J L M D C

JOURNAL OF LAHORE MEDICAL AND DENTAL COLLEGE

Volume 02 **July - December 2025** **Issue 02**

PUBLISHED BY

Lahore Medical and Dental College Lahore

ONLINE EDITION

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

PRINTED BY

TALAL PUBLISHERS

9- Rose Centre, Kabir Street, Urdu Bazar Lahore
0300-4327951

Members (National/International)

Advisory Board

TABLE OF CONTENTS

Editorial

Original Articles

Editorial

Integrating Genomics into Medical Education for Personalized Patient Care

Ahmed Badar[1]

[1]*Department of Physiology, College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia*

How to cite: Badar A. Integrating Genomics into Medical Education for Personalized Patient Care. J Lahore Med Dent Coll. 2025; 2(2): 43-45

DOI: 10.70384/jlmdc.v2i02.92

Precision medicine which tailors treatment based on individual genetic, environmental, and lifestyle factors, is rapidly becoming a cornerstone of modern healthcare. It offers enhanced diagnostic accuracy, targeted therapies, and reduced adverse drug reactions. However, its effective implementation hinges on a healthcare workforce proficient in genomic literacy. Surveys consistently show that both medical students and practicing physicians lack confidence in interpreting genomic data, highlighting the urgent need for curricular reform.[1] A study revealed that only 15% of U.S. medical schools offered dedicated genomics coursework, with even fewer integrating it longitudinally across clinical training.[2] Findings from recent UK and Australian surveys provide strong evidence of limited confidence among medical students and clinicians in applying genomic medicine, despite growing awareness and educational efforts.[3,4]

The genomic revolution has fundamentally transformed medicine. Since the completion of the Human Genome Project in 2003, advances in sequencing technologies, bioinformatics, and clinical applications have accelerated. Genomic data now supports decision-making in oncology, rare disease diagnosis, and pharmacogenomics, making it an essential component of present-day clinical practice. Despite its growing relevance, genomics remains underrepresented in medical curricula, leaving future clinicians inadequately prepared to apply genetic insights in patient care. As genomic testing becomes more widespread, clinicians must be equipped to navigate complex discussions around incidental findings, genetic discrimination, and patient autonomy.[5]

Recognizing this educational gap, several leading institutions have pioneered efforts to incorporate genomics and precision medicine into their training programs. Stanford University's Center for Genomics and Personalized Medicine offers interdisciplinary education through initiatives like the NIH-funded 'Stanford Genome Training Program' and specialized courses such as 'Personal Genomics and Your Health', which focus on variant interpretation and clinical relevance. Duke University's Precision Medicine Program integrates 'omics' technologies and machine learning to enhance clinical decision-making. The Medical College of Wisconsin has introduced a dedicated graduate program in Precision Medicine, offering certificate and master's degrees with coursework in bioethics, cancer genomics, and clinical applications.[5]

In the Middle East, King Saud University, King Abdullah University of Science and Technology, and King Faisal Specialist Hospital in Saudi Arabia have invested in genomic infrastructure and training programs. Additionally, the Saudi Medical Genetics and Genomics Fellowship Training Program, accredited by the Saudi Commission for Health Specialties, offers comprehensive training in clinical, biochemical, and molecular genetics, preparing fellows for independent practice and leadership roles.

Correspondence:
Ahmed Badar, Department of Physiology, College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam. Saudi Arabia
Email: absheikh@iau.edu.sa

Submission Date: September 23, 2025
Revision Received: November 04, 2025
Acceptance Date: November 07, 2025

Hamad Bin Khalifa University in Qatar provides a Master of Science in Genomics and Precision Medicine, combining clinical, technological, and ethical training to prepare future leaders in the field.

Effective curricular integration should be longitudinal, interdisciplinary, and case-based. Real-world scenarios, simulations, and virtual labs can make complex genomic concepts more accessible and clinically relevant. For instance, the Icahn School of Medicine at Mount Sinai incorporates genomic case studies into its clinical reasoning modules, enabling students to explore the implications of genetic variants in patient care. Similarly, the University of California, San Francisco (UCSF) embeds pharmacogenomics into its therapeutics curriculum, helping students understand how genetic profiles influence drug metabolism and efficacy.[5]

Faculty development is equally vital. Many educators lack formal training in genomics, which can hinder effective instruction. Institutions must invest in faculty workshops, certifications, and collaborative teaching models. In the U.S., the Inter-Society Coordinating Committee for Practitioner Education in Genomics (ISCC-PEG), convened by the NIH, has developed core competencies and resources to support faculty across disciplines.[6] These initiatives are essential to bridge the gap between scientific advancement and classroom delivery. A well designed educational framework for genomic literacy should define core competencies, such as variant interpretation and precision medicine application, integrated through CBME models with outcome-based assessments like OSCEs and case discussions. Evidence supports that structured curricula and faculty development enhance the effectiveness and sustainability of genomics education.[7,8]

Training must also address the ethical, legal, and social implications of genomic medicine, including data privacy, equitable access, and informed consent. The University of Oxford's MSc in Genomic Medicine includes modules on ethical frameworks and policy, encouraging students to critically assess the societal impact of genomic technologies. In addition technology plays a pivotal role in enhancing genomic education. Interactive platforms such as DNA Subway and GenomeSolver allow students to analyze real genomic data, fostering hands-on learning and critical thinking. Artificial intelligence tools are increasingly used to simulate clinical decision-making based on genetic profiles, offering immersive experiences that mirror real-world practice.[9]

The integration of genomics and precision medicine into medical education is not merely an enhancement, it is a necessity. As healthcare becomes increasingly data-driven and personalized, clinicians must be equipped to navigate this complexity. By embracing this transformation, medical schools can cultivate a workforce that is not only competent but visionary, and capable of delivering care that is truly tailored to the individual.

Ultimately, the future of medicine depends on translating genomic insights into actionable care. This requires not only technological innovation but a cultural shift in how we educate the next generation of healthcare professionals. Institutions that take the lead in this change would graduate health care professionals who would be ahead of their contemporaries in patient outcomes and satisfaction of stake holders.

Conflict of interest: None
Funding Disclosure: None
Acknowledgments: None

References

1. Korf BR, Berry AB, Limson M, Marian AJ, Murray MF, O'Rourke PP, et al. Framework for development of physician competencies in genomic medicine: report of the Inter-Society Coordinating Committee for Physician Education in Genomics. Genet Med. 2014;16(11):804–9. doi:10.1038/-gim.2014.35.
2. Skirton H, Lewis C, Kent A, Coviello DA. Genetic education and the challenge of genomic medicine: development of core competencies to support preparation of health professionals in Europe. Eur J Hum Genet. 2010;18(9):972–7. doi:10.1038/-ejhg.2010.64.
3. Seed L, Scott A, Peter M, Tadros S, Hill M, da Costa CS. Preparing tomorrow's doctors for the genomics era: A nationwide survey of UK medical students. Future Healthcare Journal. 2024 1;11(2):-100133.

4. Nisselle A, King EA, McClaren B, Janinski M, Metcalfe S, Gaff C. Measuring physician practice, preparedness and preferences for genomic medicine: a national survey. BMJ open. 2021 Jul 1;11(7):e044408.
5. Rubanovich CK, Cheung C, Mandel J, Bloss CS. Physician preparedness for big genomic data: a review of genomic medicine education initiatives in the United States. Human molecular genetics. 2018 Aug 1;27. doi: 10.1093/hmg/ddy170.
6. National Human Genome Research Institute. Inter-Society Coordinating Committee for Practitioner Education in Genomics [Internet]. NIH; [cited Sep 07, 2025]. Available from: https://www.genome-.gov/10005345/iscc-peg.
7. National Human Genome Research Institute. Framework for development of physician competencies in genomic medicine. 2022. Available from:

   https://www.genome.gov/sites/default/files/media/files/2022-06/competencies-framework-medicine.pdf
8. Sbitan L, Alzraikat N, Tanous H, Saad AM, Odeh M. From one size fits all to a tailored approach: integrating precision medicine into medical education. *BMC Med Educ*. 2025;25:90. Available from: https://bmcmededuc.biomedcentral.com/-articles/10.1186/s12909-024-06138-y.
9. Crellin E, McClaren B, Nisselle A, Best S, Gaff C, Metcalfe S. Preparing medical specialists to practice genomic medicine: education an essential part of a broader strategy. Frontiers in Genetics. 2019 Sep 11;10:789. doi:10.3389/fgene.2019.00789.

Original Article

Association of Carcinoma Breast with Vitamin D serum Levels and Polymorphism in Vitamin D receptor Gene Apa1

Shamaila Doggar,[1] Sobia Niaz,[2] Imran Ali,[3] Asfa Ikram,[1] Rubab Amjad,[1] Muhammad Ahsan Saeed[1]

[1]Department of Physiology, FMH college of Medicine and Dentistry, Lahore, Pakistan; [2]Department of Physiology, ABU AMARA College of Medicine, Lahore Pakistan; [3]Department of Biochemistry FMH College of Medicine and Dentistry, Lahore, Pakistan

How to cite: Doggar S, Niaz S, Ali I, Ikram A, Amjad R, Saeed MA. Association of Carcinoma breast with Vitamin D serum levels and polymorphism in Vitamin D receptor gene Apa1 . J Lahore Med Dent Coll. 2025; 2 (2): 46-53

DOI: 10.70384/jlmdc.v2i02.91

Abstract

Background: Breast cancer is the most common malignancy among women worldwide, and its incidence is increasing in South Asian populations, including Pakistan. While environmental and reproductive factors are well-recognized contributors, genetic susceptibility also plays a vital role. The vitamin D receptor (VDR) gene, particularly its ApaI single nucleotide polymorphism (SNP), has recently been explored for its possible involvement in cancer risk through altered vitamin D signaling.

Objective: To check the association between breast cancer, serum vitamin D levels, and polymorphism in the ApaI site of the VDR gene among Pakistani women.

Methodology: This cross-sectional comparative study included 115 healthy controls and 95 histologically confirmed breast cancer patients. Serum 25(OH) vitamin D levels were measured, and VDR ApaI genotyping was carried out using Polymerase Chain Reaction–Restriction Fragment Length Polymorphism (PCR–RFLP) analysis. Data were entered and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 21.

Results: The mean serum vitamin D level in all study subjects was 25.65 ± 13.45 ng/ml. Breast cancer patients had significantly lower levels (22.16 ± 7.95 ng/ml) than controls (29.82 ± 17.1 ng/ml). The "Aa" and "aa" genotypes of the ApaI polymorphism were more frequent among cases. In the dominant model, carriers of Aa or aa genotypes had about a twofold higher risk of breast cancer (adjusted OR = 2.03, 95% CI: 1.07–3.86; p = 0.02). Moreover, breast cancer patients with the "Aa" genotype showed markedly lower vitamin D levels ($p < 0.001$).

Conclusion: Low serum vitamin D levels and the ApaI polymorphism in the vitamin D receptor (VDR) gene are significantly associated with breast cancer in Pakistani women.

Keywords: Vitamin D Receptor, Gene Polymorphism, Breast Cancer, Single Nucleotide Polymorphism,

Introduction

Breast cancer (BC) remains the most frequently diagnosed malignancy and a leading cause of cancer-related death among women globally. According to GLOBOCAN 2020, approximately 2.3 million new cases and over 685,000 deaths were reported worldwide, with a growing burden in low- and middle-income countries (LMICs).[1] Although once considered a disease of the developed world, BC incidence is now rising in South Asia, particularly in Pakistan, where it constitutes the most common cancer among females and accounts for nearly one in nine women being at risk during their

Correspondence:
Dr. Shamaila Doggar, *Department of Physiology, FMH college of medicine and dentistry Lahore, pakistan. Email: dr.shumaila20@gmail.com*

Submission Date: September 08, 2025
1st Revision Received: September 27, 2025
2nd Revision Received: October 25, 2025
Acceptance Date: November 11, 2025

lifetime.[2] Among Asian countries, Pakistan shows one of the highest age-adjusted rates of breast cancer.[3] BC is a multifactorial disease influenced by environmental, reproductive, hormonal, and genetic factors.[4] One emerging biological determinant is vitamin D (25-hydroxyvitamin D, or 25(OH)D), a fat-soluble hormone. It is known to regulate calcium-phosphorus homeostasis and exhibit immunomodulatory, anti-proliferative, anti-angiogenic, and pro-differentiation effects in various tissues, including breast epithelium.[5] Deficiency of vitamin D has been linked not only to chronic disorders such as diabetes, cardiovascular, and autoimmune diseases, but also to increased risk and poor prognosis of several malignancies, including breast, prostate, and colorectal cancers.[6]

The biological effects of vitamin D happen mostly through its nuclear receptor, the vitamin D receptor (VDR), which works as a ligand-activated transcription factor. When active vitamin D ($1,25(OH)_2D$) binds to VDR, it changes shape and controls the expression of genes involved in cell growth, differentiation, and apoptosis.[5] Studies have found that VDR expression is lower in breast tumor cells compared to the nearby normal tissue, which suggests that VDR may have a protective role against cancer.[7] Polymorphisms in the VDR gene may alter receptor function, transcriptional activity, or mRNA stability, thereby modulating vitamin D signaling and influencing cancer susceptibility. Among these, ApaI (rs7975232), located in intron,[8] is one of the most widely studied VDR variants. ApaI does not alter the amino acid sequence but may affect mRNA processing and stability.[8] Multiple studies have evaluated the association between VDR gene polymorphisms, including ApaI, FokI, BsmI, and TaqI and breast cancer risk, but results remain inconsistent and often population specific.[9]

Pakistan is a bit of a paradox because even with plenty of sunlight, vitamin D deficiency is very common, maybe due to clothing habits, staying indoors, and not enough fortified foods. Recently it has been reported that about 80–90% of adults, including women, are deficient in vitamin D.[10] So far, many studies have assessed the associations between breast cancer risk and polymorphism in VDR gene with inconsistent results in genetically different populations. Some shows positive association while others show negative association.[11,12] Most of these studies have been done in Caucasian populations. Very few have been carried out in South Asian populations. The interplay between VDR gene polymorphisms and hypovitaminosis D in breast carcinogenesis has been underexplored in South Asian populations. Therefore, the present study aims to check the association between breast cancer, serum vitamin D levels, and polymorphism in the ApaI site of the VDR gene among Pakistani women.

