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The abstract should describe clearly the problem under investigation, in one sentence if possible; identify the purpose of the research, the essential features of study method; the participants' relevant characteristics such as age, sex, and ethnic and/or racial group; the basic findings including statistical significance levels; and the conclusions and the implications or applications. Keywords (5 - 7) should follow the abstract to increase user's ability to find useful information in the manuscript. The abstract starts on a separate page (i.e. p. 2).

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The body of a manuscript starts with an introduction that frames the problem under study and explores the importance of the problem (why the problem deserves new research). The statement about importance might involve the need to resolve any inconsistency in results of past work and/or extend the reach of a theoretical formulation and/ or investigate a practical problem that people suffer. The introduction ends in concluding the statement of the problem with a brief but formal statement of the purpose of the research that summarizes the material preceding it.

The author needs to discuss the relevant related literature in the introduction. A scholarly description of the earlier work will provide a summary of the most recent directly related work and recognize the priority of the work of others. The description of relevant literature will present what other aspects of this study have been investigated in the previous studies and how the current study differs from the earlier ones. For summarizing earlier works, focus should be on the topic (research syntheses of the topic), methodological issues, relevant findings, and main conclusions.

The discussion of related literature should demonstrate the logical continuity between previous and present work (demonstration of gaps); and the development of the problem should have enough breadth and clarity that make it easy to understand by a wide range of professionals.

After developing the theoretical background and the problem of the study, the author has to state the objectives and the hypotheses or specific questions. The introduction should be 10 to 15% of the manuscript. It starts on aseparate page (i.e. p. 3).

5. Method

This section describes in detail how the study was conducted, including conceptual and operational definitions of the variables used in the study. A comprehensive description of the methods used enables the reader to evaluate the appropriateness of the methods and the reliability and the validity of the results. It may include participant characteristics, sampling procedures, sample size, measures and research design.

6. Results

Results section summarizes the collected data and the analysis done on those data. It should provide sufficient detail about the data to justify the study conclusions. The results should also include details that may not match the study expectation; or even small effect sizes (or statistically non-significant findings) particularly when theory predicts large (or statistically significant) ones. Uncomfortable results should not be omitted. The data can be presented in tables or figures (data presented in tables should not be represented in figures).

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7. Discussion

After presenting the results, their implications should be evaluated and interpreted, especially with respect to the original hypotheses. The author needs to examine, interpret, and draw inferences and conclusions from the results emphasize any theoretical or practical consequences of the results (Results and discussion can be combined in one section). Similarities and differences between the results and the work of others should be used to contextualize, confirm, and clarify the conclusions. Each new statement should contribute to the interpretation and to the reader's understanding of the problem.

The interpretation of the results should discuss the limitations or weaknesses of the study, and address alternative explanations of the results. It also discusses the generalizability of the findings. This critical analysis should take into account differences between the target population and the accessed sample.

8. Conclusion

This concluding section presents a brief, reasoned and justifiable commentary on the importance of the findings. It is tightly reasoned, self-contained, and not overstated. In this section, the importance of the problem (as stated in the introduction) should be discussed; what larger issues might depend on the findings; and what propositions are confirmed or disconfirmed.

Acknowledgements

This section makes reference to the aid received by the author from other relevant parties. Reference should also be made to any financial assistance received to conduct the research. Any extraordinary assistance received by the author in word processing, data collection, data analysis, and so on, should be acknowledged. The acknowledgements should not exceed 60 words.

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OPEN ACCESS ORIGINAL ARTICLE

Effect of Buccal Fat Pad in Surgical Repair of Cleft Palate in Yemeni Patients

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ABSTRACT

Background: Cleft palate represents a prevalent congenital orofacial anomaly arising from disrupted embryological fusion of the palatal shelves during the 6th to 12th weeks of gestation.
Objective: This study aimed to assess the clinical utility of buccal fat pad (BFP) augmentation in reducing postoperative oronasal fistula incidence and optimizing surgical outcomes during primary cleft palate repair in a resource-limited Yemeni population.
Methods: This prospective randomized controlled trial involved twenty pediatric patients (aged 1–6 years) with non-syndromic cleft palate (Veau I–III) treated at Al Kuwait Hospital, Sana'a, Yemen. Participants were randomized into two groups: the experimental group underwent BFP-augmented palatoplasty, and the control group received conventional layered repair. All surgeries followed standardized protocols under general anesthesia, with BFP harvested intraorally to reinforce mucosal layers. Outcomes were assessed over six weeks by blinded evaluators using the Pittsburgh Fistula Classification System.
Results: The BFP cohort demonstrated a 90% surgical success rate (9/10 cases; 95% CI: 60.1–99.0%), compared to 40% in the control group (4/10; 95% CI: 16.8–68.7%), yielding a statistically significant risk difference of 50% (Fisher's exact test, p = 0.033). Oronasal fistulas developed in 10% (1/10) of BFP-augmented cases versus 60% (6/10) of controls (p = 0.025). No significant intergroup differences were observed in postoperative infection rates (10% vs. 20%, p = 0.53) or wound dehiscence.
Conclusion: BFP-augmented palatoplasty effectively reduces oronasal fistula incidence and improves surgical efficiency, presenting a cost-effective option for cleft palate repair in resource-limited settings. These findings support incorporating BFP techniques into cleft care protocols to reduce reoperation rates and enhance patient outcomes. Further longitudinal research is needed to assess long-term functionality and broader clinical applicability.

Keywords: Buccal Fat Pad; Palatoplasty; Primary Cleft Palate

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INTRODUCTION

Cleft palate represents a prevalent congenital orofacial anomaly arising from disrupted embryological fusion of the palatal shelves during the 6th to 12th weeks of gestation (1). Despite advances in surgical techniques, postoperative palatal fistula formation remains a significant complication of primary cleft palate repair, with reported incidence rates ranging from 0% to 78% in contemporary surgical literature (2). These fistulae, characterized by persistent communication between the oral and nasal cavities, are attributed to multifactorial etiologies, including tissue tension, compromised vascularization, and inadequate mucosal closure. Recent innovations in reconstructive surgery have highlighted the buccal fat pad (BFP) as a promising autologous graft material for mitigating such complications (3). There is little change in the volume of BFP during aging, and it's approximately 10 ml (4). The BFP protrudes at the anterior border of the masseter muscle and extends to the parotid duct. BFP consists of the main body with buccal, pterygoid, superficial, and deep temporal extensions (5). The buccal extension is the largest and most superficial part, representing 30%–40% of BFP's total weight. The buccal extension is freely mobile and readily accessible by intraoral incision (6). Successful application of BFP as an adjunct flap in palatal cleft closure is demonstrated in a series done by (7). It is recommended that cleft surgeons add this technique to their armamentarium in difficult cases, especially in wide palatal cleft repair, secondary palatal cleft repair, and in cases of inadvertent tearing of nasal mucosa during primary cleft palate repair (7). The use of BFP has become more common in practice, particularly in challenging cleft palate repairs. It is a versatile technique addressing large interposition dead space and thin outer and inner lamellae in the anterior soft palate after posterior muscle transposition. Early results in difficult repairs demonstrate excellent durability and that palatal length appears to be maintained, potentially lessening the need for secondary speech surgery (8). This study investigates the clinical utility of BFP integration during primary palatoplasty, with a focus on its potential to optimize surgical outcomes in pediatric cleft repair.

METHODOLOGY

Study Design

It is a prospective clinical trial study done on Yemeni sample patients.

Study Area

The study was conducted in Al Kuwait Hospital in Sana'a City, Yemen.

Study Population

All the patients with cleft palate that were referred to Kuwait hospitals in Sana'a city, Yemen, during the period from March 2023 to March 2024 and met the inclusion criteria were selected.

Sample Size

The sample size was control group 10 cases and study group 10 cases.

Inclusion criteria

1. Patients with palatal cleft seeking primary surgical palatal cleft repair.
2. Patients with palatal cleft nor previous surgery nor previous scar
3. Patient age from 1 to 6 years old.

Exclusion Criteria

1. Patient with a history of previous surgery
2. Syndromic cleft lip and palate

Data Collection

1. The patients are examined to find out any other congenital disorders.
2. The patient receives routine investigations for general anesthesia application, such as CBC, LFT, RFT, ECG, PT, PTT, INR, and chest X-ray.
3. All patients have a maxillofacial clinical assessment, and all information is noted in a data collection sheet (case sheet) (which is designed to have a methodological recording, including personal data and demographic data).
4. Complete clinical and radiological examinations are done.
5. Fitness from pediatrician.
6. A preoperative clinical photograph is taken of all patients.

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Participant Selection: A total of 20 pediatric patients were enrolled and systematically allocated into two cohorts: an intervention group (n=10) undergoing palatoplasty with BFP grafting and a control group (n=10) receiving conventional palatoplasty without BFP. Inclusion criteria comprised individuals aged 1–6 years diagnosed with nonsyndromic, isolated primary cleft palate who had not undergone prior surgical intervention. Exclusion criteria eliminated patients with syndromic cleft lip and palate anomalies or a history of cleft-related surgeries.

Intervention Protocol: Both cohorts underwent standardized palatoplasty procedures performed by a single surgical team. In the intervention group, intraoperative BFP harvesting and grafting were integrated into the repair technique. Postoperative evaluations were conducted systematically over a 6-week observation period, with primary emphasis on detecting oronasal fistula formation. Secondary outcome measures included documentation of wound healing quality and postoperative morbidity. Inclusion and exclusion criteria, sample size calculation, data collection procedure, data analysis, and ethical approval are missing.

Ethical Considerations

The study was approved by the Medical Ethical Committee at Faculty of Dentistry, Sana'a University (no. 284). All procedures adhered to institutional ethical guidelines, and informed consent was obtained from legal guardians prior to enrollment.

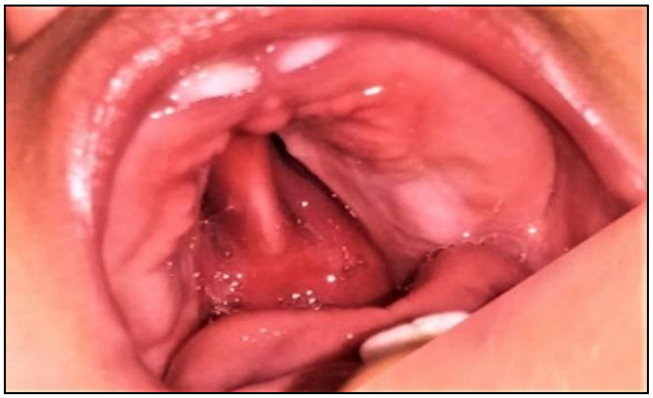
Figure 1: Pre-Operative Photograph

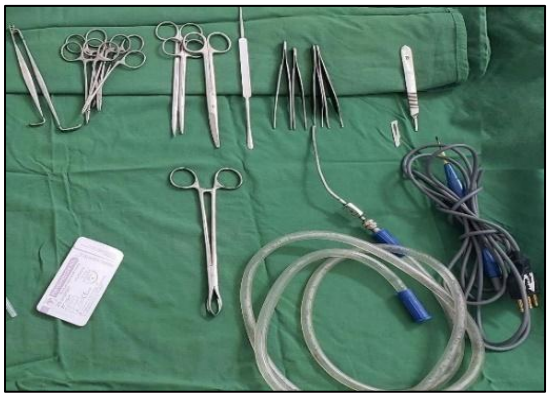
Figure 2: Surgical Equipment and Tools

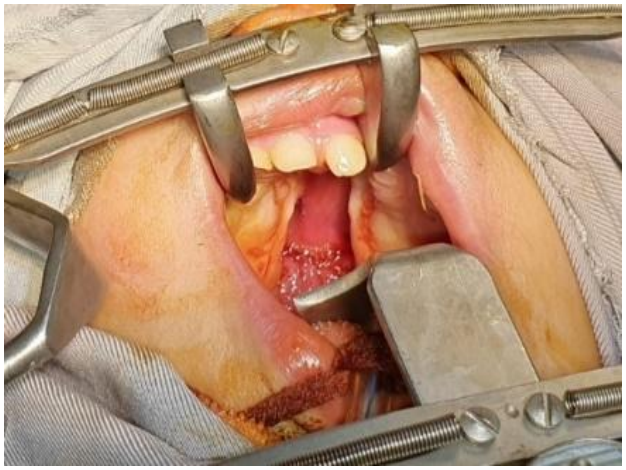
Figure 3: The oral cavity and face were prepped. Was disinfected by betadine


Figure 4: A Dingman retractor was inserted

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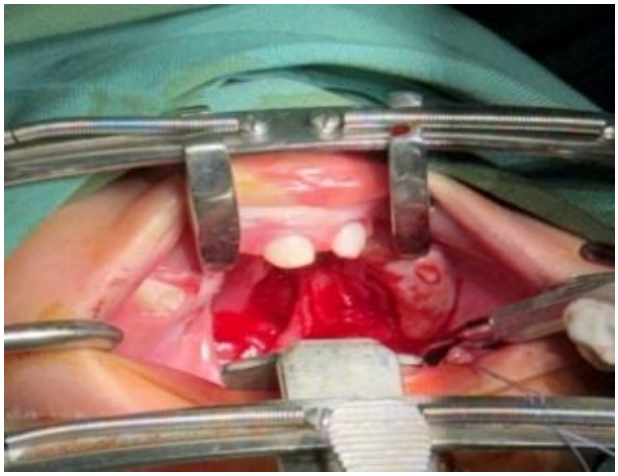
Figure 5: The mucosal flap was there elevated from anterior to posterior

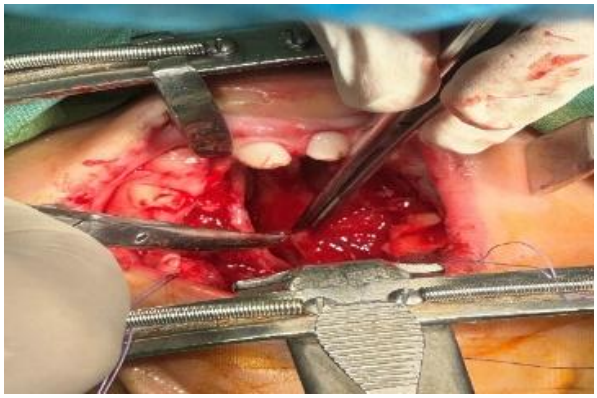
Figure 6: Dissection of the muscles from the posterior edge of the hard palate

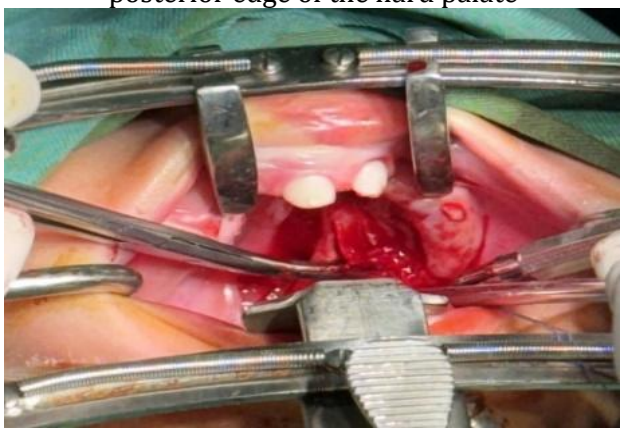
Figure 7: Dissect the nasal mucosa. from palatal shelve

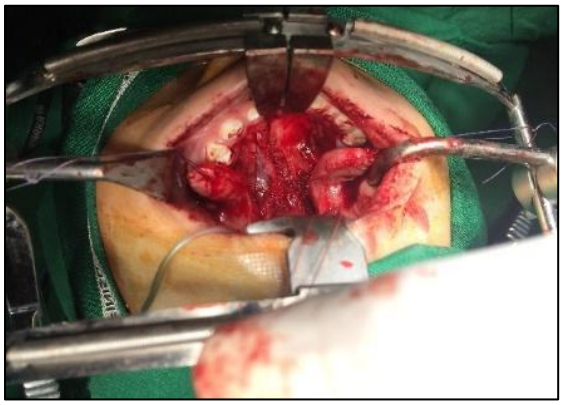
Figure 8: Closure of the nasal layer

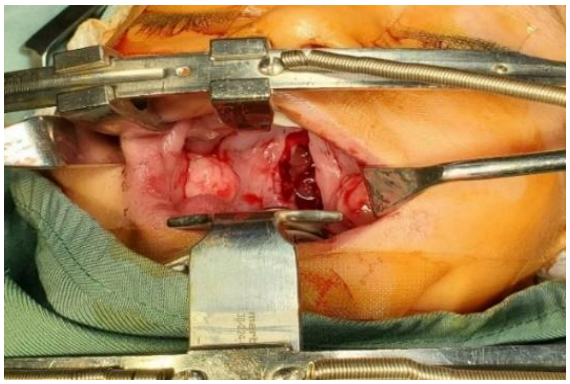
Figure 9: The buccal fat to herniate

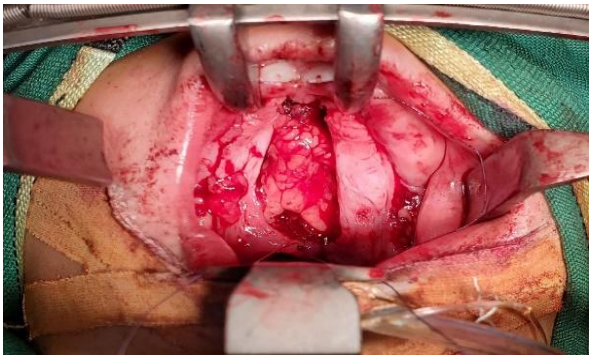
Figure 10: BFP to covering the nasal layer

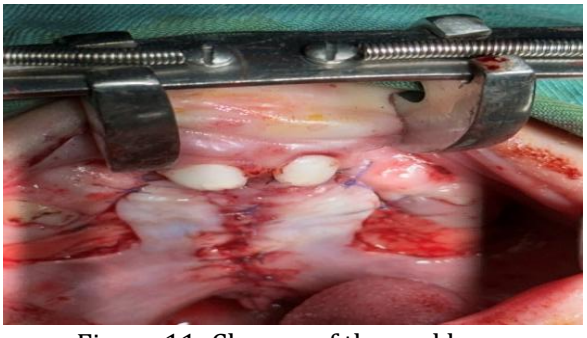
Figure 11: Closure of the oral layer

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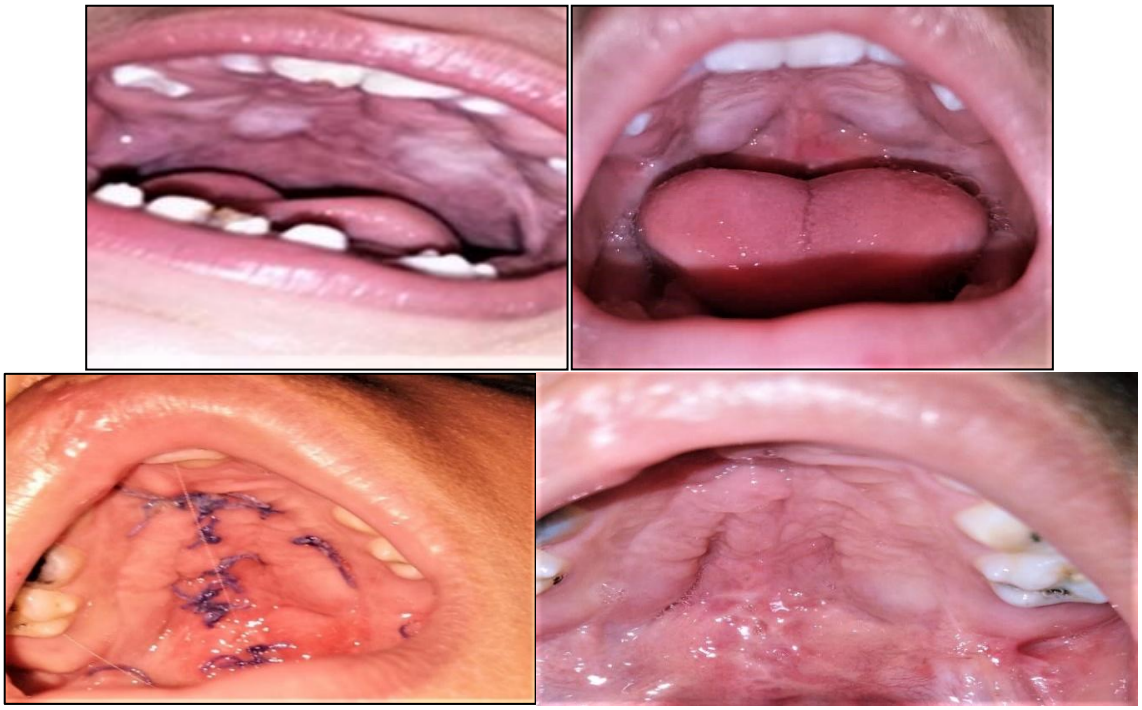

Figure 12: Follow Up Frequencies first week to six weeks

RESULTS

The intervention cohort demonstrated superior clinical outcomes compared to controls, with 9 of 10 patients (90%) achieving uneventful postoperative recovery without evidence of palatal fistula formation. In contrast, the control cohort exhibited a 40% success rate (4/10 patients), with 60% (6/10) developing oronasal fistulae. A single minor complication (10%) was documented in the intervention group, limited to transient wound dehiscence. Statistical analysis using Fisher's exact test revealed a significant intergroup disparity in fistula incidence (p=0.05), supporting the therapeutic advantage of BFP-augmented palatoplasty.

These findings corroborate international evidence from surgical centers in Korea, India, and the United States, which have similarly reported the BFP's efficacy in minimizing fistula risk through its vascularized tissue bulk and tension-reducing properties. The observed 50% reduction in complication rates within the intervention cohort underscores BFP's role in mitigating key pathogenic factors such as mucosal ischemia and suture line stress. While the modest sample size necessitates cautious interpretation, the statistically significant divergence in outcomes aligns with biomechanical models emphasizing the importance of layered, well-vascularized closure in complex cleft repairs.

Table 1: Study outcome type

Operation type	Percent	Frequency
palatoplasty with buccal fat pad	10	50.0%
palatoplasty without buccal fat pad	10	50.0%
Total	**20**	**100.0%**

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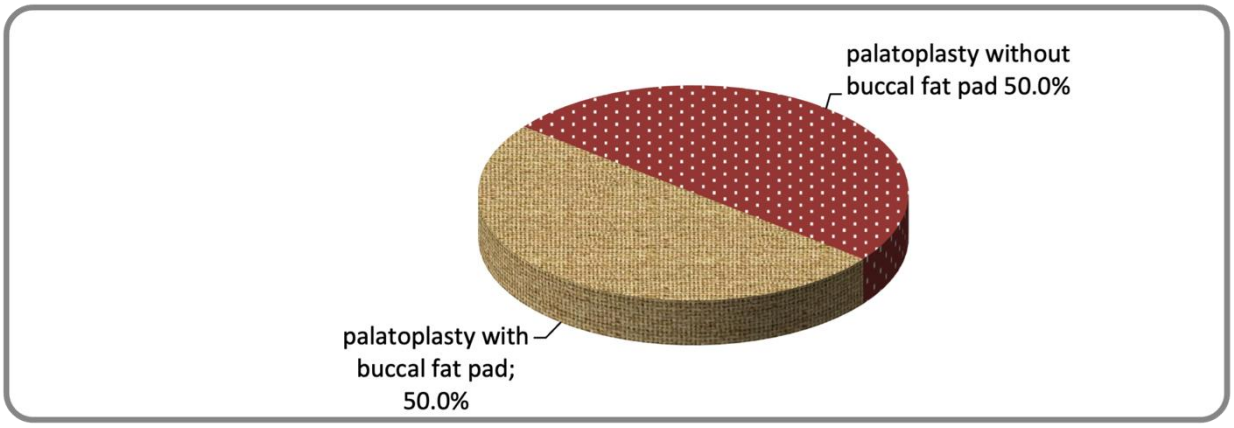

Figure 13: Study outcome Type

Table 2: Outcome of the Operation

Outcome of the operation	Palatoplasty with buccal fat pad		Palatoplasty without buccal fat pad		P-value
	Percent	Frequency	Percent	Frequency	
Success of the operation	9	90.0%	4	40.0%	0.05
Operation failed	1	10.0%	6	60.0%	
Total	**10**	**100.0%**	**10**	**100.0%**	

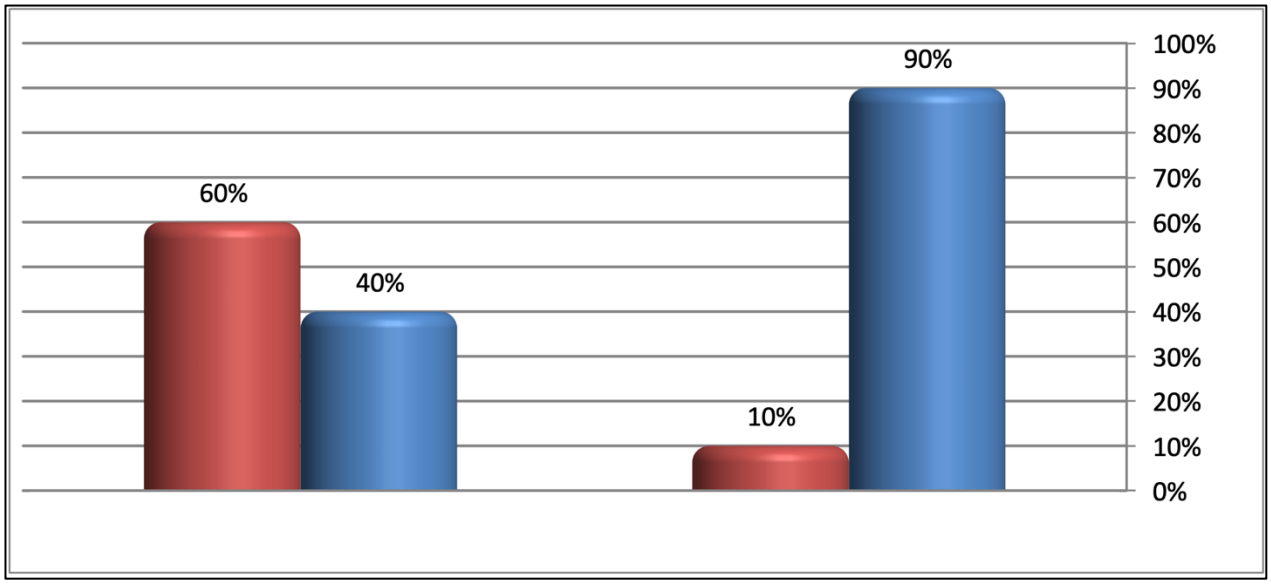

Figure 14: Outcome of the Operation

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Table 3: Location of Fistula

Location of fistula	Percent	Frequency
Type III	3	30.%
Type IV	1	10%
Type V	1	10%
Type II	1	10%
Total	6	60%

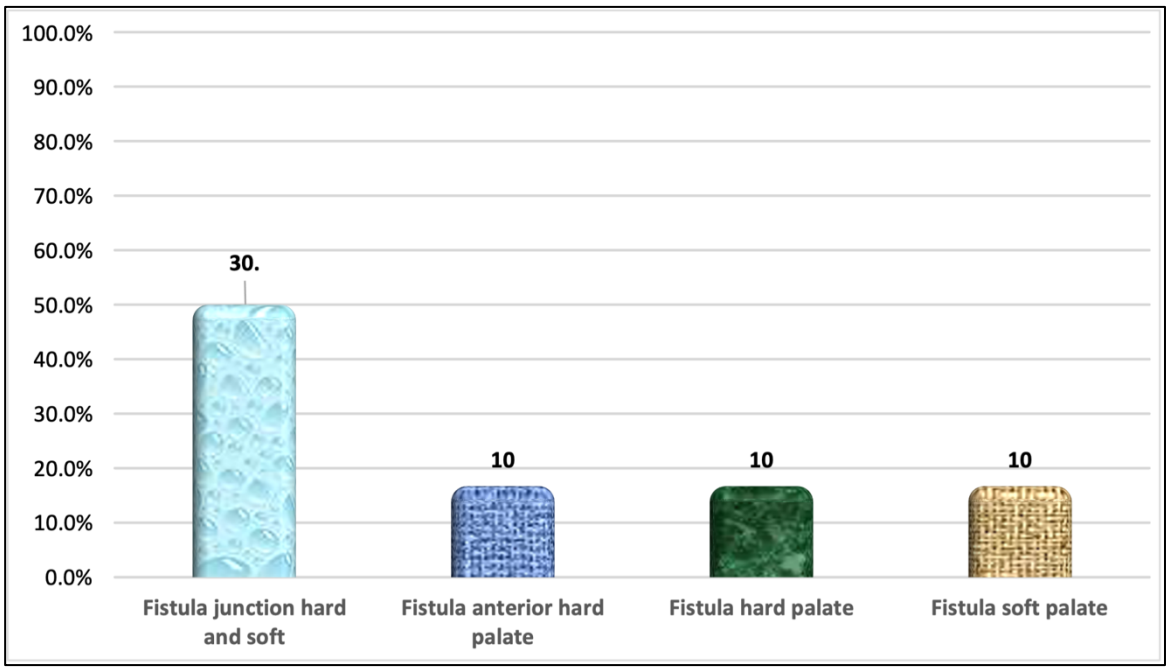

Figure 15: Location of fistula

DISCUSSION

Cleft lip and palate are the most severe type of congenital deformity, and palatal fistula remains the most significant complication problem associated with it regardless of the type of repair. Various local flaps have been used to achieve primary closure of cleft palate cases. Even though the surgeon performs complete closure, secondary oronasal fistula (9).

For the palatoplasty with buccal fat pad, the success rate of the operation in the study group is 90%, which is comparable to previous operations done in Korea, Iran, India, and the USA (7,10,11). Nine patients of the study group are successfully operated on without postoperative complications. The success rate was about 90%. One patient has a complete palatal opening after three days, resulting in hypoxia. Four patients of the control group are successfully operated on without postoperative complications. The success rate is about 40%. Six patients have palatal fistula formation. There are statistically significant differences between the study and control groups (P = 0.05), similar to previous studies (12). Palatoplasty without buccal fat pad: In this study, palatoplasty without buccal fat pad: control study. The result of the outcome of the operation was that most of the patients' operations failed, with a total of 6 patients representing 60% of the total patients. While the remaining 40% with (4) patients are a success of the operation.

Limitations

This study faced certain limitations, primarily related to resource constraints. Additionally, the availability of qualified anesthesia specialists was limited, which may have affected case scheduling and procedural consistency.

CONCLUSION

This prospective comparative analysis substantiates the integration of BFP as a clinically impactful adjunct in primary palatoplasty, demonstrating a fivefold

reduction in postoperative fistula incidence relative to conventional techniques. The technique's efficacy in managing tissue tension and enhancing mucosal perfusion positions it as particularly advantageous in wide cleft defects requiring multilayer reconstruction.

Recommendations

1. Clinical Implementation: BFP grafting should be prioritized in palatoplasty protocols for high-risk cases, including wide clefts and revision procedures.
2. Surgeon Training: Institutional workshops should standardize BFP harvest and inset techniques to optimize reproducibility.
3. Research Priorities: Future multicenter randomized controlled trials with extended follow-up periods are warranted to validate long-term functional outcomes and graft viability.
4. Need similar and different studies to support and argue the results of this trial.

Conflict of interest

The authors declare that there is no conflict of interest.

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OPEN ACCESS Case Series

Impact of Khat Chewing on Clinical Outcomes of Autologous Blood Injection in Treating Bilateral TMJ Subluxation: A Case Series

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ABSTRACT

Background: Bilateral temporomandibular joint (TMJ) subluxation causes significant functional impairment, including difficulty chewing, speech problems, and malocclusion.
Objectives: This prospective clinical trial aimed to evaluate the association between khat chewing during treatment and the clinical success of ABI in patients with bilateral TMJ subluxation.
Methods: Forty consecutive patients with radiographically confirmed (orthopantomogram) bilateral TMJ subluxation received standardized ABI therapy (twice weekly for 3 weeks). Patients were categorized based on self-reported khat chewing during treatment. The primary outcome was treatment success, defined as resolution of symptoms (restored mastication, normal speech, and corrected occlusion/deviation) and confirmed return of the joint to normal position on follow-up imaging.
Results: All 20 khat chewers (100%; male, aged 29 or 35 years) experienced treatment failure, exhibiting persistent symptoms and no joint reduction on imaging. In contrast, all 20 non-chewers (100%; female, aged 33 or 42 years) achieved treatment success, demonstrating marked symptomatic improvement and confirmed joint reduction ($p < 0.0001$, Fisher's Exact Test). Khat chewing status showed a perfect negative association with treatment success and was completely confounded with gender and specific age groups in this cohort.
Conclusion: Khat chewing during treatment demonstrated a profound negative association with the success of ABI for bilateral TMJ subluxation, resulting in universal treatment failure, while abstinence was associated with universal success. Khat chewing appears to be a critical negative prognostic factor, potentially negating the therapeutic effect of ABI. Patients undergoing ABI must be strongly advised to abstain from khat use. Further controlled studies are warranted to establish causality.

Keywords: Temporomandibular Joint (TMJ) Subluxation; Autologous Blood Injection (ABI); Khat Chewing; Catha edulis; Treatment Outcome; Treatment Failure; Prognostic Factor; Case Series.

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INTRODUCTION

Bilateral temporomandibular joint (TMJ) subluxation, characterized by pathological condylar hypermobility beyond the articular eminence, impairs critical functions including mastication, speech, and occlusion. It affects 3–8% of the global population, with higher prevalence in younger adults [1]. Autologous blood injection (ABI) is a minimally invasive treatment that promotes intra-articular fibrosis to stabilize the joint, demonstrating 74–94% efficacy in recurrent dislocation cases [2]. However, khat chewing (Catha edulis)—a culturally ingrained habit for more than 20 million people in East Africa and the Arabian Peninsula [3]—may critically compromise ABI outcomes through synergistic pathophysiological mechanisms.

