETRACTION

Ankyra Medical Journal
Original Article
DOI: 10.51271/ANKMJ-0057

# Efficiency of erector spina plane block with ultrasonography in laparoscopic cholecystectomy operations

Deniz Altıok Tandoğan[1], Esra Polat*[2], Gülçin Aydın[3], Işın Gençay[3], Kevser Peker[3], Oktay Aydın[4], Ahmet Tuğrul Şahin[5], Faruk Pehlivanlı[4], Zeynep Nur Akçaboy[6]

[1]Department of Anesthesiology and Reanimation, Abdulkadir Yüksel Public Hospital, Gaziantep, Turkiye
[2]Department of Anesthesiology and Reanimation, Kastamonu Training and Research Hospital, Kastamonu, Turkiye
[3]Department of Anesthesiology and Reanimation, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye
[4]Department of General Surgery, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye
[5]Department of Anesthesiology and Reanimation, Faculty of Medicine, Tokat Gaziosmanpaşa University, Tokat, Turkiye
[6]Department of Anesthesiology and Reanimation, Ankara Bilkent City Hospital, Ankara, Turkiye

**Cite this article:** Altıok Tandoğan D, Polat E, Aydın G, et al. Efficiency of erector spina plane block with ultrasonography in laparoscopic cholecystectomy operations. *Ank Med J.* 2026;5(1):1-9.

**Received**: 02/12/2025 ◆ **Accepted**: 06/01/2026 ◆ **Published**: 14/01/2026

## ABSTRACT

**Aims:** The aim of our study is to evaluate the effects of ultrasound–guided erector spinae plane block (ESPB) on intraoperative opioid requirement, postoperative analgesic consumption and patient satisfaction in laparoscopic cholecystectomy (LC) procedures.

**Methods:** Ninety patients aged 18–65 years with American Society of Anesthesiologists (ASA) risk classification I–III who underwent elective LC between December 2018 and December 2020 were retrospectively analyzed. Patients were divided into three groups: control (no block), preoperative ultrasound-guided ESPB and postoperative ESPB performed just before extubation. Intraoperative opioid consumption, postoperative Visual Analog Scale (VAS) scores, additional analgesic requirements, and patient satisfaction were evaluated. Analysis of variance (ANOVA) and the Kruskal–Wallis test were used for statistical analysis.

**Results:** There were no significant differences among the groups regarding age, sex, height, or ASA physical status ($p>0.05$). However, significant differences were observed in mean body weight and body-mass index (BMI) values ($p=0.006$ and $p=0.007$, respectively). Pairwise comparisons revealed no significant differences in body weight or BMI between the preoperative and postoperative ESPB groups ($p=0.787$ and $p=0.882$); however, both block groups had significantly higher values compared with the control group ($p<0.05$). VAS scores, postoperative analgesic requirements, and patient satisfaction differed significantly among the groups at postoperative 0, 1, 2, 6, 12, and 24 hours, in favor of both ESPB groups ($p<0.001$). Postoperative VAS scores at 0, 1, 2, and 6 hours were significantly lower in the preoperative ESPB group compared with the postoperative ESPB group ($p<0.001$). Intraoperative opioid consumption and postoperative additional analgesic requirements were also significantly lower in the preoperative ESPB group than in the other two groups ($p<0.001$). However, VAS scores and patient satisfaction at 12 and 24 hours were comparable between the two ESPB groups. In the control group, VAS scores at postoperative 0, 1, 2, 6, 12, and 24 hours were significantly higher ($p<0.001$), resulting in a significantly greater need for additional analgesia.

**Conclusion:** Preemptive ESPB reduces the need for intraoperative opioids and maximizes patient satisfaction with postoperative low VAS scores.

**Keywords:** Pain management, postoperative analgesia, regional anesthesia

## INTRODUCTION

Laparoscopic cholecystectomy (LC) is the most frequently performed laparoscopic surgical procedure.[1] Postoperative pain following LC is predominantly visceral in origin, while parietal pain occurs less commonly. Visceral pain results from tissue trauma, diaphragmatic and peritoneal irritation secondary to pneumoperitoneum, abdominal distension, and chemical irritation of the peritoneum. In contrast, parietal pain is primarily associated with surgical incisions and trocar insertion sites.

Multimodal analgesia in LC is achieved through the combined use of intravenous analgesics, opioids, local anesthetic infiltration at incision sites, preemptive analgesic

**Corresponding Author:** Esra Polat, esraplat@gmail.com

strategies, and appropriate regional anesthesia techniques.[2] Currently, regional anesthesia methods such as epidural block, paravertebral block, transversus abdominis plane block, and erector spinae plane block (ESPB) are widely used and preferred approaches.[3]

The ESPB is a paravertebral-type regional anesthesia technique utilized for postoperative pain management. It was first described by Forero et al.[4] in 2016. Initially proposed for the management of chronic pain associated with rib fractures, ESPB has subsequently been applied for analgesic purposes in both pediatric and adult patients undergoing abdominal and thoracic surgeries during the preoperative and postoperative periods.[5,6]

ESPB is performed by the injection of a local anesthetic into the interfascial plane between the transverse process of the vertebra and the erector spinae muscles, allowing multidermatomal spread across several vertebral levels. The local anesthetic agent spreads in a craniocaudal direction along the fascial plane beneath the muscle, resulting in sensory blockade of the lateral and posterior thoracic regions, anterior thorax, and abdominal wall. It has been demonstrated that ESPB provides effective blockade of both visceral and somatic pain by affecting the dorsal and ventral rami of the spinal nerves.[7,8]

The aim of this study is to evaluate the effects of ultrasound-guided ESPB, routinely performed in our clinic during LC procedures, on intraoperative opioid consumption, postoperative analgesic efficacy, and patient satisfaction.

## METHODS

The study was conducted at the Department of Anesthesiology and Reanimation, Kırıkkale University Faculty of Medicine, after obtaining approval from the Kırıkkale University Non-interventional Researches Ethics Committee (Date: 16.09.2021, Decision No: 2021.06.19). We obtained an informed consent form from all patients for procedure. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Medical records of patients who underwent LC between December 2018 and December 2020 were retrospectively reviewed.

A total of 90 patients were included in the study. The patients were equally divided into three groups:

- **Control group (n=30):** patients who did not receive any regional block,
- **Preoperative block group (n=30):** patients who received an ESPB during the preoperative period,
- **Postoperative block group (n=30):** patients who received ESPB during the postoperative period, immediately before extubation.

The following parameters were evaluated for all included patients:

- Demographic characteristics (age, sex, weight, and height),
- American Society of Anesthesiologists (ASA) physical status scores,
- Visual Analog Scale (VAS) pain scores at postoperative 0, 1, 2, 6, 12, and 24 hours,
- Patient satisfaction,
- Requirement for additional analgesia.

Patients with any of the following conditions were excluded from the study: known hypersensitivity to local anesthetic agents, bleeding diathesis, psychiatric disorders, a history of pneumothorax, phrenic nerve paralysis, severe aortic stenosis, obesity (body-mass index (BMI) >35 kg/m$^2$), or refusal of regional block.

In our clinic, ESPB is routinely offered to patients scheduled for elective LC procedures, provided that informed consent is obtained. According to patient preference, the block is performed either before transfer to the operating room or at the end of surgery immediately prior to emergence from anesthesia. Patients who consented to preoperative ESPB were transferred to the block room, where standard monitoring (electrocardiography, noninvasive blood pressure, and peripheral oxygen saturation) was applied. Sedation was achieved with intravenous midazolam at a dose of 0.03–0.05 mg/kg (Sedozolam®, Monemfarma, Ankara, Turkiye), and supplemental oxygen was administered via nasal cannula at 4 L/min. ESPB was performed under ultrasound guidance in the sitting position, after which patients were transferred to the operating room. Patients who consented to ESPB but declined preoperative block placement due to reasons such as needle phobia underwent ESPB at the end of surgery under general anesthesia, before extubation. In these patients, ESPB was performed in the left lateral decubitus position, followed by extubation and transfer to the post-anesthesia care unit.

Postoperative pain scores of all patients who routinely received peripheral nerve blocks in our clinic were assessed and recorded using the VAS at postoperative 0, 1, 2, 6, 12, and 24 hours. When the VAS score VAS>4, intravenous dexketoprofen trometamol 50 mg (Arveles®, Ufsa, İstanbul, Turkiye) was administered. If the VAS score was >6, intravenous tramadol at a dose of 1 mg/kg (Tramosel®, Haver, İstanbul, Turkiye) was administered. Additional analgesic requirements were documented in the block follow-up charts.

### Ultrasound-Guided Erector Spinae Plane Block

After positioning the patient in the sitting and/or lateral decubitus position and ensuring sterile conditions, a linear 10–18 MHz ultrasound probe (Esaote MyLab 30, Genoa, Italy) was placed in the paramedian sagittal plane between two transverse processes. At the T7 vertebral level, the transverse processes and pleura were identified. An 18-gauge, 50-mm needle (Pajunk, Geisingen, Germany) was advanced using an in-plane technique until contact with the transverse process was achieved. After negative aspiration, with the needle tip positioned between the erector spinae muscle and the transverse process, 20 ml of 0.5% bupivacaine (Buvasin®, Vem, İstanbul, Turkiye) was injected. Craniocaudal spread of the local anesthetic was visualized under ultrasound guidance (**Figure 1, 2**).

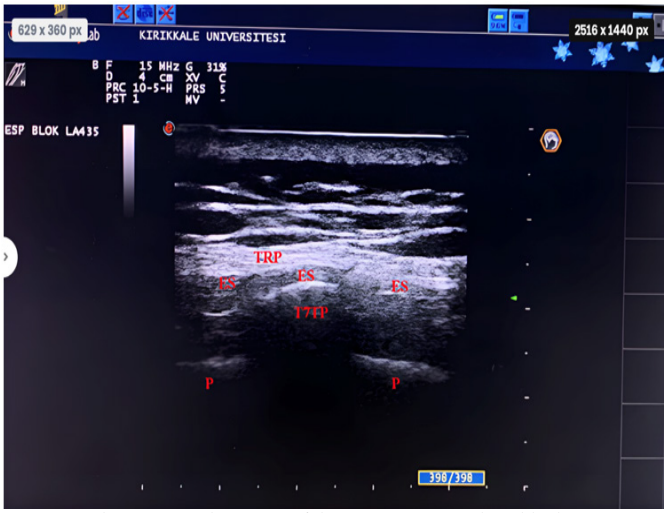


**Figure 1.** Ultrasonography image of the erector spinae plane block
TRP: Trapezius muscle, ES: Erector spinae muscle, P: Pleura, TP: Transverse process

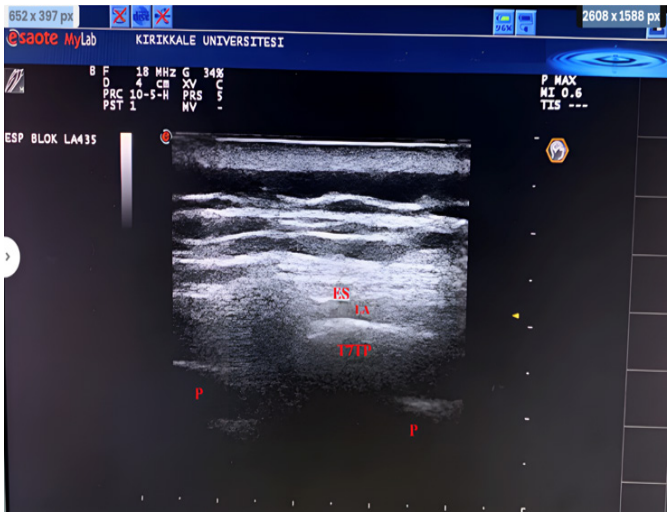


**Figure 2.** Ultrasonography image of local anesthetic distribution after ESPB
TRP: Trapezius muscle, ES: Erector spinae muscle, LA: Local anesthetic, TP: Transverse process

### General Anesthesia Protocol

All patients in the three study groups underwent surgery under general anesthesia. Anesthesia induction was achieved with intravenous propofol at a dose of 2–3 mg/kg (Propofol®, Fresenius Kabi, Melsungen, Germany), fentanyl 1 µg/kg IV (Fentanyl Citrate®, Hospira, USA), and rocuronium 0.6 mg/kg IV (Esmeron®, Organon, Oss, the Netherlands). Anesthesia maintenance was provided with 2% sevoflurane (Sevorane®, Abbott, Chicago, USA) in a mixture of 50% oxygen and 50% air.

During the intraoperative period, remifentanil infusion (Rentanil®, Vem, İstanbul, Turkiye) was initiated at a dose of 0.05–0.2 µg/kg/min when an increase of ≥20% in heart rate or blood pressure compared with baseline values at the start of surgery was observed. Intraoperative opioid consumption was recorded for all patients. Toward the end of surgery, ondansetron 8 mg IV (Zofran®, GlaxoSmithKline S.p.A., Italy) was routinely administered to all patients.

At the completion of surgery, neuromuscular blockade was reversed with neostigmine 0.04 mg/kg IV (Neostigmine®, Adeka, Samsun, Turkiye) and atropine 0.015 mg/kg IV (Atropine sulfate®, Biofarma, İstanbul, Turkiye). After recovery of adequate muscle strength, patients were extubated and transferred to the post-anesthesia care unit, where they were monitored before being discharged to the general surgery ward.

### VAS

Pain intensity is marked on a 10 cm ruler

0 1 2 3 4 5 6 7 8 9 10

where 0 indicated “no pain” and 10 indicated “worst imaginable pain.”

### Patient Satisfaction Scale

Patient satisfaction was evaluated using a 5-point scale:

5: Very satisfied

4: Satisfied

3: Undecided

2: Dissatisfied

1: Very dissatisfied

### Statistical Analysis

Data analysis was performed using the SPSS software package, version 21.0. Descriptive data were expressed as mean, median, standard deviation, minimum, maximum, and percentage values, as appropriate. The normality of data distribution was assessed using the Shapiro–Wilk test. Intergroup comparisons of normally distributed variables were performed using one-way analysis of variance (ANOVA). For variables not normally distributed, the Kruskal–Wallis test was used for intergroup comparisons, and the Mann–Whitney U test was applied for pairwise comparisons. A p value of <0.05 was considered statistically significant.

## RESULTS

A total of 90 patients were included in the study. The patients were equally divided into three groups: those who did not receive a regional block (control group), those who received a block during the preoperative period (preoperative block group), and those who received a block during the postoperative period before extubation (postoperative block group). Data obtained from the patients were analyzed using intergroup comparative methods. Comparative analysis of demographic characteristics revealed no statistically significant differences among the groups in terms of age, sex, height, or ASA physical status scores (p>0.05) (Table 1, 2).

The mean body weight in the control group was 71.93±7.13 kg, whereas it was 78.86±9.09 kg in the preoperative block group and 77.40±9.41 kg in the postoperative block group. A statistically significant difference was observed among the groups (p=0.006). Pairwise comparisons showed no significant difference between the preoperative and postoperative block groups (p=0.787); however, mean body weight was significantly higher in both block groups compared with the control group (p<0.001) (Table 1, 3).

Similarly, the mean BMI was 25.79±2.65 kg/m² in the control group, 28.51±3.23 kg/m² in the preoperative block group, and 27.98±4.28 kg/m² in the postoperative block group. Intergroup analysis revealed a statistically significant difference in BMI values (p=0.007). Pairwise comparisons demonstrated

**Table 1.** Distribution and statistical comparison of demographic data among the groups

| Group | | Age | Height | Weight | BMI | ASA |
|---|---|---|---|---|---|---|
| Control group | Mean | 42.900 | 167.200 | 71.933 | 25.794 | 1.766 |
| | Median | 46.500 | 165.000 | 72.500 | 25.955 | 2.000 |
| | SD | 15.159 | 8.014 | 7.138 | 2.654 | 0.626 |
| | Minimum | 20.000 | 155.000 | 60.000 | 21.220 | 1.000 |
| | Maximum | 65.000 | 182.000 | 85.000 | 31.220 | 3.000 |
| Preoperative block group | Mean | 43.566 | 166.500 | 78.866 | 28.513 | 1.566 |
| | Median | 41.000 | 166.000 | 79.000 | 28.220 | 1.500 |
| | SD | 12.350 | 7.426 | 9.092 | 3.238 | 0.626 |
| | Minimum | 19.000 | 155.000 | 62.000 | 23.050 | 1.000 |
| | Maximum | 65.000 | 184.000 | 95.000 | 35.160 | 3.000 |
| Postoperative block group | Mean | 49.000 | 166.933 | 77.400 | 27.980 | 1.666 |
| | Median | 50.000 | 165.000 | 76.000 | 27.955 | 2.000 |
| | SD | 12.398 | 9.288 | 9.412 | 4.283 | 0.660 |
| | Minimum | 24.000 | 150.000 | 62.000 | 20.060 | 1.000 |
| | Maximum | 65.000 | 184.000 | 97.000 | 37.460 | 3.000 |
| p value (*ANOVA, Kruskal-Wallis test) | | 0.132 | 0.946 | 0.006* | 0.007* | 0.446 |

BMI: Body-mass index, ASA: American Society of Anesthesiologists, SD: Standard deviation, ANOVA: Analysis of Variance

**Table 2.** Intergroup comparison of demographic and study variables

| | | Control | Preoperative block group | Postoperative block group | | |
|---|---|---|---|---|---|---|
| **Variable** | | **Mean±SD/ median (min-max) n (%)** | **Mean±SD/ median (min-max) n (%)** | **Mean±SD/ median (min-max) n (%)** | **F/X²** | **p** |
| Age | | 46.50 (20.00-65.00) | 41.00 (19.00-65.00) | 50.00 (24.00-65.00) | 4.057 | 0.132 |
| Gender | Female | 20 (66.6%) | 25 (83.3%) | 19 (63.3%) | 3.316 | 0.191 |
| | Male | 10 (33.3%) | 5 (16.7%) | 11 (36.7) | | |
| Height | | 165.00 (155.00-182.00) | 166.00 (155.00-184.00) | 165.00 (150.00-184.00) | 0.111 | 0.946 |
| Weight | | 71.93±7.13 | 78.86±9.09 | 77.40±9.41 | 5.407* | 0.006* |
| BMI | | 25.79±2.65 | 28.51±3.23 | 27.98±4.28 | 5.205* | 0.007* |
| ASA | | 2.00 (1.00-3.00) | 1.50 (1.00-3.00) | 2.00 (1.00-3.00) | 1.616 | 0.446 |
| Intraoperative analgesic requirement | Yes | 30 (100.0%) | 0 | 30 (100.0%) | 89.000 | <0.001 |
| | No | 0 | 30 (100.0%) | 0 | | |
| **Operation duration** | | 60 (40-75) | 60 (40-75) | 60 (35-85) | 1.124 | 0.570 |
| VAS 0 | | 5.5 (4-10) | 0 (0-2) | 2 (0-4) | 71.186 | <0.001 |
| VAS 1 | | 5 (4-8) | 0.5 (0-2) | 1 (0-3) | 64.108 | <0.001 |
| VAS 2 | | 4 (2-6) | 0 (0-2) | 1 (0-2) | 65.995 | <0.001 |
| VAS 6 | | 3 (1-6) | 0 (0-1) | 0 (0-1) | 69.420 | <0.001 |
| VAS 12 | | 2 (0-6) | 0 (0-0) | 0 (0-0) | 80.876 | <0.001 |
| VAS 24 | | 1 (0-4) | 0 (0-1) | 0 (0-0) | 66.849 | <0.001 |
| Postoperative analgesic requirement | Yes | 29 (96.7%) | 0 | 2 (6.7%) | 76.592 | <0.001 |
| | No | 1 (3.3%) | 30 (100.0%) | 28 (93.3%) | | |
| Satisfaction | | 2 (1-3) | 5 (4-5) | 5 (3-5) | 73.294 | <0.001 |

SD: Standard deviation, Min: Minimum, Max: Maximum, BMI: Body-mass index, ASA: American Society of Anesthesiologists, VAS: Visual Analog Scale, (*) ANOVA (Analysis of Variance) and Kruskal–Wallis tests (p<0.05)

no significant difference between the preoperative and postoperative block groups (p=0.882), whereas both block groups had significantly higher BMI values compared with the control group (p<0.001) (Table 1, 3).

