Turkish Journal of Public Health Dentistry
Volume 5, Issue 2, Page No: 31-38
Available Online at: **https://tjphd.com/**

ISSN: 3062-3359

Original Article

Prevalence of Implant Failures and Determining Associated Factors among Patients: A Retrospective Study in REU

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ABSTRACT

Implant failures are still an issue of concern for clinicians, since they frequently result from functional impairments, patient dissatisfaction, and extra treatment charges. There are so many reasons why an implant may fail, including Peri-implantitis, soft tissue complications, a history of periodontal diseases, and surgical or prosthetic planning. This is a radiometric retrospective study using patients' files. Each file was screened and observed for any bone loss around the implants, along with other variables such as gender, age, systemic disease, and implant position. Clinician's background, such as periodontist, resident, or surgeon, was recorded as well. The follow-up date was one year from the treatment date. This information was verified by two examiners, and inter-examiner reliability was recorded. All of the observations were listed on an Excel sheet and transferred to SPSS version 22. Inter-examiner reliability was 95%, with 270 files being screened. Implant failure was observed in 7% of the screened files. The association between implant failure and related factors will be presented in the final report. A statistically significant association was observed between implant failure and systemic diseases and age. However, no association was noted when analyzed on the basis of gender and implant position.

Keywords: Implant failure, Risk factors, Dental implants, Peri-implantitis

Introduction

Dental implants have become rather popular in contemporary societies and are known to be a solution needed for edentulism treatment that provides aesthetics and functionality for the patients [1]. Nevertheless, implant failures are still an issue of concern for clinicians, since they frequently result from functional impairments, patient dissatisfaction, and extra treatment charges [1]. Solutions can be divided into early and late implant failures depending on the occurrence before or after osseointegration [1]. There are so many reasons why an implant may fail, including Peri-implantitis, soft tissue complications, a history of periodontal diseases, surgical or prosthetic planning, and others, as postulated by Greenstein and Cavallaro (2021) [2].

It would be critically important to elaborate on the reasons for such implant failures and determine the characteristics of patients with the highest risk of experiencing these failures to enhance the rates of success in the long term and ensure the appropriate level of patient protection. Peri-implantitis is one of the significant factors that lead to implant loss; it is an inflammatory process associated with the progressive loss of implant-attached bone [3, 4].

In addition, the information indicates that certain systemic conditions, systemic diseases, smoking, and poor oral hygiene also contribute to the implant failures, pointing to the fact that implant failures are polygenic [5, 6]. As highlighted in this study, there is a dearth of research regarding implant failure, including its longevity; thus, the success of this study in addressing this gap will be significant [7]. The results of the study, therefore, would go a

HOW TO CITE THIS ARTICLE: Qamar Z, Alsaeedi M, Alnemri S, Alawadhi S, Alshammari A. Prevalence of Implant Failures and Determining Associated Factors among Patients: A Retrospective Study in REU. Turk J Public Health Dent. 2025;5(2):31-8. https://doi.org/10.51847/ZVC6IA5cDk

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Received: 29/06/2025
Accepted: 21/11/2025

long way in enhancing implant treatment planning and also long-term implant success for the benefit of both the clinicians and the patient.

There are factors that relate to the biology of the patient, the mechanics of the implanted prosthesis, and human error that affect the success of dental implants. Of these, peri-implantitis has been deemed a significant etiological factor for implant loss [4]. Peri-implantitis leads to resorption of the alveolar bone around implants, infection, and other situations that include poor hygiene, smoking, and systemic diseases such as diabetes mellitus [1]. As a result, to assess the probability of implant failure, numerous
investigations have tried to create the risk factors for Peri-Implantitis.

Sarbacher *et al*. (2022) showed that similar models should be compared and also pointed out that risk assessment can be done only patient by patient [7]. Their study also underlined the necessity of raising an intensive preventive line so as to lower the rates of implant failure. One of the most critical aspects that play a role in implant stability refers to hard and soft tissues, especially the keratinized mucosa. It is reported in the present literature that sufficient keratinized mucosa around implants plays a significant role in the stability and health of the implants. According to Greenstein and Cavallaro (2021) stated that, an adequate amount of keratinized mucosa can minimize inflammation and also provide better stability to the implant [2].