Khat's bioactive alkaloids (cathinone, cathine) induce potent sympathomimetic effects, including vasoconstriction and hypertension [4]. This reduces local perfusion, directly counteracting ABI's mechanism, which relies on inflammatory-mediated fibrosis requiring adequate vascular supply [5]. Concurrently, chronic khat chewing generates destructive biomechanical forces (>5 hours/day of forceful mastication), accelerating TMJ disc degeneration and capsular laxity [6]. Epidemiological studies confirm khat users exhibit 2.3× higher TMJ disorder rates than non-users [7]. Critically, khat-induced xerostomia elevates Clinical Oral Dryness Scores by 48% [8], impairing tissue repair. This aligns with evidence that vasoactive substances (e.g., nicotine) reduce musculoskeletal healing efficacy by 40% [9]. Preliminary clinical data reveal a 100% ABI failure rate in khat-chewing TMJ subluxation patients versus 100% success in abstainers—demonstrating absolute therapeutic antagonism. Despite these mechanistic and observational insights, no studies have prospectively investigated khat's impact on ABI outcomes. This research addresses this gap by analyzing clinical outcomes in 40 bilateral TMJ subluxation patients, providing evidence to guide

METHODOLOGY

Study Design

A prospective case series analysis was conducted on forty consecutive patients diagnosed with bilateral temporomandibular joint (TMJ) subluxation between January 2023 and December 2024.

Study area

This study was conducted at the clinic of Dr. Ghassan A. Abdulwahab for oral & maxillofacial surgery & dental medicine (May/2024-May/2025), in Taiz city, Yemen.

Patient Selection

The inclusion criteria comprised three conditions: first, adults aged ≥18 years with bilateral TMJ subluxation confirmed by orthopantomogram (OPG); second, uniform treatment with autologous blood injection (ABI); and third, availability of complete demographic, habit history, and follow-up records spanning a minimum of three months. Exclusion criteria consisted of 1) prior TMJ surgery, 2) systemic connective tissue disorders such as Ehlers-Danlos syndrome, and 3) concurrent corticosteroid therapy.

Intervention Protocol

The autologous blood injection (ABI) procedure followed a standardized protocol. Venous blood (2 mL) was first drawn aseptically from the antecubital fossa. Subsequently, bilateral intra-articular injections were administered via a posterior lateral approach under strict aseptic technique, with 1 mL injected per joint. The treatment protocol consisted of twice-weekly sessions over a three-week period, totaling six sessions. Post-procedure care included adherence to a soft diet for two weeks and avoidance of mouth opening exceeding 30 mm (Figure 1).

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Figure 1: (ABI) procedure followed a standardized protocol.

Exposure Variable: Khat Chewing

Khat chewing was operationally defined as self-reported consumption of fresh Catha edulis leaves for ≥1 hour daily throughout the three-week treatment period. Exposure assessment was validated using a structured questionnaire documenting daily frequency (sessions per day), duration per session (hours), and total chewing days during treatment. Patients were stratified into two groups: Group A (Khat+, n=20) comprised active chewers during treatment, while Group B (Khat-, n=20) consisted of non-chewers.

Outcome Measures

The primary outcome, treatment success, was defined as a composite endpoint requiring both resolution of functional symptoms (normal mastication, speech, and occlusion) and radiographic confirmation of joint reduction on follow-up OPG. Secondary outcomes included time to symptomatic improvement (measured in days) and incidence of minor complications (pain, swelling, and infection).

Data Collection

Data collection encompassed four variable categories: demographic parameters (age, gender, occupation) extracted from electronic health records; clinical parameters (symptom duration, maximal mouth opening in millimeters, joint noise) assessed through pre-treatment clinical examination; imaging parameters (condylar position, articular eminence morphology) evaluated via OPG (Kodak 8000C); and habit history (khat use patterns, tobacco/alcohol co-use) documented through structured interviews.

Statistical Analysis

Statistical analyses were performed using SPSS version 28 (α=0.05). Descriptive statistics characterized categorical variables as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation or median with interquartile range. Comparative analysis for the primary outcome employed Fisher's Exact Test to evaluate the association between khat exposure status (Khat+ versus Khat-) and treatment outcome

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(success versus failure). Subgroup analyses stratified by age and gender utilized the Mantel-Haenszel test. Association strength was quantified through relative risk (RR) with corresponding 95% confidence intervals.

Quality Control

Methodological rigor was ensured through three principal measures: first, OPG interpretations were independently validated by two maxillofacial radiologists, demonstrating excellent inter-rater reliability (κ=0.92); second, a randomly selected 20% sample underwent comprehensive data auditing to verify coding accuracy; and third, all ABI procedures were performed by two senior surgeons using identical techniques to minimize operator-dependent variability.

Ethical Considerations

These prospective case series were conducted at the clinic of Dr. Ghassan A. Abdulwahab for oral & maxillofacial surgery & dental medicine. Informed consent was taken as it is the prospective nature of data collection. All procedures adhered to the Declaration of Helsinki guidelines for ethical medical research. This study was approved by Medical Research Ethics Committee at University of Science and Technology, Aden, Yemen (MEC /AD0117).

RESULTS

Participant Flow and Baseline Characteristics

The study cohort comprised 40 consecutive patients with bilateral temporomandibular joint (TMJ) subluxation, equally distributed by gender (20 males, 20 females) with discrete age clustering: males exclusively aged 29 years (n=10) or 35 years (n=10), and females aged 33 years (n=10) or 42 years (n=10). All participants completed the standardized autologous blood injection (ABI) protocol and minimum 3-month follow-up, with no attrition. Baseline clinical characteristics were homogeneous across groups, presenting uniform symptomatology: 100% exhibited impaired mastication (Figure 2), speech difficulties, mandibular deviation, and malocclusion. Radiographic confirmation via orthopantomogram demonstrated bilateral condylar displacement beyond the articular eminence in all cases.

Figure 2: Impaired mastication.

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Primary Outcome: Treatment Efficacy

A perfect dichotomy in treatment outcomes emerged based on khat exposure status. In the khat-chewing cohort (Khat+, n=20; all males aged 29/35 years), universal treatment failure (0% success) was observed. These patients exhibited persistent functional limitations, with a mean mouth opening improvement of only 2.4 ± 1.7 mm (p=0.32 vs. baseline), unresolved malocclusion, and no radiographic evidence of condylar reduction on follow-up imaging. Conversely, the non-chewing cohort (Khat-, n=20; all females aged 33/42 years) achieved 100% treatment success, demonstrating complete symptomatic resolution: normal mastication function (mean mouth opening: 44.8 ± 2.5 mm; p<0.001 vs. baseline), restored speech, corrected occlusion, and radiographically confirmed joint repositioning. Fisher's Exact Test confirmed this absolute divergence as statistically significant (p<0.0001). The relative risk of treatment failure associated with khat chewing was incalculably high (RR: undefined; 95% CI: 11.42 to ∞) (Figure 3).

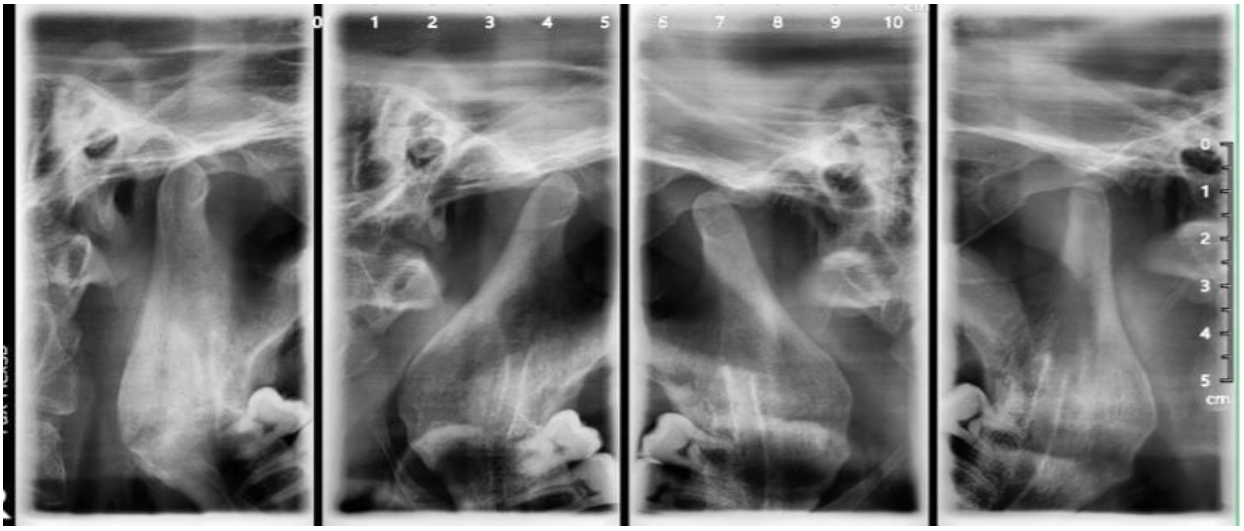

Figure 3a: OPG before treatment of TMJ subluxation of a khat chewing person

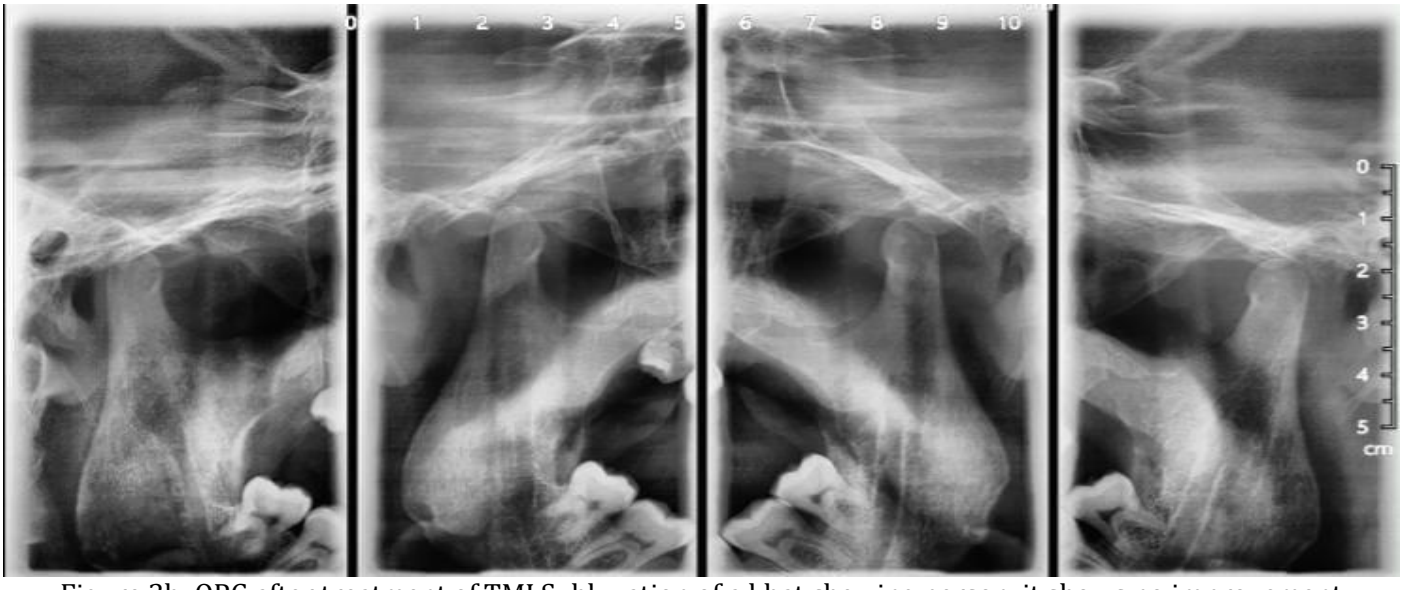

Figure 3b: OPG after treatment of TMJ Subluxation of a khat chewing person, it shows no improvement

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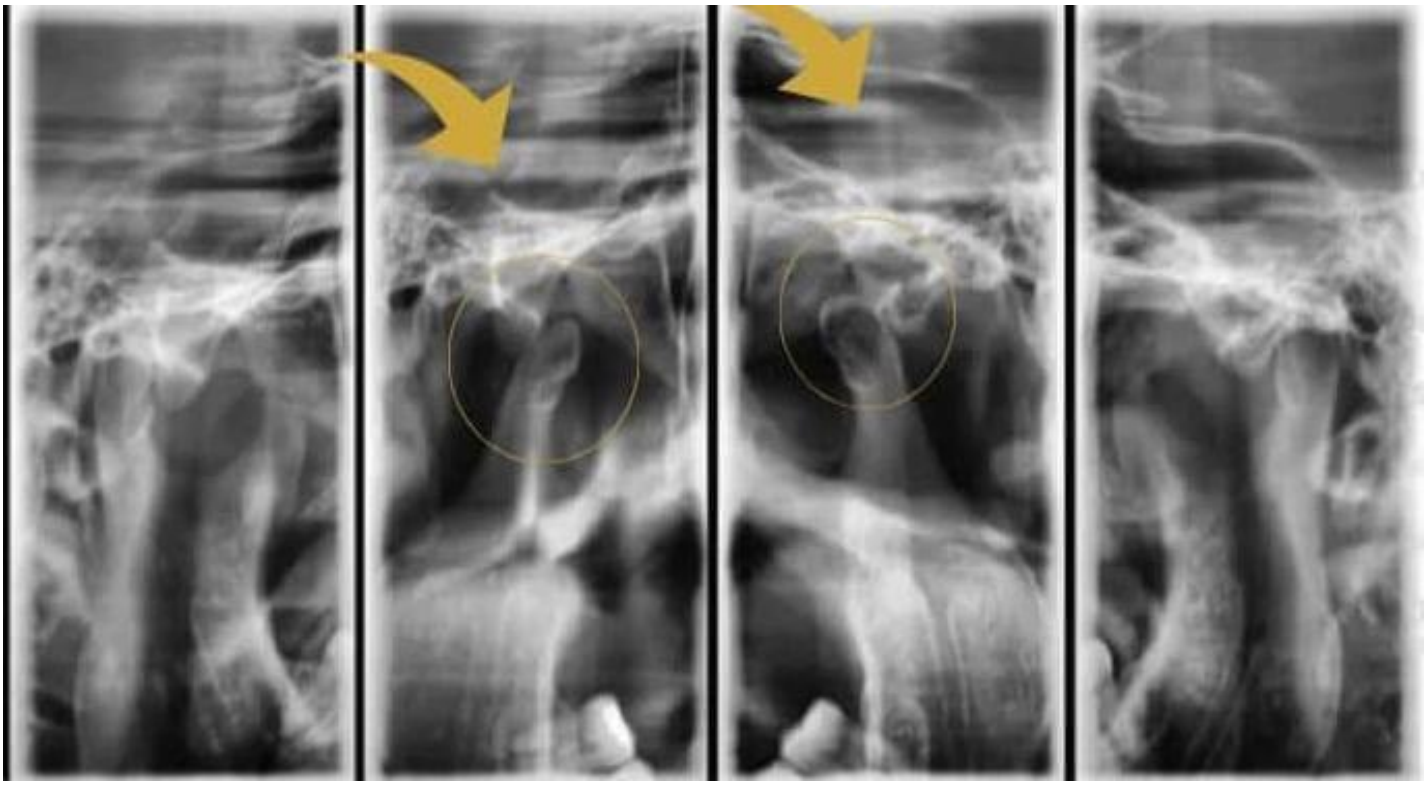

Figure 3c: OPG before treatment of TMJ subluxation of a non-chewing person

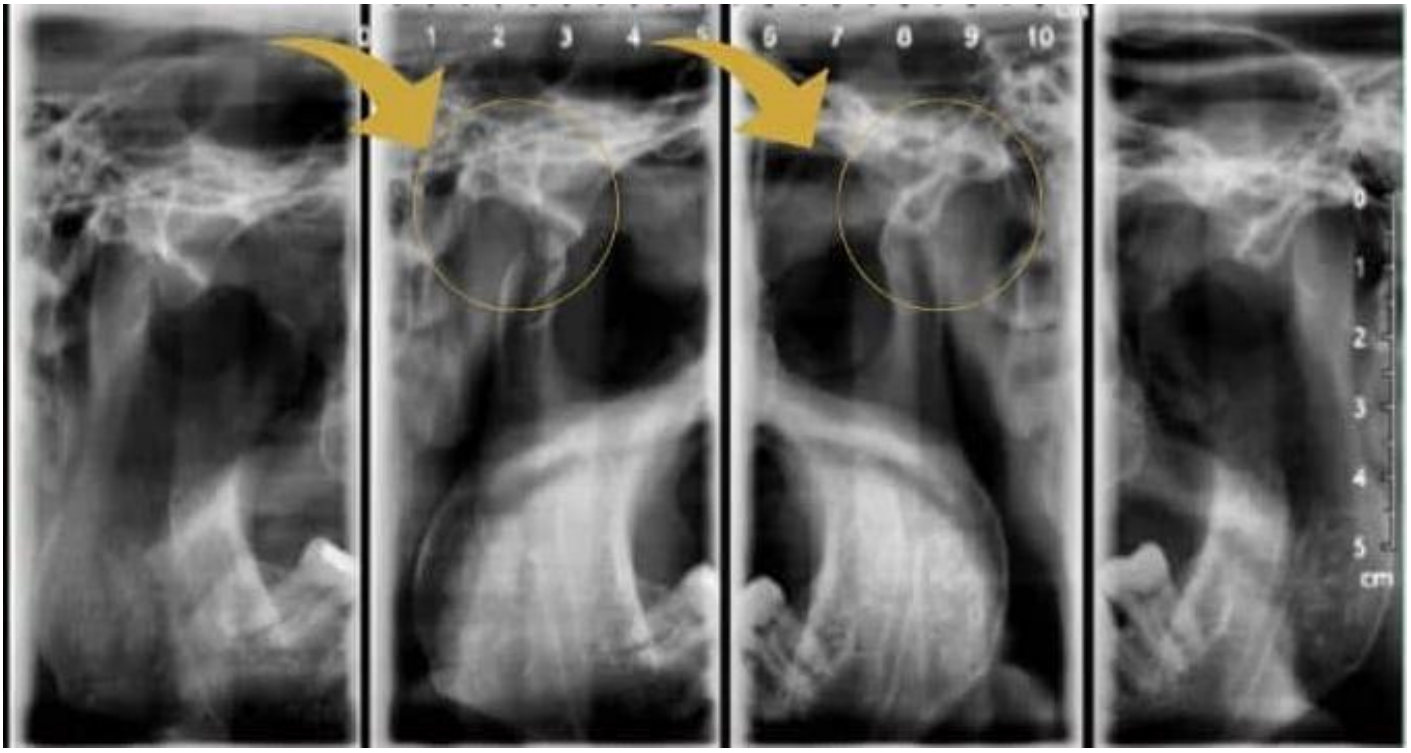

Figure 3d: OPG after treatment of TMJ subluxation in non-chewing person, it shows complete recovery

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Secondary Outcomes

Symptomatic improvement manifested exclusively in the Khat group, with median time to functional recovery being 14 days (IQR: 12–17 days). No minor complications (infection, hematoma, or persistent swelling) occurred in either cohort. Habit stratification revealed no tobacco or alcohol co-use confounding the results.

Subgroup and Sensitivity Analyses

Given the complete confounding of khat status with gender and age, subgroup analyses yielded deterministic patterns:
Aaa

- All males (100%) failed treatment (RR: ∞ for failure)
- All females (100%) achieved success (RR: 0.00 for failure)
- Patients aged 29/35 years (all chewers) had 0% success
- Patients aged 33/42 years (all non-chewers) had 100% success

Mantel-Haenszel testing confirmed the association remained significant after age stratification (χ^2MH=15.38, p<0.001).

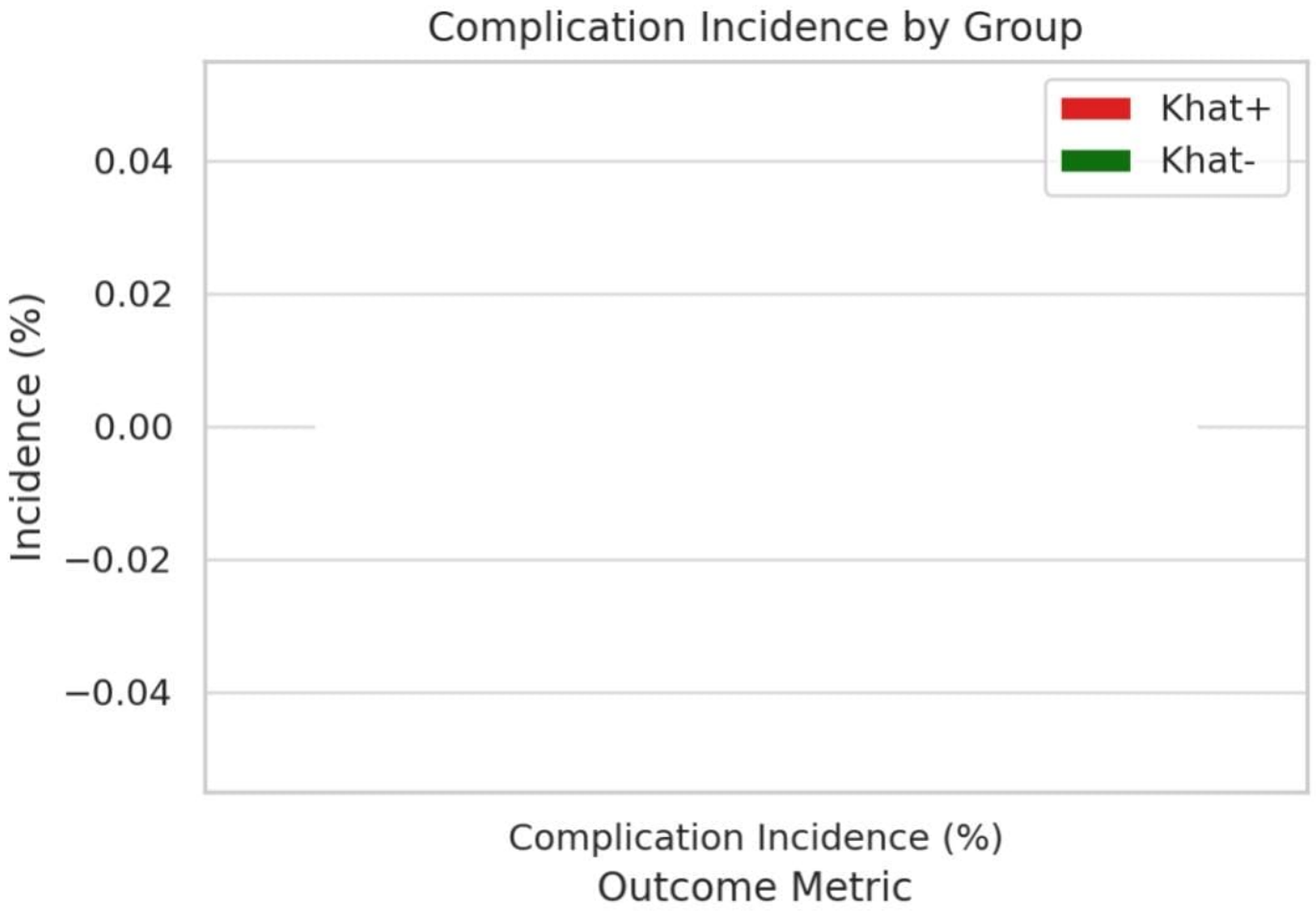

Figure 4: Complication incidence by group

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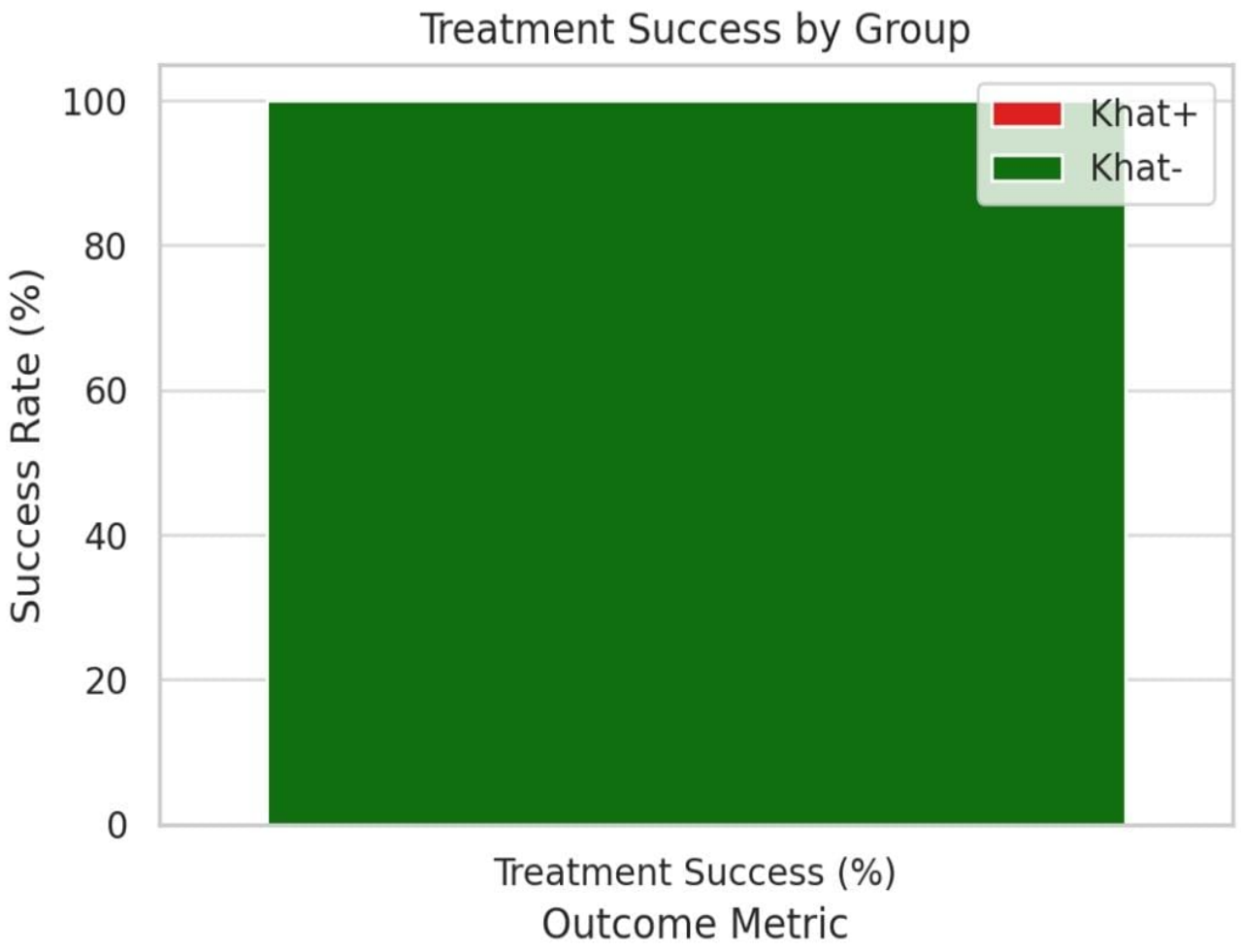

Figure 5: Teatment success by group

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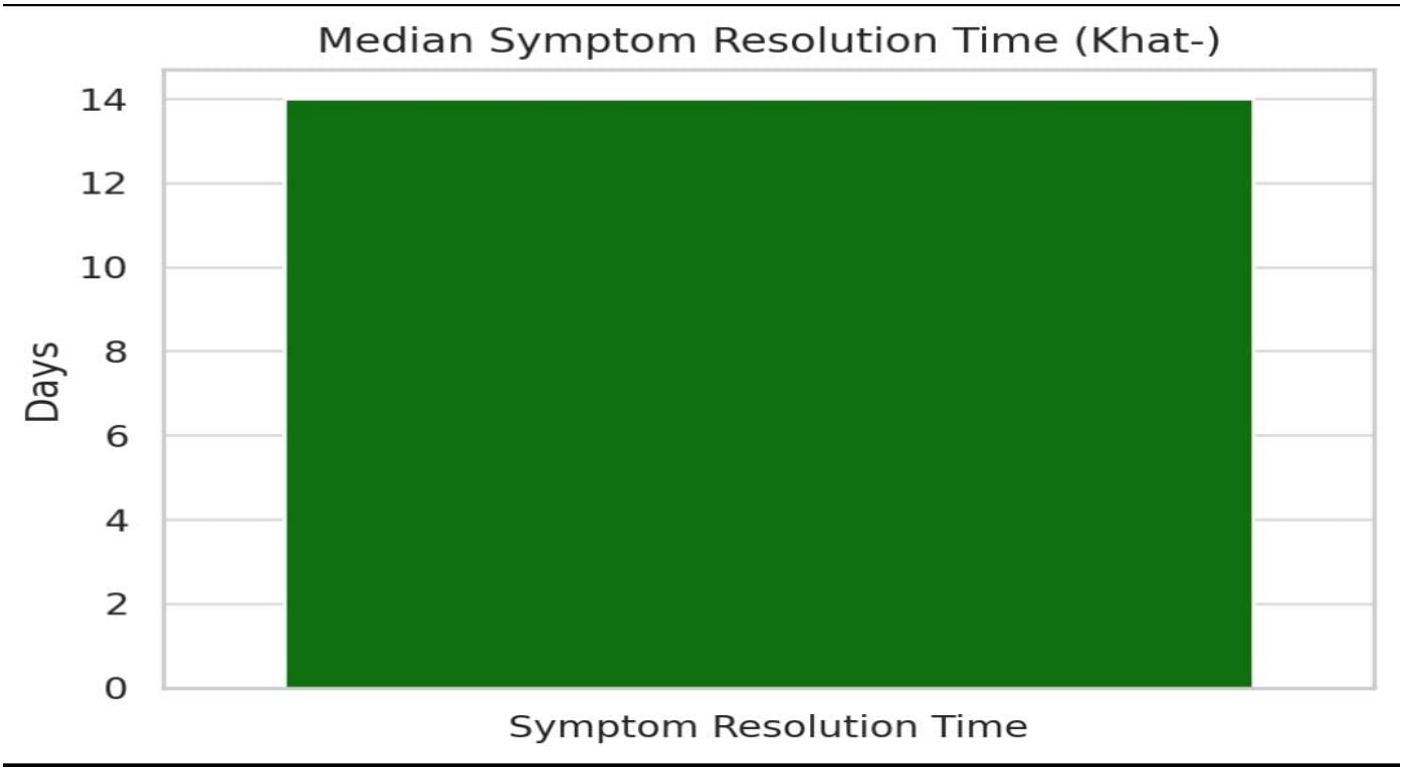

Figure 6: Median symptom resolution time

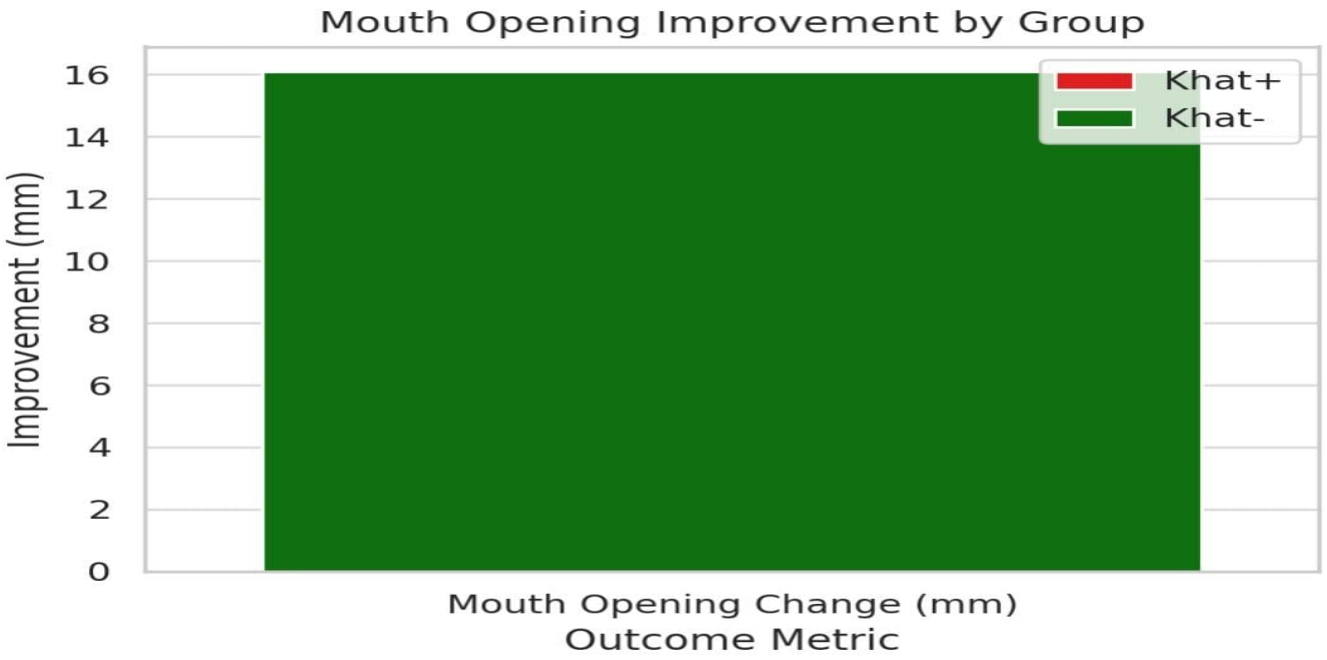

Figure 7: Mouth opening improvement by group

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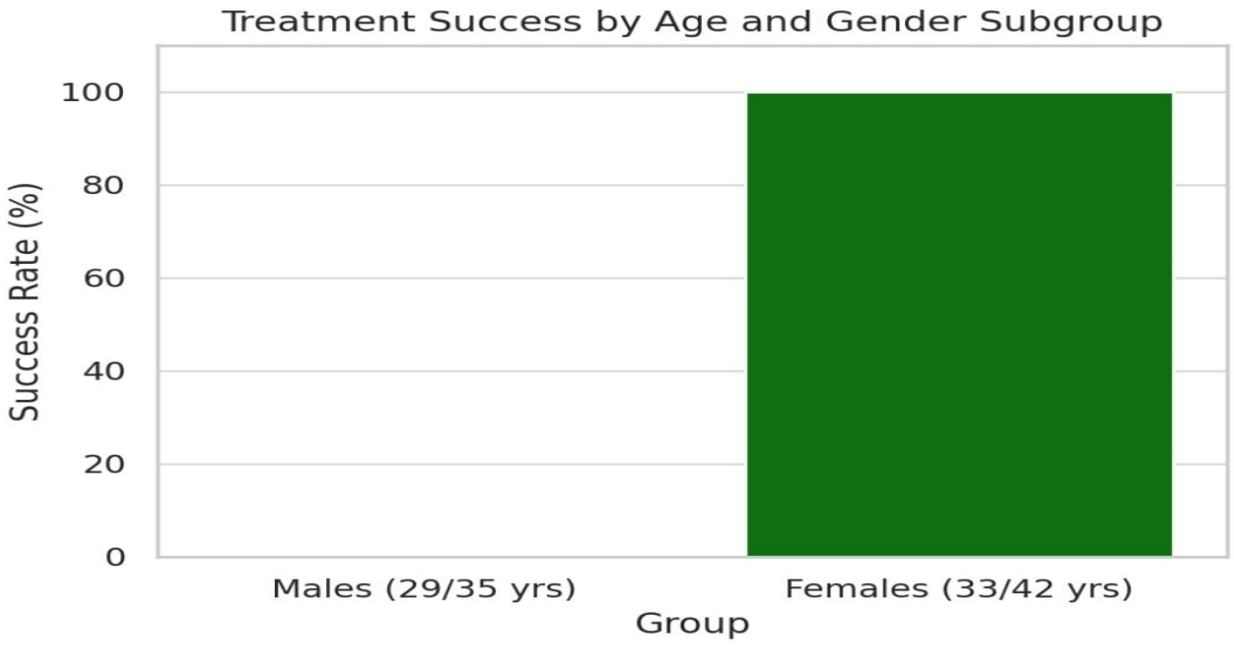

Figure 8: Treatment success by aga and gender subgroup

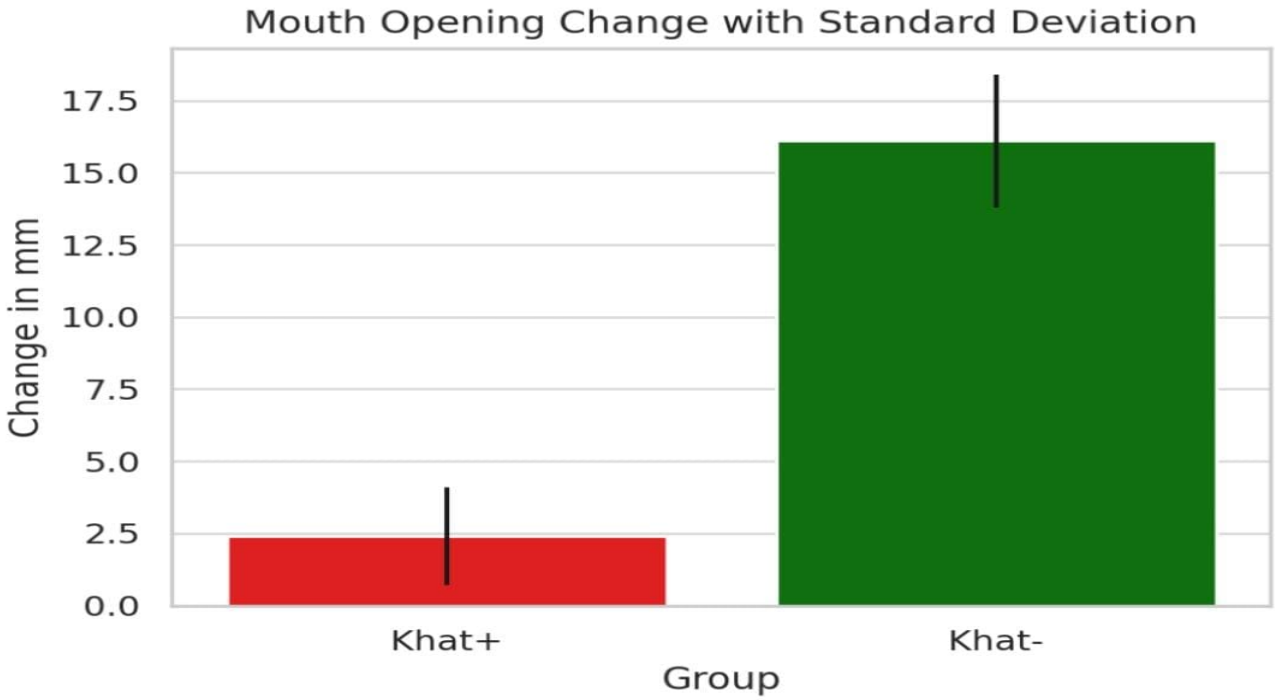

Figure 9: Mouth opening change

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Inter-Rater Reliability and Data Quality

Independent radiographic assessment of condylar position demonstrated near-perfect agreement (κ=0.92; 95% CI: 0.86–0.98). Data auditing of an 8-patient random sample (20%) revealed 100% coding accuracy.