None of the patients in the preoperative ESPB group required intraoperative opioid administration, whereas all patients in both the postoperative ESPB group and the control group required opioids during the intraoperative period. Accordingly, intraoperative opioid requirement was statistically significantly lower in patients who received preoperative ESPB compared with the other two groups (p<0.001) (Table 2, 3, 4, Figure 3).

None of the patients in the preoperative block group required postoperative opioid analgesia, whereas only 2 patients (6.7%) in the postoperative block group required postoperative analgesic treatment. In contrast, in the control group, 29 patients (96.7%) required postoperative analgesia, with only 1 patient (3.3%) not requiring analgesic treatment.

Intergroup comparison demonstrated that postoperative analgesic requirements were statistically significantly lower

**Table 3.** Pairwise comparison of the groups

| Variable | Group (I/J) | Mean difference/Z | p |
|---|---|---|---|
| Weight | Control/pre-block group | -6.933* | 0.007* |
| | Control/post-block group | -5.466* | 0.042* |
| | Pre-block group/post-block group | 1.466* | 0.787* |
| BMI | Control/pre-block group | -2.718* | 0.009* |
| | Control/post-block group | -2.185* | 0.043* |
| | Pre-block group/post-block group | 0.533* | 0.882* |
| Intraoperative opioid requirement | Control/pre-block group | -7.681 | <0.001 |
| | Control/post-block group | 0.000 | 1.000 |
| | Pre-block group/post-block group | -7.681 | <0.001 |
| Operation duration | Control/pre-block group | -0.335 | 0.737 |
| | Control/post-block group | -1.012 | 0.311 |
| | Pre-block group/post-block group | -0.736 | 0.462 |
| VAS 0 | Control/pre-block group | -6.785 | <0.001 |
| | Control/post-block group | -6.624 | <0.001 |
| | Pre-block group/post-block group | -5.090 | <0.001 |
| VAS 1 | Control/pre-block group | -6.692 | <0.001 |
| | Control/post-block group | -6.559 | <0.001 |
| | Pre-block group/post-block group | -3.261 | <0.001 |
| VAS 2 | Control/pre-block group | -6.821 | <0.001 |
| | Control/post-block group | -6.765 | <0.001 |
| | Pre-block group/post-block group | -3.104 | 0.002 |
| VAS 6 | Control/pre-block group | -7.009 | <0.001 |
| | Control/post-block group | -6.724 | <0.001 |
| | Pre-block group/post-block group | -2.895 | 0.004 |
| VAS 12 | Control/pre-block group | -6.968 | <0.001 |
| | Control/post-block group | -6.968 | <0.001 |
| | Pre-block group/post-block group | 0.000 | 1.000 |
| VAS 24 | Control/pre-block group | -6.230 | <0.001 |
| | Control/post-block group | -6.421 | <0.001 |
| | Pre-block group/post-block group | -1.000 | 0.317 |
| Postoperative analgesia | Control/pre-block group | -7.429 | <0.001 |
| | Control/post-block group | -6.917 | <0.001 |
| | Pre-block group/post-block group | -1.426 | 0.154 |
| Satisfaction | Control/pre-block group | -6.975 | <0.001 |
| | Control/post-blok group | -6.822 | <0.001 |
| | Pre-block group/post-block group | -5.185 | <0.001 |

BMI: Body-mass index, VAS: Visual Analog Scale, (*) ANOVA (Analysis of Variance) and Mann–Whitney U tests (p<0.05)

**Table 4.** Distribution and statistical comparison of intraoperative opioid requirement among the groups

| Intraoperative opioid requirement | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Group** | | | **Frequency** | **Percent** | **Valid percent** | **Cumulative percent** | **p value (Kruskal-Wallis test)** |
| Control group | Valid | Yes | 30 | 100.0 | 100.0 | 100.0 | <0.001 |
| | | No | 0 | 0 | 0 | 0 | |
| Preop block group | Valid | Yes | 0 | 0 | 0 | 0 | |
| | | No | 30 | 100.0 | 100.0 | 100.0 | |
| Postop block group | Valid | Yes | 30 | 100.0 | 100.0 | 100.0 | |
| | | No | 0 | 0 | 0 | 0 | |

in both the preoperative and postoperative block groups compared with the no-block control group (p<0.001). However, no statistically significant difference was observed between the preoperative and postoperative block groups with respect to postoperative analgesic requirement (p=0.154) (Table 2, 3, 5, Figure 4).

Postoperative patient satisfaction was scored on a scale ranging from 1 (lowest) to 5 (highest). The median satisfaction

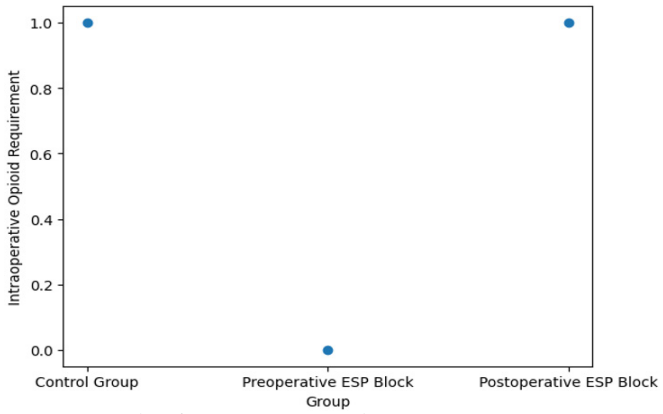


**Figure 3.** Box plot of intraoperative opioid requirement
ESP: Erector spinae plane

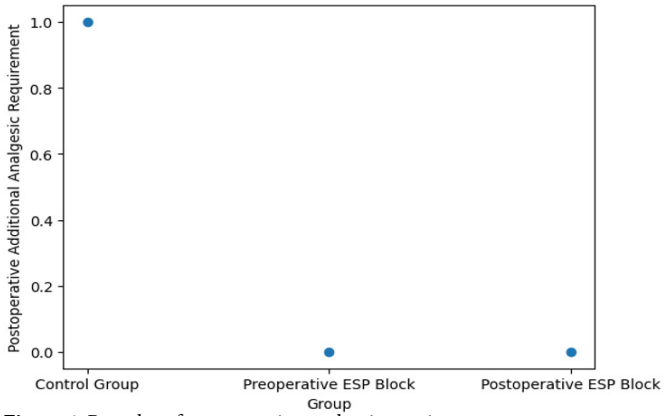


**Figure 4.** Box plot of postoperative analgesic requirement
ESP: Erector spinae plane

score in the control group was 2.00 (range: 1.00–3.00), whereas it was 5.00 (range: 4.00–5.00) in the preoperative block group and 5.00 (range: 3.00–5.00) in the postoperative block group.

Intergroup analysis demonstrated that patient satisfaction was significantly higher in both the preoperative and postoperative block groups compared with the no-block control group ($p<0.001$). Furthermore, when the preoperative and postoperative block groups were compared, patient satisfaction was significantly higher in the preoperative block group ($p<0.001$) (Table 2, 3, 6, Figure 5).

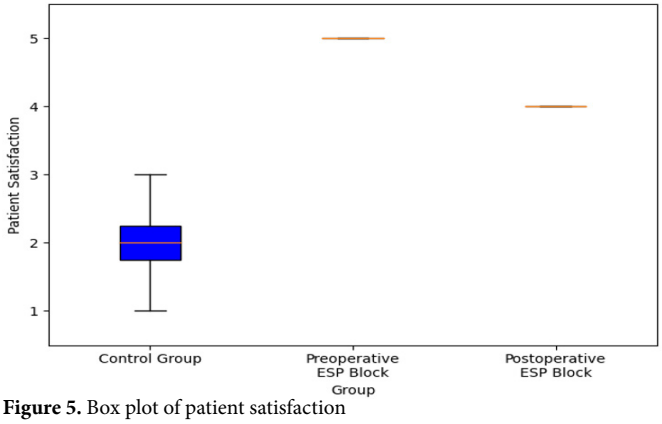


**Figure 5.** Box plot of patient satisfaction

**Table 5.** Distribution and statistical comparison of postoperative analgesic requirement among the groups

| **Postoperative additional analgesic requirement** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Group** | | | **Frequency** | **Percent** | **Valid percent** | **Cumulatiand percent** | **p value (Kruskal-Wallis test)** |
| Control group | Valid | No | 1 | 3.3 | 3.3 | 3.3 | <0.001 |
| | | Yes | 29 | 96.7 | 96.7 | 100.0 | |
| | | Total | 30 | 100.0 | 100.0 | | |
| Preop block group | Valid | No | 30 | 100.0 | 100.0 | 100.0 | |
| | | Yes | 0 | 0 | 0 | 0 | |
| | | Total | 30 | 100.0 | 100.0 | | |
| Postop block group | Valid | No | 28 | 93.3 | 93.3 | 93.3 | |
| | | Yes | 2 | 6.7 | 6.7 | 100.0 | |
| | | Total | 30 | 100.0 | 100.0 | | |

**Table 6.** Distribution and statistical comparison of patient satisfaction among the groups

| **Patient satisfaction** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Group** | | | **Frequency** | **Percent** | **Valid percent** | **Cumulative percent** | **p value (Kruskal-Wallis test)** |
| Control group | Valid | 1.00 | 14 | 46.7 | 46.7 | 46.7 | <0.001 |
| | | 2.00 | 14 | 46.7 | 46.7 | 93.3 | |
| | | 3.00 | 2 | 6.7 | 6.7 | 100.0 | |
| | | Total | 30 | 100.0 | 100.0 | | |
| Preop block group | Valid | 4.00 | 6 | 20.0 | 20.0 | 20.0 | |
| | | 5.00 | 24 | 80.0 | 80.0 | 100.0 | |
| | | Total | 30 | 100.0 | 100.0 | | |
| Postop block group | Valid | 3.00 | 5 | 16.7 | 16.7 | 16.7 | |
| | | 4.00 | 21 | 70.0 | 70.0 | 86.7 | |
| | | 5.00 | 4 | 13.3 | 13.3 | 100.0 | |
| | | Total | 30 | 100.0 | 100.0 | | |

## DISCUSSION

In this study, we investigated the effects of ultrasound-guided ESPB on intraoperative opioid requirements, postoperative analgesic consumption, and patient satisfaction in patients undergoing LC.

The main finding of our study was that postoperative VAS scores at 0, 1, 2, and 6 hours were significantly lower in patients who received preoperative ESPB compared with those who received postoperative ESPB. In addition, intraoperative opioid requirements were significantly lower in the preoperative ESPB group than in the other two groups. Postoperative additional analgesic requirements were also lower in the preoperative ESPB group compared with the other groups. At postoperative 12 and 24 hours, VAS scores were similar between the two block groups. In contrast, VAS scores at 0, 1, 2, 6, 12, and 24 hours were significantly higher in the no-block control group compared with both block groups. Therefore, we believe that preoperative ESPB reduces intraoperative opioid requirements and, together with lower postoperative VAS scores, markedly improves patient satisfaction.

LC is currently preferred over open cholecystectomy due to reduced hospital stay, decreased loss of workforce, and lower postoperative morbidity. Although it is generally associated with less postoperative pain, severe pain may still occur if appropriate pain management is not provided. Consequently, various treatment strategies have been developed to reduce postoperative pain. Parietal pain observed in the postoperative period following LC is usually well localized by the patient and is characterized by sharp and sudden onset. Previous studies have demonstrated that local anesthetic infiltration at incision sites reduces parietal pain. In addition, bupivacaine administered at trocar sites has been reported to reduce postoperative pain, opioid consumption, and the need for additional analgesia in LC.[9]

Preemptive analgesia refers to all analgesic interventions applied before a painful stimulus, with the common goal of achieving early pain control before the development of central sensitization, improving patient comfort, and reducing postoperative opioid requirements.[10,11]

It is well known that postoperative pain increases the stress response to surgical trauma, which may lead to cardiac, pulmonary, and gastrointestinal complications. By employing preemptive analgesic strategies, complications secondary to postoperative pain may also be prevented. The pathogenesis of postoperative pain is considered to be multifactorial; therefore, analgesic management should be multimodal. With advances in pain management techniques, opioid use has been reduced and multimodal analgesia strategies have become increasingly widespread.[12,13]

For this reason, ESPB is most often performed preoperatively in the block room for patients undergoing LC in our clinic. Postoperative pain following laparoscopic surgery is predominantly visceral and is mainly attributed to diaphragmatic irritation caused by carbon dioxide insufflation. The somatic component of pain originates from trocar insertion sites and surgical incisions.[14] In addition, approximately one-third of patients experience shoulder pain in the postoperative period, similar in type and localization to pain observed in biliary colic.[15] Pain originating from the gallbladder is transmitted via nerves arising from the T8–T9 spinal segments. In our study, we believe that ESPB performed at the T7 level provides sufficient somatic and visceral analgesia between the T5 and T12 dermatomes, thereby ensuring adequate analgesia for LC.

In a cadaveric study conducted by Yang et al.[16] in 2018, 20 ml of contrast medium was injected at the T5 level to evaluate the spread of the local anesthetic used in ESPB. The contrast medium was observed to pass through the superior costotransverse ligament and spread into the paravertebral space and thoracic spinal nerves.[16] In another cadaveric study investigating the mechanism of ESPB, Ivanusic et al.[17] injected 20 ml of methylene blue and observed craniocaudal and lateral spread posterior to the costotransverse foramen; however, no spread to the dorsal or ventral rami was noted. In a magnetic resonance imaging study by Schwartzmann et al.,[18] injection of 30 ml of contrast medium at the T10 level resulted in spread to the paravertebral, epidural, and intervertebral foraminal spaces between T5 and T12. Importantly, this study demonstrated that unilateral injection crossed to the contralateral side and extended into the epidural space, thereby reducing both visceral and somatic pain. Similarly, Tulgar et al.[19] reported bilateral sensory blockade following unilateral ESPB performed at the T9 level. In light of these findings, we considered that unilateral ESPB performed at the T7 level in our study could provide sufficient analgesic efficacy by taking into account its potential bilateral spread.

With the increasing use of ultrasound guidance, nerve blocks have become more widely adopted in clinical practice. One of the major advantages of ultrasound guidance is the reduction of local anesthetic dosage, thereby minimizing potential complications. Ultrasound-guided regional anesthesia allows accurate needle placement and real-time visualization of local anesthetic spread.[20] Previous studies have described ESPB performed in parasagittal and transverse planes using both in-plane and out-of-plane approaches. When ESPB is performed in the parasagittal plane, craniocaudal spread of the local anesthetic can be more clearly visualized; therefore, many studies have preferred the in-plane parasagittal approach. Moreover, improved visualization of the block needle with the in-plane technique reduces the risk of pleural puncture and inadvertent entry into the neural foramina.[21] In our clinic, ESPB is routinely performed using an in-plane parasagittal approach. The use of ultrasound enabled clearer visualization of needle placement and simultaneous monitoring of local anesthetic spread, which contributed to the methodological strength of our study.

In a study conducted by Tulgar et al.,[19] bilateral ESPB was performed at the T9 level using 20 ml of 0.375% bupivacaine in patients undergoing LC and compared with a control group. Postoperative pain, opioid consumption, and additional analgesic requirements were evaluated. Opioid consumption and the need for additional analgesia were found to be significantly lower in the ESPB group; however, the authors did not recommend routine use of ESPB due to the need for further comparison with other regional anesthesia techniques and optimization of local anesthetic dose and concentration.[3] In a similar study by Aksu et al.,[22] bilateral ESPB performed

at the T8 level using 20 ml of 0.25% bupivacaine resulted in significantly reduced 24-hour morphine consumption and lower VAS scores. In another study by Altıparmak et al.,[23] patients undergoing LC were divided into two groups: the block group received ultrasound-guided bilateral ESPB at the T7 level using 40 ml of 0.25% bupivacaine immediately before extubation, whereas the control group received bilateral injections of 40 ml of normal saline at the same level. Intraoperative opioid consumption, postoperative VAS scores, and postoperative additional analgesic requirements were found to be significantly lower in the ESPB group. The main methodological difference between our study and these studies is that ESPB was performed unilaterally at the T7 level. Despite using a lower total volume and concentration of local anesthetic (20 ml of 0.5% bupivacaine), our VAS scores were lower, indicating comparable analgesic efficacy and supporting the clinical significance of our findings.

In a study by Verma et al.,[24] one group of patients undergoing LC received 20 ml of 0.375% ropivacaine at the T7 level, while the control group received 20 ml of normal saline. The results demonstrated that patients who received ESPB had significantly lower VAS scores from postoperative hour 1 up to 48 hours, reduced intraoperative opioid requirements, decreased postoperative analgesic consumption, and earlier unassisted mobilization. Similarly, in our study, unilateral ESPB performed at the same vertebral level resulted in reduced intraoperative opioid requirements, lower postoperative VAS scores, and higher patient satisfaction.

Several studies have shown that ESPB provides a rapid onset of analgesia, with sustained postoperative analgesic effects lasting up to the first 24 hours.[25] In our study, none of the patients in the preemptive ESPB group required intraoperative opioids. This finding may be explained by the rapid onset of block efficacy, which reduced anesthetic requirements. Moreover, evaluation of postoperative hour 0 VAS scores in this group revealed a maximum score of 2, indicating that patients awakened with minimal pain and further supporting the high analgesic efficacy of ESPB.

Numerous studies have demonstrated that effective postoperative pain control significantly improves patient satisfaction.[26] In line with these findings, we believe that ESPB, which is routinely applied in our clinic, has a substantial positive impact on patient satisfaction. In our study, patient satisfaction was significantly higher in both ESPB groups compared with the control group. This outcome may be attributed to improved patient comfort resulting from the high analgesic efficacy observed in the block groups.

### Limitations

- In our study, a single-injection technique was used. Because a patient-controlled analgesia (PCA) device was not available in our clinic, catheter placement could not be performed.
- Since the methodology of this study was limited to the evaluation of VAS scores within the first 24 hours, the effect of the ESP block on chronic pain could not be assessed.
- The retrospective and observational design of the study precluded randomization of the patient groups, and group allocation was based on patient preference and routine clinical practice. This may have increased the risk of selection bias between the groups and limited the generalizability of the findings.
- Although a statistically significant difference in BMI was observed between the groups, the absence of multivariable analyses to control for the potential impact of BMI on the outcomes represents a significant methodological limitation of the study.
- Although multiple comparisons were performed in the study, effect sizes were not reported and additional statistical adjustment methods for multiple comparisons were not applied; therefore, the interpretation of the relationship between statistical significance and clinical relevance should be approached with caution.
- The single-center design and limited sample size are additional factors that may restrict the generalizability of the findings to different patient populations and clinical settings.

Despite these limitations, the study is considered to provide clinically meaningful data and to contribute to the existing literature regarding the analgesic efficacy of the ESPB in patients undergoing LC. Nevertheless, further randomized, prospective studies with larger sample sizes are required to validate these findings.

## CONCLUSION

Preoperative unilateral ESPB performed at the T7 level eliminates the need for intraoperative opioid use and provides high patient satisfaction with low postoperative VAS scores. Additionally, ESPB performed at the end of surgery (immediately before extubation) also increases patient satisfaction in the postoperative period due to its high analgesic efficacy.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

This study was approval from the Kırıkkale University Non-interventional Researches Ethics Committee (Date: 16.09.2021, Decision No: 2021.06.19).

### Informed Consent

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

## Author Contributions

Concept: D.A.T., G.A.; Design: D.A.T., A.T.Ş.; Control: G.A., E.P.; Data Collection and/or Processing: D.A.T, E.P., A.T.Ş., O.A., F.P.; Analysis and/or Interpretation: O.A., I.G., K.P., Z.N.A.; Literature Review: D.A.T., G.A.; Article Writing: G.A., D.A.T.; Critical Review: All authors.

