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Historical background and Objectives

The *Saudi Journal of Health Research and Practice (SJHRP)* was established to address the growing demand for a platform dedicated to publishing high-quality, evidence-based health research in Saudi Arabia and beyond. As healthcare in the region undergoes rapid transformation in line with Vision 2030, the journal aims to bridge the gap between clinical practice and research. The goal is to empower healthcare professionals, educators, and researchers by providing a venue for sharing innovative findings and insights that address local and global health challenges.

By amplifying regional voices, the SJHRP aspires to contribute to the global health dialogue while ensuring that the unique perspectives and priorities of the region are represented.

Theme of the Issue

This issue of the *Saudi Journal of Health Research and Practice (SJHRP)* highlights the intersection of public health, education, and clinical medicine across diverse contexts in the Kingdom. The featured studies explore lifestyle behaviors among youth, curriculum innovation in medical education, and clinical conditions of regional importance. Together, they illustrate the dynamic progress in Saudi health research and its contribution to improving population well-being and academic practice.

Editorial Message

The third issue of SJHRP presents a collection of studies that together portray a holistic view of health research in the Saudi context-spanning nutrition, physical activity, medical education, and disease profiling.

The opening article examines the generalizability of dietary patterns among university students, addressing how gender and residence influence nutritional habits-a timely topic in light of the Kingdom's ongoing focus on preventive health and youth well-being. Complementing this, the second paper investigates physical activity and perceived barriers among young women in the Jazan region, shedding light on behavioral determinants critical for designing effective health promotion programs.

In the clinical domain, two papers extend our understanding of disease epidemiology and management in local populations. The review on Familial Idiopathic Pulmonary Fibrosis offers an in-depth synthesis of current evidence and highlights the need for genetic and regional studies in rare respiratory diseases. Meanwhile, the analysis of breast cancer patients in the Jazan region provides valuable demographic and clinical insights that can inform early detection strategies and resource planning.

Adding an educational dimension, the article on teaching the History and Art of Medicine as an elective course exemplifies the growing recognition of humanistic and interdisciplinary approaches in medical training-an important step toward developing well-rounded physicians who appreciate the cultural and ethical contexts of care.

Collectively, these contributions reflect SJHRP's mission to foster high-quality research that is locally relevant, educationally enriching, and globally significant. We thank all authors and reviewers whose efforts made this issue possible and invite readers to engage with these works as part of our shared journey to advance health knowledge and practice in Saudi Arabia and beyond.

Professor Hussein M. Ageely
Editor-in-Chief
Saudi Journal of Health Research and Practice

About the Journal

The *Saudi Journal of Health Research and Practice (SJHRP)* is a peer-reviewed, open-access journal dedicated to publishing high-quality research that advances healthcare and evidence-based practice. The journal serves as a platform for researchers, clinicians, and academics to share knowledge and insights across a wide range of healthcare disciplines.

Journal Mission:

- To promote innovation and excellence in health research.
- To provide a platform for interdisciplinary collaboration.
- To address pressing health challenges both locally and globally.

Scope:

This journal covers all topics related to all aspects of health issues and healthcare research. Basic medical research with clear clinical implications will also be considered. Research fields of interest include but are not limited to:

- Public Health and Epidemiology
- Health Promotion and Disease Prevention
- Clinical Medicine Across All Specialties (including all clinical medical , dental and other clinical specialties and subspecialities)
- Pharmaceutical Research and Development
- Biomedical Sciences and Technology
- Mental Health and Behavioural Science
- Environmental and Occupational Health
- Quality of Care and Patient Safety
- Health Informatics and Digital Transformation
- Health Education and Behavioral Science
- Health Economics and Policy Research

Key Features:

- **Open Access:** Ensures free and unrestricted access to research for all readers.
- **Double-Anonymous Peer Review:** Guarantees a rigorous and unbiased review process.
- **Interdisciplinary Focus:** Publishes research from a variety of healthcare fields to encourage collaboration and innovation.

For more information, visit the journal's website at:
https://journals.jazanu.edu.sa/ojs/index.php/SJHR/index.

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Announcements:

- SJHRP is currently accepting submissions for its next issue. Researchers are encouraged to submit their work via the journal's online portal.
- Plans for indexing SJHRP in major databases such as Scopus and PubMed are underway.

Acknowledgments

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- **H.E. Professor Mohammad Aburassain**, President of Jazan University, for his visionary leadership.
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- **The Journal's Editorial Office**, for their tireless efforts in managing submissions and ensuring the journal's quality.
- **The Editorial Board Members**, whose expertise and commitment have been instrumental in shaping this journal.

Your contributions have made this milestone possible, and we look forward to your continued support as we advance together.

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Original Article

Generalizability and Consistency of Derived Dietary Patterns across Gender and Residence Subgroups among University Students in Saudi Arabia

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ABSTRACT Numerous studies have reported dietary patterns among university students. However, specific research on the generalizability and consistency of dietary patterns across student subgroups is limited. The study aimed to empirically explore dietary patterns and to assess the generalizability and consistency of these patterns across gender and residence subgroups of university students. Between 2023 and 2024, a cross-sectional study was conducted among undergraduate students at the College of Nursing and Health Sciences, Jazan University, Saudi Arabia. The dietary intake of 650 students (350 boys and 300 girls) was collected using a food frequency questionnaire. Both exploratory and confirmatory factor analysis were used to explore the dietary patterns. The congruence coefficient was used to assess the generalizability and consistency of the factors between subgroups of gender and residence. Four optimal dietary patterns were identified: a western food pattern, consisting of salty snacks/chips, fried foods, cakes/biscuits/sweets, soda drinks, pastries/pizzas, and drinks/juices; a traditional food pattern, consisting of breakfast cereals/seeds, meat/chicken, rice/pasta/potatoes, traditional foods, milk/milk products, and eggs; a protein food pattern, consisting of processed meat and fish/seafood; and a prudent food pattern, consisting of fruits, nuts, vegetables, and legumes. The empirically derived dietary patterns were generalizable and consistent across subgroups of gender and residence. Further research with a longitudinal setting is required to assess the relationships between dietary habits and chronic diseases.

Keywords: Diet, Factor Analysis, Western Foods, Traditional Foods, Prudent Foods, Protein Foods, Congruence Coefficient.

INTRODUCTION

For young people, university education is a time of transition from the safety of parental supervision to self-dependence c. Because of the unfamiliar surroundings at university, first-year students may display changes in their personalities, perspectives, and behaviors [2]. Over the last four decades, the economic boom of the Kingdom of Saudi Arabia has resulted in people moving toward westernized food choices, which are heavy in sugar, salt, and fat, leading to a high obesity rate [3]. The diets of university students have also evolved due to social circumstances, fast food, and technology [4]. Dietary habits established during students' university years often persist into adulthood, making this period critical for promoting healthy eating behaviors. Multiple studies conducted over the past two decades have shown that university students frequently adopt unhealthy eating habits [5-9]. Research from Saudi Arabia has proven that fast food influences unhealthy dietary habits [10,11]. According to a study [12], students in the United Arab Emirates consume more meat and dairy products and fewer fruits and vegetables than recommended. Evaluating dietary variations among university students can be difficult and may entail looking at foods, nutrients, or eating habits [13]. Studies have employed two broad approaches to determining dietary patterns. First, food variables can be categorized according to the combination of nutrients and the nature of the foods [14]. Second, data reduction techniques can derive dietary patterns using empirical statistical modeling of dietary data, enabling analyses that can generate hypotheses. Factor analysis is a popular posterior approach to determining dietary patterns and enables establishing the actual consumption of foods by the population [15,16]. The dietary patterns obtained by factor analysis are useful for assessing the associations between diet and chronic disease [17,18]. Overall, research has shown that dietary

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patterns are reproducible. Homogeneous dietary patterns have been observed within a wide range of population groups [18]. Studies have proven that residence and race are significantly related to nutrient consumption in the United States among White and Black men [19,20]. A cross-sectional study by Alsayegh et al. (2023) assessed the dietary behaviors of university undergraduate students in Saudi Arabia. The study reported four dietary patterns among undergraduate university students: western food, traditional food, prudent food, and protein food patterns [21]. Despite numerous general studies on diet and health using factor analysis to explore dietary risks, there is a lack of comprehensive studies on dietary information across gender and residence subgroups in the Kingdom of Saudi Arabia. Our study aimed to apply rigorous statistical approaches, both exploratory and confirmatory analysis, to empirically explore dietary patterns among university students and assess whether these dietary patterns are generalizable and consistent across student subgroups.

MATERIALS AND METHODS

Study design: The cross-sectional study was conducted between 2022 and 2023 at the College of Nursing and Health Sciences, Jazan University, Saudi Arabia. A pretested food frequency questionnaire [22], with additional questions on sociodemographic characteristics, gender, and residence, was distributed among university student groups. A pilot study was conducted among 50 students to help identify and reduce errors in the questionnaire. The final version of the questionnaire was developed in both Arabic and English. Both male and female students at Jazan University were included except pregnant students. An information program was conducted to explain the importance of the study and to motivate students to participate in the study. Ethical approval: The study addressed the ethical issues according to the Declaration of Helsinki and the National Committee of Bioethics, Saudi Arabia. Consent was obtained from the students, and they were assured that their data would remain confidential. Ethical clearance for this study was granted by the Standing Committee for Scientific Research of Jazan University (REC-44/06/471). Dietary data: In total, 103 common Saudi food items, for which the intake frequencies were included, in the questionnaire. Eight choices were given to the students to indicate their food intake frequency: more than 6 times daily, 5 to 6 times daily, 2 to 4 times daily, once daily, 5 to 6 times weekly, 2 to 4 times weekly, once weekly, and 1 to 3 times monthly. Sample size: A sample size of 648 was found to be sufficient for the Jazan University students, based on a 5% margin of error, a 1% significance level, and a 50% response distribution [21]:

$n = N*X / (X + N-1)$

where $X = Z^2 * P * (1-P) / MOE^2$, N is the size of the population, P is the participant response rate, Z is the table value of 2.58 at 1% level of significance, and margin of error is at 5%. Statistical analysis: Exploratory factor analysis (EFA) was employed to explore the dietary patterns using principal component analysis (PCA). A total of 103 food items were categorized into 18 food groups based on the nature and nutrient combinations of the foods (Supplementary Table 1) [21]. Food frequencies were converted into weekly frequencies [14]. To examine the generalizability and consistency of the identified dietary patterns, the whole sample was separated according to gender (male and female) and residence (urban and rural). The random split sample method was used to split the samples, as in earlier research [23]. EFA was employed across samples to obtain two- to four-factor solutions for improved interpretability of the results. Scree plots were created to examine the variance explained. An eigenvalue of greater than 1.1 was chosen based on the scree plots for better interpretability of the obtained factors. The aim of the study was to assess whether the factors can be derived from the whole sample or whether they should be derived separately from population subgroups. PCA was conducted on the stratified samples of gender (male and female) and residence (urban and rural) separately. The coefficient of congruence was calculated to assess the similarity between a stratified pair of sample factor solutions regarding gender (male and female) and residence (urban and rural). The congruence coefficient was categorized as “excellent” when it was >0.8, “good” when it was between 0.65 and 0.8, “acceptable” when it was between 0.5 and 0.65, and “poor” when it was <0.5 [16]. The optimal number of factors was obtained from the best congruence across gender and residency. Confirmatory factor analysis (CFA) was also employed on the stratified samples (gender and residence) as well as the entire sample to validate the PCA findings. The root mean square error of approximation (RMSEA) and the comparative fit index (CFI) were calculated both for all food groups and for the reduced food groups. Lastly, EFA was repeated for the optimal number of factors and factor loading for the individual food items. A ‘P’ value of less than 0.05 was considered significant. R software (version 4.3.1) for Windows and the ggplot2 package were used for analysis and plots.

RESULTS

In total, 650 students (350 boys and 300 girls), from whom the dietary intakes were obtained through a questionnaire, were included in the study. The scree plot at an eigenvalue of 1.1 and the PCA suggest that the four-factor solution was the optimal solution for the university students’ dietary data. Further, subsequent EFA for each stratified sample of gender (male and female) and residence (urban and rural) revealed excellent congruence for the four-factor solution (Table 1). After the food groups with a low factor loading were deleted from the CFA, the RMSEA was slightly increased, but it did not exceed the threshold of 0.05, while the CFI was greater than 0.90. Furthermore, the

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RMSEA and CFI confirmed that for each stratified sample of gender (male and female) and residence (urban and rural), the four-factor solution was excellent. Thus, all the indicators suggested that the four-factor solution was excellent and that further removing dietary groups would not significantly enhance the model fit (Figure 1).

Table-1: Congruence Coefficient for Four-Factors across Gender and Residence

	Factor Number	Factor Number	Congruence Coefficient
Gender	Male	Female	
	1	1	0.98
	1	2	0.68
	1	3	0.62
	1	4	0.63
	2	2	0.99
	2	3	0.67
	2	4	0.53
	3	3	0.98
	3	4	0.58
	4	4	0.99
Residence	Urban	Rural	
	1	1	0.99
	1	2	0.62
	1	3	0.68
	1	4	0.63
	2	2	0.99
	2	3	0.66
	2	4	0.51
	3	3	0.97
	3	4	0.53
	4	4	0.98

CFA confirmed that the four-factor solution was excellent, with an RMSEA of less than 0.05 and a CFI of 0.91. All 18 food groups had a good correlation, ranging from 0.47 to 0.71, with the respective dietary patterns. No collinearity was found, and the model fit was excellent (Figure 2).

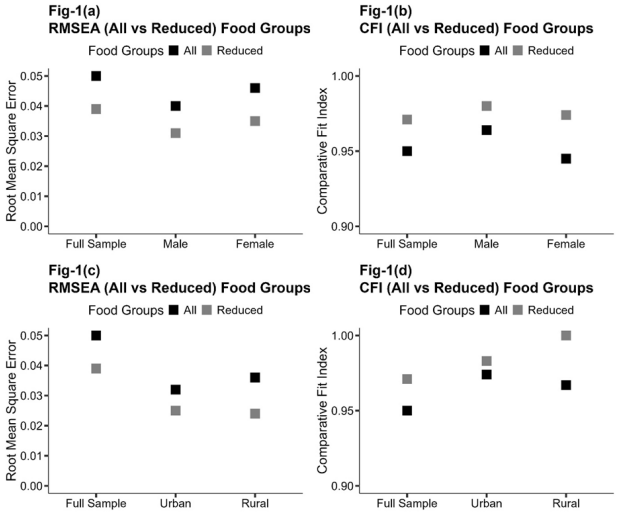

Figure 1: Four Factor Solution between Stratified Groups of Gender and Residence

PCA with varimax rotation and a fixed four-factor solution was employed on the 18 food groups of students' dietary data. This revealed that the western food pattern consisted of salty snacks/chips, fried foods, cakes/biscuits/sweets, soda drinks, pastries/pizzas, and drinks/juices; the traditional food pattern consisted of breakfast cereals/seeds, meat/chicken, rice/pasta/potatoes, traditional foods, milk/milk products, and eggs; the protein food pattern consisted of processed meat and fish/seafood; and the prudent food pattern consisted of fruits, nuts, vegetables, and legumes. The four major patterns of western, traditional, protein, and prudent foods explained 20%, 18%, 13%, and 9% of the total variance, respectively, and as a whole, the model explained 60% of the total variance (Table 2).

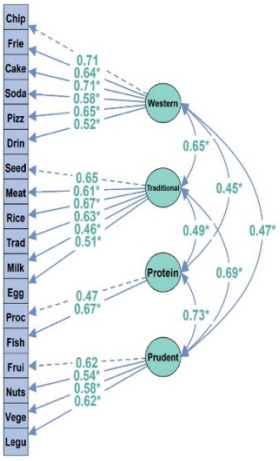

Figure 2: Confirmatory Factor Analysis of Dietary Patterns
Legu-legumes, Vege-vegetables, Frui-fruits, Fish-fish/sea foods, Proc-processed meat, Milk-milk/milk products, Trad-traditional foods, Rice-rice/pasta/potatoes, Meat-meats/chicken, Seed-breakfast/seeds, Drin-drinks/juices, Pizz-pastries/pizza, Soda-soda drinks, Cake-cake/biscuits/sweets, Frie-fried foods and chip-salty snacks/chips.*Highly significant (P<0.01)

Table 2: Dietary Patterns among University Students (Factor Loadings>0.5)

Food group	Western foods	Traditional foods	Protein foods	Prudent foods
Salty snacks/chips	0.75			
Fried foods	0.74			
Cake/biscuits/sweets	0.73			
Soda drinks	0.72			
Pastries/pizza	0.64			
Drinks/juices	0.60			
Breakfast/seeds		0.74		
Meats/chicken		0.71		
Rice/pasta/potatoes		0.67		
Traditional foods		0.60		
Milk/milk products		0.59		
Egg		0.53		
Processed meat			0.78	
Fish/sea foods			0.68	
Fruits				0.73
Nuts				0.72
Vegetables				0.53
Legumes				0.50
Proportion Variance	0.20	0.18	0.13	0.09

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Cumulative Variance	0.20	0.38	0.50	0.59

DISCUSSION

The present study revealed four dietary patterns among university students using both EFA and CFA after assessment of the reproducibility of the factors between the gender (male and female) and residence (urban and rural) subgroups of students. The analytically obtained dietary patterns were varied and explainable and confirmed the patterns of dietary intake among university students. The four derived dietary patterns were also consistent across the gender (male and female) and residence (urban and rural) subgroups of university students. Furthermore, the RMSEA and CFI confirmed that the four-factor solution was excellent for each stratified subsample of gender (male and female) and residence (urban and rural). A population-based REGARDS study aiming to find the reasons for ethnic and racial differences in stroke incidence stated that the empirically derived factors using factor analysis showed reproducibility and strong congruence across race, gender, and residence [16]. Additionally, a systematic review study from Japan assessing the generalizability of empirically derived dietary patterns using PCA stated that some of the major dietary patterns are relatively reproducible across subpopulations within a country, whereas others are not. This highlights the importance of carefully interpreting PCA-derived dietary patterns [24]. A cross-sectional study from Malaysia investigating the consistency and generalizability of empirically derived dietary patterns among members of a multiethnic working population reported that there was no subgroup-specific dietary pattern and that the empirically derived dietary patterns using a pooled sample were consistent and generalizable across the subgroups of gender, ethnicity, and residences status [25]. EFA is a widely used statistical approach to empirically derive dietary patterns among individuals. The main goal of our study was to derive dietary patterns among Jazan University students through EFA. Four dietary patterns—that is, western foods, traditional foods, prudent foods, and protein foods—were explored. Earlier research has reported that the number of dietary patterns can range from three to seven [26-30]. In fact, all these dietary factors accounted for around 54.89% of the total variance in food frequencies, with the sweet and starch food patterns accounting for most of the variance (20.68%). Similar results were obtained in the current study, showing that the western food pattern accounted for 20.020% of the total variance [27-29]. The western food pattern, consisting of salty snacks/chips, fried foods, cakes/biscuits/sweets, soda drinks, pastries/pizzas, and drinks/juices, demonstrates a significant relation to the intake of energy foods. This pattern is packed with food items with added sugars and starchy foods of refined grains, thus containing food items with a high energy intake [31]. Many other studies have derived westernized food patterns, although the composition of the food items can vary among studies. A cross-sectional survey of Mexican households in 2018 reported that the intake of foods typical of the Mexican food culture reflects a local western dietary pattern composed of pulses, oils or fats, sugar, sweets, industrialized drinks, foods made from corn/maize, wheat, rice, oats or bran, coffee, tea, and eggs [32,33]. High caloric intake coupled with an inadequate intake of fruits and vegetables is found to contribute to higher rates of diabetes and obesity [33]. The present study found that the traditional food pattern is characterized by traditional Saudi dishes, such as harees, masoob, and gerish, as well as breakfast cereals/seeds, meat/chicken, rice/pasta/potatoes, traditional foods, milk/milk products, and eggs (Table 1). Research on the diet and health of the Saudi population is scarce [34-36]. Studies have reported that the traditional Saudi diet consists of white rice, wheat bread, dates, and Arabic coffee [35,37]. This diet is high in fat and simple carbohydrates, causing the body mass index (BMI) to increase. In contrast, compared with a western diet, traditional diets are usually lower in fat and higher in complex carbohydrates. However, it does not seem to cause people of normal weight to gain weight, suggesting that limiting carbohydrate intake may not be universally effective in reducing obesity and cardiovascular risk [38,39]. The expected effect of high carbohydrate intake is probably offset by the fact that traditional foods have less total energy and possess more dietary fiber than non-traditional foods, which improves insulin resistance and protects from many chronic diseases [40,41]. The protein food pattern is composed of a high intake of processed meat and fish/seafood. This pattern could be associated with central obesity and hypertension [42]. The prudent food pattern includes fruits, nuts, vegetables, and legumes. Another label for this food pattern is the health food pattern [43-45].

LIMITATIONS

The study population was restricted to university students, who share certain key characteristics (e.g., age and education) that may have a different distribution in the general population, which could have had an influence on the patterns detected. Thus, the number of patterns obtained by factor analysis and their labeling might not be applicable to other settings.

CONCLUSIONS

The four empirically derived dietary patterns of western, traditional, protein, and prudent food patterns are generalizable and consistent across subgroups of gender and residence. Further research with a longitudinal setting is required to assess the relationships between dietary habits and chronic diseases.

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CONFLICTS OF INTEREST

Authors declare that they have no conflicts of interest.

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Original Article

Assessment of Physical Activity and Perceived Barriers to Physical Activity Among Young Adult Women in the Jazan Region, Saudi Arabia

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ABSTRACT Low physical activity levels have been reported among women in Saudi Arabia. Studies investigating the barriers to physical activity among women in the Jazan region are limited. Therefore, this study aimed to assess the physical activity levels among young adult women in the Jazan region of Saudi Arabia and identify barriers to engagement in regular physical activity. A cross-sectional design based on a web-based survey was used. A total of 394 women with a mean age of 28.14 (SD 6.62) years participated in the study. Their physical activity levels were assessed using the International Physical Activity Questionnaire Short Form (Arabic version). The Self-Perceived Barriers for Physical Activity Questionnaire was utilized to evaluate barriers to physical activity. Approximately half of the female participants were physically inactive. The most frequently perceived barriers to regular physical activity included a lack of resources, a lack of energy, and a lack of willpower. Additionally, a lack of resources, fear of injury, and a lack of skill had statistically significant effects on the physical activity levels among the participants. Regarding demographic characteristics, the place of residence significantly influenced the levels of physical activity. Strategic interventions should be implemented to overcome these barriers.

Keywords: Physical Activity, Exercise, Women, Females, Barriers, Saudi Arabia.

INTRODUCTION

Regular physical activity is a key requirement for maintaining physical and mental health. According to the American College of Sports Medicine guidelines, healthy adults aged 18–65 years should engage in 30 minutes of moderate-intensity aerobic activity five times a week or 20-25 minutes of vigorous-intensity activity three times a week. In addition, they should engage in activities aimed at muscular strength and endurance at least twice a week. They also should minimize sedentary behavior to a maximum of 2 hours per day and spread light physical activity (e.g., walking and standing) throughout the day [1]. Physical inactivity is one of the main causes of metabolic syndromes (e.g., hyperglycemia, hypertension, dyslipidemia, and obesity) [2]. These metabolic syndromes raise the risk of non-communicable diseases like stroke, cardiovascular diseases, and type 2 diabetes [3], which are important etiological contributors to global increases in mortality and disability. Hence, regular physical activity reduces the risk of these diseases and the associated health costs [4,5].

The General Authority for Statistics in Saudi Arabia has performed several studies to determine the rates of physical activity in the Kingdom of Saudi Arabia. According to the results, 58.5% of individuals aged 18 years and above engaged in physical activity for 150 minutes or more per week throughout the Kingdom. Around 23.2% of men engaged in physical activity, while the rates among women stood at 14%. Furthermore, the findings revealed a gap between men and women who were physically active in different regions in Saudi Arabia [6].

Despite Saudi Vision 2030's emphasis on women's empowerment, the levels of physical activity among women are relatively low compared to those in many other countries. For instance, in the United States, approximately 25% of women meet the recommendations for physical activity levels [7]. In European countries like Germany and Sweden, the rates are higher, with only around 21% and

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19% of women, respectively, being physically inactive [8]. According to a cross-cultural study, young Saudi women appear to be more sedentary and engage less in physical activity compared to young British women [9]. Thus, understanding the factors that prevent Saudi women from engaging in regular physical activity is crucial for Saudi society. Studies have extensively explored the barriers to low physical activity among adult women in Saudi Arabia [10–15]. Some concluded that a lack of resources, time, power, and motivation comprised the major barriers to physical activity. However, these studies were performed on small samples from specific regions in Saudi Arabia. Because past studies have focused on specific regions, their assessments may need to be replicated in different geographic regions to determine if the same conclusion can be drawn. To the best of our knowledge, no studies have investigated barriers to physical activity among women in the Jazan region. Therefore, this study aimed to assess the levels of physical activity and explore barriers to physical activity among young adult women in the Jazan region, Saudi Arabia.

MATERIALS AND METHODS

Study design and participants

This study employed a cross-sectional survey design. Young adult women were recruited from urban, suburban, and rural areas in the Jazan region of Saudi Arabia using convenience sampling. The inclusion criteria were healthy women between 18 and 35 years old. Participants were excluded if they had any of the following conditions: musculoskeletal disorders, recent trauma or fracture, neurological diseases such as multiple sclerosis, and pregnancy. Ethical approval for the study was obtained from the research ethics committee at Jazan University, Saudi Arabia (Reference No. REC-45/07/954; 25 January 2024).

Data collection (outcome measures)

A self-administered survey questionnaire was designed through the Google Forms website, and the survey link was distributed to potential participants through WhatsApp or email. The survey consisted of three parts. The first part included questions related to participants' demographic information, including age, height, weight, body mass index (BMI), level of education, current occupation, time spent at work/school per day, and place of residence. The second part collected information related to physical activity levels using the shortened Arabic version of the International Physical Activity Questionnaire (IPAQ). The last part contained questions for the assessment of barriers to physical activity by using the Self-Perceived Barriers for Physical Activity—Arabic version.

The IPAQ-short form is a seven-item, retrospective, self-report survey to quantify physical activity over the last week. Participants are asked to indicate the amount of time spent on vigorous activity, moderate activity, walking, and sitting on an average day. According to the IPAQ scoring guidelines, the reported minutes/week of physical activity were converted to metabolic equivalent task (MET)-min/week. Following IPAQ scoring, physical activity levels were classified into inactive (<600 MET-min per week), minimally active (between 600 and 3000 MET-min per week), and active (>3000 MET-min per week) [16].The Self-Perceived Barriers for Physical Activity—Arabic version is a 21-item self-report survey that assesses specific barriers to physical activity across seven sub-scales: lack of time, lack of social influence, lack of energy, lack of resources, lack of willpower, fear of injury, and lack of skill. The measurements were constructed as a 4-point Likert scale (3=very likely; 2=somewhat likely; 1=somewhat unlikely; 0=very unlikely). Each category had a maximum possible score of 9. If an item had a score of 5 or above, it was considered a major barrier [10].