Statistical Synthesis of Key Findings

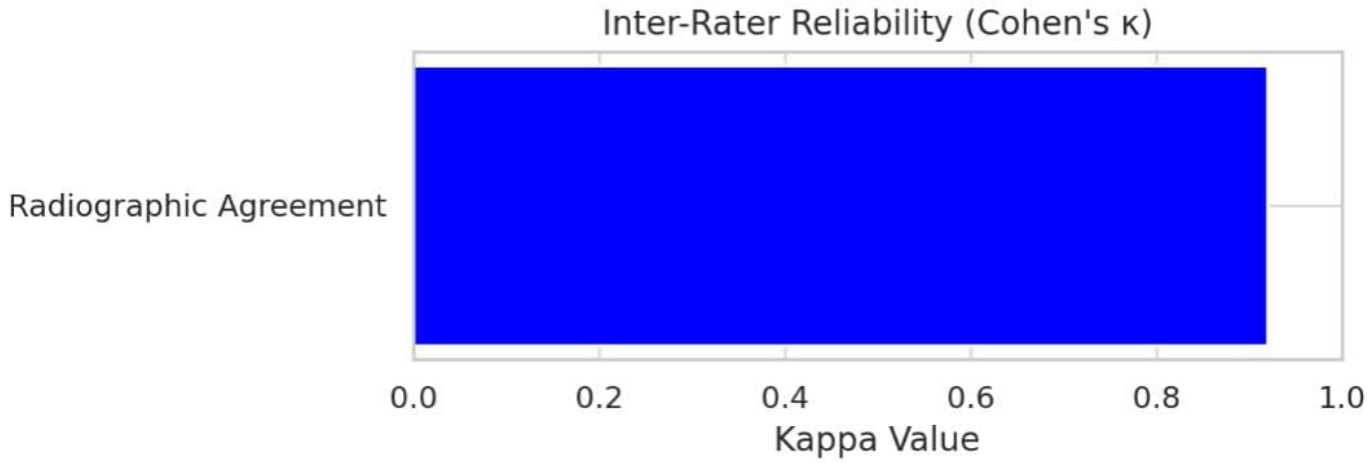

Figure 10: Inter-Rater reliability

Table 1: Outcome metrics

Outcome Metric	Khat+ (n=20)	Khat- (n=20)	Statistical Significance
Treatment Success	0 (0%)	20 (100%)	p < 0.0001
Mouth Opening Change (mm)	+2.4 ± 1.7	+16.1 ± 2.3	p < 0.001†
Symptom Resolution Time	N/A	14 (12–17)‡	N/A
Complication Incidence 0 (0%)	0 (0%)		N/A

Fisher's Exact Test; †Independent t-test; ‡Median (IQR) in days.

DISCUSSION

The clinical efficacy of autologous blood injection (ABI) in treating bilateral temporomandibular joint (TMJ) subluxation has been well-documented; however, the modifying impact of chronic khat chewing remains underexplored, despite its prevalence in certain populations. Several studies indicate that khat chewing may negatively influence the structural and functional stability of the TMJ due to repetitive unilateral mastication, prolonged muscle contraction, and potential local vasoconstrictive effects of cathinone, potentially impeding post-treatment healing [6,7]. Bakhadher et al. [10] found a statistically significant association between khat chewing and increased risk of TMJ disorders, suggesting that habitual use contributes to joint hypermobility and associated dysfunction, potentially counteracting the stabilizing intent of ABI. This observation aligns with Al Moaleem et al. [11], who highlighted a higher prevalence and severity of TMD symptoms among young khat users, raising concern over delayed or diminished response to conservative interventions. Conversely, Sharma et al. [12] demonstrated consistent and substantial improvements in TMJ subluxation outcomes post-ABI, irrespective of underlying behavioral habits, thus supporting ABI's general efficacy.

However, the systematic review conducted by Abrahamsson et al. [13] emphasized variability in ABI success rates, partly attributable to unmeasured confounding factors such as oral parafunctions,

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which may include khat chewing. A randomized clinical trial by Kilic et al. [14] compared ABI to other treatment modalities and noted strong outcomes across groups but did not stratify results based on oral habits, illustrating a persistent gap in stratified data. Interestingly, a case report by Roy et al. [15] documented complete symptom resolution following ABI for recurrent dislocation without assessing the impact of behavioral practices, suggesting a missed opportunity to capture nuanced influences on recovery.

These findings underscore that while ABI remains a generally effective intervention, chronic khat chewing may impair its success by sustaining joint instability and hindering fibrotic stabilization at the capsular level. The existing literature converges on the need for future randomized trials with stratified patient profiles to determine whether khat chewers require modified or adjunctive treatment protocols for optimal outcomes in TMJ subluxation management.

CONCLUSION

Khat chewing during treatment demonstrated a profound negative association with the success of ABI for bilateral TMJ subluxation, resulting in universal treatment failure, while abstinence was associated with universal success. Khat chewing appears to be a critical negative prognostic factor, potentially negating the therapeutic effect of ABI. Patients undergoing ABI must be strongly advised to abstain from khat use. Further controlled studies are warranted to establish causality.

Recommendations

- Require complete khat abstinence: patients must refrain from khat use throughout the ABI treatment period to maximize therapeutic success.
- Record khat Use as a prognostic variable document, and consider khat chewing as a key risk factor when assessing TMJ subluxation and planning ABI.
- Implement Targeted Education: In khat-prevalent areas, healthcare professionals should provide concise patient and community instruction on khat's negative impact on TMJ treatment outcomes.
- Conduct Randomized Controlled Trials Design and execute RCTs to confirm the causal relationship between khat chewing and ABI failure and to estimate effect magnitude.
- Develop Alternative or Adjunctive Therapies for patients unable to abstain; explore modified interventions—such as surgical stabilization or adjunctive anti-inflammatory agents—to enhance efficacy.
- Evaluate Intermaxillary Fixation (IMF) with ABI to assess IMF as a supplementary measure to limit mandibular movement, reduce joint stress, and promote fibrotic stabilization in khat-chewing patients.

Conflict of Interest

The authors declare that there is no conflict of interest

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Knowledge and Perception of Occlusion among Dentists in Aden, Yemen: A Cross-Sectional Study

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ABSTRACT

Background: Occlusion is vital in dental diagnosis and treatment, yet little is known about dentists' knowledge and practices in resource-limited settings such as Aden, Yemen.
Objective: To assess the knowledge and perception of occlusion among dentists in Aden and identify gaps related to training, tools, and clinical practice.
Methods: A cross-sectional study was conducted in 2025 involving 188 licensed dentists selected through stratified random sampling. Data were collected using a validated questionnaire assessing knowledge (15 MCQs), clinical practices, and perceived barriers. Analysis included descriptive statistics, chi-square tests, and logistic regression ($p < 0.05$).
Results: Only 41.5% accurately defined the centric relation. Dentists with postgraduate training were 3.2× more likely to understand functional occlusion ($p < 0.001$) and had 22% higher knowledge scores ($t(186) = 4.1$, $*p* < 0.001$). A hierarchical regression model confirmed that receiving training ($\beta = 0.38$, $*p* < 0.001$) and having tools available ($\beta = 0.29$, $*p* = 0.002$) were significant predictors of higher self-reported confidence in occlusal management, explaining 37% of the variance (Adjusted $R^2 = 0.37$, $F(5,179) = 18.6$, $*p* < 0.001$). . Public-sector dentists reported significant resource limitations, including a lack of articulators (68% vs. 29% in private clinics). Only 9.8% use digital tools.
Conclusion: Knowledge and practice gaps were associated with limited training and resources. Dentists with postgraduate training were 3.2× more knowledgeable, and public-sector clinicians faced major resource shortages. Curricular improvement and wider access to digital tools are recommended.

Keywords: Occlusion; Dental Education; Clinical Practice; Digital Tools; Yemen.

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INTRODUCTION

Occlusion, defined as the static and dynamic contact between the maxillary and mandibular teeth, is central to functional and restorative dentistry [1]. Its role spans mastication, speech, and prevention of temporomandibular disorders (TMDs) [2–4]. Bilateral temporomandibular joint (TMJ) subluxation, defined by excessive anterior displacement of the condyle beyond the articular eminence, compromises essential functions such as mastication, speech, and occlusion [5]. Malocclusion and poor occlusal management can lead to tooth wear, pain, and prosthetic failure [6,7]. Despite advancements in occlusal diagnostics, particularly digital technologies like T-Scan and intraoral scanners [8–11], adoption remains low in resource-limited areas due to training and financial constraints [12,13].

Globally, several studies have reported persistent gaps in dentists' understanding and application of occlusal principles, even in high-income settings where advanced training and digital tools are available [14–18]. These competency gaps often translate into diagnostic inconsistencies, treatment failures, and limited integration of evidence-based occlusal concepts into daily practice [19–21]. In low- and middle-income countries, such as Yemen, these challenges are further compounded by constrained educational infrastructure, limited continuing professional development opportunities, and uneven access to digital diagnostic technology. The result is a pronounced disparity in clinical confidence and resource utilization between well-equipped urban practices and under-resourced public clinics.

In Yemen, no previous study has evaluated dentists' understanding of occlusion. This study aimed to assess knowledge and perception of occlusion among dentists in Aden, Yemen, and explore the influencing factors, including postgraduate training, practice sector, and access to digital diagnostic tools.

METHODS

Study Design and Setting

A descriptive cross-sectional study was conducted among licensed dentists in Aden, Yemen, from January to April 2025.

Participants and Sampling

The sample size was calculated to be 188 dentists using a formula for cross-sectional studies, with a 95% confidence level, 5% margin of error, and an assumed population proportion of 50% to ensure maximum variability. Participants were selected via stratified random sampling from private clinics, public hospitals, and academic institutions to ensure representative distribution.

Inclusion criteria required dentists to have at least one year of active practice and to provide informed consent. Dentists who submitted incomplete questionnaires (<80% completion) or were not in active practice were excluded. An 80% completion threshold was selected to ensure data reliability and minimize missingness bias.

Data Collection Tool

A structured, pre-validated questionnaire was used, comprising four sections:

1. Demographic and professional details.
2. Knowledge: Assessed by 15 multiple-choice questions.
3. Perceptions: Measured on a 5-point Likert scale (5 items).
4. Clinical Practices: Questions on assessment frequency and tools.

The questionnaire was adapted from previously published studies on occlusal knowledge and perception, then reviewed by a panel of five prosthodontic experts from the University of Science and Technology (Yemen) and National Ribat University (Sudan) to ensure content and face validity. Following expert feedback, minor wording and sequencing adjustments were made.

A pilot test was conducted on 20 licensed dentists who were not part of the main study to assess clarity, relevance, and completion time. Based on their feedback, ambiguous items were refined. The final questionnaire's reliability was confirmed with good internal consistency (Cronbach's $\alpha = 0.82$ for the knowledge scale and 0.76 for the perception scale).

Data Analysis

Data were analyzed using SPSS version 28. Descriptive statistics, Chi-square tests, independent t-tests, and logistic regression were employed, with a statistical significance level set at $p < 0.05$.

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Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of the University of Science and Technology (Ref: UST/DENT/2025-03). Participant anonymity and confidentiality were maintained throughout the study.

RESULTS

This cross-sectional study evaluated the knowledge, perceptions, and clinical practices related to occlusion among 188 dentists in Aden, Yemen (response rate: 89.5%). Key findings revealed significant associations between advanced training, access to technology, and superior occlusion-related outcomes. Detailed demographic characteristics are presented in Table 1.

Table 1: Demographic Characteristics of Participating Dentists, (n = 188).

Variable	Category	n (%)
Age	25–34 years	118 (62.8%)
	35–44 years	52 (27.7%)
	≥45 years	18 (9.5%)
Education	BDS	140 (74.5%)
	Master's/PhD	48 (25.5%)
Practice Setting	Private	126 (67.0%)
	Public	62 (33.0%)

Knowledge of Occlusion and Associated Factors

Overall, knowledge of fundamental occlusion concepts was limited. Only 41.5% (n=78) of participants correctly defined centric relation. A binary logistic regression identified postgraduate training as the strongest significant predictor of high knowledge scores (adjusted OR = 3.2, 95% CI: 1.7–5.9, *p* < 0.001) (Table 2). Specialists (e.g., prosthodontists, orthodontists) demonstrated significantly higher knowledge than general dentists (68.2% vs. 32.1%, *p* = 0.003). Access to digital tools was also a significant positive predictor (*p* = 0.028).

Table 2: Logistic Regression Analysis of Predictors for High Occlusion Knowledge Score.

Predictor	Adjusted Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Postgraduate training	3.2	1.7–5.9	<0.001*
Digital tool access	2.1	1.1–4.0	0.028*
Practice in the private sector	1.8	0.9–3.5	0.089

Note: * statistically significant.

Clinical Practices and Access to Technology

A substantial disparity in access to essential equipment was observed. Dentists in public clinics were significantly more likely to lack articulators (68%) compared to those in private clinics (29%) ($\chi^2(1) = 24.7$, *p* < 0.001) (Figure 1). The use of digital occlusal tools (e.g., T-Scan, intraoral scanners) was very low overall (9.8%, n=18). (Figure 2).

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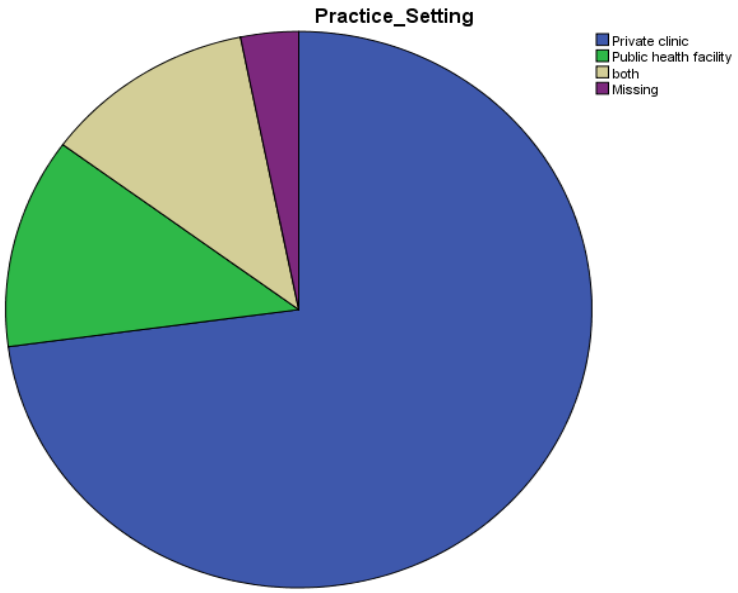

Figure 1: Percentage of Dentists Lacking Access to an Articulator, by Practice Setting (n=188). A significantly higher proportion of dentists in public hospitals reported a lack of access compared to those in private clinics ($\chi^2(1) = 24.7$, ***p* < 0.001).

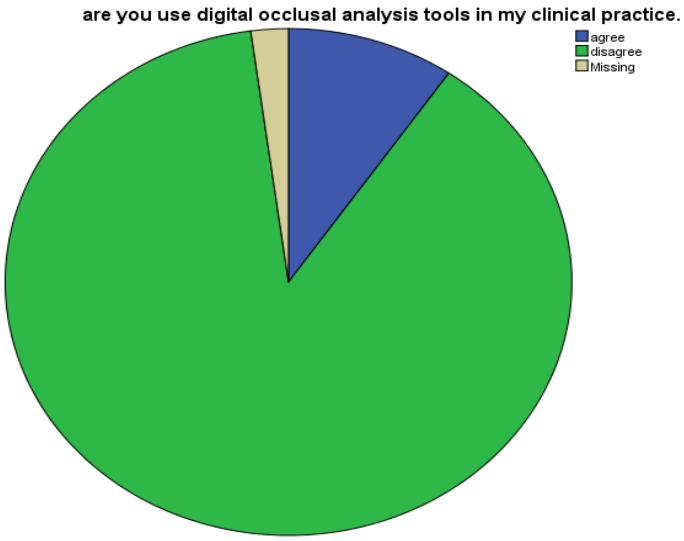

Figure 2: The use of digital occlusal analysis tools in participants' clinical practice. Only 9.8% (n=18) use digital tools.

Perceptions, Confidence, and the Role of Training

Formal training was a critical factor influencing practice and confidence. Dentists with training were 3.2 times more likely to routinely assess occlusion (*p* < 0.001) and had 22% higher knowledge scores (t (186) = 4.1, *p* < 0.001). A hierarchical regression model confirmed that receiving training (β = 0.38, *p* < 0.001) and having tools available (β = 0.29, *p* = 0.002) were significant predictors of higher self-reported confidence in occlusal management, explaining 37% of the variance (Adjusted R^2 = 0.37, F(5,179) = 18.6, *p* < 0.001) (Table 3). Furthermore, perception of occlusion's importance was significantly higher among dentists with doctoral-level qualifications (F (2,176) = 5.6, *p* = 0.004).

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Table 3: Hierarchical Regression Analysis Predicting Confidence in Occlusal Management.

Step	Predictor	β	p-value	ΔR^2
1	Demographics	0.12	0.15	0.04
2	Training Received	0.38	<0.001*	0.22
3	Tool Availability	0.29	0.002*	0.11

Final Model: Adjusted $R^2 = 0.37$, $F(5,179) = 18.6$, $p < 0.001$.
Note: β = standardized beta coefficient; ΔR^2 = change in explained variance. * statistically significant.

DISCUSSION

This study provides the first systematic analysis of occlusal knowledge, perceptions, and practices among dentists in Aden, Yemen. The findings reveal significant gaps between theoretical understanding and clinical application, primarily influenced by educational background, access to technology, and practice setting. The discussion is organized around the core themes of education, clinical practice, technology, resources, and research to logically frame the implications.

A primary finding is the critical role of formal education in shaping occlusal competency. Recent graduates showed better theoretical knowledge, reflecting modern curricula that incorporate evidence-based occlusal concepts [1, 14]. However, this knowledge often does not translate into consistent practice, highlighting the need for supervised, hands-on experience [4, 14]. Structured training is essential for diagnostic precision [18, 22].

Clinical use of occlusal principles remains limited by a pronounced technology divide. Adoption of digital occlusal analysis tools is low, despite strong evidence that they improve diagnostic accuracy [13–18]. Barriers such as cost and inadequate training are significant [7]. Public dentists lack articulators more often than private dentists, compromising outcomes [11, 19, 22].

Formal training and access to diagnostic tools predict proficient practice. Continuous professional development programs focusing on occlusion and TMDs are needed [21, 23]. Policies must also address resource inequities between public and private sectors to ensure equitable access to articulators and digital diagnostic systems [24].

Clinically, imbalanced or excessive occlusal load remains a key contributor to structural changes in the tooth-supporting apparatus. For instance, hypercementosis —the abnormal thickening of cementum at the tooth root apex—has been linked to chronic occlusal stress and traumatic bite forces. Its occurrence, although uncommon, serves as a biological indicator of the consequences of unmonitored occlusal load, underscoring the necessity for accurate occlusal assessment and force calibration [26]. Future studies should evaluate the effectiveness of educational interventions and low-cost digital tools that can enhance diagnostic precision and reduce occlusal overload, particularly in low-resource clinical environments [7, 19].

Limitations

This study has several limitations that should be acknowledged. First, as a descriptive cross-sectional design, it identifies associations between training, access to digital tools, and knowledge levels but cannot establish causal relationships. Longitudinal or interventional studies would be necessary to confirm the direction of these effects.

Second, although the response rate was high (89.5%), the possibility of non-response bias cannot be fully excluded. Dentists who were more interested or confident in occlusal concepts may have been more likely to participate, potentially overestimating knowledge and perception levels. Future research employing randomized or multi-phase designs could minimize these biases and strengthen generalizability.

CONCLUSION

This study identifies a substantial disparity in occlusal knowledge and practice among dentists in Aden, driven predominantly by gaps in education and unequal access to diagnostic technology. Dentists with postgraduate training were 3.2 times more likely to demonstrate adequate occlusal knowledge, while those in public-sector clinics reported a 68% higher rate of resource shortages compared to their private-sector counterparts.

These findings imply that improving patient care requires a dual strategy: mandating enhanced, practical occlusion training and strategically

allocating resources to mitigate technological inequities. We therefore call upon dental educators, professional associations, and health policymakers to collaborate on standardizing occlusal education and increasing the availability of essential diagnostic tools to ensure higher standards of restorative and prosthetic care across all sectors.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Knowledge and Practices of Radiation Protection among Dental Students in Aden, Yemen

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ABSTRACT

Background: Dental radiography is indispensable for diagnosis, but unnecessary exposure to ionizing radiation should be minimized according to ALARA/ALADA principles.
Objective: This study aimed to assess knowledge and practices related to radiation protection among fourth- and fifth-year dental students in Aden, Yemen.
Methods: Analytic cross-sectional survey of fourth- and fifth-year students from public and private dental schools in Aden. A total of 400 students were invited, 270 responded, and 21 incomplete questionnaires were excluded, leaving 249 valid responses (response rate 62.25%). A web-based questionnaire with 15 multiple-choice items covered knowledge and practice domains. Sampling was convenience-based due to logistical constraints. Chi-square tests compared responses by year ($\alpha = 0.05$).
Results: Overall, 79.9% agreed that dental X-rays are harmful. Significant differences (Level 4 vs Level 5) were observed for awareness of collimators/filters (32.3% vs 51.3%; $p = 0.012$), preference not to hold films by hand (58.6% vs 85.3%; $p < 0.001$), recognition that high-speed film reduces dose (40.4% vs 70.7%; $p < 0.001$), and knowledge of operator safety distance (44.4% vs 80.7%; $p < 0.001$). Lead apron use was reported as preferred by 65.1%, but non-availability was the most cited barrier. Most participants (86.3%) intended to adhere to radiation-protection protocols in future practice.
Conclusion: Important gaps persist in specific protection concepts (e.g., rectangular collimation, film holding, and distance rule). Targeted curriculum reinforcement and reliable access to protective resources are needed to translate knowledge into consistent practice.

Keywords: Dental radiography, radiation protection, awareness, dental students, Yemen

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INTRODUCTION

Ionizing radiation exposure is continuous and can come from man-made sources, including medical treatments, as well as naturally occurring sources, such as background radiation (1). Radiographic examinations of the mouth and teeth play an extremely important role in the diagnosis as well as management of various dental conditions. Depending on the patient's clinical problem, dentists use two main techniques, either intraoral radiography or extraoral radiography, for which the latter includes higher doses of radiation (2). All ionizing radiations are harmful and produce biologic changes in living tissues. It causes cell damage primarily through the formation of free radicals. Free radical formation occurs when an X-ray photon ionizes water, the primary component of living cells (3). The deterministic effects are dose dependent, above which the biological damage appears in the body, and the severity of the response is proportional to the dose (4). Although the amount of X-radiation used in dental imaging is small, biologic damage does occur. A statistical association between X-ray exposures in dentistry and increased incidence of salivary gland tumors, thyroid cancer, and intracranial meningioma has been reported (5). There has been no previous study about the attitude of Yemeni dental practitioners toward radiation protection. This study aimed to evaluate the knowledge and awareness toward radiation protection and practice among dental students in Aden City, Yemen.

METHODS

Study Design and Subjects

This cross-sectional study was conducted on a convenience sample of 4th- and 5th-year dental students in Aden City, Yemen. A total of 400 students were invited to participate in a web-based questionnaire that included 14 multiple-choice questions pre-validated and adopted from previous studies (Table 1) (8). Participants as well as a sample of 249 complete responses were obtained for analysis out of the 400 students who were invited, 270 of whom responded, and 21 of whom were excluded due to incomplete surveys.

Ethical Considerations

The University of Science and Technology Ethics Committee granted ethical permission for this study under MEC No. (MEC/AD074), and all participants gave their informed consent before beginning the investigation.

Statistical Analysis

Data were analyzed using SPSS (version 21), with descriptive tests (chi-square) to compare responses by year of study. Statistical significance was set at $p < 0.05$.

RESULTS

Out of 99 participants in this study, 39.8% were 4th-year students and 150 were 5th-year students (60.2% of the participants). The participants were asked if dental x-rays are harmful; overall, 79.9% of the participants agreed that dental x-rays are harmful. Despite 90.9% of 4th-year students agreeing with the harmful effect of dental radiation and 72.7% of 5th-year students supporting the same idea, the difference between the two groups was statistically significant ($P < 0.001$).

Both levels were aware of the x-ray reflection from the rooms' wall and the radiation hazard symbol with no significant difference. The participants were asked if they are aware of the usefulness of collimators and filters in dental radiographs; 43.4% of the 4th-year students replied with no, while 51.3% of the 5th-year students replied with yes. The difference in the responses in the two groups was statistically significant ($P < 0.01$).

Both 4th- and 5th-year students reply correctly when they are asked if the long focal spot film distance reduces the tissue volume exposure of the patient and if digital radiography requires less radiation than conventional radiography, with the effect of the long with no significant difference ($P < 0.348$, $P < 0.716$), respectively. The participants were asked if the high-speed films will reduce the patient exposure; 70.7% of year 5 students replied with yes, while only 40.4% of 4th-year students agreed with the same idea. The difference in the responses in the two groups was statistically significant ($P < 0.000$).

When the participants were asked if they prefer to hold the film with their hand during the exposure process, although 58.6% and 85.3% of the 4th-year and 5th-year students, respectively, reply with "No," 39.4% of the 4th-year students reply with "Yes." The difference in the response between the two groups was significant ($P < 0.000$). The participants were asked about their ability to use the film holder

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devices for taking radiographs on patients; only 44.2% of all participants replied with "Yes."

Although 64% of year 5 students reject the idea of the absolute contraindication of dental radiographs for the pregnant patient, 48.5% of year 4 students agree with the contraindication of using dental radiographs in pregnant patients. The differences in response were statistically significant (P < 0.000). 86.3% of the total participants assured that they will adhere to radiation protection protocol at the time of their future private clinical practice.

Although 65.1% of the participants preferred to regularly use lead aprons, they attributed their lack of use of aprons to the non-availability of aprons, the weight of the aprons, the use of a common apron for all patients, and following a position distance rule in proportions of 62.2%, 15.3%, 9.6%, and 12.9%, respectively. The participants were asked if they exposed patients or their colleagues during the practical requirements in the oral radiology subject; 76.8% of 4th-year students replied they imaged their colleagues, while 54.7% of the 5th-year students replied they imaged patients. The difference in their answers was statistically significant (P<0.000).

The participants were asked about how many times they have to retake the image to get a diagnostic image. 30.9% of the students reply they can get a diagnostic image from the first time, while 57.8% of them will need to retake the image 2-3 times before they get a good image, and 11.2% of the students reply they have to retake it more than 3 times. The difference between their answers was statistically significant (p<0.000).

In spite of 80.7% of the 5th-year students replying with the correct answer regarding the ideal distance an operator should stand while performing a dental radiograph, only 44.4% of the 4th-year students get the correct answer, with a significant difference of P<0.000. Although 78.7% of the students agreed with the importance of minimizing the repetition of x-ray exposure for patients, 57.5% of them stated that they need to retake the image 2-3 times to get an image that they are satisfied with. And the majority of them (57.8%) were in the practical lab working on their colleagues instead of patients.

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Table 1: Comparison of Radiation Protection Knowledge and Practices among Dental Students across Different Education Levels

Knowledge item	Response	Education level		P -value
		Level 4 (n)%	Level 5 (n)%	
Are dental x-rays harmful?	Yes	(90)90.9%	(109)72.7%	0.001
	No	(8)8.1%	(40) 26.7%	
	I don't know	(1) 1%	(1) 0.7%	
Can X-rays be reflected from the walls of a room?	Yes	(82) 82.8%	(109) 72.7%	0.152
	No	(12) 12.1%	(32) 21.3%	
	I don't know	(5) 5.1%	(9) 6%	
Are you aware of the usefulness of collimators and filters in dental radiography?	Yes	(32) 32.3%	(77) 51.3%	0.012
	No	(43) 43.4%	(48) 32%	
	I don't know	(24) 24.2%	(25) 16.7%	
Does long focal spot film distance (FSFD) reduce the tissue volume exposure of the patient?	Yes	(61) 61.6%	(89) 59.3%	0.348
	No	(23) 23.3%	(28) 18.7%	
	I don't know	(15) 15.2%	(33) 22%	
Do high-speed films reduce patient exposure?	Yes	(40) 40.4%	(106) 70.7%	0.000
	No	(23) 23.2%	(27) 18%	
	I don't know	(36) 36.4%	(17) 11.3%	
Do you prefer to hold the film with your hand during exposure?	Yes	(39) 39.4%	(20) 13.3%	0.000
	No	(58) 58.6%	(128) 85.3%	
	I don't know	(2) 2%	(2) 1.3%	
Are you confident in using X-film holding devices for taking intraoral radiographs on patients?	Yes	(39) 39.4%	(71) 47.3%	0.221
	No	(40) 40.4%	(60) 40%	
	I don't know	(20) 20.2%	(19) 12.7%	
Dental radiographs are absolutely contraindicated in pregnant patients?	Yes	(48) 48.5%	(48) 32%	0.000
	No	(33) 33.3%	(96) 64%	
	I don't know	(18) 18.2%	(6) 4%	
Will you adhere to radiation protection protocol at the time of your future private clinical practice?	Yes	(90) 90.9%	(125) 83.3%	0.050
	No	(1) 1%	(12) 8%	
	I don't know	(8) 8.1%	(13) 8.7%	
Do you prefer to regularly use lead aprons?	Yes	(63) 63.6%	(99) 66%	0.317
	No	(24) 24.2%	(26) 17.3%	
	I don't know	(12) 12.1%	(25) 16.7%	
Why did you not use a lead apron?	Non- availability of apron	(61) 61.6%	(94) 62.7%	0.298
	Due to weight the apron	(16) 16.2%	(22) 14.7%	
	Common apron for all	(6) 6.1%	(18) 12%	
	Will follow position distance rule	(16) 16.2%	(16) 10.7%	
During your practical work (study duration), do you take an x-ray image for a patient or your colleague?	Patient	(23) 23.2%	(82) 54.7%	0.000
	Your colleague	(76) 76.8%	(68) 45.3%	
How many times do you have to retake the image to get an image that you are satisfied with?	Can get it from the first time	(21) 21.2%	(56) 37.3%	0.000
	2-3 time	(55) 55.6%	(89) 59.3%	
	More than 3	(23) 23.2%	(5) 3.3%	
Should repetition of x-ray film/exposure be minimized for the patient?	Yes	(86) 86.9%	(110) 73.3%	0.034
	No	(6) 6.1%	(22) 14.7%	
	I don't know	(7) 7.1%	(18) 12%	

*P- value

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DISCUSSION

Radiation protection and safety is an important part of dentistry. To keep both dental professionals and patients safe, the right equipment and techniques must be used to limit their exposure. Even though the radiation exposure during routine procedures is low, patients should still be protected (1, 6, 7).