## REFERENCES

1. Lee IO, Kim SH, Kong MH, et al. Pain after laparoscopic cholecystectomy: the effect and timing of incisional and intraperitoneal bupivacaine. *Can J Anaesth*. 2001;48(6):545-550. doi:10.1007/BF03016830
2. Kehlet H, Gray AW, Bonnet F, et al. A procedure-specific systematic review and consensus recommendations for postoperative analgesia following laparoscopic cholecystectomy. *Surg Endosc*. 2005;19(10):1396-1415. doi:10.1007/S00464-004-2173-8
3. Tulgar S, Selvi O, Kapakli MS. Erector Spinae plane block for different laparoscopic abdominal surgeries: case series. *Case Rep Anesthesiol*. 2018;2018:1-3. doi:10.1155/2018/3947281
4. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: a novel analgesic technique in thoracic neuropathic pain. *Reg Anesth Pain Med*. 2016;41(5):621-627. doi:10.1097/AAP.0000000000000451
5. Tsui BCH, Fonseca A, Munshey F, McFadyen G, Caruso TJ. The erector spinae plane (ESP) block: a pooled review of 242 cases. *J Clin Anesth*. 2019;53:29-34. doi:10.1016/J.JCLINANE.2018.09.036
6. Thomas DT, Tulgar S. Ultrasound-guided erector spinae plane block in a child undergoing laparoscopic cholecystectomy. *Cureus*. 2018;10(2):e2241. doi:10.7759/CUREUS.2241
7. Elkoundi A, Bentalha A, El Kettani SEC, Mosadik A, Koraichi A El. Erector spinae plane block for pediatric hip surgery-a case report. *Korean J Anesthesiol*. 2019;72(1):68-71. doi:10.4097/KJA.D.18.00149
8. Singh S, Pandey R, Chowdhary N. Bilateral ultrasound-guided erector spinae plane block for postoperative analgesia in choledochal cyst resection surgery. *Saudi J Anaesth*. 2018;12(3):499-500. doi:10.4103/SJA.SJA_188_18
9. Altuntaş G, Akkaya ÖT, Özkan D, Sayın MM, Balas Ş, Özlü E. Comparison of intraabdominal and trocar site local anaesthetic infiltration on postoperative analgesia after laparoscopic cholecystectomy. *Turk J Anaesthesiol Reanim*. 2016;44(6):306-311. doi:10.5152/TJAR.2016.75983
10. Vadivelu N, Mitra S, Schermer E, Kodumudi V, Kaye AD, Urman RD. Preventive analgesia for postoperative pain control: a broader concept. *Local Reg Anesth*. 2014;7(1):17-22. doi:10.2147/LRA.S62160
11. Rafiq S, Steinbrüchel DA, Wanscher MJ, et al. Multimodal analgesia versus traditional opiate based analgesia after cardiac surgery, a randomized controlled trial. *J Cardiothorac Surg*. 2014;9(1):52. doi:10.1186/1749-8090-9-52
12. Alexander JI. Pain after laparoscopy. *Br J Anaesth*. 1997;79(3):369-378. doi:10.1093/BJA/79.3.369
13. Lee IO, Kim SH, Kong MH, et al. Pain after laparoscopic cholecystectomy: the effect and timing of incisional and intraperitoneal bupivacaine. *Can J Anaesth*. 2001;48(6):545-550. doi:10.1007/BF03016830
14. Labaille T, Mazoit JX, Paqueron X, Franco D, Benhamou D. The clinical efficacy and pharmacokinetics of intraperitoneal ropivacaine for laparoscopic cholecystectomy. *Anesth Analg*. 2002;94(1):100-105. doi:10.1097/00000539-200201000-00019
15. Raetzell M, Maier C, Schroder D, Wulf H. Intraperitoneal application of bupivacaine during laparoscopic cholecystectomy--risk or benefit? *Anesth Analg*. 1995;81(5):967-972. doi:10.1097/00000539-199511000-00013
16. Yang HM, Choi YJ, Kwon HJ, O J, Cho TH, Kim SH. Comparison of injectate spread and nerve involvement between retrolaminar and erector spinae plane blocks in the thoracic region: a cadaveric study. *Anaesthesia*. 2018;73(10):1244-1250. doi:10.1111/ANAE.14408
17. Ivanusic J, Konishi Y, Barrington MJ. A cadaveric study investigating the mechanism of action of erector spinae blockade. *Reg Anesth Pain Med*. 2018;43(6):567-571. doi:10.1097/AAP.0000000000000789
18. Schwartzmann A, Peng P, Maciel MA, Forero M. Mechanism of the erector spinae plane block: insights from a magnetic resonance imaging study. *Can J Anaesth*. 2018;65(10):1165-1166. doi:10.1007/S12630-018-1187-Y
19. Tulgar S, Selvi O, Ahiskalioglu A, Ozer Z. Can unilateral erector spinae plane block result in bilateral sensory blockade? *Can J Anaesth*. 2019;66(8):1001-1002. doi:10.1007/S12630-019-01402-Y
20. Aydin G, Aydin O. The Efficacy of ultrasound-guided paravertebral block in laparoscopic cholecystectomy. *Medicina (Kaunas)*. 2018;54(5):75. doi:10.3390/MEDICINA54050075
21. Chin KJ, Adhikary S Das, Forero M. Erector spinae plane (ESP) block: a new paradigm in regional anesthesia and analgesia. *Curr Anesthesiol Rep*. 2019;9(3):271-280. doi:10.1007/S40140-019-00333-0
22. Aksu C, Kus A, Yörükoglu HU, Kiliç CT, Gürkan Y. The effect of erector spinae plane block on postoperative pain following laparoscopic cholecystectomy: a randomized controlled study. *J Anesth*. 2019;27(1):9-14. doi:10.5222/JARSS.2019.14632
23. Altiparmak B, Toker MK, Uysal Aİ, Kuşçu Y, Demirbilek SG. Efficacy of ultrasound-guided erector spinae plane block for analgesia after laparoscopic cholecystectomy: a randomized controlled trial. *Braz J Anesthesiol*. 2019;69(6):561-568. doi:10.1016/J.BJAN.2019.09.001
24. Verma R, Srivastava D, Saxena R, et al. Ultrasound-guided bilateral erector spinae plane block for postoperative analgesia in laparoscopic cholecystectomy: a randomized controlled trial. *Anesth Essays Res*. 2020;14(2):226. doi:10.4103/AER.AER_41_20
25. Kot P, Rodriguez P, Granell M, et al. The erector spinae plane block: a narrative review. *Korean J Anesthesiol*. 2019;72(3):209-220. doi:10.4097/KJA.D.19.00012
26. Aydin G, Sahin AT, Gencay I, et al. Which is more effective for minimally invasive pectus repair: epidural or paravertebral block? *J Laparoendosc Adv Surg Tech A*. 2020;30(1):81-86. doi:10.1089/LAP.2019.0403

Ankyra Medical Journal
Original Article
DOI: 10.51271/ANKMJ-0058

# Evaluation of the effects of regular caffeine intake on body composition measurements and psychological status in healthy individuals

Hafize Kızılkaya[1], Banu Gannemoğlu[1], Bartu Gannemoğlu[2], Zeynep Tuğba Ozan*[1]
[1]Department of Internal Medicine, Faculty of Medicine, Yozgat Bozok University, Yozgat, Turkiye
[2]Department of Public Health, Faculty of Medicine, Karadeniz Technical University, Trabzon, Turkiye

**Cite this article:** Kızılkaya H, Gannemoğlu B, Gannemoğlu B, Ozan ZT. Evaluation of the effects of regular caffeine intake on body composition measurements and psychological status in healthy individuals. *Ank Med J.* 2026;5(1):10-14.

**Received**: 16/12/2025 ◆ **Accepted**: 10/01/2026 ◆ **Published**: 14/01/2026

## ABSTRACT

**Aims:** Research continues on the health effects of caffeine, whose use is increasing among young people. It has been determined that caffeine products consumed to increase alertness have both positive and negative effects on body metabolism. In addition to metabolic effects, it is necessary to consider the psychological dimension. While it can improve exercise performance and cognitive capacity, it can also lead to sleep problems, anxiety disorders, and cardiac problems. It can also affect fluid and fat metabolism. This study investigated the metabolic and psychological effects of regular caffeine intake, as well as its impact on body composition.

**Methods:** Sociodemographic data were collected from individuals aged 18 and over who regularly consumed caffeine, and psychological status was assessed. Laboratory tests and body composition measurements were recorded using a bioelectrical impedance analyzer.

**Results:** The majority of the 176 individuals were female, had a bachelor's degree, and were low-income. The mean age was 23.3±5.2 years. The body fat percentage of high dose caffeine-consuming individuals was 29.2±9.0 %, muscle mass 27.2±7.0 kg/m2, visceral fat 9.3±4.8%, and waist/hip ratio was 0.8±0.1. Mean anxiety level was found 3.66, tension level 3.35, and depression level 2.38. Sleep problems were detected in 42.0%, palpitations in 35.2%, dyspeptic complaints in 39.8%, and bowel complaints in 26.1% of.

**Conclusion:** Regular caffeine consumption has been shown to affect sleep, urinary frequency, and dyspeptic complaints, but it is not a criterion that alone affects anthropometric values and psychological status. Although relatively high doses of caffeine can cause tachycardia attacks, they do not increase anxiety levels. Caffeine has also been found to be ineffective against mood disorders like depression or anxiety, and its primary use in young people is believed to be to increase alertness. However, it's important to remember that an increase in sleep problems or dyspeptic symptoms can negatively impact quality of life.

**Keywords:** Caffeine, anxiety, bioelectrical impedance analysis

## INTRODUCTION

Caffeine is a substance that is commonly ingested through beverages such as coffee, tea, cocoa, chocolate, and guarana, and can also be found in supplements and medications. Although caffeine is present in many foods and drinks, coffee (with a content of approximately (50–70%) is the best-known source of caffeine.[1] Many studies in the literature have examined the health effects of caffeine use.[2] Positive effects reported include enhanced exercise performance and cognitive capacity, and reduced fatigue.[3] Reported adverse effects include mood changes, sleep disturbances, anxiety disorders, diuretic effects, fluid electrolyte imbalances, cardiac problems, and disruptions in bone metabolism.[4]

Caffeine is associated with the release of neurotransmitters such as dopamine and serotonin, which influence mood changes.[5] Symptoms resulting from caffeine consumption may vary between individuals.[6] Generally, moderate caffeine consumption has been found to improve depressive symptoms, whereas insufficient intake, abrupt cessation, or excessive intake has been associated with increased anxiety.[7] Caffeine is one of the well-known chemical stimulants; after ingestion it enters the circulation within 45 minutes. Although the duration of effect varies by individual, it commonly lasts between 2.5 and 4.5 hours. Its well-known effects include reduction of fatigue and increased alertness.

*Corresponding Author: Zeynep Tuğba Ozan, drtugba09@gmail.com

In addition, caffeine is known to suppress appetite and contribute to weight loss. However, at high doses it may increase blood pressure, especially cause anxiety disorders and prolonged sleep latency. Abrupt cessation of regular use may lead to withdrawal symptoms such as headache and a depressed mood.

Natural caffeine is found in coffee beans, tea leaves, cocoa beans, guarana fruits, and yerba mate leaves. Caffeine preparations may be added to beverages, foods, tablets, or powdered supplements. In the United States, approximately 85% of adults consume caffeine daily, with an average intake of 135 mg per day (equivalent to a 12-oz cup of coffee). The most common source of caffeine for adults is coffee, while for younger individuals it is soft drinks and tea.[5] According to the 2015 report of the European Food Safety Authority (EFSA), a daily caffeine intake of 200 mg/day (for a 70 kg adult) or 3 mg/kg/day is considered safe for children, adolescents, and adults and does not pose a health problem.[8] Although different types of coffee contain varying amounts of caffeine, one cup of coffee contains approximately 100 mg of caffeine on average.[9]

The aim of this study was to determine the effects of regular coffee consumption on body composition and biochemical parameters by evaluating the sociodemographic characteristics of individuals who regularly drink coffee.

## METHODS

All individuals were informed about the research and written informed consent was obtained. The study was approved by the Yozgat Bozok University Non-interventional Researches Ethics Committee (Date: 22.01.2025, Decision No: 2025-GOKAEK-252_2025.01.22_321). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. As the analyzed raw data did not include personally identifiable information, anonymity and confidentiality were guaranteed.

This single-center, prospective study included individuals aged 18 years and older who consumed caffeine. Sociodemographic data were recorded and anthropometric measurements were performed. Body composition was assessed using bioelectrical impedance analysis (BIA), focusing on fat and muscle mass. Blood samples were taken after an 8-hour fast. Daily/weekly caffeine intake in mg/day was calculated by questioning individuals about their consumption frequency of tea, coffee, soft drinks, and chocolate. Psychological status was assessed using a 10-point Likert scale included in a demographic form prepared by the researchers.

### Statistical Analysis

Data were evaluated using SPSS 25.0 program. Descriptive statistics were given as number and percentage for categorical variables, and mean and standard deviation for quantitative variables. Pearson Chi-square/Fisher Exact test was used in the analysis of categorical data. Kolmogorov-Smirnov/Shapiro Wilk tests were used to check the suitability of the data for normal distribution. Student t test was used to compare the numerical characteristics in 2 groups for data that conformed to normal distribution, and Mann-Whtiney U test was used for those that did not. The statistical significance level was accepted as $p<0.05$ for all tests used.

## RESULTS

The sociodemographic characteristics of the 176 individuals included in the study are shown in Table 1. The study, which was predominantly female, consisted mostly of individuals with bachelor's degrees and low incomes. Sleep disturbances were observed in 42% of individuals, palpitations in 35.2%, frequent urination in 27.8%, and bowel problems in 25.6%. Approximately 70 % had a normal body-mass index (BMI). About one-third of the individuals consumed more than 4 cups of Turkish coffee or Nescafe per month.

**Table 1.** Sociodemographic characteristics

| Variable | Number (n)/percentage (%) |
|---|---|
| **Gender** | |
| Female | 103 (58.5%) |
| Male | 73 (41.5%) |
| **Education level** | |
| High school | 16 (9.1%) |
| Bachelor's degree | 138 (78.4%) |
| Master's degree | 22 (12.5%) |
| **Marital status** | |
| Married | 25 (14.2%) |
| Single | 138 (78.4%) |
| In a relationship | 13 (7.4%) |
| **Income level** | |
| Low | 127 (72.1%) |
| Medium | 40 (22.7%) |
| High | 9 (5.2%) |
| **Occupation** | |
| Unemployed | 12 (6.8%) |
| Civil servant | 38 (21.6%) |
| Worker | 3 (1.7%) |
| Self-employed | 3 (1.7%) |
| Other | 120 (68.2%) |
| **Alcohol consumption** | 38 (21.6%) |
| **Smoking** | 50 (28.4%) |
| **Regular exercise** | 50 (28.4%) |
| **Sleep disturbance** | 74 (42% ) |
| **Palpitation** | 62 (35.2%) |
| **Dyspepsia** | 70 (39.8%) |
| **Frequent urination** | 49 (27.8%) |
| **Bowel problems** | |
| None | 131 (74.4%) |
| Diarrhea | 20 (11.4%) |
| Constipation | 25 (14.2%) |
| **Turkish coffee consumption** | |
| Once a week | 62 (35.2%) |
| Twice a week | 34 (19.3%) |
| Three times a week | 16 (9.1%) |
| Four or more times a week | 64 (36.4%) |
| **Instant coffee consumption** | |
| 1 cup per week | 69 (39.4%) |
| 2 cups per week | 25 (14.2%) |
| 3 cups per week | 18 (10.2%) |
| ≥4 cups per week | 64 (36.4%) |
| **Body mass index (BMI) (kg/m²)** | |
| Underweight | 8 (4.5%) |
| Normal | 122 (69.3%) |
| Overweight | 31 (17.6%) |
| Obese | 12 (6.8%) |
| Morbidly obese | 3 (1.8%) |

Anthropometric measurements, body composition analysis, and laboratory data of the individuals are shown in Table 2. The mean age in the study, which included young people, was

23.3±5.2 years. In this group, the mean BMI and waist-to-hip ratio were within the normal range. Among the biochemical parameters, serum iron, ferritin, vitamin B12, folate, glucose, and cholesterol levels were within the normal range, while vitamin D levels were low.

**Table 2.** Anthropometric measurements, body composition analysis, and laboratory data

| Variables (n=176) | Median±SD |
|---|---|
| Age (years) | 23.3±5.2 |
| Height (cm) | 169.9±9.7 |
| Weight (kg) | 69.6±15.2 |
| Body-mass index (BMI) (kg/m²) | 23.9±3.9 |
| Waist circumference (cm) | 78.4±14.2 |
| HbA1c (%) | 5.1±0.5 |
| Folate (ng/ml) | 7.0±4.1 |
| LDL (mg/dl) | 91.8±25.9 |
| Glucose (mg/dl) | 84.2±11.7 |
| Vitamin D (ng/ml) | 16.1±7.6 |
| Triglycerides (mg/dl) | 97.4±56.8 |
| Insulin | 14.5±11.0 |
| Vitamin B12 (pg/ml) | 359.0±148.0 |
| HDL (mg/dl) | 54.9±14.9 |
| Systolic blood pressure (mmHg) | 122.5±11.3 |
| Diastolic blood pressure (mmHg) | 76.9±6.3 |
| Ferritin (ng/ml) | 55.4±49.2 |
| Iron (µg/dl) | 101.5±97.5 |
| Total iron binding capacity | 267.0±67.2 |
| Waist-to-hip ratio | 0.8±0.1 |
| Visceral fat level | 9.3±4.8 |
| Skeletal muscle mass (kg/m²) | 27.2±7.0 |
| Body fat percentage (%) | 29.2±9.0 |
| Degree of obesity (%) | 114.7±19.2 |

SD: Standard deviation, LDL: Low density lipoprotein, HDL: High-density lipoprotein

Table 3 evaluates the parameters affecting individuals' mood. Any significance was found between mood scores and gender (p=0.86), alcohol use (p=0.08), marital status (p=0.96), income (p=0.61), occupation (p=0.37), regular exercise (p=0.47), or BMI (p=0.93). Individuals who consumed Turkish coffee more frequently had significantly lower psychological evaluation scores (p=0.04), while no difference was observed for Nescafe. Younger age and lower education level were significantly associated with higher caffeine intake (p=0.01). Individuals reporting sleep problems (p=0.02), indigestion (p<0.001), frequent urination (p=0.02), and bowel irregularities (p=0.04) had higher psychological scores. The average anxiety level is 3.66, the tension level is 3.35, and the depression level is 2.38 (out of 10).

## DISCUSSION

In recent years, caffeinated beverages (especially coffee) have become increasingly popular worldwide, particularly among young people. One of the main reasons for this is the ability to wake up faster in the mornings and stay alert throughout the day, especially while attending classes. Studies have shown a positive correlation between higher levels of education and caffeine intake[10] indeed, in our study, 77.3% of caffeine-consuming participants held a bachelor's degree.