Statistical analysis

SPSS software version 29 was utilized for data analysis. Descriptive analyses included mean, standard deviation, frequency, and percentage. A multiple linear regression analysis was performed to assess the effect of physical activity barriers and participants' demographic characteristics on physical activity levels. The level of significance was set at $p<0.05$.

RESULTS

Out of 446 recruited participants, 394 met the study's eligibility criteria and were included in the analysis. As illustrated in Table 1, the mean age of the participants was 28.14 (SD 6.62) years. The mean BMI was 25.36 (SD 6.14) kg/m^2. Around half of the participants were single. Most participants (n=146, 65.2%) had a bachelor's degree or pursued a bachelor's degree education level. Most participants were either students (n=146, 37.1%) or employees (n=156, 39.6%). The mean time spent at work/school per day was 6.14 (1.65) hours. Around half of the participants (n=204, 51.8%) lived in urban areas.

Table 1: Demographic characteristics of the study participants (n=394)

Age (years), mean (SD)		28.14 (6.62)
Weight (kg), mean (SD)		62.44 (7.42
Height (cm), mean (SD)		156. 29 (14.40)
Body mass index (kg/m^2), mean (SD)		25.36 (6.14)
Material status		
	Single	197 (50)
	Married	176 (44.7)
	Divorced	21 (5.3)
Current/highest educational level, n (%)		
	Elementary school	2 (0.5)
	Secondary school	5 (1.3)
	High school	73 (18.5)
	Diploma degree	45 (11.5)
	Bachelor's degree	257 (65.2)
	Master's degree	9 (2.3)
	Doctorate	3 (0.8)
Occupation, n (%)		
	Student	146 (37.1)
	Employee	156 (39.6)
	Personal business	6 (1.5)
	Housewife	48 (12.2)
	Retired	25 (6.3)
	Non-employee	13 (3.3)
Time spent at work/school per day (hours), mean (SD)		6.14 (1.65)
Place of living, n (%)		
	Urban	204 (51.8)
	Suburban	128 (32.5)
	Rural/village	62 (15.7)

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Levels of physical activity

As illustrated in Table 2, the mean MET for vigorous-intensity and moderate-intensity physical activity was 520.51±962.39 MET-min/week and 295.07±600.52 MET-min/week, respectively. The mean MET for walking among participants was 426.57±642.95 MET-min/week. The overall physical activity score was 1242.155±1730.86 MET-min/week. Table 3 shows that 10.9% of participants were active, while 38.6% and 50.9% were minimally active and inactive, respectively.

Table 2: Levels of physical activity among the participants

Item	Mean	SD
High intensity (MET-min per week)	520.51	962.39
Moderate intensity (MET-min per week)	295.07	600.52
Walking (MET-min per week)	426.57	642.95
Sitting (MET-min per day)	226.14	182.80
**Total METs per week*	1242.155	1730.86

MET: Metabolic equivalent task
Min: Minute
*Total METs per week without sitting

Table 3: Levels of physical activity in the sample by category

Categories	Frequency	Percentage
Active	43	10.9
Minimally active	152	38.6
Inactive	199	50.9
Total	394	100

Barriers to physical activity

Overall, the mean score for physical activity barriers was 4.60±2.48, representing 51.7%. Lack of energy was perceived as a significant barrier to physical activity (71.7%). The second barrier to physical activity was a lack of resources (69.9%). Lack of willpower ranked third, with a percentage of 66.7%. Fear of injury was the least common barrier to physical activity, accounting for only 30.2%.

Table 4: Barriers to physical activity in the sample

Barrier	Mean	SD	Percentage	Ranking
Lack of time	5.23	2.37	62.7	4
Social influence	4.26	2.43	43.2	5
Lack of energy	5.74	2.44	71.7	1
Lack of willpower	5.44	2.38	66.7	3
Fear of injury	3.27	2.63	30.2	7
Lack of skill	3.68	2.68	35.7	6
Lack of resources	5.58	2.36	69.9	2
Overall score	4.60	2.48	51.7	

Influence of barriers on the levels of physical activity.

Multiple linear regression analysis was performed to determine the influences of various barriers to physical activity (Table 5). Lack of resources, fear of injury, and lack of skill had statistically significant effects on the levels of physical activity among young women in the Jazan region, with p-values of 0.03, 0.037, and 0.018, respectively. We observed no effects of barriers associated with lack of time, social influence, lack of energy, and lack of willpower on the levels of physical activity among the study participants.

Table 5: The influences of barriers faced by participants on physical activity levels

Model	B	Std Error	Beta	t	P-value
(Constant)	1731.558	228.117		7.591	<.001
Lack of time	−33.751	58.597	−.049	−.576	.565
Social influence	−78.070	59.537	−.114	−1.311	.191
Lack of energy	−9.448	56.276	−.014	−.168	.867
Lack of willpower	−67.588	58.830	−.099	−1.149	.251
Fear of injury	−101.506	48.477	.160	−2.094	.037
Lack of skill	−140.857	59.402	−.223	−2.371	.018
Lack of resources	−116.513	53.479	.144	−2.179	.030
R=−0.278; R^2= 0.078; f= 4.77; p-value= <0.001 Multiple linear regression					

The influences of demographic characteristics of participants on the levels of physical activity

We also conducted a multiple linear regression analysis to determine the influence of demographic characteristics, including age, BMI, level of education, time spent at work/school, and place of residence, on participants' physical activity levels. Only the place of residence had a significant impact on the participants' physical activity levels (p=0.036). Participants who resided in rural/village areas had low physical activity levels compared to those in urban and suburban areas.

Table 6: The influences of demographic characteristics on physical activity levels

Model	B	Std Error	Beta	t	P-value
(Constant)	2.106	0.037		7.883	<.001
Age	0.011	0.267	0.107	1.266	0.206
BMI	−0.001	0.008	−0.010	−0.155	0.877
Marital status	0.003	0.008	0.003	0.042	0.967
Educational level	0.010	0.078	0.013	0.226	0.821
Time spent at work/school	−0.028	0.043	−0.068	−1.212	0.226
Place of residence	0.101	0.023	0.117	2.109	0.036
R=0.158; R^2= 0.025; f= 1.391; p-value= 0.218 Multiple linear regression					

DISCUSSION

The present study aimed to determine the prevalence of physical activity and identify barriers to physical activity among young adult women in the Jazan region, Saudi Arabia. Our study revealed that 50.9% of the female participants did not engage in any form of physical activity, while 38.6% engaged in minimal physical activity. Only 10.9% of the participants regularly engaged

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in physical activity. Lack of energy, lack of resources, and lack of willpower were the most significant barriers to engaging in physical activity among study participants. Additionally, the most influential factors preventing women in the Jazan region from participating in regular physical activity were a lack of resources, fear of injury, and a lack of skill. Furthermore, the place of residence significantly influenced physical activity levels among participants.

The main focus of the current study was not only to determine physical activity levels but also to explore factors that limit women in the Jazan region, Saudi Arabia, from engaging in regular physical activity. Our findings were consistent with prior studies that reported low physical activity among Saudi women [10–13]. For instance, a study among female college students in southwestern regions found that 58.5% of female students were physically inactive [10]. Similarly, previous studies among female university students and female workers in Riyadh, Saudi Arabia, revealed that around half of the participants did not engage in any form of regular physical activity [11,12]. In addition, a study among female medical students at the University of Dammam, Saudi Arabia, reported that 75% of the participants did not engage in regular physical activity [13]. Contrary to our findings, a recent study has reported a high rate of physical activity among women in Saudi Arabia [14].

The current study's participants reported a lack of resources, a lack of energy, and a lack of willpower as the major barriers to physical activity. These findings aligned with a recent study among Saudi Arabian women by A. Alrimali [14] that highlighted similar barriers. Identifying factors influencing physical activity is important for implementing intervention plans to promote physical activity. We noted that lack of resources, lack of skill, and fear of injury significantly affected the physical activity levels among the study participants. A recent study among Saudi women also revealed that lack of willpower, fear of injury, and environmental barriers significantly impacted their participation in regular physical activity [14]. According to Samara et al. [11], a lack of resources was the most significant barrier preventing Saudi women from engaging in physical activity. Another study including female participants from Saudi Arabia and the United Kingdom identified a lack of resources as a barrier to physical activity, suggesting that gender segregation and cultural sensitivity regarding exercise facilities may be significant considerations [9]. A lack of resources includes the unavailability of sports complexes for women, such as swimming pools and suitable areas for walking and jogging. This finding is supported by a study from Princess Nora Bint Abdul Rahman University, which found that young Saudi women faced no specific sociocultural barriers to engaging in physical activity; rather, a lack of designated facilities limited their engagement in physical activity [11]. Thus, enhancing infrastructure in smaller cities and raising awareness about physical activity could help address these obstacles, in line with the objectives of Saudi Vision 2030.

Moreover, our results showed that a lack of skill and fear of injury had a substantial impact on women's participation in physical activity. Without proper knowledge or training, women may not know how to perform exercises correctly or safely. Consequently, this may heighten fears of injury, leading to the avoidance of physical activity [17,18]. Delivering customized exercise programs that emphasize skills and education can build confidence and competence in their physical abilities, helping them overcome these barriers. Furthermore, providing supportive environments, such as gyms or sports facilities with professional instruction or coaching, can help young women in Saudi Arabia develop physical skills, confidence, and a lifelong interest in physical activity.

In addition, our findings confirmed that the place of residence significantly influenced the levels of physical activity among young women in the Jazan region. Participants residing in rural or village areas exhibited lower physical activity levels than those in urban or suburban areas. A major reason for these low levels among rural women is the limited availability of exercise resources and facilities, which reduces the number of opportunities for structured exercise. Zhang et al. [19] and Perry et al. [20] reported that rural women often encounter barriers to accessing exercise-related resources, such as fitness centers and recreational facilities, which may be sparse or more difficult to reach compared to those in urban areas. Additionally, a lack of safe places to exercise and the absence of suitable environments can contribute to lower rates of participation in exercise among women living in rural areas. Whitfield et al. [21] indicated that environments supportive of physical activity, like safe walking paths and parks, tend to be less available in rural settings, discouraging physical activity. The presence of parks and walking trails has been associated with physical activity among urban populations; however, such associations are less pronounced or nonexistent in rural areas. Furthermore, a previous study reported lower awareness about the benefits of physical activity among women in rural areas due to less access to health services, such as health promotion programs with exercise programs [22].

The current study has some limitations worth considering. First, the study employed a cross-sectional study design, which does not allow for causal inferences. Second, the study relied on self-reported data through an online survey, which might be subject to reporting bias. Finally, the study included women from only the Jazan region, who may not represent all women in Saudi Arabia. Therefore, the findings cannot be generalized to all Saudi women due to environmental and cultural differences.

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CONCLUSIONS

The present study revealed that a large proportion of young adult women in the Jazan region exhibit insufficient levels of physical activity. The most cited barriers to participation in physical activity were lack of energy, lack of resources, and lack of power. Lack of resources, lack of skill, fear of injury, and the place of residence had significant effects on physical activity levels. By understanding and addressing these obstacles, policymakers and community leaders can develop effective strategies to promote physical activity and improve the overall health and well-being of young Saudi women. Future intervention strategies focused on changing the behavior of Saudi women should account for the types of activities women are willing to engage in and the perceived social norms surrounding physical activity for women. This consideration is particularly important in developing prevention programs tailored to individual and culturally specific needs. The recent call for Saudi women to participate in national sports has the potential to empower women and drive changes in opportunities for women in sports and physical education.

LIST OF ABBREVIATIONS

MET: Metabolic equivalent task
BMI: Body mass index
IPAQ: International Physical Activity Questionnaire

INFORMED CONSENT STATEMENT

Informed consent was obtained from all participants involved in the study.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors on request

PATENTS

Not applicable

SUPPLEMENTARY MATERIALS

Not applicable

AUTHOR CONTRIBUTIONS

All authors have made the same contributions to the conception or design of the work; the acquisition, analysis, interpretation of data; the creation of new software used in the work; and to have drafted and substantially revised the work.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Review Article

Familial Idiopathic Pulmonary Fibrosis (FIPF): A Comprehensive Review

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ABSTRACT Familial Idiopathic Pulmonary Fibrosis (FIPF) is a subset of idiopathic pulmonary fibrosis (IPF) characterized by familial clustering, affecting multiple relatives across generations. While most IPF cases are sporadic, FIPF accounts for approximately 5–20% of cases and is linked to genetic mutations that predispose individuals to the disease. This review provides a comprehensive overview of FIPF, focusing on its genetic basis, clinical manifestations, diagnostic approaches, and therapeutic strategies. It also highlights recent research findings and future directions in the field.

Keywords: Familial idiopathic pulmonary fibrosis (FIPF), idiopathic pulmonary fibrosis (IPF), genetic, surfactant-related gene mutations, telomere-related gene mutations.

INTRODUCTION

Idiopathic Pulmonary Fibrosis (IPF) is a chronic, progressive fibrotic lung disease marked by excessive extracellular matrix deposition and irreversible lung scarring [1,2]. While most IPF cases are sporadic, 10–20% exhibit familial clustering, termed Familial Idiopathic Pulmonary Fibrosis (FIPF) [3, 4]. FIPF is defined by the presence of two or more affected individuals within a single family, often showing an autosomal dominant inheritance pattern with variable penetrance [5]. First described in 1907 and formally defined in 2000, FIPF was later recognized by the ATS/ERS/JRS/ALAT in 2010 as a familial form of IPF [6,7]. The disease's etiology involves genetic predisposition, environmental factors (e.g., smoking, occupational exposures, viral infections), and mutations in genes related to surfactant proteins (e.g., *SFTPA1*, *SFTPB*) and telomerase (e.g., *TERT*, *TERC*) [7, 8]. These mutations impair lung epithelial cell function and repair mechanisms, leading to progressive fibrosis [9].

METHODS

A systematic literature search was performed in databases including PubMed, Web of Science, Embase, and Cochrane Library, and selected relevant studies. We evaluated the included studies, extracted and synthesized data to summarize the current update about Familial Idiopathic Pulmonary Fibrosis. We excluded non-peer-reviewed articles from the preprint databases. Inclusion criteria: the topic of the study must be related to FIPF.

1. Epidemiological Challenges in Familial IPF:

Epidemiological studies on FIPF face multiple challenges. The rarity of the disease makes large-scale research difficult, and identifying familial cases often depends on self-reported family history, which may be incomplete or inaccurate [9, 10]. Additionally, variations in diagnostic criteria and limited access to genetic testing further complicate the estimation of prevalence and incidence rates [11, 12].

1.1 Prevalence of Familial IPF

Familial IPF is defined as the occurrence of idiopathic pulmonary fibrosis (IPF) in two or more members of the same family. Research estimates suggest that FIPF accounts for 10–20% of all IPF cases [13–16]. However, the exact prevalence varies across studies due to differences in diagnostic criteria, genetic testing availability, and cohort selection. Furthermore, studies conducted in different geographic regions have reported varying prevalence rates, suggesting that both genetic and environmental factors may influence disease occurrence [17].

1.2 Demographics and Risk Factors

The demographic characteristics of familial IPF are broadly similar to those of sporadic IPF [18]. The disease is more common in older adults, with a peak incidence between the ages of 40 and 50 years [19]. Both men and women are affected, but a slight male predominance is observed, similar to sporadic IPF [20, 21]. Key risk factors

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for FIPF include a positive family history of interstitial lung disease and specific genetic mutations, which are thought to contribute to disease susceptibility and progression [22, 23].

2. Genetic Basis of FIPF

2.1 Genetic Factors

Genetic predisposition plays a crucial role in the pathogenesis of FIPF [33,34]. Among the most well-established genetic contributors are mutations in genes responsible for telomere maintenance, such as *TERT* (telomerase reverse transcriptase) and *TERC* (telomerase RNA component). These genes are essential for maintaining chromosomal stability and cellular longevity by preserving telomere length. Mutations in these genes lead to telomere shortening, a hallmark feature in many FIPF patients, which contributes to alveolar epithelial cell senescence, apoptosis, and impaired tissue regeneration [24, 34, 35, 36].

Additionally, rare mutations in genes encoding surfactant proteins particularly *SFTPC* (surfactant protein C) and *SFTPA2* (surfactant protein A2) have also been implicated in FIPF. These mutations can result in the accumulation of misfolded proteins within alveolar type II epithelial cells, triggering endoplasmic reticulum (ER) stress, unfolded protein responses, and ultimately, cellular injury and fibrosis. The pathological consequences of these mutations underscore the role of epithelial dysfunction in fibrotic remodeling of lung tissue [25, 37].

Variants in genes associated with host defense and cell stress responses, such as *MUC5B*, have been linked to an increased risk of both sporadic and familial idiopathic pulmonary fibrosis (IPF) [37,38]. The *MUC5B* promoter variant (rs35705950) is a single-nucleotide polymorphism (a G-to-T change) that elevates the expression of the *MUC5B* protein in the lungs. This increased production of *MUC5B* disrupts immune signaling pathways, including heightened IL-3 activity, and activates cellular stress responses, which may collectively "prime" lung tissue for future injury and fibrosis. Over time, these effects contribute to the development of IPF, making the *MUC5B* variant the strongest known genetic risk factor for the disease. Interestingly, while this variant predisposes individuals to fibrosis, it may also have a protective role by enhancing mucociliary clearance and strengthening host defense mechanisms, highlighting its complex and dual impact on lung health. This duality underscores the intricate balance between beneficial and detrimental effects of genetic variants in disease pathogenesis [26, 38, 39,40].

2.2 Environmental and Epigenetic Contributions

In addition to genetic factors, environmental exposures and epigenetic modifications are thought to contribute to the development and progression of familial IPF. However, the incomplete penetrance of these mutations suggests the involvement of additional factors. Environmental triggers, such as occupational exposure to metal or wood dust, air pollution (including PM2.5, ozone, and nitrogen oxides), and smoking, interact with genetic risks to amplify disease susceptibility. These exposures contribute to oxidative stress, impaired mucociliary clearance, and epithelial injury, further exacerbating the condition. Epigenetic mechanisms, including DNA methylation and histone modifications, also play a critical role by modulating gene expression in response to environmental insults. For instance, promoter variants in *MUC5B* and *DSP* are linked to differential methylation patterns, which can alter epithelial barrier function and mucin production. Additionally, accelerated biological aging, as measured by epigenetic clocks, has been observed in both familial IPF patients and asymptomatic carriers, independent of telomere length, suggesting senescence as a potential mediator of fibrosis [29-31]. These epigenetic changes may serve as a molecular bridge, integrating cumulative environmental damage with genetic risk to drive disease progression in susceptible families. Together, these interconnected pathways highlight the multifaceted nature of FIPF pathogenesis, Figure (1).

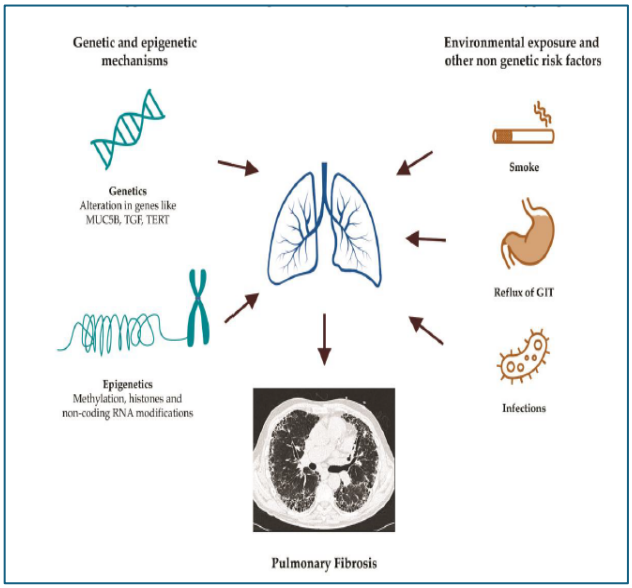

Figure 1: The image outlines the factors contributing to pulmonary fibrosis, categorized into genetic and epigenetic mechanisms and environmental/non-genetic risk factors. Adapted from Tirelli, Claudio et al., [4].

2.3 Genetic and Ethnic Heterogeneity in Familial Idiopathic Pulmonary Fibrosis

FIPF exhibits significant genetic and ethnic variability, influencing its prevalence, progression, and clinical outcomes. Studies have identified several genetic mutations associated with familial IPF, though their

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prevalence varies across ethnic groups. For instance, telomere-related mutations are more commonly observed in Caucasian populations, whereas other genetic factors may play a more prominent role in non-European ancestries. Additionally, ethnic disparities in disease susceptibility and severity have been reported, with some studies suggesting a higher risk or earlier onset in certain populations, possibly due to genetic, environmental, or socioeconomic factors [10,11,15,35].

2.4 The Heritability Gap

FIPF demonstrates a notable heritability gap, meaning that while there is clear evidence of inherited risk, current genetic testing and research explain only a portion of this familial clustering. Although about 5-20% of IPF patients have a family history of interstitial lung disease, known rare pathogenic variants in genes related to telomere maintenance or surfactant production account for only a small fraction of familial cases. Common genetic variants, such as those in the MUC5B promoter, contribute to overall risk but still leave much of the heritability unexplained. This gap is likely due to a combination of factors, including the involvement of many genes with small effects, incomplete penetrance of known variants, the influence of non-coding or regulatory regions of the genome, and possible gene-environment interactions. Additionally, some at-risk family members may not yet show symptoms due to the age-dependent nature of IPF, making it harder to trace inheritance patterns. Epigenetic factors and limitations in current genetic testing technologies may also play a role in this heritability gap. Bridging this gap will require more comprehensive genetic studies, including whole-genome sequencing, better characterization of non-coding variants, and long-term follow-up of families with a history of IPF [8, 9, 10, 14, 31,37].

2.5 Genetic Variants Associated with FIPF, Figure 2, [33].

- Telomerase Complex Mutations (*TERT*, *TERC*): Present in 15–20% of familial cases, leading to telomere shortening and fibrosis [24, 34, 35, 36].
- Surfactant Protein Mutations (*SFTPC*, *SFTPA2*): Associated with early-onset disease [25, 37].
- Other Contributors (*PARN*, *RTEL1*, *MUC5B*): Involved in telomere maintenance and mucus production [26, 38, 39,40].

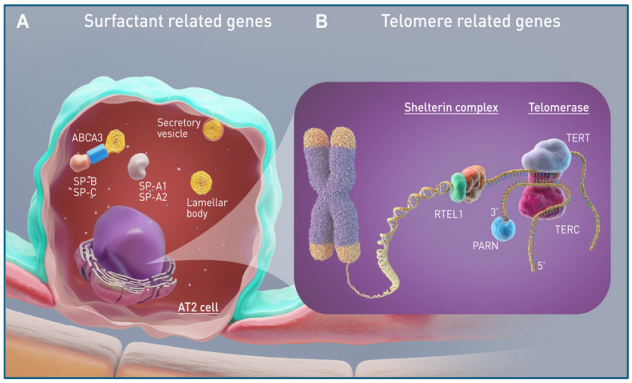

Figure 2: The image illustrates genetic components involved in lung surfactant production and telomere maintenance, which are critical for normal lung function and cellular aging and development of FIPF. Adapted from Hurley, Killian et al., [33].

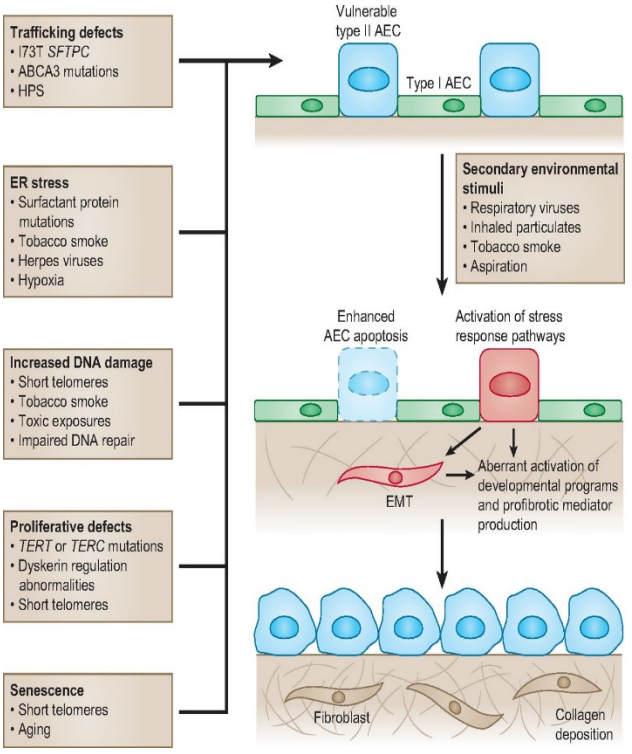

Figure 3: The image illustrates the pathogenesis of pulmonary fibrosis, highlighting various factors and cellular processes that contribute to FIPF. Adapted from Kropski, Jonathan A et al., [41].

3. Pathogenesis

FIPF pathogenesis involves a complex interplay of genetic predisposition and environmental triggers. Key mechanisms include:

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- Telomere Dysfunction**:** Accelerated cellular senescence in alveolar epithelial cells impairs regeneration and promotes fibrosis [24,34].
- Surfactant Dysfunction: Mutations in *SFTPC* and *SFTPA1/A2* cause ER stress and epithelial injury [25,37].
- Dysregulated *MUC5B* Expression: Overexpression increases fibrosis risk [26, 38].
- Aberrant Wound Healing: Repetitive alveolar injuries lead to fibroblast activation and excessive extracellular matrix deposition [43].
- Environmental Triggers: Smoking, pollution, and viral infections exacerbate disease progression in genetically predisposed individuals, Figure 3, [21].

4. Clinical Manifestations

Clinically, FIPF presents similarly to sporadic IPF, with common symptoms including chronic dry cough, exertional dyspnea, and bibasilar inspiratory crackles. Over time, patients may develop clubbing of the fingers, hypoxemia, and worsening pulmonary function, often reflected in a restrictive pattern on spirometry with reduced diffusion capacity for carbon monoxide (DLCO). However, FIPF may have an earlier onset and more aggressive course in some families [2, 9, 13]

4.1 Clinical Implications of Surfactant-Related Gene Variants

Surfactant-related gene variants, such as mutations in *SFTPB*, *SFTPC*, *ABCA3*, and *NKX2-1*, can lead to significant pulmonary disorders, particularly neonatal respiratory distress syndrome (NRDS), interstitial lung diseases (ILDs), and chronic lung conditions [37,41].

- SFTPB & SFTPC mutations: Cause surfactant protein deficiencies, leading to severe neonatal respiratory failure or progressive ILD in older children and adults.
- ABCA3 mutations: Affect surfactant metabolism, resulting in surfactant dysfunction disorders with variable severity.
- NKX2-1 mutations: Associated with lung, thyroid, and neurological disorders (brain-lung-thyroid syndrome).