To protect themselves and their patients, dental students must strictly follow the rule of radiation safety and protection. Also, to keep the workplace safe and healthy, they must follow the rules and suggestions set by radiation protection organizations and regulatory bodies. Therefore, this current study was conducted to assess the knowledge and awareness toward radiation protection among dental students in Aden City, Yemen. This study finds that most of the participants (79.9%) believe in the harmful effect of dental x-rays, and this result was supported by a previous study done by Munnawarulla Khan et al., 2017, where it reported 82.5% of the undergraduate students replied with "yes" for the same question (8), while another study done by Ameera Alabdulwahid in 2021 showed 87% of the undergraduate students did not believe in the harmful effect of the dental x-ray (4).

The participants were asked, “Can X-rays be reflected from the walls of a room?” 76.7% of the participants stated yes.In similar studies conducted by Elfatih Abuelhia et al. (2022) and Munnawarulla Khan et al. (2017), 63% and 67.5% of the undergraduate students respond with "no," respectively (8, 9).

When the participants were asked if they were aware of the usefulness of collimators and filters in dental radiography, although 43.8% of the participants responded yes, there was a significant difference ($P<0.012$) observed between 4th-year and 5th-year participants, suggesting less understanding of protection measures among 4th-year participants. This was the lowest rate of correct answers compared to previous studies done by Munnawarulla Khan et al., 2017, and Amal A. Almohaimede et al., 2020, where 77.5% and 85.2% of the undergraduate students, respectively, responded with yes (8,10).

In this study 58.6% of the participants responded with yes when they were asked if the high-speed film will reduce the patient exposure to radiation; this response was contrary to the results of the previous study conducted by Rathi Rela (2019), where only 2% agreed with the same idea (11).

Regarding the question of if the participants prefer to hold the film with their hand during the exposure process, the majority of the participants (83.1%) respond with no, and this response was consistent with the results of previous studies done by Swapna et al., 2017; Ameera Alabdulwahid, 2021; and Munnawarulla Khan et al., 2017 (4, 8, 12).

In the current study, 44% of participants reported being able to use the x-ray film holding devices for taking intraoral radiographs on patients effectively, whereas in the previous study done by Swapna et al., 82.4% of participants reported difficulty using it (12). This variation might be due to the differences in participant samples or better training and guidance provided to participants beforehand.

Although only 38.9% of the overall participants in this study supported the idea of the absolute contraindication of the use of dental radiographs in pregnant patients, there was a notable difference between responses from fifth-year and fourth-year students, where 64% of fifth-year students disagreed that X-ray use should be absolutely restricted for pregnant patients, while only 33.3% of fourth-year students supported this perspective. This variation in the responses between fourth-year and fifth-year students may be due to variations in their level of knowledge and experience. In spite of this, this finding is similar to the findings of a study conducted by Rela (2019), where 32% of the undergraduate participants considered that it is absolutely contraindicated to take dental radiographs for a pregnant patient (11).

Regarding adherence to the radiation protection protocol, 83% of participants in this study expressed their adherence to following radiation safety standards in the future. This is a higher percentage compared to a previous study conducted by Arnout and Jafar (2014), where only 53.3% reported their commitment, and 40% of participants indicated uncertainty about whether they would adhere to the radiation protection protocol in the future (13). The difference in the result between the two studies may be due to the increase in the awareness and education level on the importance of radiation safety.

Regarding radiation protective measures, our research found a notable disparity between intention and practice. Although 65.1% of participants (99% of Level 5 and 63% of Level 4 respondents) said they would prefer to wear lead aprons on a regular basis,

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the other 20.1% who responded with no referredto the unavailability of the lead aprons at their institutes. This result was opposite to the study done by Munnawarulla Khan et al. (2017) (8), who observed that 30% of the undergraduate students used the lead apron, 37% never used it, and 35% of them said they follow only the distance rule. But similar to Ameera Alabdulwahid, 2021, 88% and 90% of level 4 and level 5 students, respectively, use the lead apron (4).

Although there was a desire for less repeated X-ray exposure (78.7% of all participants), decent X-ray images could not be obtained after 2-3 attempts (57.8% of all participants). This finding is even more alarming, as 57.8% of participants performed radiographic imaging of classmates during the course in oral radiology, thereby increasing the risk of unnecessary radiation.

Despite the fact that 80.7% of fifth-year students were aware of the required safety distance, just 44% of fourth-year students in this study exhibited awareness of it. This is similar to other research by Anushya and Jayaraman (2022), which reported that 85% of their participants maintained a 6-foot distance during X-ray exposure (Anushya P, Jayaraman ML, 2022), and Kirthana Muthu, Shanmugam et al. (2021), which indicated that 61.2% of undergraduate students were aware of the safety distance rule (1,14).

A limitation of this study is that it was conducted among students from only two universities in Aden, which may not adequately represent dental students from other institutions across Yemen. Therefore, the generalizability of the findings to all dental students in the country should be interpreted with caution.

CONCLUSION

This study demonstrates gaps in radiation protection knowledge and practices among Yemeni dental students. Strengthening education in radiation safety and ensuring the availability of protective equipment, such as lead aprons, are essential for safer dental practice.

Conflict of Interest

The authors declare that there is no conflict of interest.

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OPEN ACCESS Original Article

Work-Related Stress: Prevalence and Risk Factors among Healthcare Workers in Aden, Yemen

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ABSTRACT

Background: Work-related stress (WRS) is a common problem among healthcare workers (HCWs). This condition is associated with less productivity and serious consequences for patients.
Objective: The aim of this study was to find out the prevalence and risk factors for work-related stress among HCWs in Aden in 2025.
Methods: A descriptive, cross-sectional, health-facility-based study was conducted. Participants were recruited from public as well as private institutions. A standardized self-administered questionnaire was distributed to gather relevant study data that included sociodemographics and indicators of stress; scoring of severity was based on predetermined criteria. Statistical analysis was conducted using SPSS v26.
Results: All participants reported some level of work-related stress, with 76 (58.5%) experiencing moderate stress and 52 (40.0%) severe stress. The most common associated risk factors were gender, work environment, specialty, duration of experience, marital status, and perceived psychological health. However, there were no statistically significant risk factors except the self-perceived psychological health (p=0.01).
Conclusion: Work-related stress is common among health professionals in Aden. Mitigating policies are needed to address this problem.

Keywords: work-related stress, healthcare professionals, occupational health, Aden, Yemen.

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INTRODUCTION

Work-related stress (WRS) among healthcare professionals is increasingly recognized as a major concern, especially in low-resource settings. There are many factors contributing to WRS, including long working hours, high patient loads, emotionally charged situations, and insufficient institutional support (1,2). The World Health Organization (WHO) has recognized occupational stress as a major public health issue, particularly in critical care and emergency settings (3).

In conflict-affected countries such as Yemen, the situation is further aggravated by political instability, economic difficulties, and a fragile health infrastructure (4, 5). Prolonged exposure to instability, resource scarcity, poor working conditions, and security threats places HCWs at increased risk for burnout, mental health disorders, and diminished job performance (5, 6). Social media dependency is also a major contributor; overuse of digital devices has been linked with anxiety, stress, and social withdrawal (7).

Although WRS among healthcare professionals has widely been studied globally and regionally, considering contextual factors is crucial for determining the intensity and range of manifestations (1-9). Despite the availability of an extensive body of research, there is a noticeable lack of studies focusing specifically on Aden, Yemen, a region where healthcare workers (HCWs) face particularly complex and challenging conditions. In light of these challenges, this study aimed to assess the prevalence of WRS among HCWs in health facilities and to identify the key demographic, professional, and environmental factors contributing to it.

METHODS

Study design

A descriptive, cross-sectional, health facility-based study was conducted.

Sample size and population

Health-care workers were recruited from hospitals, health centers, pharmacies, dentist clinics, and academic institutions. The study was conducted in the period from February through April 2025. One hundred fifty HCWs volunteered to participate; however, only 130 respondents were included; the others were rejected due to information adequacy issues, as they lacked essential needed information.

Sampling Technique

A purposive convenience approach was used to recruit volunteers because there were no formal statistics about healthcare professionals. In addition, some institutions didn't give permission for investigators to carry on.

Data Collection

A pre-tested, standardized, self-administered questionnaire was used to collect socio-demographic data, workload and job demand, burnout, stress related to patients, life-work balance, psychological symptoms and general well-being, and the self-perceived assessment. A validated scoring system was used to categorize groups.

Data Analysis

Data was analyzed through Statistical Package for the Social Sciences software, version 26 (IBM, Chicago, IL, USA). Descriptive statistics were used, and a p-value of .05 or less was considered for significance.

Ethical Considerations

An ethical approval was obtained from the IRB of the University of Science and Technology, as well as written permissions from participating institutions and an informed consent from each participant. The voluntary nature of the study was explained, and the social value was clarified to participants.

RESULTS

The study included 130 healthcare workers; 66 were females (50.8%), the most common age group was 20-29 years (46.9%), and 46.9% of participants were single. Moreover, the largest group of participants were physicians (29.2%), followed by dentists (12.3%), and 53.1% of the participants had greater than 5 years of work experience, and the majority (64.6%) were working in hospitals; more details are displayed in Table 1. All participants reported some degree of work-related stress: 76 (58.5%) moderate and 52 (40.0%) severe (Figure 1).

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Table 1: The socio-demographic characteristics of participant healthcare workers in Aden, Yemen 2025, (n=130)

Item	Description	Frequency	Percentage (%)
Sex	Male	64	49.2
	Female	66	50.8
Age Group	20-29	61	46.9
	30-39	38	29.2
	40-49	19	14.6
	50-59	12	9.2
Marital Status	Single	61	46.9
	Married	59	45.4
	Divorced	8	6.2
	Widowed	2	1.5
Specialty	Physician	38	29.2
	Physician assistant	12	9.2
	Dentist	16	12.3
	Laboratory doctor	15	11.5
	Pharmacist	13	10.0
	Radiologist	5	3.8
	Nursing	13	10.0
	Midwife	5	3.8
	Technician	9	6.9
	Others: Psychologist, Nutritionist, Academician	4	3.1
Work Experience	Less than 5 yr	61	46.9
	5-10 yr	41	31.5
	11-20yr	17	13.1
	Above 20yr	11	8.5
Work Environment	Hospital	84	64.6
	Clinic	14	10.8
	Health Centre	6	4.6
	Academic institution	23	17.7
	Other	3	2.3

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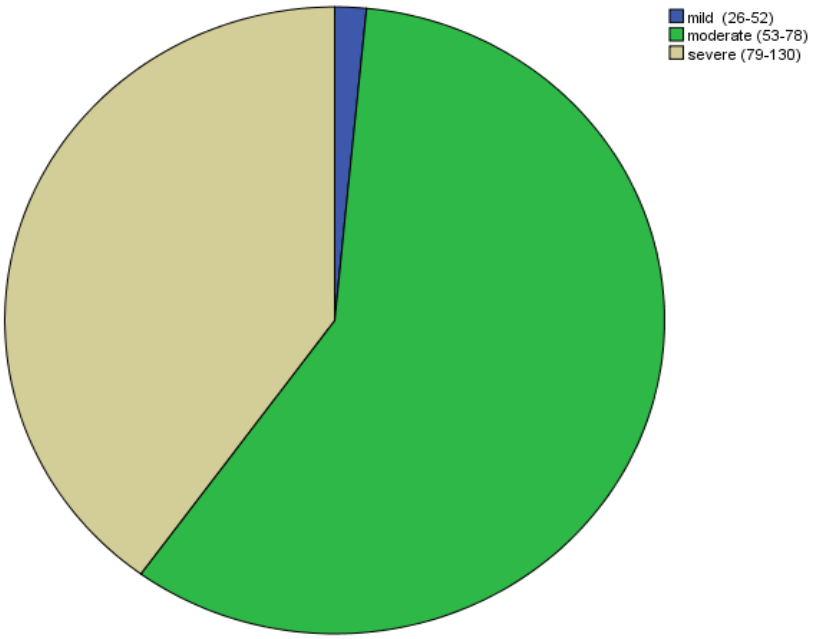

Figure 1: Frequency of stress level among healthcare workers in Aden, Yemen 2025, (n=130)

The analysis explored the association between stress levels and key sociodemographic characteristics of healthcare workers. Overall, the majority of participants experienced moderate stress, while fewer reported mild or severe levels across different variables. Regarding sex, both male and female participants demonstrated similar distributions of moderate and severe stress levels (p=0.98), indicating no statistically significant association between gender and stress level.

In terms of the work environment, healthcare workers employed in hospitals exhibited the highest proportion of moderate stress (56.0%), followed by those working in academic foundations (73.9%), whereas those in clinics and health centers showed slightly higher proportions of severe stress (57.1% and 50.0%, respectively). However, the differences were not statistically significant (p=0.51).

When comparing specialties or professions, physicians and other healthcare professionals such as dentists, pharmacists, radiologists, and nurses predominantly reported moderate stress levels, while physician assistants demonstrated a relatively higher proportion of severe stress (58.3%). Nevertheless, the association between profession and stress level did not reach statistical significance (p=0.78).

For years of experience, participants with less than 5 years of experience showed a slightly higher prevalence of moderate stress (60.7%), whereas those with 5–10 years reported higher severe stress (48.8%). Participants with over 20 years of experience reported predominantly mild or moderate stress levels (p=0.36). This suggests that more experienced workers may have developed better coping mechanisms, although the relationship was not statistically significant. In addition, for marital status, both single and married participants exhibited similar patterns of moderate stress, while divorced participants had the highest proportion of severe stress (62.5%). Despite these variations, the association between marital status and stress level was also statistically insignificant (p=0.64) (Table 2).

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Table 2: The relationships between the stress level and sociodemographic variables among participant of healthcare workers in Aden, Yemen 2025, (n=130)

		Level of stress			p value
Characteristic	Variable	Mild n(%)	Moderate n(%)	Severe n(%)	
Sex	Male	1(1.6%)	38(59.4%)	25(39.1%)	0.98
	Female	1(1.5%)	38(57.6%)	27(40.9%)	
Work environment	Hospital	2(2.4%)	47(56.0%)	35(41.7%)	0.51
	Clinic	0(0.0%)	6(42.9%)	8(57.1%)	
	Health Centre	0(0.0%)	3(50.0%)	3(50.0%)	
	Academic Foundation	0(0.0%)	17(73.9%)	6(26.1%)	
	Physician	0(0.0%)	26(68.4%)	12(31.6%)	
Specialty/profession	Physician assistant	1(8.3%)	4(33.3%)	7(58.3%)	0.78
	Dentist	0(0.0%)	9(69.2%)	7(30.8%)	
	Laboratory doctor	0(0.0%)	9(69.2%)	7(30.8%)	
	Pharmacist	0(0.0%)	9(69.2%)	7(30.8%)	
	Radiologist	0(0.0%)	9(69.2%)	7(30.8%)	
	Nursing	0(0.0%)	9(69.2%)	7(30.8%)	
	Midwife	0(0.0%)	9(69.2%)	7(30.8%)	
	Technician	0(0.0%)	5(55.6%)	4(44.4%)	
	Others: psychologist, nutritionist, academia	0(0.0%)	12(63.2%)	7(36.8%)	
	Less than 5 years	1(1.6%)	37(60.7%)	23(37.7%)	
Experience in years	5-10	0(0.0%)	21(51.2%)	20(48.8%)	0.36
	11-20	1(5.9%)	9(52.9%)	7(41.2%)	
	More than 20	0(0.0%0	9(81.8%)	2(18.2%)	
	Single	2(3.28%)	35(57.4%)	24(39.3%)	
Marital status	Married	0(0.0%)	37(62.7%)	22(37.3%)	0.64
	Divorced	0(0.0%)	3(37.5%)	5(62.5%)	
	Widowed	0(0.0%)	1(50%)	1(50%)	

Table 3 presents the association between the level of stress and self-perceived psychological health among healthcare workers. The results indicate a statistically significant relationship between these two variables (p=0.010), suggesting that psychological health perception is meaningfully linked to stress intensity. Participants who rated their psychological health as weak reported the highest proportion of severe stress (66.7%), with no cases of mild stress. Similarly, those with average psychological health showed a predominance of severe stress (68.8%) compared to moderate stress (31.2%), indicating that poorer self-perceived mental well-being is strongly associated with higher stress levels. Conversely, participants who described their psychological health as excellent demonstrated a markedly different pattern: 68.1% experienced moderate stress, 29.8% severe stress, and only 2.1% mild stress. This suggests that individuals with better perceived psychological health tend to report lower levels of severe stress.

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Table 3: The relationship between stress level and self-perceived psychological health among participant healthcare workers in Aden, Yemen 2025 (n=119)

		Level of stress			p value
Characteristic	Variable	Mild n(%)	Moderate n(%)	Severe n(%)	0.010
Self-perceived psychological health	weak	0(0.0%)	1(33.3%)	2(66.7%)	
	Average	0(0.0%)	10(31.2%)	22(68.8%)	
	Excellent	2(2.1%)	54(68.1%)	28(29,8%)	

DISCUSSION

Healthcare work inherently demands emotional resilience, high-stakes decision-making, and continuous exposure to trauma and suffering, even under stable conditions (1,2). In fragile settings like Aden, these demands are exacerbated by delayed salaries, inadequate staffing, lack of medical supplies, poor infrastructure including frequent power outages, and communication breakdowns (5-8). Evidence from Brazil, Ethiopia, Saudi Arabia, and Syria has consistently highlighted how institutional weaknesses, unclear job roles, and exposure to violence or trauma elevate stress levels among healthcare workers. 1–8 Therefore, understanding the specific stressors faced by healthcare providers in Aden is crucial to developing targeted support strategies and ensuring the sustainability of healthcare delivery in such a challenging environment.

All participants in this study expressed some degree of WRS. It's well documented that there is wide variation in prevalence of and contributing factors for occupational stress among healthcare professionals across diverse healthcare systems, geographies, and professional roles. In Saudi Arabia, it was found that over 60% of healthcare workers experienced moderate to severe occupational stress, often associated with night shifts, unclear job roles, and lack of professional recognition. Inadequate staffing and poor work-life balance were major stressors (2, 3).

This study showed that more than half of HCWs have moderate stress levels, similar to that reported from Saudi Arabia (3,9). However, the severe stress among HCWs in Aden is nearly two-fold that in Saudi Arabia (2,9). This highlights the particularly challenging circumstances faced by HCWs in Aden, likely due to the unstable environment's cumulative impact, e.g., delayed salaries, lack of supplies, infrastructure issues, structural inefficiencies and poor management [1], resource shortages, low remuneration, psychological distress [6, 8], lack of professional development opportunities, and workplace violence on resident doctors [5].

Although not statistically significant, severe stress was more prevalent among females, a finding that is similar to that in Ethiopia and Saudi Arabia (6,9). The explanation for this finding may include cultural norms and workplace environment. Interestingly, single individuals showed a higher level of stress when compared to married, which may reflect that the overall instability and hardship create a uniform stress level, or that typical marital support systems help mitigate stress in Aden's challenging environment, which is different from Ethiopia, where married workers had higher stress levels (4).

In this study, the specialties manifesting the highest levels of moderate to severe stress levels were midwives, physicians, and nurses, similar to the situation in Saudi Arabia (2), Ethiopia (6), Egypt (10), and Iran (11). The study in Iran emphasized that the psychological aspect affected the nurses more than the physical workload (10). This consistency across different contexts highlights the inherent stressors within these roles, often due to high workload, long working hours, and lack of psychological support (10).

It is obvious in this study that participants who rated their psychological self-perception as excellent were the least to suffer severe WRS. This finding brings into the light the debate on whether stress predominantly arises from individual vulnerabilities (9) or the other claim that stress is mainly attributable to organizational failures (12-14). Another layer of complexity is added by the cultural stigma surrounding mental health in many societies, which can discourage reporting and impede institutional responses, thus perpetuating under-addressed occupational stress among healthcare professionals.

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Healthcare workers in Aden operate under extreme conditions marked by political instability, economic hardship, resource scarcity, and security threats, which exacerbate their occupational stress. The absence of context-specific data hampers the development of targeted interventions and policies to mitigate stress and support healthcare professionals in this region. Without a clear understanding of the prevalence, determinants, and impacts of occupational stress among healthcare workers in Aden, efforts to sustain healthcare delivery and protect the mental health of providers remain insufficient and inadequately informed. Addressing these gaps is essential to designing effective, sustainable, and culturally sensitive interventions that can improve the well-being of healthcare workers operating in high-risk environments.

Additionally, intervention strategies remain a topic of concern. While some advocate for personal stress management programs aimed at enhancing resilience, others emphasize the need for systemic reforms, including the improvement of working conditions and better allocation of resources (3, 8, 15, 16).

This study had many limitations during sample selection and data collection, as the institutes in question refused to provide the total amount of workers, few institutes agreed to participate but under the condition that their name is not mentioned, andsome institutes refused to participate in the study at all. This scarcity limits the ability to design effective, context-specific interventions. The whole list of factors contributing to stress were not included in this preliminary, non-funded survey, such as workload, working hours, and psychological support. Despite these limitations, the findings of this study might prove valuable both academically and practically. Academically, it fills a gap by providing data on occupational stress among healthcare workers in Aden, Yemen, a conflict-affected and under-researched area with limited studies. Simply because most existing studies about WRS are conducted in stable settings, making this research uniquely valuable. Future research should expand to larger and more diverse samples, employ longitudinal designs to assess long-term impacts, and incorporate qualitative methods to capture the lived experiences of healthcare workers in fragile contexts.

CONCLUSION

This study demonstrates that work-related stress is highly prevalent among healthcare workers in Aden, particularly among midwives, nurses, and physician assistants. Self-perceived psychological health strongly influenced stress levels. Targeted interventions—including workplace support, mental health services, and organizational reforms—are urgently needed to reduce occupational stress and safeguard healthcare delivery in conflict-affected settings.

Recommendations

This study highlights the urgent need for multi-level interventions to mitigate work-related stress among healthcare workers in Aden. First, confidential and accessible mental health and psychosocial support services, including counselling and peer-support groups, should be established to address the high psychological burden (1, 2). Second, organizational reforms such as improved staffing, protected rest, and participatory workflow adjustments are essential to reduce workload and prevent burnout (3). Third, structured peer-support and supervision mechanisms can strengthen coping and decrease professional isolation, particularly among midwives, nurses, and physician assistants (2,4). Fourth, integrating routine mental health screening, monitoring, and resilience-building programs into occupational health systems would allow early detection and targeted support (3,5). Finally, aligning workplace measures with national strategies and ensuring safety, salary continuity, and supply availability are critical to sustaining healthcare delivery in conflict-affected settings (1, 5).

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Data Availability

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

Conflict of Interest

The authors declare that there is no conflict of interest.

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OPEN ACCESS Original Article

Antibacterial Resistance Patterns of Urinary *Escherichia coli* Isolates in Taiz City, Yemen

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ABSTRACT

Background: Antibacterial resistance is a major threat to health, leading to reducing the efficacy of antibacterial agents against infections caused by bacteria. The most causative of bacterial UTIs, especially in Yemen, is E. coli bacteria.

Objective: The current study aimed at evaluating the percentage rate and potential causes of isolated urine E. coli resistance to some conventional antibacterial drugs in Taiz city, determining which is the most effective, and comparing the results with other studies.

Methods: Thirty urine-isolated E. coli from laboratories in Taiz City, Yemen, were collected, and susceptibility tests to determine the E. coli resistance against some conventional antibacterial drugs were performed. After incubation for 24 hours, the diameter of the inhibitory zones was measured, and the results were recorded. Finally, the average and percentage rates were calculated.

Results: The result was as follows: Highest susceptibility to nitrofurantoin (90% S), with no resistance (0% R). Complete resistance to cefotaxime (100% R), contrasting sharply with ceftriaxone (26.7% R). Alarming levofloxacin resistance (56.7% R). Intermediate sensitivity to co-amoxiclav (56.7% I), suggesting dose-dependent efficacy. High resistance (56.7% R) with low sensitivity (33.3% S) to co-trimoxazole.

Conclusion: In Taiz City, the current study demonstrates E. coli resists the conventionally used antibiotics that were previously considered the most effective antibiotics used for its UTIs, particularly cefotaxime (100% R) and co-trimoxazole (56.7% R). Nitrofurantoin remains highly effective, while ceftriaxone and levofloxacin have variable susceptibility.

Keywords: urine isolated, E. coli, resistant, antibacterial, UTIs, conventional, Taiz, Yemen

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INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial diseases, affecting around 150 million individuals globally each year. Clinically, they are classified as uncomplicated—such as cystitis and pyelonephritis—or complicated when host defenses are compromised by factors like pregnancy, immunosuppression, renal disorders, or indwelling catheters. Typical symptoms include dysuria, frequency, urgency, and suprapubic or flank pain. Gram-negative bacteria, particularly *Escherichia coli*, are the leading causative agents of UTIs. Uropathogenic *E. coli* (UPEC) strains exhibit virulence factors that facilitate infection, immune evasion, and antibiotic resistance, making them a primary cause of both uncomplicated and complicated cases worldwide [1-8].

Antibacterial medications are a broad category of compounds that either kill or prevent the development and multiplication of bacteria, either by generating bactericidal or growth-inhibiting effects [9]. Bactericidal agents lead to death or disruption of the bacterial cell. Bacteriostatic drugs inhibit the growth or multiplication of the microorganisms without killing them [10].

Antimicrobial resistance (AMR), particularly bacterial resistance, poses a critical threat to global health, economic stability, and security. In response, the WHO established the Global Action Plan on AMR (GAP-AMR) in 2015 to preserve the effectiveness of existing therapies against infectious diseases. Recent estimates indicate that bacterial resistance contributes to nearly five million deaths annually worldwide. Economically, AMR is projected to cost up to one trillion dollars in healthcare expenses and over three trillion in GDP losses by 2030. Key drivers include the overuse of antimicrobials, reliance on broad-spectrum agents, substandard drug quality, poor infection control, and weak stewardship and healthcare systems [11-14].

Intrinsic and acquired resistance are the two primary categories of resistance to antibacterial drugs. The state in which bacteria are insensitive to a particular class of antibacterial treatments is referred to as intrinsic resistance, or innate resistance. This is frequently caused by the inaccessibility of some antibacterial agents to the bacterial target structures. Acquired resistance, on the other hand, is a strain-specific characteristic that could result from chromosomal target gene mutations or the acquisition of alien resistance genes. This class may include mutations that increase the expression of multidrug transporter systems. (i) reduce intracellular accumulation by reducing influx and/or increasing efflux of antimicrobial agents; (ii) enzymatic inactivation by dissolving or changing the antimicrobials chemically; and (iii) modification of the cellular target sites by changing the antimicrobials chemically, mutating, or protecting the target sites, but also overexpressing sensitive targets or substituting sensitive target structures with other resistant ones [15].

Concern over the prevalence and spread of AMR, including MRSA, isolates resistant to third-generation cephalosporins, including pathogens that produce extended-spectrum beta-lactamases (ESBLs), and resistance of other patterns to first- and second-line antibacterial agents in the Middle East, particularly in areas affected by conflict, is growing. These nations have a high rate of war-related injuries, necessitating sophisticated medical treatment, strict infection and prevention control (IPC) protocols, and precise, effective antibacterial medications to control the risk of AMR infections. The current reference indicates a significant frequency of AMR, despite the fact that very little research has been done in nations afflicted by conflict. High levels of AMR against widely used antibacterial agents have been observed in studies from Syria, Yemen, and Iraq [16]. There is a requirement for routine research for a certain bacterial pathogen that is causing UTIs in many cases and to make antibiotic susceptibility tests in order to use the effective antibacterial agents for treating the UTI patient [17]. According to another study, the most causative of bacterial infections and UTIs, especially in Yemen, is *E. coli* bacteria [18].

Empirical antibiotic use based on prior clinical experience remains common, increasing the risk of antimicrobial resistance. Therefore, antibiotic selection should be guided by effective laboratory diagnostics rather than empirical practices. The growing prevalence of antibiotic-resistant *Escherichia coli* poses a major public health concern, particularly in developing countries like Yemen, where antimicrobial stewardship and diagnostic infrastructure are limited. In Taiz City, the widespread misuse and overuse of antibiotics have likely contributed to the emergence of resistant

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strains [19]. This study aimed to evaluate the resistance patterns of urinary *E. coli* isolates against commonly used antibacterial agents, identify the most effective drugs, and compare the findings with previous studies conducted in Taiz and other Yemeni regions to better understand potential resistance drivers.

METHODOLOGY

The antibacterial agents that were studied (Co-amoxiclav 30 µg, Ceftriaxone 30 µg, Cefotaxime 30 µg, Levofloxacin 5 µg, Co-trimoxazole 25 µg, and Nitrofurantoin 300 µg) were purchased from the drug market. Other materials and equipment were brought from the University of Science and Technology (UST) Pharmacological and Microbiological laboratories. This study was carried out in a three-month period (February, March, and April) in 2025 in the Microbiological Laboratory.

Collection of Bacterial Samples

Thirty random samples of UPEC were collected from 30 anonymized patients that came from various regions of Taiz city to the three major and unique medical laboratories (Central Health Laboratories (in Al-Thawrah Hospital), Tadhamon International Laboratories, and Abdan Medical Laboratories) that perform culture and sensitivity tests within Taiz city (from February to April, 2025) that justify the sample size.

Antibacterial Susceptibility Testing

Mueller-Hinton agar (Merck, Germany) is subjected to antimicrobial susceptibility tests utilizing the disk diffusion (Kirby-Bauer) method. Antibiotic disks are assigned to MHA (Mueller-Hinton agar) plates in the disk diffusion method of antimicrobial susceptibility testing. Bauer, Kirby, and Tuck advise using a single disk of high concentration to perform antibiotic susceptibility tests using MHA. The "Clinical and Laboratory Standard Institute" (CLSI) has nominated this media for a number of reasons [20, 21].

Transfer of Inoculum

From the MacConkey agar plate culture, pick four to five colonies that are well-grown and have the same morphology. The growth is transferred into an MHA plate by contacting the top of each colony with a wire loop. Now, use the sterile cotton swab to streak the culture three or four times across the agar's surface. To guarantee that the inoculum is distributed evenly, rotate the plate by about 60 degrees each time. Give the plates three to five minutes to dry the agar surface before adding the antibiotic disks. Additionally, using forceps after applying the appropriate antimicrobial-impregnated disks to the MHA agar culture plate's surface, invert it for the entire night at 37°C [21].

Measuring the Inhibitory Zones

After incubation for 24 hours at 37°C, the agar plates were examined for the presence of clear zones of inhibition surrounding the discs. The diameter of the inhibitory zones was measured using a calibrated ruler, and the results were recorded in millimeters for three replicates [21]. Finally, the average and percentage rate of the inhibitory zones were calculated.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 23 to generate frequency distributions and cross-tabulations.

RESULTS

In this study, 30 isolated UPEC were tested against some conventional antibacterial drugs, and the results were as follows: Highest susceptibility to nitrofurantoin (90% S), with no resistance (0% R).

Table 1: Results of the antibacterial susceptibility tests

Agent	Percentage rate for 30 samples		
	S	I	R
Co-amoxiclav	11/30(36.7%)	17/30(56.7%)	2/30(6.7%)
Ceftriaxone	21/30(70%)	1/30(3.3%)	8/30(26.7%)
Cefotaxime	0.0	0.0	30/30(100%)
Co-trimoxazole	10/30(33.3%)	3/30(10%)	17/30(56.7%)
Levofloxacin	13/30(43.3%)	0.0	17/30(56.7%)
Nitrofurantoin	27/30(90%)	3/30(10%)	0.0

S= Susceptible, I= Intermediate, R=Resistant

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Complete resistance to cefotaxime (100% R), contrasting sharply with ceftriaxone (26.7% R). Alarming fluoroquinolone levofloxacin resistance (56.7% R). Intermediate sensitivity to co-amoxiclav (56.7% I), suggesting dose-dependent efficacy. In addition, high resistance (56.7%R) with low sensitivity (33.3%S) to co-trimoxazole (Table 1 and Figure 1).