In addition, periodontal diseases presents predispose the patient to be at risk to a higher rate of implant failure. Implant-supported fixed prostheses in patients with periodontal diseases were reviewed by Carra *et al*. (2022), and the authors concluded that patients with periodontal diseases are more prone to develop peri-implant diseases [3]. But they stated that if proper treatment planning and implant maintenance were done properly, then it is possible to get implants. Likewise, Marconcini *et al*. (2021) looked into the outcomes of immediate restoration techniques, including the flat one-bridge method, and the authors affirmed that these techniques could work given that patients complied with instructions after the surgery [8]. Apart from biological and prosthetic factors, patients' perception is also essential in any implant procedure.

Wu *et al*. (2022), therefore, assessed patient-reported outcomes that would inform satisfaction in terms of post-operation care, functional efficiency, and aesthetics [6]. For instance, there is little evidence on long-term implant success determinants, especially regarding the implant material and placement, and maintenance approaches pointed out by Basaad *et al*. (2023) [4]. To further understand these factors and enhance implant outcomes for various patient populations, more research is needed.

Study rationale

This study will provide useful insights into the frequency of implant failures among the patients visiting the REU clinics, and the factors associated with it will assist the clinicians in preventing such failures.

Aim of the study

To determine the prevalence of failed implants among the patients visiting REU clinics.

Objectives:

- To list down the factors associated with implant failure.
- To compare the implant failure prevalence between genders, age groups, and other related variables

Research question

What is the prevalence of implant failures among REU patients, and which factors play the most significant role in causing them?

Materials and Methods

Study design

A radiometric retrospective study using patients' files.

Sampling

Sample was calculated using **www.raosoft.com**:

Margin of error: 5%

Confidence level: 95%

Population size: 1000

Response distribution: 50%

Recommended sample size: 278

Methodology

Patients' files were retrieved after ethical approval, which utilized an inclusion criterion, which is as follows:

- Files with clear bitewings and PAs of implants
- Files of patients who were treated in the past 10 years (2015 onwards)
- Files of patients who are more than 18 years of age
- Patients who are medically compromised
- Files with radiographs having good quality

Exclusion criteria

- Files with poor-quality radiographs
- Patients less than 18 years of age

Each file was screened and observed for any bone loss around the implants, along with other variables such as gender, age, systemic disease, and implant position. Clinician's background, such as periodontist, resident, or surgeon, was recorded as well. The follow-up date was one year from the treatment date. This information was verified by two examiners, and inter-examiner reliability was recorded (0.951). All of the observations were listed on an Excel sheet.

Statistical analysis: Data from the Excel sheet were transferred to the Statistical Package for Social Sciences (SPSS) version 22 (IBM, New York, 2017). Results were computed using frequencies, and comparisons were made using the chi-square test with the p-value less than 0.05 to be statistically significant.

Results and Discussion

Inter-examiner reliability was 95%, with 278 files being screened. Implant failure was observed in 7% of the screened files. The association between implant failure and related factors will be presented in the final report. A statistically significant association was observed between implant failure and systemic diseases and age. However, no association was noted when analyzed on the basis of gender and implant position.