These genetic abnormalities impact surfactant production, metabolism, and function, often necessitating lung transplantation in severe cases. Genetic screening and personalized treatment approaches, including experimental surfactant replacement and targeted therapies, are crucial for management.

4.2 Clinical Implications of Telomere-Related Gene Variants

Telomere-related gene variants impact telomere maintenance, influencing aging, cancer risk, and various telomere biology disorders (TBDs). Mutations in genes like *TERT*, *TERC*, *DKC1*, and *RTEL1* can lead to conditions such as dyskeratosis congenita, pulmonary fibrosis, and bone marrow failure syndromes [25]. These variants contribute to genomic instability, increasing susceptibility to cancers like leukemia and melanoma. Conversely, telomerase activation in cancer cells promotes uncontrolled proliferation. Clinically, telomere length assessment and genetic testing aid in disease diagnosis, prognosis, and personalized treatment strategies, such as stem cell transplantation for TBDs or telomerase-targeted therapies in oncology, [37].

4.3 Clinical Features and Disease Course

The clinical presentation of familial IPF is largely indistinguishable from that of sporadic IPF. Patients typically present with progressive exertional dyspnea, a dry cough, and bilateral pulmonary crackles on auscultation. Radiological findings on high-resolution computed tomography (HRCT) commonly show a usual interstitial pneumonia (UIP) pattern. Familial IPF may have a slightly earlier age of onset compared to sporadic cases, although this observation has not been consistently reported. The disease course in familial IPF is variable, with some individuals experiencing rapid progression and others having a more indolent disease trajectory. Familial Idiopathic Pulmonary Fibrosis (FIPF) is distinguished from sporadic Idiopathic Pulmonary Fibrosis (IPF) by its earlier age of onset and its occurrence within related families [6,7,13,14,15]. Table 1.

Table 1: Clinical Features for Familial Pulmonary Fibrosis.

Category	Clinical Features
Family History	- History of pulmonary fibrosis in one or more family members
	- Age of pulmonary fibrosis onset within family
	- Younger age of onset with each generation affected (genetic anticipation)
	- Lung cancer and pulmonary fibrosis co-segregation within kindred
Extrapulmonary Manifestations	- Bone marrow failure (e.g., aplastic anemia, myelodysplastic syndrome)
	- Macrocytosis with or without anemia
	- Cryptogenic cirrhosis or portal hypertension
	- Premature graying of the hair by the third or fourth decade of life
Age of Onset	- Pediatric onset (age <18 years)

5. Diagnostic Approaches

5.1 High-Resolution Computed Tomography (HRCT)

HRCT is the imaging modality of choice for diagnosing IPF. Typical findings include subpleural reticulation,

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honeycombing, and traction bronchiectasis. In FIPF, HRCT findings are indistinguishable from those of sporadic IPF, but the presence of a family history of IPF should raise suspicion for FIPF [42-44].

5.2 Lung Biopsy

In cases where HRCT findings are atypical, surgical lung biopsy may be required to confirm the diagnosis. Histopathological features of FIPF include usual interstitial pneumonia (UIP) pattern, characterized by temporal heterogeneity, fibroblastic foci, and honeycombing [46, 47].

5.3 Clinical Genetic Testing Considerations

- Genetic Counseling: Families with multiple members affected by familial idiopathic pulmonary fibrosis (FIP) often worry about the risk to other relatives. FIP appears to follow an autosomal dominant pattern with reduced penetrance, which complicates the estimation of precise risk figures for family members, especially when no known mutation has been identified. While the exact penetrance of FIP is unknown, the risk to the offspring of FIP patients may be as high as 50%, although reduced penetrance suggests a lower risk. Second- and third-degree relatives are presumed to have a lower risk compared to immediate family members, but still higher than that of the general population. Notably, unaffected relatives with one or two copies of the MUC5B SNP may have a 6.8 to 20.8-fold increased risk of developing pulmonary fibrosis [16, 22].
- Genetic Variants: Common genetic variants, such as a polymorphism in the *mucin 5B (MUC5B)* promoter, have been associated with an increased risk of both familial and sporadic forms of IPF. Testing for these variants could serve as a useful screening approach for IPF [34, 35].
- Biomarkers: Research has identified various biomarkers in blood and bronchoalveolar lavage (BAL) fluid that could aid in the diagnosis of IPF. These include cytokines, chemokines, surfactant protein D, Krebs von den Lunge-6 antigen (KL-6), defensins, and matrix metalloproteinases (MMP) 1 and 7. By integrating genetic testing with clinical and biomarker assessments, a more accurate diagnosis and risk assessment for familial IPF can be achieved [34-39].
- The psychological impact is more closely linked to receiving evidence of actual disease rather than simply learning about genetic risk factors. Abnormal genetic test results (e.g., short telomeres or PF-related variants) do not significantly increase regret or negative feelings when compared to abnormal clinical findings. Living with a known genetic predisposition to pulmonary fibrosis can create ongoing uncertainty and anxiety, as the disease may present with varying severity and age of onset within families [40].

5.4 The Impact of AI and Digital Pathology on Diagnosing Familial Idiopathic Pulmonary Fibrosis

Advances in artificial intelligence (AI) and digital pathology hold significant promise for improving the diagnosis and subclassification of Familial IPF. Machine learning algorithms can analyze high-resolution histopathological images to identify subtle patterns that may distinguish familial cases from sporadic IPF or other interstitial lung diseases. Deep learning models, trained on large datasets of digitized lung biopsies, could uncover novel biomarkers or morphological signatures associated with genetic mutations (e.g., in *SFTPC*, *TERT*, or *MUC5B*). Additionally, AI-powered tools may integrate radiological, genomic, and clinical data to enhance diagnostic accuracy and predict disease progression. By enabling precise, automated analysis, these technologies could facilitate earlier detection, personalized risk assessment, and targeted therapeutic strategies for FIPF [42,43].

Table (2): Diagnostic Criteria.

Diagnostic Criteria of FIPF
Presence of two or more affected first-degree relatives.
HRCT showing UIP pattern.
Exclusion of other ILD causes.
Genetic testing for telomere-related and surfactant-associated mutations.

6. Therapeutic Strategies

The management of FIPF is similar to that of sporadic IPF, with a focus on slowing disease progression and improving quality of life. However, the recognition of genetic mutations in FIPF has opened new avenues for targeted therapies [33, 48, 52].

6.1 Antifibrotic Agents

While antifibrotic drugs such as pirfenidone and nintedanib have shown efficacy in slowing disease progression in sporadic IPF, their effectiveness in familial IPF remains limited. These drugs primarily target pathways involved in fibrosis, such as TGF-β and tyrosine kinase signaling, but familial IPF often involves genetic mutations (e.g., in *TERT*, *SFTPC*, or *MUC5B*) that drive fibrogenesis through distinct mechanisms, potentially reducing therapeutic responsiveness. Additionally, antifibrotics do not reverse existing fibrosis and only modestly delay decline in lung function, leaving a significant unmet need for more targeted therapies [53-60]. Research into novel treatments for familial IPF is ongoing, with several investigational drugs in clinical trials. For example, inhibitors of LOXL2 (lysyl oxidase-like 2), such as simtuzumab, have been explored, though earlier trials showed limited efficacy. Other approaches include

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targeting senescence-associated pathways with drugs like danazol (in trials for telomere-related pulmonary fibrosis) or modulating mucin production in *MUC5B* variant carriers. Additionally, gene therapy and precision medicine strategies are being investigated to address specific genetic defects underlying familial IPF. Despite these efforts, challenges remain in developing therapies that can halt or reverse fibrosis in genetically predisposed individuals, highlighting the need for further research into the molecular mechanisms driving familial IPF and more personalized treatment approaches [53-60].

6.2 Lung Transplantation

Lung transplantation is a viable option for FIPF patients with advanced disease. However, the presence of telomere-related mutations may impact post-transplant outcomes, as these patients are at increased risk of complications such as bone marrow failure and infections. Careful evaluation and management of extrapulmonary manifestations are essential in FIPF patients undergoing lung transplantation [60-64].

6.3 Emerging Therapies

The identification of genetic mutations in FIPF has spurred interest in developing targeted therapies. For example, telomerase activation strategies are being explored as a potential treatment for FIPF patients with telomere-related mutations. Additionally, therapies aimed at reducing endoplasmic reticulum stress and alveolar epithelial cell injury are under investigation for FIPF patients with surfactant protein-related mutations. Moreover, precision medicine strategies, including targeted therapies and gene editing, hold potential for improving treatment outcomes. As research progresses, integrating genetic insights with clinical management could enhance patient care and disease-modifying strategies in FPF, [11, 31, 33].

7. Prognosis

FIPF has a variable disease course, with a mean survival of 3–5 years post-diagnosis. Telomere mutations (e.g., *TERT*, *TERC*) are associated with more aggressive disease [62, 63].

8. Future Directions

The future of familial idiopathic pulmonary fibrosis (IPF) research holds promising avenues for understanding and managing this complex disease. One key area of focus is telomere biology, where further research is needed to elucidate the underlying mechanisms driving telomere dysfunction in familial IPF and explore potential therapeutic interventions to mitigate its effects. Additionally, the development of targeted therapies tailored to specific genetic mutations could revolutionize treatment, offering personalized approaches that improve patient outcomes [46-51].

Another critical direction involves enhancing genetic counseling practices by refining guidelines and better understanding the psychological impact of genetic testing on patients and families. This will ensure that individuals at risk receive comprehensive support and informed decision-making tools. Finally, investigating gene-environment interactions will be essential to unravel how genetic predispositions and environmental exposures collectively contribute to disease progression. By addressing these key areas, researchers can pave the way for more effective prevention, diagnosis, and treatment strategies for familial IPF [65-70].

CONCLUSION

FIPF is a genetically predisposed form of IPF with earlier onset and familial clustering. Mutations in telomere maintenance and surfactant protein genes play a central role in its pathogenesis. Early diagnosis, genetic counseling, and antifibrotic therapy are crucial for managing FIPF. Lung transplantation remains the only curative option, highlighting the need for continued research into disease-modifying therapies. Future studies should focus on large, multicenter collaborations to improve outcomes for affected families.

INFORMED CONSENT STATEMENT

No consent for this review.

ETHICAL APPROVAL

Not applicable.

DATA AVAILABILITY STATEMENT

Literature review.

SUPPLEMENTARY MATERIALS

Figures 1, 2, 3 and Table 1,2.

AUTHOR CONTRIBUTIONS:

Single Author.

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CONFLICTS OF INTEREST

The author declares no conflicts of interest.

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Original Article

Implementation of the History and Art of Medicine as an Elective Course for Medical Students: A Theoretical Review

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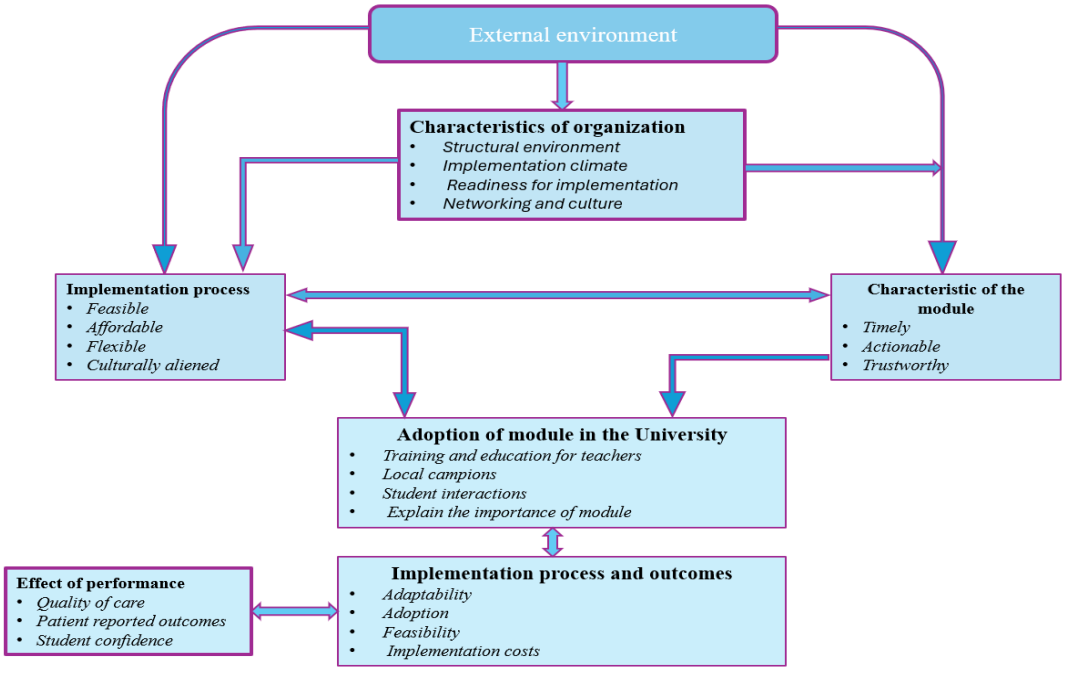
ABSTRACT The integration of the history and art of medicine into medical education offers a unique opportunity to improve the learning outcomes of future physicians. This review explores the theoretical foundations, benefits, and challenges of introducing such an elective course into medical curricula, as well as potential implementation strategies. By examining historical perspectives, artistic representations of medicine, and pedagogical approaches, this article argues that a deeper understanding of medicine's cultural, creative, and historical context nurtures empathy, critical thinking, and professional identity among medical students. It also discusses potential barriers to implementation and suggests ways to overcome them, advocating for a multidisciplinary approach that bridges science and humanities in medical education.

Keywords: Medical Education, Implementation, Barriers, Medical History, Elective Course

INTRODUCTION

Modern medical education is predominantly structured around biomedical sciences, clinical skills, and evidence-based practice, ensuring that future physicians are well-equipped to diagnose and treat disease. However, as medicine evolves into an increasingly complex and patient-centred discipline, there is growing recognition that technical proficiency alone is insufficient. The humanistic dimensions of medicine, including empathy, ethical reasoning, cultural sensitivity, and an understanding of the sociocultural context of health, are considered essential competencies for healthcare professionals [1-3].

Graphical Abstract: *Framework for Implementing History & Art in Medical Education*



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In response to this realisation, medical educators are increasingly turning to the medical humanities, an interdisciplinary field that integrates history, literature, philosophy, and the arts into medical training. Among these disciplines, the history and art of medicine hold particular significance. The history of medicine provides important insights into the evolution of medical knowledge, ethics, and societal attitudes toward health and illness [3-5]. Meanwhile, medical art, ranging from anatomical illustrations to patient portraiture, serves as a powerful medium for enhancing observational skills, fostering empathy, and reflecting on the human experience of disease [6, 7].

Despite these benefits, medical history and art are rarely formally included in medical curricula, more often being relegated to optional seminars or extracurricular activities rather than structured, credit-bearing courses. This gap represents a missed opportunity to cultivate well-rounded physicians who appreciate medicine both as a science and as a deep human endeavour shaped by centuries of cultural, ethical, and intellectual development. This review explores the theoretical foundations, pedagogical benefits, and practical challenges of implementing an elective course on the history and art of medicine for medical students. By examining existing literature and case studies, the author argues that such a course can 1) enhance clinical observation and diagnostic skills through visual literacy training [8, 9]; 2) deepen professional identity and ethical awareness by contextualising modern practices within historical narratives [6, 10, 11]; 3) foster empathy and patient-centred care by enabling engagement with artistic representations of illness and healing [12, 13]. Additionally, this review discusses barriers to implementation, such as curricular constraints and faculty readiness, and proposes strategies for successful integration, including interdisciplinary collaboration and digital learning tool use. Ultimately, this review advocates for a more comprehensive approach to medical education, one that bridges the sciences and humanities to produce physicians who are not only skilled clinicians but also thoughtful, culturally aware, and compassionate healers.

This review seeks to answer the following research questions:

1. Why should medical students study the history and art of medicine?
2. What are the proven benefits of integrating the humanities into medical training?
3. What challenges might institutions face in implementing a medical history course?
4. How can medical schools effectively incorporate history and art into their curricula?

MATERIALS AND METHODS

Theoretical and Conceptual Framework for Implementation

The integration of the history and art of medicine into medical education is grounded in robust pedagogical and implementation frameworks. While prior models emphasise learning and reflection, successful adoption also requires a structured, strategic approach to curriculum design and delivery [14]. The theoretical justification for incorporating medical history and art into curricula draws from educational psychology, medical humanities, constructivist learning theory, and narrative medicine, among other disciplines. The framework developed previously focused on educational curriculum development and is further utilised in the current context:

A. Kern's Six-Step Approach to Curriculum Development

To guide the development of the proposed elective, the author applied Kern's framework:

Problem Identification: Humanities content remains underrepresented in medical curricula.

Targeted Needs Assessment: Stakeholder feedback and empirical literature highlight a lack of emphasis on empathy, ethical awareness, and cultural competence.

Goals and Objectives: To promote visual literacy, historical understanding, empathy, and critical reflection

Educational Strategies: The use of interdisciplinary seminars, visual analysis, historical cases, and narrative reflection

Implementation: Position the course in preclinical years, utilising digital archives, art museums, and faculty workshops.

Evaluation and Feedback: Employ mixed-method assessments including reflective writing, pre/post attitudinal surveys, and OSCE empathy stations.

B. Consolidated Framework for Implementation Research (CFIR)

This framework was used to guide practical implementation:

Intervention Characteristics: Adaptable, evidence-informed, and relevant to competency-based training

Inner Setting: Faculty support, institutional culture, and curriculum committee readiness

Outer Setting: Increasing demand for humanistic competencies in global medical education

Characteristics of Individuals: Development for biomedical educators in humanities facilitation

Process: Iterative implementation with pilot-testing, feedback, and refinement

Knowledge Synthesis Methodology

The author used a narrative synthesis approach supported by Braun and Clarke's thematic analysis framework. The literature was reviewed through thematic coding, and the findings were integrated with established theoretical

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models. This approach allowed for the synthesis of varied sources, ranging from qualitative studies to curriculum reports, to develop a cohesive framework for course implementation.

RESULTS

Thematic Synthesis of the Literature

Using narrative synthesis guided by Braun and Clarke's six-step framework, the following key themes emerged from the literature:

1. *Underrepresentation of Humanities in Curricula*

A consistent theme across qualitative and empirical studies was the marginalisation of humanities content within medical education. The humanities were often described as "elective", "enrichment", or "non-essential", leading to their fragmented or superficial integration. This gap underscored the problem identification phase of Kern's framework and reinforced the need for structured curricular inclusion.

2. *Demand for Humanistic Competencies*

The outer setting analysis, per CFIR, revealed strong global policy and accreditation support for competencies such as empathy, ethical reasoning, and cultural sensitivity. Reports from the AAMC, GMC, and WFME were cited in over 70% of the reviewed literature as driving forces for curricular innovation in this domain.

3. *Pedagogical Relevance of Art and History*

Curriculum reports and reflective essays consistently linked visual art analysis and historical case study with improved diagnostic acumen, ethical decision-making, and student well-being. This validated the educational strategies and intervention characteristics identified in both the Kern and the CFIR frameworks. Narrative medicine and constructivist learning theory emerged as common theoretical justifications.

4. Institutional and Faculty Readiness

Themes related to inner setting indicated that faculty development and institutional endorsement were prerequisites for successful implementation. Key enabling factors included leadership buy-in, time allocation in timetables, and interdisciplinary faculty collaboration.

5. *Evaluation Innovation*

Articles describing course outcomes often employ mixed-method evaluations such as the following:

- Pre/post empathy and attitude surveys
- Reflective writing analysis
- OSCE empathy station performance

This aligned with Kern's evaluation and feedback phase and confirmed the feasibility of multi-modal assessment.

Pilot Implementation

A pilot elective based on these synthesised insights was introduced for Year 2 medical students across two academic semesters. It includes the following:

- Six biweekly interdisciplinary seminars
- Digital engagement with art archives and historical medical records

DISCUSSION

This review highlights the critical role of the medical humanities, particularly the history and art of medicine, in enriching medical education via professional identity development, reflective practice, ethical reasoning, and cultural competence. Drawing on multiple theoretical frameworks and empirical studies, one can argue that integrating humanities-based learning into health professions education is not only desirable but also essential for cultivating compassionate, ethically aware, and adaptive clinicians.

The integration of the medical humanities fosters professional identity formation, defined as the internalisation of the values, norms, and responsibilities of the medical profession. As Cress et al. (2022) suggest, this transformation from layperson to healer is not purely cognitive but also moral and emotional [15]. History and art serve as "mirrors and windows", allowing students to reflect on medicine's past and empathise with diverse patient experiences. For example, studying Rembrandt's *The Anatomy Lesson of Dr. Nicolaes Tulp* or Frida Kahlo's depictions of chronic illness facilitates critical conversations about the physician's gaze, suffering, and the human condition [5,6]. These engagements deepen students' understanding of their future roles, moving beyond technical mastery to include compassionate care and social advocacy.

Constructivist learning theory and experiential education further reinforce the rationale for including medical humanities in medical curricula. Piaget and Vygotsky emphasised that learners construct knowledge through meaningful, socially embedded experiences [22,23]. Medical history and art lend themselves naturally to such experiential, inquiry-driven learning. When students examine primary sources like 19th-century cholera maps or Renaissance anatomical drawings, they engage in reflective observation and abstract conceptualisation, key stages in Kolb's Experiential Learning Cycle [24]. These activities foster cognitive flexibility and problem-solving, preparing students to navigate complex and evolving clinical scenarios with historical insight and ethical awareness.

Narrative medicine and reflective practice also offer compelling pedagogical models. As Charon (2006) asserts, narrative competence, that is, the ability to absorb, interpret, and act on patient stories, is fundamental to patient-centred care [5]. Reflective exercises grounded in historical or artistic narratives (e.g. Semmelweis's

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struggles or Kahlo's paintings) encourage students to explore moral ambiguities, process emotional challenges, and develop resilience [7,10]. This aligns with Schön's reflective practitioner model, which emphasises learning through reflection, in and on action [12]. By engaging with stories of suffering, healing, and resistance, students learn to listen deeply, think critically, and practice medicine with humility.

The study of medical history also illuminates the sociopolitical forces shaping healthcare, underscoring the need for culturally competent and ethically grounded practitioners. Ethical frameworks like those of Beauchamp and Childress, paired with critical race theory and decolonial perspectives, contextualise medicine's evolution, considering systemic injustices ranging from the Tuskegee Syphilis Study to colonial anatomical exploitation [11,18,28]. Engaging with these narratives challenges students to confront the legacy of exclusion and inequity in medicine, fostering cultural humility and a commitment to justice-oriented care [1,4].

Empirical evidence further supports the benefits of humanities-based learning. Studies demonstrate that art observation improves diagnostic accuracy, while narrative exercises enhance empathy, reduce burnout, and promote ethical reasoning [6,14,17,19,29]. For instance, students who underwent Visual Thinking Strategies training showed superior attention to clinical detail, while those engaged in reflective writing reported greater emotional intelligence and resilience [3,29]. Humanities education has also been linked to higher job satisfaction and lower attrition among clinicians, affirming its role in sustaining compassionate practice over time [23].

However, implementing humanities curricula presents challenges. Overcrowded timetables, faculty resistance, limited resources, and difficulties in assessment remain significant barriers [3,12,18,21]. Yet, strategic integration (such as embedding humanities content into existing ethics or public health modules) and digital tools (e.g. virtual museum tours or online archives) offer practical solutions. Faculty development initiatives and interdisciplinary partnerships can also bridge gaps between clinical and humanities educators [7,22]. Importantly, assessment methods should reflect the nature of humanities learning, utilising reflective portfolios, narrative essays, and OSCEs to capture growth in empathy, ethical reasoning, and cultural sensitivity [9,30].

The elective discussed in this review aligns well with competency-based medical education (CBME) goals. Frameworks like Kern's Six-Step Approach and the CFIR offer practical guidance for curriculum development and evaluation. By embedding humanities content within a competency-based scaffold, institutions can ensure alignment with accreditation standards while fostering holistic professional development.

Implications for Health Professions Education

The implementation of this elective has significant implications for health professions education. It offers a replicable model for integrating the humanities into medical curricula in alignment with CBME. By using the Kern and CFIR frameworks, institutions can scaffold cultural competence, narrative capability, and ethical reasoning within their curricula. Future physicians trained through such models may be better equipped to navigate the complex interpersonal and sociocultural dimensions of modern healthcare.

CONCLUSIONS

The elective course on the history and art of medicine offers a theoretically sound and empirically supported model for enriching medical education. By synthesising medical humanities, experiential learning, narrative medicine, and ethical inquiry, this course cultivates a new generation of physicians equipped to navigate both the scientific and the humanistic demands of modern practice. Its implementation can help recalibrate medical education towards a more compassionate, inclusive, and reflective model of care. Institutions seeking to nurture such capacities in their graduates should consider this elective not as an add-on but as a vital component of transformative health professions education.

However, successful implementation requires intentional strategies to overcome challenges such as curricular constraints, faculty readiness, and assessment limitations. Interdisciplinary collaboration, innovative teaching methods, and institutional support will be essential to sustain this integration. Future research should evaluate long-term outcomes, including the course's impact on clinical practice and patient care. Ultimately, the history and art of medicine are not mere supplements to medical education but vital tools for fostering a generation of physicians who practice with both scientific rigour and profound human understanding. As medicine continues to advance technologically, preserving its narrative and historical roots through structured, theory-informed implementation will remain indispensable to nurturing healers who can navigate complexity with wisdom and compassion.

INFORMED CONSENT STATEMENT

Not applicable.

DATA AVAILABILITY STATEMENT

Data are available with the author and can be provided on request.

SUPPLEMENTARY MATERIALS

None

AUTHOR CONTRIBUTIONS

A.M. drafted the methodology and wrote the manuscript.

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Original Article

Demographic and Clinical Profiles of Patients with Breast Cancer in the Jazan Region: A Descriptive Analysis

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ABSTRACT Breast cancer is a leading cause of cancer-related mortality among women worldwide. Despite the availability of national data, research on the demographic and clinical characteristics of patients with breast cancer in the Jazan region of Saudi Arabia is limited. This study aimed to address this gap by analyzing local patient profiles and treatment patterns. A retrospective review of 98 patients with breast cancer who were treated in Jazan was conducted. Key demographic, clinical, and treatment data were collected, including information regarding disease stage at diagnosis, detection method, and treatment modality. Descriptive statistics were used to summarize the data. Factor analysis was used to explore treatment patterns, and logistic regression was used to examine the factors associated with mastectomy. **Results:** The mean age of the patients was 50.18 ± 13.03 years; most patients were Saudi (76.6%), married (59.2%), and housewives (85.7%). Comorbidities were present in 46.9% of the patients. The left breast was affected in 56.8% of the patients. Only 16.3% of the cancers were detected through screening; the remaining cases were identified symptomatically. Stages 2a (18.2%) and 4 were the most common. Mastectomy was performed in 51% of the patients, followed by chemotherapy (63.3%) and hormone therapy (43.9%). Two dominant treatment clusters emerged: one centered on mastectomy and chemotherapy and the other on breast-conserving surgery, radiation, and hormone therapy. No significant predictors of mastectomy were identified in this study. Most cases of breast cancer in Jazan were diagnosed in the late stages, with low screening uptake and a high reliance on mastectomy. The predominance of non-working women among these patients challenges assumptions linking occupational exposure to the risk of breast cancer. These findings underscore the need for targeted awareness campaigns, improved screening access, and further research on the risk factors and treatment outcomes in the region.