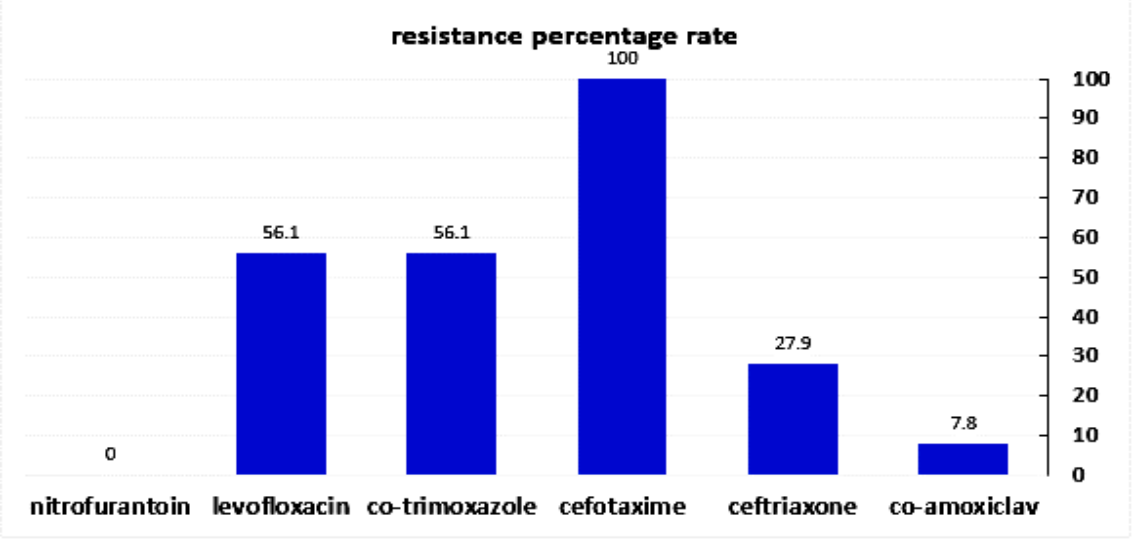

Figure 1: Resistance pattern of 30 UPEC isolated in Taiz city-Yemen

Table 2: Comparison of current results with other previous similar studies in Yemen

E. coli resistance	CV	CR	CF	CT	LF	NT	References
resistance % in Sana'a		29		66.9			**[23]**
resistance % in Aden	84.6	79.7					**[25]**
	72.40	32.45	68.47	76	27.5		**[19]**
Our findings	6.7	26.7	100	56.7	56.7	0	

CV=Co-amoxiclav, CR=Ceftriaxone, CF= Cefotaxime, CT=Co-trimoxazole, LF=Levofloxacin, NT= Nitrofurantoin

Table 2 demonstrates a comparison of current results with other previous similar studies in Yemen, in which the current result of antibacterial resistance is approximately similar to the results of other studies, such as resistance against CR; higher than the results of other studies, such as resistance against CF and LF; and lower than the results of other studies, such as resistance against CV and CT.

DISCUSSION

The emergence of bacterial resistance to antibiotics is primarily attributed to genetic alterations driven by the inappropriate and excessive use of antimicrobial agents. Among pathogenic microorganisms, Gram-negative bacteria represent a predominant cause of infections in clinical environments, posing a major challenge to effective therapeutic management [22]. Urinary tract infections (UTIs) caused by *E. coli*, the most common uropathogen, remain a major public health challenge in Yemen, particularly in regions like Taiz City, where healthcare resources are limited and antibiotic misuse is prevalent.

In the current study, the 100% cefotaxime resistance in Taiz City surpasses pre-war Yemeni reports (65–70% R) and is higher than the previous study (68.47% R, Badulla *et al.,* [19] in Aden. Potential drivers may be overprescribed and have unregulated use of cephalosporins that may lead to cross-resistance to ceftriaxone (26.7% R). In Sana'a, Al-Ofairi *et al.* [14] reported resistance against

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cefuroxime (73.68%R) and ceftizoxime (75.96%R) that is near to cefotaxime (a drug of the cephalosporin class) [14]. Data of ceftriaxone (26.7%R) showed the resistance of *E. coli* that appears near to results of other studies. Moharem *et al.* [23], in Sana'a and Taiz, showed 29%R and 30.6%R, respectively. And also, Badulla *et al. [19],* in Aden, showed (32.45%R) [23, 19]. On the other hand, current findings were higher than Al-Jendy & Al-Ofairi [24], in which the data of ceftriaxone resistance was (18%R) in Taiz, and lower than Al-Hajj *et al.* [25] (79.7%R) in Aden [24, 25].

The current study showed levofloxacin resistance (56.7% R) higher than other previous studies. Badulla *et al.* [19] in Aden showed 27.5% R; the current result may be due to improper use (over-the-counter sales) in Taiz (Al-Jendy & Al-Ofairi, [24]). A study by Al-Hajj *et al.* [25] in Aden reported 58.1% R of ciprofloxacin (drugs of the same class) resistance, which is near the levofloxacin resistance rate [25]. Furthermore, Sana'a Al-Ofairi *et al.* [14] reported (76.93%R) of both ofloxacin and norfloxacin (drugs of the same class) that they have higher resistance than levofloxacin. This class of drugs, called fluoroquinolones, was considered the first line of conventional antibacterials used for *E. coli*. The absence of intermediate resistance suggests a bimodal distribution, where isolates are either fully susceptible or resistant. This may be due to mutations in DNA gyrase or efflux pump upregulation. Co-amoxiclav exhibited moderate susceptibility (36.7% S), with a high rate of intermediate resistance (56.7% I) that was lower than the results of Badulla *et al.* [19] and Al-Hajj *et al.* [25]. In Aden, the reported results were 84.6%R and 72.40%R, respectively. These results suggest that some bacterial strains remain susceptible and many exhibit reduced sensitivity in Taiz, possibly due to widespread β-lactamase-producing strains. The low resistance rate (6.7%R) indicates that complete resistance is less common, but the high intermediate resistance may necessitate higher dosing or alternative treatments and more studies in Taiz.

The current study showed the lowest susceptibility to co-trimoxazole (33.3%S) with a resistance rate of (56.7%R) that was lower than studies of Moharem *et al.* [23] in Sana'a and Badulla *et al.* [19] in Aden that reported (66.9%R) and (76%R), respectively [24, 19]. Nitrofurantoin appears to have a high inhibition zone in all dishes, which indicates its effectiveness, and it still works with a susceptibility rate of 90% R. *E. coli* showed the lowest susceptibility to co-trimoxazole (33.3% S) and the highest susceptibility to nitrofurantoin (90% S). These results may be due to:

-Co-trimoxazole is the lowest in cost, which leads to over- and misuse in its use, particularly in Taiz, which is considered one of the most conflict-affected areas in Yemen, and the people of Taiz have low incomes, which necessitates selecting the lowest-cost drugs. Nitrofurantoin is rarely available in the local drug market and pharmacies, which leads to it being less prescribed and dispensed and not commonly used by the patients or may have stability against common resistance mechanisms. According to the current results, there is 100% cefotaxime resistance, while nitrofurantoin remains effective; therefore, the clinicians in Taiz City should avoid cefotaxime for UTIs and prescribe nitrofurantoin while monitoring its efficacy.

CONCLUSION

The *E. coli* bacteria resist the conventionally used antibiotics that were previously considered the most effective antibiotics used for *E. coli* infections, particularly cefotaxime and co-trimoxazole, while nitrofurantoin remains highly effective, and ceftriaxone and levofloxacin have variable susceptibility. These findings emphasize the need for antimicrobial stewardship, updated treatment guidelines, and continuous surveillance to combat antibiotic resistance in Taiz City, Yemen.

Recommendations

It is recommended that healthcare providers in Taiz implement comprehensive antibiotic stewardship programs and establish regular surveillance systems to monitor *E. coli* resistance patterns, thereby enabling evidence-based updates to local treatment guidelines. Furthermore, future research should focus on molecular investigations, such as testing for extended-spectrum β-lactamase (ESBL) genes, and on comparative analyses between urban and rural settings to better understand the epidemiological dynamics of antimicrobial resistance. Overall, these findings underscore the critical need for sustained antibacterial stewardship, continuous resistance monitoring, and the periodic revision of therapeutic

protocols to effectively address the growing challenge of antibiotic resistance in Taiz City.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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The Influence of Social Media Content on Teeth Whitening Practices among Adults in Taiz, Yemen

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ABSTRACT

Background: Teeth whitening is becoming increasingly popular among adults in Yemen, and part of this is the social media marketing of cosmetic products and procedures. Nevertheless, no research has studied this point in Yemen.

Objective: To assess how the content of social media affects teeth whitening behavior, awareness of risks, and use of various platforms among the adults in Taiz, Yemen.

Methods: A cross-sectional study was carried out among 398 subjects older than 18 years in Taiz. Data were collected with a structured questionnaire including demographics, social media use, whitening awareness, practices, and perceptions of risk. Descriptive statistics, chi-square, and odds ratio were calculated using SPSS.

Results: More than two-thirds of participants (73.4%) had used at least one whitening technique, principally whitening toothpaste and home whitening. More than half (57.8%) reported being directly influenced by social media in their decision to try whitening. Awareness of potential risks (75.9%) did not limit participation in whitening practices. The influence of social media was significantly correlated with whitening behavior ($p<0.001$), whereas heavy users (>4 h/day) were less likely to whiten than moderate users ($p=0.0002$). Gender differences were not significant, but undergraduates were more likely than other education groups to whiten ($p<0.001$).

Conclusion: Whitening behaviors in adults in Taiz are strongly affected by social media. People still engage in risky behaviors even though they are aware of them. These conclusions are important, as they reflect that health authorities and professionals in the field of dentistry have to provide clear and evidence-based messages via social media.

Keywords: Teeth whitening, social media, cosmetic dentistry, Yemen

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INTRODUCTION

Teeth whitening is one of the most requested cosmetic dental procedures worldwide, and it is particularly popular among young adults [1]. The reasons for its increasing popularity are mainly the increasing request for beautiful smiles [2] and the diffusion of social networks like TikTok, Instagram, and YouTube, where the "whitening" products and homemade remedies are often advertised [3]. While these sites are important sources for health information, a significant proportion of information shared on such platforms is without scientific evidence, leading to concerns about misinformation and suboptimal practices [4]. From a clinical point of view, tooth whitening is a safe and effective cosmetic treatment when carried out under medical supervision and employing evidence-based products (e.g., hydrogen peroxide, carbamide peroxide gels) in the form of in-office bleaching or professionally prescribed take-home kits [5, 6]. Nonetheless, misuse of unregulated over-the-counter products and home remedies sold on internet markets may result in side effects, including tooth sensitivity, enamel loss, and gingival irritation [7]. Internationally, several studies have reported a high relationship between social media exposure and the uptake of teeth whitening behaviors.

A study in Saudi Arabia found that social media significantly influenced individuals' perception of esthetics and motivated them to pursue whitening and smile-enhancement procedures [8,9]. Similarly, a recent study from Pakistan highlighted that exposure to social media content shaped perceptions of dentofacial esthetics and encouraged cosmetic dental treatment [10]. Also, a 2021 British Dental Journal article stressed the gap between online promotional material and clinically recommended procedures and raised questions around the safety of unregulated whitening techniques [11]. Although there is increased worldwide recognition of issues related to social media, insufficient local studies reporting the impact of social media on oral health behaviors in Yemen exist.

There has been no published investigation on social media and the effects on teeth whitening behaviors among adults in Yemen. Thus, a significant gap in knowledge has emerged, given that cosmetic dentistry is gaining popularity but risks associated with unregulated whitening are largely unknown. Thus, this study will explore the influence of social media content on teeth whitening behaviors among adults in Taiz, Yemen. The study will seek to determine the degree to which exposure to social media content influences teeth whitening decisions, determine which social media platforms have the most influence, determine the participants' awareness of potential risks, and provide evidence-based recommendations to improve public awareness of oral health.

METHODS

Study Design

A descriptive cross-sectional study was conducted in Taiz, Yemen, between April and July 2025.

Study Population and Sampling

The study population was male and female adults aged ≥ 18, living in Taiz. Individuals who provided incomplete responses were excluded. Participants were recruited using a convenience sampling approach through an online questionnaire distributed via social media platforms (WhatsApp and Telegram).

Sample Size

A total of 398 participants completed the questionnaire. The sample size (n) was calculated using the formula for single proportion:

$n = Z2 \times p (1 - p) / d2$,

where Z = 1.96 (for 95% confidence level), p = 0.5 (expected prevalence), and d = 0.05 (margin of error). The minimum sample required was 384; however, 398 participants were included to compensate for potential non-responses.

Data Collection Tool

Data were collected using a structured questionnaire [8, 9]. Developed in English and translated into Arabic for participant comprehension. The questionnaire included both closed-ended and multiple-choice questions. The questionnaire was developed after topics of interest were extracted from previous studies and adapted to the local context of Yemen. The questionnaire contained six sections:

1. Demographic information (age, sex, level of education).
2. Social media activities (platforms used, hours spent per day).

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3. Awareness about teeth whitening (exposure to teeth whitening-related content, sources of information).
4. Whitening practices (history of whitening, products used, influence of social media).
5. Awareness of risk (knowledge of potential risks or side effects, consulted with a dentist).
6. General opinion (perceived accuracy of information, preferred source of reliable information).

The questionnaire was administered virtually via Google Forms.

Study Variables

The primary outcome variable was teeth whitening practice (Yes/No). Key predictor variables comprised of exposure/non-exposure to social media on whitening, what platforms they recollected, if they used it daily, their gender, and their education level. Additional variables included awareness of risks and dental consultations.

Ethical Considerations

The Medical Ethics Committee at the University of Science and Technology, Aden, Yemen, has approved the study [MEC/AD0104]. Participation was voluntary, and informed consent was obtained electronically from all participants prior to data collection. Participants were assured that their responses would be anonymous and confidential and that they could withdraw from the study at any time.

Data Analysis

Data were entered and analyzed using SPSS version 26. Descriptive statistics (frequencies, percentages) were calculated to describe participants' demographic characteristics, awareness, and practices. The chi-square test was employed to assess associations between categorical variables. Crude odds ratios (ORs) with 95% confidence intervals (CIs) were estimated using 2×2 contingency tables in order to assess the strength of associations between predictors and whitening practices. A p-value < 0.05 was considered statistically significant.

RESULTS

Sample Characteristics

A total of 398 participants were included. Most were males, 73.9% (Figure 1). Over half were undergraduate students (55.8%), and 30.2% were internship students. Regarding social media, 41.1% reported using a mix of platforms; the most cited single platforms were Facebook (22.1%), Instagram (12.6%), YouTube (11.6%), and TikTok (10.1%) (Figure 2). Daily use of social media was 1–3 hours (39.2%), 4–6 hours (30.7%), >6 hours (14.1%), and <1 hour (16.1%) (Table 1).

Table 1: Demographic and social media characteristics, (n=398)

Variable	Category	n (%)
Gender	Male	294 (73.9%)
	Female	104 (26.1%)
Age (Years)	<25	158 (39.7%)
	25-30	172 (43.2%)
	>30	68 (17.1%)
Educational Level	Undergraduate student	222 (55.8%)
	Internship student	120 (30.2%)
	Others	56 (14.0%)
Most used platform	Facebook	88 (22.1%)
	Instagram	50 (12.6%)
	YouTube	46 (11.6%)
	TikTok	40 (10.1%)
	Snapchat	10 (2.5%)
	Mixed platforms	164 (41.1%)
Daily hours on social media	<1 hour	64 (16.1%)
	1–3 hours	156 (39.2%)
	4–6 hours	122 (30.7%)
	>6 hours	56 (14.1%)

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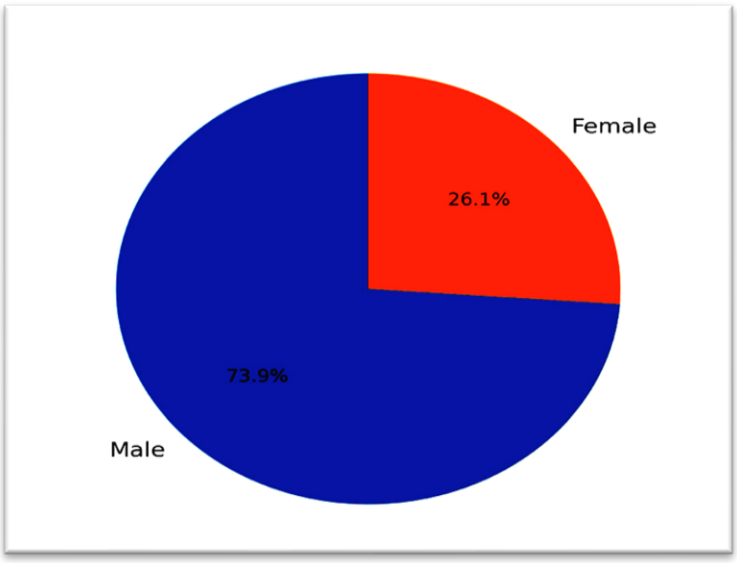

Figure 1: Gender distribution of participants

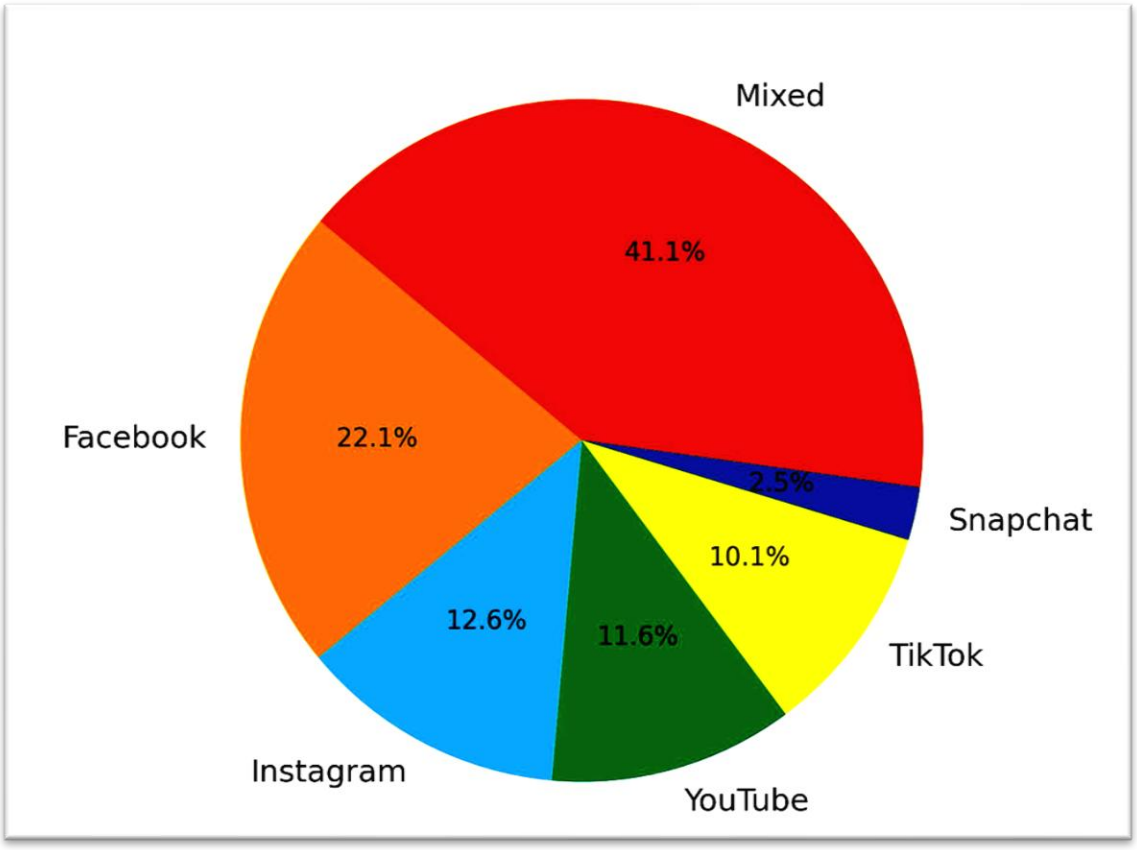

Figure 2: Most used social media platforms among participants

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Awareness, practices, and influence of social media on teeth whitening

Most respondents had heard about teeth whitening on social media (80.4%). Main information sources were dentists (40.2%), friends/family (14.6%), social media (14.1%), advertisements (5.5%), and mixed sources (25.6%).

Overall, 73.4% had tried at least one whitening method. The most common were whitening toothpaste (40.2%) and home remedies (17.1%); whitening strips (6.5%) and in-clinic whitening (6.5%) were less frequent. More than half (57.8%) reported being influenced by social media content to try whitening (Table 2).

Table 2: Awareness and practice related to teeth whitening

Variable	Category	n (%)
Heard about whitening on social media	Yes	320 (80.4%)
	No	78 (19.6%)
Main sources of information	Dentists	160 (40.2%)
	Friends/family	58 (14.6%)
	Social media	56 (14.1%)
	Advertisements	22 (5.5%)
	Mixed sources	102 (25.6%)
Tried at least one whitening method	Yes	292 (73.4%)
	No	106 (26.6%)
Products used (if yes)	Whitening toothpaste	160 (40.2%)
	Home remedies	68 (17.1%)
	Whitening strips	26 (6.5%)
	In-clinic whitening	26 (6.5%)
Influenced by social media content	Yes	230 (57.8%)
	No	168 (42.2%)

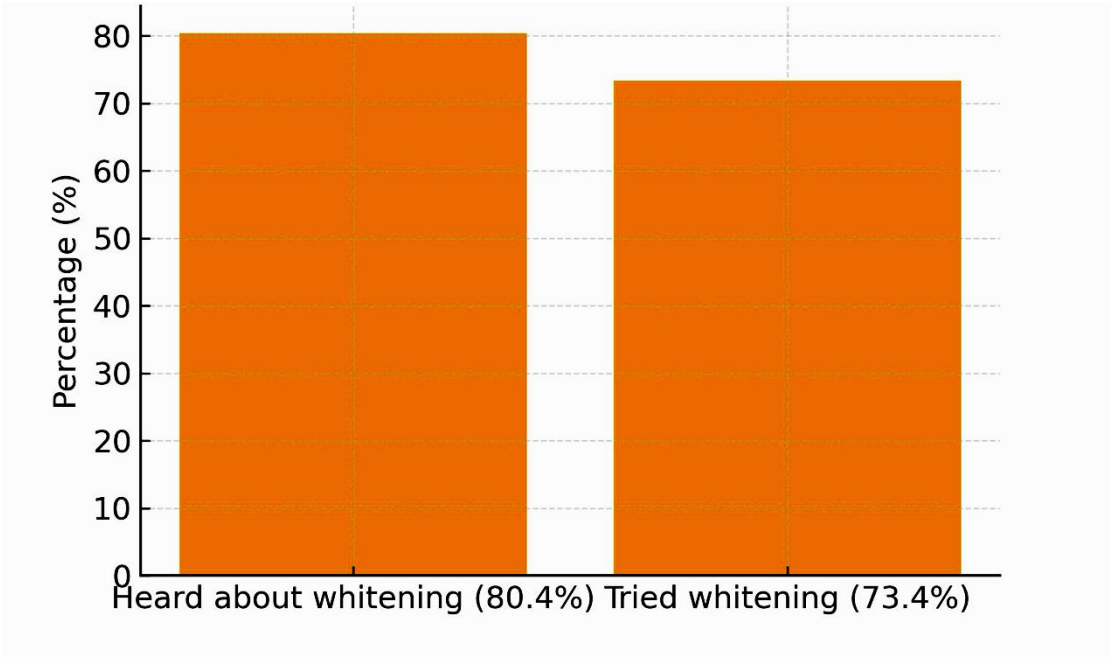

Figure 3: Awareness vs tried whitening

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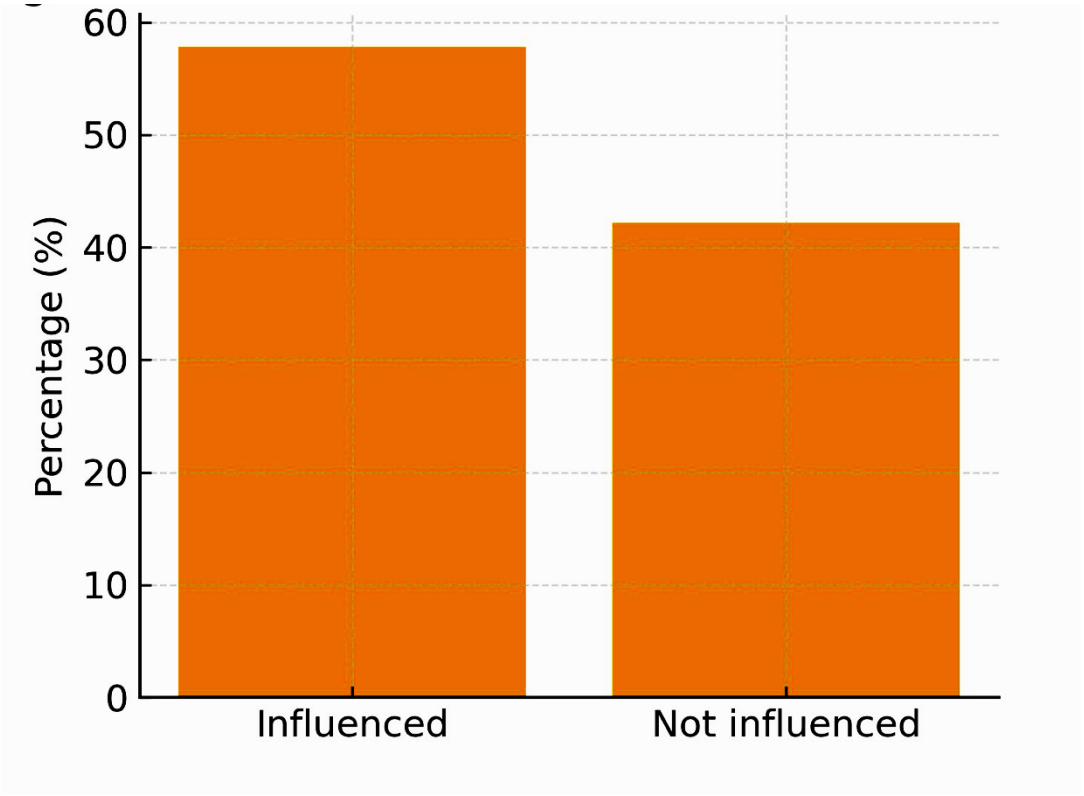

Figure 4: influence of social media

Risk awareness and consultation

Most participants (75.9%) were aware that some whitening products may cause sensitivity or enamel damage. 53.8% reported consulting a dentist before whitening, 22.6% did not, and 23.6% had never tried whitening (Table 3).

Table 3: Risk awareness and general opinions, (n=398)

Available	Category	N (%)
Aware of risks (sensitivity, enamel damage)	Yes	302 (75.9%)
	No	96 (24.1%)
Consulted dentist before whitening	Yes	214 (53.8%)
	No	90 (22.6%)
	Never tried whitening	94 (23.6%)
Perception of social media information	Accurate	170 (42.7%)
	Not accurate	86 (21.6 %)
	Not sure	142 (35.7%)
Willing to receive reliable information	Yes	340 (85.4%)
	No	58 (14.6 %)

Associations (Chi-square tests)

Chi-square tests revealed statistically significant associations between social media exposure and whitening behaviors. Participants who had heard about whitening or were influenced by online content were significantly more likely to have tried whitening ($p < 0.001$). (Table 4). Gender showed no significant association with whitening behavior ($p=0.757$), whereas education level was significantly associated ($p<0.001$).

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Table 4: Associations between social media and whitening behaviors (Chi-square test results, n=398)

Variable	χ^2	df	p-value
Heard whitening on social media	22.83	1	<0.001
Influence by social media content	37.74	1	<0.001
Awareness of risks	22.59	1	<0.001
Daily social media hours	15.14	3	0.0017

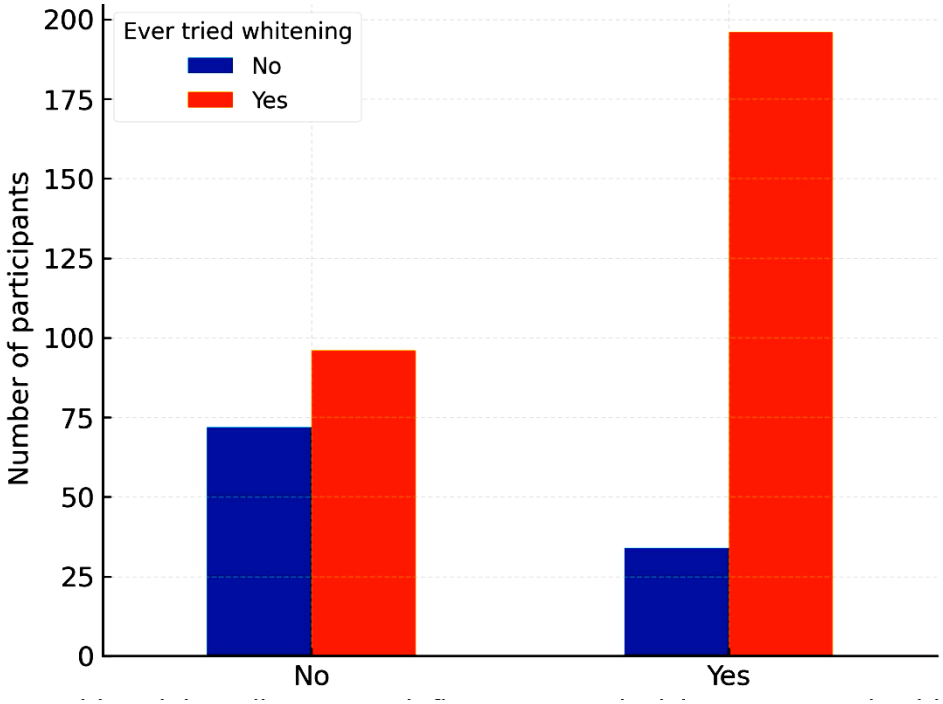

Figure 5: Association between social media influence and teeth whitening practices among participants

The analysis of crude odds ratios revealed significant associations between social media exposure and participants' perceptions and behaviors related to skin whitening. Individuals who reported being influenced by social media were over four times more likely to engage in whitening-related practices compared with those who were not influenced (OR = 4.32; 95% CI: 2.69–6.95; p < 0.001). Similarly, participants who had heard about whitening products on social media demonstrated a more than threefold increase in likelihood of engagement (OR = 3.52; 95% CI: 2.10–5.91; p < 0.001). Awareness of the potential risks associated with whitening practices was also significantly associated with social media influence (OR = 3.28; 95% CI: 2.01–5.34; p < 0.001). Conversely, participants who reported using social media for four or more hours per day were significantly less likely to exhibit whitening-related behaviors compared with those who used social media for three hours or less (OR = 0.42; 95% CI: 0.27–0.66; p = 0.0002) (Table 5).

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Table 5: crude odds ratios (OR) for predictors of whitening practice

Variable	OR	95% CI	p-value
Influenced by social media (Yes vs No)	4.32	2.69–6.95	<0.001
Heard about whitening on social media (Yes vs No)	3.52	2.10–5.91	<0.001
Awareness of risks (Yes vs No)	3.28	2.01–5.34	<0.001
Daily social media ≥4 h vs ≤3 h	0.42	0.27–0.66	0.0002

Figure 6 illustrates that participants who reported being influenced by social media were significantly more likely to try whitening (57.8%) than those who were not influenced (42.2%), confirming the strong impact of online content on whitening decisions.

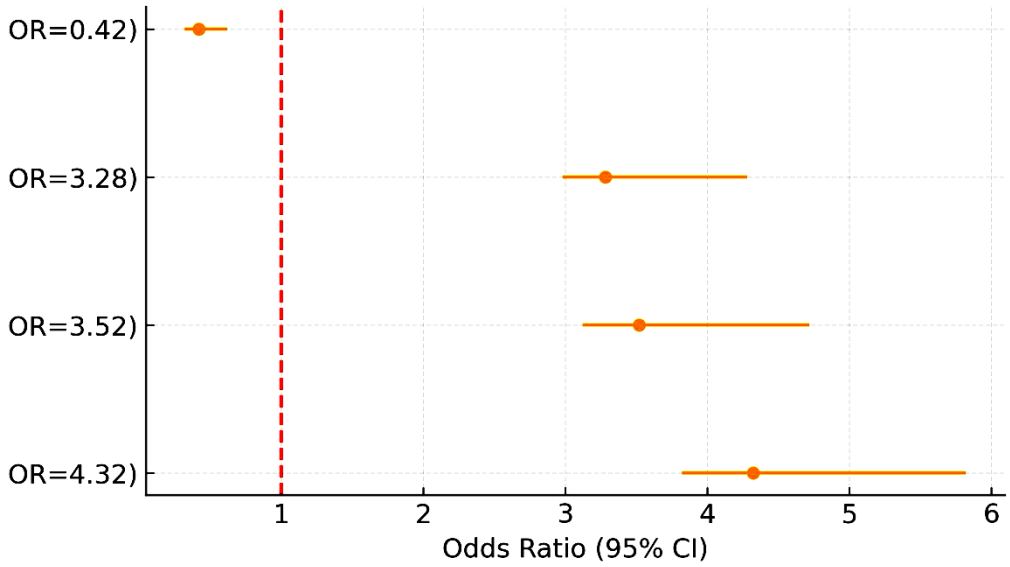

Figure 6: odd ratios for predictors of whitening practice

DISCUSSION

This study is the first in Yemen to assess the effects of social media features on teeth whitening practices in young adults. We found that more than two-thirds (73.4%) of the participants had tried at least one whitening method, and whitening toothpaste and home remedies were the most common methods, which is consistent with global studies that detail the use of do-it-yourself and home whitening approaches [5,6]. Social media was a significant part of participants' practices, with more than half (57.8%) reporting they were directly influenced by online content when trying to whiten their teeth. As we hypothesized, our results confirmed that social media has a strong impact on cosmetic oral-health behaviors, similar to studies in other countries in which TikTok and Instagram were important drivers of whitening trends. Content analysis of YouTube indicated that social media platforms have a serious impact on the perceptions of the users about teeth whitening and their behavior [12].

Hearing about whitening on social media was significantly associated with pursuing whitening treatment ($p<0.001$), and the likelihood of trying whitening treatment was 4.3 times higher among participants who reported being influenced by social media compared to those who were not influenced. Corresponding results have been documented in Saudi Arabia, where social media was found to have a strong bearing on the decision-making of young

adults regarding cosmetic dentistry and whitening [8,9]. These findings were further supported by a study carried out in Pakistan, which revealed that exposure to social media changed the perceptions of dentofacial esthetics and expectations of cosmetic interventions [10]. Reviews of online dental-created content have confirmed that a majority of the content provided online is of low quality and routinely misleading [12, 13].