Methodology

The study was carried out at the Research Center in Endocrinology and Reproductive Sciences, Department of Physiology & Cell Biology, University of Health Sciences, Lahore. It was designed as a cross-sectional comparative study, conducted over a period of twelve months following approval from the Ethical Review Board.

Ethical Consideration

Ethical approval for the study was obtained from the Ethical Review Committee of the University of Health Sciences, Lahore (No. UHS/Education/126-14-847, Approval date: 24/03/2014). Written informed consent was obtained from all participants prior to inclusion, and confidentiality of all personal information was strictly maintained throughout the study.

Keeping in view an earlier study by Dalessandri et al., 2012, the sample size was calculated based on the observed difference in VDR ApaI genotype frequencies and specified to achieve 90% statistical power with a two-sided $\alpha = 0.05$.[13] To improve precision and allow for potential sample loss, a total of 210 participants were targeted. Ultimately, 95 histologically confirmed breast cancer patients and 115 age-matched healthy controls were recruited. The patients were enrolled from the surgical and oncology departments of tertiary care hospitals in Lahore, including the INMOL Cancer Hospital, while controls were selected from the general population.

A structured questionnaire was administered to all participants to record their demographic characteristics and known risk factors for breast cancer, including maternal age, parity and age at first childbirth, history and duration of breastfeeding, age at menarche and menopause (if applicable), and family history of breast cancer.

Inclusion Criteria

The study included newly diagnosed, histopathologically confirmed female patients of primary breast cancer, regardless of disease stage. Controls were age-matched healthy women, relatives of the recruited cancer patients, with no history of malignancy or metabolic syndrome.

Exclusion Criteria

Patients with any other concurrent malignancy, or those who had received chemotherapy or radiotherapy, were excluded. Participants who had taken vitamin D or calcium supplements were also excluded.

Following written informed consent, a detailed history and general physical examination were performed for each participant. Using a convenient sampling technique, 5 mL of venous blood was drawn from each subject, 3 mL was placed in EDTA-containing tubes and the remaining 2 mL in serum tubes. Estimation of serum 25-hydroxy vitamin D [25(OH)D_3] levels were measured using a total enzyme-linked immunosorbent assay (ELISA) kit (AESKULISA 25-OH-Vitamin D). A 96-well microtiter plate coated with monoclonal antibodies was used for the assay.

Whole blood of all the study participants was used for the isolation of DNA by adopting phenol/chloroform technique. For the purpose of genotyping, latest procedure of Polymerase chain reaction of Restriction Fragment Length Polymorphism (PCR-RFLP) was performed. Forward as well as reverse primers which were specific for Apa1 allele were used as shown in Table I.[14]

A final reaction mixture of 15uL of PCR was formed by adding 8µL of PCR master mix, 0.5µL of each forward and reverse primer, 4µL of nuclease free water and 2µL of 50ng template DNA. The enhancement of VDR gene fragments for Apa1 polymorphism was performed by denaturing them at 95ºC for 5 minutes. Then incubation of the samples was performed for 35 cycles of denaturing, annealing and chain extension. At 72ºC, the final step of elongation was performed for 5 minutes. The annealing temperature for Apa1 was 69 ºC as shown in Figure I.

Analysis of the final PCR products was performed by a mixture of ethidium bromide and 1.5% agarose gel and finally observing them with the help of a UV transilluminator. The product obtained was of 740bp for Apa1. Restriction digestion was performed by Apa1 Restriction enzyme (Thermo Scientific) at 37℃ for 16 hours. The digested product was loaded on 2.5% agarose for 60 min at 100 volts (Figure II). Results were visualized under UV transilluminator gel

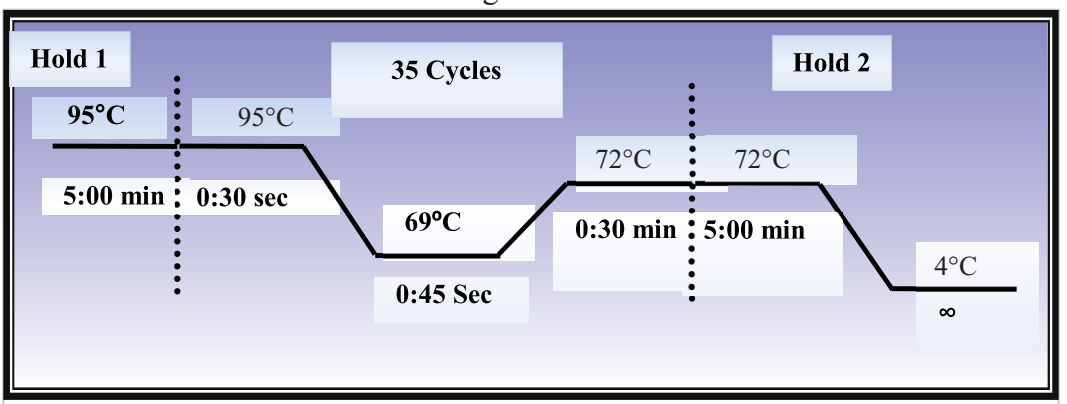


Figure I: *PCR cycle for Apa1 polymorphism*

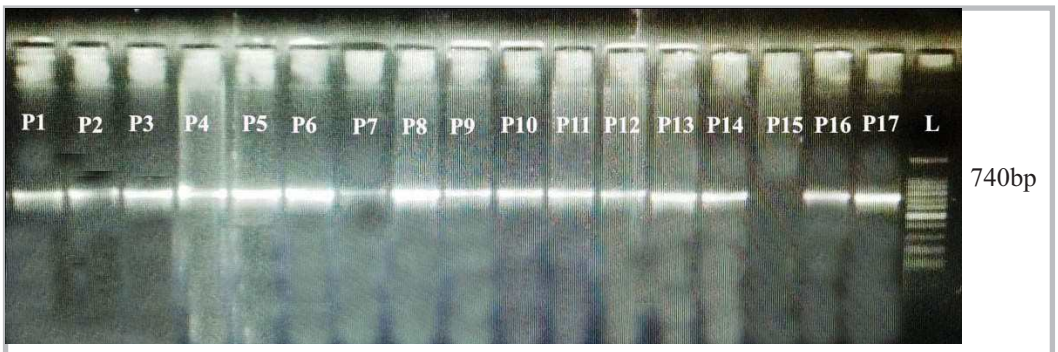


Figure II: *Ethidium bromide stained agarose gel for Apa1 PCR of VDR gene. Lane L shows 100 bp ladder. P stands for patient sample 1 -17.*

Table I: *Primer with GC content*

No	Primer	Sequence	GC content (%)	Annealing Temperature
1	*Apa1*-F	5´-AGA GCA TGG ACA GGG AGC AAG-3´	56%	69 ° C
2	*Apa1*-R	5´-GCA ACT CCT CAT GGC TGA GGT CTC-3´		

documentation system. The allele "A" was determined by the undigested product at 740bp whereas allele "a" was observed with digested product at 225bp and 515bp (Figure: III).

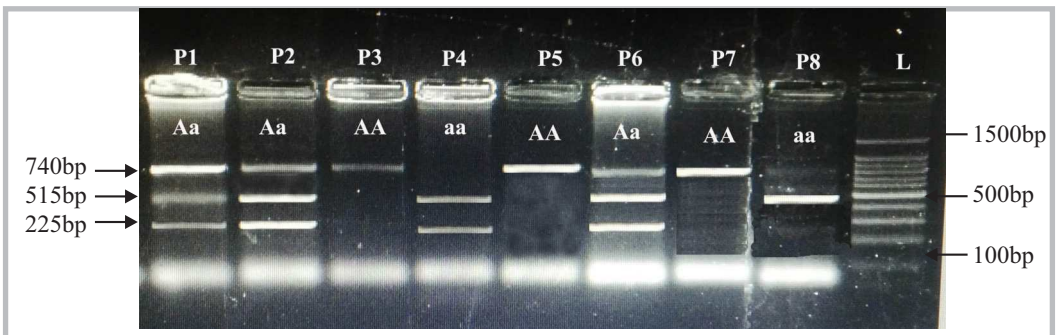


Figure III: *Ethidium bromide-stained agarose gel after RFLP for Apa1 polymorphism of VDR gene. All three possible genotype are visible. Lane L shows 1500bp ladder. P stands for patient samples 1-8*

Statistical Analysis

Data were entered and analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 21. For the categorical data frequencies were taken while the numerical data was summarized in the form of Mean ± SD. Normality of the scale variables was checked by Shapiro-wilk test and depending upon the normality of the variables, parametric or non-parametric analysis was performed. For the comparison of the difference of mean for numerical parameters Independent Student's T-test was applied. The genotype distribution and evaluation of controls for Hardy-Weinberg equilibrium was calculated by using online calculator,[15] which helps in the analysis of various genotypic distributions i.e. dominant, recessive, co-dominant or log-additive as well as the association of the risk of disease development with every Single Neucltise Polymorphism (SNP). Logistic regression was conducted for both the crude and adjusted analysis. Mann-Whitney U test was applied for com-parison of the non-normally distributed Vitamin D levels in genome of study participants. In this study, p value less than 0.05 was set for statistical significance.

Results

The results show that the mean age of controls was 39.4

Table II: *Comparison of age, menarche age, marital status and family history of Ca breast in study groups*

Parameter		Over All n (%)	Controls n (%)	Cases n (%)	χ^2 (df)	p-value*
Age (years)	21-30	31 (14.8)	22 (19.1)	09 (9.5)	7.174 (3)	0.06
	31-40	66 (31.4)	40 (34.8)	26 (27.4)		
	41-50	66 (31.4)	32 (27.8)	34 (35.8)		
	>50	47 (22.4)	21 (18.3)	26 (27.4)		
Age of Menarche (years)	<=12	85 (40.5)	49 (42.6)	36 (40.5)	0.480 (1)	0.49
	>12	125 (59.5)	66 (57.4)	59 (62.1)		
Marital Status	No	16 (7.6)	09 (7.8)	07 (7.4)	0.015 (1)	0.90
	Yes	194 (92.4)	106 (92.2)	88 (92.6)		
Family History	No	197 (93.8)	109 (94.8)	88 (92.6)	0.414 (1)	0.52
	Yes	13 (6.2)	06 (5.2)	07 (7.4)		

*Chi-square test was applied to compare categorical variables between groups. A *p-value < 0.05 was considered statistically significant.*

Table III: *Comparison of Serum Vitamin D (Mean + S.D) levels of study subjects according to student 't' test*

Parameter	Overall (n=210)	Controls (n=115)	Cases (n=95)	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Vitamin D (ng/ml)	25.65± 13.45	29.82 ± 17.1	22. 16±7.95	0.001*

*Mean + SD (Standard deviation), p-value calculated using Independent Samples t-test, *p-value <0.05 was considered statistically significant.*

±9.1 years, while the mean age of breast cancer patients was 43.6 ± 8.8 years. Most study subjects (62.8%) were between 31-50 years old. Age at menarche, marital status, and family history of breast cancer were similar between the two groups as shown in Table II.

Serum vitamin D levels were significantly higher in controls (29.82 ±17.1 ng/ml) compared to breast cancer patients (22.16 ± 7.95 ng/ml). as shown in Table III.

Table IV exhibits the genotype modeling to assess the association of Apa1 genotype with the disease. The Apa1 genotype distribution showed a slight increase in the "Aa" and "aa" genotypes among breast cancer patients compared to controls. Adjusted analysis showed an odds ratio of 2.03 (p=0.02) for the association between the "Aa" and "aa" genotypes and breast cancer.

The "Aa" genotype of the Apa1 polymorphism was associated with lower vitamin D levels in breast cancer patients compared to controls as shown in the Table V.

Table IV: *Genotype models for disease (Breast Cancer) association of Apa1 genotype*

Genotypes/ Models		Controls n (%)	Cases n (%)	*p*-value	OR crude [95% CI]	*p*-Value adjusted*	OR Adjusted* [95% CI]
Co-dominant Model	AA	83 (72.2)	58 (61.0)	0.23	1.00	0.07	1.00
	Aa	23 (20.0)	26 (27.4)		1.62 (0.84-3.11)		1.83 (0.90-3.75)
	Aa	09 (7.8)	11 (11.6)		1.75 (0.68-4.49)		2.64 (0.93-7.53)
Dominant Model	AA	83 (72.2)	58 (61.0)	0.08	1.00	0.02	1.00
	Aa & aa	32 (27.8)	37 (39.0)		1.65 (0.93-2.96)		2.03 (1.07-3.86)
Recessive Model	AA & Aa	106 (92.2)	84 (88.4)	0.36	1.00	0.12	1.00
	Aa	09 (7.8)	11 (11.6)		1.54 (0.61-3.89)		2.23 (0.80-6.22)
Over-dominant	AA & aa	92 (80.0)	69 (72.6)	0.21	1.00	0.18	1.00
	Aa	23 (20.0)	26 (27.4)		1.51 (0.79-2.86)		1.61 (0.80-3.24)
Log-additive	---	---	---	0.1	1.41 (0.93-2.13)	0.02	1.69 (1.07-2.68)

p-values were calculated using binary logistic regression analysis under co-dominant, dominant, recessive, over-dominant, and log-additive genetic models. Adjusted p-values and odds ratios (ORs) were obtained after controlling for age, body mass index (BMI), marital status, age at menarche, parity, history and duration of breastfeeding, use of hormonal therapy, menopausal status, and consanguinity. A p-value of <0.05 was considered statistically significant.