Keywords: Breast Cancer, Mastectomy, Chemotherapy, Early Screening, Saudi Arabia.

INTRODUCTION

Recent research indicates that breast cancer has surpassed lung cancer as the most frequently diagnosed cancer in women worldwide [1]. In 2020, more than 2.3 million new breast cancer cases were reported, representing 11.7% of all newly diagnosed malignancies. Regrettably, breast cancer was also responsible for 684,996 deaths in 2020 [2]. Breast cancer mortality rates differ substantially between transitioning and developed nations, with transitioning countries exhibiting higher rates [3]. The most commonly diagnosed malignancies in the Kingdom of Saudi Arabia (KSA) include breast, colorectal, and prostate cancer [4]. The incidence of breast cancer has been reported to be 14.8%, with a cumulative risk of 2.87% in both males and females [5]. In 2018, the prevalence of breast cancer in females was 29.7%. More than 50% of breast cancer cases in the KSA are identified at an advanced stage, in contrast to 20% in wealthy nations [6].

Multiple risk factors contribute to the onset of breast cancer in women, including reproductive and hormonal influences, tobacco use, lifestyle decisions, and genetic predispositions [7]. Approximately 8%–10% of breast tumors are linked to

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harmful genetic mutations, with BRCA1/2 mutations representing 50% of these cases. Gene variants are categorized as high-, moderate-, and low-penetrance, and risk-reducing surgery may be considered on the basis of the level of penetration [8]. Furthermore, screening for hereditary BRCA1/2 mutations is essential to identify individuals who might benefit from targeted therapies, such as poly (ADP-ribose) polymerase inhibitors or platinum-based agents [9,10]. A Saudi study evaluating the incidence of BRCA1 and BRCA2 mutations in 310 individuals found that 87% had no mutations, 11% had BRCA1 mutations, and 2% had BRCA2 alterations [11]. Triple-negative breast cancer (TNBC) was observed in 86% of the individuals with mutations [12].

The Jazan region, located in southwestern Saudi Arabia, is home to over 1.6 million people, with a significant proportion residing in rural areas and having limited access to specialized healthcare services. Despite improvements in national cancer care in Saudi Arabia, region-specific data are lacking. Breast cancer remains a major health concern in Saudi Arabia, but research exploring the demographic and clinical profiles of patients in underserved areas such as Jazan is limited [2]. Existing studies have often focused on national datasets and overlooked localized factors that influence disease presentation, progression, and access to treatment [13].

This study aimed to bridge this gap by comprehensively analyzing patients with breast cancer in the Jazan region. The findings will provide valuable insights into patient demographics, tumor characteristics, and treatment patterns. Understanding these regional trends is essential for designing effective, evidence-based interventions tailored to the unique needs of this population. These findings aim to support public health initiatives, enhance early detection efforts, improve access to optimal care, and guide policymaking to reduce the regional cancer burden. By identifying the critical factors and disparities, this study will contribute to broader efforts to reduce breast cancer morbidity and mortality in Saudi Arabia.

MATERIALS AND METHODS

Study Area

This study was conducted in the Jazan region in the southwestern part of Saudi Arabia. Jazan has unique demographic and cultural characteristics with a diverse population that includes both urban and rural communities. Healthcare facilities in the region include specialized centers that provide diagnostic and treatment services for patients with breast cancer.

Study Design and Sample Size

This descriptive, cross-sectional study aimed to analyze the demographic and clinical profiles of patients with breast cancer. This design provided a snapshot of the characteristics of the population under study, focusing on the patterns and trends in disease presentation and management. This study included 98 patients with breast cancer who were diagnosed and treated at healthcare facilities in the Jazan region. The sample size was not based on a statistical power calculation but was determined by the total number of eligible cases available in institutional medical records during the defined data collection period. Participants were selected using a non-probability convenience sampling method, ensuring that they met the inclusion criteria such as a confirmed diagnosis of breast cancer and the availability of complete medical records. Data for certain variables, such as weight, tumor side, and cancer stage, were missing for 10 patients owing to incomplete documentation, which is reflected in the corresponding tables.

Study Measures

Data collection focused on key variables, including demographic characteristics (age, weight, marital status, nationality, and occupation), clinical features (tumor side, stage, duration of illness, and comorbidities), and management approaches (mastectomy, chemotherapy, radiotherapy, and other treatments). These data were extracted from patients' medical records and standardized data collection forms.

Data Quality

To ensure accuracy, the data were cross-checked by multiple researchers and verified against the original medical records. Missing or inconsistent data were addressed through follow-up assessments with healthcare providers. A pilot review of the data collection forms was conducted to refine the process and ensure comprehensiveness.

Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Frequencies and percentages were calculated for categorical variables, whereas means and standard deviations were reported for continuous variables. Associations between variables were examined using chi-squared tests and logistic regression, where appropriate. Logistic regression analysis was performed to assess the effects of demographic factors on mastectomy (the dependent variable). Principal component analysis was conducted to identify patterns in the cancer management plans. All statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 25.0, (Released 2017; IBM Corp., Armonk, NY, USA) to ensure methodological rigor and reproducibility.

RESULTS

Demographic Characteristics

This study focused on the demographics and characteristics of a sample of 98 patients with breast cancer from the Jazan region. Table 1 presents the demographic profiles of the study population. The average age of the patients was 50.18 years, with nearly equal representation of those aged 31-50 years (46.9%) and those aged >50 years (48%). Regarding weight distribution, the majority of patients were in the 56–

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70-kg range (42.1%). Most patients were Saudi nationals (77.6%). Marital status varied, with the majority being married (59.2%). Among the patients, 28.6% reported having no children, and a substantial proportion (85.7%) were housewives. Comorbidities, including hypertension (10.2%) and diabetes (7.1%), were present in 46.9% of the patients. Additionally, 15.3% of the patients had multiple comorbidities.

Table 2 focuses on the breast cancer characteristics of the study participants. A higher proportion of tumors was found on the left side (56.8%) than on the right side (43.2%). Most patients (83.7%) discovered their condition through diagnosis rather than screening. Cancer staging data showed a diverse spread, with 18.2% of cases each showing stage 2a and stage 4 disease. Benign tumors accounted for 10.2% of the cases. The duration of illness among the patients varied significantly, with an average duration of 17.94 months, a minimum of 2 months, and a maximum of 132 months.

Table 1: Sociodemographic characteristics of the participants

Variable	**N**	**%**
Age (50.18 ± 13.03 yr)		
Less than 30 yr	5	5.1
31-50 yr	46	46.9
More than 50 yr	47	48.0
Weight (67.06 ± 14.30 kg)		
less than 50 kg	15	19.7
51-70 kg	32	42.1
More than 70 kg	29	38.2
Nationality		
Saudi	76	77.6
Non-Saudi	22	22.4
Marital status		
Single	13	13.3
Married	58	59.2
Widowed	16	16.3
Divorced	11	11.2
Children		
No kids	28	28.6
1-3 kids	26	26.5
4-7 kids	26	26.5
More than 7 kids	18	18.4
Occupation		
Housewife	84	85.7
Employed	14	14.3
Comorbidity		
None	52	53.1
At least one comorbidity	46	46.9
Types of diseases		
None	52	53.1
Hepatitis B virus infection	2	2.0
Hypertension	10	10.2
Diabetes	7	7.1
Multiple comorbidities	15	15.3
Others	12	12.2
Total	98	100

The management plans outlined in Table 3 reveal a multifaceted approach to breast cancer treatment. Mastectomy was performed in 51% of the patients, while 15.3% underwent partial mastectomy. Chemotherapy was the most frequently used treatment (63.3%), followed by hormone therapy (43.9%) and radiotherapy (39.8%). Other treatment modalities, such as immunotherapy (12.2%) and various less common interventions, were also applied. These findings highlight the diverse management strategies employed in breast cancer care in the Jazan region.

Table 2: Characteristics of breast cancer

Variable	N	%
Tumor side		
Left	50	56.8
Right	38	43.2
How did the patient come to know about the disease		
Screening	16	16.3
Diagnosis	82	83.7
Stage		
Stage 1(T1N0M0)	5	5.7
Stage 2a (T2N0M0)	16	18.2
Stage 2b (T2N1M0)	15	17.0
Stage 3a (T2N2M0)	16	18.2
Stage 3b (T4bN2M0)	7	8.0
Stage 3c (T2N3M0)	4	4.5
Stage 4	16	18.2
Benign	9	10.2
Duration		
Mean ± standard deviation	Maximum	Minimum
17.94±18.98	132.00	2.00

Table 3: Management plans

Management	**Number (N)**	**Percentage (%)**
Mastectomy	50	51
Partial mastectomy	15	15.3
Benign excision	2	2.0
Chemotherapy	62	63.3
Radiotherapy	39	39.8
Hormone therapy	43	43.9
Anti-hormonal therapy	1	1.0
Immunotherapy	12	12.2
Aspirate of cyst	1	1.0
Biological therapy	1	1.0
Anti-breast cancer	1	1.0

Factor Analysis

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was 0.615; this value indicated a high level of suitability for factor analysis, since values less than 0.5 indicate that the data may not be adequately factorable. Bartlett's Test of Sphericity showed significant results (χ^2 = 70.450, df = 10, $p < 0.001$), suggesting that correlations among the variables were sufficient to proceed with factor

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analysis. The analysis yielded two components with eigenvalues greater than 1, explaining a cumulative variance of 60.85%. Component 1 accounted for 32.93% of the variance, whereas Component 2 accounted for 27.92%. Thus, the two extracted factors explained most of the variation in the dataset, with three additional components contributing minimally to the variation. The rotated matrix using Varimax with Kaiser normalization revealed the following loadings: mastectomy (0.880) and chemotherapy (0.627) loaded strongly on Component 1, whereas partial mastectomy (0.764) and radiotherapy (0.667) loaded strongly on Component 2. Hormone therapy resulted in moderate cross-loading of both components. The rotation converged in three iterations, confirming the structure presented in Table 4. These results suggest two distinct underlying factors related to treatment modalities: one focused on surgical and systemic therapies, and the other on combination treatments.

Table 4: Factor Analysis

	Components	
	1	2
Mastectomy	0.880	-0.148
Chemotherapy	0.627	0.116
Partial mastectomy	-0.429	0.764
Radiotherapy	0.537	0.667
Hormone therapy		0.577

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Logistic Regression Analysis

The logistic regression analysis revealed no statistically significant predictors of mastectomy among the examined variables (Table 5). Women with more children showed lower odds of undergoing mastectomy than those with no children; however, these results were not significant. Similarly, marital status, weight, nationality, occupation, tumor side, and comorbidities showed varying odds ratios but lacked statistical significance. Widowed women had the highest odds of mastectomy (OR = 9.82), and non-Saudi women (OR = 4.53) and patients with comorbidities (OR = 3.70) also showed higher odds of mastectomy, although these associations were not significant due to wide confidence intervals. Tumor characteristics, including the side and method of diagnosis, and patient age did not significantly influence the likelihood of mastectomy. Duration of illness was also not significantly associated. These results indicate that other factors not included in this analysis may play a critical role in determining the likelihood of mastectomy in this population.

Table 5: Logistic regression analysis (dependent variable: mastectomy)

Variables	Categories	P-value	Odds ratio		
			Value	Lower 95%	Upper 95%
Number of children	No Kids (Reference)				
	1-3 kids	0.37	0.40	0.05	2.97
	4-7 kids	0.19	0.23	0.03	2.07
	More than 7 kids	0.19	0.22	0.02	2.16
Marital status	Single (Reference)				
	Married	0.68	1.73	0.13	23.68
	Widowed	0.17	9.82	0.39	250.03
	Divorced	0.85	0.77	0.05	11.87
Weight	Less than 50 kg (Reference)				
	56-70 kg	0.27	2.83	0.45	17.65
	More than 70 kg	0.73	0.70	0.10	5.09
Nationality	Saudi (Reference)				
	Non-Saudi	0.11	4.53	0.72	28.39
Breast cancer diagnosis	Screening (Reference)				
	Diagnosis	0.70	1.44	0.22	9.41
Occupation	Housewife (Reference)				
	Employed	0.28	0.38	0.07	2.21
Side of tumor	Left (Reference)				
	Right	0.13	0.36	0.09	1.35
Comorbidity	None (Reference)				
	At least one comorbidity	0.10	3.70	0.77	17.73
Age	31–50 yr (Reference)				
	More than 50 yr	0.21	0.36	0.07	1.79
Duration months		0.45	1.01	0.98	1.04

Dependent variable encoding: No, 0; Yes, 1.

DISCUSSION

Breast cancer continues to be one of the most common cancers globally, and requires an in-depth understanding of tumor attributes and therapeutic approaches. This study presents an overview of breast cancer demographics, tumor characteristics, and treatment modalities in 98 patients in the Jazan region. The average age of the participants was 50.18 years, and the study population predominantly consisted of Saudi nationals and housewives. Clinical diagnosis accounted for the majority of cases (83.7%), as opposed to routine screening, with the most common cancer stages being 2a and 4 (18.2% each). The primary treatment was mastectomy (51%) followed by chemotherapy (63.3%) and radiotherapy (39.8%). The mean age of 50.18 years in this study was somewhat lower than that reported in Western studies, where breast cancer is often diagnosed in patients over 60 years of age [14]. Nevertheless, it closely corresponds to the data from Saudi Arabia and other Middle Eastern nations [15-17]. Using data from the Saudi Cancer Registry for the years 2001 to 2017, Basudan indicated that the median age at diagnosis had increased to 51 years,

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correlating with the ongoing transition to a more Westernized lifestyle in Saudi Arabia [18]. Al Zomia et al. recently reported that the average age at breast cancer diagnosis in Saudi women was 45–49 years [5]. Thus, breast cancer starts earlier in this region than in Western populations. This could be due to genetic factors or lifestyle choices. This could also be because the Saudi population is mostly young (with a median age of 28 years and over 30% under 18 years) rather than a biologically different condition. Two-thirds of the participants were married, aligning with findings from the Saudi Cancer Registry and data on female breast cancer from 1990 to 2021, which indicated that married women constituted the majority of patients with breast cancer [5, 18]. Conversely, research in Western populations indicated a higher incidence of breast cancer among unmarried and childless women. Although two-thirds of patients with breast cancer in this study were married, this may reflect general demographic trends rather than a clear causative association. Marriage may be correlated with access to healthcare, reproductive history, and lifestyle factors, all of which can affect the risk of breast cancer and diagnostic trends. Future studies should investigate the effect of marital status on breast cancer outcomes, treatment adherence, and psychological resilience. Our findings showing that one-third of the patients were childless raises questions about whether nulliparity or late childbearing may influence the risk of breast cancer, a trend also noted in Middle Eastern studies [16].

A significant number of patients with breast cancer in this study were housewives (85.7%), which contradicts several prior studies stating that that job exposure and workplace-related stress enhance breast cancer risk [19]. In Saudi Arabia, a substantial majority of women, especially those in the older age groups, choose to stay at home because of their traditional family responsibilities and lower rates of female labor participation. Housewives may show greater levels of physical inactivity than working women, who participate in more regular exercise and scheduled activities. These variables, in addition to the fact that 83.7% of the cases in this study were identified via diagnosis rather than screening, imply that many housewives may have skipped regular tests, perhaps contributing to the greater reported prevalence of breast cancer in this group. Our study revealed that screening identified only 16.3% of the cases, whereas symptoms led to the diagnosis in the remaining 83.7%. This low uptake of mammography, despite national screening initiatives, aligns with the findings of previous studies [20, 21] reporting that Saudi women were more likely to receive an advanced-stage breast cancer diagnosis than women in Western countries. However, another study revealed that an increasing proportion of cases were identified in earlier stages [22]. Early detection through breast cancer screening programs is likely to have contributed to this finding. In contrast, nations with well-established screening programs (e.g., the U.S., Canada, and parts of Europe) report higher screening rates, leading to earlier-stage diagnoses and decreasing breast cancer–associated mortality by 20%-30% [23]. This highlights the critical need for enhanced breast cancer awareness and increased participation in screening in Jazan and other underprivileged communities. The breast cancer staging data in our analysis indicated a large number of late-stage diagnoses, with stages 3 and 4 accounting for over 40% of the cases. This correlates with evidence from sub-Saharan African countries, Saudi Arabia, and other Gulf countries, where advanced-stage presentation is more prevalent than in Western nations [5, 24, 25]. In contrast, European and North American studies have revealed a larger percentage of stage 1 and 2 diagnoses owing to successful early detection programs [25, 26]. Mastectomy was the predominant surgical intervention (51%), exceeding the rates documented in many studies from the US [27] while aligning with those from Saudi Arabia and other Gulf countries [5, 25, 28, 29]. The preference for mastectomy over breast-conserving surgery (BCS) in Saudi Arabia may stem from patient and physician preferences, insufficient knowledge, or apprehensions over recurrence. Research from the United States and Europe indicates increased BCS rates, which are indicative of enhanced patient information and the availability of reconstructive surgical alternatives [27]. These results highlight the need for more initiatives to address spatial inequalities in breast cancer treatment. Logistic regression failed to reveal any significant predictors of mastectomy, possibly because of the limited sample size or unmeasured covariates. Nonetheless, non-Saudi women, widowed patients, and those with comorbidities had increased probabilities of undergoing mastectomy, but the differences were not statistically significant. Other Middle Eastern studies have reported similar patterns, wherein socioeconomic and cultural variables influence surgical choices [16, 28]. Conversely, Western studies have suggested that tumor size, receptor status, and genetic variables significantly influence surgical choices [27]. Chemotherapy is crucial for enhancing patient outcomes and is a fundamental component of contemporary cancer treatment, despite its possible adverse consequences [30]. Our analysis revealed that chemotherapy was the most commonly used treatment modality (63.3%), consistent with findings from Saudi Arabia, Algeria, Jordan, and Egypt, where late-stage presentations contributed to the elevated use of chemotherapy [31]. The lower rates of hormone therapy (43.9%) and radiation (39.8%) suggest that a variety of treatment protocols and administrative procedures are needed to obtain these treatments, which may reflect the influence of tumor subtypes and healthcare accessibility [32]. The results of factor analysis highlighted two different groups of treatment methods. One group focused on aggressive surgical and systemic interventions such as mastectomy and chemotherapy. The other group focused on less invasive or adjuvant methods such as partial mastectomy and radiotherapy. This pattern aligns with trends noted in both local and global studies, where surgical and systemic treatments prevailed in advanced cases, whereas conservative therapy was favored in earlier stages [31, 32]. These classifications provide important insights into

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treatment priorities and regional preferences, illustrating the clinical and resource-based dynamics of breast cancer therapy in Jazan.

Strengths and Limitations of the Study

One strength of this study is the extensive assessment of tumor staging and treatment techniques, which provided a real-world perspective on regional management trends. The survey also discusses comorbidities and healthcare access, highlighting the major impediments to early identification and treatment.

Another strength of this study is its focus on the Saudi population, which provided localized data that can contribute to regional healthcare planning and cancer awareness programs. Many international studies have focused on Western populations, where lifestyle, access to healthcare, and genetic predispositions may differ. This study also explored the roles of screening- versus diagnosis-based detection, emphasizing the need for enhanced early detection programs. Furthermore, the use of factor analysis and logistic regression added quantitative depth to the findings, potentially revealing patterns in treatment choices.

Nevertheless, this study also had several limitations. The sample size (n = 98) limited generalizability and reduced the statistical power for inferential analyses, such as logistic regression. The absence of a control group and reliance on hospital-reported cases may have introduced selection bias and overrepresented cases of advanced-stage disease. Key factors, such as genetics, lifestyle, and long-term outcomes, were not assessed. Additionally, the use of non-probability convenience sampling may have further restricted generalizability. Future studies should adopt probability-based multicenter designs and explore broader risk factors to enhance their clinical relevance.

CONCLUSIONS

This study identified key demographic and clinical trends among patients with breast cancer in the Jazan region, including a predominance of late-stage diagnoses, low screening rates, and a high reliance on mastectomy. These findings indicate major gaps in early detection and access to preventive care. In comparison with global benchmarks, the data reflect the ongoing challenges in timely diagnosis and comprehensive treatment delivery. The study also revealed two distinct patterns in treatment modalities, indicating opportunities for personalized evidence-based care. Practically, these insights can inform targeted surgical training initiatives to better manage advanced-stage cases, guide the allocation of diagnostic and surgical resources, and shape patient education programs that focus on early symptom recognition and screening awareness. To address these challenges, healthcare policies should prioritize community-based screening programs, provider training, and enhanced access to diagnostic and therapeutic services. Future research should include larger multicenter studies to validate these findings and explore the predictive factors for treatment decisions, thereby contributing to the advancement of precision oncology in Saudi Arabia.

ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Jazan Health Ethics Committee - Jazan Ministry of Health (Reference No. 23106, 01 September 2023). The study was conducted in accordance with the national ethical guidelines.

INFORMED CONSENT STATEMENT

A waiver of consent was granted because the data were extracted from patient medical records.

DATA AVAILABILITY STATEMENT

Data supporting the reported results can be obtained from the corresponding author on reasonable request.

PATENTS

Not applicable

SUPPLEMENTARY MATERIALS

Not applicable

AUTHOR CONTRIBUTIONS:

Conceptualization: Jobran M Moshi, Siddig Ibrahim Abdelwahab, and Osama Albasheer; methodology: Siddig Ibrahim Abdelwahab; software: Manal Mohamed Elhassan Taha; validation: Wafa Khudier and Raya M Badri; formal analysis: Osama Albasheer; investigation: Jobran M Moshi; resources: Jobran M Moshi; data curation: Jobran M Moshi, Siddig Ibrahim Abdelwahab, and Osama Albasheer; writing—original draft preparation: Jobran M Moshi, Siddig Ibrahim Abdelwahab, Ali Shubaili, and Osama Albasheer; writing—review and editing: Mayssa S. Nadeem, Maha A Hummadi, and Sama M Maashi; visualization: Jobran M Moshi, Siddig Ibrahim Abdelwahab, and Osama Albasheer; project administration: Maha A Hummadi and Sama M Maashi; funding acquisition: Jobran M Moshi. All the authors have read and agreed to the published version of this manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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المجلة السعودية للبحوث والممارسة الصحية

Volume: 1, Issue: 4

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Volume1, Issue 4

Saudi Journal of Health Research and Practice

Volume 1, Issue 4

Historical background and Objectives

The *Saudi Journal of Health Research and Practice (SJHRP)* was established to address the growing demand for a platform dedicated to publishing high-quality, evidence-based health research in Saudi Arabia and beyond. As healthcare in the region undergoes rapid transformation in line with Vision 2030, the journal aims to bridge the gap between clinical practice and research. The goal is to empower healthcare professionals, educators, and researchers by providing a venue for sharing innovative findings and insights that address local and global health challenges.

By amplifying regional voices, the SJHRP aspires to contribute to the global health dialogue while ensuring that the unique perspectives and priorities of the region are represented.

Theme of the Issue

This fourth issue of the Saudi Journal of Health Research and Practice (SJHRP) brings together original studies and reviews that address both clinical and community aspects of health in Saudi Arabia. The contributions span infectious disease epidemiology, genetic awareness, diagnostic technology, and maternal-child health-reflecting the journal's commitment to multidisciplinary perspectives that link public health with clinical and technological innovation.

Editorial Message

The diversity of topics featured in this issue underscores the dynamic and interconnected nature of health research within the Kingdom. Each paper contributes to a deeper understanding of how social, biological, and technological factors shape health outcomes.

The opening study examines socio-demographic characteristics associated with vector-borne diseases in the Jazan region, a topic of ongoing public health importance in southern Saudi Arabia. The findings highlight environmental and social determinants that must inform regional vector-control strategies and health education programs.

The second paper focuses on parents' knowledge and awareness of sickle cell disease, providing essential insights into public understanding of hereditary disorders. This work is particularly relevant to community-based prevention programs and reinforces the role of health education in reducing disease burden in high-prevalence areas.

The third article offers a comparative review of Cone Beam CT and Fan Beam CT, evaluating image quality and radiation dose. This systematic analysis integrates diagnostic science with patient safety considerations, guiding radiologists and clinicians toward more efficient and safer imaging practices.

Finally, the study on epidemiological aspects of prematurity in Riyadh adds valuable data to maternal and neonatal health research in Saudi Arabia. By identifying patterns and risk factors, the paper contributes to the national agenda for improving perinatal care and reducing neonatal morbidity.

Together, these contributions advance the SJHRP mission to promote evidence-based, locally relevant, and globally oriented research. They show how fields as different as epidemiology and medical imaging come together with one shared purpose to improve people's health through science and collaboration.

We extend our appreciation to the authors, reviewers, and editorial team for their continued commitment to scholarly excellence and to advancing the research ecosystem within the Kingdom of Saudi Arabia.

Professor Hussein M. Ageely
Editor-in-Chief
Saudi Journal of Health Research and Practice

About the Journal

The *Saudi Journal of Health Research and Practice (SJHRP)* is a peer-reviewed, open-access journal dedicated to publishing high-quality research that advances healthcare and evidence-based practice. The journal serves as a platform for researchers, clinicians, and academics to share knowledge and insights across a wide range of healthcare disciplines.

Journal Mission:

- To promote innovation and excellence in health research.
- To provide a platform for interdisciplinary collaboration.
- To address pressing health challenges both locally and globally.

Scope:

This journal covers all topics related to all aspects of health issues and healthcare research. Basic medical research with clear clinical implications will also be considered. Research fields of interest include but are not limited to:

- Public Health and Epidemiology
- Health Promotion and Disease Prevention
- Clinical Medicine Across All Specialties (including all clinical medical , dental and other clinical specialties and subspecialities)
- Pharmaceutical Research and Development
- Biomedical Sciences and Technology
- Mental Health and Behavioural Science
- Environmental and Occupational Health
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- Health Informatics and Digital Transformation
- Health Education and Behavioral Science
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- **Interdisciplinary Focus:** Publishes research from a variety of healthcare fields to encourage collaboration and innovation.

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Announcements:

- SJHRP is currently accepting submissions for its next issue. Researchers are encouraged to submit their work via the journal's online portal.
- Plans for indexing SJHRP in major databases such as Scopus and PubMed are underway.

Acknowledgments

The launch of the *Saudi Journal of Health Research and Practice (SJHRP)* is the result of the collaborative efforts and unwavering support of numerous individuals and institutions.

We extend our deepest gratitude to:

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- **The Journal's Editorial Office**, for their tireless efforts in managing submissions and ensuring the journal's quality.
- **The Editorial Board Members**, whose expertise and commitment have been instrumental in shaping this journal.