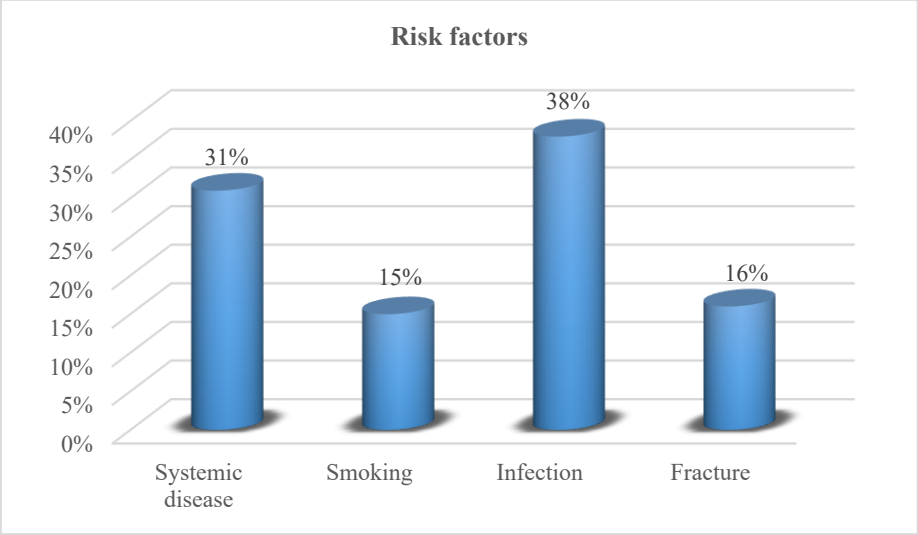

Figure 1. Risk factors associated with implant failure

Risk factors for implant failure

As illustrated in **Figure 1**, a bar graph depicting the contribution of various risk factors to failure of the implant shows Infection emerging as the most prominent risk factor, accounting for 38% of failures. This remarkably high percentage points toward the critical role infections play in implant failure, which may stem from poor hygiene, inadequate sterilization during the surgery, or may even have postoperative complications. Recovery Systemic diseases contribute towards 31% of implant failures, which means that patients with prior existing conditions like

diabetes or autoimmune disorders tend to have difficulties in healing and integrating with the implant. These diseases adversely affect the body's acceptance and maintenance of the implant. Fractures with 16% also represent a considerable factor, where physical trauma or stress on the implant could lead to its failure. Lastly, smoking contributes towards 15%, standing out as yet another key risk factor. Negative circulation effects, in addition to a slower tissue healing rate, make smokers more vulnerable to numerous post-implant complications such as infection or tissue rejection.

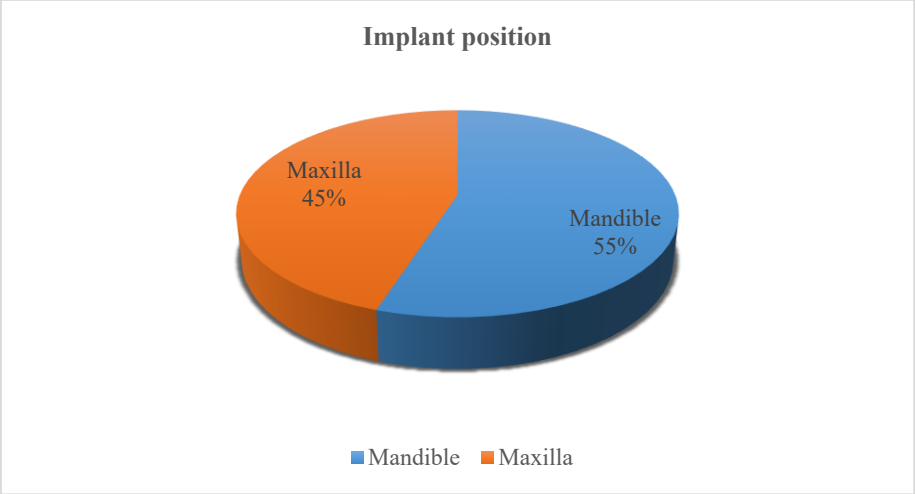

Figure 2. Association of Implant position with implant failure (p-value >0.05)

Implant position and failure

In a pie chart, **Figure 2** illustrates the correlation of the position of an implant with its failure rate and describes the mandible's (lower jaw) contribution to the overall failure rate. It can be seen that the mandible also has a slightly greater failure rate at 55% compared to the maxilla (upper jaw) with 45%. These facts are likely due to the anatomical differences in the two regions. The mandible may have less bone and blood supply than the maxilla. This would adversely affect healing and implant stabilization. Also, the functions and forces that are applied to implants in the mandible, as in chewing, may explain the greater failure rate.