Table V: *Comparison of Vitamin D levels among different genotypes of study subjects*

Parameter		Vitamin D levels			Mann-Whitney U	p-value
		Over all	Controls	Cases		
		Median (IQR)	Median (IQR)	Median (IQR)		
Apa1 genotype	AA	27.14 (16.8)	22.77 (23.9)	28.74 (56.9)	1198.5	0.164
	Aa	18.52 (17.4)	35.15 (31.9)	14.91 (7.1)	62.5	< 0.000*
	aa	18.86 (11.9)	20.12 (20.5)	18.86 (11.1)	33.0	0.98

*Data are presented as Median (Interquartile Range, IQR). p-values calculated using the Mann–Whitney U test for comparison of vitamin D levels between cases and controls within each Apa1 genotype. *p < 0.05 was considered statistically significant.*

Discussion

This study provides evidence of a significant association between reduced serum 25(OH) vitamin D levels and increased risk of breast cancer in Pakistani women. The mean serum vitamin D level was notably lower in breast cancer patients compared to healthy controls.

Additionally, a higher frequency of the "Aa" and "aa" genotypes of the Apa1 polymorphism in the vitamin D receptor (VDR) gene was observed among breast cancer patients, and these genotypes were associated with significantly lower serum vitamin D levels. These findings underscore a potential gene- environment interaction that may influence breast cancer susceptibility. Several studies have established a protective role of vitamin D in breast tissue, with its anti-proliferative, pro-differentiation, and immune-modulating effects mediated through VDR signaling.[5,9] Low serum 25(OH)D levels have been associated with increased risk and poor prognosis in breast cancer, particularly in postmeno-pausal women.[16] The findings of the current study align with a large meta-analysis that demonstrated a dose–response inverse relationship between vitamin D status and breast cancer risk.[17] In the present study, 36.5% of cases were vitamin D deficient (<20 ng/mL) compared to 22.5% of controls, supporting these observations.

Findings from regional studies further reinforce this association. Ismail et al. reported significantly lower vitamin D levels in Egyptian women with breast cancer, where deficiency correlated with advanced tumor stage and nodal involvement.[18] Similarly, El-Shorbagy et al. also reported a negative prognostic impact of low vitamin D in Egyptian breast cancer patients.[19] Beyond vitamin D levels alone, genetic polymorphisms in the VDR gene may influence how vitamin D functions in the body. The ApaI polymorphism (rs7975232), located in intron 8 of the VDR gene, may affect mRNA stability and expression of the receptor.[20] In the current study, the dominant genotype model (Aa + aa) was significantly associated with increased breast cancer risk (adjusted OR: 2.03, $p = 0.02$). This is in agreement with Curran et al., who first reported an increased frequency of "Aa" and "aa" genotypes among breast cancer cases.[21] Yao et al. further demonstrated that combined effects of VDR polymorphisms and vitamin D deficiency may synergistically increase breast cancer risk, highlighting the importance of gene–environment interactions.[22] In this study, the "Aa" genotype was not only more prevalent in cases but was also associated with significantly lower serum vitamin D levels among patients. This suggests that the ApaI polymorphism may affect VDR function, potentially reducing vitamin D activity and contributing to the lower vitamin D levels observed in these individuals. Similar findings have been observed by Colagar et al., who reported lower vitamin D levels among women with "a" alleles of the VDR gene, further supporting the idea of a functional consequence of this SNP.[23]

The widespread vitamin D deficiency in Pakistan has been well documented, despite abundant sunlight. Cultural clothing practices, limited outdoor exposure, lack of food fortification, and insufficient dietary intake are likely contributing factors.[24] Given the high prevalence of vitamin D deficiency in the Pakistani population, this association becomes particularly significant, as recent research has demonstrated a strong link between lower vitamin D levels and an increased risk of breast cancer.[25] This deficiency may be especially concerning in genetically susceptible individuals, as suggested by our findings. VDR polymorphisms such as ApaI may also have implications for prognosis and therapeutic response. Therefore, screening for vitamin D levels and VDR genotypes could aid in risk stratification and guide potential preventive or therapeutic interventions.

Conclusion

In conclusion, this study demonstrates that both low serum vitamin D levels and the ApaI polymorphism in the vitamin D receptor (VDR) gene are significantly associated with breast cancer in Pakistani women. While vitamin D deficiency is well-recognized in the Pakistani population, our findings find the association of these low levels with breast cancer. These results emphasize the importance of exploring gene– environment interactions in disease prevention and suggest that maintaining adequate vitamin D status may have implications for breast cancer risk reduction.

Limitations and Recommendations

This study had certain limitations. The use of a convenience sampling technique may have introduced selection bias, thereby limiting the generalizability of the results to the wider population. Additionally, the cross-sectional study design restricts the ability to infer causality between serum vitamin D levels, VDR gene polymorphisms, and breast cancer risk. As serum vitamin D concentration was measured only once, potential fluctuations due to seasonal variation could not be accounted for. Moreover, the absence of tumor subtype information

(ER, PR, HER2) may have influenced the observed associations. The study also did not include other important vitamin D receptor polymorphisms such as FokI, BsmI, and TaqI, which might further elucidate gene – environment interactions relevant to breast cancer susceptibility.

Conflict of interest: None

Funding Disclosure: The study was supported by funds from University of Health Sciences Lahore.

Acknowledgments: None

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide. CA Cancer J Clin. 2021;71(3):209–249. doi: 10.3322/caac.21660.
2. Aslam A, Mustafa AG, Hussnain A, Saeed H, Nazar F, Amjad M, et al. Assessing Awareness, Attitude, and Practices of Breast Cancer Screening and Prevention Among General Public and Physicians in Pakistan: A Nation With the Highest Breast Cancer Incidence in Asia. Int J Breast Cancer. 2024;2024:2128388. doi: 10. 1155/2024/2128388.
3. Bhurgri Y. Karachi Cancer Registry Data – Implications for the National Cancer Control Program. Asian Pac J Cancer Prev. 2004;5(1):77–82. Available on https://pubmed.ncbi.nlm.nih.gov/15075010/.
4. Tao Z, Shi A, Lu C, Song T, Zhang Z, Zhao J. Breast Cancer: Epidemiology and Etiology. Cell Biochem Biophys. 2015;72(2):333-338. doi: 10.1007/s12013-014-0459-6.
5. Haussler MR, Livingston S, Sabir ZL, Haussler CA, Jurutka PW. Vitamin D receptor mediates a myriad of biological actions dependent on its 1,25 dihydroxyvitamin D ligand: distinct regulatory themes revealed by induction of Klotho and fibroblast growth factor 23. JBMR Plus. 2020;5(1):e10432. doi:10.1002/ jbm4. 10432.
6. Grant WB, Boucher BJ. Why Vitamin D Clinical Trials Should Be Based on 25-Hydroxyvitamin D Concentrations. J Steroid Biochem Mol Biol. 2018; 177: 266–269. doi: 10.1016/j.jsbmb.2017.08.009
7. Bahador M, Saeedi Nejad M, Dabiri S, Larizadeh MH, Soofiabadi MF. Investigating the level of vitamin D receptor gene expression in two tumoral and healthy breast tissues in breast cancer patients and its association with prognostic factors. J Egypt Natl Cancer Inst. 2024; 36(1): 12. doi:10.1186/s43046-024-00215-5
8. Mishra DK, Wu Y, Sarkissyan M, Sarkissyan S, Chen Z, Shang X, Ong M, et al. Vitamin D receptor gene polymorphisms and prognosis of breast cancer among African-American and Hispanic women. PLoS One. 2013; 8(3):e57967. doi: 10.1371/journal.pone.0057967.
9. Zhang K, Song L. Association between vitamin D receptor gene polymorphisms and breast cancer risk: a meta-analysis of 39 studies.PLoS One. 2014;9(4):e96125. doi: 10.1371/journal.pone.0096125
10. Mahar BA, Qamar S, Sattar S, Rozina M, Jamshed W, Qamar A. Vitamin D Deficiency Prevalence in Pakistan: Common, Important, and Neglected: A Comprehensive Meta-Analysis. J Diabetol. 2024;15(4):335-348. doi: 10.4103/jod.jod_61_24
11. Abd-Elsalam EA, Ismaeil NA, Abd-Alsalam HS. Vitamin D receptor gene polymorphisms and breast cancer risk among postmenopausal Egyptian women. Tumour Biol. 2015;36(8):6425-6331. doi: 10.1007/s13277-015-3332-3.
12. Buyru N, Tezol A, Yosunkaya-Fenerci E, Dalay, N. Vitamin D receptor gene polymorphisms in breast cancer. Exp Mol Med. 2003;35(6):550–555. doi: 10.1038/emm.2003.72
13. Dalessandri KM, Miike R, Wiencke JK, Farren G, Pugh TW, Manjeshwar S, et al. Vitamin D receptor polymorphisms and breast cancer risk in a high-incidence population: a pilot study. Am Coll Surg. 2012;215(5):652-657. doi: 10.1016/j.jamcollsurg.2012.06.413.
14. Ali R, Maqbool SA, Khan TA. Vitamin D Receptor Microsatellite Repeats in the 3'untranslated region: Relation to Early Onset Breast Cancer among Pakistani Women. Adv Basic Med Sci. 2022;6(2). doi: 10.35845/abms.2022.2.236
15. OEGE - Online Encyclopedia for Genetic Epidemiology studies. Hardy-Weinberg equilibrium calculator [Internet]. Available from: http://www.oege.org/software/hwe-mr-calc.shtml SNPStats [Internet]. Available from: http://bioinfo.iconcologia.net/index.php?module=Snpstats
16. Song D, Deng Y, Liu K, Zhou L, Li N, Zheng Y, Hao Q, Yang S, Wu Y, Zhai Z, Li H, Dai Z. Vitamin D intake, blood vitamin D levels, and the risk of breast cancer: a dose-response meta-analysis of observational studies. Aging (Albany NY). 2019;11(24):12708-12732. doi: 10.18632/aging.102597.
17. Mohr SB, Gorham ED, Garland CF, Kane CJ, Macera CA, Parsons JK et al. Serum 25-hydroxyvitamin D and prevention of breast cancer: pooled analysis. Anticancer Res. 2011;31(9):2939–2948. PMID: 21868542

18. Ismail A, El-Awady R, Mohamed G, Hussein M, Ramadan SS. Prognostic Significance of Serum Vitamin D Levels in Egyptian Females with Breast Cancer. Asian Pac J Cancer Prev. 2018;19(2):571-576. doi: 10.22034/ APJCP.2018.19.2.571.
19. El-Shorbagy S, Haggag R, Ebian HF, et al. Prognostic impact of 25-hydroxyvitamin D levels in Egyptian patients with breast cancer. J Cancer Sci Ther. 2017; 9(6):496–502. doi:10.4172/1948-5956.1000466.
20. Li Y, Zhang J, Tian F, Anvarifard P, Li N. Association between vitamin D receptor polymorphism and breast cancer in women: An umbrella review of meta-analyses of observational investigations. Exp Gerontol. 2024; 194:112502. doi: 10.1016/j.exger.2024.112502.
21. Curran JE, Vaughan T, Lea RA, Weinstein SR, Morrison NA, Griffiths LR. Association of a vitamin D receptor polymorphism with sporadic breast cancer develop-ment. Int J Cancer. 1999;83(6):723–726. doi: 10. 1002/ (SICI)10970215(19991201)83-:6<723::AID-IJC6 >3.0.CO;2-1
22. Yao S, Zirpoli G, Bovbjerg DH, Jandorf L, Hong CC, Zhao H, et al. Variants in the vitamin D pathway, serum levels of vitamin D, and estrogen receptor negative breast cancer among African-American women: a case-control study. Breast Cancer Res. 2012;14(2):R58. doi: 10.1186/bcr3162.
23. Colagar AH, Firouzjah HM, Halalkhor S. Vitamin D receptor poly(A) microsatellite polymorphism and 25-hydroxyvitamin D serum levels: Association with susceptibility to breast cancer. J Breast Cancer. 2015; 18(2):119–125. doi:10.4048/jbc.2015.18.2.119
24. Mahmood Y, Waris N, Fawwad A, Basit A. Vitamin D deficiency and diseases: a review from Pakistan. J Diabetol. 2021;12(4):391–400. doi:10.4103/jod.jod_32 _ 21.
25. Pereira TSS, Marques SSA, Olandoski M, Polakowski CB, Beltrame OC, Elifio-Esposito S, et al. Vitamin D and Breast Cancer Risk: Evaluating the Association and Effective Risk Reduction. Breast Care (Basel). 2024 ;19(4):197-206. doi: 10.1159/000539750.

Authors Contribution

All authors have read the final version and are responsible for the integrity of the study.

SD: Conception of the idea, literature search, data analysis, writeup and revision.