**Table 3.** Parameters affecting mood in individuals with regular caffeine consumption

| | | Median±SD | p |
|---|---|---|---|
| Gender | Female | 22.6±13.7 | 0.25 |
| | Male | 20.1±14.2 | |
| Alcohol consumption | Present | 21.7±14.0 | 0.86 |
| | Absent | 160.6±11.2 | |
| Smoking | Present | 18.7±13.8 | 0.08 |
| | Absent | 22.8±13.9 | |
| Regular exercise | Present | 20.0±12.4 | 0.47 |
| | Absent | 22.2±14.5 | |
| Sleep disorder | Present | 25.0±14.9 | 0.02 |
| | Absent | 19.4±12.9 | |
| Palpitation | Present | 23.7±15.4 | 0.29 |
| | Absent | 20.5±13.1 | |
| Bowel problem | Absent | 19.9±13.3 | 0.04 |
| | Diarrhea | 24.7±11.9 | |
| | Constipation | 28.0±16.8 | |
| Dyspepsia | Present | 26.8±15.1 | <0.001 |
| | Absent | 18.4±12.2 | |
| Frequent urination | Present | 26.5±15.6 | 0.02 |
| | Absent | 20.0±13.0 | |
| Educational status | High school | 27.2±15.9 | 0.01 |
| | Bachelor's degree | 22.2±13.8 | |
| | Postgraduate | 13.3±10.7 | |
| Marital status | Married | 20.2±12.7 | 0.96 |
| | Single | 21.8±14.3 | |
| | In a relationship | 20.7±12.5 | |
| Income | Low | 22.1±13.7 | 0.61 |
| | Medium | 19.3±14.9 | |
| | High | 22.2±15.3 | |
| Occupation | Unemployed | 30.1±17.2 | 0.37 |
| | Civil servant | 18.8±12.4 | |
| | Worker | 14.0±0.0 | |
| | Self-employed | 19.0±25.4 | |
| | Other | 21.6±13.7 | |
| Weekly Turkish coffee consumption | 1 cup | 24.2±14.2 | 0.04 |
| | 2 cup | 24.3±13.5 | |
| | 3 cup | 15.6±12.9 | |
| | ≥4 cup | 18.8±13.6 | |
| Weekly instant coffee consumption | 1 cup | 21.2±12.8 | 0.29 |
| | 2 cup | 23.7±13.1 | |
| | 3 cup | 27.3±17.9 | |
| | ≥4 cup | 19.7±14.3 | |
| Body-mass index (BMI) (kg/m²) | Underweight | 19.5±5.8 | 0.93 |
| | Normal/healthy | 20.5±12.4 | |
| | Overweight | 23.9±16.9 | |
| | Class I obesity | 24.1±18.8 | |
| | Class II obesity | 27.3±24.8 | |

SD: Standard deviation

The question of "at what doses caffeine has beneficial effects on human health or at what intake levels it becomes harmful" remains controversial. In our study, high caffeine consumption was associated with increased diuresis and dyspeptic symptoms as well as sleep irregularity; Turkish

coffee had a stronger effect compared to Nescafe. Any association with alcohol or smoking was found. Tachycardia was observed in approximately one-third of individuals.

Daily caffeine intake above 300 mg has been proposed to increase frequent urination.[11] In a group with regular coffee consumption (average 308 mg/day), no significant changes in total body water or body weight were found even after 3 days of coffee and water intake.[12] Similarly, our study found increased diuresis with no significant change in total body water.

Several studies report that caffeine increases dyspeptic symptoms, gastritis, and gastroesophageal reflux disease.[13] However, some studies have found any association between coffee consumption and dyspeptic complaints,[14,15] possibly due to varying caffeine doses.

Although low doses of caffeine (60 mg/day) have been reported to have no effect on sleep patterns, long-term or high-dose consumption may lead to insomnia.[16,17] In our study, high-dose coffee consumption was associated with sleep disturbances in nearly half of the individuals.

In a study of sedentary young adults aged 18-25, BMI and body fat percentage were lower compared to our group of caffeine consumers; however, waist/hip ratios were similar.[18] Another study in a similar age group reported a body fat percentage of 32.78%.[19] In our study, body fat percentage was 29.2±9.0%. Although waist/hip ratios and visceral fat percentages were in the normal range, total body fat was near the upper limit.

Limited literature exists on the relationship between coffee consumption and muscle mass. Some studies have found lower muscle mass among older adults consuming ≥3 cups of coffee per day,[20] while others report higher muscle mass with moderate coffee intake in older adults.[21] In our study, individuals consuming ≥4 cups per week had an average muscle mass of 27.2±7.0 kg/m$^2$. Another study in young adults reported muscle mass of 44.30±8.77 kg/m$^2$.[22] Increased coffee intake may negatively influence muscle mass.

Moderate caffeine consumption has been associated with mood enhancement and relaxation, while high doses have been linked to increased tension, restlessness, and irritability.[11] Studies examining caffeine and anxiety show inconsistent results; one analysis found lower anxiety in coffee drinkers compared to non-drinkers,[23] while another study reported increased anxiety with caffeine intake.[24] In our study, anxiety rates were low, supporting literature suggesting no clear association. Some literature indicates that higher caffeine intake may be associated with lower depressive symptoms;[25] our findings similarly showed low depression symptom scores. Conversely, some studies report increased depression with caffeine.[26]

### Limitations

The study was conducted only on a young population. Female dominance was present. A study with a larger sample size and a more similar gender ratio could have been conducted. Participants were evaluated based on whether they consumed Turkish coffee or other types of coffee. Differentiation between other coffee types could have been made. Whether caffeine intake occurred during the day or night could have been determined. Caffeine intake doses could have been further clarified. More biochemical parameters, such as HOMA-IR, could have been studied. These are the limitations of our study.

## CONCLUSION

As a result, caffeine consumption was found to have the most significant effect on anxiety and the least effect on depression. Regular caffeine consumption was associated with sleep disturbances, frequent urination, and dyspeptic symptoms, but was not found to be an independent predictor of anthropometric measurements or psychological status. Caffeine, a frequently consumed, diverse, and significant stimulant in the diet, requires further research into its effects on health. We believe that these studies should include childhood age groups, particularly to determine the long-term effects of caffeine. Therefore, more randomized controlled trials involving larger population groups are needed to clarify the causal relationships between caffeine intake, anthropometric measurements, and psychological outcomes.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

The study was approved by the Yozgat Bozok University Non-interventional Researches Ethics Committee (Date: 22.01.2025, Decision No: 2025-GOKAEK-252_2025.01.22_321).

### Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights—including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

### Author Contributions

Concept: H.K.; Design: H.K., B.G.[1]; Control: H.K., B.G.[1], Z.T.O.; Resources: H.K., B.G.[1]; Materials: H.K., B.G.[1], B.G.[2]; Data Collection and/or Processing: H.K., B.G.[1], B.G.[2]; Analysis and/or Interpretation: H.K., B.G.[1], B.G.[2], Z.T.O.; Literature Review: H.K., Z.T.O.; Writing the Article: H.K., Z.T.O.; Critical Review: H.K., B.G.[1], B.G.[2], Z.T.O.

## REFERENCES

1. Abalo R. Coffee and caffeine consumption for human health. *Nutrients*. 2021;13(9):2918. doi:10.3390/nu13092918

2. Rochat C, Eap CB, Bochud M, Chatelan A. Caffeine consumption in Switzerland: results from the first national nutrition survey MenuCH. *Nutrients*. 2019;12(1):28. doi:10.3390/nu12010028
3. Maqsood U, Zahra R, Latif MZ, Athar H. Caffeine consumption & perception of its effects amongst university students. *Proceedings of Shaikh Zayed Medical Complex Lahore*. 2020;34(4):46-51. doi:10.47489/p000s344z770mc
4. Pereira-Morales AJ, Casiraghi LP, Adan A, Camargo A. Mood rhythmicity is associated with depressive symptoms and caffeinated drinks consumption in South American young adults. *Chronobiol Int*. 2019;36(2):225-236. doi:10.1080/07420528.2018.1530257
5. Lucas M, Mirzaei F, Pan A, et al. Coffee, caffeine, and risk of depression among women. *Arch Intern Med*. 2011;171(17):1571-1578. doi:10.1001/archinternmed.2011.393
6. Yang A, Palmer AA, de Wit H. Genetics of caffeine consumption and responses to caffeine. *Psychopharmacology (Berl)*. 2010;211(3):245-257. doi:10.1007/s00213-010-1900-1
7. Yin J, Ding Y, Xu F, et al. Does the timing of intake matter? Association between caffeine intake and depression: evidence from the National Health and Nutrition Examination Survey. *J Affect Disord*. 2023;340:362-368. doi:10.1016/j.jad.2023.07.115
8. EFSA Panel on Dietetic Products, Nutrition and Allergies. Scientific opinion on dietary reference values for iron. *EFSA J*. 2015;13:4254.
9. Frary CD, Johnson RK, Wang MQ. Food sources and intakes of caffeine in the diets of persons in the United States. *J Am Diet Assoc*. 2005;105(1):110-113. doi:10.1016/j.jada.2004.10.027
10. Champlin SE, Pasch KE, Perry CL. Is the Consumption of energy drinks associated with academic achievement among college students? *J Prim Prev*. 2016;37(4):345-359. doi:10.1007/s10935-016-0437-4
11. Antonio J, Newmire DE, Stout JR, et al. Common questions and misconceptions about caffeine supplementation: what does the scientific evidence really show? *J Int Soc Sports Nutr*. 2024;21(1):2323919. doi:10.1080/15502783.2024.2323919
12. Armstrong LE, Pumerantz AC, Roti MW, et al. Fluid, electrolyte, and renal indices of hydration during 11 days of controlled caffeine consumption. *Int J Sport Nutr Exerc Metab*. 2005;15(3):252-265. doi:10.1123/ijsnem.15.3.252
13. Nehlig A. Effects of coffee on the gastro-ıntestinal tract: a narrative review and literature update. *Nutrients*. 2022;14(2):399. doi:10.3390/nu14020399
14. Lien HC, Chen GH, Chang CS, Kao CH, Wang SJ. The effect of coffee on gastric emptying. *Nucl Med Commun*. 1995;16(11):923-926. doi:10.1097/00006231-199511000-00008
15. Boekema PJ, van Dam van Isselt EF, Bots ML, Smout AJ. Functional bowel symptoms in a general Dutch population and associations with common stimulants. *Neth J Med*. 2001;59(1):23-30. doi:10.1016/s0300-2977(01)00128-0
16. Saimaiti A, Zhou DD, Li J, et al. Dietary sources, health benefits, and risks of caffeine. *Crit Rev Food Sci Nutr*. 2023;63(29):9648-9666. doi:10.1080/10408398.2022.2074362
17. Liu QS, Deng R, Fan Y, et al. Low dose of caffeine enhances the efficacy of antidepressants in major depressive disorder and the underlying neural substrates. *Mol Nutr Food Res*. 2017;61(8):10.1002/mnfr.201600910. doi:10.1002/mnfr.201600910
18. Uğraş Z, Özdenk Ç. Biyoelektrik impedans yöntemi ve antropometrik ölçümler ile vücut kompozisyon analizinin sedanter genç erkek ve kadınlarda karşılaştırmalı olarak değerlendirilmesi. *Sağlık Bilimleri Derg*. 2020;29(1):14-18. doi:10.34108/eujhs.578119
19. Karakaş S, Taşer F, Yıldız Y, Köse H. Tıp fakültesi ve spor yüksekokulu öğrencilerinde biyoelektriksel impedans analiz (BİA) yöntemi ile vücut kompozisyonlarının karşılaştırılması. *Adnan Menderes Üniversitesi Tıp Fakültesi Dergisi*. 2005;6(3):5-9.
20. Chung H, Moon JH, Kim JI, Kong MH, Huh JS, Kim HJ. Association of coffee consumption with sarcopenia in Korean elderly men: analysis using the Korea National Health and Nutrition Examination Survey, 2008-2011. *Korean J Fam Med*. 2017;38(3):141-147. doi:10.4082/kjfm.2017.38.3.141
21. Kim JH, Park YS. Light coffee consumption is protective against sarcopenia, but frequent coffee consumption is associated with obesity in Korean adults. *Nutr Res*. 2017;41:97-102. doi:10.1016/j.nutres.2017.04.004
22. Günşen U, Eseceli H, Selçuk KT, Atan RM. Üniversite öğrencilerinde vücut kompozisyonu ve antropometrik ölçümlerin uyku süresi ve uyku kalitesiyle ilişkisi. *IGUSABDER*. 2022;(18):751-769. doi:10.38079/igusabder.1096981
23. Klevebrant L, Frick A. Effects of caffeine on anxiety and panic attacks in patients with panic disorder: a systematic review and meta-analysis. *Gen Hosp Psychiatry*. 2022;74:22-31. doi:10.1016/j.genhosppsych.2021.11.005
24. Liu C, Wang L, Zhang C, et al. Caffeine intake and anxiety: a meta-analysis. *Front Psychol*. 2024;15:1270246. doi:10.3389/fpsyg.2024.1270246
25. Iranpour S, Sabour S. Inverse association between caffeine intake and depressive symptoms in US adults: data from National Health and Nutrition Examination Survey (NHANES) 2005-2006. *Psychiatry Res*. 2019;271:732-739. doi:10.1016/j.psychres.2018.11.004
26. EFSA Panel on Dietetic Products, Nutrition and Allergies. Scientific opinion on the safety of caffeine. EFSA J. 2015;13(5):4102.

Ankyra Medical Journal
Original Article
DOI: 10.51271/ANKMJ-0059

# Occupational health characteristics of dentists: a descriptive study

Mehmet Erdem Alagüney*[1], Mehmet Celal Almaz[2], Zubeyir Dedeoğlu[3], Meltem Sengelen[4], Banu Çakır[4]

[1]Department of Internal Medicine, Ankara Bilkent City Hospital, Ankara, Turkiye
[2]Occupational Health Doctoral Program, Institute of Health Sciences, Ankara University, Ankara, Turkiye
[3]Director, Ministry of Environment, Urbanization and Climate Change, Ankara, Turkiye
[4]Department of Public Health, Faculty of Medicine, Hacettepe University, Ankara, Turkiye

**Cite this article:** Alagüney ME, Almaz MC, Dedeoğlu Z, Sengelen M, Çakır B. Occupational health characteristics of dentists: a descriptive study. *Ank Med J.* 2026;5(1):15-19.

**Received**: 02/12/2025 ◆ **Accepted**: 10/01/2026 ◆ **Published**: 14/01/2026

## ABSTRACT

**Aims:** Dentists are exposed to a range of occupational hazards, including chemical and biological agents, ergonomic and psychosocial stress. There is limited data on how frequently they encounter these risks or how well they are protected.

**Methods:** This descriptive study gathered data through an online questionnaire. It explored demographic characteristics, occupational exposures, overall health, and the availability and use of occupational health and safety (OHS) measures.

**Results:** Of the 123 dentists, 44.7% reported having contracted COVID-19, and 35% experienced at least one occupational accident in the past year—two-thirds of which involved sharps injuries. Only 41.7% of these incidents were officially reported. Musculoskeletal problems were widespread, 66.7% of participants attributing them to their work. 54.5% had undergone pre-employment exams, 72.4% had periodic checkups, and 87.8% received OHS training. However, 74.8% noted a lack of local exhaust ventilation, and 68.3% said there was no general ventilation system. Dentists working night shifts or assigned to COVID-19 duties reported higher levels of stress and emotional strain.

**Conclusion:** While PPE use was generally adequate, there were serious shortcomings in ventilation, accident reporting, and ergonomic conditions. Improved training, workplace modifications, and better reporting systems is essential to ensure the health and safety of dental professionals.

**Keywords:** Dentists, occupational health and safety, sharp injuries, occupational diseases, COVID-19

## INTRODUCTION

Oral and dental health personnel face many health and safety risks in their working lives. Compared to general health services, it has characteristics such as close contact with the patient, patient's respiratory area, and more frequent work with fast-rotating motorized and cutting tools.[1] These characteristics lead to more aerosol exposure, blood, and body fluid splashes.[2-5] While these usually occur in the form of occupational accidents, they can also occur as occupational infectious diseases after infection transmission.[6,7] It has been reported that 72% of dentists in Europe have experienced at least 1 sharps injury during their working life.[8] One study suggests that reporting of sharps injuries is 10 times lower than it should be.[9]

Dentists were in the high-risk group for COVID-19 infection due to the high formation of bioaerosols during intraoral interventions. However, due to the postponement of dental procedures and increased biosecurity measures, the numerical increase in the incidence of COVID-19 infection in dentists was less than expected.[10,11]

Musculoskeletal disorders due to ergonomic risk factors are also an important problem in oral dental health services.[12,13] Long working hours, prolonged standing, abnormal hand and wrist joints as well as abnormal posture involving the whole body are among the factors that cause musculoskeletal disorders.[14]

Stress, anxiety, and burnout are important psychological problems for dentists.[15] Studies have shown a high prevalence of work-related mental disorders.[16] Cumulative stress is known to reduce overall productivity.[17] Long working hours have been shown to negatively affect the general health and well-being of dentists.[18]

Recognizing and anticipating the existence of all these risks is essential for their prevention. Studies that will determine how

*Corresponding Author: Mehmet Erdem Alagüney, alaguney@gmail.com

and how often dentists are exposed to these risks will provide guidance to first identify the existing problems and then to make the necessary interventions to prevent them.

Therefore, it is aimed to determine the current situation of dentists working in Ankara province in terms of occupational health and safety (OHS) through a survey study. We investigated the associations between OHS services status and outcomes such as injuries and illnesses. We also investigated the organizational workloads and how dentists feel about them.

With the results of this study, it will be possible to identify priority areas and to make the necessary improvements. Again, scientific research, including intervention research, will be conducted in the light of the data to be obtained from the results of this study. In the long term, it is aimed to improve the working conditions of dentists and to ensure that they have a healthier and more productive working life.

## METHODS

This study has been approved by the Hacettepe University Ethics Committee (Date: 14.06.2022, Decision No: E-35853172), and all procedures were conducted in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards

This is a descriptive study and conducted between April- May 2022. The population of the study is the dentists who are working at 12 health institutions under the Ankara Provincial Health Directorate and a sample was not selected as it was aimed to reach all dentists working in these institutions. Although the total number of dentists may vary due to reasons such as leave, transfer, temporary or permanent assignment, it was reported to be around 500 dentists in these institutions.

Data were collected using an online survey (Google Survey). Survey links were sent to the chief physicians of the relevant institutions, and they were forwarded to the physicians through communication clusters and asked for the participation of volunteers.

Data analysis was performed with SPSS 23.0 package program.

## RESULTS

A total of 123 participants, 96 female and 27 male dentists, participated in our study. The mean age of the participants was 41.5 years (27-67). 100 participants were married and 19 were single. All participants were dental school graduates, 21 (17.1%) had a master's degree, 18 (14.6%) had a doctorate degree, and 16 (13%) had a specialty degree in dentistry.

While 73 (59.3%) of the participants stated that they never smoked cigarettes, 27 (22%) stated that they smoked regularly and 23 (18.7%) stated that they had quit smoking. While 68 (55.3%) of the participants had never used alcohol, 53 (43.1%) used alcohol occasionally and 2 people stated that they used alcohol frequently. 32 (26%) of the participants stated that they had chronic diseases. The mean body mass index value of male dentists was 26.1±2.1 and 23.7±3.4 for female dentists.

Participants were asked whether they had been diagnosed with PCR positive COVID-19 disease to find out whether they had COVID-19 disease. 55 people (44.7%) stated that they were diagnosed with PCR positive COVID-19 disease.

After general demographic and health information, participants were asked about their vaccination status. When asked about hepatitis B vaccination status, 112 participants (91.1%) stated that they had HBV vaccines with all doses completed. The frequency of tetanus vaccination was 72.4% (89 people). When asked about influenza vaccination status in the last 1 year, it was learned that 30 people (24.4%) had been vaccinated. COVID-19 vaccination status was also asked. It was learned that 119 people (96.7%) had COVID vaccination and 4 people did not. Some characteristics of the general health status of the dentists participating in the study are summarized in Table 1.

**Table 1.** Some characteristics of the dentists participating in the study regarding their general health status

| | | n | Percent |
|---|---|---|---|
| Smoking | Never | 73 | 59.3 |
| | Still smoking | 27 | 22 |
| | Quit smoking | 23 | 18.7 |
| Chronic disease | Present | 32 | 26 |
| | Absent | 91 | 74 |
| COVID-19 disease | Yes | 55 | 44.7 |
| | No | 68 | 55.3 |
| Vaccination (full dose) | HBV | 112 | 91.1 |
| | Tetanose | 89 | 72.4 |
| | Influenza | 30 | 24.4 |
| | COVID-19 | 119 | 96.7 |

Participants were asked questions about their working life. Physicians had worked for a median total of 17 years (1-38) and had been working in their last institution for 4 years (1-28). It was found that they worked a median of 40 hours per week (7-68) and saw a median of 25 patients per day (0-70) and, 71.5% of the physicians worked night shifts. 93 dentists (75.6%) stated that they had a task related to COVID-19 during the pandemic. Some information about the working lives of the dentists participating in the study is summarized in Table 2.