Your contributions have made this milestone possible, and we look forward to your continued support as we advance together.

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Saudi Journal of Health Research and Practice
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Original Article

Socio-demographic characteristics and their correlations with the vector-borne diseases in the Jazan region, Kingdom of Saudi Arabia

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ABSTRACT The vector-borne diseases (VBDs) can negatively affect not only public health in community but also, influence the community economy, life aspects, and quality. This study aims to examine the socio-demographics and evaluating people's knowledge and experiences about vector-borne diseases (such as dengue fever, and malaria). So, an online survey with 44 questions was built, and 521 participants completed it to seek the required information in Jazan region. Also, data were collected and analyzed with the level of Statistical significance (P-value) of less than 0.05. Statistical findings indicate varied results, such as the socio demographic factors (gender, age, place of living, working status) have a weak negative association with the frequency of mosquito bitten (r=-0.098), while in the education level factor there is a very weak positive correlation (r=0.090 to r=0.155) with all VBD variables. However, the study reveals that there is a significant very weak positive association between socio demographic factors (educational level) with all VBD variables, while the other factors (such as gender, age, place of living, working status) showed other various findings. Although this study is considered a regional study, it can be generalized in many countries worldwide.

Keywords: Dengue, Malaria, Vector-Borne Diseases (VBD), Socio-Demographic Characteristics, Jazan Region.

INTRODUCTION

One of the most serious threats in urban and rural communities in the world is Vector-borne diseases (VBDs). VBDs can affect negatively not only people's public health but also, they impact on the community economy, all life aspects and quality in any community, especially in tropical areas such as Jazan region which located in the southern area of the Kingdom of Saudi Arabia [1,2]. Dengue has a significant financial impact on the local economy, costing US$110.17 million year and costing an average of US$11 947.6 per patient. The prices were very variable between the various kinds of healthcare institutions, and productivity years lost accounted for almost 80% of the overall expenses.[15] Considering that half of the world's population is currently at risk, a few straightforward numbers highlight the significance of VBDs on a global level: an estimated 1 billion people get infected yearly, and more than 1 million die, making up 17% of the burden of infectious diseases worldwide[16].

In addition, altering exposure to the diseases by shifting geographic distributions, as previously mentioned, climate change could change the rate of transmission of vector-borne diseases. The responses of the vector and pathogen to changes in the specific range of temperature or moisture involved, as well as the immunological condition of the host population, determine how susceptible the disease is to changes in transmission rates.[2] Global change encompasses a variety of factors, including land usage, water storage and irrigation, urbanization and population expansion, trade and travel, and chemical contamination. While the threats posed by climate change to people and the environment remain unknown, other local changes are happening more quickly and are having a big impact on vector-borne diseases. [2]

The most prevalent mosquito-borne diseases in Saudi Arabia are Rift valley fever, dengue, filaria, malaria, and warrel's disease (Fakeeh and Zaki 2001, 2003; Ayyub et al. 2006; Khan et al. 2008). [17] Urban areas can serve as

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breeding grounds for newly emerging and reemerging infectious diseases. Poverty, population movement, urban ecology, and microbiological adaptation to change are potential contributors to this [4, 5]. Cities and metropolitan regions are becoming "gateways for the worldwide spread of infections" since vector-borne diseases (VBD) are on the rise there. [18]. There is no doubt that climate change is occurring, and it is expected to cause the geographic distribution of many vector-borne diseases, such as malaria and dengue, to shift to higher latitudes and altitudes. Visceral leishmaniasis, filariasis, Japanese encephalitis, dengue, and malaria are the six primary vector-borne diseases (VBD) that are endemic to India.[19]

Both generalized additive models and generalized linear models were used for the geographical data's correlational analysis. Disease incidence was highly associated with average temperature, minimum temperature, and wind speed. In Cucuta, a region with a consistently high prevalence of dengue, the spread of Zika during the 2016 epidemic seems to have reduced dengue circulation. A negative influence on the spread of dengue, Zika, and chikungunya was suggested by socioeconomic issues such as barriers to health and children's services, inadequate sanitation, and poor water supply in all three habitats.[20]

Thus, in this study, an online questionnaire was carried out to find the prevalence of the most common vector-borne diseases (VBDs) in Jazan region (i.e., Dengue and Malaria) [5,6,7] as they are one of the major health problems in various places in both urban and rural areas, and people's knowledge about clinical symptoms of VBDs, impact on public health, VBDs breeding sites. Findings will be beneficial to help in estimating and detecting the occurrence probability of dengue fever and malaria, and their impact on the public health [3]. In this research, we explore the socio ecological model that includes community, environment, and predisposing factors of VBD occurrence and finding the association between socio demographic characteristics with vector borne disease variables.

MATERIALS AND METHODS

Sampling and data collection:

Data were collected via an online survey from April 2023 to May 2023. Participants were recruited via social network platforms such as Twitter, Instagram, Facebook, and WhatsApp. This study only allowed participants who were at least 18 years old, and from Jazan to be included. Incomplete answers were also excluded. About 521 participants took part but only 519 were qualified for inclusion. Ethical approval was provided by the Ministry of education.

Survey design

An online survey was built with 44 questions, 6 of these questions about the participants' socio-demographic characteristics (i.e., age, gender, occupation, accommodation type, area of living type, and education level) [8]. While the variables (the 38 questions) are about vector-borne diseases including mosquito massive breeding sites and weather variables, mosquito common breeding sites and water accumulation, prevalence of malaria and dengue in the Jazan region, kingdom of Saudi Arabia. These questions were designed as nominal data, and ordinal data that can be quantified and calculated statistically easily [9]. The ordinal data type, such as in the Likert scale [10], for example, 1 present (Least likely), while 5 (Most likely), or 1 present (Unlikely), while 5 (Very likely)), while the nominal data (such as YES or NO answers, or as gender type). These questions and their answers had mentioned in detail in (Tables 1, and 2) below.

Statistical analysis

Valid data were analyzed via suitable statistical analysis such as percents and correlation. To evaluate the association between the participants' socio-demographic characteristics and the variables (vector-borne diseases), SPSS (Statistical Package for the Social Sciences) software, version 26, was used, and the Statistical significance (P-value) of less than 0.05 was defined [11,12]. Also, to estimate the degree of association among the variables, we considered (Correlation Coefficient) r = 0-0.19 if the association is considered as very weak, 0.2-0.39 as weak, 0.40-0.59 as moderate, 0.6-0.79 as strong and 0.8-1 as very strong correlation. Besides (-) indicates the negative association, and (+) indicates the positive association [13,14]. Answers obtained were either of ordinal data type (e.g., Likert scale) or nominal data type (e.g., YES or NO), and then were quantified and calculated statistically.

RESULTS

The results were illustrated as in (Tables 1,2, and 3) as follows. (Table1) illustrate an overview of the information about socio-demographic characteristics (as percentages and frequencies), (Table2) presents an overview of the information about vector-borne diseases frequencies, (Table 3) presents an overview of the information about correlations between socio-demographic factors with VBD variables.

Socio-demographic characteristics:

Table 1: Socio-demographic characteristics

Q. N	The Question	The answer	Frequency	Percent
1	Gander	Male	344	66.0
		Female	177	34.0
		Total	521	100.0
2	Age	From 18:19 years	19	3.6
		From 20:29 years	261	50.1
		From 30:39 years	69	13.2

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		From 40:49 years	106	20.3
		More than 49 years	62	11.9
		Total	517	99.2
3	Educational level	High school diploma or less	116	22.3
		Bachelors	381	73.1
		Masters	12	2.3
		Doctorates	5	1.0
		Total	514	98.7
4	Working status	Student	182	34.9
		Government employee or private sector	237	45.5
		Unemployed	60	11.5
		Others	37	7.1
		Total	516	99.0
5	Place of living	City	349	67.0
		Close to the beach or sea	46	8.8
		Agricultural area	84	16.1
		Mountainous area	33	6.3
		Total	512	98.3
6	Type of Accommodation	Popular House	61	11.7
		Apartment	182	34.9
		Villa	218	41.8
		Others	56	10.7
		Total	517	99.2

(Table 1) shows that the surveyed participants sample consists of 344 males and 177 females. Among 521 participants there are 66% are males, and 34 are females. Among 517 participants, 50.1% were from 20:29 years, 20.3% from 40:49 years, 13.2% from 30:39 years, 11.9% more than 49 years, and 3.6% from 18:19 years. Among 514 participants, 74.1% have Bachelor, 22.6% have a high school diploma or less, and 3.3% have a Master. 1% have Doctorates. Among 516 participants, 45.9% work as government employees or the private sector, 35.3% work as students, 11.6% are unemployed, and 7.1% other. Among 512 participants, 68.2% live in a city, 16.4% live in an agricultural area, 9% live close to the beach or sea, and 6.4% live in a mountainous area. Also, among 517 participants 35.2 % live in an apartment, 42.2% live in a villa, 11.8 live in a popular house, and 10.8% live in other accommodations.

Table 2: The variables (vector-borne diseases) frequencies

Q. N	The Question	The answer	Frequency	Percent
1	How many times a week have you been bitten by a mosquito?	Twice or less per week	270	51.8
		From 3-5 times a week.	136	26.1
		From 6-7 times a week	96	18.4
		Total	502	96.4
2	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Home]	1 (Least likely)	195	37.4
		2	88	16.9
		3	58	11.1
		4	32	6.1
		5 (Most likely)	42	8.1
		Total	415	79.7
3	On a scale of 1 to 5, what places have you been bitten by mosquitoes (with 1 being the least likely and 5 being the most likely) [Work]	1 (Least likely)	177	34.0
		2	71	13.6
		3	37	7.1
		4	24	4.6
		5 (Most likely)	20	3.8
		Total	329	63.1
4	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Gardens]	1 (Least likely)	67	12.9
		2	37	7.1
		3	81	15.5
		4	103	19.8
		5 (Most likely)	126	24.2
		Total	414	79.5
5	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Beaches]	1 (Least likely)	87	16.7
		2	52	10.0
		3	79	15.2
		4	63	12.1
		5 (Most likely)	84	16.1
		Total	365	70.1
6	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Coasts]	1 (Least likely)	72	13.8
		2	52	10.0
		3	84	16.1
		4	64	12.3
		5 (Most likely)	70	13.4
		Total	342	65.6
7	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Others]	1 (Least likely)	92	17.7
		2	50	9.6
		3	47	9.0
		4	49	9.4
		5 (Most likely)	50	9.6
		Total	288	55.3
8	Had malaria or dengue fever within 3 years [I was medically diagnosed with malaria]	Yes	18	3.5
		No	480	92.1
		Total	498	95.6
9	Had malaria or dengue fever within 3 years [I was medically diagnosed with dengue]	Yes	29	5.6
		No	467	89.6
		Total	496	95.2
10	Had malaria or dengue fever within three years [a family member has been diagnosed with malaria]	Yes	20	3.8
		No	468	89.8
		Total	488	93.7
11	Had malaria or dengue fever within three years [a family member has been diagnosed with a fever or dengue]	Yes	42	8.1
		No	451	86.6
		Total	493	94.6
12	Had malaria or dengue fever within 3 years [a friend has been diagnosed with malaria]	Yes	44	8.4
		No	445	85.4
		Total	489	93.9
13	Had malaria or dengue fever within 3 years [a friend has been diagnosed with dengue]	Yes	77	14.8
		No	413	79.3
		Total	490	94.0
14	Had malaria or dengue fever within 3 years [a co-worker was	Yes	40	7.7
		No	443	85.0

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	diagnosed with malaria]	Total	483	92.7
15	Have had malaria or dengue fever within 3 years [a co-worker has been diagnosed with dengue]	Yes	52	10.0
		No	441	84.6
		Total	493	94.6
16	In case of injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or none and 5 is very severe) Ignore the question if you have not been exposed [fever and tiredness]	1 (Mild or none)	192	36.9
		2	31	6.0
		3	37	7.1
		4	22	4.2
		5 (Very severe)	34	6.5
		Total	316	60.7
17	In case of injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or no and 5 is very severe) Ignore the question if you were not injured [back and muscle pain]	1 (Mild or none)	153	29.4
		2	41	7.9
		3	43	8.3
		4	31	6.0
		5 (Very severe)	24	4.6
		Total	292	56.0
18	In case of injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or no and 5 is very severe) Ignore the question if you have not been exposed [rash]	1 (Mild or none)	187	35.9
		2	40	7.7
		3	27	5.2
		4	14	2.7
		5 (Very severe)	16	3.1
		Total	284	54.5
19	In case of injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or none and 5 is very severe) Ignore the question if you were not injured [Inability to get out of bed]	1 (Mild or none)	167	32.1
		2	30	5.8
		3	38	7.3
		4	27	5.2
		5 (Very severe)	27	5.2
		Total	289	55.5
20	In your opinion, the possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [after it rains]	1 (Unlikely)	81	15.5
		2	51	9.8
		3	69	13.2
		4	96	18.4
		5 (Very likely)	187	35.9
		Total	484	92.9

In (Table 2), we can review the most important points in the following:

Mosquito bitten by number of times and by places:
Among the 502 participants, 51.8% people reported that 3-5 times a week they been bitten by a mosquito, and 19.1% of people reported that they have been bitten by mosquitoes 6-7 times a week. Among there are 47% people were reported that they have been bitten by mosquitoes at home and 53.8% of people reported that they have been bitten by mosquitoes at workplace and with gardens 30.4% were bitten, 23.8% at beaches, and coasts there are 24.6%, and other places are 31.9%.

Prevalence of Malaria and Dengue:
Similarly, 498(with 96.4%) of the people were not medically diagnosed with malaria within 3 years and 3.6% were diagnosed with malaria. Among, 496 (94.2%) of the people were medically not diagnosed with dengue while 5.8% were diagnosed with malaria. In 488 (95.9%) were reported that the family member has been not diagnosed with malaria while 4.1% were diagnosed with malaria. Among 493 participants, 91.5% reported that the family member has not been diagnosed with dengue while 8.5% were diagnosed. In 489, (91.5%) reported that a friend has not been diagnosed with malaria or dengue while 8.5% agreed that their friend has been diagnosed with malaria or dengue. Likewise, with 483 participants, 91.7% reported that their co-worker was not diagnosed with malaria while 8.3% agreed. In 493 participants, 89.5% reported that a co-worker was not diagnosed with dengue while 10.5% agreed.
Similarly, among 316 participants, 60.8% reported no fever and tiredness while 7% agreed. Among 292 participants, 52.4% reported they did not have back and muscle pain, while 8.3% agreed about severe back and muscle pain. Among 284 participants, 65.8% reported they did not have rash but 4.9% agreed about rash. Among 289 participants, 57.8% reported not for Inability to get out of bed while 9.3% reported for severity.

Table 3: The variables (mosquito breeding) frequencies

Q. N	The Question	The answer	Frequency	Percent
1	In your opinion, the possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [after it rains]	1 (Unlikely)	81	15.5
		2	51	9.8
		3	69	13.2
		4	96	18.4
		5 (Very likely)	187	35.9
		Total	484	92.9
2	In your opinion, the possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [when the temperature rises]	1 (Unlikely)	196	37.6
		2	94	18.0
		3	79	15.2
		4	31	6.0
		5 (Very likely)	37	7.1
		Total	437	83.9
3	In your opinion, the possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [at high humidity]	1 (Unlikely)	88	16.9
		2	94	18.0
		3	108	20.7
		4	72	13.8
		5 (Very likely)	80	15.4
		Total	442	84.8
4	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [conditioners]	1 (Unlikely)	147	28.2
		2	71	13.6
		3	68	13.1
		4	39	7.5
		5 (Very likely)	79	15.2
		Total	404	77.5
5	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [the farmer]	1 (Unlikely)	47	9.0
		2	33	6.3
		3	63	12.1
		4	103	19.8
		5 (Very likely)	220	42.2
		Total	466	89.4
6	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Gardens]	1 (Unlikely)	48	9.2
		2	33	6.3
		3	74	14.2
		4	109	20.9
		5 (Very likely)	199	38.2
		Total	463	88.9
7	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely	1 (Unlikely)	50	9.6
		2	25	4.8

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	and 5 is very likely). [animal pens]	3	67	12.9
		4	97	18.6
		5 (Very likely)	205	39.3
		Total	444	85.2
8	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Vast lands where water gathers]	1 (Unlikely)	50	9.6
		2	34	6.5
		3	58	11.1
		4	101	19.4
		5 (Very likely)	230	44.1
		Total	473	90.8
9	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Wells]	1 (Unlikely)	59	11.3
		2	65	12.5
		3	92	17.7
		4	94	18.0
		5 (Very likely)	131	25.1
		Total	441	84.6
10	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [septic chamber openings]	1 (Unlikely)	44	8.4
		2	28	5.4
		3	63	12.1
		4	106	20.3
		5 (Very likely)	220	42.2
		Total	461	88.5
11	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Municipal water leaks in public places]	1 (Unlikely)	48	9.2
		2	35	6.7
		3	70	13.4
		4	107	20.5
		5 (Very likely)	201	38.6
		Total	461	88.5
12	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Sewage leaks]	1 (Unlikely)	49	9.4
		2	31	6.0
		3	74	14.2
		4	105	20.2
		5 (Very likely)	205	39.3
		Total	464	89.1
13	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [a goal or a sanitation station]	1 (Unlikely)	46	8.8
		2	32	6.1
		3	60	11.5
		4	107	20.5
		5 (Very likely)	213	40.9
		Total	458	87.9
14	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [garbage dumps]	1 (Unlikely)	41	7.9
		2	37	7.1
		3	66	12.7
		4	116	22.3
		5 (Very likely)	194	37.2
		Total	454	87.1
15	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [old car tires]	1 (Unlikely)	113	21.7
		2	93	17.9
		3	102	19.6
		4	51	9.8
		5 (Very likely)	81	15.5
		Total	440	84.5
16	In your opinion, the probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [empty soft drink cans]	1 (Unlikely)	109	20.9
		2	109	20.9
		3	96	18.4
		4	53	10.2
		5 (Very likely)	72	13.8
		Total	439	84.3
17	Are there any of these places near: [place of residence]	Yes	192	36.9
		No	278	53.4
		Total	470	90.2
18	Are there any of these places close to: [the place of residence of a relative and friend (whom you visit frequently)]	Yes	180	34.5
		No	262	50.3
		Total	442	84.8
19	Are there any of these places near: [your workplace]	Yes	102	19.6
		No	325	62.4
		Total	427	82.0

Mosquito breeding according to Season and climatic conditions:

Mosquito breeding according to seasons or climatic conditions, among 484 participants, 38.6% reported more breeding after it rains, while 10.5% reported less breeding. Among 437 participants, 44.9% reported for more breeding while the temperature rises and 7.1% were not agreed. In 442 participants, 24.4% reported for high breeding at high humidity while 10.5% not supported.

Mosquito breeding according to places:

Among 404 participants, 36.4% reported strongly about the probability of breeding places in containers, while the least reported with 9.7%. In 466 participants, 47.2% reported for the breeding place as farms while the least support with 7.1%. Among 463 participants, 43% agreed the probability of mosquito breeding place at Gardens, while the least with 7.1% of not agree. For the probability of breeding at Animal pens, among 444 participants, 46.2% agreed, while 5.6% did not agree. In Vast lands where water gathers, among 473 participants, 48.6% were agreed while 7.2% did not agree. Among 441 participants, 29.7% reported that the probability of breeding at wells while 13.4% did not agree. Among 461 participants, 47.7% reported positive for the probability of breeding at septic chamber openings but 6.1% were not. Among 461 participants 43.6% agreed that mosquito breeding may happen at Municipal water leaks in public places while 7.6% did not agree. For the place of Sewage leaks among 464 participants, 44.2% agreed while 6.7% did not agree. For the place of sanitation station among 458 participants, 46.5% reported as agree while 7% did not agree. In place of Garbage dumps, among 454 participants, 42.7% agreed, while 8.1% did not agree. In place of Old car tires, among 440 participants, 25.7% agreed, while 11.6% did not agree. In the Empty soft drink cans, among 439 participants, 24.8% agree while12.1 does not agree.

Likewise for the breeding of mosquitoes the place of residence, among 470 participants, 59.1%, did not agree while 40.9% agreed. For the Place of residence of a relative and friend (whom you visit frequently)], among 442 participants, 59.3% reported disagree, while 40.7% agreed. In workplace, among 427 participants, 76.1% reported disagree while 23.9% agree.

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Table 4: Correlations between socio-demographic characteristics and the variables (vector-borne diseases)

Q. N	The question	Test	Gender	Age	Educational level	Working status	Living Place	Accommodation
1	How many times a week have you been bitten by a mosquito?	Correlation Coefficient	-.098*	.116**	0.021	.097*	.180**	-0.062
		Sig. (1-tailed)	0.014	0.005	0.317	0.015	0.000	0.084
		N	502	501	498	499	496	500
2	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Home]	Correlation Coefficient	0.037	0.044	0.054	-0.032	.112*	-0.062
		Sig. (1-tailed)	0.225	0.185	0.139	0.261	0.012	0.105
		N	415	414	412	412	410	413
3	On a scale of 1 to 5, what places have you been bitten by mosquitoes (with 1 being the least likely and 5 being the most likely) [Work]	Correlation Coefficient	0.068	.145**	-.114*	0.088	0.009	-0.054
		Sig. (1-tailed)	0.109	0.004	0.019	0.056	0.436	0.167
		N	329	328	328	327	326	327
4	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Gardens]	Correlation Coefficient	-0.017	-0.079	-0.028	0.019	0.056	-0.077
		Sig. (1-tailed)	0.364	0.054	0.289	0.351	0.129	0.058
		N	414	413	410	411	408	412
5	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Beaches]	Correlation Coefficient	0.064	0.038	0.024	0.059	0.046	-0.047
		Sig. (1-tailed)	0.110	0.235	0.325	0.131	0.191	0.188
		N	365	364	362	363	363	363
6	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Coasts]	Correlation Coefficient	0.064	0.051	0.030	.116*	-0.016	-0.031
		Sig. (1-tailed)	0.119	0.173	0.292	0.016	0.382	0.286
		N	342	341	340	340	340	340
7	On a scale of 1 to 5, what places have you been bitten by mosquitoes (1 being the least likely and 5 being the most likely) [Others]	Correlation Coefficient	-0.075	0.041	-0.027	.151**	-0.010	-0.048
		Sig. (1-tailed)	0.102	0.244	0.322	0.005	0.432	0.209
		N	288	287	287	286	285	287
8	Had malaria or dengue fever within 3 years [I was medically diagnosed with malaria]	Correlation Coefficient	0.023	0.029	0.042	-0.058	0.051	-0.024
		Sig. (1-tailed)	0.306	0.256	0.173	0.099	0.131	0.300
		N	498	496	493	495	491	496
9	Had malaria or dengue fever within 3 years [I was medically diagnosed with dengue]	Correlation Coefficient	0.012	0.052	0.013	0.036	-0.002	-0.004
		Sig. (1-tailed)	0.397	0.126	0.390	0.211	0.480	0.466
		N	496	494	491	493	489	494
10	Had malaria or dengue fever within three years [a family member has been diagnosed with malaria]	Correlation Coefficient	.080*	0.004	0.007	-0.023	-0.054	0.072
		Sig. (1-tailed)	0.039	0.465	0.443	0.305	0.120	0.058
		N	488	486	483	485	481	486
11	Had malaria or dengue fever within three years [a family member has been diagnosed with a fever or dengue]	Correlation Coefficient	-.094*	-0.003	-0.018	-0.013	0.020	0.026
		Sig. (1-tailed)	0.018	0.471	0.349	0.390	0.334	0.282
		N	493	491	488	490	486	491
12	Had malaria or dengue fever within 3 years [a friend has been diagnosed with malaria]	Correlation Coefficient	.115**	-0.065	-0.025	-0.047	-0.057	0.029
		Sig. (1-tailed)	0.005	0.075	0.294	0.153	0.106	0.262
		N	489	487	484	486	482	487
13	Had malaria or dengue fever within 3 years [a friend has been diagnosed with dengue]	Correlation Coefficient	0.033	-0.013	0.003	0.053	-0.056	0.000
		Sig. (1-tailed)	0.234	0.389	0.471	0.121	0.109	0.496
		N	490	488	485	487	483	488

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14	Had malaria or dengue fever within 3 years [a co-worker was diagnosed with malaria]	Correlation Coefficient	.100*	-.085*	0.014	-0.059	0.037	-0.046
		Sig. (1-tailed)	0.014	0.031	0.384	0.098	0.209	0.156
		N	483	481	478	480	476	481
15	Had malaria or dengue fever within 3 years [a co-worker has been diagnosed with dengue]	Correlation Coefficient	0.049	-.127**	-0.038	-0.072	0.033	-0.044
		Sig. (1-tailed)	0.139	0.002	0.204	0.055	0.236	0.166
		N	493	491	488	490	486	491
16	In case of injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or none and 5 is very severe) Ignore the question if you have not been exposed [fever and tiredness]	Correlation Coefficient	-.093*	-0.023	0.076	-0.013	.125*	-0.046
		Sig. (1-tailed)	0.049	0.341	0.090	0.411	0.014	0.209
		N	316	314	313	314	312	315
17	In case of injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or no and 5 is very severe) Ignore the question if you were not injured [back and muscle pain]	Correlation Coefficient	-0.065	-0.015	0.090	0.007	0.061	-0.043
		Sig. (1-tailed)	0.135	0.399	0.064	0.452	0.152	0.230
		N	292	290	289	290	288	291
18	In the event of an injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or no and 5 is very severe) Ignore the question if you have not been exposed [rash]	Correlation Coefficient	-0.089	-0.071	.102*	0.021	0.033	0.017
		Sig. (1-tailed)	0.068	0.116	0.045	0.362	0.294	0.386
		N	284	282	281	282	280	283
19	In the event of an injury, to what extent was the disease affected? Choose from 1 to 5 (where 1 is mild or none and 5 is very severe) Ignore the question if you were not injured [Inability to get out of bed]	Correlation Coefficient	-0.066	-0.023	0.089	-0.005	0.040	-0.030
		Sig. (1-tailed)	0.131	0.351	0.066	0.466	0.251	0.308
		N	289	287	286	287	285	288
20	1_ In your opinion, the possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [after it rains]	Correlation Coefficient	0.001	0.070	.110**	0.054	.164**	-0.043
		Sig. (1-tailed)	0.489	0.062	0.008	0.118	0.000	0.174
		N	484	482	479	481	478	482
21	Possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [when the temperature rises]	Correlation Coefficient	-0.001	0.036	.082*	.080*	.088*	0.007
		Sig. (1-tailed)	0.494	0.224	0.044	0.049	0.034	0.446
		N	437	435	434	434	430	435
22	Possibility of mosquito breeding according to seasons or climatic conditions, (where 1 is unlikely and 5 is very likely). [at high humidity]	Correlation Coefficient	0.070	-0.015	.080*	0.050	0.027	0.065
		Sig. (1-tailed)	0.071	0.373	0.047	0.148	0.290	0.087
		N	442	440	437	439	436	440
23	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [conditioners]	Correlation Coefficient	0.012	.124**	.151**	0.041	0.043	0.010
		Sig. (1-tailed)	0.408	0.006	0.001	0.206	0.196	0.419
		N	404	402	402	402	399	402
24	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [the farmer]	Correlation Coefficient	0.064	0.018	0.055	0.007	.121**	-0.072
		Sig. (1-tailed)	0.083	0.351	0.121	0.437	0.005	0.061
		N	466	464	462	463	459	464