SN & IA: Literature search, data interpretation and write up and review.

AI, RA & MAS: Data collection and analysis, write up and revision.

Original Article

Frequency Of Primary Postpartum Hemorrhage in Tertiary Care Hospital, Hayatabad Medical Complex Peshawar: A Descriptive Cross Sectional Study

Saima Ahmed,[1] Syeda Madiha Tahir,[1] Sadaf Ali,[1] Syed Muhammad Asim,[1] Ayesha Khalid[2]

[1]Department of Obstetrics & Gynecology, Hayatabad Medical Complex MTI-Peshawar; [2]Department of Microbiology, Garrison University, Lahore-Pakistan

How to cite: Ahmed S, Tahir SM, Ali S, Asim SM, Khalid A. Frequency of primary postpartum hemorrhage in tertiary care hospital, Hayatabad Medical Complex Peshawar: A descriptive cross sectional study. J Lahore Med Dent Coll. 2025; 2 (2): 54-60

DOI: 10.70384/jlmdc.v2i02.81

Abstract

Background: Postpartum hemorrhage (PPH) is an obstetric emergency that causes almost 25% of deaths among pregnant ladies every year globally.

Objective: To determine the frequency of primary postpartum hemorrhage and its risk factors in Hayatabad Medical Complex Peshawar.

Methodology: It was a descriptive study that was held at Department of Gynecology& Obstetrics, Hayatabad Medical Complex, Peshawar, Pakistan which enrolled 162 patients through non-probability consecutive sampling. After informed consent, history was taken, and physical examination was done. Demographic details of all patients were documented. All female patients in spontaneous labour reporting in emergency with a single, alive, healthy, full term (≥ 37 weeks) pregnancy with parity up to 7 were enrolled. Patients who had blood loss more than 500 ml in spontaneous vaginal delivery (SVD) and ≥ 1000 ml in cesarean section were taken as postpartum hemorrhage. All the data was processed by SPSS v26.0. Quantitative variables were presented as mean ± SD. Qualitative variables were presented in terms of frequencies and percentages. Post-stratification, chi-square test was applied taking p-value ≤ 0.05 as significant.

Results: Mean age of patients with PPH was 31.44 ± 5.7years. PPH was seen in 32.1% (n=52) cases among enrolled patients (n=162). PPH when stratified for gestational age and maternal age showed insignificant p-value ≥ 0.05. PPH when stratified with mode of delivery showed significant difference with p-value of 0.018.

Conclusion: The study concluded that postpartum hemorrhage occurs with high frequency in the studied Pakistani population. Moreover, PPH is more common following spontaneous vaginal delivery and is associated with uterine atony, which remained the most frequent underlying cause

Key words: Frequency, Primary Postpartum Hemorrhage, Risk Factors, Tertiary Care Hospital.

Correspondence:
Dr. Ayesha Khalid, *Department of Microbiology, Garrison University, Lahore Pakistan.*
Email: ayeshahumair03@gmail.com

Submission Date: July 13, 2025
1st Revision Received: July 17, 2025
2nd Revision Received: September 24, 2025
3rd Revision Received: October 9, 2025
Copyedited and Corrected: November 20, 2025
Final Revision Accepted: November 25, 2025

Introduction

Postpartum hemorrhage (PPH) is an obstetric emergency that accounts for nearly 25% of maternal deaths worldwide each year, particularly in Africa and Asia.[1] Women in low income countries have a higher risk of death (1 in 100) than in high-income countries (1 in 1000). The global prevalence of postpartum hemorrhage is reported at 6% with the

prevalence reported at 10.5% in Africa and 2.55% in Asia.[2] Postpartum hemorrhage is a major cause of maternal mortality accounting for 25% of all maternal deaths internationally.[3]

PPH is defined as a blood loss of ≥500 mL after vaginal birth or ≥1000 mL after caesarean birth within 24 hours. The blood loss in PPH is sufficient to cause hypovolemia resulting in more than a 10% fall in hematocrit occurring within 24 hours of birth or necessitating blood transfusion.[4] The common causes of postpartum hemorrhage are uterine atony, vaginal hematoma, genital tract injuries, retained or adherent placental tissue, coagulation abnormalities, uterine inversion and ruptured uterus.[5] Multiple risk factors for postpartum hemorrhage include past history of postpartum hemorrhage, uterine atony, grand multigravida, older maternal age, preterm births, genital tract injuries, lack of prophylactic oxytocin use, induced labour, intrauterine fetal death, cesarean section, placenta previa or accreta, coagulation abnormalities, anemia, prolonged labour and instrumental vaginal delivery.[6] Maternal morbidity and mortality associated with postpartum hemorrhage can be prevented if the condition is promptly identified and adequately managed. The complications associated with PPH include anemia, disseminated intravascular coagulation, hypovolemic shock, liver dysfunction, renal failure, blood transfusions, hysterectomy, acute respiratory distress and death.[7] A literature review revealed that frequency of primary postpartum hemorrhage was 18.60%.[3] The most common cause of primary PPH was uterine atony (57.6%), followed by genital tract tears (29.2%), retained placental tissue (10%), uterine rupture (3.6%) and uterine inversion (1.6%) respectively.[3] One researcher reported the prevalence of primary PPH to be 1.19% in Saudi Arabian women and 7.2% in Pakistani women.[8]

The rationale of present study is that postpartum hemorrhage is a major cause of maternal mortality in our country with considerable variability over the exact frequency and its association with risk factors in Pakistani population. In a developing country like Pakistan, it is the need of the hour to identify the women at risk of developing PPH through prompt identification of its causes. The current study was planned with the aim to determine the frequency of primary postpartum hemorrhage and its risk factors in Hayatabad Medical Complex Peshawar. The findings of this study will not only help in developing local evidence-based practices to decrease the burden of PPH but also in improving delivery settings for the prevention of PPH.

Methodology

It was a descriptive cross-sectional study conducted at the Department of Gynecology & Obstetrics, Hayatabad Medical Complex, Peshawar-Pakistan which enrolled 162 patients through non-probability consecutive sampling.[3] The duration of the study was six months following ethical approval. The sample size was calculated using the WHO sample size calculator for population proportion with specified absolute precision, taking a 95% confidence level, 6% absolute precision, and an anticipated population proportion of 18.6%.[3]

Ethical Consideration: After obtaining ethical approval (Reference No.: CPSP/REU/OBG-2016-021-7997, dated June 24, 2019), informed written consent was taken, and demographic parameters, including age, gravidity, parity, and duration of gestation, were docu-mented for all patients.

Inclusion criteria: A relevant clinical examination was performed, followed by necessary investigations and delivery. Labor and birth details were documented, including duration of labor; mode of delivery (spontaneous, instrumental, or cesarean section); placenta delivery time (complete or piecemeal), and estimated blood loss was calculated by counting the number of soaked pads since delivery. The amount of blood loss was recorded. Patients who had blood loss >500 mL in SVD and ≥1000 mL in cesarean section were classified as having postpartum hemorrhage. Active management of the third stage of labor was performed by an experienced gynecologist.

Exclusion criteria: Patients who had pregnancy associated with hypertension, diabetes, obesity, anemia, fever, chorioamnionitis, polyhydramnios, placenta previa, placenta accreta or placental abruption, ruptured uterus, uterine inversion, fetal congenital anomalies, preterm, intrauterine fetal death, twin pregnancies and secondary PPH were excluded from the study.

Statistical Analysis:

All data were processed using SPSS version 26.0. Nor-

mality of the data distribution was evaluated using the Shapiro–Wilk test to determine the suitability of parametric tests. Quantitative variables like maternal age, gravidity, parity, and gestational age were presented as mean ± standard deviation (SD). Qualitative variables like postpartum hemorrhage status, mode of delivery, and etiology of PPH were presented in terms of frequencies and percentages. Post-stratification, the chi-square test was applied, taking p-value ≤ 0.05 as statistically significant.

Results

Baseline parameters of all enrolled patients (n=162) in terms of age, gestational age, gravidity, parity, mode of delivery, PPH, and genital tract tear were presented as frequencies and percentages in Table I. The mean ± SD for age was 31.44 ± 5.7 years. PPH was seen in 32.1% (n=52) of the cases among the enrolled patients.

Table I: *Baseline Characteristics of the Enrolled Patients (n = 162)*

Parameters	Categories	Frequency (n)	Percentage (%)
Age (years)	18-25	36	22.2
	26-32	79	48.8
	33-40	47	29
	Mean ± SD (Years)	31.44 ± 5.7	
Gestational Age (weeks)	35-36.6	46	28.4
	37-39.9	71	43.8
	>40	45	27.8
	Mean ± SD (weeks)	32.44 ± 9.8	
Gravidity (weeks)	1-3	83	51.8
	4-6	79	48.8
	Mean ± SD	32.44 ± 9.8	
Parity	1 -2	58	35.8
	3-4	82	50.6
	>4	22	13.6
Mode of Delivery	SVD	76	46.9
	Cesarean Section	86	53.1
PPH	Yes	52	32.1
	No	110	67.9
Genital Tract tear	Yes	49	30.2
	No	113	69.8
Uterine atony	Yes	96	59.3
	No	66	40.7

Table II: *Stratification of Primary Postpartum Hemorrhage by Gestational Age Groups*

		Gestational Age			Total	P-value
		35-36+	37-39+	>40		
Primary Postpartum Hemorrhage	Yes	15	21	15	51	0.459
	No	31	51	29	111	
Total		46	72	44	162	
Stratification of Primary Postpartum Hemorrhage with Maternal Age groups						
Maternal Age (years)		18-25	26-32	33-40	Total	p-value
Primary Postpartum Hemorrhage	Yes	16	20	15	51	4.266
	No	20	60	31	111	
Total		36	80	46	162	

p value < 0.05 significant, p value calculated by Chi square test of association

Table III: *Primary Postpartum Hemorrhage stratification with Mode of Delivery*

		Mode of Delivery		Total	P-value
		Normal Vaginal Delivery	Cesarean Section		
Primary Postpartum Hemorrhage	Yes	24	27	51	0 .028*
	No	52	59	111	
Total		76	86	162	

*p value < 0.05 significant, p value calculated by Chi square test of association, *Statistically significant*

Post partum hemorrhage was stratified for gestational age, maternal age and mode of delivery as shown in Table-II. PPH when stratified for gestational age and maternal age that showed insignificant p-value ≥ 0.05.

PPH when stratified with mode of delivery showed significant difference with p-value of 0.028 as shown by Table-III.

Discussion

The effectiveness of a nation's health care system is reflected in maternal mortality or morbidity. Twenty five percent of maternal mortality worldwide and

sixty percent in some underdeveloped nations are caused 1 by postpartum hemorrhage. Prevalence of PPH in Pakistan has been documented as 34%.[5] In the present study, the frequency of PPH was 18.6%, which is lower than this earlier national estimate but higher than the 2.5% incidence reported in a tertiary hospital in Greece by Mitta et al.[9] Differences in study design, population characteristics, case definition and methods of blood-loss assessment may explain the variability in reported rates.

PPH has been reported to be less common in high-income settings, affecting roughly 2–11% of deliveries, but is more frequent and more deadly in many low and middle-income countries, including those in sub-Saharan Africa, where it accounts for around one-third of maternal deaths.[2,10] The majority of patients (74.8%) who experienced PPH in the current study were un-booked, meaning they had not used the prenatal health services and had not been evaluated for the possibility of developing PPH during birth. Globally, variations in prevalence reflect disparities in access to skilled birth attendants, facility-based deliveries, and Active Management of the Third Stage of Labor (AMTSL), all of which significantly influence outcomes. Recent WHO data reaffirms that the risk of maternal mortality due to PPH in low-income countries is almost tenfold higher than in high-income nations.[11] In such contexts, even moderate delays in diagnosis and response significantly increase morbidity and mortality.