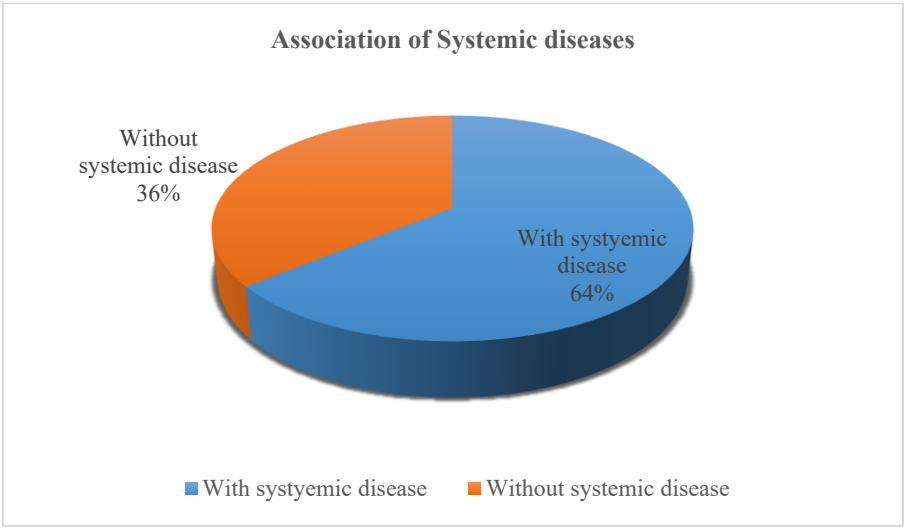

Figure 3. Association of systemic disease and implant failure (p-value <0.05*)

Systemic diseases and implant failure

Figure 3 underscores the importance of systemic diseases as contributors to implant failure. The pie chart demonstrates that such underlying systemic conditions affect 64% of the patients with implant failures, which is quite substantial. Systemic conditions like as diabetes, cardiovascular disease, and some immunological disorders may interfere with the body's natural ability to heal and integrate implants. These chronic ailments can obstruct the bone's scaffolding architecture or can lead to the clogging of the body's mechanism to build bone around the

implant, which can result in rejection or failure. On the other hand, 36% of failures occurring in the absence of systemic disease suggests, alongside systemic health, some technical or procedural elements of the treatment, local site conditions, or other factors may also be influential in the overall s in failure of the implant.

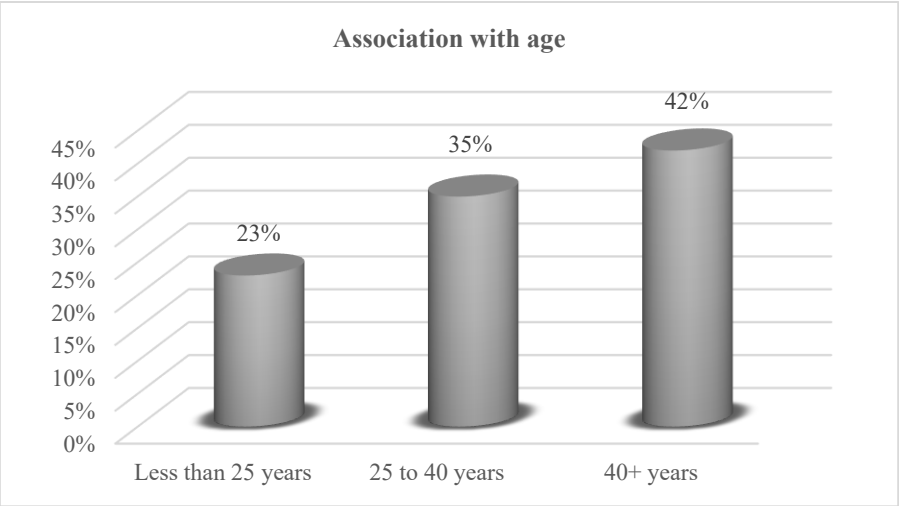

Figure 4. Association of age with implant failure (p value <0.05*)

Age and implant failure

Figure 4 scrutinizes the relationship between a patient's age and the failure of the implant. The bar chart demonstrates that the failure rate of an implant tends to escalate with age. The highest failure rate of 42% was recorded among patients aged 40 and above, followed by those aged 25-40 years at 35%, while those under 25 years had the lowest failure rate of 23%. This pattern indicates that older people may have greater difficulty achieving success with implants due to lower bone density, healing rate, and other age-related medical conditions. Patients aged below 25 appear to possess a good bone-to-soft tissue ratio, which is greatly beneficial for postoperative healing, which explains the lower failure rates seen within this demographic.

Implant failure in relation to gender

In **Figure 5**, which is presented in a pie chart, we analyze the failure of the implant in correlation to gender. Men constitute 53% of patients with failure of the implant, while women constitute 47%. Despite the fairly even gender split, this slight inclination towards men could be due to high bone density or other biological factors associated with gender that exist and affect the healing response, or the presence of some systemic conditions that affect the success of the implant.