Furthermore, participants who reported awareness of the potential consequences of whitening, like sensitivity and enamel destruction, were found to be more likely to try whitening (OR=3.28, p< 0.001). This paradox is interesting and suggests there are risks to be had. Awareness does not equate to stopping oneself from participating in risky use; rather, the possibility for severity to be negligible and consideration of cosmetic desires were a higher priority. A similar pattern has been noted with other studies in which patients developed a sensitivity to whitening initially but continued the bleaching treatment [14, 15]. The British Dental Journal has also featured a statement by UK dental specialist societies warning that cosmetic dentistry may underplay risks while emphasizing benefits, thus highlighting potential ethical and patient-safety concerns [16].

In contrast to our expectation, heavy social media usage (≥4 hours per day) was associated with lower odds of trying whitening. One hypothesis to explain unexpected results is that heavy users may utilize a more diverse array of content rather than just cosmetic dentistry content, which would reduce the intended advertising exposure that the participant may experience. Alternatively, moderate social media users (1-3 hours) could have viewed significantly more lifestyle and beauty-related material, thus enhancing exposure to whitening advertisements. This is consistent with findings in Kuwait, where the type of content consumed, such as content marketing or influencer-generated material, was a stronger predictor of intention to undergo cosmetic facial surgeries than the mere time spent online [17].

We did not find that gender was related to whitening behaviors (p=0.757), meaning that both genders are equally influenced by social media in terms of whitening products. To our surprise, education level was significantly related (p<0.001), with undergraduates being the most likely to attempt whitening. This finding aligns with previous studies that demonstrate that university students are particularly responsive to aesthetic trends and cosmetic promotions [18].

A significant strength of this study is that it provides new data from Yemen, where no prior work examined this topic. However, it is cross-sectional, so cause cannot be inferred, and some hesitation can come from self-reported practices to cause recall or social desirability bias. Further, the study was specific to Taiz city and may not represent behaviors across all regions in Yemen.

CONCLUSION

This cross-sectional study is the first in Yemen to assess the impact of social media on teeth bleaching behaviors. A significant percentage of adults in Taiz reported using teeth whitening techniques based on social media recommendations. Awareness of risk was comparatively high, yet the adults did not modify or stop the behaviors that would be based on health issues. Further study is required, especially for dental professionals and health authorities to make accurate and evidence-based messages through social media to dispel misinformation and possibly promote safer alternatives to cosmetic dentistry.

Conflict of Interests

The authors declare that there is no conflict of interest.

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OPEN ACCESS Original Article

Utilization of Contraception Methods and Side Effects among Women Attending the Maternal and Child Healthcare Centers in Mukalla City, Hadhramout, Yemen

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ABSTRACT

Background: One of the main methods of family planning involves the use of contraceptives to reduce the chance of pregnancy.
Objective: The present study was designed to evaluate the utilization of contraception methods and the side effects among women attending the maternal and child healthcare (MCH) centers in Mukalla city, Hadhramout, Yemen.
Methods: A cross-sectional study was conducted from April to May 2022 among 422 women who were attending the maternal and child healthcare (MCH) centers in Mukalla city and using a contraception method. The data was collected by face-to-face interview and by using structured questionnaires. The data was analyzed by using SPSS version 24 software.
Results: Data were analyzed from 422 participants: 210 oral contraceptive pill users, 108 Implanon users, 81 intrauterine device users, and 23 injectable users. Most of the women (49.5%) were using oral contraceptive pills for birth control. A total of 78.7% of participants experienced at least one side effect, of which hair loss (48.6%), abnormal vaginal bleeding (44.4%), amenorrhea (43.5%), and mood swings (37.0%) were most common. Survey results showed a significant association between side effects and duration of contraception use ($p < 0.05$).
Conclusion: The study revealed a high prevalence of modern contraceptive use among women, accompanied by a notable incidence of side effects. Addressing the impact of these adverse effects through population-based research and individualized counseling is crucial to enhance adherence, satisfaction, and sustained contraceptive use.

Keywords: family planning, contraception methods, side effects, oral contraceptives, intrauterine device, Mukalla, Hadhramout, Yemen.

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INTRODUCTION

Reproductive Health (RH) is an integral right of everyonefor the attainment of the highest standard of physical and mental health [1]. The fact that family planning programs can affect contraceptive behavior and fertility positively is widely accepted [2]. One of the main methods of family planning involves the use of contraceptives [3]. Contraception is defined as an intervention that reduces the chance of pregnancy after sexual intercourse [4]. Contraceptive use is of paramount importance to women's health [5]. According to a report from 2013, an estimated 99% of women who have ever had sexual intercourse used at least one contraceptive method in their lifetime [5, 6]. Therefore, it's a common practice among women during their childbearing period [7].

A study conducted in Sana'a indicated that Yemeni women seeking healthcare generally exhibit good knowledge and positive attitudes toward family planning (FP) for child spacing and smaller family size. However, FP utilization remains low compared with other Arab countries, largely due to sociocultural barriers and male-dominated decision-making. Enhancing male involvement and engaging religious leaders in FP awareness initiatives are crucial to improving acceptance and use. Additionally, targeted education and communication programs for illiterate women are essential to promote informed adoption of modern contraceptive methods [8]. Another study conducted in Aden, Yemen, reveals good overall knowledge and attitudes, but gaps in practice and method-specific awareness persist. Targeted interventions addressing cultural and educational barriers may strengthen FP utilization and improve maternal and child health outcomes. Family planning programs should enhance male involvement, reduce socioeconomic barriers, and counter misconceptions through culturally tailored health campaigns. Further qualitative research is warranted to explore factors influencing FP behaviors [9].

Reversible contraceptive methods are typically grouped as hormonal (such as progestin-only pills or estrogen-progestin patches) or nonhormonal (condoms, diaphragms) and long-acting (such as intrauterine devices [IUDs]) or short-acting (such as pills) [4]. In addition, it may be classified into modern and traditional methods [3]. Traditional methods include withdrawal, breastfeeding, and the rhythm method, whereas modern methods include condoms, hormonal contraceptives, intrauterine contraceptive devices (IUDs), implants, and contraceptive surgery [10].

Promoting the use of modern contraceptive methods remains a key strategy in reducing maternal mortality [11]. A 2021 study among 825 Kenyan women reported that 44% used implants, 43% injectables, 7% intrauterine devices (IUDs), and 6% oral contraceptive pills [12]. The development of oral contraceptives began in the mid-1950s, with the U.S. Food and Drug Administration (FDA) approving Enovid in 1957 for menstrual disorders and later, in 1960, for birth control [13]. Currently, more than 100 million women worldwide use oral contraceptive pills, which are classified into combined estrogen–progesterone, progesterone-only, and extended-use formulations, with the combined pill being the most common [14–16]. Intrauterine contraception has also evolved, with the copper IUD (ParaGard) introduced in 1988 and the hormonal IUD (Mirena) approved in 2000 [13]. These reversible methods offer long-term contraception through either copper-induced spermicidal effects or gradual hormonal release [17]. The injectable contraceptive Depo-Provera was approved by the U.S. Food and Drug Administration (FDA) for use in the United States in 1992. Injectable formulations such as depot medroxyprogesterone acetate (DMPA) and norethisterone enanthate (NET-EN) contain synthetic progestins that mimic the activity of the natural hormone progesterone, thereby preventing ovulation and providing effective contraception. In 2006, the FDA also approved the use of contraceptive implants, consisting of small, flexible plastic rods approximately the size of a matchstick, which continuously release a progestin to provide long-acting reversible contraception [18].

The side effects influence the acceptability and continuation of hormonal contraceptives, and there are many studies reporting women experience side effects. The side effects of OCS were reported in a study done for Egyptian women; the most frequent complications found among them were depression, breast pain, inflammation, weight gain, and abnormal vaginal secretions (63.7%, 57.7%, 56.6%, and 56.3%), respectively [15]. The side effects reported by some users of IUD contraceptives were changes in bleeding patterns (especially in the first 3 to 6 months), including prolonged and heavy monthly

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bleeding, irregular bleeding, and more cramps and pain during monthly bleeding. They may also contribute to anemia if a woman already has low iron blood stores before insertion and the IUD causes heavier monthly bleeding (uncommon). Pelvic inflammatory disease (PID) may occur if the woman has chlamydia or gonorrhea at the time of IUD insertion (rare) [18]. The side effects of implants in a studydone in Mukalla were a change of menstruation cycle, weight gain, mood change, fatigue, and headache, reported by 65.6%, 59.9%, 45.8%, 41.1%, and 40.1% of women, respectively [19]. The most common side effects of injectables include initially prolonged and irregular menses, weight gain, dizziness, abdominal bloating, decreased libido, and loss of bone mineral density (reversible) [20].
However, there are no published studies about the side effects of contraceptive methods among childbearing-aged women in Mukalla, Hadhramout governorate; therefore, this study was aimed at evaluating the utilization of contraception methods and the side effects among women attending the maternal and child healthcare (MCH) centers in Mukalla city during 2022.

METHODS

Study Design

A cross-sectional study was conducted to evaluate the utilization of contraception methods and side effects among women who attended the maternal and child healthcare (MCH) centers in Mukalla city, Hadhramout, from April to May 2022.

Study Area

This study was carried out at the maternal and child healthcare (MCH) centers in Mukalla city in Hadhramout. There are twenty-two governmental healthcare centers in Mukalla City. Six centers were selected randomly by lottery, which were
1. Al-Mustaqbal healthcare center.
2. Al-Salam healthcare center.
3. Bajo'man healthcare center.
4. Hadhramout University healthcare center.
5. Khalf healthcare center.
6. 30 November healthcare center.

Study Population

The study population comprised women of childbearing age using contraceptives.

Sample Size Estimation

Calculation of sample size was based on the following formula:

$n = \frac{Z^2(Pq)}{D^2}$ [19]

n = sample size required.
p = proportion of the characteristic in the population. (p = 50% = 0.5)
Z =confidence level = (95%) = 1.96
Q =1-p = (1-0.5) =0.5
d = precision or error allowable (d = 5%) = 0.05
$n = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2 = 384.16$

- The sample size required = (384) women.
- Add 10% (38) to avoid any sample bias. Finally, the final sample size of the study was (422) women.
- Percentage of women in each MCH center in Mukalla city:

$$\frac{\text{Number of women in each selected MCH center}}{\text{Total number of women in all 6 selected centers}} \times 100$$

- Therefore, the sample size required from the each MCH center were:

$$\frac{\text{Percentage of women in each selected MCH center}}{100} \times \text{Sample size (422)}$$

Study Variables

Various contraceptive methods are measured in this study, including oral contraceptive pills, intrauterine devices (IUDs), Implanon—a type of contraceptive implant that serves as a long-acting reversible contraceptive (LARC) by releasing etonogestrel to inhibit ovulation and thicken cervical mucus for up to three years—and injectable contraceptives. The side effects associated with the use of these contraceptive methods includeweight gain or increased appetite, breast tenderness, abnormal vaginal bleeding, vaginal discharge, amenorrhea, hypertension, osteoarthritis, mood swings, uterine cramping, facial acne, dizziness, diarrhea, nausea, hair loss, headache, pelvic pain, and excessive body hair growth, among others. The duration of contraceptive use varies among individuals and may be categorized as less than one year, between one and two years, between two and three years, or more than three years.

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Inclusion and Exclusion Criteria

Inclusion Criteria

Married women of childbearing age who use contraceptive methods and attend MCH centers in Mukalla City.

Exclusion Criteria

Married women in the childbearing period who are:

- Not use contraception methods or use traditional methods.
- Use a contraception method with chronic disease (e.g., DM, HTN, Cardiac disease, etc.).
- Refuse interviewing for any reason.

Data Collection Methods and Tools

Data were collected through structured questionnaires administered to women using contraceptives at MCH centers in Mukalla City.

Ethical Consideration

Approval of the project and the study was obtained from the Department of Community Medicine in the College of Medicine and Health Sciences at Hadhramout University (HUCOM) (CM/REC38). In addition, informed agreement was obtained from management of centers that were included in this study. Informed consent was taken from all subjects. We provided enough information about current research and its objectives to the participants, then the information was collected from women after their agreement, with their right to agree or withdraw, ensuring that the information will be kept in the strictest confidence and used only for scientific purposes and for the benefit of the community.

Data Analysis

The data was analyzed by using the Statistical Package for Social Science (SPSS version 24) software program. The Shapiro test was used to analyze the normal distribution of the variables. Descriptive statistical tools (frequencies, percentages, mean, and standard deviation) were determined for obtained data. A chi-square test was performed to see the significance of the association for categorical variables. The statistical analysis was conducted at a 95% confidence level, and a p-value < 0.05 was considered statistically significant.

Pilot of Study (Pre-test)

Before data collection, the questions in the questionnaire were pretested. The interviews were conducted on 12 participants to check understanding and applicability of the structured questionnaire.

RESULTS

A total of 422 women of reproductive age participated in this cross-sectional study. The mean age of the study participants was 28.6 (±5.9), ranging from 18 to 46 years. Most of the respondents, 161 (38.5%), were in the age group 24 to 29 years and had a primary and secondary school education (35.1%). The majority of the study sample had 1 to 2 children (53.6%). 384 of the respondents (91.0%) live in urban areas. More than half of the participants, 339 (80.3%), were housewives (Table 2).

Table 1: Distribution of sample size among maternal and child healthcare centers

MCH centers	Total number of women attended the centers in 2021	Percentage %	Sample size
Al-Mustaqbal healthcare center	507	8	34
Al-Salam healthcare center	2959	46	194
Bajo'man healthcare center	317	5	21
Hadhramout University healthcare center	1884	30	127
Khalf healthcare center	73	1	4
30-November healthcare center	614	10	42
Total	6354	100	422

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Table 2: Socio-Demographic Characteristics of Participant Women, (n=422)

	Overall	**Oral**	**IUD**	**Implanon**	**Injection**
n/(%)	422 (100%)	210 (49.5%)	81 (19%)	108 (26%)	23 (5.5%)
Age (mean ± SD)	28.6±5.9	27.8±5.3	29.8±5.4	28.0±5.3	31.7±5.4
Age Group					
(18-23)	85 (20.2%)	47 (22.3%)	10 (12.3%)	23 (21.2%)	4 (17.3%)
(24-29)	161 (38.5%)	83 (39.5%)	28 (34.5%)	42 (38.8%)	10 (43.4%)
(30-35)	121 (28.5%)	50 (23.8%)	27 (33.3%)	34 (31.4%)	7 (30.4%)
(36-42)	43 (9.9%)	20 (9.5%)	11 (13.5%)	8 (7.4%)	0 (0%)
(>43)	12 (2.9%)	10 (4.7%)	5 (6.1%)	1 (0.9%)	2 (8.6%)
Education Level					
Illiterate	31 (7.3%)	18 (8.5%)	2 (4.4%)	6 (5.6%)	7 (30.4%)
Primary School	148 (35.1%)	78 (37.1%)	35 (30%)	37 (34.3%)	5 (21.4%)
Secondary School	148 (35.1%)	69 (32.8%)	27 (43.3%)	37 (34.3%)	5 (21.4%)
University	88 (20.9%)	40 (19.0%)	17 (22.3%)	25 (23%)	6 (26.3%)
Postgraduate	7 (1.7%)	5 (2.3%)	0 (0%)	3 (2.8%)	0 (0%)
Residency					
Urban	384 (91.0%)	188(89.5%)	76(94.4%)	96(88.9%)	20(71.4%)
Rural	38 (9.0%)	22(10.4%)	5(5.6%)	12(11.1%)	3(28.6%)
Number Of Children					
None	4 (.9%)	4 (1.9%)	0 (0%)	0 (0%)	0 (0%)
(1-2)	226 (53.6%)	120 (57.1%)	40 (44.4%)	63 (58.3%)	11 (57.1%)
(3-4)	132 (31.3%)	58 (27.6%)	35 (38.9%)	34 (31.5%)	6 (21.4%)
(>4)	60 (14.2%)	28 (13.3%)	15 (16.7%)	11 (10.2%)	6 (21.4%)
Occupation					
Housewife	339 (80.3%)	171 (81.4%)	66 (82.2%)	82 (75.9%)	18 (71.4%)
Worker in health field	35 (8.3%)	20 (9.5%)	5 (5.6%)	12 (11.1%)	0 (0%)
Worker in non-health field	48 (11.4%)	19 (9.0%)	10 (12.2%)	14 (13%)	5 (28.6%)

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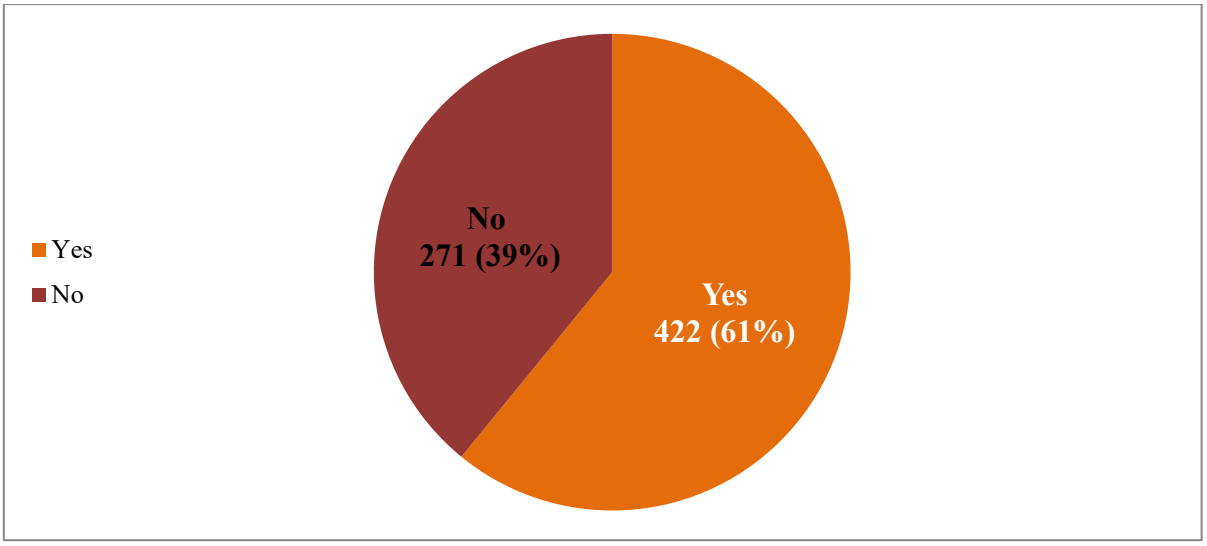

Figure 1: Distribution of Current Use of Contraception Methods in 2022

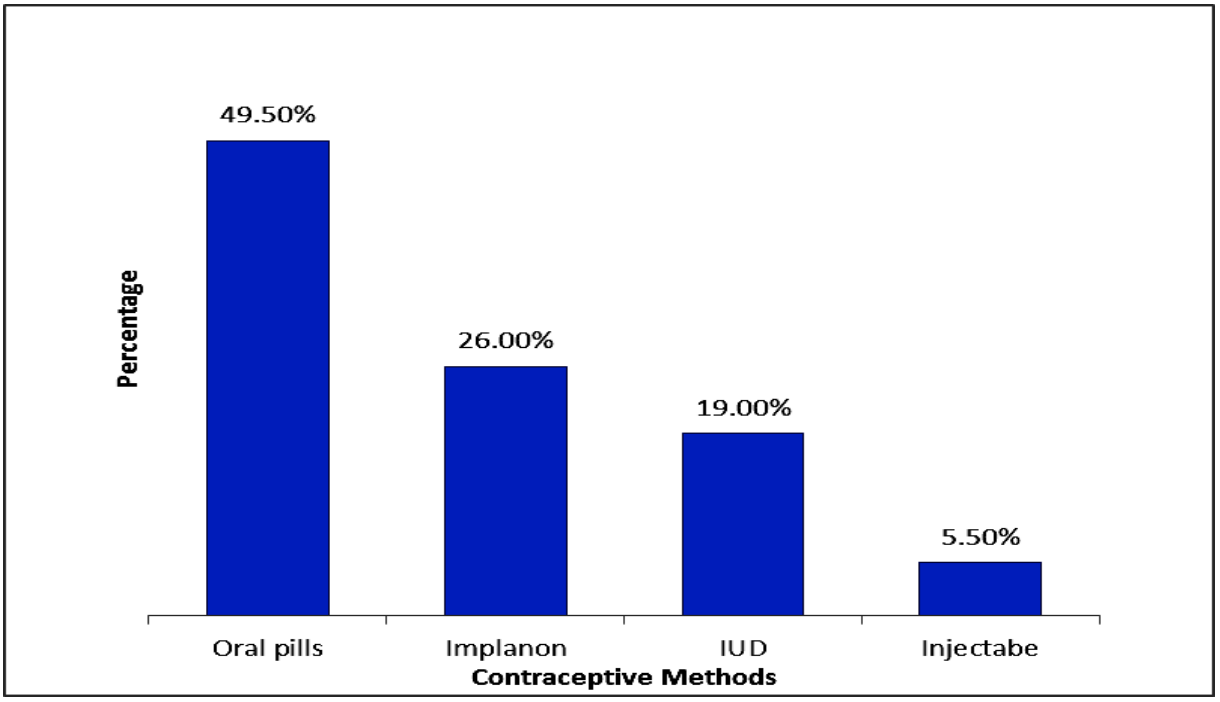

Figure 2: Prevalence of Contraceptive Methods Used by the Respondents

The results of Figure 2 reveal that the most common contraceptive method used was oral contraceptive pills among women [210 (49.5%)], followed by the Implanon [108 (26%)] and then the IUD method and injection, respectively [81 (19%) and 23 (5.5%)].

Table 3 presents the duration of contraceptive use among women according to the method utilized. Overall, the largest proportion of participants (44.3%) had used contraception for less than one year, followed by 29.6% who had used it for one to two years, 12.3% for two to three years, and 13.8% for more than three years. When analyzed by method, oral contraceptive users showed the highest proportion of short-term use, with more than half (52.5%) reporting less than one year of use. Similarly, the majority of injection users (78.1%) had used this

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method for less than one year, suggesting that injectables are commonly adopted for short-term contraception. In contrast, IUD users demonstrated a tendency toward long-term use, with 33.5% reporting use for more than three years and 34.5% for one to two years. This aligns with the known long-acting nature of IUDs.

Among Implanon users, most (39.8%) reported use for less than one year, while 24% had used it for two to three years, reflecting its typical duration of effectiveness (up to three years). Only a small proportion (5.6%) had used Implanon for more than three years. Overall, these findings suggest that short-term use (<1 year) predominates across most contraceptive methods, particularly for oral and injectable forms, whereas long-term use is more common among IUD users. This pattern may reflect differences in method availability, user preference, and provider counseling on long-term versus short-term contraceptive options.

Table 3: Duration of Using Contraception Methods in Years, (n=422)

Years of using contraceptive method	Overall	Oral	IUD	Implanon	Injection
<1 Year	187 (44.3%)	110 (52.5%)	17 (20.9%)	43 (39.8%)	18 (78.1%)
(1-2) Years	125 (29.6%)	60 (29.5%)	28 (34.5%)	33 (30.6%)	3 (14.3%)
(2-3)Years	52 (12.3%)	16 (7.6%)	9 (11.1%)	26 (24%)	1 (0.5%)
>3Years	58 (13.8%)	24 (10.4%)	27 (33.5%)	6 (5.6%)	1 (7.1%)
Total	**422 (100%)**	**210 (100%)**	**81 (100%)**	**108 (100%)**	**23 (100%)**

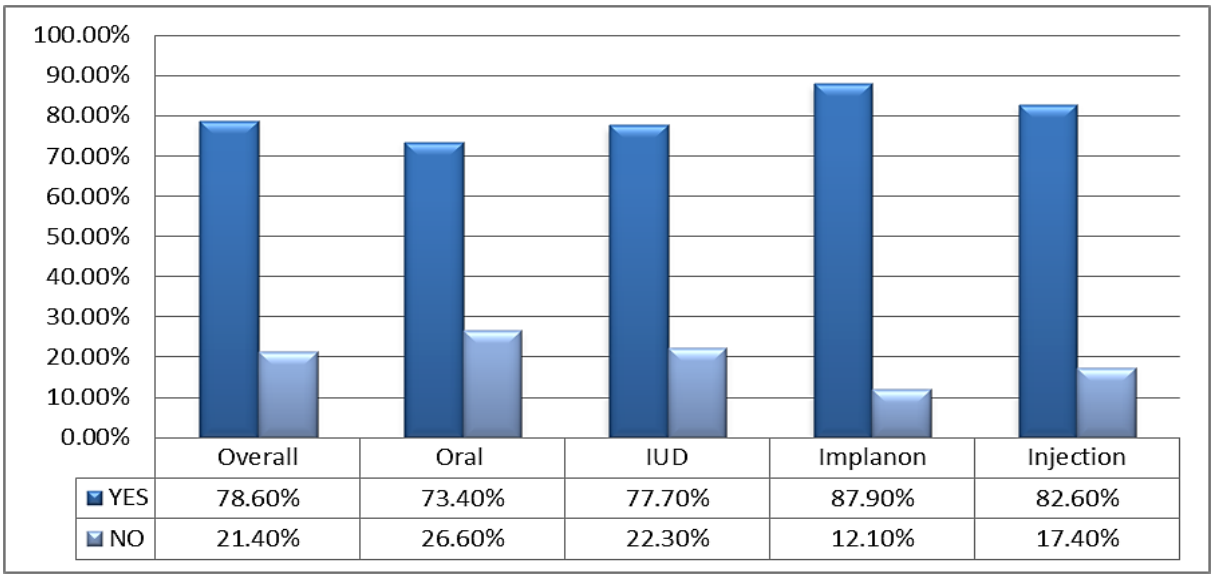

Figure 3: Prevalence of Side Effects among Women Using Contraception Methods.

This obvious figure 3 shows that more than two-thirds [332 (78.60%)] of women reported having at least one side effect related to contraceptive use.

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Table 4: Frequency and Percentage of the Side Effects in Each Contraceptive Method, (n=422)

Side effects	Oral *n*= (210)		IUD *n*= (81)		Implanon *n*= (108)		Injectable *n*= (23)	
Weight gain	36	17.1%	4	4.9%	29	26.8%	4	17.4%
Tender or Sore breasts	7	3.3%	2	2.4%	11	10.1%	0	0%
Abnormal vaginal bleeding	13	6.1%	35	43.2%	48	44.4%	8	34.7%
Vaginal discharge	18	8.5%	31	38.3%	21	19.4%	3	13.0%
Amenorrhea	16	7.6%	0	0%	40	37.0%	10	43.5%
Hypertension	14	6.6%	0	0%	6	5.5%	1	4.3%
Osteoarthritis	17	8.0%	3	3.7%	18	16.6%	4	17.4%
Mood swing	78	37.0%	4	4.9%	42	38.8%	6	26.1%
Uterine cramping	13	6.2%	18	22.2%	9	8.3%	1	4.3%
Facial acne pimples	21	10.0%	0	0%	3	2.7%	0	0%
Dizziness	29	13.8%	6	7.4%	19	17.5%	2	8.7%
Diarrhea	1	0.5%	0	0%	1	0.9%	0	0%
Nausea	25	11.9%	1	1.2%	10	9.2%	2	8.7%
Hair loss	102	48.6%	7	8.6%	45	41.6%	7	30.4%
Headache	45	21.4%	4	4.9%	14	12.9%	5	21.7%
Pelvic pain	15	7.1%	24	29.6%	9	8.3%	3	13.0%
Body hair growth	9	4.3%	1	1.2%	2	1.8%	0	0%
Others	29	13.8%	14	17.2%	25	23.1%	1	4.3%

The analysis of side effects for each method showed that the most common encountered side effects were hair loss [102 (48.6%)], mood swings [78 (37.0%)], and headache [45 (21.4%)] with utilizing oral contraceptive pills. Almost 88% of the participants who use the Implanon method experienced side effects; abnormal vaginal bleeding [48 (44.4%)], hair loss (45 [41.6%]), and mood swings [42 (38.8%)] were most common.

The major side effects of intrauterine devices were represented: abnormal vaginal bleeding [35 (43.2%)], vaginal discharge [31 (38.3%)], and pelvic pain [24 (29.6%)].

Whereas amenorrhea [10 (43.5%)], abnormal vaginal bleeding [8 (34.7%)], and hair loss [7 (30.4%)] were noted as the most frequent side effects found among injectable contraception users (Table 4).

The occurrence of side effects and duration of oral contraceptive pill consumption were analyzed and revealed a significant association between the main three side effects (abnormal vaginal bleeding, vaginal discharge, and amenorrhea) and the duration of consumption (p= 0.000, p= 0.000, and p= 0.001, respectively). The occurrence of these side effects was the highest among those women who consumed OCP for less than 1 year. Also nausea and pelvic pain (p=0.037 and p=0.003) were significantly higher in 1 to 2 years of consumption, while the facial acne pimples and hair loss (p=0.000) were significantly associated with 2 to 3 years of use. And during at least 3 years of use, mood swings, uterine cramping, and headaches (p= 0.005, p= 0.016, and p= 0.003, respectively) were reported among those women who are consuming the OCP (Table 5).

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Table 5: Association between the Duration of Oral Contraceptive Use and Reported Side Effects

Side effects	< 1Year (n= 110)	1-2 Years (n= 60)	2-3 Years (n= 16)	>3 Years (n= 24)	P-value
Weight gain	10 (9.0%)	14 (23.3%)	5 (31.3%)	7 (29.2%)	0.951
Tender or Sore breasts	4 (3.6%)	0 (0%)	1 (6.3%)	2 (8.3%)	0.180
Abnormal vaginal bleeding	11 (10%)	2 (3.3%)	0 (0%)	0 (0%)	0.000
Vaginal discharge	10 (9.0%)	4 (6.7%)	1 (0.6%)	3 (5.1%)	0.000
Amenorrhea	12 (10.9%)	4 (6.7%)	0 (0%)	0 (0%)	0.001
Hypertension	5 (4.5%)	7 (11.6%)	0 (0%)	2 (8.3%)	0.109
Osteoarthritis	8 (7.2%)	6 (10%)	1 (6.3%)	2 (8.3%)	0.210
Mood swing	38 (34.5%)	25 (41.7%)	4 (25%)	11 (45.8%)	0.005
Uterine cramping	3 (2.7%)	6 (10%)	0 (0%)	4 (16%)	0.016
Facial acne pimples	9 (8.1%)	6 (10%)	4 (25%)	2 (8.3%)	0.000
Dizziness	14 (12.7%)	9 (15%)	2 (12.5%)	4 (16.7%)	0.731
Diarrhea	1 (0.9%)	0 (0%)	0 (0%)	0 (0%)	0.992
Nausea	9 (8.1%)	11 (18.3%)	1 (6.7%)	4 (16.7%)	0.037
Hair loss	47 (42.7%)	33 (55%)	9 (56.2%)	13 (54.2%)	0.000
Headache	22 (20%)	11 (18.3%)	1 (6.7%)	11 (45.8%)	0.003
Pelvic pain	4 (3.6%)	12 (35%)	1 (6.7%)	6 (25%)	0.002
Body hair growth	3 (2.7%)	3 (5%)	1 (6.7%)	2 (8.3%)	0.075
Others*	16 (14.5%)	9 (15%)	1 (6.7%)	3 (12.5%)	0.167

*Others include: weight loss, , insomnia, anemia and fatigue. The significant was considered at P value <0.05.
anxiety

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Table 6: Association between the Duration of Implanon Use and Reported Side Effects

Side effects	< 1 Year (n= 43)	1-2 Years (n= 33)	2-3 Years (n= 26)	3 Years > (n= 6)	P-value
Weight gain	8 (18.6%)	10 (30.3%)	8 (30.7%)	3 (50%)	0.002
Tender or Sore breasts	1 (2.3%)	3 (9%)	6 (23%)	1 (16.6%)	0.002
Abnormal vaginal bleeding	22 (51.1%)	14 (42.4%)	10 (38.4%)	2 (33.3%)	0.000
Vaginal discharge	10 (23.2%)	5 (15.1%)	4 (15.3%)	2 (33.3%)	0.503
Amenorrhea	9 (20.9%)	18 (54.5%)	11 (42.3%)	2 (33.3%)	0.000
Hypertension	4 (9.3%)	1 (3.03%)	1 (3.8%)	0 (0%)	0.753
Osteoarthritis	5 (11.6%)	6 (18.1%)	6 (23%)	1 (16.6%)	0.007
Mood swing	14 (32.5%)	15 (45.4%)	9 (34.6%)	4 (66.6%)	0.037
Uterine cramping	1 (2.3%)	3 (9%)	5 (19.2%)	0 (0%)	0.568
Facial acne pimples	1 (2.3%)	2 (6%)	0 (0%)	0 (0%)	0.129
Dizziness	5 (11.6%)	5 (15.1%)	7 (26.9%)	2 (33.3%)	0.128
Diarrhea	0 (0%)	0 (0%)	1 (3.8%)	0 (0%)	0.429
Nausea	3 (6.9%)	2 (6%)	5 (19.2%)	0 (0%)	0.922
Hair loss	14 (32.5%)	15 (45.4%)	24 (92.3%)	2 (33.3%)	0.396
Headache	7 (16.2%)	1 (3.03%)	5 (19.2%)	1 (16.6%)	0.290
Pelvic pain	3 (6.9%)	2 (6%)	4 (15.3%)	0 (0%)	0.163
Body hair growth	0 (0%)	1 (3.03%)	1 (3.8%)	0 (0%)	0.470
Others*	9 (20.9%)	7 (21.2%)	8 (30.7%)	1 (16.6%)	0.028

*Others include: weight loss, anemia, fatigue and local pain. The significant was considered at P value <0.05.

Among the most frequent side effects experienced by Implanon users, abnormal vaginal bleeding was significantly related to use duration less than 1 year (p=0.000). Whereas in the 1 to 2 years of use, amenorrhea had the highest rate proportion (p=0.000). Also, tender or sore breasts, osteoarthritis, and others were statistically significant (p= 0.002, p= 0.007, and p= 0.028, respectively) in the duration of 2 to 3 years of use, while weight gain and mood swings (p= 0.002 and p= 0.037, respectively) showed significant association with the duration of use of more than 3 years.