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25	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Gardens]	Correlation Coefficient	.077*	0.047	0.037	0.038	.114**	-0.023
		Sig. (1-tailed)	0.050	0.155	0.216	0.211	0.007	0.309
		N	463	462	459	460	456	461
26	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [animal pens]	Correlation Coefficient	0.066	0.077	0.056	.112**	.101*	-0.050
		Sig. (1-tailed)	0.082	0.052	0.121	0.009	0.018	0.148
		N	444	442	441	442	437	442
27	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Vast lands where water gathers]	Correlation Coefficient	0.015	0.029	.091*	0.072	.100*	0.012
		Sig. (1-tailed)	0.376	0.262	0.025	0.060	0.016	0.398
		N	473	471	469	471	467	471
28	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Wells]	Correlation Coefficient	0.048	.127**	0.046	.127**	0.015	0.008
		Sig. (1-tailed)	0.158	0.004	0.168	0.004	0.380	0.430
		N	441	439	437	439	435	439
29	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [septic chamber openings]	Correlation Coefficient	0.048	0.024	-0.004	0.034	0.037	0.031
		Sig. (1-tailed)	0.154	0.302	0.465	0.231	0.219	0.257
		N	461	459	457	459	454	459
30	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Municipal water leaks in public places]	Correlation Coefficient	0.061	0.037	0.058	0.016	0.030	0.042
		Sig. (1-tailed)	0.097	0.218	0.107	0.367	0.262	0.187
		N	461	459	457	459	454	459
31	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [Sewage leaks]	Correlation Coefficient	0.039	0.033	0.060	0.015	0.073	-0.002
		Sig. (1-tailed)	0.200	0.242	0.100	0.376	0.060	0.485
		N	464	462	460	462	457	462
32	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [a goal or a sanitation station]	Correlation Coefficient	0.043	0.073	0.026	0.057	0.058	-0.002
		Sig. (1-tailed)	0.179	0.060	0.287	0.112	0.110	0.486
		N	458	456	453	455	451	456
33	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [garbage dumps]	Correlation Coefficient	0.058	0.004	-0.026	0.076	0.037	0.034
		Sig. (1-tailed)	0.110	0.466	0.291	0.053	0.217	0.236
		N	454	452	450	451	447	452
34	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [old car tires]	Correlation Coefficient	0.017	0.077	.090*	0.039	0.070	0.004
		Sig. (1-tailed)	0.362	0.055	0.030	0.210	0.073	0.466
		N	440	438	436	438	433	438
35	Probability of mosquito breeding according to places, (where 1 is unlikely and 5 is very likely). [empty soft drink cans]	Correlation Coefficient	0.032	0.032	.097*	.080*	-0.048	0.014
		Sig. (1-tailed)	0.254	0.255	0.022	0.048	0.161	0.389
		N	439	437	435	437	432	437
36	Are there any of these places near: [place of residence]	Correlation Coefficient	.114**	-0.067	-0.031	-0.039	-0.062	-0.021
		Sig. (1-tailed)	0.007	0.075	0.253	0.199	0.091	0.322
		N	470	468	465	467	463	468
37	Are there any of these places close to: [the place of residence of a relative and friend (whom you visit frequently)]	Correlation Coefficient	.116**	-0.064	-0.008	-.106*	-.107*	-0.007
		Sig. (1-tailed)	0.007	0.090	0.435	0.013	0.013	0.444
		N	442	440	437	439	435	440
38	Are there any of these places near: [your workplace]	Correlation Coefficient	0.032	-.119**	0.043	-0.063	-0.022	-0.009
		Sig. (1-tailed)	0.254	0.007	0.188	0.096	0.328	0.425
		N	427	425	422	424	420	425

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In (Table 4), we can review the answers to the following: all variables were estimated at P-Value less than 0.05. Also, we considered (Correlation Coefficient) r = 0-0.19 if the association is considered as very weak, 0.2-0.39 as weak, 0.40-0.59 as moderate, 0.6-0.79 as strong, and 0.8-1 as very strong correlation. Besides (-) indicates the negative association, or (+) indicates the positive association. Also, all the answers do not correlate (including all the types of accommodation answers) except in the followings:

Correlation between VBD Variables with gender:
The correlation Coefficient value is -0.098, with a weak negative association for number of times a week been bitten by a mosquito. The correlation Coefficient is 0.080, with a very weak positive association for family member diagnosed with malaria within three years. Similarly, the correlation Coefficient is -0.094, with a very weak negative association. For a family member diagnosed with a fever or dengue. The correlation coefficient is 0.115, with a very weak positive association for a friend has been diagnosed with malaria and the correlation coefficient is 0.100, with a very weak positive association for a co-worker diagnosed with malaria. For fever and tiredness, the correlation coefficient is -0.093, with very negative association. The probability of mosquito breeding according to places at Gardens the Correlation Coefficient is 0.077, with a very weak positive association. For breeding near place of residence the Correlation Coefficient is 0.114, with a very weak positive association. For the places close to: the place of residence of a relative and friend the correlation Coefficient= .116, with a very weak positive association.

Correlation between VBD Variables with age:
With age, there are correlations (or associations) as in the followings:
The Correlation Coefficient is 0.116, with a very weak positive association for number of times mosquito bitten in a week. The Correlation Coefficient is 0.145, with a very weak positive association for workplaces bitten by mosquitoes. The Correlation Coefficient is -0.085, with a very weak negative association for a co-worker diagnosed with malaria within 3 years. For the probability of mosquito breeding according to places such as containers, the Correlation Coefficient is 0.124, with a very weak positive association. Similarly, for the probability of mosquito breeding according to places Wells is the Correlation Coefficient as 0.127, with a very weak positive association. For the breeding places at these places near your workplace, has the Correlation Coefficient value -0.119, with a very weak negative association.

Correlation between VBD Variables with education Level:
With the educational level, there are correlations (or associations) as in the followings:
The Correlation Coefficient is 0.102, with a very weak positive association for the event of an injury very severe and rash. The Correlation Coefficient is 0.110, with a very weak positive association for the possibility of mosquito breeding according to seasons or climatic conditions, after it rains. The Correlation Coefficient= .082, with a very weak positive association for the possibility of mosquito breeding according to seasons or climatic conditions when the temperature rises. Likewise, the Correlation Coefficient is 0.080, with a very weak positive association for the possibility of mosquito breeding according to seasons or climatic conditions, at high humidity. For the probability of mosquito breeding according to places like conditioners the Correlation Coefficient is 0.151, with a very weak positive association. The probability of mosquito breeding according to places like Vast lands where water gathers has got the Correlation Coefficient as 0.091, with a very weak positive association. Similarly, the probability of mosquito breeding according to places like old car tires has the Correlation Coefficient as .090, with a very weak positive association. Also, the probability of mosquito breeding according to places empty soft drink cans has the Correlation Coefficient value 0.097, with a very weak positive association.

Correlation between VBD Variables with working status:
With the working status, there are correlations (or associations) as in the followings:
The Correlation Coefficient is 0.097, with a very weak positive association for number of times a week bitten by a mosquito. The Correlation Coefficient is 0.116, with a very weak positive association for the places bitten by mosquitoes was coasts. The Correlation Coefficient is 0.151, with a very weak positive association for the places bitten by mosquitoes are others. The Correlation Coefficient is 0.080, with a very weak positive association for the possibility of mosquito breeding according to seasons or climatic conditions when the temperature rises. The Correlation Coefficient is 0.112, with a very weak positive association for the probability of mosquito breeding according to places at animal pens. The Correlation Coefficient= .127, with a very weak positive association for the probability of mosquito breeding according to places at Wells. The Correlation Coefficient is 0.080, with a very weak positive association for the probability of mosquito breeding according to places at empty soft drink cans. The Correlation Coefficient is -0.106, with a very weak negative association for any of these places close to the place of residence of a relative and friend (whom you visit frequently).

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Correlation between VBD Variables with Place of living:

With the place of living, there are correlations (or associations) as in the followings:

The Correlation Coefficient is 0.180, with a very weak positive association for the number of times a week bitten by a mosquito. The Correlation Coefficient is 0.112, with a very weak positive association for the places where bitten by mosquitoes at Home. The Correlation Coefficient is 0.125, with a very weak positive association for what extent the disease affected fever and tiredness. The Correlation Coefficient is 0.164, with a very weak positive association for the possibility of mosquito breeding according to seasons or climatic conditions after it rains. The Correlation Coefficient is .088, with a very weak positive association for the possibility of mosquito breeding according to seasons or climatic conditions when the temperature rises. The Correlation Coefficient is 0.121, with a very weak positive association for the probability of mosquito breeding according to places the farmer. The Correlation Coefficient is 0.114, with a very weak positive association for the probability of mosquito breeding according to places at Gardens. The Correlation Coefficient is 0.101, with a very weak positive association for the probability of mosquito breeding according to places at animal pens. The Correlation Coefficient is 0.100, with a very weak positive association for the probability of mosquito breeding according to places in Vast lands where water gathers. Similarly, the Correlation Coefficient is -0.107, with a very weak negative association for there any of these places close to: the place of residence of a relative and friend (whom you visit frequently).

DISCUSSION

Disease incidence was lower in Bello, where the poverty index was low. Socioeconomic issues that have been linked to the spread of disease include substandard housing, inadequate sanitation, inadequate water supply, and barriers to health and children's services. Consequently, the risk of disease, as they are expanding their geographic range due to climate change. Arboviral epidemiology is further confounded by humanitarian crises (such as the political and economic unrest in Venezuela that has resulted in mass migration) and the COVID-19 pandemic, which emphasizes how urgent it is to comprehend for understanding the dynamics of these global health problems [20]. In the rural villages of northwest Ethiopia, the frequency of self-reported vector-borne diseases was significant. The low prevalence was linked to the family head, routine cleaning of the living space, and the cleanliness of the floor. This is due to the fact that most vector-borne diseases can readily be caused by their causative agents when a floor is dirty, and that a clean floor is not conducive to the growth of vectors [22]. In Thailand, sociodemographic and water management parameters had varying degrees of influence on the development of immature Ae. aegypti. In suburban Laos, there were very few statistically significant relationships between the generation of immature Ae. aegypti and socio-demographic and water management variables. Since the rural village was a uniformly underprivileged, uneducated agricultural population, it was not included in the comparisons [23].

The current study revealed the association between the VBD variables and socio demographic attributes. It shows that there is a significant weak negative association between the socio demographic factors (gender, age, place of living, working status) and VBD variables like frequency of mosquito bitten, a family member diagnosed with fever or dengue and fever and tiredness, place of residence of a relative and friend, a co-worker diagnosed with malaria and the probability of mosquito breeding in your workplace.

The socio demographic factors (gender, age, place of living, working status) significantly have a very weak positive correlation with the VBD variables like family member diagnosed with malaria, a friend diagnosed with malaria, a co-worker diagnosed with malaria, how many times a week bitten by a mosquito, what places have been bitten by mosquitoes in workplace. The socio demographic factors (gender, age, place of living, working status) also have a very weak positive correlation with the probability of mosquito breeding according to places- wells, coasts and others, according to seasons or climatic conditions, like animal pens, Wells, empty soft drink cans. the probability of mosquito breeding according to places, places near place of residence, the place of residence of a relative and friend. The education level factor significantly very weak positive correlations with all VBD variables.

The study explored the impact of socio-demographic factors and climate variables with Vector borne disease variables on the distribution of diseases. Its original contribution was that it selected socio demographic factors shown any association with any VBD variables may induce any disease. The study identified which climate condition or seasons makes more risk for VBD diseases, by estimating where dengue vectors are more likely to occur given their suitability to climate conditions in terms of mosquito breeding and its severity. By estimating the chance of a vector occurring in a community, we could then assess the impact of socio-demographic and climate factors on the incidence of dengue and malaria. The results confirmed a very week positive association between socio-economic factors and VBD disease. Hence, our study suggested that the very weak positive correlation of education level and working status may reduce the occurrence of Vector borne diseases among the community. There is a very weak positive association for mosquito breeding according to the places with VBD. So, there is a possibility of putting

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the community at risk. Designing and enhancing an intervention strategy for regular cleaning and environmental sanitation will be taken into consideration. Although many studies in many various countries are similar to this study, there are no sufficient studies that mentioned these issues in the Jazan region, the Kingdom of Saudi Arabia. However, this research is done in population of the Jazan region only, with somewhat a limited sample size, it was not done in many regions with larger sample sizes.

CONCLUSIONS

The correlation analysis between socio-demographic characteristics and vector-borne diseases reveals that there are either very weak but significant positive correlation between VBD variables and educational level. The other socio-demographic variables (gender, age, residence, working status) had very weak positive or negative correlations with VBD variables. The study's results have important implications for policymakers and public health practitioners. Targeted interventions, such as awareness campaigns, vector control programs, and improved access to healthcare, can be designed to address the specific needs of vulnerable populations. By considering the socio-demographic characteristics of communities, health authorities can develop more effective strategies to prevent and control vector-borne diseases, ultimately reducing the burden of these diseases on individuals, families, and society as a whole. These results, though from Jazan, could be generalizable to other tropical areas of the world and thus support wider public health measures.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all participants prior to their participation in the survey. All data were collected anonymously, and confidentiality was maintained throughout the study.

ETHICAL APPROVAL

Ethical standards were adhered to the requirement of Deputyship for Research & Innovation, Ministry of Education in Saudi Arabia and Jazan University (Project ISP22-14.).

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS:

All authors contributed substantially to the conception and design of the study, data acquisition and analysis, interpretation of results, and manuscript preparation; all authors reviewed and approved the final version of the manuscript

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

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Original Article

Parents' Knowledge and Awareness of Sickle Cell Disease in the Jazan Region, Kingdom of Saudi Arabia: A cross-sectional study

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ABSTRACT Sickle cell disease (SCD) is a significant genetic health concern worldwide. The Jazan region in Saudi Arabia has the second-highest rate of SCD, emphasizing the need for comprehensive data on disease knowledge and awareness in this region. This study evaluated parents' understanding of SCD in the Jazan region and determined the knowledge gap. After expert consultation and a literature review, we conducted an online survey to enroll 384 Saudi citizens over 18 years of age living in Jazan, aiming for a 95% confidence level. The data was analyzed using SPSS v23.0. Most participants (n=358; 93.2%) were aware of SCD, with 303 (78.9%) knowing it is a blood disorder. About 331 (82.6%) agreed that premarital investigation is necessary to reduce SCD incidence, and 276 (71.9%) knew that genetic counseling could help manage it, but only 95 (24.7%) had checked their genotype. Over one-third of participants (n=144; 37.5%) believed genetic testing should be conducted in primary school, while 52 (13.5%) understood the likelihood of a child inheriting SCD if both parents had sickle cell traits. The study revealed a good awareness of SCD but significant gaps in the understanding of its genetic transmission, highlighting the need for expansive education and awareness campaigns in the Jazan region to improve genetic counseling and health management decisions.

Keywords: Sickle cell disease, Awareness, Knowledge, Parents, Jazan, Anemia, Saudi Arabia, Sickle cell anemia.

INTRODUCTION

Sickle cell disease (SCD) is an autosomal recessive hereditary blood disease and is the most common single-gene-inherited severe hematological disorder among humans worldwide. SCD is reported mainly in sub-Saharan African countries, Saudi Arabia, South and Central America, India, and the Mediterranean regions, with five main haplotypes linked with specific geographic areas with variations in clinical manifestations and severity, including Senegal, Bantu, Benin, Cameroon, and Arab-Indian variants.[1,2]

Approximately 330,000 newborns are born with severe SCD every year, and it has become more prevalent globally due to migration and population movements with estimated birth rates of 10.68 per 1000 in Africa, 0.68 per 1000 in South and Southeast Asia, 0.49 per 1000 in the Americas, and 0.07 per 1000 in Europe.[1,3]

SCD is caused by a mutation in the beta-globin gene, producing hemoglobin S (HbS), which is abnormal and causes red blood cells (RBCs) to take on a sickle shape, especially under low oxygen levels. The deformed RBCs may block blood vessels, which is a leading cause of the clinical manifestations of SCD, resulting in symptoms including hemolytic anemia, vaso-occlusive painful episodes, priapism, chronic leg ulcers, pulmonary hypertension, renal failure, gallstones, auto splenectomy, and an increased risk of infection, blindness, and stroke.[4] The occurrence of these adverse effects results in increased medical expenses and reduced quality of life for those affected.[5] In contrast, individuals with sickle cell trait (SCT) are usually asymptomatic but may experience vaso-occlusive complications during acute dehydration.[6]

There has been a growing awareness of hemoglobinopathies, including SCD; however, comprehensive epidemiological data on their prevalence and burden is still required. In 2006, the World Health Organization recognized SCD as a global public health problem, which was further strengthened in 2010 when the World Health Assembly adopted a resolution to prevent and manage congenital disabilities, such as SCD and thalassemia.[1,2]

SCD was first reported in Saudi Arabia's Eastern Province in the 1960s. Following this, several national and regional screening studies were performed to identify its clinical characteristics and gene frequency in different Saudi regions.[1,2] The prevalence of SCD in Saudi Arabia is

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common and varies between regions, with the highest rates in the eastern and southwestern provinces. The estimated prevalence of SCD through the Saudi premarital screening program was 3.8 per 1000 people, while newborn screening estimated a prevalence of 2.6% in the Eastern region of KSA.

Jazan has the highest prevalence of SCT, ranging from 2% to 27%, and the second highest prevalence of SCD in the Kingdom of Saudi Arabia (KSA), reaching up to 2.6% and over 20% of Jazan hospital admissions in the medicine and pediatric departments, ranging from a mild to severe phenotype.[3]

The increasing global impact of SCD requires urgent attention and the establishment of clear national guidelines for effective public health planning, which can be accomplished through community education. Assessing the general population's awareness of this common disease will aid in implementing preventive measures.[7] Preventing the birth of infants affected by SCD through prenatal diagnosis and genetic counseling is the most effective long-term solution to reduce mortality and public health costs.[8] Screening newborns for SCD using rapid testing, providing parental education, and offering comprehensive care can significantly reduce SCD-related illness and death. National SCD screening is cost-effective and successful in identifying infants with the disease and preventing fatalities [1, 2].

Multiple studies have indicated considerable gaps in parents' knowledge and attitudes toward SCD worldwide, impacting disease management and prevention. In Nigeria, 45% of parents only discovered their sickle cell genotype after their child's diagnosis.[9] In Uganda, while 57.8% of caregivers had heard of SCD, thorough knowledge about its causes and prevention was limited.[10] Similar gaps were found in Congo and Benin, where parents acknowledged the severity of SCD but lacked awareness of preventive measures.[11,12] At the National Sickle Cell Disease Center in Benin, only 29.1% of 117 parents understood the disease well, with lower health literacy more common among parents of younger children.

There have been no studies in Saudi Arabia of how well children identified as carriers of SCD are informed about the impact of the disease on their health and their ability to have affected children despite 20 years of newborn screening. Understanding parental knowledge about sickle cell inheritance, its effects on health and reproduction, the use of genetic educational resources, and associated stigma is crucial for accurate information transmission.[6] Various studies have examined SCD awareness among parents, students, and medical professionals in Saudi Arabia.

A study in Tabuk (KSA) found that while participants were aware of SCD's prevalence, they had limited knowledge of transmission risks and crisis management.[7] At Al-Baha University (Al Baha, KSA), medical students demonstrated varying levels of understanding, with clinical-year students showing better awareness but only 14% knowing proper SCD management.[13] A study in Al-Ahsa (KSA) found that 89% of high school students had heard of SCD, but many were unaware of its hereditary risks and prevalence.[14] Research in Riyadh (KSA) showed that while most participants lacked symptom and management knowledge, awareness of risk factors and prevention was relatively high.[15] Another cross-sectional study was conducted in the eastern region of Saudi Arabia at different shopping malls in August 2019. Using convenience sampling, 675 participants were randomly recruited, most of whom reported very good knowledge about premarital screening and its importance.[16]

Other studies in Saudi Arabia explored the perceptions of treatment and caregiver burden. A study in Jeddah (KSA) showed diverse attitudes toward hematopoietic stem cell transplantation, with concerns about side effects affecting acceptance.[17] Another study found that caregivers, specifically mothers of SCD children, encountered considerable emotional and financial stress, impacting their quality of life.[18]

Overall, while foundational awareness of SCD exists in Saudi Arabia, significant gaps remain in the knowledge of disease management, treatment options, and crisis prevention. Addressing these issues through targeted education and support programs is essential to improving patient care and family well-being. In 2020, Hazzazi et al. reported that one out of every four patients admitted to Jazan hospitals had SCD, with vaso-occlusive crisis being the most common complication, followed by acute chest syndrome.[3] Based on these findings, our study aimed to evaluate parents' knowledge and awareness of SCD in the Jazan region and analyze existing gaps in this knowledge and determine how demographic factors may influence awareness. Ultimately, our goal is to provide valuable insights that can improve public health education, thereby enhancing SCD awareness in the area.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Jazan region, one of the 13 regions of the Kingdom of Saudi Arabia. It is situated on the Red Sea coast in the southwestern part of the country and covers an area of 11,716 km^2, including around 5,000 villages and towns. According to the last population survey, conducted in 2019, Jazan is a densely populated region with an estimated population of more than 1.6 million individuals. This study targeted parents who met the following inclusion criteria: Saudi citizens, living in the Jazan region, over 18 years old, and agreeing to participate. The data were collected via the Arabic language self-administered electronic questionnaire, which took participants around 4–5 minutes to complete following their consent. The sampling method for this study was a nonrandom convenience sampling technique; mothers were approached through various social media platforms, including WhatsApp and Telegram groups, from January 1 to the end of June 2024. The sample size was estimated to be 384 using the Cochran formula, $n = (z)\ 2 \times p\ (1 - p)/d2$, where P = 50% is the anticipated response and

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z = 95% is the confidence interval, with an error of no more than 5% and a 25% nonresponse rate. The questionnaire was designed after thoroughly analyzing the relevant literature and consulting a field expert. It was reviewed by a panel of experts with extensive experience in SCD, including two consultants from the Family and Community Medicine Department and one from the Pediatric Department at Jazan University. Their expertise and recommendations ensured questions' clarity and standardized response options for more consistent and manageable data analysis. The first section of the survey included sociodemographic characteristics, such as gender, age, education level, and marital status, while the second section assessed participants' knowledge of SCD. The questionnaire underwent pretesting in a pilot study with 20 participants to evaluate completion time and question understanding. The analysis revealed a Cronbach's alpha of 0.79 for reliability, though these data were excluded from the main study.

Ethical approval was obtained from the Institutional Review Board of Jazan University (reference number REC-45/08/1009, dated March 10, 2024).

RESULTS

This study included 384 parents who completed the questionnaire. Most respondents were female (n=227; 59.1%), while males comprised 40.9% (n=157). More than a third of the participants (n=140; 36.5%) were 18 to 25 years old, and a quarter (n=98; 25.5%) were aged 26–35. Approximately half of the participants (n=189; 49.2%) were married, and 173 (45.1%) were single. Nearly two-thirds of the participants (n=268; 69.8%) had a university education, while only four (1%) were illiterate (Table 1).

Table 1: Sociodemographic data (n=384)

Variable	Categories	N (%)
Gender	Male	157 (40.9)
	Female	227 (59.1)
Age (years)	18–25	140 (36.5)
	26–35	98 (25.5)
	36–45	74 (19.3)
	> 45	72 (18.8)
Marital status	Single	173 (45.1)
	Married	189 (49.2)
	Divorced	18 (4.7)
	Widowed	4 (1)
Education	Illiterate	4 (1)
	Primary school	4 (1)
	Middle school	7 (1.8)
	Secondary school	81 (21.1)
	University	268 (69.8)
	Postgraduate	20 (5.2)

N: number, %: percentage

Most participants (n=358; 93.2%) indicated they were aware and familiar with SCD, and 311 (81%) correctly noted that SCD affects RBCs. However, only a quarter of the participants (n=95; 24.7%) reported having checked their genotype, and more than half of the participants (n=224; 58.3%) stated that they knew someone with SCD (Table 2).

Concerning the etiology of SCD, more than three-quarters of the participants (n=303; 78.9%) knew that it was a blood disorder inherited from a person's parents. Additionally, only a quarter of the participants (n=102; 26.6%) knew that a person who carries the sickle cell gene does not experience symptoms, and a small number (n=66; 17.2%) disagree that only one parent is required for transmission of SCD to the offspring. More than two-thirds of the participants (n=276; 71.9%) knew that genetic counseling could help control it. Most of the participants (n=287; 74.7%) knew that pain is one of the most common symptoms of SCD, while a smaller percentage (n=233; 60.7%) knew that SCD is not a curable disease (Table 2).

Table 2: General knowledge and awareness of parents toward sickle cell disease

Question	Yes n (%)	No n (%)	I don't know n (%)
Have you ever heard of sickle cell disease (SCD)?	358 (93.2)	26 (6.8)	-
Have you ever checked your genotype?	95 (24.7)	289 (75.3)	-
Do you know someone who has sickle cell disease	224 (58.3)	160 (41.7)	-
Does sickle cell disease affect red blood cells?	**311 (81) ***	10 (2.6)	63 (16.4)
Is sickle cell disorder a contagious disease?	18 (4.7)	**298 (77.6) ***	68 (17.7)
Sickle cell disease is a group of blood disorders usually inherited from a person's parents.	**303 (78.9) ***	9 (2.3)	72 (18.8)
Can some bacteria in the blood cause sickle cell disease?	77 (20.1)	**114 (29.7) ***	193 (50.3)
Does a person who carries the sickle cell gene experience symptoms of sickle cell anemia?	161 (41.9)	**102 (26.6) ***	121 (31.5)
Some viral infections in the blood can cause sickle cell disease	76 (19.8)	**120 (31.3) ***	188 (49)
Only one parent contributes to the transmission of sickle cell disease to the offspring	217 (56.5)	**66 (17.2) ***	101 (26.3)
Genetic counseling is a way to control sickle cell disease	**276 (71.9) ***	14 (3.6)	94 (24.5)
Pain is one of the most common symptoms of sickle cell disease	**287 (74.7) ***	17 (4.4)	80 (20.8)
Is SCD curable?	151 (39.3)	**233 (60.7) ***	-

* Correct answer, N: number, %: percentage, SCD: sickle cell disease

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Concerning SCD etiology, more than three-quarters of the participants (n=294; 76.6%) knew that SCD is a blood disease (**Figure 1**). A total of 224 (58.3%) participants knew someone with SCD, most of whom (n=155; 69.2%) have a friend with SCD, and 38 (17%) have an affected aunt or uncle (**Figure 2**). Regarding the symptoms of SCD, fatigue and tiredness were the most commonly identified symptoms (n=276; 71.9%), followed by chronic pain episodes (n=264; 68.8%), pale skin (n=243; 63.3%), headache (n=178; 46.4%) and recurrent infections (n=97; 25.3%) (**Figure 3**).