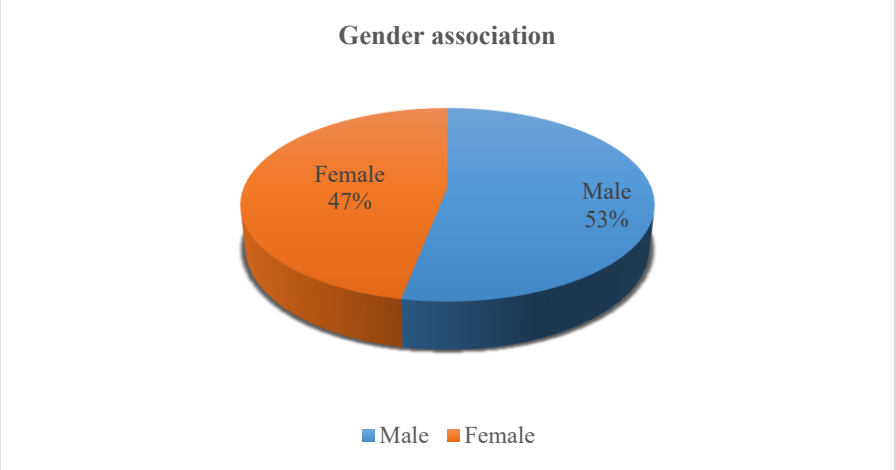

Figure 5. Association of gender with implant failure (p-value >0.05)

This study sheds new light on the features associated with the failure of medical implants, paying particular attention to systemic diseases, age, gender, position of the implant, and other risk factors. A detailed review of the

current literature shows that implant failure has both commonalities and varying features when compared to significant past studies on the same topic, considering the abundant and almost paradoxical explanations of why the medical implant fails.

Inter-examiner agreement and dependability relate to implant failure rate

The level of inter-examiner reliability, which was measured in this study, is 95%. This indicates that there is a high degree of variability between examiners in the collection of information within the study. This is a key aspect of the study, which many argue is highly reliable because there are no biases toward how the data was touched or the evaluation was done through different methods. When the data was analyzed in this study, the failure rate was calculated to be 7%, which is moderate and within the range of several previous studies.

In comparison, Thiebot *et al*. (2022) reported an implant-level failure rate of 3.1% and a patient-level failure rate of 10.4% [9]. The failure rate in Thiebot's study is lower, perhaps because it was concentrated around a particular set of patients, aged 55.5 years on average, and included bone type density metrics as well as pre-implant surgeries, which could affect the results. Moreover, Thiebot's study's smaller sample size (12 implants) would limit generalizability, and while the current study screened 278 files, generalizability may still be an issue based on different criteria used in the studies. Still, despite the variation, the current study demonstrates lower rates of bone density as stratified by age, showing the lack of generalizability to study age stratification. Hence, despite the failure rates in our study being comparatively higher, the varying methodologies, sample size, population characteristics, and geographic differences should be considered.

Implant location and failure rates

The current study noted that 55% of implant failures took place in the mandible as opposed to 45% in the maxilla. This is consistent with the findings of Wu *et al*. (2021), who found that implants put in the posterior mandible were more likely to fail, but that the posterior maxilla had a higher propensity for early implant failure [10]. In this study, it was proposed that the anatomical differences of the mandible and maxilla, including blood supply and bone density, may explain the failure rate being slightly higher failure rate in the mandible. In addition, the mechanical stress from chewing would add to the forces used during mastication of the alternately active lower jaw that holds mandible implants, leading to greater failure rates.

Nevertheless, prior research, including Rotim *et al*. (2021) and Chrcanovic *et al*. (2014), found that implants placed in the maxilla had a higher rate of failure due to inadequate bone quantity and sinus lift procedures [11, 12]. Thiebot *et al*. (2022) also mentioned that 83% of all failures of implants in the maxilla were from the upper jaw, suggesting some populations do have a higher risk of failure in the upper jaw [9]. The difference in outcomes from other studies could be influenced by the variability in the sample populations, such as bone quality, surgical methods, and other aspects of the implants used.