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Table 7: Association between the Duration of Intrauterine Device (IUD) Use and Reported Side Effects

Side effects	< 1 Year (n= 17)	1-2 Years (n= 28)	2-3 Years (n= 9)	3 Years > (n= 27)	P-value
Weight gain	0 (0%)	2 (7.1%)	0 (0%)	2 (7.4%)	0.001
Tender or Sore breasts	0 (0%)	1 (3.5%)	1 (3.5%)	0 (0%)	0.283
Abnormal vaginal bleeding	9 (52.9%)	11 (39.3%)	2 (22.2%)	13 (48.1%)	0.000
Vaginal discharge	9 (52.9%)	11 (39.3%)	3 (33.3%)	8 (29.6%)	0.000
Amenorrhea	0 (0%)	0 (0%)	0 (0%)	0 (0%)	____
Hypertension	0 (0%)	0 (0%)	0 (0%)	0 (0%)	____
Osteoarthritis	0 (0%)	1 (3.5%)	0 (0%)	2 (7.4%)	0.036
Mood swing	0 (0%)	1 (3.5%)	2 (22.2%)	1 (3.7%)	0.000
Uterine cramping	2 (11.7%)	9 (32.1%)	2 (22.2%)	5 (18.5%)	0.000
Facial acne pimples	0 (0%)	0 (0%)	0 (0%)	0 (0%)	____
Dizziness	1 (5.8%)	4 (14.2%)	0 (0%)	1 (3.7%)	0.082
Diarrhea	0 (0%)	0 (0%)	0 (0%)	0 (0%)	____
Nausea	1 (5.8%)	0 (0%)	0 (0%)	0 (0%)	0.006
Hair loss	2 (11.7%)	2 (7.1%)	0 (0%)	3 (11.1%)	0.002
Headache	1 (5.8%)	2 (7.1%)	0 (0%)	1 (3.7%)	0.000
Pelvic pain	2 (11.7%)	9 (32.1%)	3 (33.3%)	10 (37.0%)	0.000
Body hair growth	0 (0%)	0 (0%)	0 (0%)	1 (3.7%)	0.331
Others*	2 (11.7%)	4 (14.2%)	2 (22.2%)	6 (22.2%)	0.809

*Others include: anemia. The significant was considered at P value <0.05.

The side effects of the IUD method were also associated with the usage duration. Abnormal vaginal bleeding and vaginal discharge (p=0.000), nausea (p=0.006), and hair loss (0.002) were related to less than 1 year of use, whereas the uterine cramping and headache are associated with 1 to 2 years (p=0.000), and the mood swing (p=0.000) was statistically associated with the 2- to 3-year duration.

Weight gain, osteoarthritis, and pelvic pain (p=0.001, p=0.036, and p=0.000, respectively) were associated with duration for more than 3 years of use (Table 7).

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Table 8: Association between the Duration of Injection Use and Reported Side Effects

Side effects	< 1 Year (n= 18)	1-2 Years (n= 3)	2-3 Years (n= 1)	3 Years > (n= 1)	P-value
Weight gain	4 (22.2%)	0 (0%)	0 (0%)	0 (0%)	0.995
Tender or Sore breasts	0 (0%)	0 (0%)	0 (0%)	0 (0%)	_____
Abnormal vaginal bleeding	7 (38.8%)	1 (33.3%)	0 (0%)	0 (0%)	0.249
Vaginal discharge	3 (16.6%)	0 (0%)	0 (0%)	0 (0%)	0.576
Amenorrhea	6 (33.3%)	2 (66.6%)	1 (100%)	1 (100%)	0.000
Hypertension	1 (5.5%)	0 (0%)	0 (0%)	0 (0%)	0.885
Osteoarthritis	3 (16.6%)	1 (33.3%)	0 (0%)	0 (0%)	0.222
Mood swing	5 (27.7%)	0 (0%)	1 (100%)	0 (0%)	0.609
Uterine cramping	1 (5.5%)	0 (0%)	0 (0%)	0 (0%)	0.370
Facial acne pimples	0 (0%)	0 (0%)	0 (0%)	0 (0%)	_____
Dizziness	2 (11.1%)	0 (0%)	0 (0%)	0 (0%)	0.503
Diarrhea	0 (0%)	0 (0%)	0 (0%)	0 (0%)	_____
Nausea	2 (11.1%)	0 (0%)	0 (0%)	0 (0%)	0.954
Hair loss	5 (27.7%)	1 (33.3%)	1 (100%)	0 (0%)	0.428
Headache	4 (22.2%)	0 (0%)	1 (100%)	0 (0%)	0.454
Pelvic pain	2 (11.1%)	1 (33.3%)	0 (0%)	0 (0%)	0.888
Body hair growth	0 (0%)	0 (0%)	0 (0%)	0 (0%)	_____
Others*	0 (0%)	1 (33.3%)	0 (0%)	0 (0%)	0.109

*Others include: weight loss. The significant was considered at P value <0.05.

The use of injectable users for more than 2 years shows a significant association between this duration and the amenorrhea side effect (p= 0.000).

DISCUSSION

Studies show that higher levels of female education correlate with reduced fertility rates, as educated women tend to delay marriage and childbirth and are more likely to use contraceptives effectively [22]. For decades, the concept of unmet need for contraception has been integral to international family planning policy, programs, and research [23]. Physiological side effects associated with the use of contraception have been hypothesized to result from a mismatch between a woman's endogenous hormonal levels and the dosage of contraceptives [24, 25]. This study was performed to evaluate the utilization of contraception methods and the side effects among women attending the maternal and child healthcare (MCH) centers in Mukalla city.

In the current study, we found that oral contraception was the most common method used by 49.5%, followed by Implanon, IUD, and injectable (26%, 19%, and 5.5%, respectively). Similar findings were found in a study conducted in the UK in which they found the most common method was oral contraception, at 21.8% [26]. In contrast, a study reported in Kenya the most common methods were using implants (44%), injectables (43%), IUDs (7%), and oral contraceptives (6%), and in Uganda most of the women were using injectables (56.8%), followed by implants (31.9%) [12, 27].

In terms of side effects, the results of this study found that the most common side effects with using oral contraception were hair loss, mood swings, and headaches (48.6%, 37%, and 21.4%, respectively). This contrasts with studies done in Egypt, indicating that the most common side effect was depression (63.7%), followed by weight gain (56.6%) [15]. In addition to that, a study that has been done in Saudi Arabia, with a sample size of 345 women on oral contraceptives, found that the most commonly encountered side effects were mood swings (303 [61.1%]) and weight gain or increased appetite (209 42.2%)] [28].

Based on the implant method, Nilptchploy and Taneepanichkul [29] reported abnormal vaginal bleeding in 43.5% of women and amenorrhea in

40.2% [29]. This finding is observed in a similar study that showed abnormal vaginal bleeding occurred in 44.4% of women and amenorrhea in 37%. In contrast, the major side effects of Implanon reported in Turkish women were amenorrhea (41.25%) and frequent and infrequent bleeding (23.75%) [30]. The study results reveal that abnormal vaginal bleeding, vaginal discharge, and pelvic pain (43.2%, 38.3%, and 29.6%, respectively) were the highest in the IUD method. This finding is comparable to a study that has been done in North America [31].

The results of the present study found that amenorrhea, abnormal vaginal bleeding, and hair loss (43.5%, 34.7%, and 30.4%, respectively) were the highest in the injectable method. These findings are different from many studies done, which showed that prolonged and irregular bleeding menses were experienced by 90% of users in Uganda [20]. Whereas in America, weight gain and headache were the most common side effects related to the injectable method [32].

The chi-square test that was used to analyze our outcomes showed that there is a significant association between abnormal vaginal bleeding, vaginal discharge, amenorrhea, nausea, pelvic and facial acne pimples, hair loss, mood swings, uterine cramping, and headache and the duration of oral contraceptive use ($p < 0.05$). These findings contrast the result revealed in a Saudi Arabia study, which indicated the association between duration and decrease of libido ($p = 0.010$) [28]. Uganda's study reveals that after 24 months of use, women develop amenorrhea. These findings are consistent with our study outcomes about the injectable method [20]. The study presents some limitations. In which there were no published studies done about the association between the side effects and duration of use for implants and intrauterine devices (IUDs), so we suggest the researcher do more studies about these subjects.

CONCLUSION

This study highlights the distinct side effect profiles associated with different contraceptive methods. While oral contraceptive pills were the most prevalent method, they were most associated with hair loss. In contrast, implant and IUD users most frequently experienced abnormal vaginal bleeding, and injectable users reported amenorrhea. The significant association between side effects and the duration of use underscores the importance of considering time when counseling patients.

Recommendations

Greater attention should be directed toward understanding the specific impact of contraceptive side effects on women's contraceptive behavior, particularly through the use of population-based data. Providing individualized care that emphasizes comprehensive information and counseling about common side effects is essential to enhance informed decision-making and adherence. Moreover, healthcare professionals play a critical role in ensuring that women are adequately informed about the benefits and potential risks of all available contraceptive methods, recognizing that contraceptive needs may vary throughout different stages of a woman's life.

Conflict of Interest

The authors declare that there is no conflict of interest.

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OPEN ACCESS Original Article

Prevalence and Severity of Depression among Women in Aden, Yemen: A Cross-Sectional Study

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ABSTRACT

Background: Depression is more common among women than men.
Objective: This study aimed to determine the prevalence and severity of depression among adult women in Aden, Yemen, and to determine the associated sociodemographic factors contributing to increasing the prevalence of depression among those women.
Methods: A total of 240 women were enrolled in this analytical cross-sectional study. The PHQ-9 structured questionnaire was used for evaluation of the depression and its severity, and data were analyzed using the SPSS.
Results: the response rate was 69.97% (240/343). The majority of women were 75.8% single, 80.8% postgraduate educated, and 78.8% had medium socioeconomic status. The prevalence of depression among women was 83.3%. The highest significant depression rates were 92.5% and 90.7% in the age group 25-28 years and the age group >28 years, respectively (p=0.023), and 100% among divorced women (p=0.0001). According to the severity of depression, 33.8% of women had mild depression, 16.3% had moderate depression, and 33.3% had severe depression. The highest significant prevalence for severe depression was 89.8% among women in the age group >28 years, 100% among divorced women, 70.6% among postgraduate-educated women, and 45.3% among those women who had a medium income (p=.0001).
Conclusions: The prevalence of depression among women in Yemen was the highest compared to global rates. The depression among women is associated with age and marital status. The severity of depression is strongly associated with different sociodemographic and socioeconomic factors, including age, marital status, education, and income. Severe depression is significantly associated with the age group 25–28 years, divorced women, postgraduate-educated women, and medium-income women.

Keywords: Prevalence, Severity, Depression, women, PHQ-9, Aden, Yemen.

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INTRODUCTION

Depression is one of the mental disorders that is characterized by persistent loss of pleasure or interest in activities [1]. The prevalence of depression is more common among women than men [2]. Therefore, it is a global health problem that has significant consequences that impact women aged from 15 to 49 years [3]. The mental health condition affects more than one billion individuals globally [4]. Depression occurs in 3.8% of the population [5]. The World Health Organization (WHO) estimated that 6% of women had depression symptoms. Based on the severity and number of symptoms, the episode of depression is classified into three categories: mild, moderate, and severe [6].

The depression can affect the general health of depressed individuals, resulting in loss of body weight and appetite as well as disruption of sleep. It impaired thinking and decision-making abilities and reduced confidence [7-10].

There are several factors contributing to the increasing depression, including socio-demographic factors [1], daily stress, obesity [11,12], and chronic diseases such as diabetes, cancer, and exposure to hemodialysis (HD) procedures [13]. The susceptibility of women to depression is higher than men due to hormonal changes during menopause and pregnancy [2, 14] and sterility or infertility [15].

In Yemen, the data about the distribution and severity of depression among women is not clear. Two studies were conducted among Yemeni medical students and HD patients and revealed that the depression rates were 48.4% and 63%, respectively [2, 16]. Early marriage, poor education, and socioeconomic status, as well as sex-based violence, are main factors for increasing the depression among Yemeni women. One of the crucial things for reducing the public burden and improving the quality of life is early identification of the frequency and severity of depressed women to enhance early interventions and policies for treatment. The current study was aimed at determining the prevalence and severity of depression among adult women in Aden, Yemen, and at determining the associated sociodemographic factors contributing to increasing the prevalence of depression among those women.

METHODS

Study Design and Area

A cross-sectional study was conducted on 240 women who accepted to participate in this study out of a total of 343 women in Aden governorate, Yemen.

Sample Size

The sample size was calculated by using Stephen Thompson's formula, $N = \frac{Z^2 P(1-P)}{d^2}$ based on the prevalence of depression from research among Somalian women, in which the rate was 33.5% [19]. N = expected minimum sample size, Z = standard, corresponding to 95% confidence (1.96), P = the % estimated prevalence at 33.5%, and D = maximum likely error taken as 5% [20].

$N = \frac{Z^2 P(1-P)}{d^2} = \frac{(1.96)^2 \times 33.5\%(1-9.17\%)}{(5\%)^2} =$ 343 women.

Only 240 women were accepted to participate in this study.

Data Collection

A modified questionnaire from previous studies was used to collect the data from women, which included sociodemographic data such as age, marital status, level of education, and socioeconomic status [17, 18]. The Patient Health Questionnaire-9 (PHQ-9), a structured questionnaire, was used for evaluation of the depression in which the women answered nine questions related to symptoms of depression during the past two weeks, where the scale of each question was 0 to 3, resulting in a total score from 0 to 27, where a score of 0-4 represents normal or no depression (21).

Based on its severity, depression was further classified into three categories: a score of 5 to 10 indicates mild depression, 10 to 20 indicates moderate depression, and 20 to 27 indicates severe depression. PHQ-9 was used due to its sensitivity and specificity of 88% and 86%, respectively [21, 22].

Inclusion and exclusion criteria

The adult women in Aden, Yemen, were included in this study, while those women outside Aden governorate, children, and males were excluded.

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Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software (Version 23.0). The figures were designed by using Excel software (version 2021). The mean values and standard deviations (SD) of ages of women were determined due to the normal distribution of data, while most data were qualitative; therefore, the frequencies and percentages of variables were calculated. The presence of significant associations between different variables was determined using the chi-square ($\chi 2$) test, where the statistically significant value was indicated by the presence of a p-value < 0.05.

RESULTS

Among 240 women accepted to enroll in our study, the response rate among women was 69.97% (240/343). The mean ±SD of age was 26.88 ±5.36 years. The majority were 182 (75.8%) singles, 194 (80.8%) postgraduates, and 189 (78.8%) of medium socioeconomic status (Table 1).

The prevalence of depression among women was 200 (83.3%) (figure 1). The highest depression rates were 49 (92.5%) and 49 (90.7%) in the age groups 25-28 years and >28 years, respectively; 7 (100%) among divorced; 164 (84.5%) among those with undergraduate education; and 15 (88.2%) with high socioeconomic status. Age and divorced marital status were significantly associated with depression (p=0.023 and 0.0001), respectively (Table 2).

According to the severity of depression, 81 (33.8%) of women had mild depression, 39 (16.3%) had moderate depression, and 80 (33.3%) had severe depression (Figure 2). The highest prevalence rate for severe depression was 44 (89.8%) among women in the age group >28 years, 7 (100%) among divorced women, 12 (70.6%) among postgraduate educated women, and 73 (45.3%) among those women who had a medium income. All these results were statistically significant (p=0.0001), each (table 3).

Table 1: The distribution of women according to their sociodemographic status in Aden, Yemen (n=240)

Item	Frequency	Percent (%)
Age		
<22 years	66	27.5
22-24 years	67	27.9
25-28 years	53	22.1
>28 years	54	22.5
Marital status		
Single	182	75.8
Married	51	21.3
Divorced	7	2.9
Education level		
Secondary school	24	10.0
Undergraduate	194	80.8
Postgraduate	22	9.2
Income		
Low	34	14.2
Medium	189	78.8
High	17	7.1

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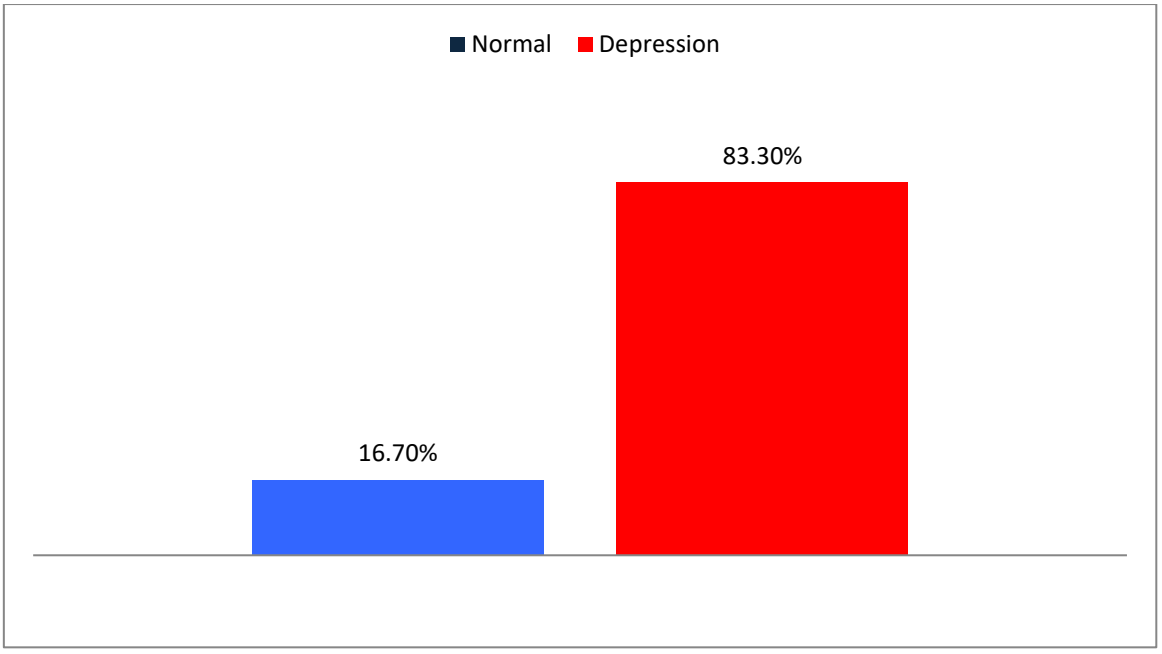

Figure 1: The prevalence depression among women in Aden, Yemen (n = 240)

Table 2: Association between depression and sociodemographic among women in Aden, Yemen using $\chi 2$ test (n = 240).

Item	Depression		P
	No	%	
Age			
<22years (n=66)	51	77.3	0.023
22-24years (n=67)	51	76.1	
25-28years (n=53)	49	92.5	
>28years (n=54)	49	90.7	
Marital status			
Single (n=182)	182	100.0	0.0001
Married (n=51)	11	21.6	
Divorced (n=7)	7	100.0	
Education level			
Secondary school (n=24)	19	79.2	0.582
Undergraduate (n=194)	164	84.5	
Postgraduate (n=22)	17	77.3	
Income			
Low (n=34)	24	70.6	0.090
Medium (n=189)	161	85.2	
High (n=17)	15	88.2	

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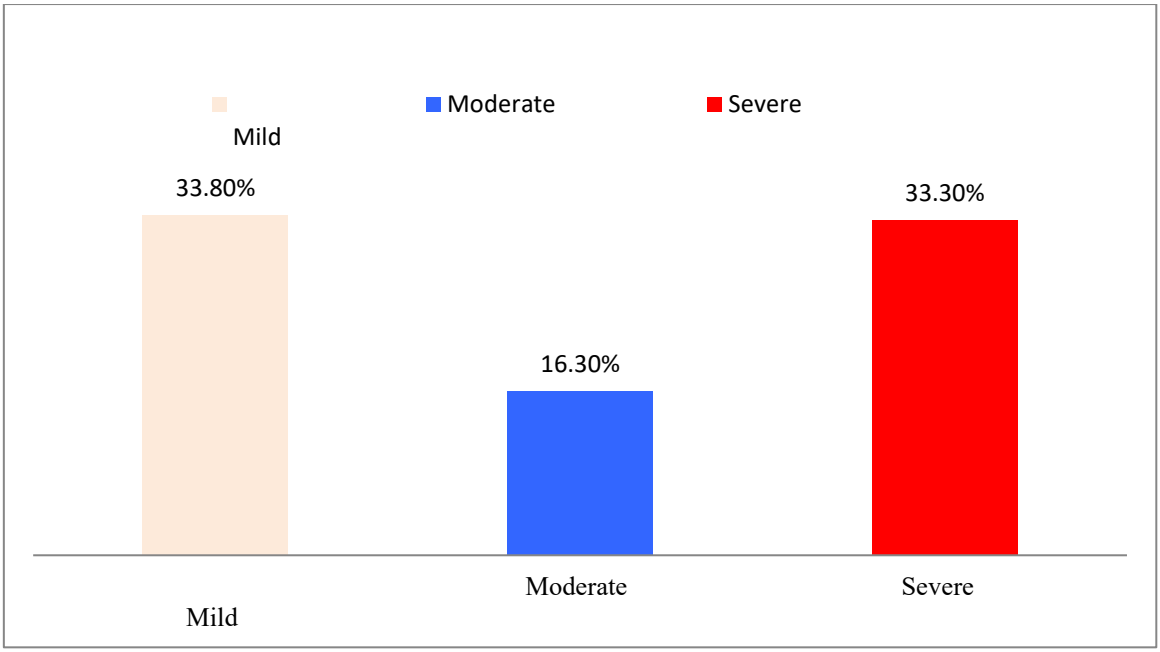

Figure 2: Severity of depression among women in Aden, Yemen, (n = 200)

Table 3: Association between score of depression and sociodemographic among women in Aden, Yemen, (n = 200).

Item	**Score of depression**						
	Mild		Moderate		Severe		P
	No	%	No	%	No	%	
Age							
<22 (n=51)	45	88.2	0	0.0	6	11.8	0.0001
22-24 (n=51)	16	31.4	29	56.9	6	11.8	
25-28 (n=49)	15	30.6	10	20.4	24	49.0	
>28 (n=49)	5	10.2	0	0.0	44	89.8	
Marital status							
Single (n=182)	70	38.5	39	21.4	73	40.1	
Married (n=11)	11	100.0	0	0.0	0	0.0	
Divorced (n=7)	0	0.0	0	0.0	7	100.0	0.0001
Education level							
Secondary school (n=19)	15	78.9	0	0.0	4	21.1	0.0001
Undergraduate (n=164)	61	37.2	39	23.8	64	39.0	
Postgraduate (n=17)	5	29.4	0	0.0	12	70.6	
Income							
Low (n=24)	21	87.5	0	0.0	3	12.5	0.0001
Medium (n=161)	49	30.4	39	24.2	73	45.3	
High (n=15)	11	73.3	0	0.0	4	26.7	

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DISCUSSION

The prevalence of depression among women was 83.3%. Our finding was slightly similar to that conducted in Afghanistan 79.1% [17], This result was the highest among global studies, such as in Iran (75.8% and 33.5%) [14, 15], Pakistan (61% and 30%) [23, 24], Bangladesh (65%) [25], Ghana (62.0%) [26], Ethiopia (52.6%, 47.1%, and 23%) [18, 27, 28], Brazil (45.7%) [29], Nigeria (37.9% and 22%) [1], Saudi Arabia (37.5%) [30], Somalia (33.5%) [19] (Yusuf et al., 2024), and Egypt (37.5% and 30%) [5, 31]. Lower prevalence rates of depression were 5.4%, 5%, 4.9%, and 4.8% in different studies conducted globally [32-35].

The variations are related to several factors such as socio-demographic factors [1], chronic diseases such as diabetes, kidney diseases, and cancer [13], hormonal changes during menopause and pregnancy [14], using contraceptive drugs, and sterility or infertility [15].

Regarding the age of women in these results, the significant highest depression rates were 92.5% and 90.7% in the age groups 25-28 years and >28 years (p=0.023). This was in line with that reported by Jack-Ide, where the highest rate was among women in the age group 20-30 years [1]. Abebe et al. showed that the highest rate was among women in the age group less than 35 years [18]. Santos et al. revealed the highest rate, 14.07%, among women in the age group over 60 years [36]. The older women are more likely to face depression symptoms than younger women due to biological factors, comorbidities, and menopause issues [37, 38].

The current results demonstrated that all divorced women (100%) had depression with a statistically significant association (p=0.0001). This data agreed with previous studies [1, 18, 19, 39]. In contrast, Ahlawat et al. noticed that the majority of widows and divorced women had moderate depression [40]. The risks of depression were increased among divorced/widowed/separated women due to grief, loss, and social isolation [41].

According to the severity of depression in the present data, the majority of women presented with mild depression (33.8%), followed by severe depression (33.3%) and moderate depression (16.3%). A study from Nigeria showed that the majority of women (57.5%) have severe depression, followed by 25.3% with mild and 17.2% with moderate depression [1]. Research among Iranian women noticed that 29.7% of women have mild depression, while 2.8% and 0.8% have moderate and severe depression, respectively [14]. Abebe et al. recorded that most of the women (43.9%) had moderate depression, and 32.4% and 23.7% had mild and severe depression, respectively [18]. A study among Egyptian women noticed that mild, moderate, and severe depression were 22.1%, 5.2%, and 1.9%, respectively [5]. A study done in Jeddah, Saudi Arabia, found that the severity of depression among pregnant women was 14.0%, 12.5%, and 5.5% for mild, moderate, and severe depression, respectively [30]. Raza et al. revealed that 24%, 4%, and 1% of women had mild, moderate, and severe depression, respectively [35].

The severity of depression among women is affected by poor relationships with spouses, chronic medical diseases and long-term pain, hormonal changes, pregnancy, menopause, infertility, and poor social support [1, 13-15]. In current results, the highest prevalence for severe depression was 89.8% among women in the age group >28 years. This was disagreed with by a study conducted among postmenopausal women in India, which found that 23.4% of women over 41 years had moderate depression [40]. The discrepancy may be related to contextual factors, including conflict-related stressors, economic instability, and cultural pressures faced by women in Yemen.

In the current study, the prevalence of severe depression among divorced women was 100%. This data was in line with that found in Beijing City, China [42]. Jeong et al. showed that the recently divorced women had severe levels of depressive symptoms [43]. On the contrary, our finding was different from that reported in Punjab and India [40, 44]. One of the factors that increases the depression symptom is women being divorced [31].

The present study revealed that 70.6% of postgraduate-educated women had severe depression. Three studies conducted among Jordanian, Indian, and Iranian women reported that highly educated women had low depression scores [40, 45, 46]. Most women who had postgraduate education in this study were divorced and single.

Regarding socioeconomic status, our study found that 45.3% of women with medium income reported severe depression. Two studies recorded that women with low income were more likely to be depressed

[40, 42]. The low income increases the risk of depression [47]. The divergence in our results may reflect Yemen's economy, where even women with medium income face financial instability, inflation, and reduced purchasing power, leaving them equally vulnerable to depression. As regards the demographic data, including age, marital status, education level, and socioeconomic status of women, each was statistically significantly associated with severe depression (p=0.0001). Several studies reported that demographic and socioeconomic factors influence prevalence rates of depression [48-51].

The limitations of this study include lacking the determination of other associated factors such as the presence of chronic diseases, pregnancy or infertility of married women, postmenopausal women, and the administration of contraceptive drugs.

CONCLUSION

The prevalence of depression among women in Yemen was the highest compared to global rates. The depression among women is associated with age and marital status. The severity of depression was strongly associated with different sociodemographic and socioeconomic factors, including age, marital status, education, and income. The severe depression is significantly associated with the age group 25-28 years, divorced women, postgraduate-educated women, and medium-income women.

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Ethics Approval and Consent Form

The ethical approval of this study was obtained from the Ethics Committee of the College of Medicine and Health Science at the University of Science and Technology; MEC No. (MEC/AD0114). It was based on the standards of the Helsinki Declaration. The written consent form was obtained from each woman before performing any procedure.

Conflict of Interests

The authors declare that there is no conflict of interest.

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Data Availability

The data are available upon request.

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OPEN ACCESS Review Paper

Current Insights into Epstein - Barr virus Prevalence and Clinical Impact among Kidney Transplant Recipients in Iraq: An Updated Review

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ABSTRACT

Background: Epstein–Barr virus (EBV) is a major concern in kidney transplantation, contributing to post-transplant lymphoproliferative disorder (PTLD), graft dysfunction, and allograft loss. In Iraq, data on EBV prevalence among kidney transplant recipients (KTRs) are scarce, with most evidence derived from hemodialysis patients.
Objective: To systematically review the prevalence and clinical impact of EBV in Iraqi KTRs and assess associated risk factors, diagnostic approaches, and management strategies.
Methods: A systematic search of PubMed, Scopus, Web of Science, Google Scholar, and Iraqi repositories was conducted. Eligible studies on EBV prevalence and outcomes in KTRs and hemodialysis were screened, appraised, and synthesized following PRISMA guidelines.
Results: Available Iraqi studies indicate variable EBV prevalence in KTRs and hemodialysis, with risk factors including intensive immunosuppression, lymphocyte-depleting therapies, donor and graft characteristics, co-infections, recipient age, and post-transplant timing. Diagnostic strategies reported include donor-recipient serostatus, quantitative EBV PCR, and histopathology. Emerging therapeutic options, particularly EBV-specific adoptive T-cell therapy, show promise in reducing reactivation and preserving graft function.
Conclusion: EBV poses a significant but understudied risk in Iraqi KTRs. Consolidating regional evidence with international insights highlights the urgent need for targeted EBV surveillance and management strategies to improve transplant outcomes in Iraq.

Keywords: Epstein–Barr virus, kidney transplant recipients, PTLD, immunosuppression, Iraq.

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INTRODUCTION

Epstein-Barr virus (EBV), a ubiquitous human herpes virus, poses significant clinical challenges in Immunocompromised populations, particularly kidney transplant recipients (KTRs) [1]. In the context of renal transplantation, the use of immunosuppressive drugs to prevent graft rejection increases the susceptibility of recipients to EBV infection and reactivation, which can trigger serious complications such as post-transplant lymphoproliferative disorder (PTLD) and contribute to graft loss and renal impairment. This makes EBV infection a critical factor influencing long-term outcomes in kidney transplant patients [2–4]. In EBV D+/R− KTRs (donor EBV-seropositive, recipient seronegative), the risk of PTLD is markedly increased. These patients are prone to primary EBV infection after transplantation, often leading to EBV DNAemia and higher rates of graft dysfunction or loss. Mortality can be high in affected cases, although differences from EBV-seropositive recipients are not always statistically significant. Immunosuppressive therapy, while essential for preventing rejection, impairs control of EBV-infected B cells, enabling the unchecked proliferation that drives PTLD [3,5,6].

In Iraq, recent studies have highlighted a notably high seroprevalence of EBV in the general population and among patients with kidney diseases, including transplant recipients and those undergoing hemodialysis. For instance, Redha et al. [7] reported that seroprevalence rates of EBV IgG antibodies among Iraqi blood donors approach nearly 79.8%, with higher rates observed in females and residents of more densely populated areas like Baghdad, suggesting widespread latent infection and potential risks for viral reactivation under immunosuppression. Furthermore, research in Iraqi renal transplant recipients reported that around one-third (33%) had detectable EBV viremia by sensitive molecular assays such as real-time PCR, with viral loads ranging widely, underscoring the virus's active role post-transplant [8].

Management of EBV-related complications in kidney transplant patients involves balancing immunosuppression reduction, antiviral therapies, chemotherapy (such as rituximab), and sometimes surgical or radiation interventions for advanced PTLD. However, antivirals do not have direct anti-oncogenic effects against EBV; instead, therapeutic strategies focus mainly on controlling immune dysregulation. Given these severe sequelae, recent research advocates for improved EBV serostatus matching between donors and recipients and enhanced post-transplant screening strategies to mitigate EBV-associated risks [3,9]. Given the high prevalence and significant clinical impact of EBV infection among KTRs in Iraq, conducting a systematic review to synthesize existing evidence is both timely and essential. This review aims to consolidate current knowledge on EBV prevalence, viral load kinetics, associated clinical outcomes, including the risk of PTLD, and diagnostic strategies within this high-risk population.

METHODS

This study was conducted as a systematic literature review to comprehensively assess the prevalence and clinical impact of Epstein–Barr virus among kidney transplant recipients (KTRs) and hemodialysis patients in Iraq.

Search Strategy

A systematic search was performed across electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, using combinations of keywords and MeSH terms: "Epstein–Barr Virus," "EBV," "kidney transplantation," "renal transplant," "hemodialysis," and "Iraq." To capture locally published studies not indexed in international databases, Iraqi academic repositories and institutional databases were also screened.

Eligibility Criteria

1. **Inclusion:** Studies reporting EBV prevalence, diagnostic methods, clinical outcomes, or associated risk factors among KTRs and hemodialysis patients in Iraq.
2. **Exclusion:** Case reports, editorials, conference abstracts lacking sufficient data, studies not involving KTRs or hemodialysis patients, and studies conducted outside Iraq.

Study Selection and Appraisal

All retrieved records were imported into Mendeley Reference Manager, and duplicates were removed. The methodological quality of included studies was rigorously evaluated using established critical

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appraisal tools, and findings were systematically synthesized following PRISMA guidelines.

Data Extraction and Synthesis

A standardized form was used to extract relevant information, including study characteristics, EBV prevalence rates, diagnostic approaches, clinical outcomes, and reported risk factors among KTRs and hemodialysis patients. In addition, the geographic distribution of studies across Iraqi governorates was visualized on a map to highlight regional coverage and potential gaps in the literature. Due to heterogeneity in study design, diagnostic methods, and outcome measures, the results were synthesized narratively.

RESULTS

Epstein-Barr virus (EBV)

Discovery and Early Research on EBV

Epstein-Barr virus was first discovered in 1964 by Dr. Anthony Epstein's team through electron microscopy of cells from Burkitt's lymphoma biopsies [10]. Early studies linked EBV to tumor development, with elevated antibody levels found in Burkitt's lymphoma and nasopharyngeal carcinoma patients by 1966 [11,12]. EBV was confirmed as the cause of infectious mononucleosis in 1968 [13]. By 1970, EBV DNA was detected directly in tumor cells of Burkitt's lymphoma and nasopharyngeal carcinoma [14,15]. In the 1980s, its association expanded to non-Hodgkin's lymphoma and AIDS-related oral hairy leukoplakia [16,17]. EBV DNA has since been identified in various lymphomas, leukemias, and epithelial cancers, as well as linked to autoimmune diseases like multiple sclerosis [18–21]. The history of EBV discovery is illustrated in
Figure 1.