In the present study, uterine atony and lower genital tract lacerations were found to be the primary causes of postpartum hemorrhage. This pattern is consistent with previous literature, which identifies atony as the leading cause of PPH and highlights genital tract trauma as another major contributor.[10,12] The incidence of uterine atony was 58% in one earlier study, which is comparable to our findings of 59.3%.[13] Uterine atony remains the leading cause of primary PPH globally. Oxytocin remains the standard uterotonic used during active management of the third stage of labor. However, in resource-limited settings where oxytocin storage or administration is a challenge, misoprostol or heat 15 stable carbetocin offer feasible alternatives as reflected in recent clinical studies in which oxytocin served as the comparator against carbetocin, including randomized trials of heat-stable carbetocin and dose-finding studies of carbetocin in caesarean delivery.[14,15] Recent Cochrane meta-analyses suggest that combination regimens such as ergometrine-oxytocin are more effective in reducing severe PPH than single-agent therapy, although implementation must consider side-effect profiles and storage feasibility.[16] Oxytocin-assisted active third-stage labor management lowers the incidence of PPH by 40%.[16] Because Misoprostol 800 micrograms per rectum is affordable and can be kept at room temperature, it can be used in place of injectable oxytocic medications for the prevention of PPH in home or basic health facility births.[16] Patients who are at risk of developing PPH should be referred to medical facilities with trained medical staff and blood banks. In 29.2% of cases in our study, lower genital tract injuries during delivery were discovered. Differences in the distribution of PPH etiologies, such as genital tract lacerations, have been reported across studies, and variations may be influenced by population characteristics, delivery practices, and gestational age, which is known to affect PPH risk.[17] According to a hospital-based study from Nigeria, 11.84% of PPH cases were attributed to tears of the vulva, perineum, vagina, cervix or uterus.[18] Genital tract trauma is recognized as a key contributor to hemorrhage in both vaginal and operative deliveries. Routine post-delivery inspection of the birth canal, particularly after instrumental birth or prolonged labor, is therefore essential. The RCOG Green-top Guideline No. 52 specifically emphasizes early recognition and skilled repair of perineal and genital tract trauma as part of effective PPH prevention and management.[18,19] Furthermore, supervised training and mannequin drills for junior residents performing instrumental deliveries can reduce iatrogenic injuries and improve patient outcomes. These results emphasize that for postgraduate trainee physicians to perform instrumental deliveries, appropriate supervision and training are required. The need for early recognition of bleeding cannot be over emphasized. Traditional visual estimation underestimates blood loss by up to

50%. WHO and ACOG now recommend using calibrated drapes and quantitative blood loss (QBL) protocols as standard practice.[14,19-20] Implementing QBL rather than relying on soaked pad counts, as used in this study, would provide more accurate diagnosis and timely intervention. Moreover, recent evidence from the E-MOTIVE trial has revolutionized early PPH care. This multicenter randomized trial showed that using a bundled approach including uterine massage, oxytocin, tranexamic acid (TXA), IV fluids, and early team escalation, reduced severe bleeding by 60%.[20,21] This highlights the importance of bundle-based management and structured team responses. TXA, in particular, has emerged as a first-line adjunctive therapy. The WOMAN trial demonstrated a significant reduction in maternal deaths due to bleeding when TXA was administered within 3 hours of birth.[21,22] Its incorporation into first-response kits in all labor rooms could be a cost-effective, high-impact intervention. There should be mannequin drills, and senior registrar-level physicians with the necessary skills should either perform instrumental deliveries themselves or allow junior physicians to do so under close super vision. Primary PPH is a potentially fatal obstetric emergency that raises Pakistan's rate of maternal morbidity and mortality. According to the current research, primary PPH is more common in our healthcare system than in the developed world.

Conclusion

Postpartum hemorrhage continues to be a major obstetric concern in Pakistan, with this study demonstrating a high frequency of PPH in the studied population. Uterine atony emerged as the most frequent underlying cause, followed by genital tract injuries, and PPH was found to be more common following spontaneous vaginal delivery. These findings underline the need for vigilant intrapartum monitoring and timely management to reduce preventable complications. Strengthening maternal healthcare services, ensuring early risk identification, and promoting adherence to evidence-based preventive measures remain essential to mitigating the burden of PPH and improving maternal outcomes.

Limitations and Recommendations

This study was conducted at a single tertiary care hospital, which may limit the generalizability of its findings to other settings, particularly rural or primary healthcare environments. The cross-sectional design restricts the ability to establish causal relationships between identified risk factors and the occurrence of postpartum hemorrhage. Additionally, the use of visual estimation and pad counts for assessing blood loss may have introduced measurement bias, potentially underestimating the actual prevalence of PPH. The exclusion of certain high-risk obstetric cases also limits the scope and applicability of the results.

To improve maternal outcomes and reduce the burden of PPH, early antenatal booking and regular follow-ups should be strongly encouraged. Training programs focused on emergency obstetric care and perineal repair must be implemented for clinical staff, particularly junior residents. Active management of the third stage of labor should be standardized in all delivery settings. Health facilities must adopt quantitative blood loss monitoring instead of subjective estimation methods and ensure the timely availability of uterotonics and tranexamic acid. Public health efforts should focus on educating communities about the importance of institutional deliveries, early recognition of danger signs, and seeking timely care. Strengthening referral systems and equipping healthcare system with essential resources are also vital to address life-threatening obstetric emergencies like PPH.

Conflict of interest: None
Funding Disclosure: None
Acknowledgments: The authors are thankful to their senior colleague for valuable guidance and support throughout this study and also extend gratitude to all colleagues for their valuable input.

References

1. Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. Lancet. 2006 Apr 1;367(9516):1066-1074. doi: 10.1016/S0140-6736(06)68397-9.
2. CCox AL, Shainker SA. Postpartum hemorrhage: a comprehensive review of medical and surgical treatment. Maternal Fetal Med. 2025. doi:10.1097/FM9.00000-00000000302.

3. Deneux-Tharaux C, Bonnet MP, Tort J. Epidemiology of post-partum haemorrhage. Journal de gynecol, obstet biol de la reprod. 2014 ;43(10):936-950. doi:10.1016/j.jgyn.-2014.09.023
4. Bell SF, Watkins A, John M, Macgillivray E, Kitchen TL, James D, et al. Incidence of postpartum haemorrhage defined by quantitative blood loss measurement: a national cohort. BMC Pregnancy Childbirth. 2020 ;20(1):271. doi:10.1186/s12884-020-02971-3.
5. Munir SI, Sadiq A, Ishtiaq S. Frequency of causes of primary postpartum haemorrhage in a tertiary care hospital. Ann King Edward Med Uni. 2025;21(1):33-38. doi:10.21649/akemu.-v21i1.692.
6. Betti T, Gouveia HG, Gasparin VA, Vieira LB, Strada JKR, Fagherazzi J. Prevalence of risk factors for primary postpartum hemorrhage in a university hospital. Rev Bras Enferm. 2023;76(5):e20220134. doi: 10.1590/0034-7167-2022-0134.
7. Nigussie J, Girma B, Molla A, Tamir T, Tilahun R. Magnitude of postpartum hemorrhage and its associated factors in Ethiopia: a systematic review and meta-analysis. Reprod Health. 2022;19(1):63. doi: 10.1186/s12978-022-01360-7.
8. Ende HB, Lozada MJ, Chestnut DH, Osmundson SS, Walden RL, Shotwell MS, et al. Risk Factors for Atonic Postpartum Hemorrhage: A Systematic Review and Meta-analysis. Obstet Gynecol. 2021;137(2):305-323. doi: 10.1097/AOG.0000000000004228.
9. Mitta K, Tsakiridis I, Dagklis T, Grigoriadou R, Mamopoulos A, Athanasiadis A, et al. Incidence and risk factors for postpartum hemorrhage: a case-control study in a tertiary hospital in Greece. Medicina. 2023 ;59(6):1151. doi:10.3390/medicina59061151.
10. Andrikopoulou M, D'Alton ME. Postpartum hemorrhage: early identification challenges. In Seminars in perinatology 2019;43(1):11-17. doi:10.1053/j.semperi.2018.11.003.
11. Menezes RM, Cardoso PM, Tiwari P. A Retrospective Study of Maternal Mortality at a Tertiary Care Hospital. JSAFOG 2025;17(1):51-57. doi:10.5005/jp-journals-10006-2593.
12. Coviello E, Iqbal S, Kawakita T, Chornock R, Cheney M, Desale S, et al. Effect of Implementing Quantitative Blood Loss Assessment at the Time of Delivery. Amer J Perinatol 2019;36 (13):1332–1336. doi:10.1055/s-0039-1688823.
13. Liu C, Yu F, Xu Y, Li J, Guan Z, Sun M, et.al. Prevalence and Risk Factors of Severe Postpartum Hemorrhage: A Retrospective Cohort Study. BMC Pregnancy Childbirth 2021; 21 (1): 332. doi:10.1186/s12884-021-03818-1.
14. Tyagi A, Sasi T, Nigam C, Rautela RS, Malhotra RK, Suneja A. Minimum effective dose of carbetocin for preventing uterine atony during Cesarean delivery in patients with and without preeclampsia: a biased sequential allocation study: Can J Anaesth. 2025;72(8):1305-1313. doi: 10.1007/s12630-025-03005-2.
15. Vernekar SS, Goudar SS, Metgud M, Pujar YV, Somannavar MS, Piaggio G, et al. Effect of heat stable carbetocin vs oxytocin for preventing postpartum haemorrhage on post-delivery hemoglobin–a randomized controlled trial. J Matern Fetal Neonatal Med. 2022 ;35(25):8744-8751. doi:10.1080/14767058.2021.2001799.
16. Gallos ID, Papadopoulou A, Man R, Athanasopoulos N, Tobias A, Price MJ, et al. Uterotonic agents for preventing postpartum haemorrhage: a network meta-analysis. Cochrane Database Syst Rev. 2018;12(12)-:CD011689. doi:10.1002/14651858.CD011689.pub3.
17. Butwick AJ, Liu C, Guo N, Bentley J, Main EK, Mayo JA, et al. Association of Gestational Age with Postpartum Hemorrhage: An International Cohort Study. Intel J Med Anesthesiology. 2021;134 (6):874–886. doi:10.1097/aln.0000000000003730.
18. Ajenifuja KO, Adepiti CA, Ogunniyi SO. Post partum haemorrhage in a teaching hospital in Nigeria: a 5-year experience. Afr Health Sci. 2010;10(1):71-4. PMID: 20811528
19. Prevention and Management of Postpartum Haemorrhage: Green-top Guideline No. 52. BJOG. 2017;124(5):e106-e149. doi: 10.1111/1471-0528.14178.
20. Shields LE, Goffman D, Caughey AB. ACOG practice bulletin:2017 Oct 1;130(4):e168-186. doi:10.1097/AOG.0000000000002351
21. Gallos I, Devall A, Martin J, Middleton L, Beeson L, Galadanci H, et al. Randomized trial of early detection and treatment of postpartum hemorrhage. N Engl J Med. 2023;389(1):11-21. doi: 10.1056/NEJMoa2303966.

22. Shakur H, Roberts I, Fawole B, Chaudhri R, El-Sheikh M, Akintan A, et al. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial. The Lancet. 2017;389(10084):2105-2116. doi: 10.1016/S0140-6736(17)30638-4.

Authors Contribution:

SA: Conceptualization of Project, Data collection and Revision

SMT: Data Collection, Statistical Analysis and Revision of manuscript.

SA: Literature Search, Drafting and Proof Reading.

SMA: Statistical Analysis, Data collection and Revision

AK: Drafting, Writing of manuscript and Revision.

Original Article

Upper Airway Dimensional Changes After Two and Four Premolar Extractions: A Retrospective Analytical Study

Maira Mubashar,[1] Asma Shafique,[1] Hafiz Muhammad Ali Jameel,[1] Maleeha Mustafa,[1] Fizza Tahir,[2] Mariyah Javed[2]

[1] Department Of Orthodontics, Lahore Medical And Dental College, Lahore; [2]Department of Prosthodontics , Rahbar Medical And Dental College, Lahore

How to cite: Mubashar M, Shafique A, Jameel HMA, Mustafa M, Tahir F, Javed M. Upper airway dimensional changes after two and four premolar extractions: A retrospective analytical study. J Lahore Med Dent Coll. 2025; 2 (2): 61-67

DOI: 10.70384/jlmdc.v2i02.87

Abstract

Background: Upper airway space (UAS) structures play a significant role in the development of the craniofacial complex and are key parameters in orthodontic diagnosis and treatment planning. Airway space can be influenced by different extraction patterns.

Objective: To compare the effect on upper airway dimensions in orthodontic patients with two and four-premolar extraction patterns.

Methodology: The study was conducted in the Department of Orthodontics, Lahore Medical and Dental College, after approval from the Institutional Review Board and Ethical Committee. Patient's records from January 2020 to December 2023 were assessed. A total of 45 orthodontic patients aged 16–20 years with a dental Class II pattern and no significant medical history were included. All patients were treated with fixed orthodontic appliances. Standardized lateral cephalograms were traced manually on acetate paper, and nasopharyngeal airway dimensions were measured before and after orthodontic treatment. Descriptive statistics and paired t-tests were used to assess changes in pre and post-treatment values.

Results: There was an insignificant change in the values for PPW-PNS (the distance between the posterior pharyngeal wall and the posterior nasal spine) and PPW-S (the distance between the posterior pharyngeal wall and the soft palate) before and after treatment. No significant differences were observed in upper airway dimensions between patients treated with extraction of four premolars and those treated with extraction of two premolars. The average treatment duration was approximately 2.5 years.

Conclusion: Extraction of two or four premolars did not cause significant alterations in upper airway dimensions. Premolar extraction can therefore be considered safe in orthodontic treatment planning with respect to airway space.