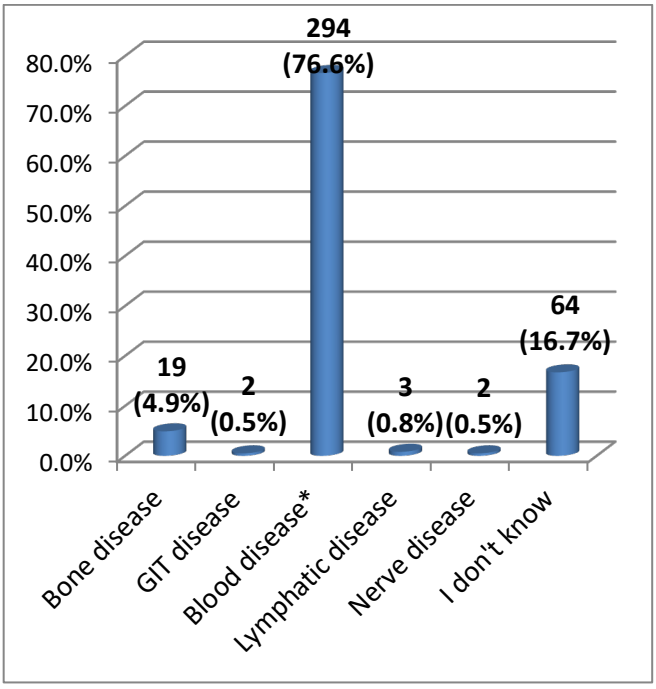

Figure 1: Sickle cell disease etiology
* Correct answer

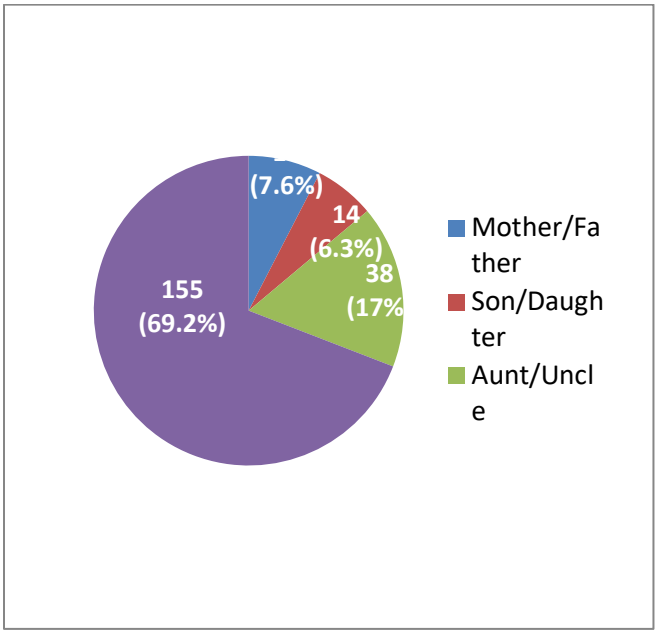

Figure 2: Relatives known to have sickle cell disease.

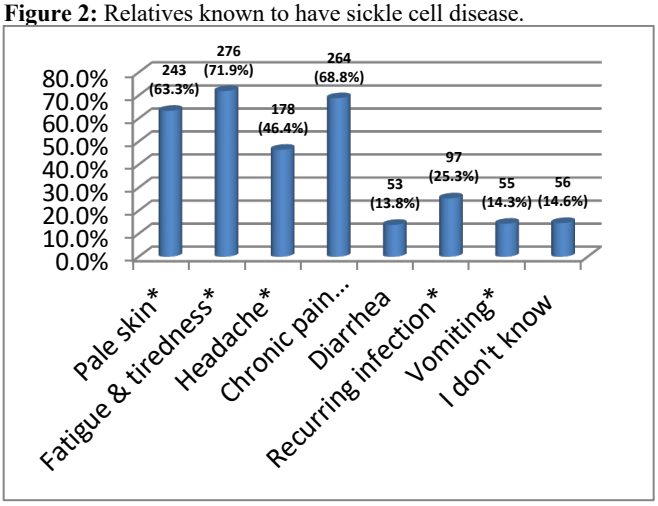

Figure 3: The numbers/percentages of participants who were aware of the symptoms of sickle cell anemia
* Correct answer

Concerning participants' knowledge about SCD severity, nearly two-thirds of the participants (n=245; 63.8%) knew it is a severe disease. When it came to the diagnosis of SCD, more than half of the participants (n=213; 55.5%) were aware that a newborn screening program could diagnose it, while more than a third (n=139; 36.2%) knew it could be diagnosed prenatally. Most participants (n=331; 86.2%) understood the importance of premarital investigation in reducing the incidence of SCD. When asked about the appropriate age for genetic testing to determine carrier status, one-third of participants (n=144; 37.5%) suggested primary school and one-third (n=139; 36.2%) thought it should be done immediately before marriage **(Table 3).**

Table 3: Participants knowledge about Sickle Cell Disease.

Question	Categories	N (%)
What do you think about the severity of SCD?	**Severe** *	245 (63.8)
	Moderate	86 (22.4)
	Not severe	7 (1.8)
	I do not know	46 (12)
Sickle cell anemia can be diagnosed during pregnancy	**Yes***	139 (36.2)
	No	52 (13.5)
	I don't know	193 (50.3)
A newborn screening program can diagnose sickle cell disease	**Yes***	213 (55.5)
	No	17 (4.4)
	I don't know	154 (40.1)
Prenatal diagnosis can help prevent sickle cell disease	Yes	212 (55.2)
	No*	48 (12.5)
	I don't know	124 (32.3)
Do you think that premarital examination is necessary to reduce the incidence of SCD?	**Yes***	331 (86.2)
	No	9 (2.3)
	I don't know	44 (11.5)
Which one of those tests is used to diagnose SCD?	Ultrasound	5 (1.3)
	Blood test*	299 (77.9)
	Urine/feces test	6 (1.6)
	I do not know	74 (19.3)
What is the appropriate age for individuals to undergo genetic testing to determine whether they are disease carriers?	Primary school	144 (37.5)
	Secondary school	23 (6)
	Immediately before marriage	139 (36.2)
	I don't know	78 (20.3)

* Correct answer

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Regarding the probability of a child getting SCD if both parents had the SCT, only 52 (13.5%) of the participants knew that a quarter of offspring would get SCD, while about a third (n=127; 33.1%) think that 50% of offspring will get SCD if both parents have the SCT (**Figure 4**).When asked about the best decision for a couple about to get married if their genetic test shows the chance of having a child with SCD, nearly 50% (n=181; 47.1%) thought that they should consult a doctor, one-third (n=138; 35.9%) believed that they should separate and only seven (1.8%) reported that they should continue their marriage (**Figure 5**).

Regarding the correlation between participants' knowledge and demographic data, nearly half of the participants (n=19; 48%) who were categorized as having good knowledge were within the age group 18–24, while only five (12%) were aged >45. Seventeen (42%) of the participants who had good knowledge were married, half of them were single (n=20; 50%), and 32 (80%) had a university level of education. (Table 4).

Table 4: Correlations of participants' knowledge to their age, marital status, and level of education.

Knowledge	Good Knowledge		Moderate Knowledge		Poor Knowledge		P value
Variable	N	Mean	N	Mean	N	Mean	
Age	40		190		161		p>0.05
18 to 25	19	48%	73	38%	51	32%	
26 to 35	11	28%	49	26%	42	26%	
36 to 45	5	12%	34	18%	35	22%	
More than 45	5	12%	34	18%	33	20%	
Sex	40		190		161		p>0.05
Female	27	68%	118	62%	86	53%	
Male	13	32%	72	38%	75	47%	
Marital Status	40		190		161		p>0.05
Divorced	3	8%	4	2%	11	7%	
Married	17	42%	99	52%	75	47%	
Single	20	50%	85	45%	73	45%	
Widowed	0	0%	2	1%	2	1%	
Education	40		190		161		**P<0.05**
Elementary	0	0%	1	1%	6	4%	
High school	4	10%	31	16%	48	30%	
illiterate	0	0%	0	0%	4	2%	
Postgraduate	4	10%	9	5%	8	5%	
Primary	0	0%	1	1%	3	2%	
University	32	80%	148	78%	92	57%	

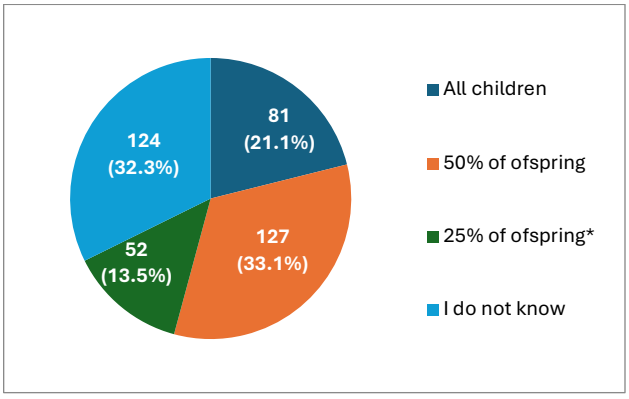

Figure 4: Probability of a child getting SCD if both parents have the sickle cell trait
*: Correct answer, %: percentage

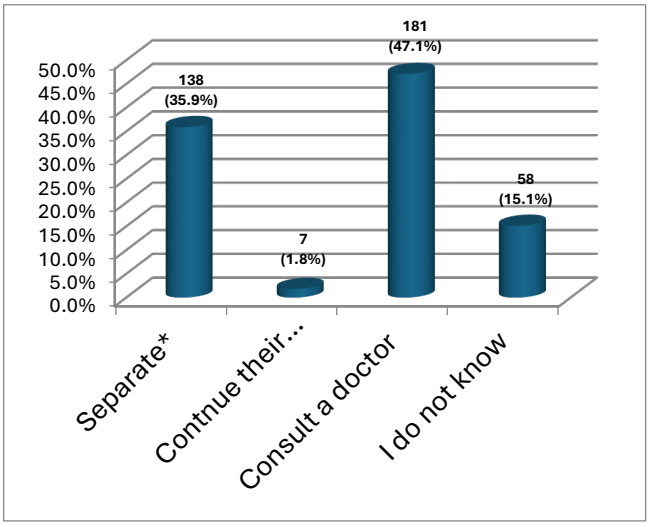

Figure 5: If a couple who are about to get married found out that their genetic test showed the chance of having a child with SCD, what do you think they should do?
* Correct answer

DISCUSSION

This study evaluates the knowledge and awareness of SCD among parents in the Jazan region of Saudi Arabia. Most participants were female (n=227; 59.1%) and had a university education (n=268; 69.8%), indicating a correlation between higher education and improved health literacy. The study found that 358 (93.2%) of parents were aware of SCD, and 224 (58.3%) knew someone affected by the disease (Table 2). This level of awareness aligns with findings from a study conducted in Tabuk, Saudi Arabia, which also reported high awareness among participants.[7] A study in the Al-Darb governorate of the Jazan region found that most participants demonstrated acceptable knowledge about SCD, including general awareness of transmission methods and prevention measures.[9] In contrast, an equivalent study in Riyadh indicated that the level of awareness regarding SCD was low, emphasizing

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the need for increased public education on the disease to address misconceptions and enhance knowledge among the general public.[10] A study in Uganda and Nigeria indicated a high level of awareness of SCD, primarily due to its high incidence in these regions [11,12]. Although participants were aware of SCD, only 95 (24.7%) had checked their genotype (Table 2)**.** This reflects a notable difference between awareness and health monitoring behaviors, revealing common misunderstandings about how the disease is passed on genetically. Similar findings have been reported in other studies from different regions, including the United States, which found that while many parents were aware of SCD, fewer took proactive steps such as seeking genetic counseling.[13-15] This highlights a crucial area for public health intervention.

This study demonstrated a high awareness of SCD as a blood disorder in most participants (n=294; 76.6%; Figure 1), consistent with the well-established characterization of SCD in the scientific and medical literature.[16] Around two-thirds of the participants (n=155; 69.2%) reported knowing a friend with SCD; these findings align with previous studies demonstrating strong community connections and social support systems.[7]

Regarding the symptoms of SCD, fatigue and tiredness were the symptoms most commonly identified in this study, followed by chronic pain episodes and pale skin (**Figure 3**), which aligns with other reports. [17,18] Fatigue and tiredness are common symptoms of anemia, which occur when there are not enough RBCs to carry oxygen throughout the body, leading to exhaustion. Chronic pain episodes occur when sickled cells block blood flow in various body parts.

Most participants (n=245; 63.8%) considered SCD a severe disease (Table 3). This perception reflects the disease's potential complications and impact on individuals' lives, which supports the existing literature indicating that the public generally acknowledges the significant health impact of SCD. [19,20]. In this study, only one-third of the participants (n=139; 36.2%) were aware of prenatal diagnosis of SCD. This finding differs from similar studies, and the variations could be due to differences in geographic regions, demographics, or the effectiveness of local health education programs, which indicates the need for improved public health education about the availability and importance of prenatal screening.[19]

The study findings revealed that a significant number of participants (n=181; 47.1%) believe that consulting a doctor is the appropriate response if a couple about to get married discovers that their genetic test shows the possibility of having a child with SCD, indicating trust in medical guidance. Additionally, 138 (35.9%) suggested that couples should separate, seven (1.8%) supported the idea of continuing the marriage, and 58 (15.1%) were unsure of the correct decision. These results suggest a potential stigma associated with genetic conditions, which contradicts modern views in genetic counseling that emphasize Informed decision-making over separation.[21] Consanguinity plays a significant role in the transmission of SCD in Saudi Arabia. In a study by Alhamdan et al. (2007), approximately 90% of at-risk relatives still opt for marriage despite knowing the potential risks of inheriting the disease. Another study in 2010 by Al-Sulaiman et al. reported an even higher percentage (98%). Reasons for ignoring premarital screening results include family pressures, existing romantic relationships, and a lack of trust in the accuracy of the results.[22] In a study conducted in Jazan in 2020, researchers found that 75.8% (n=69) of sickle cell patients had a positive history of consanguinity. Furthermore, 30% of individuals were born after premarital screening was implemented, showing that a significant percentage of those at high risk still choose to proceed with the marriage.[23] This presents a significant challenge in controlling SCD in Saudi Arabia, especially compared to many other countries where parental counseling and follow-up care for affected cases have led to a decrease in SCD-related morbidity and mortality.[24]

In Saudi Arabia, despite improvements in public healthcare following the implementation of a mandatory premarital screening program and genetic counseling (PMSGC) since 2004 for couples intending to marry, requiring them to undergo screening for SCD, thalassemia, HIV, hepatitis B, and hepatitis C, there is still a need for greater awareness and understanding of PMSGC. A comprehensive study in 2021 involving 6,263 participants found that only 9.2% had satisfactory knowledge about PMSGC and the screened genetic diseases, while 52.4% had fair knowledge and 38.4% had poor knowledge. The median total knowledge score was 21 (IQR 18–25).[23,25] High-risk marriages remain common, partially due to delays in premarital screening and a lack of legal measures to prevent them. Raising awareness of SCD and the importance of premarital screening is essential for informed family planning. Nursing and social work professionals can develop community-based care models to support the well-being of children with SCD and their families.[26] To effectively tackle this issue, it is proposed that premarital screening be made mandatory for students in secondary and intermediate schools in Saudi Arabia. This approach will assist individuals in understanding their health status prior to entering into marriage.[7]

Our study provides valuable insights but has limitations that could significantly influence interpretation and broader application. The study's cross-sectional design means the data represent only a snapshot in time and may not capture changes in awareness or knowledge. Using self-reported questionnaire responses and nonrandom convenience sampling introduces the risk of bias, as the sample may not accurately represent the population, limiting the generalizability of the findings. The reliability of the results can be questioned because the sample may not accurately represent the variables being analyzed.

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CONCLUSIONS

The study found that parents in the Jazan region have good knowledge and awareness of SCD but lack a meaningful understanding of its genetic transmission, highlighting the need for comprehensive genetic education to address misconceptions about SCD inheritance and prevention. It is recommended that public health strategies be enhanced to disseminate accurate information and encourage proactive health management behaviors among at-risk populations. Targeted educational initiatives are required to improve understanding and guide health management decisions. Incorporating educational strategies in schools should include adding SCD education to the curriculum, providing teacher training, organizing student workshops, and conducting awareness campaigns. Schools should establish support groups, conduct regular health screenings, partner with healthcare providers for on-site medical support, and involve parents and the community to create an informed and supportive environment for effectively managing and controlling SCD.

INFORMED CONSENT STATEMENT

Informed consent was obtained from all subjects involved in the study.

DATA AVAILABILITY STATEMENT

The authors will make the raw data supporting this article's conclusions available upon request.

SUPPLEMENTARY MATERIALS

Table S1: Sociodemographic data (n=384). Table S2: General knowledge and awareness of parents toward sickle cell disease. Table S3: Severity and diagnosis of sickle cell disease. Figure S1: Sickle cell disease etiology. Figure S2: Relatives known to have sickle cell disease. Figure S3: The symptoms of sickle cell anemia. Figure S4: Probability of a child getting SCD if both parents had sickle cell trait, Table S5: If a couple who are about to get married found out that their genetic test showed the chance of having a child with SCD, what do you think they should do?

AUTHOR CONTRIBUTIONS:

MM, SA, GG, KM, OH, AN; Concept and design of study, acquisition of data, data interpretation, drafting the article, and revising the article critically for important intellectual content.

AY, AH, NA, YA, MT; Data interpretation, analysis, creation of new software, drafting the article, and revising the article critically for important intellectual content

All authors were involved in the writing and revision of the manuscript and approved the submitted version.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Original Article

A Systematic Review of Image Quality and Dose Delivered by Cone Beam CT and Fan Beam CT: A Comparative Analysis

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ABSTRACT Advances in medical imaging have led to the widespread use of cone beam computed tomography (CBCT) and fan beam computed tomography (FBCT) for three-dimensional anatomical imaging with reduced radiation exposure. Understanding the balance between image quality and radiation dose is critical for optimizing clinical outcomes and patient safety. This systematic review follows PRISMA guidelines to compare image quality and radiation dose between CBCT and FBCT. A systematic search identified 20 relevant studies, which were analyzed for study characteristics, imaging parameters, and key findings. CBCT consistently offered superior imaging with lower radiation doses than FBCT. However, FBCT showed advantages in noise reduction, particularly in complex body regions. Most studies were of moderate-to-high quality, but protocol variability was noted. Optimizing protocols and considering clinical requirements are crucial for selecting the appropriate modality. Future research should address protocol standardization and broader clinical aspects for enhanced utilization.

Keywords: Cone beam CT, Fan beam CT, Image quality, Radiation dose

INTRODUCTION

In recent years, advances in medical imaging technology have revolutionized the field of diagnostic radiology, enabling clinicians to obtain high-quality images for accurate disease detection and treatment planning [1]. Cone beam computed tomography (CBCT) and fan beam computed tomography (FBCT) are two commonly used imaging modalities that provide detailed three-dimensional representations of anatomical structures [2]. These modalities have gained significant popularity due to their ability to capture volumetric data with relatively lower radiation exposure than conventional computed tomography (CT) scanners [1,3].

It is important to consider the health risks associated with high radiation doses, particularly the potential for increased cancer risk. Studies have shown that exposure to ionizing radiation, even at lower doses, can contribute to the cumulative risk of developing cancer over a patient's lifetime. Therefore, optimizing imaging protocols to minimize radiation exposure while maintaining diagnostic quality is crucial for patient safety [1,2].

CBCT employs diverging kilovolt (kV) X-rays that can visualize anatomical structures and capture images over a significantly larger volume in a single scan than FBCT. Building on this, significant progress has been made in the radiation therapy field by integrating linear accelerator-mounted CBCT systems for radiation therapy units. Moreover, this method has been used in different fields, such as dentistry and orthopedics. The dose delivered during a CBCT scan can vary depending on factors such as the specific CBCT system, imaging protocol, and body region. Generally, CBCT scans deliver a higher radiation dose than two-dimensional dental X-rays but a lower dose than conventional CT scans [2–4]. Conversely, FBCT systems use a fan-shaped X-ray beam and multiple detectors to acquire data for image reconstruction. FBCT is commonly used in medical imaging for applications such as diagnostic imaging and interventional procedures. The dose delivered during an FBCT scan also depends on factors such as the system parameters, imaging protocol, and specific clinical application. FBCT scans typically produce a higher radiation dose than CBCT scans but can provide higher spatial resolution and faster scanning times [2,5,6]. There are several advantages to using these modalities in the medical field. For example, the integration of CBCT imaging with radiotherapy units enables the direct imaging

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of patients immediately before treatment. This approach offers the advantage of providing pre-treatment verification of normal and target tissue anatomy. Consequently, any minor alterations in the geometry of the affected area can be identified before the administration of the dosage [7].

The quality of the images obtained and the radiation dose delivered during CBCT and FBCT examinations are crucial factors that impact diagnostic accuracy and patient safety. Understanding the trade-off between image quality and radiation dose is essential for optimizing imaging protocols, ensuring patient safety, and enhancing clinical outcomes [3]. CBCT and FBCT are recognized as valuable tools for diagnosis and treatment planning in hospitals. However, artifacts can be a disadvantage of CBCT imaging [2,3]. Artifacts are discrepancies between the reconstructed visual image and the actual content of the subject, which can degrade the quality of CBCT and FBCT images. They can occur due to various factors, such as patient motion, the image capture process, and the reconstruction process. Additionally, artifacts can lead to the appearance of structures that do not exist in the subject being imaged [4,8]. To optimize image quality in CBCT and FBCT, it is essential to understand the different types of artifacts. Some examples of artifacts mentioned in the article include aliasing artifacts, beam-hardening artifacts, motion artifacts, scanner-related artifacts, and stair-step artifacts [2–4]. It is important to note that radiation dose management and optimization are critical considerations in CBCT and FBCT imaging. Radiology professionals and medical physicists work to ensure that imaging protocols and techniques are optimized to minimize patient exposure to radiation while maintaining image quality for accurate diagnosis [2,4].

Several studies have compared CBCT and FBCT in terms of image quality and dose delivery, providing valuable insights into the advantages and disadvantages of these two imaging modalities [1,2,7,9,10]. Therefore, this systematic review aims to evaluate and compare the image quality and radiation dose delivered by CBCT and FBCT systems. The findings will contribute to a better understanding of the trade-off between image quality and radiation dose, ultimately enhancing these imaging modalities' diagnostic accuracy and safety.

MATERIALS AND METHODS

The recommendations put forth by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines have been utilized to ensure reporting of the highest quality. In addition, the selection process was carried out according to the PRISMA flow chart, as illustrated in Figure 1.

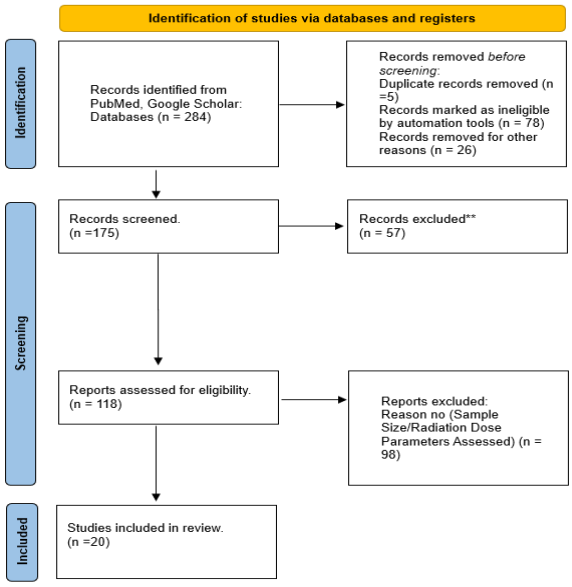

Fig. 1: PRISMA flow chart** for the selection process [11].

**Note: The 57 records were excluded because they did not provide a direct comparison of image quality and radiation dose between CBCT and FBCT. This includes studies that focused solely on one modality, lacked relevant data, or did not meet the predefined criteria for comparison.

1. Search Strategy

To conduct a complete evaluation, a systematic search strategy was employed to identify relevant research that evaluated the image quality and dose introduced by CBCT and FBCT. The following digital databases were searched: PubMed and Google Scholar (since inception until 25-3-2024). Appropriate key phrases consisting of "Cone beam CT," "Fan beam CT," "Image Quality," "Dose Delivered," and related expressions were used for the hunt. This method aims to acquire all relevant literature from diverse sources.

2. Selection Criteria

The choice criteria consisted of studies that directly compared image quality and dose among CBCT and FBCT. Two independent authors (AM and BA) considered experimental and scientific studies to assess their eligibility for inclusion in this study. Articles that provided quantitative data on various image quality metrics, which include the spatial decision (e.g., "spatial resolution refers to the ability to distinguish small details in an image"), evaluation-to-noise ratio, and radiation dose measurements for both CBCT and FBCT, were blanketed in the evaluation.

3. Inclusion and Exclusion Criteria

The following criteria were considered for this systematic review: (a) studies comparing image quality and dose between CBCT and FBCT; (b) studies reporting quantitative data on image quality metrics, such as spatial resolution, contrast resolution, and noise; (c) studies

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reporting radiation dose metrics, including dose-length product and effective dose; and (d) studies published in peer-reviewed journals.

Studies were excluded if they did not meet the inclusion criteria or if their focus was solely on image quality assessment or dose evaluation of either CBCT or FBCT, without a direct comparison between the two.

4. Data Extraction

Data was extracted from the selected studies, along with a look at characteristics (e.g., author, year, have a look at design), imaging parameters, image high-quality metrics, dose metrics, statistical evaluation techniques used, and key findings. The extracted information was prepared in a tabular layout for a similarly complete analysis and evaluation across studies (**Table 1)**.

5. Quality Assessment

The quality of the included studies was thoroughly assessed to determine the reliability and validity of the findings. The assessment utilized established quality assessment tools specific to the study design, including the Joanna Briggs Institute (JBI) Checklist for observational studies. Various factors were considered in this comprehensive quality evaluation, including the study design, sample size, data collection methods, and statistical analysis.

The JBI Checklist is a tool developed by the Joanna Briggs Institute to evaluate the methodological quality of studies, particularly observational ones. It includes criteria for research clarity, design appropriateness, sample selection, data collection methods, and statistical analysis, ensuring the reliability and validity of the reviewed findings.

The systematic search of digital databases yielded 284 relevant studies that met the inclusion criteria. After screening the titles and abstracts, 57 studies were excluded because they did not directly compare image quality and radiation dose between CBCT and FBCT. Following this screening process, 20 studies were included in the systematic review. The included studies encompass a wide range of imaging parameters and quality metrics, providing a comprehensive assessment of the comparison between CBCT and FBCT.