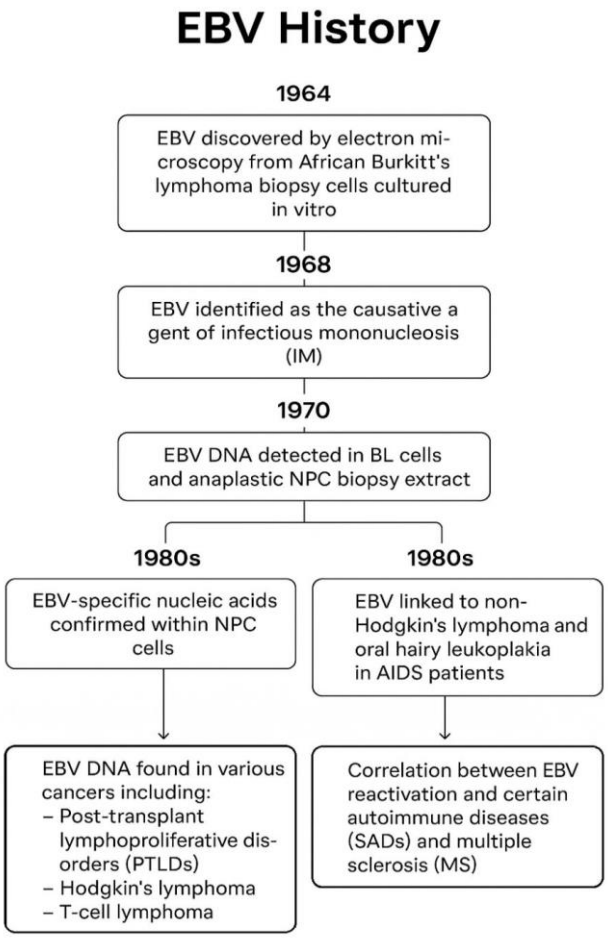

Figure 1: Historical Milestones in EBV Discovery and Disease Associations. Created by the authors.

Genomic and Structural Properties of EBV

Epstein–Barr virus, classified as a gammaherpesvirus, possesses a linear, double-stranded DNA genome measuring approximately 170–185 kb and encoding over 85 genes [22]. At both ends of the genome lie ~0.5 kb terminal direct repeats, while internal repeat sequences divide the genome into distinct long and short domains, each encoding various proteins [23]. The EBV nucleocapsid consists of 162 capsomeres surrounded by a viral envelope derived from host cell membranes. Between the nucleocapsid and envelope lies the tegument layer. The envelope is embedded with surface glycoproteins that form characteristic "spike-like" protrusions (

Figure 2) [24,25]. Viral entry into epithelial cells and lymphocytes is mediated by the interaction of these glycoproteins with specific cellular receptors, enabling direct fusion of the viral envelope with host cell membranes. Once inside the cell, the linear viral DNA circularizes through the joining of terminal direct repeats at both ends. Within the infected cell, the EBV genome persists as an extrachromosomal episome, allowing its stable maintenance during cell replication [26].

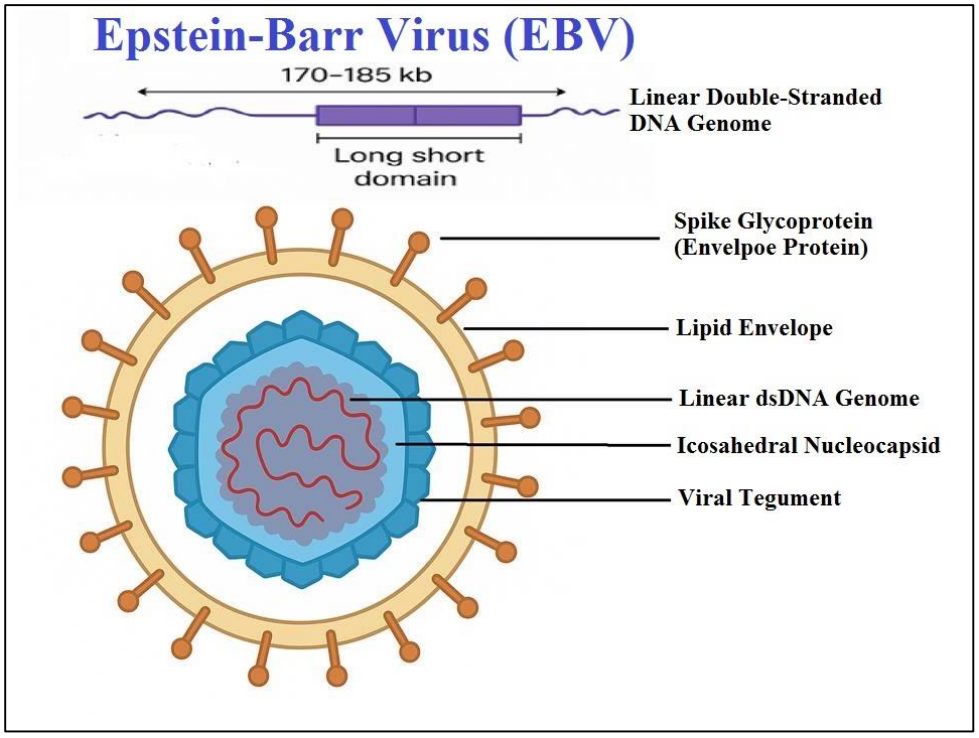

Figure 2: Diagram of the Structural Components of EBV. Created by the authors.

Viral Latency and Replication

EBV Latency

Following primary infection, EBV persists as an episome in memory B cells, maintaining a dynamic balance between latency, replication, and immune surveillance. Latency gene expression involves six nuclear antigens (EBNAs), three latent membrane proteins (LMPs), two non-coding RNAs (EBERs), and numerous microRNAs [27]. Three latency programs are recognized:

- Type III: Full latency gene expression; common in immunocompromised patients with PTLD or certain diffuse large B-cell lymphomas [28].
- Type II: Restricted expression (EBNA1, LMP1, LMP2, EBERs, and miRNAs); observed in Hodgkin lymphoma and nasopharyngeal carcinoma.
- Type I/0: Minimal expression (EBNA1, EBERs, miRNAs); characteristic of Burkitt lymphoma and EBV-associated gastric carcinoma.

EBNA1 is essential for genome maintenance, LMP1 drives oncogenic signaling, and LMP2 regulates reactivation. Non-coding RNAs facilitate immune evasion [29].

EBV Lytic Cycle

The lytic cycle progresses through immediate early, early, and late phases, involving the expression of more than 80 proteins. Immediate early proteins BZLF1 (ZEBRA) and BRLF1 (Rta) initiate the switch from latency to replication, followed by early replication proteins and late structural proteins such as capsid antigens, protease, and glycoproteins [30]. Lytic antigens are targeted by $CD8^+$ and $CD4^+$ T cells, while surface glycoproteins elicit neutralizing

antibodies [31,32]. Evidence indicates that lytic proteins contribute to oncogenesis [33, 34].

Kidney Transplantation and Immunosuppression

Transplantation has revolutionized the treatment of end-stage organ failure, providing life-saving options for patients who would otherwise have limited alternatives. For those with end-stage kidney disease (ESKD), kidney transplantation offers improved survival and quality of life compared with long-term dialysis [35–37]. The first successful kidney transplant, performed between identical twins in December 1954 by Dr. Joseph Murray and colleagues, represented a landmark achievement in medical history [38]. The primary challenge in transplantation medicine is the recipient's immune system rejecting the transplanted organ. The immune system distinguishes between self and foreign tissue, leading to immune-mediated injury and potential graft failure. Such rejection may occur in different forms: hyperacute, developing within minutes after the transplant; acute, arising days to months post-transplant; or chronic, which can progress over several years [39]. While advances in surgical techniques and organ preservation have greatly contributed to transplant success [40], the management of the recipient's immune response remains the primary determinant of outcomes. As a result, widespread adoption of kidney transplantation did not accelerate until decades later. The 1980s marked a turning point with the introduction of the calcineurin inhibitor cyclosporine [41, 42]. The use of calcineurin inhibitors (CnIs) and antimetabolite-based immunosuppressive regimens significantly reduced acute rejection rates, improving short-term graft survival. However, long-term graft outcomes have seen more modest gains, partly due to the nephrotoxic and metabolic side effects associated with prolonged immunosuppression. Chronic CnI exposure can cause arteriolar hyalinosis, tubular injury, and interstitial fibrosis [43, 44], while long-term corticosteroid use has been linked to cardiovascular complications and increased mortality. To address these challenges, recent research has focused on optimizing immunosuppressive strategies, including CnI- and steroid-sparing regimens, to enhance long-term graft survival [45].

Induction immunosuppression remains a critical initial phase following kidney transplantation, aimed at reducing the risk of early graft rejection. Commonly used agents include interleukin-2 receptor antagonists (IL2Ra) and rabbit antithymocyte globulin (r-ATG). Recent evidence suggests that IL2Ra induction may offer superior long-term survival compared to r-ATG without increasing graft loss, highlighting ongoing efforts to refine induction protocols for improved outcomes [46]. Immunosuppressive strategies have also been adapted for special populations, such as pediatric patients and individuals with autoimmune disorders like lupus nephritis, where careful balancing of immune suppression and disease control is essential. Despite these advances, progress has been limited by the scarcity of new drug approvals, underscoring the need for continued innovation through collaboration between clinical research and pharmaceutical development [47, 48]. Emerging approaches aim to achieve operational tolerance, allowing recipients to maintain graft function with minimal or no immunosuppression. Techniques such as transient mixed allogeneic chimerism, although still experimental, hold the potential to transform kidney transplantation by reducing or even eliminating lifelong immunosuppressive therapy [49]. Parallel improvements in donor-recipient matching, including precision strategies like eplet matching via registries, have further enhanced transplant outcomes. These methods are associated with reduced formation of donor-specific antibodies, lower graft failure rates, and opportunities for immunosuppression minimization, representing an important adjunct in optimizing both graft longevity and patient safety.

Prevalence of EBV Infection in Kidney Transplant Recipients

Global context: EBV Prevalence in Kidney Transplant Populations Worldwide

Epstein–Barr virus infection is highly prevalent worldwide among kidney transplant populations, carrying significant implications for transplant outcomes. Multiple studies confirm that EBV is frequently detected both before and after kidney transplantation, with prevalence influenced by geographic, genetic, and clinical factors. Globally, pre-transplant EBV exposure is widespread, with EBV IgG seropositivity in kidney transplant candidates often exceeding 90%. Among hemodialysis (HD) patients, the main group awaiting transplantation, rates reflect the near-universal exposure to EBV in the general population. In the Middle East, EBV prevalence is similarly high. In Iran, anti-EBV (VCA) IgG seropositivity among HD patients is reported at 96.42%, with EBV DNA detected in 8.33% of cases [50]. Another Iranian study reported 100% EBV IgG positivity among adult potential kidney donors and recipients [51]. Among renal transplant recipients, EBV infection has been documented in 15.5% of patients [52]. Nikoobakht et al. observed EBV DNA positivity in 44.1% of pre-transplant saliva samples, increasing to 67.6% after transplantation [53]. In Europe, similarly high pre-transplant EBV exposure rates are observed. In Croatia, 98% of HD patients were EBV IgG positive [54], while in Cyprus, the prevalence was 94% [55]. In the United Kingdom, a sero-epidemiological survey of 2,325 individuals aged 0–25 years found 85.3% seropositivity, with higher rates among females during adolescence (ages 10–15) [56]. Regarding post-transplant EBV reactivation, Italy reported 24.8% of kidney transplant recipients (KTRs) testing positive for EBV DNA within the first year [57], while Germany observed EBV reactivation in 18.4% of recipients during the same period, with pre-transplant EBV shedding and male sex identified as risk factors; importantly, reactivation was not associated with severe complication [58]. In North America, particularly the United States, Verghese et al. [59] detected EBV DNA in 34% (32/95) of pre-transplant patients. A large retrospective cohort study involving 962 KTRs found EBV infection in 11.3%, with most cases developing more than three years post-transplant [60]. Furthermore, recipients with donor-positive/recipient-negative (D+/R−) serostatus demonstrated a 22.1% cumulative incidence of post-transplant lymphoproliferative disorder (PTLD), with 48.1% of these recipients developing EBV DNAemia after transplantation [3]. The variation in EBV prevalence and DNAemia rates across these regions reflects differences in host genetic background, immunosuppressive regimens, diagnostic approaches, and local epidemiology. Post-transplant immunosuppression facilitates EBV reactivation or primary infection, which can increase the risk of PTLD, a potentially fatal malignancy. Although often asymptomatic, EBV reactivation can accelerate graft dysfunction, reduce estimated glomerular filtration rate (eGFR), and raise the likelihood of acute rejection. Co-infection with other viruses such as cytomegalovirus (CMV) can further worsen patient outcomes. Consequently, routine EBV DNA monitoring using sensitive PCR-based methods is recommended worldwide to support early detection, guide clinical decision-making, and mitigate EBV-related complications in KTRs [8,60].

Regional/Local data: EBV Prevalence among Hemodialysis and Kidney Transplant Patients in Iraq

Epstein-Barr virus poses a significant health concern among immunocompromised patients, particularly those undergoing kidney transplantation or hemodialysis. EBV can establish lifelong latency and reactivate under immunosuppressed conditions, increasing the risk of complications such as PTLD and potential graft dysfunction or loss. In Iraq, where kidney transplantation programs have been developing since the early 1973s [61], limited studies have examined the prevalence of EBV among transplant patients (
Figure 3). A study in Baghdad reported that 33% of renal transplant recipients exhibited EBV viremia, highlighting the potential role of EBV in post-transplant renal dysfunction and the utility of real-time PCR as a sensitive diagnostic tool [8]. Given the limited transplant-focused data, regional research has increasingly evaluated EBV prevalence in hemodialysis and chronic kidney disease (CKD) populations, who share similar immunological risks. In Al-Najaf, multiple studies reported EBV prevalence among hemodialysis patients. One study found 36%

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positivity by RT-qPCR and 22% by EBNA2 IgG, with higher prevalence in younger patients (17–26 years) and no infection detected in healthy controls [62]. Another study in the same region found 41.4% IgM positivity, 57.6% IgG positivity, and 44.9% PCR positivity among 118 patients, indicating a substantial EBV burden, slightly higher in males [63]. Further, co-occurrence of EBV and systemic lupus erythematosus (SLE) was observed in 36% of patients, with elevated IL-10 and IL-18 levels, suggesting a link between EBV infection and inflammatory responses [64]. In Kirkuk, studies reported 42.8% IgG and 7.6% IgM positivity among hemodialysis patients, with acute EBV infection (IgM) significantly associated with longer dialysis duration and higher weekly dialysis frequency ($p = 0.015$) [65]. Another study from the same city reported 43.7% IgM positivity compared to 9.1% in healthy controls, confirming the heightened susceptibility of hemodialysis patients to acute EBV infection [66]. Furthermore, patients with acute EBV infection had significantly elevated IL-8 and IL-10 levels, indicating that EBV may promote pro-inflammatory cytokine production in this population [67]. In Erbil, ABO blood group was shown to influence EBV susceptibility, with hemodialysis patients carrying blood group A+ being more prone to infection compared to other groups [68]. Collectively, these findings demonstrate that EBV infection is highly prevalent among kidney transplant and hemodialysis patients across different Iraqi cities, with younger age, longer dialysis duration, and specific blood groups increasing susceptibility. Real-time PCR and serological assays remain essential tools for accurate detection and monitoring of EBV in this high-risk population, and the virus may contribute to immune dysregulation, inflammatory responses, and potential post-transplant complications.

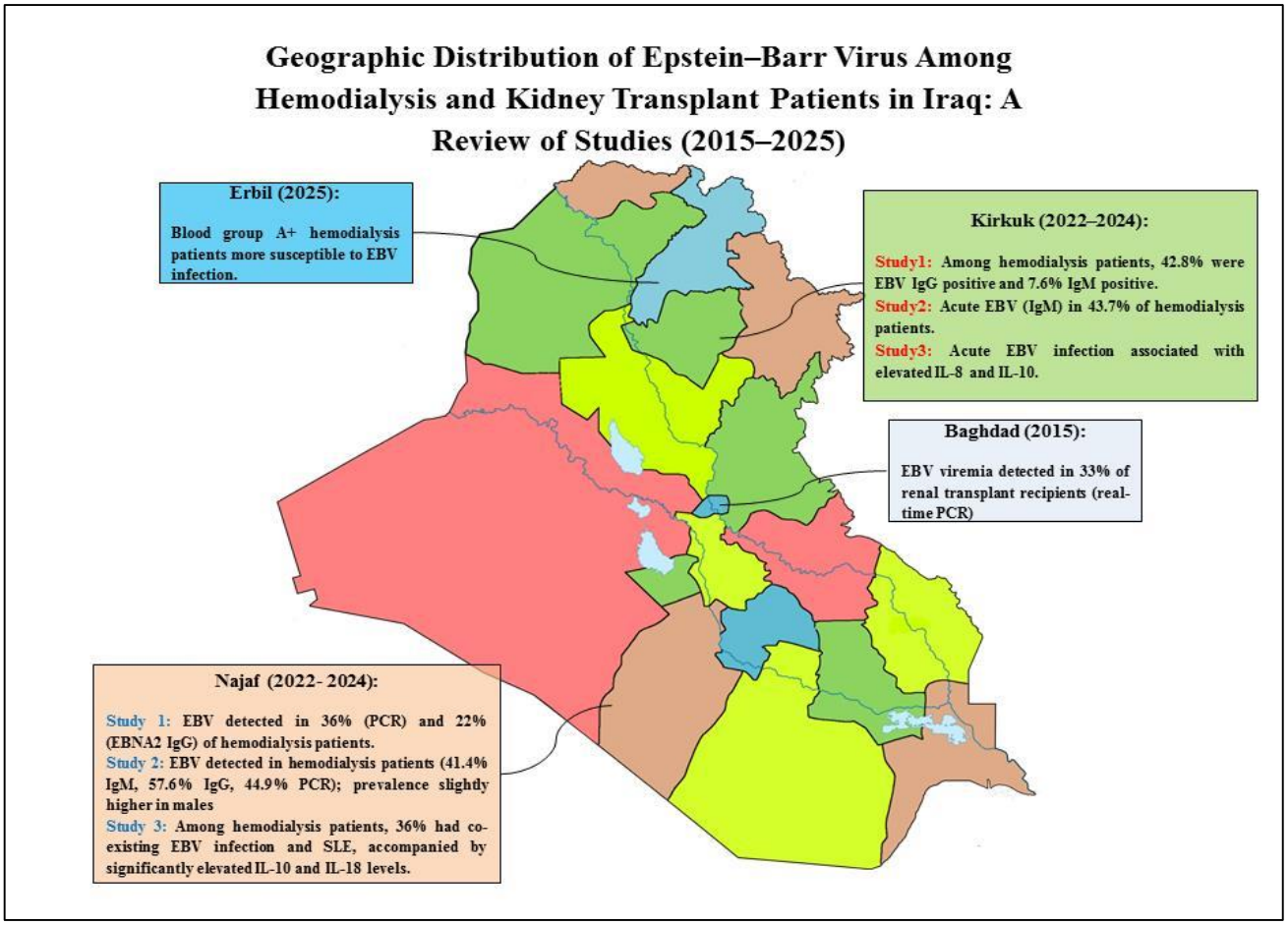

Figure 3: Map of Iraq illustrating EBV prevalence and key findings among hemodialysis and kidney transplant patients across different cities. Created by the authors.

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Emerging Risk Factors for EBV Infection in Kidney Transplant Recipients

Epstein-Barr virus infection remains a critical challenge in kidney transplantation, particularly due to the immunosuppressed state of recipients, which favors both primary infection and viral reactivation. These infections can precipitate serious complications, most notably PTLD. Recent studies (2020–2025) have refined our understanding of risk factors, highlighting novel insights into patient susceptibility and viral dynamics (Figure 4)

Donor-Recipient EBV Serostatus Mismatch

The highest risk occurs in EBV-seronegative recipients receiving kidneys from EBV-seropositive donors. Recent cohort studies indicate that up to 22% of these high-risk recipients develop PTLD within three years, with aggressive disease and significant mortality in a subset [3]. Seropositive recipients prior to transplantation show markedly reduced PTLD risk, suggesting that pre-existing immunity is a protective factor [3, 69].

Age and Developmental Factors

Pediatric and young adult transplant recipients remain disproportionately susceptible to primary EBV infection [70, 71]. Data indicate that EBV-naïve children receiving EBV-positive donor organs exhibit the highest incidence of PTLD, emphasizing the continued importance of age-stratified risk assessment in clinical protocols [72, 73].

Intensified and Targeted Immunosuppression

Modern immunosuppressive strategies have nuanced effects on EBV risk [72]. Intensive therapy within the first year post-transplant or following acute rejection impairs T-cell surveillance, increasing EBV reactivation and PTLD risk. Lymphocyte-depleting agents, such as thymoglobulin, and elevated tacrolimus trough levels further amplify susceptibility [69]. Emerging biologics, including belatacept, slightly elevate PTLD risk in EBV-seropositive adults but may offer overall safety advantages compared to conventional regimens [74–76].

Coinfections and Immune-Modulating Factors

Concurrent viral infections, particularly active cytomegalovirus (CMV), are increasingly recognized as amplifiers of EBV DNAemia and immune perturbation [77].

Graft Source, Donor Characteristics, and Microenvironment

Organs from deceased donors and grafts rich in lymphoid tissue are linked to higher EBV risk, particularly in pediatric and immunologically naive recipients [78–80]. Current research is exploring how donor-specific viral microenvironments within the graft may influence EBV replication dynamics post-transplant.

Post-Transplant Timeline

EBV reactivation and PTLD predominantly occur within the first 1–2 years, but late-onset complications are increasingly reported, underscoring the need for long-term surveillance in high-risk recipients [72].

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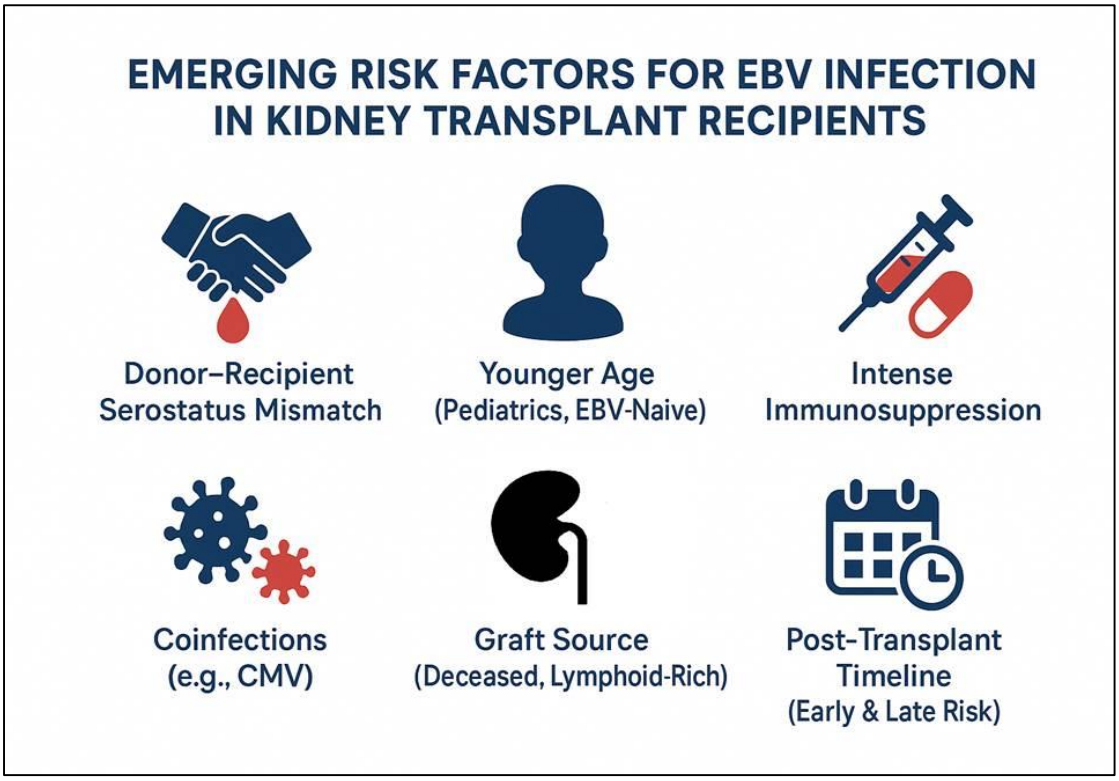

Figure 4: Risk Factors for EBV Infection in Kidney Transplant Recipients. Created by the authors.

Clinical Impact of EBV in Kidney Transplant Recipients

In kidney transplant recipients (KTRs), Epstein–Barr virus manifests along a continuum from asymptomatic DNAemia to infectious mononucleosis–like illness, graft-involving disease, and post-transplant lymphoproliferative disorders (PTLD). Contemporary syntheses place the cumulative incidence of PTLD in adult renal recipients around 0.6–2.5%, far lower than thoracic/intestinal grafts but still clinically consequential because 60–70% of PTLD is EBV-related and mortality remains substantial [81–84]. Recent registry and cohort work underscores how donor–recipient serostatus dominates risk: early-onset PTLD in EBV-seronegative recipients of seropositive donor kidneys (D^+/R^-) is markedly enriched; one recent adult cohort estimated a 22.1% cumulative incidence of early PTLD in D^+/R^- pairs [3]. PTLD remains associated with substantial mortality beyond the first posttransplant year. Evidence from multiple cohorts indicates that patient survival is adversely affected by PTLD, even in cases where graft survival rates are not consistently reduced [5]. Immunosuppressive therapy compromises EBV-specific T-cell surveillance, leading to unchecked B-cell proliferation, viral reactivation, and, in a subset of cases, malignant transformation. Evidence from reviews and consensus guidelines supports a graded, exposure-dependent risk model: T-cell–depleting induction regimens (such as antithymocyte globulin [ATG] or alemtuzumab) and augmented therapy for rejection confer a markedly higher risk of EBV DNAemia and PTLD compared with non–depleting induction agents (such as basiliximab). This association was reinforced by a large multicenter study, which demonstrated a significantly greater incidence of PTLD with ATG or alemtuzumab relative to basiliximab, even after comprehensive multivariable adjustment [69].

Children and young adults are more susceptible to early EBV infection after transplantation, partly because of their younger age and often being EBV-naïve (not previously exposed to the virus) [5, 85]. Coinfections, especially CMV, are frequent and can heighten viral loads and immune dysregulation, reinforcing the value of coordinated surveillance for herpesviruses in high-risk KTRs [86]. EBV DNAemia and PTLD are associated with increased

hospitalization, intensified immunosuppression, and higher mortality, even when graft survival is maintained in some cases. Contemporary studies in solid-organ transplant cohorts report PTLD-related mortality between 30 and 60%, depending on histology and treatment response [81, 87]. Iraqi studies further confirm that opportunistic viral infections, particularly Epstein-Barr virus (EBV), represent a significant threat to renal transplant recipients, especially under contemporary immunosuppressive regimens. EBV reactivation can result in graft dysfunction and loss if not promptly detected and managed. Gaining insight into EBV prevalence, associated risk factors, and its clinical impact is essential for optimizing outcomes in KTRs in Iraq [8, 88].

Diagnosis and Management of EBV among Kidney Transplant Recipients

Diagnosis

Accurate diagnosis of clinically significant Epstein–Barr virus infection in kidney transplant recipients (KTRs) rests on three pillars: 1) pre-transplant risk stratification (donor/recipient serostatus), 2) molecular surveillance by quantitative EBV PCR, and 3) tissue diagnosis when invasive disease or PTLD is suspected. Pre-transplant EBV serology remains essential to identify high-risk D^+/R^- pairs who require intensified post-transplant monitoring because primary infection in a naïve recipient carries the highest early PTLD risk. Guidelines and registry analyses therefore recommend documenting donor and recipient EBV IgG prior to transplantation and flagging seronegative recipients for more intensive follow-up [80, 89, 90]. Quantitative nucleic-acid testing (qPCR) of blood remains the cornerstone of EBV diagnosis and monitoring. Whole blood provides greater sensitivity for low-level, cell-associated EBV DNA, while plasma more accurately reflects free viral DNA indicative of lytic replication and active disease. Adoption of the WHO International Standard has enhanced assay harmonization across laboratories. Nevertheless, qPCR demonstrates a high negative predictive value but a limited positive predictive value, making it more reliable for ruling out EBV disease than for confirming it [91–93].

Serological testing for EBV, most commonly by measuring viral capsid antigen (VCA) IgG/IgM, EBV nuclear antigen (EBNA-1) IgG, and occasionally early antigen (EA), is primarily used pre-transplant to determine the EBV serostatus of both donor and recipient. This stratification (D^+/R^-, D^+/R^+, D^-/R^+, D^-/R^-) identifies recipients at greatest risk for primary EBV infection and subsequent PTLD, particularly in D^+/R^- pairs. Post-transplant, however, serology is of limited diagnostic value: antibody responses may be blunted by immunosuppression, and interpretation is complicated by donor-derived antibodies or passive transfer via transfusion or IVIG. Thus, while serology remains crucial for risk assessment and baseline classification, molecular assays (EBV PCR) are the preferred tool for monitoring active infection or reactivation after transplantation [94–96]. In Iraq, most studies on EBV among KTRs have employed diagnostic strategies comparable to those used globally, primarily relying on serological assays and molecular techniques such as PCR to detect infection.

Surveillance Strategies

Surveillance strategies should be risk-adapted. Most expert reviews and society guidance recommend frequent EBV PCR during the early post-transplant period (for example, weekly to biweekly for the first 1–3 months in high-risk D^+/R^- recipients, then gradually spacing to monthly through 6–12 months), with lower intensity or no routine monitoring for low-risk adult D^+/R^+ or D^-/R^- pairs depending on center practice. Because evidence for exact schedules and thresholds is imperfect, many centers adopt programmatic algorithms that combine serostatus, age (pediatric vs. adult), induction regimen, and clinical events (e.g., rejection) to decide frequency and action thresholds [97, 98].

Initial management (first-line: reduce net immunosuppression ± rituximab)

The universally recommended first step for significant EBV DNAemia or early EBV-driven disease is reduction of immunosuppression (RIS) to restore EBV-specific T-cell surveillance, balanced against rejection risk. RIS typically involves stepwise reduction or withdrawal of anti-proliferative agents (mycophenolate) and lowering calcineurin inhibitor exposure. For EBV-positive PTLD or persistent/high-level DNAemia despite RIS, rituximab (anti-CD20), often given as weekly infusions, is the standard next intervention for B-cell PTLD (polymorphic or early

lesions) and increasingly used preemptively in high-risk scenarios; combination with RIS improves response rates compared with RIS alone in many series [75, 99–101]. Antiviral agents (acyclovir, ganciclovir) have limited efficacy against latent EBV and are not reliable as stand-alone therapies for EBV DNAemia or established PTLD; they may have a role in specific settings with lytic replication but are not substitutes for RIS/rituximab or cellular therapy in established disease. Intravenous immunoglobulin (IVIG) is occasionally used adjunctively but lacks definitive evidence as primary therapy [102, 103].

Emerging and Advanced Therapies

For rituximab-refractory, relapsed, or high-risk EBV-positive PTLD, EBV-specific adoptive T-cell therapy has rapidly advanced from case series to regulatory approvals in some jurisdictions. The allogeneic, partially HLA-matched product tabelecleucel (brand name Ebvallo™/Tab-cel) received conditional marketing authorization in the European Union (2022) and in several other countries for relapsed/refractory EBV-positive PTLD after failure of at least one prior therapy, and real-world and trial data show meaningful durable responses with acceptable safety. The product's U.S. regulatory path has been active, with recent submissions and regulatory interactions reflecting manufacturing and inspection issues rather than lack of clinical effect; therefore, availability remains region-dependent and evolving. Adoptive therapy using donor-derived or third-party EBV-specific cytotoxic T lymphocytes in specialized centers also demonstrates high response rates and is increasingly included in algorithms for refractory disease [104].

Research Gap

Despite the recognized global importance of the Epstein–Barr virus in organ transplantation, there is a striking scarcity of local studies in Iraq, particularly among transplant recipients. Most available research focuses on EBV prevalence in hemodialysis patients, while data on kidney transplant recipients remain limited. Geographic representation is uneven, with significant variation between governorates, and there is substantial inconsistency in diagnostic approaches across studies. Notably, there are no long-term studies examining post-transplant complications such as post-transplant lymphoproliferative disorder (PTLD) or graft dysfunction. Furthermore, the role of EBV in donor status, whether positive or negative, has not been investigated. Addressing these gaps is crucial to better understand the epidemiology, risk factors, and clinical impact of EBV in Iraq and to align local knowledge with global evidence.

CONCLUSION

The impact of Epstein–Barr virus on kidney transplant outcomes in Iraq remains an underexplored yet critical area of study. Evidence from regional hemodialysis and transplant populations indicates that EBV infection contributes substantially to post-transplant complications, including PTLD and graft dysfunction. Recognizing and addressing the multifactorial risk factors, such as immunosuppressive regimens, donor-recipient characteristics, and co-infections, is essential to optimize patient care. Implementation of systematic EBV monitoring, adoption of sensitive molecular diagnostics, and integration of emerging therapies, including EBV-specific adoptive T-cell strategies, could transform management and improve long-term graft survival. Future research should focus on expanding national surveillance, clarifying EBV epidemiology in transplant recipients, and evaluating innovative prevention and treatment approaches to mitigate the virus's clinical burden.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Authors' Contribution

All authors contributed to the conception and design of the study. Safaa Shehab Ahmed conducted the literature search, data extraction, and synthesis. Anfal Kadhim Abed prepared the figures, including the map of study locations, and assisted in data analysis. Shahad Saad Alwan drafted the manuscript, and all authors critically revised the content for intellectual accuracy. All authors have read and approved the final version of the manuscript.

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