Key words: Airway, Nasopharyngeal airway, Premolar extraction, Orthodontic treatment, Lateral cephalogram

Correspondence:
Dr. Maleeha Mustafa, *Department of Orthodontics, Lahore Medical and Dental College, Lahore-Pakistan.*
Email: maleeha.mustafa@ubas.edu.pk

Submission Date: August 12, 2025
1st Revision Received: September 03, 2025
2nd Revision Received: October 08, 2025
3rd Revision Received: October 19, 2025
4th Revision Received: November 03, 2025
Acceptance Date: November 13, 2025

Introduction

The structures of the upper airway space (UAS) are important for the development of the craniofacial complex and are crucial for orthodontic diagnosis and treatment planning. Furthermore, obstructive sleep apnoea (OSA) and respiratory problems are somewhat influenced by the UASs craniofacial morphologic, and more especially anatomical features.[1]

Since Angle's 1907 report describing children with Class II dentofacial deformities as having a constricted upper airway, numerous studies have demonstrated a correlation between specific craniofacial features such as mandibular deficiency and a steep mandibular plane, and a reduced upper airway dimension.[2-5] Treatment options for malocclusions vary depending on the features of the issue, including age, patient co-operation, and antero-posterior disparity. Extra oral appliances, functional appliances, and fixed appliances connected to intermaxillary elastics are among the tech-niques utilised to treat such malocclusions. Extractions may also be part of the therapy regimen. These treatment methods aim to achieve optimal face equilibrium in addition to addressing the dental connection. Dimensional alterations in the airways follow dental arch extension.[6] Although extraction treatments alter the dimensions of the arch, the majority of the space they generate is mostly used for incisor retraction and lip procumbency correction in patients with bimaxillary dental proclination. It is necessary to anticipate that changing the position of the incisors, soft tissues, and arch may have an impact on the position of the tongue and, consequently, the dimensions of the upper airways.[6]

Additionally, the literature has not yet extensively discussed maxillary extraction spaces' ability to be used in a predictable manner. The choice of teeth to be extracted depends on the treatment objectives for the soft tissues as the extraction of upper first premolars only, result in 66.5% of anterior segment retraction, affecting the lip procumbence to a greater extent, in comparison to the extraction of upper 4's and lower 5's where the anterior segment retracts by 56.3%. Moreover, it has been concluded that with moderate anchorage consideration, extraction of all second premolars leads to vertical increase in airway dimensions and lesser anterior retraction.[7] Although the effects of premolar extraction on dental arch dimensions have previously been examined, more research is still needed to determine whether extraction of all four premolars or just the upper premolars may alter the size of the upper and lower airways. The present study aimed to assess the impact of two and four premolar extraction patterns on upper airway dimensions. Orthodontic space closure and incisor retraction may influence airway morphology, potentially affecting breathing and post-treatment quality of life. Specifically, the study sought to determine whether different extraction strategies produce measurable changes in airway space, and to compare the extent and direction of these changes between the two treatment modalities. The findings will aid clinicians in achieving a balance between functional airway health and optimal aesthetic outcomes.

Methodology

This retrospective cross-sectional analytical study was conducted at the Department of Orthodontics, Lahore Medical and Dental College. Patient records from January 2020 to December 2023 were reviewed after obtaining approval from the Ethical Review Board of Lahore Medical and Dental College .

Ethical Consideration: The study was approved by the Ethical Review Board of Lahore Medical & Dental College (Reference No. LMDC/FD/4988/24; dated 15 October 2024). Informed written consent was obtained from all study participants prior to data collection. Participants were assured of the confidentiality of their information, and all data was handled following ethical research guidelines.

A total of 45 patients with dental Class II malocclusion, characterized by a distal relationship of the mandibular teeth relative to the maxillary teeth by more than one-half cusp width as described by Angle, were included. The sample size (n = 45) was selected pragmatically from available records that met the inclusion and exclusion criteria. To confirm that this number is consistent with previously published cephalometric work, we referenced pre and post-extraction airway data published by Sharma et al. in 2014. Using their reported Soft Palate Point to Soft Posterior Pharyngeal Wall (SPP-SPPW) values (pre-treatment mean 15.03±3.73 mm; post-treatment mean 13.80 ± 3.79 mm) and assuming a conservative within-subject correlation (r = 0.69), the calculated standard deviation (SD) of paired differences was approximately 2.95 mm, yielding a standardized effect size (Cohen's d) of about 0.42. Applying the paired-sample t-test formula for $\alpha = 0.05$ and 80% power results in a required sample of 45 paired observations. Thus, the available sample of 45 participants provides adequate power based on comparable published data.[8]

All available records that fulfilled the inclusion and exclusion criteria were selected using non-probability purposive sampling. The patients were between the ages of 16 to 20. Lateral Cephalogram was traced manually on acetate paper and Pre Orthodontic measurement of nasopharyngeal airway was done. Four-unit versus two-unit extraction of teeth was performed in different individuals.

Inclusion Criteria

Patients were included if they were between 16 and 20 years of age, of either gender, and diagnosed with Dental Class II malocclusion, defined according to Angle's classification as a distal relationship of the mandibular teeth relative to the maxillary teeth of more than one-half the width of the cusp. Only those cases with complete pre-treatment and post-treatment lateral cephalograms of adequate diagnostic quality were included in the study.

Exclusion Criteria

Patients with congenital craniofacial anomalies such as cleft lip or palate, nasal obstruction, or any detectable upper airway pathology were excluded. Those with a history of snoring or obstructive sleep apnea, previous orthodontic treatment, or orthognathic/orofacial surgery were also excluded. Records with incomplete or poor-quality radiographs were not considered for analysis.

The following cephalometric measurements were taken to evaluate the nasopharyngeal airway (Fig. I).

PPW–SP represents the distance between the posterior pharyngeal wall and the soft palate, while PPW–PNS denotes the distance between the posterior pharyngeal wall and the posterior nasal spine. Both parameters were measured on pre-treatment and post-treatment lateral cephalograms and compared to assess changes in upper airway dimensions following orthodontic treatment.

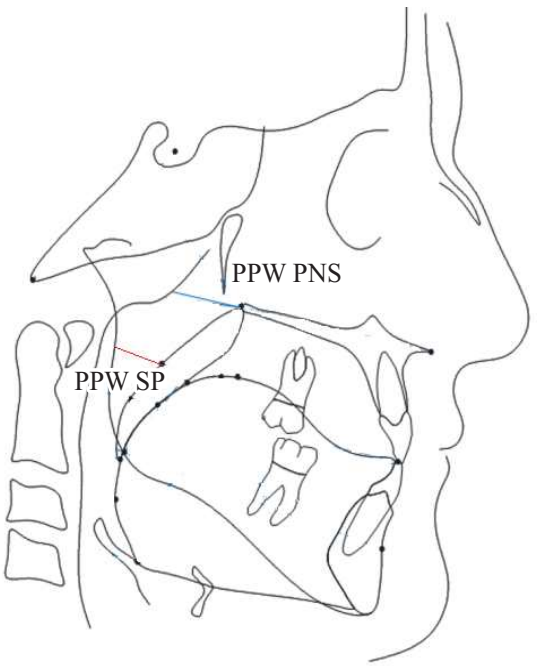


Figure I: *Upper airway dimensions on lateral cephalogram*

Statistical Analysis

Data Analysis was performed using SPSS (Statistical Package for Social Sciences) version 29. Normality of the data was checked by Shapiro-wilk test. Initial analysis included frequency distribution and calculation of descriptive statistics. Descriptive statistics for gender were recorded. Descriptive statistics were used to summarize the distribution of extraction patterns. The study sample comprised 45 patients, with 30 (66.7%) undergoing extraction of four premolars and 15 (33.3%) undergoing extraction of two premolars. Mean and Standard deviation was calculated for quantitative variables like PPW-SP and PPW-PNS etc. A paired sample t-test was used to assess changes in pre and post treatment values (Table II and III) and pearson's correlation coefficient was calculated to evaluate the reliability of observations. The p-value of <0.05 was considered significant.

Results

A total of 45 individuals participated in the study, comprising 7 males (15.6%) and 38 females (84.4%). Descriptive statistics of gender is presented in Table I.

Table I: *Descriptive statistics for Gender*

Gender	Frequency	Percent
Male	07	15.6
Female	38	84.4
Total	45	100.0

Paired sample t-test revealed no statistically significant differences in upper airway measurements, PPW – SP and PPW–PNS before and after extraction of all four premolars ($p = 0.31$ and $p = 0.39$, respectively), as shown in Table II. Similarly, paired sample t-test for the two-premolar extraction group also demonstrated no statistically significant differences in PPW–SP and PPW–PNS measurements before and after extraction ($p = 0.41$ and $p = 0.29$, respectively). Furthermore, the paired sample correlations indicated weak relationships between pre- and post-treatment values for both parameters (PPW-SP: $r = 0.09$, $p = 0.62$; PPW-PNS: $r = 0.10$, $p = 0.56$) as shown in Table II, suggesting that the extrac-tion protocol did not result in consistent or measurable changes in upper airway space.

Pearson's correlation coefficient showed statistically significant correlations in the airway parameters following only upper premolar extractions. (Table III)

The results showed that there was an insignificant change

Table II: *Comparison of pre and post treatment values of upper airway with upper and lower 4s extraction*

Paired Samples Test [a]								
	Paired Differences					t	df	Sig(2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence interval of the difference				p value*
				Lower	Upper			
Pair -1 ppw-sp-pre & ppw-sp-post	0.85	4.57	0.83	-0.85	2.55	1.01	29	0.31
Pair -2 ppw-pns-pre & ppw-pns-post	.093	5.86	1.07	-1.25	3.12	0.87	29	0.39
a. Extraction pattern All 4s								
Paired Samples correlations								
		N		Correlation				p value**
Pair 1 ppw -sp-pre & ppw -sp-post		30		0.09				0.62
Pair 2 ppw -pns-pre & ppw -pns-post		30		0.10				0.56

** p value calculated by paired t test, ** p value calculated by Pearson's correlation, p value < 0.05 considered significant*

Table II: *Comparison of pre and post treatment values of upper airway with upper and lower 4s extraction*

Paired Samples test [a]								
	Paired Differences					t	df	Sig(2-tailed)
	Mean	Std. Deviation	Std.Error Mean	95% Confidence interval of the difference				
				Lower	Upper			
Pair 1 ppw -sp-pre & ppw -sp-post	0.80	3.70	0.95	-.1.25	2.85	0.83	14	0.41
Pair 2 ppw -pns-pre & ppw -pns-post	1.13	4.01	1.03	-3.35	1.09	1.09	14	0.29
a. Extraction pattern = upper 4s								
Paired samples Correlation								
			N	Correlation		Sig.		
Pair 1 ppw -sp-pre & ppw -sp-post			15	0.66		.007		
Pair 2 ppw -pns-pre & ppw -pns-post			15	0.49		.058		

** p value calculated by paired t test, ** p value calculated by Pearson's correlation, p value < 0.05 considered significant*

in the values for ppw-pns and ppw-s pre and post treatment. There were no changes following either the extraction of four premolars or the extraction of two premolars.

Discussion

An essential component of the craniofacial complex is the upper airway. Literature suggests that Pharyngeal airway width is largely unaffected by malocclusion type.[9-11] Retrognathic patients, on the other hand, had a considerably smaller mean total airway capacity than those with a normal anteroposterior relationship, according to Kim et al.[12] Similarly, Grauer et al. found patients with varying anteroposterior jaw relationships had various airway volumes and shapes.[13] Additionally, Hakan El et al. noted that Class II subjects with a retrusive mandible had the lowest oropharyngeal and nasopharyngeal airway volumes.[14] For more than a century, Orthodontic literature has examined the effects of extraction versus non-extraction treatment on the teeth, skeleton, and soft tissues. As the upper airway's close proximity to the oral structures, different procedures have an impact on its dimensions. While extraction treatment can alleviate crowding and lessen facial convexity, its effect on respiratory function, especially in the upper airway regions of the nasopharynx, oropharynx, and hypopharynx, must be carefully considered. The nasopharynx and hypopharynx are primarily supported by bone and cartilage and are situated farther from the oral cavity, making them less susceptible to changes induced by extraction treatment. Conversely, the oropharynx, which consists of soft tissue and tongue, is directly connected to the oral cavity and may be more influenced by changes resulting from dental extractions. Extraction of teeth also affects the dimensions. The present study aimed to ascertain the impact of extracting two versus four premolars on the upper airway and

found no changes following either extraction pattern. This is in line with the Sharma et al. study in which they discovered that the retraction of anterior teeth had no direct effect on the nasopharyngeal dimension.[8]

The evaluation of airway health should be one of the fundamental considerations prior to the commencement of orthodontic treatment that involves the premolars extraction. Earlier research had explored pharyngeal changes dimensions after extraction of premolars in bimaxillary dental proclination patients.[15] Some studies observed discernible constriction following the extraction procedure of the hypopharyngeal space behind the base of the epiglottis, the glossopharyngeal space behind the base of the tongue, and/or the velopharyngeal space behind the soft palate.[16,17] These conflicting results may stem from variations in sample characteristics, such as differences between skeletal Class I Dental Proclination patients with well-developed chins and skeletal Class II Dental Proclination patients with retruded chins. These unique patterns frequently show disparate early pharyngeal morphologies and dimensions, which may have various effects on the approach dentoskeletal therapy is administered.[18] However, following therapy, one research discovered no appreciable alterations in any of the pharyngeal areas.[19] This study aligns with the current research, as it also discovers that upper airway dimensions are unaffected by changes in arch dimensions after extraction therapy. Additionally, Valiathan et al.[20] found no long-term, substantial alterations to the airways. They also concluded that no statistically significant changes in oropharyngeal (OP) airway volume were seen between the four premolar extraction groups and the non-extraction group, even though changes in incisor angulations and positioning were predicted.[20] Consistent with the present hypothesis, a recent retrospective cephalometric study found that extraction orthodontic treatment using maximum anchorage resulted in reductions of upper airway dimensions, whereas moderate anchorage (less anchorage loss) was associated with increases in airway dimensions.[21] The size of the upper airways did not significantly change after extracting two or four premolar teeth, which indicates that, within the studied population, such extractions may not significantly affect airway dimensions. This result is clinically significant for orthodontists and dental practitioners, as it suggests that premolar extractions for orthodontic reasons are unlikely to have a major impact on the airway, potentially easing concerns about airway compromise in patients undergoing these procedures.

Conclusion

In conclusion, the present study found no statistically significant changes in upper airway dimensions following the extraction of either two or four premolars. The comparative analysis between groups confirmed that the extent of premolar extraction did not adversely affect airway space. These results suggest that, within the study's parameters, premolar extractions can be performed without measurable compromise to upper airway dimensions, thereby supporting their continued use in orthodontic treatment planning when clinically indicated.