**Table 2.** Some information about the working life of the dentists participating in the study

| | | n | Median (min-max) |
|---|---|---|---|
| Total working time in the profession | (Years) | 123 | 17 (1-38) |
| Time spent in the last unit | (Years) | 123 | 4 (1-28) |
| Weekly working time | (Hours) | 123 | 40 (7-68) |
| Number of patients per day | | 123 | 25 (0-70) |
| | | n | Percent |
| Night shift? | Yes | 88 | 71.5 |
| | No | 35 | 28.5 |
| Working in COVID-19 duties? | Yes | 93 | 75.6 |
| | No | 30 | 24.4 |

Min: Minimum, Max: Maximum

When asked about occupational health risks, 94.3% of dentists stated that they were not exposed to radiation. There were 110 (89.4%) who stated that they were exposed to cleaning chemicals and disinfectants, 83 (67.5%) who were exposed to dust and other chemicals, 114 (92.7%) who were exposed to patient blood and other body fluids, and 110 (89.4%) who were exposed to patient breathing air. Among the ergonomic risk factors, 85.4% of the physicians stated that they were exposed to prolonged standing, while 94.3% of the physicians stated that they performed procedures requiring abnormal posture such as reaching, bending, and standing still.

In the questions about the status of dentists regarding OHS services, 67 (54.5%) of the participants stated that they were examined at the beginning of their employment, 89 (72.4%) stated that they were periodically examined, and 108 (87.8%) stated that they received OHS training. When the measures for controlling occupational health risks were questioned, 74.8% (92 people) of the dentists stated that there was no local exhaust ventilation system against dust and biological agents, and 68.3% stated that there was no general ventilation system. In addition, 98 (79.7%) stated that personal protective equipment was available and used regularly, while 16 (13%) stated that personal protective equipment was not sufficient. When asked about protection from radiation exposure, 60 (48.8%) of the participants stated that they do not perform X-rays. Sixty-one of the 63 dentists who performed X-rays stated that there was a lead-blocked room and that they performed all X-rays in that area.

When asked about the frequency of occupational accidents and occupational diseases, 65% of the dentists (80 people) stated that they did not experience an occupational accident in the last 1 year. Since one person can have more than one accident, a total of 56 accidents occurred. Of these accidents, 37 (66%) were reported as penetrating sharps injuries, 18 (32.1%) as biological material splashes and 1 gas poisoning. When asked whether a notification was made after an occupational accident, 28 (58.3%) of the 48 people who had an accident answered no. Of the 123 participants, 92 (74.8%) stated that they were not diagnosed with an occupational disease, 19 (15.4%) stated that they were referred with suspicion of occupational disease, and 12 (9.8%) stated that they were diagnosed with an occupational disease. The declared diagnoses were: Latex allergy, lumbar disc herniation, cervical disc herniation, right hand Kienböck's precursor, varicose veins, epicondylitis, neck flattening, tennis elbow, onset of lumbar disc herniation, heel spur, tendonitis, covid 19, arthritis, spinal curvature, kyphosis, carpal tunnel syndrome. When asked "do you think you have an occupational disease?" 82 people (66.7%) answered yes. When they were asked open-endedly what these diseases were; although more than one disease was declared, almost all the participants stated that they thought that back, neck and joint pain were occupational.

No difference was observed between the frequency of occupational accidents and receiving periodic examinations, while the frequency of occupational accidents in those who stated that they did not receive OHS training was found to be significantly higher than those who received training (p=0.042) (Table 3). No relationship was observed between the frequency of notification after an occupational accident and receiving a fitness for work examination, periodic examination or OHS training.

**Table 3.** The relationship between OHS services and occupational injuries

| | | Occupational injury | | |
|---|---|---|---|---|
| | | No n (%) | Yes n (%) | p |
| OHS training | No | 6 (40) | 9 (60) | 0.042* |
| | Yes | 74 (68.5) | 34 (31.5) | |
| Periodic examination | No | 20 (58.8) | 14 (41.2) | 0.403 |
| | Yes | 60 (67.4) | 29 (32.6) | |
| Fitness for work assessment | No | 34 (60.7) | 22 (39.3) | 0.448 |
| | Yes | 46 (68.7) | 21 (31.3) | |

OHS: Occupational health and safety, p<0.05 significant

The correlation between some variables in the working life of dentists and their answers about the worry of not being able to finish the work, the thought of not being useful, feeling unhappy and feeling inadequate were analyzed by Spearman correlation test. As the number of patients seen per day increased, there was an increase in the feeling of not being useful (r=0.213, p=0.018) and feeling unhappy (r=0.290, p=0.001). There was no correlation between the total years of service in the profession and the duration of service in the last unit of employment and the anxiety of not being able to complete the work, feeling unhappy and feeling inadequate.

The status of working night shifts and working in pandemic-related tasks during the pandemic compared with the status of worrying about not being able to finish work, feeling unhappy, feeling inadequate and feeling inadequate. It was found that those who worked night shifts had higher unhappy feeling scores (p=0.005). The unhappy feeling scores and thoughts of not being useful were found to be significantly higher in those who took tasks related to the COVID-19 pandemic (p=0.045 and p=0.041 -Fisher's Exact test-, respectively).

## DISCUSSION

In our study, data on general demographic information, health status, OHS services, occupational accidents and occupational diseases, OHS risks and precautions taken, and psychosocial status of dentists in working life were obtained.

In our study, 35% of the physicians who responded to our survey had occupational accidents. Of these accidents, 66% were identified as penetrating sharps injuries. In a study conducted in the United States of America, it was determined that 20% of percutaneous penetrating sharps injuries reported by healthcare workers were reported by oral and dental health personnel. It was observed that 66.7% of these notifications were made by dentists.[19] In another study, nurses accounted for more than half of the cases, and the majority of affected workers were female.[20] Shimoji et al.[1] found that 50-60% of oral and dental health personnel sustained penetrating sharps injuries and 88% were exposed to blood and body fluid splashes.

In a study conducted in the UK, it was estimated that penetrating sharps injuries were detected approximately 10 times less than the actual situation.[9] In Shimoji's study,[1] 30.3% of those who sustained a penetrating sharps injury

reported it. When evaluated accident-specifically, it was found that 10.3% of dentists reported penetrating sharps injuries and 15.5% of splash injuries. In our study, the rate of reporting after occupational accidents was 41.7%. However, no occupational accident was reported in case of biological material splashing.

In our study, 74.8% of dentists stated that there was no local exhaust ventilation system against dust and biological agents, and 68.3% stated that there was no general ventilation system. In a study conducted in Nigeria, 72.2% of the participants stated that ambient ventilation was adequate.[6] In our study, 79.7% of the participants stated that personal protective equipment was available and used regularly. In Shimoji's study,[1] compliance with PPE use was reported as 60.3%.

In a study conducted in dentists, 47% of the dentists surveyed stated that they had work-related musculoskeletal disorders. It was found that dentists who reported having these disorders were older, had longer working hours and worked longer.[13] A systematic review found that the prevalence of musculoskeletal pain in dentists ranged from 64 to 93%.[21] In a study from Australia, 87% of dentists surveyed reported experiencing at least one work-related musculoskeletal symptom in the past year.[22] In a study conducted in Nigeria, musculoskeletal disorders were found to be the most frequently reported occupational health problem among oral and dental health personnel.[6] In a study conducted in oral dental health workers in Turkiye, musculoskeletal disorders were reported as the most frequently reported work-related health problem.[23] In a systematic review, the annual prevalence of musculoskeletal disorders affecting at least one body region was reported to range between 68% and 100%.[24] In our study, like the literature, musculoskeletal disorders were the most frequently complained health problem by dentists. 66.7% of the participants stated that they had these musculoskeletal disorders as occupational diseases.

Studies in Latin America have shown that the COVID-19 pandemic process and its restrictions had negative effects on dentists' perceived stress and subjective well-being.[25,26] A study conducted in Italy also showed that dentists experienced feelings of worry, anxiety, and fear during the COVID-19 pandemic.[27] In a review in 2025, work-related stress was reported to be widespread and to be associated with mental health outcomes such as burnout syndrome, emotional exhaustion, and suicidal ideation, among dental personnel.[28] In our study, unhappy feeling scores and thoughts of not being useful were found to be significantly higher in those who worked in relation to the COVID-19 pandemic.

### Limitations

The main limitation of the research is the low response rate since the questionnaires were not applied face-to-face. For this reason, it only reflects the views of those who responded to the research and is not generalizable to any group.

## CONCLUSION

The results of the study showed that dentists in Ankara province were in good condition in terms of OHS services. Although the presence and use of personal protective equipment was appropriate in terms of OHS risks, it was thought that there were deficiencies in local and general exhaust ventilation systems. In addition, the presence of ergonomic risk factors such as abnormal posture and prolonged standing, which may cause musculoskeletal system disorders, drew attention. It was observed that radiation exposure was low, and protective measures were observed in cases where there was radiation exposure. A low level of awareness in terms of occupational accident notifications was observed.

In the light of all these findings, training in ergonomics and corrective actions in the work environment are required. Fitness for work assessments of employees with musculoskeletal disorders should be conducted again to identify and eliminate situations that will cause the progression of their diseases. It is recommended that technical corrections be made to ventilation systems to reduce exposure to biological and inorganic dust and aerosols in the work environment.

It would be appropriate to eliminate the deficiencies in the legally mandatory periodic examinations, recruitment examinations and OHS trainings. In addition, it is recommended that training and administrative measures be used to overcome the deficiencies in the legally mandatory reporting of occupational accidents.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

This study has been approved by the Hacettepe University Ethics Committee (Date: 14.06.2022, Decision No: E-35853172).

### Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights—including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent form.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

### Author Contributions

Concept: M.E.A., M.C.A.; Design: M.E.A., M.S.; Control: M.E.A., M.S., B.Ç.; Resources: M.E.A., M.C.A., Z.D.; Materials: M.E.A., M.C.A., Z.D.; Data Collection and/or Processing: M.E.A., M.S., M.C.A.; Analysis and/or Interpretation: M.E.A., M.S., B.Ç.; Literature Review: M.E.A., M.C.A.; Writing the Article: M.E.A., M.S., M.C.A.; Critical Review: M.E.A., M.S., B.Ç.

## REFERENCES

1. Shimoji S, Ishihama K, Yamada H, et al. Occupational safety among dental health-care workers. *Adv Med Educ Pract*. 2010;1:41-47. doi:10.2147/AMEP.S13130
2. Ishihama K, Iida S, Koizumi H, et al. High incidence of blood exposure due to imperceptible contaminated splatters during oral surgery. *J Oral Maxillofac Surg*. 2008;66(4):704-710. doi:10.1016/j.joms.2007.06.663
3. Harrel SK, Molinari J. Aerosols and splatter in dentistry: a brief review of the literature and infection control implications. *J Am Dent Assoc*. 2004;135(4):429-437. doi:10.14219/jada.archive.2004.0207
4. Yamada H, Ishihama K, Yasuda K, Hasumi-Nakayama Y, Shimoji S, Furusawa K. Aerial dispersal of blood-contaminated aerosols during dental procedures. *Quintessence Int*. 2011;42(5):399-405.
5. Ishihama K, Koizumi H, Wada T, et al. Evidence of aerosolised floating blood mist during oral surgery. *J Hosp Infect*. 2009;71(4):359-364. doi:10.1016/j.jhin.2008.12.005
6. Osazuwa-Peters N, Azodo CC, Obuekwe ON. Occupational health issues of oral health care workers in Edo State, Nigeria. *Int Dent J*. 2012;62(3):117-121. doi:10.1111/j.1875-595X.2011.00101.x
7. Kohn WG, Collins AS, Cleveland JL, et al. Guidelines for infection control in dental health-care settings--2003. *MMWR Recomm Rep*. 2003;52(RR-17):1-61.
8. Bouya S, Balouchi A, Rafiemanesh H, et al. Global prevalence and device related causes of needle stick injuries among health care workers: a systematic review and meta-analysis. *Ann Glob Health*. 2020;86(1):35. doi:10.5334/aogh.2698
9. Elder A, Paterson C. Sharps injuries in UK health care: a review of injury rates, viral transmission and potential efficacy of safety devices. *Occup Med (Lond)*. 2006;56(8):566-574. doi:10.1093/occmed/kql122
10. Evaristo-Chiyong T, Mattos-Vela MA, Agudelo-Suarez AA, et al. General labor well-being in Latin American dentists during the COVID-19 pandemic. *Int J Environ Res Public Health*. 2022;19(10):6317. doi:10.3390/ijerph19106317
11. Araujo MWB, Estrich CG, Mikkelsen M, et al. COVID-2019 among dentists in the United States: a 6-month longitudinal report of accumulative prevalence and incidence. *J Am Dent Assoc*. 2021;152(6):425-433. doi:10.1016/j.adaj.2021.03.021
12. Wu J, McCullough M, Panisset MG, Galea MP. Prevention of work-related musculoskeletal disorders among dental professionals: a scoping review. *Work*. 2022;72(1):91-108. doi:10.3233/WOR-205257
13. Alnaser MZ, Almaqsied AM, Alshatti SA. Risk factors for work-related musculoskeletal disorders of dentists in Kuwait and the impact on health and economic status. *Work*. 2021;68(1):213-221. doi:10.3233/WOR-203369
14. Aljanakh M, Shaikh S, Siddiqui AA, Al-Mansour M, Hassan SS. Prevalence of musculoskeletal disorders among dentists in the Hail Region of Saudi Arabia. *Ann Saudi Med*. 2015;35(6):456-461. doi:10.5144/0256-4947.2015.456
15. Mandel ID. Occupational risks in dentistry: comforts and concerns. *J Am Dent Assoc*. 1993;124(10):40-49. doi:10.14219/jada.archive.1993.0215
16. Puriene A, Janulyte V, Musteikyte M, Bendinskaite R. General health of dentists. Literature review. *Stomatologija*. 2007;9(1):10-20.
17. Yee T, Crawford L, Harber P. Work environment of dental hygienists. *J Occup Environ Med*. 2005;47(6):633-639. doi:10.1097/01.jom.0000165745.89527.7e
18. Puriene A, Aleksejuniene J, Petrauskiene J, Balciuniene I, Janulyte V. Occupational hazards of dental profession to psychological wellbeing. *Stomatologija*. 2007;9(3):72-78.
19. Shah SM, Merchant AT, Dosman JA. Percutaneous injuries among dental professionals in Washington State. *BMC Public Health*. 2006;6:269. doi:10.1186/1471-2458-6-269
20. Zhang M, Chen Y, Zhang S, Fan X. Sharps injuries in a dental specialty hospital: retrospective analysis of occupational risks, 2020-2024. *BMC Oral Health*. 2025;25(1):1618. doi:10.1186/s12903-025-07020-z
21. Hayes M, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. *Int J Dent Hyg*. 2009;7(3):159-165. doi:10.1111/j.1601-5037.2009.00395.x
22. Leggat PA, Smith DR. Musculoskeletal disorders self-reported by dentists in Queensland, Australia. *Aust Dent J*. 2006;51(4):324-327. doi:10.1111/j.1834-7819.2006.tb00451.x
23. Ocek Z, Soyer MT, Aksan AD, Hassoy H, Manavgat SS. Risk perception of occupational hazards among dental health care workers in a dental hospital in Turkey. *Int Dent J*. 2008;58(4):199-207. doi:10.1111/j.1875-595x.2008.tb00349.x
24. Soo SY, Ang WS, Chong CH, Tew IM, Yahya NA. Occupational ergonomics and related musculoskeletal disorders among dentists: a systematic review. *Work*. 2023;74(2):469-476. doi:10.3233/WOR-211094
25. Leon-Manco RA, Agudelo-Suarez AA, Armas-Vega A, et al. Perceived stress in dentists and dental students of Latin America and the Caribbean during the mandatory social isolation measures for the COVID-19 pandemic: a cross-sectional study. *Int J Environ Res Public Health*. 2021;18(11):5889. doi:10.3390/ijerph18115889
26. Garces-Elias MC, Leon-Manco RA, Armas-Vega A, Viteri-Garcia A, Agudelo-Suarez AA. Impact of mandatory social isolation measures due to the COVID-19 pandemic on the subjective well-being of Latin American and Caribbean dentists. *J Clin Exp Dent*. 2022;14(1):e40-e47. doi:10.4317/jced.58776
27. Consolo U, Bellini P, Bencivenni D, Iani C, Checchi V. Epidemiological aspects and psychological reactions to COVID-19 of dental practitioners in the Northern Italy Districts of Modena and reggio Emilia. *Int J Environ Res Public Health*. 2020;17(10):3459. doi:10.3390/ijerph17103459
28. Căminişteanu F, Vorovenci A, Perieanu VŞ, et al. Occupational diseases among dental personnel: a scoping review. *J Med Life*. 2025;18(6):526-535. doi:10.25122/jml-2024-0412

Ankyra Medical Journal

Review

DOI: 10.51271/ANKMJ-0060

# Advanced review on biodegradable materials for bone repair: polymers, magnesium-based metals, and ceramics

**Mehmet Kabalcı***

*Department of Cardiovascular Surgery, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye*

**Cite this article:** Kabalcı M. Advanced review on biodegradable materials for bone repair: polymers, magnesium-based metals, and ceramics. *Ank Med J.* 2026;5(1):20-23.

**Received**: 10/11/2025 ◆ **Accepted**: 18/12/2025 ◆ **Published**: 14/01/2026

## ABSTRACT

Biodegradable materials have garnered substantial attention in the field of bone repair due to their potential to eliminate the need for secondary surgeries, reduce patient pain, and decrease economic costs associated with orthopedic interventions. This review systematically summarizes the current knowledge, recent advancements, and clinical applications of three major categories of biodegradable bone repair materials: magnesium-based metals, polymers and ceramics. The physicochemical properties, degradation mechanisms, mechanical behaviors, and biocompatibility of these materials are discussed in depth. Additionally, this review highlights the challenges and future directions in the development of next-generation biodegradable bone implants, providing insights for researchers and clinicians aiming to optimize biomaterial selection for specific clinical applications.

**Keywords:** Biodegradable materials, bone repair, polymers, magnesium alloys, ceramics, biocompatibility, degradation mechanisms

## INTRODUCTION

Bone repair materials are crucial in orthopedic surgery, trauma repair, and dentistry due to the increasing incidence of bone defects arising from trauma, infection, and tumor resection. Traditional bone grafts include autografts, allografts, and synthetic materials. Autografts remain the gold standard; however, they are limited by donor site morbidity, secondary surgical requirements, immune rejection, and the risk of disease transmission.[1]

Consequently, synthetic biodegradable materials have become a focal point of research, offering design flexibility, controlled degradation rates, and the potential to reduce patient morbidity.[2]

Biodegradable materials are generally categorized into bio-inert and bioresorbable (biodegradable) types. Bio-inert materials, such as titanium and stainless steel, have a long history of clinical success but remain permanently in the body unless removed surgically. In contrast, biodegradable materials gradually transfer mechanical load to healing tissue, thereby mitigating stress shielding and eliminating the need for secondary surgery.[3]

The primary classes of biodegradable biomaterials are polymers, magnesium-based metals, and ceramics.[4]

This review presents an in-depth discussion of their physicochemical properties, degradation mechanisms, mechanical characteristics, biocompatibility, and current clinical and experimental applications.