Systemic conditions and the failure of implants

The most critical issue in the current research is the link between systemic diseases and the failure of an implant. Sixty-four percent of the failures happened in patients with some form of systemic disorder. Diabetes, cardiovascular disorders, and autoimmune diseases are examples of systemic diseases. These can hinder the ability to heal and integrate the implants. The studies of Papaspyridakos *et al*. (2012) and Nyland *et al*. (1998) also pointed out these systemic conditions as great contributors to the failure of an implant, showing that these systemic diseases greatly contribute to the failure of an implant [13]. Things such as diabetes will lead to insufficient healing of bones, reduced immune function, and greater chances of infections, which all, in some way or the other, will lead to the failure of dental implants.

There is strong statistical relevance in the studies done with respect to systemic diseases and failure of implants in a p-value of less than point oh five. Unlike Rotim *et al*. (2020), this particular set of respondents reported no differences in failure rates with the presence or absence of systemic diseases [11]. Differences may arise due to the type of systemic diseases in the patients under study. As an example, Thiebot *et al*. (2022) have pointed out risks such as rheumatoid arthritis combined with pre-implant sinus lifts [9], whereas Chrcanovic *et al*. (2014) preferred the broader range of systemic conditions spanning thyroid disorders and osteoporosis [12].

Age and failure of the implant

The study noted that patients over the age of 40 have the highest failure rate, which is recorded at 42%. This is followed by the ages of 25 to 40 years at a 35% rate and patients under 25 at a 23% failure rate. This complies

with Wu *et al*. (2021), who mentioned that older patients tend to have a higher rate of failure due to decreased bone density, slower healing times, and increased risk for other health concerns, which makes the integration of implants troublesome [10].

Other past studies, such as French *et al*. (2021), mentioned age as a factor; however, its significance was nonexistent [14]. This means that while older tell do have a trend toward failing implants, there could be more underlying conditions of health and surgical methods that strengthen bone quality and systemic health dictating the results. Lázaro-Abdulkarim *et al*. (2022) also noted that age and sex do not have a direct correlation with the failure of an implant, and that makes the matter more complex [15].

Gender and the failure of implants

In the ongoing study, the gender of an individual did not seem to have a great association with implant failure (p-value > 0.05), where 53% of failures were in male patients and 47% of failures were in females. This is consistent with other studies, Rotim *et al*. (2021) and Chrcanovic *et al*. (2014), which also noted that there was no significant difference in failure rates considering the gender differences [11, 12]. Lázaro-Abdulkarim *et al*. (2022) similarly found that there was no considerable difference pertaining to the gender and the rates of implant failure [15]; however, some studies have purported that especially menhas higher chances of failure due to some components of greater bone density and particular systemic diseases.

Implant failure of patients with systemic disease, smoking, and older age became more prevalent in females, highlighting the need for further research targeting these demographic areas. The outcome of the present study and the balanced distribution of failure rates suggest that other such factors are more likely to influence the implant failure than gender consideration. Nyland *et al*. (2024) and Papaspyridakos *et al*. (2012) noted that gender is an important determinant of the outcome of implants [13, 16]. However, more common yet vital factors, such as managing and observing the general health and well-being of an individual, are essential for the success of the implant.

Study Limitations: In order to determine the generalizability, we need to increase the sample size, which is one of the limitations of this study. Moreover, other clinical finding, such as keratinized mucosa, was not included. Finally, the scope of the study was limited to a university teaching hospital, which does not represent the rest of the population.

Conclusion

Overall, although there is agreement with previous research, such as the impact of gum disease, aging, and smoking on the failure of implants, there are differences in the interplay of gender, position of the implant, and the failure rate. In this study, the mandible was found to have a higher failure rate, while other studies suggest a higher failure rate in the maxilla. In the present study, gender did not play a significant role in the failure of the implants. However, there is literature to suggest that male patients may have higher rates of failure.

Comparison with other studies demonstrates the multifactorial nature of the problem of implant failure, which incorporates primary factors like systemic diseases and quality of the bone, surgical technique, patient's age, and demographics, warranting additional research to reach a reliable conclusion. Implementation of the study in the future with larger sample sizes and with patients from different ethnic backgrounds will solidify these results and will serve as a guideline for medical practitioners to reduce the chances of implant failure.

Acknowledgments: None

Conflict of Interest: None

Financial Support: None

Ethics Statement: This study received an IRB approval # FUGRP/2025/415/1228/1117 (Riyadh Elm University).

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