Limitations & Recommendations

Although the study provides valuable insights, several limitations must be acknowledged. This study's retrospective design presents certain inherent limitations. The data were collected from existing orthodontic records, which may include variability in radiographic quality, treatment timing, and documentation. Because the sample was selected through nonprobability purposive sampling from a single institution, the findings may not be generalizable to broader populations with different demographic or craniofacial characteristics. Another limitation is the reliance on two-dimensional lateral cephalograms instead of three-dimensional imaging such as CBCT, which offers a more accurate volumetric assessment of the airway. Moreover, the timing of post-treatment assessments may also have influenced the outcomes.

Longer follow-up periods and bigger, more diversified sample sizes in future research could offer more definitive conclusions regarding the impact of premolar extractions on airway dimensions. Future studies could investigate the impact of premolar extraction in patients having different vertical and sagittal patterns in addition to anchorage considerations on the dimensions of airways. Furthermore, exploring how extraction patterns affect other aspects of airway function, such as airflow and breathing patterns, could offer a more comprehensive understanding of the connection between orthodontic treatments and overall upper airway health.

Conflict of Interest: None

Funding Disclosure: None

Acknowledgment:

Authors are thankful to Hibbah Shafique- O Level student for helping with the data entry.

References

1. Papageorgiou SN, Zyli M, Papadopoulou AK. Extraction of premolars in orthodontic treatment does not negatively affect upper airway volume and minimum cross-sectional area: a systematic review with meta-analysis. Eur J Orthod. 2025;47(2): cjaf012. doi: 10.1093/ejo/cjaf012.
2. Guo RZ, Li LW, Zhang LW, Yu QY, Huang YP, Li WR. Effect of premolar extraction on the upper airway in adult and adolescent orthodontic patients: a meta-analysis. Chin J Dent Res. 2023;26(1):35–45. doi:10.3290/ j.cjdr.b3978679.
3. Fang MR, Yan XZ, Ni JL, Gu YG, Meng L, Yuan LC, et al. Study of pharyngeal airway morphology with CBCT: benefits of four premolar extraction orthodontic treatments. Niger J Clin Pract. 2022; 25(12): 1955–1962. doi: 10.4103/njcp.njcp_1815_21.
4. Mladenovic M, Freezer S, Dreyer C, Meade MJ. The orthodontic extraction of second premolars: the influence on airway volume. Am J Orthod Dentofacial Orthop. 2024; 166(1):61-68. doi: 10.1016/j.ajodo.2024. 02. 013.
5. Steegman RM, Renkema AM, Schoeman A, Kuijpers-Jagtman AM, Ren Y. Volumetric changes in the upper airway on CBCT after dentofacial orthopedic interventions. Clin Oral Investig. 2023;27:5737–5754. doi: 10.1007/s00784-023-05207-8.
6. Pop SI, Procopciuc A, Arsintescu B, Miţariu M, Miţariu L, Pop RV, et al.Three-dimensional assessment of upper airway volume and morphology in patients with different sagittal skeletal patterns. Diagnostics (Basel). 2024;14(9):903. doi.org/10.3390/diagnostics14090903.
7. Rodrigues J, Narkhede S, Patel K, Nair P, Agarwal S. Impact of Class II and Class III skeletal malocclusion on pharyngeal airway dimensions: a systematic literature review and meta-analysis. Heliyon. 2024; 10(6): e27284. https://doi.org/10.1016/j.heliyon.2024. e27284.
8. Sharma K, Shrivastav S, Sharma N, Hotwani K, Murrell MD. Effects of first premolar extraction on airway dimensions in young adolescents: A retrospective cephalometric appraisal. Contemp Clin Dent. 2014; 5(2): 190-194. doi: 10.4103/0976-237X.132314.
9. Ning R, Guo J, Martin D. Effect of premolar extraction on upper airway volume and hyoid position in hyperdivergent adults with different mandibular length. Am J Orthod Dentofacial Orthop. 2022;161(4):e390-e399. doi: 10.1016/j.ajodo.2021.01.027.
10. Nath M, Ahmed J, Ongole R, Denny C, Shenoy N. CBCT analysis of pharyngeal airway volume and comparison of airway volume among patients with skeletal Class I, Class II, and Class III malocclusion: a retrospective study. Cranio. 2019;39(5):379-390. doi: 10.1080/08869634.2019.1652993.
11. Brito FC, Brunetto DP, Nojima MCG. Three-dimensional study of the upper airway in different skeletal Class II malocclusion patterns. Angle Orthod. 2019; 89(1):93-101. doi:10.2319/112117-806.1.
12. Zicari AM, Duse M, Occasi F, Luzzi V, Ortolani E, Bardanzellu F, et al. Cephalometric pattern and nasal patency in children with primary snoring: the evidence of a direct correlation. PLoS One. 2014;9(10):e111675. doi: 10.1371/journal.pone.0111675.
13. Deng J, Gao X. A case–control study of craniofacial features of children with obstructed sleep apnea. Sleep and Breathing. 2012;16:1219-1227. doi:10.1007/s11325- 011-0636-4.
14. Germec-Cakan D, Taner T, Akan S. Uvulo-glosso-pharyngeal dimensions in non-extraction, extraction with minimum anchorage, and extraction with maximum anchorage. Eur J Orthod. 2011;33(5):515-520. doi: 10.1093/ejo/cjq109.
15. Karaman A, Güdük Z, Genc E. Evaluation of pharyngeal airway dimensions and cephalometric changes after premolar extraction and nonextraction orthodontic treatment in adolescent and adult patients. J Stomatol Oral Maxillofac Surg. 2023;124(1):101275. doi: 10.1016/ j.jormas.2022.08.018.
16. Roedig JJ, Phillips BA, Morford LA, Van Sickels JE, Falcao-Alencar G, Fardo DW, et al. Comparison of BMI, AHI, and apolipoprotein E ε4 (APOE-ε4) alleles among sleep apnea patients with different skeletal classifications. J Sleep Med. 2014;10(4):397-402. doi.org/10.5664/jcsm. 3614.
17. Alves PV, Zhao L, O'Gara M, Patel PK, Bolognese AM. Three-dimensional cephalometric study of upper airway space in skeletal class II and III healthy patients. J Craniofac Surg. 2008;19(6):1497-1507. doi: 10.1097/ SCS.0b013e31818972ef.
18. Kim YJ, Hong JS, Hwang YI, Park YH. Three-dimensional analysis of pharyngeal airway in preadolescent children with different anteroposterior skeletal patterns. Am J Orthod Dentofac Orthop. 2010; 306.e1-11; discussion 306-7. doi: 10.1016/j.ajodo.2009.10.025.

19. Diwakar R, Kochhar AS, Gupta H, Kaur H, Sidhu MS, Skountrianos H, et al. Effect of Craniofacial Morphology on Pharyngeal Airway Volume Measured Using Cone-Beam Computed Tomography (CBCT). A Retrospective Pilot Study. Int J Environ Res Public Health. 2021;18;5040.https://doi.org/10.3390/ijerph 18095040.
20. Vejwarakul W, Ko EW, Lin CH. Evaluation of pharyngeal airway space after orthodontic extraction treatment in class II malocclusion integrating with the subjective sleep quality assessment. Sci Rep. 2023;13(1):9210. doi: 10.1038/s41598-023-36467-9.
21. Golchini E, Rasoolijazi H, Momeni F, Shafaat P, Ahadi R, Jafarabadi MA, et al. Investigation of the relationship between mandibular morphology and upper airway dimensions. J Craniofac Surg. 2020; 31(5): 1353 – 1361. doi: 10.1097/SCS.0000000000006341.

Authors Contribution

All the authors contributed equally in accordance with ICMJE guidelines and are accountable for the integrity of the study. The final version of the manuscript has been revised by all the authors.

MM: study design, acquisition of data, manuscript writing, data analysis, final approval of the manuscript

AS& HMAJ: Contribution to study design, acquisition of data, revision

MM: acquisition of data, analysis of results, revision

FT: literature search, data analysis, review of the manu-script writeup

MJ: Literature search, data analysis and interpretation, revision

Original Article

Self-Medication Practices among Health Professional Students during the COVID-19 Pandemic: A Cross-Sectional Study in Lahore

Muhammad Abdullah,[1] Wardah Javaid,[1] Hina Zafar Raja,[2] Muhammad Nasir Saleem[3]

[1]Department of Operative Dentistry, Institute of Dentistry, Combined Military Hospital (CMH), Lahore; [2]Department of Prosthodontics, Rahbar College of Dentistry, Lahore; [3]Department of Operative Dentistry, Rahbar College of Dentistry, Lahore

How to cite: Abdullah M, Javaid W, Raja HZ, Saleem MN. Self-medication practices regarding COVID-19 among health professional students of Lahore during the pandemic. J Lahore Med Dent Coll. 2025; 2 (2): 68-75

DOI: 10.70384/jlmdc.v2i02.88

Abstract

Background: Self-medication is a global concern, particularly among health professional students who have easier access to medical knowledge.

Objective: The main objective of this study was to assess the frequency of self-medication among health professional students and to compare the frequencies between COVID-19 positive individuals and patients having flu-like symptoms during the pandemic.

Methodology: A descriptive cross-sectional study was conducted among 380 health professional students from various medical and dental colleges in Lahore. Response rate was 65.3%. Survey was administered via google forms and included sections containing questions about participants' history of self-medication. Both COVID-19 affected and unaffected participants were asked about their history or tendency toward self-medication.

Results: Results reported that 58.57% participants with COVID-19 and 63.47% with flu-like sickness gave a positive response about self-medication. 80.49% COVID-19 individuals and 78.30% with flu-like sickness claimed that self-medication helped with the symptoms.

Conclusion: Self-medication was highly prevalent among health professional students during the pandemic, driven by easy access to over-the-counter drugs, prior experiences, and reluctance to consult physicians. This practice underscores the urgent need for targeted awareness programs and stricter regulatory strategies.

Keywords: Self-Medication, COVID-19, Health Professional Students, Pandemic

Introduction

Self-medication implies the use of drugs without prescription from a licensed doctor. Prophylactic self-medication can lead to unfavorable consequences such as microbial resistance and addiction.[1] With self-medication, the individual is entirely responsible for any undesirable effects that might occur.[2] Delayed seeking of professional guidance due to self-medication masks the relevant signs of any underlying disease and may lead to adverse pharmacodynamic interactions.[3] In Pakistan, during the COVID-19 pandemic, an increased trend of self-medication was observed. The non-availability of COVID-19 treatment, unawareness and fear of the pandemic led to excessive hoarding of medicines for future use during the pandemic.[4]

Self-medication is an important public health issue all over the world with a particularly high percentage in Pakistan, around 84%. The main source of self-

Correspondence:
Dr. Muhammad Abdullah, *Institute Of Dentistry , Combined Military Hospital, Lahore-Pakistan. Email: muhammadabdullah.raza66@gmail.com*

Submission Date: August 15, 2025
1st Revision Received: September 01, 2025
2nd Revision Received: October 03, 2025
3rd Revision Received: October 14, 2025
Acceptance Date: October 25, 2025

medication include the easy availability of drugs without prescription at pharmacies and recommendations from friends or relatives.[1] Evaluation of self-medication practices is important to understand perceptions and to plan strategies of discouraging it in the future.[5] The aim of this study was to assess how the COVID-19 pandemic affected the trends of self-medication among health professional students in Pakistan. Studying health professional students is important as their medical know-ledge and influence on community health behaviors may both encourage rational use and increase the risk of misuse. Data on self-medication practices among students in Lahore remain scarce, with very few studies specifically addressing this issue during the COVID-19 pandemic.

Methodology

A cross-sectional descriptive study was performed using a convenience sampling technique over a duration of six months, after approval from the Institutional Review Board.

Ethical Consideration:

Ethical review of the study was conducted by the Ethical Review Committee (ERC) at Rahbar Dental College (No. 37/RCoD/ERC/03/2024, dated: 30-09-2024). For data collection, participation from students was voluntary, and unwillingness to participate was taken as non-verbal refusal to take part in the study.

The study population comprised undergraduate health professional students in Lahore. Data was collected from various medical and dental colleges in Lahore. Convenience sampling could introduce selection bias and limit the generalizability of the findings. However, this approach was the most practical, as it allowed to reach enough students quickly and efficiently through online platforms. While random sampling would have provided stronger generalizability, convenience sampling ensured timely data collection. The sample size was 380 students from various medical and dental colleges. The WHO calculator was used to calculate the sample size with a confidence level ($1–\alpha = 95\%$), anticipated population proportion ($p = 0.50$), and absolute precision ($d = 0.05$).[6] $n = ([Z(1–\alpha/2)]^2 \times P(1–P))/d^2$

Inclusion Criteria: The age group ranged from 18 to 26 years, including both genders, who were able to comprehend the english language and who provided consent to participate.

Exclusion Criteria: Exclusion criteria included faculty members and individuals with systemic illnesses (e.g., diabetes, cardiovascular disease, chronic respiratory disorders, or other long-term conditions) to avoid confounding factors that could influence self-medication practices.

A questionnaire was used as the study tool, designed on Google Forms. The questionnaire consisted of twenty-nine questions divided into three sections. The first section comprised demographic details, including age, gender, field of study, and presence or absence of COVID-19 infection in the past. The second section was meant for participants who had a positive history of COVID-19 infection since the start of the pandemic. This section assessed the symptoms, severity of the disease, and type of drugs utilized. The third section was meant for participants with a history of flu-like illness other than COVID-19 since the pandemic started. It included the symptoms of the disease and medicines that were utilized, paracetamol, painkillers, antibiotics, antivirals, antiallergics, multivitamins, steroids, antimalarials, and inhalers/nebulizers, and the reasons that influenced self-medication, such as internet use, prior experience in treating similar symptoms, recommendations from someone who had similar symptoms, advice from a pharmacist, easy availability of over-the-counter drugs, and duration of recovery. An average student took approximately three minutes to complete the form.