## BIODEGRADABLE MAGNESIUM-BASED METALS

### Overview

Magnesium (Mg) and its alloys are promising biodegradable metals due to their favorable density, elastic modulus, biocompatibility, and bioactive degradation products.[5]

Mg-based metals corrode in vivo, producing $Mg^{2+}$ ions that are absorbed or excreted by the body. Their mechanical properties surpass those of polymers and ceramics, making them suitable for load-bearing applications. Despite their excellent biocompatibility, the rapid corrosion rate of Mg alloys limits their clinical applications.[6]

### Current Studies on Magnesium Alloys

Commercial alloys:

**AZ31B, AZ91, and WE43:** Commercial alloys such as AZ31B, AZ91, and WE43 were initially developed for engineering purposes. While biocompatible, some alloys release Al and rare earth elements, raising toxicity concerns. Pure

***Corresponding Author:** Mehmet Kabalcı, kabalci@hotmail.com

Mg exhibits uniform degradation but limited mechanical strength.[7]

**MgeCa alloys:** Calcium-containing alloys (Mg-Ca) provide densities similar to bone and release $Mg^{2+}$ and $Ca^{2+}$ ions to enhance osteogenesis. Mg-Ca alloys exhibit good biocompatibility, promoting osteoblast and osteocyte activity.[8]

**MgeZn alloys:** Zinc addition improves corrosion resistance and mechanical strength. Mg-6% Zn alloys demonstrate tensile strength of 279.5 MPa and elongation of 18.8%, with controlled degradation in vivo and minimal cytotoxicity.[9]

**MgeRE alloys:** Rare earth element alloys such as Mg-Y, Mg-Gd, and Mg-Nd show enhanced corrosion resistance and mechanical performance. Mg-Nd alloys exhibit slower degradation, making them promising for long-term implants.[10]

### Degradation Mechanisms

Mg alloys corrode via electrochemical reactions producing $Mg(OH)_2$ and $H_2$ gas. Chloride ions accelerate corrosion through pitting, while phosphate, carbonate, and protein layers can inhibit corrosion. Stress corrosion cracking is a critical concern for load-bearing applications.

### Applications in Bone Repair

Mg alloys are investigated for screws, plates, and porous scaffolds. Their use in load-bearing bones is limited by rapid degradation, gas evolution, and mechanical weakening. Surface modifications such as anodization, micro-arc oxidation, electrodeposition, and biomimetic coatings are explored to enhance corrosion resistance.

## BIODEGRADABLE POLYMERS

### Overview

Biodegradable polymers are widely used in tissue engineering and bone repair implants due to their versatility and processability. Polymers can be natural or synthetic. Natural polymers, such as collagen, fibrin, chitosan, and hyaluronic acid, are biocompatible but often have limited mechanical strength, unpredictable degradation rates, and potential immunogenicity. Synthetic polymers, including polylactic acid (PLA), polyglycolic acid (PGA), polycaprolactone (PCL), and polyhydroxybutyrate (PHB), allow precise control over mechanical properties and degradation kinetics.[11]

Polymers consist of macromolecules with covalently bonded monomeric units, which can be arranged linearly, branched, or cross-linked. They may exhibit amorphous, crystalline, or semi-crystalline regions, which influence their mechanical behavior and degradation. Temperature-dependent properties such as the glass transition temperature (Tg) are critical, with Tg values above physiological temperature preferred to maintain structural integrity in vivo.

### Common Biodegradable Polymers

**Polycaprolactone (PCL)**: PCL is a hydrophobic aliphatic polyester with lower degradation rates than PLA or PGA due to its high crystallinity. It possesses excellent flexibility, drug permeability, and machinability, making it suitable for long-term implants and drug delivery systems.[12] PCL can be processed via extrusion, injection molding, and 3D printing.

**Polyglycolic acid (PGA)**: PGA is a highly crystalline aliphatic polyester synthesized via ring-opening polymerization. Its hydrophilicity results in rapid hydrolytic degradation, reducing tensile strength to approximately 50% within 14 days post-implantation. PGA is frequently copolymerized with PLA to form PLGA, which provides tunable degradation rates suitable for surgical sutures and bone repair applications.[13] PLGA-based materials include Vicryl® and Polyglactin 910, widely utilized in clinical practice.

**Polylactic acid (PLA):** PLA is among the most extensively studied biodegradable polymers. Derived from renewable resources such as corn starch, PLA can exist in L-PLA (mostly crystalline) and DL-PLA (mostly amorphous) forms. Crystalline L-PLA exhibits slower hydrolysis and higher mechanical strength, whereas DL-PLA degrades more rapidly.[14] PLA has been employed in sutures, screws, rods, and scaffolds, demonstrating biocompatibility and FDA approval for clinical use.

**Poly-para-dioxanone (PDS):** PDS is a synthetic biodegradable polyester with high mechanical flexibility, biocompatibility, and bioabsorbability. Commonly used in fracture fixation and controlled drug delivery, PDS degrades over months in vivo, allowing gradual transfer of mechanical load to regenerating bone.[15]

**Polyhydroxybutyrate (PHB):** PHB is a highly crystalline biopolymer produced by bacterial fermentation. Its excellent stereoregularity and absence of catalyst residues make it an ideal model material for polymer studies. However, its brittleness and narrow processing window limit direct clinical application.[16] PHB is often blended with other polymers to improve mechanical properties and decrease brittleness.

### Physicochemical and Mechanical Properties

Polymer properties such as tensile strength, elongation at break, and modulus depend on stereochemistry, molecular weight, and processing history. PLLA exhibits higher mechanical strength and slower degradation than PDLA, making it suitable for load-bearing applications. PLGA offers tunable properties by adjusting the ratio of lactide to glycolide units.[17]

### Degradation Mechanisms

Polymers degrade primarily through hydrolysis and enzymatic action. Ester bond cleavage converts macromolecules to oligomers, eventually yielding carbon dioxide and water. Degradation rates are influenced by crystallinity, molecular weight, stereochemistry, and the local physiological environment.

### Applications in Bone Repair

Polymers are used in screws, pins, plates, and scaffolds for non-load-bearing and partially load-bearing bones. Biodegradable polymers reduce stress shielding, avoid secondary surgeries, and can be combined with bioactive molecules to promote osteogenesis. Clinical products include Lactosorb® (PLGA) and Natureworks PLA®.

## BIODEGRADABLE/BIORESORBABLE CERAMICS

### Overview

Ceramics, including hydroxyapatite (HA), tricalcium phosphate (TCP), and bioactive glasses, are used for bone and dental defect repair.[18] They are categorized as bio-inert, bioactive, or bioresorbable based on interactions with tissue.

### Common Bioresorbable Ceramics

**Hydroxyapatite (HA):** Synthetic HA is highly crystalline with composition $Ca_{10}(PO_4)_6(OH)_2$, closely resembling bone mineral. HA is osteoconductive, biocompatible, and can act as a carrier for osteoinductive factors. Clinical use is primarily in non-load-bearing bone defects.

**Tricalcium phosphate (TCP) ($Ca_3(PO_4)_2$):** TCP is resorbable, with higher degradation rates than HA. Implants facilitate bone ingrowth and are resorbed by osteoclastic activity.[19]

**Bioactive glass-ceramics:** Bio-glass forms HA microcrystals on surfaces, providing strong bonding with bone. It is used in craniofacial reconstruction, bone defect filling, and dental applications. Bio-glasses maintain superior mechanical strength compared with others.[20]

### Physicochemical and Mechanical Properties

Bioresorbable ceramics generally exhibit lower mechanical strength than bio-inert ceramics. Non-porous HA and cerabone A/W glass-ceramics show the highest strength among bioactive materials but remain less fracture-resistant than $ZrO_2$ ceramics.

### Degradation Mechanisms

Bioresorbable ceramics degrade via solution-driven and cell-mediated processes. Osteoclasts, mesenchymal cells, and macrophages facilitate resorption, which is influenced by implantation site and protein interactions. Gradual replacement by lamellar bone occurs during physiological remodeling.

### Applications in Bone Repair

Bioresorbable ceramics are applied in cranial, maxillofacial, and dental reconstruction, as well as in joint and periodontal repair. Commercial products include Depuy Spine Conduit® (TCP), Medtronic MasterGraft® (HA/TCP), Stryker Vitoss® (TCP), and Stryker Cortoss® (bioactive glass).

## SUMMARY AND FUTURE PERSPECTIVES

Biodegradable polymers, Mg-based metals, and bioresorbable ceramics each offer unique advantages in bone repair applications. Polymers provide tunable degradation and flexible processing but may exhibit limited mechanical strength. Mg alloys offer load-bearing capacity and bioactive degradation products but require corrosion control.[21] Ceramics provide excellent osteoconductivity but are brittle and mechanically weaker.[22]

Future research should focus on optimizing material properties, degradation kinetics, and bioactivity.[23] Composite materials combining polymers, metals, and ceramics may harness the advantages of each class. Surface modifications, alloying strategies, and doping of ceramics can enhance mechanical and biological performance. Personalized approaches, including 3D-printed scaffolds and patient-specific implants, are expected to improve clinical outcomes.

## CONCLUSION

As a result, the development of biodegradable materials for bone repair continues to advance rapidly, offering new opportunities for safer, more effective, and patient-specific orthopedic treatments. Continued interdisciplinary research integrating materials science, biology, and clinical practice is essential to translate these materials into widespread clinical application.

## ETHICAL DECLARATIONS

### Peer Review Process

This review was externally peer-reviewed.

### Conflict of Interest

The authors declare no conflicts of interest.

### Financial Disclosure

No financial support was received for the preparation or publication of this article.

### Author Contributions

The author is solely responsible for the conception, data collection, analysis, and writing of this manuscript.

## REFERENCES

1. Sakkas A, Wilde F, Heufelder M, Winter K, Schramm A. Autogenous bone grafts in oral implantology-is it still a "gold standard"? A consecutive review of 279 patients with 456 clinical procedures. *Int J Implant Dent*. 2017;3(1):23. doi:10.1186/s40729-017-0084-4
2. Bastioli C. Biodegradable materials—present situation and future perspectives. In Macromolecular Symposia. Weinheim, Germany: WILEY-VCH Verlag GmbH & Co. KGaA. 1998.
3. Vieira AC, Guedes RM, Marques AT. Development of ligament tissue biodegradable devices: a review. *J Biomech*. 2009;42(15):2421-2430. doi: 10.1016/j.jbiomech.2009.07.019
4. Godavitarne C, Robertson A, Peters J, Rogers B. (2017). Biodegradable materials. *Orthopaedics Trauma*. 2017;31(5):316-320. doi:10.1016/j.mporth.2017.07.011
5. Gao J, Su Y, Qin YX. Calcium phosphate coatings enhance biocompatibility and degradation resistance of magnesium alloy: correlating in vitro and in vivo studies. *Bioact Mater*. 2020;6(5):1223-1229. doi:10.1016/j.bioactmat.2020.10.024
6. Rahman M, Dutta NK, Roy Choudhury N. Magnesium alloys with tunable interfaces as bone implant materials. *Front Bioeng Biotechnol*. 2020;8:564. doi:10.3389/fbioe.2020.00564
7. Ezhilmaran V, Suya Prem Anand P, Kannan S, Sivashanmugam N, Jayakrishna K, Kalusuraman G. Review of bioresorbable AZ91, AZ31 and Mg–Zn–Ca implants and their manufacturing methods. *Mater Sci Technol*. 2023;39(8):901-925. doi:10.1080/02670836.2022.2153207
8. Nie X, Shi Y, Wang L, Abudureheman W, Yang J, Lin C. Study on the mechanism of magnesium calcium alloys/mineralized collagen composites mediating macrophage polarization to promote bone repair. *Heliyon*. 2024;10(9):e30279. doi:10.1016/j.heliyon.2024.e30279
9. Cai S, Lei T, Li N, Feng F. (2012). Effects of Zn on microstructure, mechanical properties and corrosion behavior of Mg–Zn alloys. *Mater Sci Engineering*. 2012;32(8), 2570-2577. doi:10.1016/j.msec.2012.07.042

10. Kubásek J, Vojtěch D. Structural and corrosion characterization of biodegradable Mg–RE (RE= Gd, Y, Nd) alloys. *Trans Nonferrous Met Soc China*. 2013;23(5):1215-1225. doi:10.1016/S1003-6326(13)62586-8
11. Ghanbarzadeh B, Almasi H. Biodegradable polymers. (eds. Chamy R, Rozenkrans F). Biodegradation-Life of Science. 2013;Chapter 6:141-186.
12. Woodruff MA, Hutmacher DW. The return of a forgotten polymer—polycaprolactone in the 21st century. *Progress Polymer Sci*. 2010;35(10): 1217-1256. doi:10.1016/j.progpolymsci.2010.04.002
13. Benatti ACB, Pattaro AF, Rodrigues AA, et al. Bioreabsorbable polymers for tissue engineering: PLA, PGA, and their copolymers. In materials for biomedical engineering. Elsevier. 2019.
14. Tschakaloff A, Losken HW, von Oepen R, et al. Degradation kinetics of biodegradable DL-polylactic acid biodegradable implants depending on the site of implantation. *Int J Oral Maxillofac Surg*. 1994;23(6 Pt 2):443-445. doi:10.1016/s0901-5027(05)80043-8
15. Daniels AU, Chang MK, Andriano KP. Mechanical properties of biodegradable polymers and composites proposed for internal fixation of bone. *J Appl Biomater*. 1990;1(1):57-78. doi:10.1002/jab.770010109
16. Turco R, Santagata G, Corrado I, Pezzella C, Di Serio M. In vivo and post-synthesis strategies to enhance the properties of PHB-based materials: a review. *Front Bioeng Biotechnol*. 2021;8:619266. doi:10.3389/fbioe.2020.619266
17. Lee NK, Oh HJ, Hong CM, Suh H, Hong SH. Comparison of the synthetic biodegradable polymers, polylactide (PLA), and polylactic-co-glycolic acid (PLGA) as scaffolds for artificial cartilage. *Biotechnol Bioprocess Eng*. 2009;14(2), 180-186.
18. Bellucci D, Sola A, Cannillo V. Hydroxyapatite and tricalcium phosphate composites with bioactive glass as second phase: state of the art and current applications. *J Biomed Mater Res A*. 2016;104(4):1030-1056. doi:10.1002/jbm.a.35619
19. Wiltfang J, Merten HA, Schlegel KA, et al. Degradation characteristics of alpha and beta tri-calcium-phosphate (TCP) in minipigs. *J Biomed Mater Res*. 2002;63(2):115-121. doi:10.1002/jbm.10084
20. Ghasabpour T, Sharifianjazi F, Bazli L, Tebidze N, Sorkhabi M. Bioactive glasses, ceramics, glass-ceramics and composites: State-of-the-art review and future challenges. *J Composites Compounds*. 2025. doi:10.61186/jcc.7.3.1
21. Keerthiga G, Prasad MJNV, Vijayshankar D, Singh Raman RK. Polymeric coatings for magnesium alloys for biodegradable implant application: a review. *Materials (Basel)*. 2023;16(13):4700. doi:10.3390/ma16134700
22. Kuśnierczyk K, Basista M. Recent advances in research on magnesium alloys and magnesium-calcium phosphate composites as biodegradable implant materials. *J Biomater Appl*. 2017;31(6):878-900. doi:10.1177/0885328216657271
23. Joiner JB, Prasher A, Young IC, et al. Effects of drug physicochemical properties on in-situ forming implant polymer degradation and drug release kinetics. *Pharmaceutics*. 2022;14(6):1188. doi:10.3390/pharmaceutics14061188

Ankyra Medical Journal

Case Report

DOI: 10.51271/ANKMJ-0061

# Papillon-Lefèvre syndrome in early childhood: a case report with literature review

Tuba Betül Karadeniz[1], Esra Hato[2], Cihat Şanlı[3], Merve Erkmen Almaz[2], Ayşegül Alpcan*[3]

[1]Department of Dermatology, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye
[2]Department of Pedodontics, Faculty of Dentistry, Kırıkkale University, Kırıkkale, Turkiye
[3]Department of Pediatrics, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye

**Cite this article:** Karadeniz TB, Hato E, Şanlı C, Erkmen Almaz M, Alpcan A. Papillon-Lefèvre syndrome in early childhood: a case report with literature review. *Ank Med J.* 2026;5(1):24-28.

**Received**: 12/07/2025 ◆ **Accepted**: 12/11/2025 ◆ **Published**: 14/01/2026

## ABSTRACT

Papillon-Lefèvre syndrome (PLS) is a rare genetic disorder with autosomal recessive inheritance, typically manifesting in childhood. The hallmark features include palmoplantar hyperkeratosis and premature loss of teeth. Additional associated findings may include psoriasiform plaques on the knees and elbows, hyperhidrosis, recurrent pyogenic infections, intracranial calcifications, and both physical and mental developmental delays. This case report presents a 5-year-old child who was admitted to the Faculty of Dentistry at Kırıkkale University with tooth loss and was subsequently diagnosed with PLS, accompanied by a review of the relevant literature.

**Keywords:** Papillon-Lefèvre syndrome, palmoplantar hyperkeratosis, tooth loss

## INTRODUCTION

Papillon–Lefèvre syndrome (PLS), first described by Papillon and Lefèvre in 1924, is a rare hereditary disorder that manifests during childhood.[1] It is characterized by palmoplantar hyperkeratosis and premature loss of both primary and permanent dentition due to severe periodontitis. Although the precise pathogenesis of PLS remains incompletely understood, it is known to result from mutations in the cathepsin C (CTSC) gene, which follows an autosomal recessive inheritance pattern.[2] PLS is regarded as a subtype within the genetically and clinically heterogeneous group of palmoplantar keratodermas. Consanguineous marriages play a significant role in its occurrence, as the likelihood of inheriting the same defective *CTSC* allele from both parents increases in such unions. The estimated prevalence of PLS is between 1 and 4 cases per million individuals.[3,4]

This report presents a 5-year-old female patient who was admitted to the Faculty of Dentistry at Kırıkkale University with a complaint of tooth loss and was subsequently diagnosed with PLS after palmoplantar hyperkeratosis was detected during systemic evaluation. The aim of this report is to emphasize the importance of a thorough anamnesis and comprehensive systemic examination.

## CASE

A 5-year-old female patient was admitted to the Faculty of Dentistry at Kırıkale University with a chief complaint of tooth loss. According to her parents, the patient had experienced spontaneous loss of teeth without any signs of dental caries, beginning at the age of two. Systemic evaluation revealed thickening of the skin on the palms and soles, for which she had been using topical treatments. The parents reported that hyperkeratosis and fissures on the palms and soles had first appeared when the child was one month old, and that regular use of dermatology-prescribed topical medications had resulted in significant improvement of the symptoms.

Family history revealed that the parents and two siblings were healthy, with no similar dermatologic or dental conditions, and that the parents were second-degree relatives.

Intraoral examination showed that all primary teeth, except for three molars, were missing. The remaining teeth exhibited gingival recession with root exposure and severe periodontal destruction. Radiographic evaluation demonstrated horizontal alveolar bone loss without evidence of root resorption (**Figure 1**). Based on these findings, the patient was referred to the Departments of Pediatrics and Dermatology with a preliminary diagnosis of PLS.

During pediatric evaluation, the patient was found to have been born via cesarean section with a birth weight of 2800 g following an uneventful pregnancy. There were no complaints during the neonatal period and no history of serious infections or additional diseases. Physical examination

*Corresponding Author: Ayşegül Alpcan, ozcalk@yahoo.com

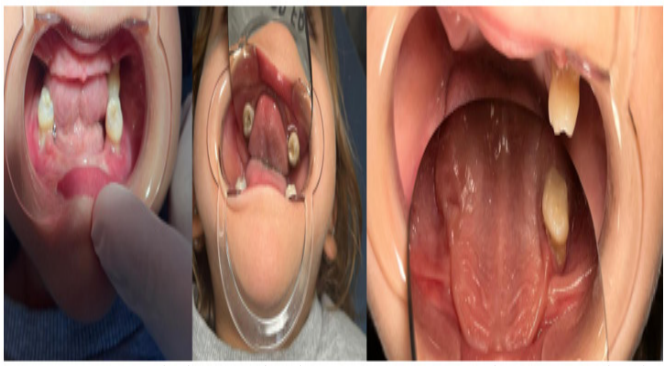

**Figure 1.** Intraoral photographs showing severe gingival recession, alveolar bone loss, and remaining primary molars in a 5-year-old patient with suspected Papillon-Lefèvre syndrome

revealed a height of 102 cm (3rd percentile) and a weight of 17 kg (25th-50th percentile). Since the results of investigations for short stature were within normal limits, it was considered that the patient's dental problems might have adversely affected her nutrition and, consequently, her growth. Therefore, dietary modifications were recommended. Mental development was assessed as normal, and no abnormalities were detected in other systemic examinations. Laboratory investigations were unremarkable except for a 25(OH) vitamin D level of 18 ng/ml. Echocardiographic evaluation revealed no pathological findings. The patient was subsequently referred to the Department of Medical Genetics for genetic counseling.