The quality evaluation of the included research revealed variations in the study design, sample size, and data collection methods. While most of the studies employed robust methodologies and appropriate statistical analyses, some limitations were noted in certain studies, particularly in the reporting of imaging parameters and dose metrics.

The comprehensive analysis and comparison of the protected research provide precious insights into the image first-rate and dose concerns for both CBCT and FBCT. Further studies and standardization of imaging protocols are needed to improve understanding of the comparative advantages and limitations of these imaging modalities.

PRISMA guidelines ensure transparency and rigor inside the overview method. The systematic assessment aimed to evaluate the image quality and radiation dose introduced using CBCT and FBCT.

RESULTS

This systematic review aimed to compare image quality and dose delivered by CBCT and FBCT through a comprehensive analysis of relevant studies. A total of 20 studies were included in this review, covering a range of medical specialties, including radiology, dentistry, and orthopedics.

1. Study Selection

The study selection process involved thoroughly searching electronic databases such as PubMed and Google Scholar. Specific keywords related to CBCT, FBCT, image quality, and radiation dose were used. The aim was to include studies comparing CBCT and FBCT in terms of imaging, qualitatively and quantitatively, and in clinical settings. After screening and preliminary analysis, 20 studies were selected for further examination [3,10].

2. Characteristics of Studies

The included studies varied in sample size, ranging from 50 to 500 patients. This study used CBCT and FBCT systems, each with technical specifications, such as detector type, scanning protocol, image reconstruction algorithm, and various metrics used to evaluate image quality, including spatial resolution, noise level, and contrast-to-noise ratio. In addition, radiation dose parameters, such as dose-length product (DLP) and effective dose, have been reported in most studies [3,6,12].

3. Summary of Results

Studies comparing CBCT and FBCT have consistently shown that CBCT provides better imaging results than FBCT. CBCT consistently produced sharp, detailed images (high spatial resolution), providing well-organized anatomical identification and accurate diagnoses. However, FBCT showed lower noise levels, especially when imaging larger patients or complex body regions. In general, the noise difference between CBCT and FBCT was comparable. In terms of radiation dose, CBCT consistently results in decreased dose-length product (DLP) and lower effective dose than FBCT, suggesting that radiation may have a beneficial effect on patients [2,12,13].

4. Quality Assessment

Quality assessment of the included studies was based on established criteria, including study design, methodology, sample size, statistical analysis, and reporting of results. In other words, overall, most of the included studies were of moderate-to-high quality. Clear research objectives, appropriate study design, and rigorous statistical analyses were provided. However, several limitations were found, such as a small sample size in some studies, potential biases in patient selection, and variability in technical parameters

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and imaging protocols in CBCT and FBCT protocols [12,14,15].

Table 1: The JBI Checklist uses a scoring system to evaluate the quality of studies based on specific criteria. Each criterion is scored as follows: criterion is met (✓), criterion is not met (x), and unclear is (o).

Study	Inclusion criteria	Describing of subjects and the setting	validity of exposure	measurement of condition	confounding factors	strategies to deal with confounding	valid of outcomes	statistical analysis	Score (out of 8)
Alaei P 2015 (1)	✓	✓	x	✓	x	x	✓	o	4
Al Towairqi 2017 (2)	✓	✓	✓	✓	o	x	✓	o	5
Lechuga L 2016(3)	✓	✓	✓	✓	✓	o	✓	✓	7
Miracle AC 2009 (4)	x	x	✓	✓	x	o	o	o	2
Liu H 2023(8)	✓	✓	✓	x	x	✓	✓	x	6
Abramovitch K 2014(5)	✓	x	o	✓	x	x	o	x	2
Sykes JR 2013 (6)	x	✓	✓	✓	o	x	✓	o	4
Kan MWK 2008 (9)	✓	✓	✓	✓	x	x	✓	✓	6
Stewart HL 2023 (10)	✓	✓	✓	✓	x	✓	✓	✓	7
Posiewnik M(11)	✓	✓	✓	✓	✓	✓	✓	✓	8
Gardner SJ 2014(12)	x	✓	✓	x	x	x	✓	✓	4
Damet J 2010 (13)	o	✓	✓	✓	✓	o	✓	x	5
Ogilvy A 2023(14)	✓	✓	✓	✓	o	✓	✓	x	6
Roxby P 2009(15)	✓	✓	✓	✓	o	o	✓	o	5
Isambert A 2008 (16)	x	✓	✓	✓	✓	o	o	x	4
Bachar G 2009(17)	✓	✓	✓	✓	o	o	✓	x	5
Zbijewski W 2011(18)	o	✓	✓	✓	✓	✓	✓	o	6
Rührnschopf EP 2011(19)	x	✓	✓	✓	o	o	✓	x	4
Kaliyaperumal V 2017(20)	✓	✓	✓	✓	✓	✓	✓	✓	8
Venkatesh E 2017(21)	o	✓	✓	✓	o	o	✓	o	4

Figure 2 presents the quality assessment (risk of bias) and quality scores for all the studies. Quality scoring evaluates a study's methodological rigidity and reliability using criteria from the Joanna Briggs Institute (JBI). Studies are assessed as "Yes," "No," or "Unclear" for each criterion, with higher scores indicating stronger methodology and reduced bias. This process helps ensure the inclusion of only trustworthy evidence in research and practice.

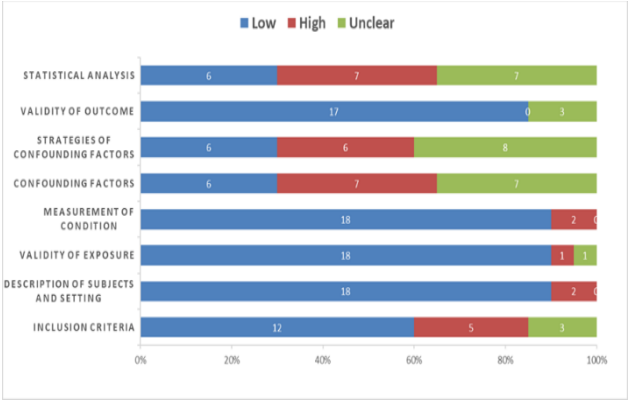

Fig. 2: Proportion of studies with low, unclear, and high risk of bias

5. Impact of Protocol Variability

Variability in protocols, such as kV ranging from 80 to 120 and scan times from 5 to 30 seconds, influenced dose and quality outcomes, reducing generalizability but mirroring clinical practice diversity.

DISCUSSION

This study's systematic review aimed to compare the image quality provided by CBCT and FBCT. Its findings are insightful and valuable in terms of the advantages and limitations of both imaging modalities.

Image quality analysis showed that CBCT and FBCT achieved comparable performance in terms of spatial resolution, contrast ratio, and noise level. Still, CBCT showed better performance in reducing metallic objects than FBCT. This is attributed to the cone-shaped beam of the CBCT, which allows better penetration and imaging of metal objects [12,16].

In terms of radiation dose, CBCT generally showed lower doses than FBCT. Local CBCT imaging, with variable field of view (FOV) capabilities, helps to reduce radiation consumption, but it should be noted that the actual dose may vary depending on factors such as scan parameters, patient anatomy, and imaging settings [10,17].

The clinical implications of these findings are important. Where accurate imaging of metallic objects or reduction of metallic objects is required, CBCT can be considered as the preferred technique. Additionally, the low radiation exposure associated with CBCT makes it safe for vulnerable patients, especially children, individuals undergoing multiple imaging procedures, and patients with conditions requiring frequent monitoring [10,18,19].

This systematic review highlights the comparable image quality between CBCT and FBCT, emphasizing the advantages of CBCT in reducing metal artifacts and delivering lower radiation doses. However, several limitations of CBCT must be acknowledged. The cone-shaped beam geometry of CBCT can lead to nonuniform voxel resolution throughout the volume, resulting in lower resolution in certain areas, particularly within the field of view (FOV). In contrast, FBCT tends to provide consistent resolution across sections but may be more susceptible to the formation of artifacts from metallic objects [19–21].

Another significant limitation is the lack of standardized protocols and imaging parameters for both CBCT and FBCT. This variability can hinder the comparability of studies and limit the generalizability of findings. Therefore, future research and clinical practice should focus on establishing standardized protocols to ensure consistent and reliable results [2,22].

Additionally, while this review primarily focused on image quality and radiation dose, it did not extensively address other critical factors, such as cost-effectiveness, workflow efficiency, and specific clinical applications. Future studies should incorporate these aspects to provide a more comprehensive evaluation of CBCT and FBCT [17,23].

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Recent advancements in CBCT technology have been improving workflow efficiency and clinical utility. Sluijter et al. showed that a high-performance CBCT system with AI-based autosegmentation enhances delineation confidence for pelvic organs, potentially streamlining radiotherapy workflows, even though it does not significantly reduce correction times [24]. Mirzaei et al. developed a method to enhance low-dose CBCT image quality by 98.63%, reducing aliasing artifacts and boosting diagnostic accuracy in dental and medical contexts without increasing radiation [25]. These innovations highlight CBCT's potential to overcome limitations and offer more effective imaging solutions.

This systematic evaluation also faced challenges, including the heterogeneity of studies, as it concentrated solely on image quality and radiation doses as primary outcome measures. Important factors such as value-effectiveness and workflow performance were not considered, which could provide a more holistic view of both imaging modalities [5,8].

Moreover, the review was limited to studies published within a specific timeframe, potentially overlooking the latest CBCT and FBCT technology advancements. The field of radiology is continuously evolving, and recent iterations of these imaging modalities may have addressed some of the limitations identified in this review [10,15,17].

Lastly, reliance on published literature introduces the potential for publication bias, and the review did not perform a quantitative meta-analysis due to the heterogeneity of the studies. Although the findings are primarily qualitative, they offer valuable insights into the comparative analysis of image quality and radiation dose between CBCT and FBCT. These insights can assist clinicians and researchers in selecting the most appropriate imaging modalities for specific clinical needs. Future research should address these limitations and explore broader aspects of CBCT and FBCT in clinical practice [3,22].

CONCLUSIONS

This systematic review evaluates the image quality and radiation doses of CBCT and FBCT across 20 studies. It finds that CBCT generally provides better imaging and lower radiation exposure. Both modalities are crucial for accurate diagnosis and treatment planning, but each has its strengths: CBCT reduces metal artifacts and radiation doses, while FBCT excels in noise reduction for larger patients. Limitations include variable resolution and a lack of standardized protocols. Future research should focus on addressing these issues and examining cost-effectiveness and workflow efficiency. The review offers important insights for radiologists and healthcare professionals to enhance patient care and safety in diagnostic imaging.

Clinicians can optimize CBCT protocols by reducing kV settings for smaller regions such as the head, thereby minimizing radiation exposure, while FBCT protocols may benefit from longer scan times to enhance noise reduction in larger regions such as in abdominal imaging.

INFORMED CONSENT STATEMENT

Not applicable.

AUTHOR CONTRIBUTIONS:

HSB, AZM, and BFM conceived the project and wrote and reviewed the manuscript; YM, MFM, and ASA wrote and reviewed the manuscript; and RMR and NAM reviewed and revised it.

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CONFLICTS OF INTEREST

The authors declares that they have no competing interests.

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Original Article

Epidemiological aspects of prematurity at Al Yamamah Hospital in Riyadh

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ABSTRACT Background: Prematurity continues to be the primary cause of infant mortality and morbidity globally. Proper, regular neonate screening is necessary to lower the burden of healthcare associated with prematurity and its complications. Aim: This study aimed to assess the epidemiological features of prematurity and survival rates in preterm neonates. Methods: Retrospective observational research was conducted at AlYamamah Hospital in Riyadh, Saudi Arabia, on preterm infants admitted to the neonatal intensive care unit with prematurity between January 2022 and July 2023. SPSS program version 22.0 was used for data analysis. Ethical approval was obtained from the ethics committee of King Fahd Medical Research Center. Results: A total of 402 participants were enrolled; 37.6% and 46.7% had very low birth weight and were very preterm, respectively. Significant inverse correlations were found between mortality, birth weight, and gestational age (P≤0.001). The major found complications were Patent ductus arteriosus (PDA) (14.2%) and pulmonary hemorrhage (11.2%). Conclusions: There was a male dominancy among preterm infants, and the largest proportions of the infants were very low birth weight and very preterm and experienced many complications, which were majorly PDA. There were inverse correlations between gestational age and birth weight with mortality rate and complications.

Keywords: Complications, Mortality rate, Preterm, Survival

INTRODUCTION

The World Health Organization defines prematurity as birth occurring before 37 gestational weeks, which is before the 259th day from the 1st day of the last menstrual cycle [1]. There are four categories of prematurity: extreme (births less than 28 gestational weeks), very high (births between 28 to 31 gestational weeks), moderate (births between 32 to 33 weeks), and late prematurity (births between 34 to 36 gestational weeks) [2]. Unfortunately, prematurity still being one of the leading causes of neonatal mortality and morbidity in both developed and undeveloped countries [3,4]. It is considered the second primary factor of neonatal mortality after congenital anomalies [5], affecting almost 11.1% of all pregnancies worldwide [6]. Subsequently, anatomic or functional immaturity is more likely to occur in premature infants [7]. Several studies reported that as gestational age and birth weight increase, the mortality and morbidity rates for neonates with low birth weight decrease [8]. Moreover, the majority of intensive care unit (ICU) admissions during the first few days of life are due to prematurity, as well as 28% are associated with deaths within the first seven days of life [9]. However, in the last two decades, the advanced improvements in prenatal and neonatal intensive care have dramatically reduced the mortality rates in low birth weight infants [10]. The healthcare costs of premature neonates are high, as in 2016, the US birth cohort reached $25.2 billion, including medical, delivery care, early intervention, and disabilities [11]. Consequently, determining the prevalence of prematurity and related complications is crucial for proper management and early intervention [12,13] since fatal morbidities could increase the risk of permanent disability in those who survive. Regular screening is essential to reduce prematurity complications and healthcare burden through understanding the factors causing prematurity [14]. This study aimed to assess the epidemiological features of

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prematurity and survival rate in preterm neonates diagnosed at AlYamamah Hospital in Riyadh, Saudi Arabia.

MATERIALS AND METHODS

Study Design and Population:

A retrospective observational study was conducted at Al Yamamah Hospital in Riyadh between January 2022 and July 2023. The study included all preterm infants admitted to the neonatal intensive care unit (NICU) with a diagnosis of prematurity, any birth before 37 completed weeks of pregnancy, or less than 259 days since the first day of the woman's last menstrual period. Preterm infants born at a pregnancy age of 23 weeks or less or infants with a birth weight of less than 400g were excluded from the study.

Data collection tool and method:

The data was collected from the medical records of neonates, including demographics (gestational age, birth weight, and gender) and neonatal survival rate. In addition, the study reviewed the percentage of morbidity among preterm infants, including retinopathy of prematurity, necrotizing enterocolitis, Patent ductus arteriosus (PDA), pulmonary complications, and intraventricular hemorrhage.

For this study, prematurity was subdivided based on the gestational age into extremely preterm (<28 weeks), very preterm (28 to <32 weeks), and the last is late preterm (32 to <37 completed weeks of gestation). Birthweight classification was based on the Centers for Disease Control guidelines, as birth weight <1000g is considered extremely low, and birth weight ranging between 1000-1499g is very low. Birth weights ranging between 1500-2499g are low, while normal birth weights range between 2500-3999g. Birth weights equal to or more than 4000g is high birth weights. Mortality was defined by death as a result of prematurity and at least one of its short-term complications during the hospitalization period. Small for pregnancy age was defined as birth weight below the 10th percentile for age.

Statistical analysis:

The data was obtained from the hospital Excel Google Sheets. The SPSS program, version 22.0, was used for data analysis. Descriptive statistics, such as frequency and percentage, were performed. Chi-square or Fisher tests assessed the association between mortality, birth weight, and gestational age. A P-value of 0.05 or less was considered statistically significant.

Ethical considerations:

The local Ethics Committee of King Fahd Medical Research Center (KFMRC) approved this study, with IRB log number 23-406. All data was collected anonymously and confidentially.

RESULTS

Four hundred two preterm infants were enrolled in this study; based on birth weight, the largest proportion had very low birth weight, 151 (37.6%), and the largest proportion were males, 93 (41.2%). Regarding gestational age, less than one-half of the infants, 185 (46.7%), were very preterm (Table 1).

Table 1: Classification of the study population gender according to gestational age and birth weight

Characteristic		Female		Male		Total cases	
		N	%	N	%	N	%
BW (g)	Less than 1000 (ELBW)	66	37.5%	47	20.8%	113	28.1%
	1000 to 1499 (VLBW)	58	33.0%	93	41.2%	151	37.6%
	1500 to 2499 (LBW)	49	27.8%	82	36.3%	131	32.6%
	2500 to 3999 (NBW)	3	1.7%	4	1.8%	7	1.7%
GA	Extremely preterm (<28 weeks)	57	32.4%	61	27.0%	118	29.8%
	Very preterm (28 to <32 weeks)	75	42.6%	111	49.1%	185	46.7%
	Late preterm (32 to <37 weeks)	44	25.0%	54	23.9%	93	23.5%

BW: birth weight, ELBW: extremely low birth weight, GA: gestational age, LBW: low birth weight, NBW: Normal birth weight, VLBW: very low birth weight

Table 2 displays the correlation between mortality with birth weight and gestational age. Indicating that as the birth weight increases, the mortality rate decreases significantly (P≤0.001). Similarly, late preterm infants had a significantly (P≤0.001) lowest mortality rate compared to very and extremely preterm infants.

Table 2: The correlation between mortality and birth weight and gestational age

		Death				P value
		No		Yes		
		N	%	N	%	
BW (g)	**Less than 1000 (ELBW)**	57	50.4%	56	49.6%	**≤0.001**
	1000 to 1499 (VLBW)	132	87.4%	19	12.6%	
	1500 to 2499 (LBW)	125	95.4%	6	4.6%	
	2500 to 3999 (NBW)	7	100.0%	0	0.0%	
GA	**Extremely preterm (<28 weeks)**	62	52.5%	56	47.5%	**≤0.001**
	Very preterm (28 to <32 weeks)	165	88.7%	21	11.3%	
	Late preterm (32 to <37 weeks)	94	95.9%	4	4.1%	

BW: birth weight, ELBW: extremely low birth weight, GA: gestational age, LBW: low birth weight, NBW: Normal birth weight, VLBW: very low birth weight, N: number

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Table 3 illustrates the prevalence of preterm infant morbidities; the largest proportion had PDA, 57 (14.2%), whereas chorion-amnionitis was the least reported condition, 6 (1.5%).

Table 3: Prevalence of preterm infant morbidities in the including neonates

Preterm infant morbidities	No		Yes	
	N	%	N	%
PDA	345	85.8	57	14.2
Pulmonary haemorrhage	357	88.8	45	11.2
IUGR	364	90.5	38	9.5
Chorion-amnionitis	396	98.5	6	1.5
PET	365	90.8	37	9.2

IUGR: Intrauterine growth restriction, PDA: Patent ductus arteriosus, PET: Pre-eclampsia Toxemia, N: number

The association between birth weight and preterm infant revealed significant correlations between birth weight and PDA (P=0.001), pneumothorax (P=0.001), pulmonary hemorrhage (P≤0.001), and chorion-amnionitis (P=0.01) (Table 4).

Table 4: Association between birth weight and preterm infant morbidities

	BW								P value
	<1000		1000-1455		1500-2499		2500-3999		
	N	%	N	%	N	%	N	%	
PDA	33	29.5	19	12.6	4	3.1	0	0.0	0.001
Pneumothorax	12	70.6	4	23.5	1	5.9	0	0.0	0.001
Pulmonary hemorrhage	27	24.1	13	8.6	4	3.1	0	0.0	≤0.001
IUGR	16	14.3	16	10.6	6	4.6	0	0.0	0.057
Chorion-amnionitis	0	0.0	6	4.0	0	0.0	0	0.0	0.018
PET	12	10.7	17	11.3	6	4.6	1	14.3	0.168

BW: Birth weight, IUGR: Intrauterine growth restriction, PDA: Patent ductus arteriosus, PET: Pre-eclampsia Toxemia, N: number

Table 5 displays the correlations between mortality and preterm infant morbidities. Significant correlations were found between mortality and PDA (P=0.002), pulmonary hemorrhage (P≤0.001), chorion-amnionitis (P=0.001), and pneumothorax (P≤0.001).

Table 5: Association between mortality and preterm infant morbidities

Preterm infant morbidities			Death		P value
			No	yes	
PDA	**No**	**N**	284	61	**0.002**
		%	82.3%	17.7%	
	yes	**N**	37	20	
		%	64.9%	35.1%	
Pulmonary Haemorrhage	**No**	**N**	310	47	**≤0.001**
		%	86.8%	13.2%	
	Yes	**N**	11	34	
		%	24.4%	75.6%	
IUGR	**No**	**N**	291.6	72	0.568
		%	80.2%	19.8%	
	Yes	**N**	29	9	
		%	76.3%	23.7%	
Chorio amnionitis	**No**	**N**	317	79	**0.001**
		%	80.1%	19.9%	
	Yes	**N**	4	2	
		%	66.7%	33.3%	
Pneumothorax	**No**	**N**	315	70	**≤0.001**
		%	81.8%	18.2%	
	Yes	**N**	6	11	

IUGR: Intrauterine growth restriction, PDA: Patent ductus arteriosus, N: Number

Gestational age displayed significant correlations with PDA (P≤0.001), pulmonary hemorrhage (P≤0.001), and pneumothorax (P≤0.001), showing the highest proportions among extremely preterm neonates. (Table 6).

Table 6: Association between gestational age and preterm infant morbidities

Preterm infant morbidities	GA						P value
	Extremely preterm (<28 weeks)		Very preterm (28 to <32 weeks		Late preterm (32 to <37 weeks)		
	N	%	N	%	N	%	
PDA	37	31.4	13	7.0	7	7.1	**≤0.001**
Pulmonary hemorrhage	32	27.1	11	5.9	2	2.0	**≤0.001**
Pneumothorax	13	11.0	4	2.2	0	0.0	**≤0.001**
PET	5	4.2	21	11.3	11	11.2	0.085
IUGR	8	6.8	21	11.3	9	9.2	0.422
Chorion amnionitis	3	2.5	3	1.6	0	0.0	0.303

GA: gestational age, IUGR: Intrauterine growth restriction, PDA: Patent ductus arteriosus, PET: Pre-eclampsia Toxemia, N: number

DISCUSSION

Prematurity is one of the major causes of neonatal mortality and morbidity in ICUs globally and the second leading cause of neonatal mortality following congenital anomalies [15]. Therefore, this study was established to assess the epidemiological features of prematurity and survival rate in

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preterm neonates diagnosed at AlYamamah Hospital in Riyadh, Saudi Arabia.

In this study, males were more dominant than females, where males represented more than one-half of the total sample. Similar to our findings, a previous Saudi study revealed that male gender formed the highest proportion of preterm infants, 55.25% [16]. Furthermore, a study conducted in Croatia revealed male dominancy (58%) among infants, whereas in contrast to our findings, most infants (85%) belonged to the late-preterm category [17]. In our study, the largest proportion belonged to very preterm (46.7%). A study conducted on 179 infants revealed that 5%, 22%, and 73% were extremely preterm, very preterm, and moderate to late preterm, respectively [18]. A previous Saudi study revealed that most of the study population was late preterm (70.6%), and regarding birth weight, more than one-half were low birth weight [15].

Our study revealed that the survival of infants was significantly higher among those with normal and low birth weight. Regarding gestational age, very preterm infants' survival rate was also high. Based on a previous Saudi study, the survival rate was the highest among those with low birth weight and normal birth weight; the survival rate increased with increasing birth weight to the normal range, which agreed with our findings. Also, in agreement with our findings, the previous Saudi study displayed that regarding gestational age, the highest survival rate was detected among those who were very preterm and late preterm [15].

The mortality among preterm infants was significantly associated with gestational age and birth weight in one study. Furthermore, a gestational age less than 28 increased the odds of mortality by more than one-fold (OR: 1.8), and a birth weight less than 1000g increased the risk of mortality by more than twofold (OR: 2.8) [19]. Hence, the mortality rate increases with reduced gestational age and birth weight, whereas the survival rate increases with increased gestational age and birth weight; there are reversible correlations between mortality rate and survival rate with birth weight and gestational age. A study from India reported a significant association between low birth weight and infant deaths [20]. A study from China reported that the incidence and risk of perinatal mortality of infants increased as birth weight decreased [21]. A previous study revealed that the survival rate among preterm neonates increased with increased gestational age [22]. Preterm infants are at a higher risk for acquiring complications that lead to either functional or anatomic immaturity [23]. The complications of preterm birth account for 35% of mortality [22]. In the present study, PDA was the major finding among the infants, followed by pulmonary hemorrhage, whereas chorion-amnionitis was the least reported finding. A previous study involved premature infants, with a total number of 293 infants; Intrauterine growth restriction (IUGR) was reported to be among the 6.8%, and PDA was prevalent among the 12.3% [24].

The risk of developing complications among low-birth-weight infants reduces with increasing gestational age and birth weight [23]. Our study found that a low birth weight of less than 1000 g was significantly associated with PDA, pneumothorax, and pulmonary hemorrhage. Also, those with a birth weight of 1000-1455 g tended significantly to experience chorion-amnionitis. Such findings indicate that the lower the birth weight, the more likely the presence of complications among infants. One study revealed that based on a multivariate regression model, several factors were associated with the time to death among preterm neonates, including respiratory distress, birth weight, and gestational age [22]. Also, we found that significantly higher proportions of those with extremely preterm birth experienced PDA, pulmonary hemorrhage, and pneumothorax. Another demonstrated that IUGR wasn't associated with mortality, whereas PDA was associated with hospital mortality [24]. These findings were similar to ours, where there was no significant association between mortality and IUGR, whereas a significant association was found between mortality and PDA.

Our study revealed valuable insights into the epidemiology and characteristic features of premature neonates and highlighted the mortality and survival rates among them. However, the study had several limitations, including the retrospective nature that exposed the study to the possible selection and observer biases and restriction of confounding variables. Therefore, comparative prospective studies are highly recommended to explore more risk factors and get better information about the effect of prematurity on neonates.

CONCLUSIONS

This study revealed male dominance among preterm infants. The largest proportions of the infants were very low birth weight, very preterm, and experienced many complications, which were majorly PDA. Low birth weight and low gestational age were significantly associated with mortality and experiencing many complications. On the other hand, increasing birth weight and gestational age were significantly associated with a higher survival rate and fewer complications.

INFORMED CONSENT STATEMENT

Not applicable to retrospective studies.

DATA AVAILABILITY STATEMENT

The data are available upon request from the authors.

AUTHOR CONTRIBUTIONS:

All authors have contributed equally in the following: the conception or design of the work; the acquisition, analysis, and interpretation of data; manuscript writing; and substantially revising the work.

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CONFLICTS OF INTEREST
The authors declare no conflict of interest.

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