On dermatological examination, no remarkable findings were observed other than hyperkeratosis and fissures on the plantar surfaces. The skin appendages and mucous membranes appeared normal, and there were no pathological findings such as sweating abnormalities or arachnodactyly (Figure 2). A skin biopsy was obtained from the plantar region to differentiate among psoriasis, pityriasis rubra pilaris, and PLS.

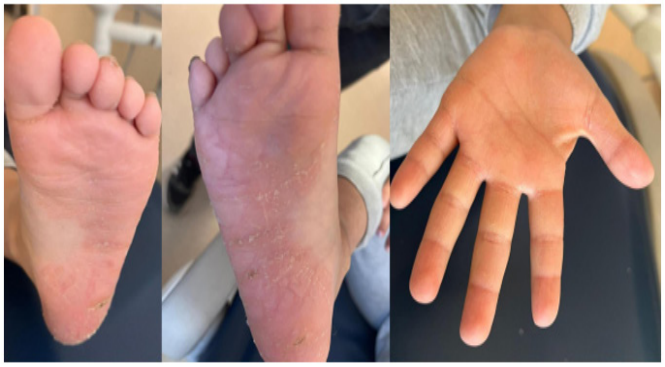

**Figure 2.** Palmar and plantar hyperkeratosis in a child with suspected Papillon-Lefèvre syndrome. Images show dry, thickened skin and fissures on the soles of the feet and mild hyperkeratosis on the palm

Histopathological examination revealed diffuse hyperkeratosis with focal areas of parakeratosis. Although the histopathological findings were not diagnostic for PLS, they excluded other dermatoses such as psoriasis, pityriasis rubra pilaris, and eczema. There were no acquired causes of keratoderma, such as dermatitis, chemical exposure, or drug use. Because early tooth loss accompanied keratoderma and no additional cutaneous findings were present, hereditary keratoderma disorders such as Mal de Meleda and Unna–Thost syndrome were considered unlikely.

Radiographs of the hands, feet, and long bones were obtained to evaluate for Haim–Munk syndrome, which is characterized by keratoderma and premature tooth loss and is regarded as a severe variant of PLS. No abnormalities were detected on radiography. DNA sequence analysis of the CTSC gene revealed a homozygous frameshift mutation (c.378delG). Based on these genetic and clinical findings, a definitive diagnosis of PLS was established.

For the treatment of keratoderma, topical corticosteroids and emollients containing 20% urea were prescribed. The family declined systemic therapy due to potential adverse effects. The patient continues to be followed regularly by the departments of dentistry, pediatrics, and dermatology.

## DISCUSSION

PLS is a rare autosomal recessive disorder characterized by palmoplantar keratoderma and premature tooth loss resulting from severe periodontal destruction. Approximately 250 cases have been reported in the literature. Additional clinical manifestations may include intracranial calcifications, psoriasiform plaques over the knees and elbows, nail abnormalities, hyperhidrosis, recurrent pyogenic infections, and developmental delay in physical and mental growth. Although symptoms typically emerge between 6 months and 4 years of age, late-onset cases have also been described.[2-4]

The disease results from mutations in the CTSC gene located on chromosome 11q14–q21.[5,6] CTSC is a lysosomal cysteine protease that plays a key role in activating several serine proteases involved in immune and inflammatory responses. The CTSC gene is primarily expressed in epithelial tissues such as the palms, soles, knees, and keratinized oral gingiva, and is also present in osteoclasts.[6-9]

Premature loss of both primary and permanent teeth is a hallmark of PLS. Typically, complete loss of the primary dentition occurs by four years of age, whereas permanent teeth are lost by adolescence.[3] In our patient, tooth mobility and spontaneous exfoliation of deciduous teeth began around two years of age; at examination, only four molars remained. The primary cause of tooth loss in PLS is aggressive periodontitis.[10] Studies suggest that alterations in the oral microbiome contribute to the pathogenesis of periodontitis by promoting the proliferation of specific pathogenic species.[10-13] Other studies implicate immune dysfunction, citing impaired chemotaxis and phagocytosis of polymorphonuclear leukocytes (PMNLs), reduced integrin expression, and increased superoxide production.[14-17] However, some reports have demonstrated preserved PMNL chemotaxis and normal peripheral lymphocyte populations.[18-21] These findings support a multifactorial pathogenesis involving both microbial and host-related factors.

In young children presenting with early tooth loss, the differential diagnosis should include leukemia, neutropenia, hypophosphatasia, Langerhans cell histiocytosis, and Chediak–Higashi syndrome.[22-23] These conditions were excluded in our case based on clinical and laboratory evaluations.

Periodontitis has also been linked to systemic conditions such as cardiovascular disease. It is recognized as a risk factor for bacterial endocarditis and may contribute to valvular damage.[22,23] In our patient, both clinical and

echocardiographic evaluations revealed no cardiac abnormalities.

The cutaneous and dental manifestations of PLS may not appear simultaneously.[3] One study reported no correlation between the severity of dermatologic and periodontal involvement, noting that skin lesions do not regress with age.[24] In our patient, palmoplantar keratoderma began at one month of age and regressed notably after thİe first year of life.

Palmoplantar keratoderma, the primary cutaneous manifestation of PLS, typically develops between 6 months and 4 years of age. It presents as sharply demarcated, erythematous or yellowish hyperkeratotic plaques that may extend to the dorsal surfaces of the hands and feet. These lesions can impair manual function and cause painful fissures on the soles, leading to secondary infections and unpleasant odor.[2] Additional cutaneous findings may include psoriasiform plaques over the knees and elbows, thickened or fissured nails, and thinning of scalp hair.[3] In the absence of dental symptoms, these dermatologic features may lead to misdiagnosis as psoriasis, eczema, or dermatophytosis.[1] Our patient showed only mild plantar keratosis on examination, and histopathologic evaluation excluded other dermatoses. During infancy, when keratoderma was more pronounced, topical treatments were administered for presumed eczema and dryness.

Haim–Munk syndrome (HMS) and PLS are phenotypically related disorders caused by *CTSC* gene mutations.[25] Differentiation between the two may rely on identifying specific mutation types—such as the homozygous c.378delG (p.His127Metfs49)* variant detected in our patient—as well as assessing *CTSC* enzyme activity and exon copy number analysis. Although both disorders share similar genotypes, they exhibit distinct phenotypic features: onychogryphosis, pes planus, arachnodactyly, and acro-osteolysis are characteristic of HMS. In HMS, cutaneous and skeletal manifestations are more severe, whereas periodontal involvement tends to be milder compared with PLS.[26] PLS, generally associated with nonsense mutations in *CTSC*, is considered a milder form, while HMS represents a more severe clinical phenotype. Our patient exhibited no nail or skeletal abnormalities.[26]

Recurrent pyogenic infections due to PMNL dysfunction are common in PLS. Reported infections include cutaneous abscesses as well as hepatic, renal, and pulmonary involvement.[27,28] In patients with unexplained fever, hepatic abscess should be considered. Our patient had no history of recurrent or severe infections.

Although developmental delays in PLS have been reported, their association with the disease remains uncertain.[3] Our patient's cognitive development was normal. Her height was at the 3$^{rd}$ percentile and weight between the 25$^{th}$ and 50$^{th}$ percentiles. In the absence of familial short stature, vitamin D deficiency, anemia, or recurrent infections, it was considered that premature tooth loss might have adversely affected her nutrition and, consequently, her growth. In addition to nutritional consequences, early tooth loss can alter facial appearance, cause speech difficulties, and lead to psychosocial distress.[29] Psychological support by child psychiatrists should therefore be recommended. Early diagnosis and timely dental intervention are essential for achieving optimal physical and emotional development.

Intracranial calcifications represent another potential feature of PLS.[30] However, cranial imaging was not performed in our patient due to her young age and absence of neurological symptoms. PLS has also been associated with hearing loss, pseudoainhum, and ocular surface squamous neoplasia.[31-33] Although malignant cutaneous neoplasms are rarely observed, an increased incidence of malignant melanoma has been reported, particularly among Japanese patients.[26]

The prevalence of autosomal recessive disorders increases with consanguinity.[30] In this case, the patient was born to first-degree consanguineous parents. Genetic counseling was provided to the family following identification of the CTSC mutation. Accurate diagnosis and optimal management of PLS require a comprehensive, multidisciplinary approach involving dentistry, pediatrics, dermatology, and medical genetics, ideally complemented by child psychiatry and nutrition specialists. Treatment should be individualized according to clinical presentation and family circumstances.

Dental treatment options for PLS include oral hygiene recommendations, antibiotic therapy, prosthodontic rehabilitation, and implant placement. However, conventional periodontal therapy has generally been ineffective, as periodontitis in PLS is aggressive and leads to rapid destruction of the alveolar bone.[34] Due to severe bone loss, prosthetic rehabilitation remains a major challenge in these patients.

Dental management may include the use of osseointegrated implants, which represent the future rehabilitation plan for this case.[35] Following implant therapy, functional and esthetic oral rehabilitation can be achieved with a pediatric prosthesis. Regular follow-up appointments are essential to maintain oral hygiene, monitor implant stability, and ensure long-term success.

The treatment of palmoplantar keratoderma includes the use of topical emollients, corticosteroids, keratolytic agents, and systemic retinoids. Systemic retinoids such as isotretinoin, acitretin, and etretinate can lead to near-complete resolution of keratoderma and are also effective in reducing periodontitis and recurrent pyogenic infections.[36-38] For the management of periodontitis, initiation of systemic retinoid therapy is recommended after the eruption of permanent teeth.[36] However, the long-term use of systemic retinoids may be limited by adverse effects, including xerosis, cheilitis, musculoskeletal complications, and teratogenicity. Moreover, acitretin requires extended contraception for up to two years after discontinuation, which further restricts its use.[35]

In our patient, palmoplantar keratoderma showed marked improvement with topical therapies, and there was no indication for systemic treatment specifically targeting keratoderma. However, considering the potential benefits on periodontal disease, acitretin therapy was recommended to the family after consultation with the department of dentistry. After being informed about the possible benefits and adverse effects of systemic retinoid therapy, the family declined treatment. Regular follow-up with the departments of dentistry, pediatrics, and dermatology was therefore advised. Because of its rarity and multisystem involvement, the diagnosis of PLS is often delayed or overlooked.[39]

## CONCLUSION

Early diagnosis, timely initiation of treatment, and regular multidisciplinary follow-up can significantly improve the patient's quality of life. Through this case report, we aim to emphasize the importance of detailed medical history taking, comprehensive systemic evaluation, and collaborative multidisciplinary care in patients presenting with findings involving multiple organ systems.

## ETHICAL DECLARATIONS

### Informed Consent

Informed consent was obtained from the legal guardians of the pediatric patient(s) described in this report. Where developmentally appropriate, assent was also sought from the child. The inclusion of vulnerable populations in this study adhered to national and international ethical guidelines. Extra care was taken to ensure voluntary participation, understanding, and protection of participant dignity and autonomy.

### Peer Review Process

This report underwent external peer review.

### Conflict of Interest

The authors declare no conflicts of interest.

### Financial Disclosure

This case report did not receive any financial support.

### Author Contributions

Concept: T.B.K., E.H., C.Ş., M.E.A., A.A. T.Ö.; Design: T.B.K., E.H., A.A.; Control: T.B.K., M.E.A., A.A.; Data Collection and/or Processing: T.B.K., E.H., M.E.A., A.A.; Analysis and/or Interpretation: T.B.K., E.H., M.E.A., A.A.; Literature Review: T.B.K., E.H., M.E.A., A.A.; Article Writing: T.B.K., E.H., C.Ş., M.E.A., A.A.; Critical review: All authors.

## REFERENCES

1. Fardal O, Drangsholt E, Olsen I. Palmar plantar keratosis and unusual periodontal findings. *J Clin Periodontol*. 1998;25(2):181-184. doi:10.1111/j.1600-051x.1998.tb02425.x
2. Angel TA, Hsu S, Kornbleuth SI, Kornbleuth J, Kramer EM. Papillon-Lefevre syndrome: a case report of four affected siblings. *J Am Acad Dermatol*. 2002;46(1):8-10. doi:10.1067/mjd.2002.104968
3. Hart TC, Hart PS, Bowden DW, et al. Mutations of the cathepsin C gene are responsible for Papillon–Lefèvre syndrome. *J Med Genet*. 1999;36(12):881-887.
4. Machado RA, Cuadra-Zelaya FJM, Martelli-Júnior H, et al. Clinical and molecular analysis in Papillon–Lefèvre syndrome. *Am J Med Genet A*. 2019;179(10):2124-2131. doi:10.1002/ajmg.a.61285
5. Allende LM, Moreno A, de Unamuno P. A genetic study of cathepsin C gene in two families with Papillon-Lefevre syndrome. *Mol Genet Metab*. 2003;79(2):146-148. doi:10.1016/s1096-7192(03)00070-2
6. Sahar S, Abouzaid MR, Mostafa I, et al. Abnormal profiles of cathepsin C secreted in urine of Papillon Lefevre syndrome patients. *Eur J Med Genet*. 2022;65(10):600-605. doi:10.1016/j.ejmg.2022.104605
7. Bullón P, Castejón-Vega B, Román-Malo L, Jiménez-Guerrero M. Autophagic dysfunction in patients with Papillon-Lefevre syndrome is restored by recombinant cathepsin C treatment. *J Allergy Clin Immunol*. 2018;142(4):1131-1143. doi:10.1016/j.jaci.2018.01.018
8. Castejón-Vega B, Battino M, Quiles JL, Bullon B. Potential role of the mitochondria for the dermatological treatment of Papillon-Lefèvre. *Antioxidants*. 2021;10(1):95-100. doi:10.3390/antiox10010095
9. Giannetti L, Apponi R, Dello Diago AM, Jafferany M, Goldust M, Sadoughifar R. Papillon-Lefèvre syndrome: oral aspects and treatment. *Dermatol Ther*. 2020;33(3):155-160. doi:10.1111/dth.13336
10. Pacheco JJ, Coelho C, Salazar F, et al. Treatment of Papillon–Lefèvre syndrome periodontitis. *J Clin Periodontol*. 2002;29(4):370-374. doi:10.1034/j.1600-051x.2002.290414.x
11. Albandar JM, Khattab R, Monem F, et al. The subgingival microbiota of Papillon–Lefevre syndrome. *J Periodontol*. 2011;28(5):400-414. doi:10.1902/jop.2011.110450
12. Colombo AP, Boches SK, Cotton SL, et al. Comparisons of subgingival microbial profiles of refractory periodontitis, severe periodontitis, and periodontal health using the human oral microbe identification microarray. *J Periodontol*. 2009;80(9):1421-1432. doi:10.1902/jop.2009.090185
13. Robertson KL, Drucker DB, James J, et al. A microbiological study of Papillon–Lefèvre syndrome in two patients. *J Clin Pathol*. 2001;54(5):371-376. doi:10.1136/jcp.54.5.371
14. Wiebe CB, Hakkinen L, Putnins EE, et al. Successful periodontal maintenance of a case with Papillon–Lefevre syndrome: 12-year follow-up and review of the literature. *J Periodontol*. 2001;72(6):824-830. doi:10.1902/jop.2001.72.6.824
15. Hart TC, Shapira L. Papillon–Lefèvre syndrome. *Periodontol*. 1994;6:88-100. doi:10.1111/j.1600-0757.1994.tb00029.x
16. Firatli E, Tuzun B, Efeoglu A. Papillon–Lefèvre syndrome: analysis of neutrophil chemotaxis. *J Periodontol*. 1996;67:617-620. doi:10.1902/jop.1996.67.6.617
17. Lundgren T, Parhar RS, Renvert S, et al. Impaired cytotoxicity in Papillon-Lefèvre syndrome. *J Dent Res*. 2005;84(5):414-417. doi:10.1177/154405910508400503
18. Lyberg T. Immunological and metabolical studies in two siblings with Papillon–Lefevre syndrome. *J Periodontol Res*. 1982;17(6):563-568. doi:10.1111/j.1600-0765.1982.tb01177.x
19. Preus HR, Morland B. In vitro studies of monocyte function in two siblings with Papillon–Lefevre syndrome. *Scand J Dent Res*. 1987;95(1):59-64. doi:10.1111/j.1600-0722.1987.tb01394.x
20. Celenligil H, Kansu E, Ruacan S, et al. Papillon–Lefèvre syndrome: characterization of peripheral blood and gingival lymphocytes with monoclonal antibodies. *J Periodontol*. 1992;19(6):392-397. doi:10.1111/j.1600-051x.1992.tb00668.x
21. Firatli E, Gurel N, Efeoglu A. Papillon–Lefevre syndrome: analysis of peripheral blood lymphocyte subsets. *J Clin Periodontol*. 1996;23(9):823-825. doi:10.1111/j.1600-051x.1996.tb00618.x
22. Loesche WJ, Grossman NS. Periodontal disease as a specific, albeit chronic, infection: diagnosis and treatment. *Clin Microbiol Rev*. 2001;14(4):727-752. doi:10.1128/CMR.14.4.727-752.2001
23. Lamster IB, Smith QT, Celenti RS, et al. Development of a risk profile for periodontal disease: microbial and host response factors. *J Periodontol*. 1994;65(Suppl 5S):511-520. doi:10.1902/jop.1994.65.5s.511
24. Ullbro C, Crossner CG, Nederfors T, et al. Dermatologic and oral findings in a cohort of 47 patients with Papillon-Lefevre syndrome. *J Am Acad Dermatol*. 2003;48(3):345-351. doi:10.1067/mjd.2003.197
25. Hart TC, Hart PS, Michalec MD, et al. Haim-Munk syndrome and Papillon-Lefèvre syndrome are allelic mutations in cathepsin C. *J Med Genet*. 2000;37(2):88-94. doi:10.1136/jmg.37.2.88
26. Dababneh RH, Jebrin SE, Khouri AT, Bissada NF. Papillon-Lefèvre or Haim-Munk syndrome? Report on two sisters in a consanguineous family. *Clin Adv Periodontics*. 2015;5(3):192-200. doi:10.1902/cap.2014.130089
27. Almuneef M, Al Khenaizan S, Al Ajaji S, et al. Pyogenic liver abscess and Papillon-Lefevre syndrome: not a rare association. *Pediatrics*. 2003;111(1):85-88. doi:10.1542/peds.111.1.e85
28. Morgan RD, Hannon E, Lakhoo K. Renal abscess in Papillon-Lefevre syndrome. *Pediatr Surg Int*. 2011;27(12):1381-1383. doi:10.1007/s00383-011-2931-3
29. Gorlin RJ, Sedano H. The syndrome of palmar-plantar hyperkeratosis and premature periodontal destruction of the teeth: a clinical and genetic analysis of the Papillon-Lefevre syndrome. *J Pediatr*. 1964;65:895-908. doi:10.1016/s0022-3476(64)80014-7
30. Jain V, Gupta R, Parkash H. Prosthodontic rehabilitation in Papillon-Lefevre syndrome: a case report. *J Indian Soc Pedod Prev Dent*. 2005;23(2):96-98. doi:10.4103/0970-4388.16451
31. Bas AY, Yilmaz G, Ertan U, et al. Papillon–Lefevre syndrome: a case report. *Int Pediatr*. 2004;19:224-225.
32. Mashhood AA, Humayun A, Saleem M, et al. Papillon–Lefevre syndrome associated with pseudoainhum. *J Am Acad Dermatol*. 2004;51(2 Suppl):S134-S136. doi:10.1016/j.jaad.2004.03.021

33. Ramesh M, Santosh G, Honavar MD, et al. Ocular surface squamous neoplasia in Papillon–Lefevre syndrome. *Am J Ophthalmol*. 2005;139(1): 207-209. doi:10.1016/j.ajo.2004.07.028
34. Shapira J, Eidelman E, Fuks A, Hacham-Zadeh S. Treatment of Papillon-Lefevre syndrome with chemotherapy: report of cases. *Spec Care Dentist*. 1985;5(2):71-74. doi:10.1111/j.1754-4505.1985.tb00389.x
35. Etöz OA, Ulu M, Kesim B. Treatment of patient with Papillon-Lefevre syndrome with short dental implants: a case report. *Implant Dent*. 2010; 19(5):394-399. doi:10.1097/ID.0b013e3181ed0798
36. Leuenberger M, Fischer L, Mylonas A, et al. Papillon-Lefevre syndrome treated by acitretin: case report and cytokine profile. *JEADV*. 2022; 36(12):235-238. doi:10.1111/jdv.17772
37. Sarma N, Ghosh C, Kar S, Bazmi BA. Low-dose acitretin in Papillon–Lefevre syndrome: treatment and 1-year follow-up. *Dermatol Ther*. 2014;46(4):135-138. doi:10.1111/dth.12177
38. Lee MR, Wong LCF, O'Fischer G. Papillon-Lefevre syndrome treated with acitretin. *Australas J Dermatol*. 2005;46(3):199-201. doi:10.1111/j. 1440-0960.2005.00180.x
39. Kellum R. Papillon–Lefevre syndrome in four siblings treated with etretinate: a nine-year evaluation. *Int J Dermatol*. 1989;28(9):605-608. doi:10.1111/j.1365-4362.1989.tb02539.x

Ankyra Medical Journal
Original Article
DOI: 10.51271/ANKMJ-0062

# Retracted
# Investigation of *Staphylococcus aureus* nasal carriage rates in hemodialysis patients *Staphylococcus aureus* nasal carriage in hemodialysis patients

Hakkı Öztürk[1], Metin Özsoy[2]

[1]*Infectious Diseases Epidemiologist, Private Ankara Dialysis Center, Ankara, Turkiye*
[2]*Department of Infectious Diseases and Clinical Microbiology, Ankara Training and Research Hospital, University of Health Sciences, Ankara, Turkiye*

**Cite this article:** Öztürk H, Özsoy M. Investigation of *Staphylococcus aureus* nasal carriage rates in hemodialysis patients *Staphylococcus aureus* nasal carriage in hemodialysis patients. *Ank Med J.* 2026;5(1):29-32.

**Received**: 18/11/2024 ◆ **Accepted**: 25/12/2024 ◆ **Published**: 14/01/2026

## ABSTRACT

**Aims:** This study aimed to assess the prevalence of nasal carriage of *Staphylococcus aureus (S. aureus)* in patients receiving hemodialysis and to evaluate the susceptibilities to mupirocin and fusidic acid in those with nasal carriage of *S. aureus*.

**Methods:** A total of 165 hemodialysis patients, 55 (33.3%) females and 109 (66.03%) males, were included in the study. Nasal swab samples obtained from the patients were inoculated on mannitol-salt agar (Beslab, Turkey) medium. The media were incubated in an oven at 37°C for 72 hours. Methicillin resistance was determined on Mueller-Hinton agar medium with cefoxitin disk (Bioanalyse, Turkey), and mupirocin and fusidic acid susceptibilities were determined by disk diffusion method with the discs of these antibiotics (Bioanalyse, Turkey).

**Results:** A total of 14 patients (8.48%) exhibited nasal carriage of *S. aureus*, comprising 9 patients (5.45%) with methicillin-sensitive *S. aureus* (MSSA) and 5 patients (3.03%) with methicillin-resistant *S. aureus* (MRSA). Of a total of 5 MRSA strains, 1 was resistant to mupirocin, and 1 was resistant to fusidic acid. Of a total of 9 MSSA strains, 2 were resistant to mupirocin and 2 were resistant to fusidic acid. It was determined that mupirocin and fusidic acid resistance was higher in MSSA strains.

**Conclusion:** In our study, the rate of *S. aureus* nasal carriage in hemodialysis patients was found to be low. In addition, the resistance rates of MSSA strains to mupirocin and fusidic acid, which are topical antibiotics that can be used in the eradication of *S. aureus* nasal carriage, were higher than the resistance rates of MRSA strains to mupirocin and fusidic acid. We think that planning the eradication of nasal carriage in dialysis patients according to mupirocin and fusidic acid susceptibility results will increase the eradication success.

**Keywords:** Hemodialysis patients, nasal carriage, *Staphylococcus aureus*, mupirocin, fusidic acid



## INTRODUCTION

Infections in hemodialysis patients and end-stage renal failure patients are an important cause of mortality and morbidity. Hemodialysis patients are in the risk group in terms of methicillin-resistant *Staphylococcus aureus* (MRSA) infection and colonization.[1] MRSA and coagulase-negative staphylococci are commonly identified as etiological agents of catheter-associated bacteremia in hemodialysis patients, as well as peritoneal dialysis catheter infections and peritonitis in peritoneal dialysis patients. The elevated resistance rate to mupirocin, a topical antibiotic employed in the elimination of *Staphylococcus aureus (S. aureus)* nasal carriage in these patients, constitutes a significant issue.[2] The most frequently colonized body site of *S. aureus* is the nose. It has been reported that nasal carriage of *S. aureus* plays an important role in the pathogenesis of infections due to this agent.[4-6]

Studies have reported that the rates of *S. aureus* nasal carriage in diabetic patients, hemodialysis patients, intravenous drug addicts, and patients with HIV infection are higher than the population.[4-10] The relationship between *S. aureus* nasal carriage in hemodialysis patients and infections developing due to this agent has been shown in many studies. It has been reported that the rates of bacteremia and catheter-related infections are higher in *S. aureus* nasal carriers than in non-carriers.[3,5,7,8] MRSA have an important place in staphylococcal infections. Many studies have reported the relationship between nasal MRSA carriage and MRSA infections. The main risk factors for MRSA nasal carriage are hospitalization, broad-spectrum antibiotic use, surgical intervention, residence in a nursing home, presence of hospital personnel in the family, etc.[1,3-5]

**Corresponding Author:** Hakkı Öztürk, ozturk_h@msn.com

This study aimed to ascertain the prevalence of nasal carriage of *S. aureus* in hemodialysis patients, identify the related risk factors, and evaluate susceptibilities to mupirocin and fusidic acid in patients with nasal carriage of *S. aureus*.

## METHODS

A total of 165 hemodialysis patients, including 55 (33.3%) females and 109 (66.03%) males, who were dialyzed at the Private Ankara Balgat Dialysis Center, were included in the study. Nasal swab samples obtained from the patients were sown on Mannitol-salt agar (Beslab, Turkey) medium. The media were incubated in an oven at 37°C for 72 hours. Colonies that grew on Mannitol salt agar medium with yellow color reflex were evaluated as *S. aureus*, and the strains with positive catalase and coagulase tests were evaluated as *S. aureus*. MRSA1 strains was determined on Mueller Hinton agar medium with cefoxitin disk (Bioanalyse, Turkey), and mupirocin and fusidic acid susceptibilities were determined by disk diffusion method with the discs of these antibiotics (Bioanalyse, Turkey).

The mean age of the patients was 52±12.08 years. For the study, a patient consent form was obtained from hemodialysis patients, and ethics committee approval was obtained from Ankara Bilkent City Hospital Medical Research Scientific and Ethical Evaluation Board (Date: 04.12.2024, Decision No: TABED 1-24-384). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

### Statistical Analysis

SPSS (Statistical Package for the Social Sciences) is a software program used by researchers in various disciplines for quantitative analysis of complex data. A Chi-square test was used in the statistical analysis; $p \leq 0.05$ was considered statistically significant.



## RESULTS

Among the 165 hemodialysis patients, nasal carriage of *S. aureus* was identified in 14 (8.48%) individuals, with 9 (5.45%) exhibiting methicillin-sensitive *Staphylococcus aureus* (MSSA) nasal carriage and 5 (3.03%) displaying methicillin-resistant *Staphylococcus aureus* (MRSA) nasal carriage.

Of a total of 5 MRSA strains, 1 was resistant to mupirocin, and 1 was resistant to fusidic acid. Of a total of 9 MSSA strains, 2 were resistant to mupirocin and 2 were resistant to fusidic acid. It was determined that mupirocin and fusidic acid resistance was higher in MSSA strains (Table 1).

**Table 1.** Mupirocin and fusidic acid resistance was identified in MSSA and MRSA strains

| Agent | Mupirocin resistant (n) | Fusidic acid resistant (n) |
|---|---|---|
| MSSA (n:9) | 7 | 7 |
| MRSA (n:5) | 1 | 1 |
| Total (n:14) | 8 | 8 |

MSSA: Methicillin-sensitive *Staphylococcus aureus*, MRSA: Methicillin-resistant *Staphylococcus aureus*

All patients who grew MRSA and MSSA in nasal cultures had a history of antibiotic use in the last 6 months and hospital or outpatient clinic admission in the last year as risk factors. Congestive heart failure was present in 3 patients with MRSA and 7 patients with MSSA nasal cultures. Diabetes mellitus was present in one patient with MRSA growth and in two patients with MSSA growth. Two patients who grew MSSA in nasal culture had a history of surgical intervention, and one patient had a family history of healthcare personnel. None of the patients who grew MRSA and MSSA in nasal cultures had a history of nursing home stay, hospitalization in the last 1-year, immunosuppressive treatment, or malignancy. The risk factors in patients with MRSA and MSSA growth in nasal cultures are shown in Table 2.

## DISCUSSION

*S. aureus* nasal carriage plays a key role in the pathogenesis and epidemiology of *S. aureus* infections.[3,4,7] *S. aureus* nasal carriage rates in hemodialysis patients and patients receiving continuous outpatient peritoneal dialysis treatment have been reported to be higher than those in the general population.[4-8] *S. aureus* infections are common in hemodialysis patients due to hospitalization, immunosuppression, invasive interventions (hemodialysis catheter, subclavian catheter, etc.), frequent antibiotic use and high staphylococcal colonization on the skin and nose.[4,5]

Nasal carriage of *S. aureus* is one of the most important risk factors in the pathogenesis of catheter infections, bacteremia, and sepsis in hemodialysis patients.[4-13]

Compared to the general population, hemodialysis patients have been reported to be more colonized with *S. aureus*. Scheuch et al.[14] found *S. aureus* carriage in an average of 40% of hemodialysis patients in their cross-sectional study, while the carriage rate in the general population was reported as 27%.

Dialysis patients are often exposed to *S. aureus* due to their regular stay in dialysis centers, hospitals, and nursing homes. In studies, the rate of *S. aureus* carriage was reported as 51% in hemodialysis patients, 43% in patients receiving continuous outpatient peritoneal dialysis treatment, and 37% in the normal population.[3,4,14]

*S. aureus* is one of the most common causative agents of catheter-related bacteremia and sepsis in hemodialysis patients.[15] The eradication of *S. aureus* nasal carriage with topical antibiotics in patients undergoing hemodialysis and peritoneal dialysis has been shown to significantly reduce infection rates associated with this pathogen.[1,4,5]

In studies conducted in hemodialysis patients in Turkey, MRSA nasal carriage rates ranging from 1.8% to 40.4% have been reported.[5] Çelik et al.[5] investigated the rate of *S. aureus* nasal carriage and risk factors in 127 patients on hemodialysis. In this study, *S. aureus* nasal carriage was found in 41 (32.3%) patients, while MRSA nasal carriage was found in five (3.9%) patients. When risk factors were evaluated, a statistically significant relationship was found between *S. aureus* carriage and concomitant gastrointestinal disease and history of antibiotic use in the last year. In the present study, all of the patients with *S. aureus* nasal carriage had a history of antibiotic use within 6 months and a history of admission to a hospital or outpatient clinic within the last year as risk factors. In addition, it was noteworthy that 10 (71.4%) patients with *S. aureus* nasal carriage had congestive heart failure.

Risk factors for MRSA nasal carriage in hemodialysis patients have been reported as advanced age (≥75 years), prolonged hospitalization, history of repeated antibiotic use, and proximity to another MRSA colonized area. In the present study, the rates of *S. aureus* and MRSA nasal carriage in

**Table 2.** Risk factors in patients with MRSA and MSSA growth in nasal cultures

| Risk factors<br>Reproductive agent | DM (n*) | Antibiotic use in the last 6 months | History of admission to hospital or outpatient clinic in the last year | CHF | History of Surgical Intervention | Presence of health personnel in the family | Staying in a care home | Hospitalization in the last 1 year | History of immunosuppressive therapy or malignancy |
|---|---|---|---|---|---|---|---|---|---|
| MRSA (n:5) | 1/5 | 5/5 | 5/5 | 3/5 | 0/5 | 0/5 | 0/5 | 0/5 | 0/5 |
| MSAA (n:9) | 2/9 | 9/9 | 9/9 | 7/9 | 2/9 | 1/9 | 0/9 | 0/9 | 0/9 |
| Total | 3/14 | 14/14 | 14/14 | 10/14 | 2/14 | 1/14 | 0/14 | 0/14 | 0/14 |

MRSA: Methicillin-resistant *Staphylococcus aureus,* MSSA: Methicillin-sensitive *Staphylococcus aureus,* n*: Patient number, DM: Diabetes mellitus, CHF: Congestive heart failure

hemodialysis patients were lower than the rates reported in the literature. The main risk factors for MRSA and MSSA nasal carriage in hemodialysis patients were antibiotic use in the last 6 months, history of hospital or outpatient clinic admission in the last year and congestive heart failure.

MRSA nasal carriage has been reported to be associated with poor clinical outcomes in outpatients on hemodialysis. Early identification of colonized patients, isolation, and elimination of carriage with a decolonization regimen is an appropriate approach to minimize MRSA transmission rates.[4,7,13] In studies conducted in hemodialysis patients in our country, *S. aureus* nasal carriage rates were reported by Şencan et al.[6] 67%, Kurutepe et al.[11] 33%, and Çelik et al.[5] 32.3%. The rates of MRSA nasal carriage in hemodialysis patients were reported as 3.9% by Çelik et al.[5]; 40.4% by Şencan et al.[6]; 11% by Kurutepe et al.[11]; and 1.8% by Mutlu et al.[12] Cesur et al.[9] found *S. aureus* nasal carriage in 23 (22.1%) of 104 patients on hemodialysis. Of the *S. aureus* strains isolated from the patients, 22 (95.6%) were reported as MSSA, and one (4.34%) as MRSA.

Lu et al.[7] reported *S. aureus* carriage rate as 22% and MRSA carriage rate as 2.4%, and Lederer et al.[8] reported *S. aureus* carriage rate as 53% and MRSA carriage rate as 12% in hemodialysis patients.

### Limitations

The limitation of our study is that we could not determine whether S. aureus carriage was permanent or transient carriage because the patients were not followed up for a long period of time. In our study, the rate of S. aureus nasal carriage was found to be low in hemodialysis patients. Possible reasons for this may be that hemodialysis patients apply to dialysis centers on a daily basis, attention is paid to infection control measures in the dialysis center, and mupirocin pomade is applied to patients with nasal carriage.

## CONCLUSION

Our study found that MSSA strains were more likely to be resistant to mupirocin and fusidic acid than MRSA strains were. Mupirocin and fusidic acid are topical antibiotics that can be used to get rid of S. aureus nasal carriage. In conclusion, we think that planning the eradication of nasal carriage in hemodialysis patients according to mupirocin and fusidic acid susceptibility results will increase the eradication success.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

The study was initiated with the approval of the Ankara Bilkent City Hospital No 1 Medical Researches Scientific and Ethics Committee (Date: 04.12.2024, Decision No: TABED 1-24-384).

### Informed Consent

All patients signed and free and informed consent form.

### Referee Evaluation Process

Externally peer-reviewed.

### Conflict of Interest Statement

The authors have no conflicts of interest to declare.

### Financial Disclosure

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

### Author Contributions

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



## REFERENCES

1. Çifci A, Erol ÖÖ, Kaya Ç, Ergen E, Cesur S. Hemodiyaliz hastalarında MRSA burun taşıyıcılığı ve VRE rektal taşıyıcılığı oranlarının belirlenmesi. *Ortadoğu Tıp Derg.* 2013;5(4):214-218.
2. Berns JS. Infection with antimicrobial-resistant microorganisms in dialysis patients. *Semin Dial.* 2003;16(1):30-37.
3. Kluytmans JA, Belkum AV, Verbrugh H. Nasal carriage of *Staphylococcus aureus*: epidemiology, underlying mechanisms, and associated risks. *Clin Microbiol Rev.* 1997;10(3):505-520.
4. Kluytmans J, Harbarth S. Methicillin-resistant *Staphylococcus aureus* decolonization: "yes, we can," but will it help? *Infect Control Hosp Epidemiol.* 2009;30(7):633-635.
5. Çelik G, Gülcan A. Hemodiyaliz tedavisi alan hastalarda nazal *Staphylococcus aureus* taşıyıcılığı ve risk faktörlerinin belirlenmesi. *Türk Mikrobiyol Cem Derg.* 2010;40(2):79-86.
6. Şencan İ, Kaya D, Atakoğlu N, Şahin İ, Bahtiyar Z, Yıldırım M. Hemodiyaliz hastalarında burunda *Staphylococcus aureus* taşıyıcılığı. *İnfeksiyon Derg.* 2003;17:31-34.
7. Lu PL, Tsai JC, Chiu YW, et al. Methicillin resistant *Staphylococcus aureus* carriage, infection and transmission in dialysis patients, healthcare workers and their family members. *Nephrol Dial Transplant.* 2008;23(5):1659-1665.
8. Lederer SR, Riedelsdorf G, Schiffl H. Nasal carriage of *Staphylococcus aureus*: the prevalence, patients at risk and the effect of elimination on outcomes among outclinic haemodialysis patients. *Eur J Med Res.* 2007; 12(7):284-288.
9. Cesur S, Ertürk Ş, Nergizoglu G, Tekeli E. Hemodiyaliz hastaları ve personelinde burunda *Staphylococcus aureus* taşıyıcılığı. *İnfeks Derg.* 2004;18(1):49-52.
10. Cesur S, Kurşun Ö, Aylı D, et al. Ayaktan takip edilen hemodiyaliz hastalarında *Staphylococcus aureus* nazal taşıyıcılığı oranları ve izole edilen suşların mupirosin, fusidik asit, trimetoprim-sulfametoksazol duyarlılıkları. *Ortadoğu Tıp Derg.* 2016;8(4):177-181.
11. Kurutepe S, Gaz H, Sürücüoğlu S, Aktaş E, Özbakkaloğlu B. Klinik ve pre-klinik hastane personelinde metisiline dirençli *Staphylococcus aureus* burun taşıyıcılık oranları. *Türk Mikrobiyol Cem Derg.* 2005; 35(3):178-182.
12. Mutlu B, Gündeş S, Kolaylı , et al. Hastane personelinin burun kültürlerinden izole edilen stafilokok türlerinin metisilin duyarlılığı. *Klimik Derg.* 2001;14(3):159-160.

13. Schmid H, Romanos A, Schiffl H, Lederer SR. Persistent nasal methicillin-resistant *Staphylococcus aureus* carriage in hemodialysis outpatients: a predictor of worse outcome. *BMC Nephrol*. 2013;14(1):93. doi:10.1186/1471-2369-14-93

14. Scheuch M, Freiin von Rheinbaben S, Kabisch A, et al. *Staphylococcus aureus* colonization in hemodialysis patients: a prospective 25 months observational study. *BMC Nephrol*. 2019;20(1):153. doi:10.1186/s12882-019-1332-z

15. Lafrance JP, Rahme E, Lelorier J, Iqbal S. Vascular access-related infections:definitions, incidence rates, and risk factors. *Am J Kidney Dis*. 2008;52(5):982-993.