The reliability of the questionnaire was checked through a pilot study, which yielded a Cronbach's alpha value of 0.77, and the validity was assessed by five expert faculty members. Participants were approached on whatsApp to fill out the questionnaire. This approach was particularly convenient, enabling quick dissemination of the form to the target population and allowing participants to complete it comfortably on their devices.[7] It also comprised a written consent section at the start, along with the purpose of the study. All participants were assured of absolute confidentiality and anonymity. The response rate was 65.3%.

Statistical Analysis:

Data was entered and analyzed using SPSS version 22. Normality of the data was checked by Shapiro Wilk's test. Descriptive statistics, including frequencies, were calculated, and the Chi-square test of association was applied.

Results

The questionnaire was sent to 380 participants, out of

which 248 responded (response rate: 65.3%). Demographic information is given in Table I. Among them,

Table I: *Demographic information of the participants*

		n(%)
Age Groups (in Years)	≤20	121(48.8)
	21-30	123(49.6)
	31-40	2(0.8)
	>40	2(0.8)
Gender of Participants	Male	72(29)
	Female	176(71)
Field of Study	MBBS	55(22.2)
	BDS	152(61.3)
	AHS	41(16.5)

n = sample size, Bachelor of Dental Surgery (BDS), Bachelor of Medicine & Bachelor of Surgery (MBBS), Allied Health Sciences (AHS).

25.5% were 18–19 years old, and 72.07% were 20–24 years old. There were 70.97% females and 29.03% males in the sample. There were 61.29% Bachelor of Dental Surgery (BDS) students, 22.18% Bachelor of Medicine and Bachelor of Surgery (MBBS) students, and 16.53% Allied Health Sciences (AHS) students.

Among the surveyed population, 28.22% had a history of COVID-19 infection since the start of the pandemic. Among them, 58.57% had a positive COVID-19 report, while 41.43% did not undergo COVID-19 screening. Of those who were declared infected with COVID-19, 81.43% had a symptomatic episode once, whereas 18.57% reported more than one episode of infection. 38.57% reported mild symptoms during the infection, 55.71% reported moderate symptoms, while 5.71% reported a severe infection. Participants also responded to questions about the symptoms they experienced. Figure I demonstrates all the symptoms reported by COVID-19 positive individuals along with their percentages. It shows that the most prevalent symptoms were fever, headache, muscle pain, and cough, in that order. 47.14% of them visited a doctor for treatment, while 52.86% did not. Results showed that 58.57% of participants gave a positive response regarding self-medication, whereas 41.43% did not report any self-medication.

Those who self-medicated reported that 87.80% had prior exposure to COVID-19 infection, whereas 12.20% gave a negative response to this. Figure II demonstrates which drugs were prescribed by doctors to COVID-19 patients and which drugs were used for self-medication by COVID-19 individuals. Paracetamol was the most commonly prescribed drug as well as the most commonly used for self-medication. Interestingly, antibiotics were the second most prescribed drug, even though COVID-19 is a viral and not a bacterial disease.

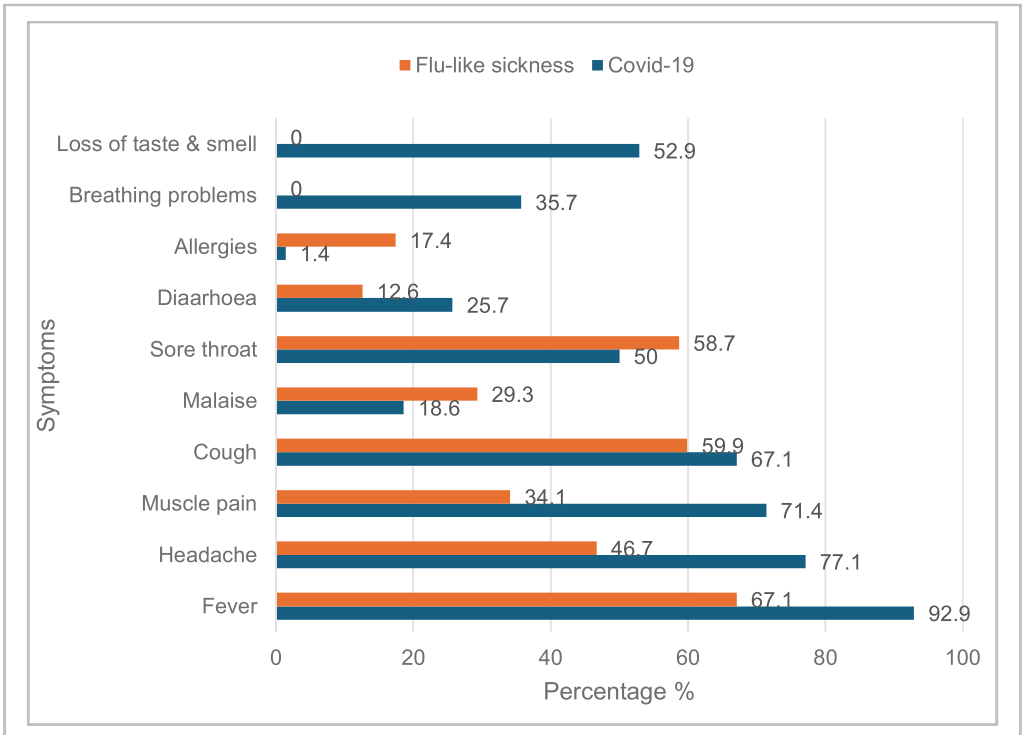


Figure I: *Self-reported Symptoms of COVID-19 and Flu-like Illness*

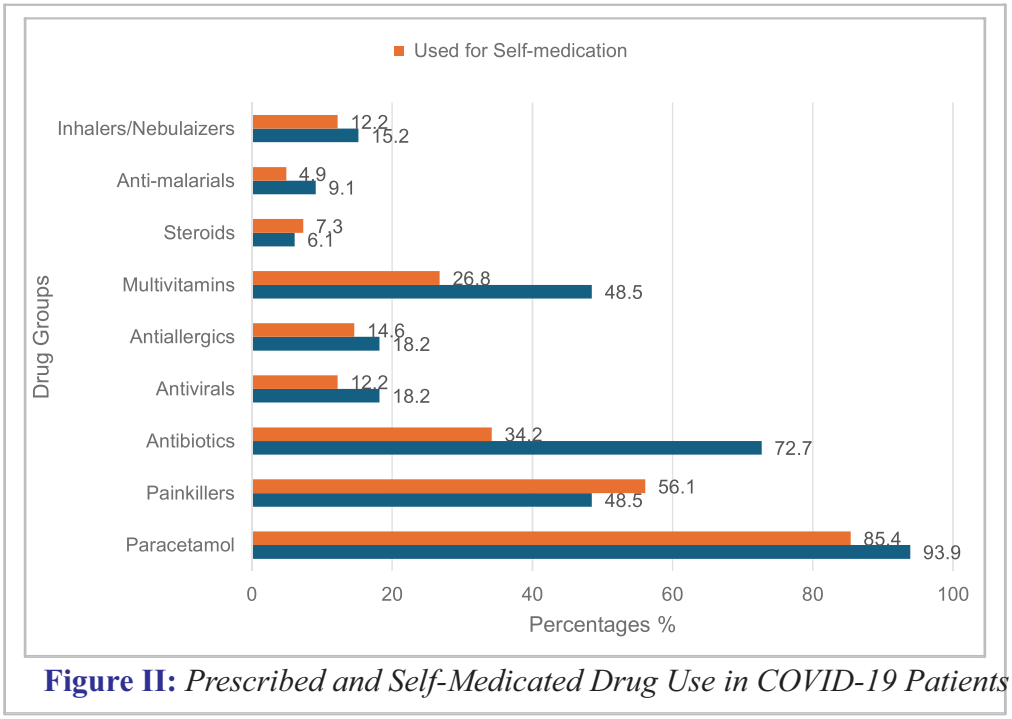


Figure II: *Prescribed and Self-Medicated Drug Use in COVID-19 Patients*

A majority (80.49%) claimed that self-medication helped relieve their symptoms, whereas 19.51% mentioned reduced effectiveness. Participants also responded about the duration of recovery after self-medication: 43.90% recovered in less than seven days, 46.34% in 7–14 days, and 9.76% took more than fourteen days to recover.

Among the participants, 67.33% reported having experienced flu-like sickness since the start of the pandemic. 57.49% of them had not taken a COVID-19 test when they were sick, while 42.51% took a test to rule out COVID-19. These participants were also asked about the symptoms they experienced. These are displayed in Figure I, along with a comparison between the symptoms experienced by individuals with COVID-19 and those with flu-like sickness according to the frequencies in the respective groups. The most frequent symptoms in the flu-like sickness group were fever, cough, and

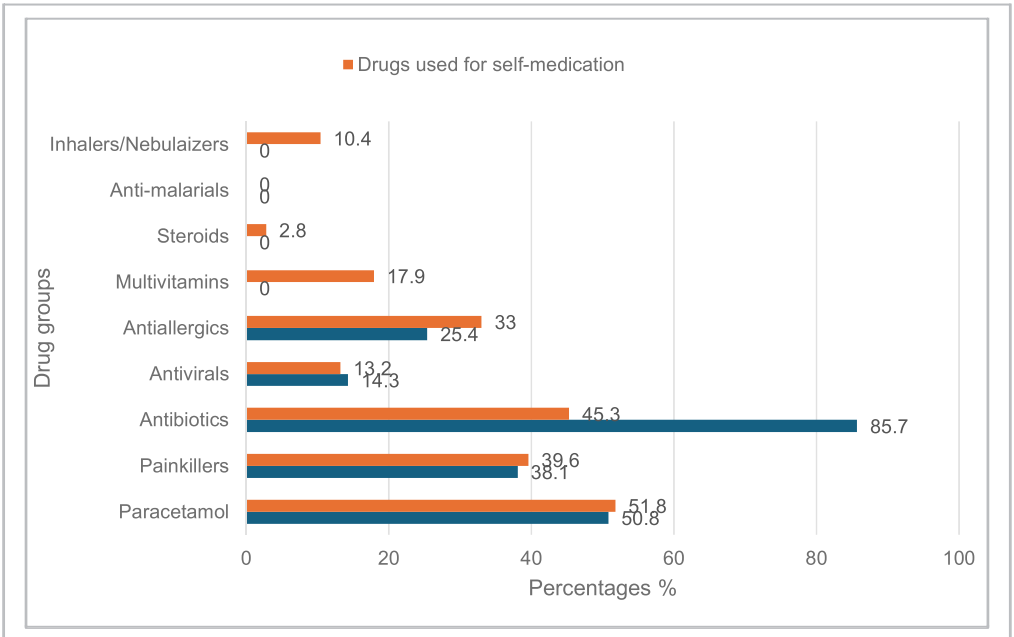


Figure III: *Prescribed and Self-Medicated Drug Use Among Individuals With Flu-like Symptoms*

Table II: *Association of Self-Medication Practices With COVID-19 and Flu-like Illness*

		Self Medication		Total
		No	Yes	
Groups	Flu-like sickness	61	106	167
	COVID-19	29	41	70
Total		90	147	237

Chi Square Test(χ^2) =0.503, p-value = 0.478, p value < 0.05 considered significant

sore throat, in descending order. 37.72% consulted a doctor for flu, whereas 62.28% did not. Those who consulted a doctor reported the drugs that were prescribed to them, i.e., antibiotics, paracetamol, painkillers, and antiallergics. In the flu-like sickness group, 63.47% reported self-medication, while 36.53% did not. Figure III provides a clearer view of all the drugs that were prescribed, along with those used for self-medication by individuals with flu-like sickness, together with their percentages. 78.30% reported that self-medication helped with their symptoms. Regarding the recovery duration of participants on self-medication, 79.25% recovered in less than seven days, 18.87% took 7–14 days, while 1.89% took more than fourteen days.

Participants were also questioned about what influenced them to self-medicate. Figure IV presents all the reasons for self-medication provided by COVID-19 and flu-like sickness individuals. Prior experience in treating similar symptoms and suggested medicines by a relative or friend who had been treated for similar symptoms were the two most common reasons leading to self-medication in both groups.

Chi-square test of association was applied to compare COVID-19 and flu-like sickness groups on the basis of self-medication, as shown in Table II. The p-value was statistically non-significant (0.478).

Discussion

In this cross-sectional descriptive study carried out on 380 students from various medical and dental colleges, the most common reason for self-medication among COVID-19-positive patients was the prior experience of someone who had COVID-19 (56.1%). The most common reason reported for self-medicating during a flu-like sickness was previous personal experience to treat similar symptoms (64.15%). This finding is in accordance with a study conducted on university students in Karachi that also identified prior experience in treating similar symptoms as the main reason behind self-medication.[8] A study conducted in Nigeria reported that people opted for self-medication for COVID-19 prevention and treatment due to fear of discrimination in hos-pitals, fear of quarantine, unavailability of COVID-19 drugs and delay in receiving treatment.[9] Similar factors contributed to self-medication in Pakistan as well. In this sample the internet influenced 21.95% of the participants in their decision to self-medicate during COVID-19 infection and 56.1% of participants reported self-

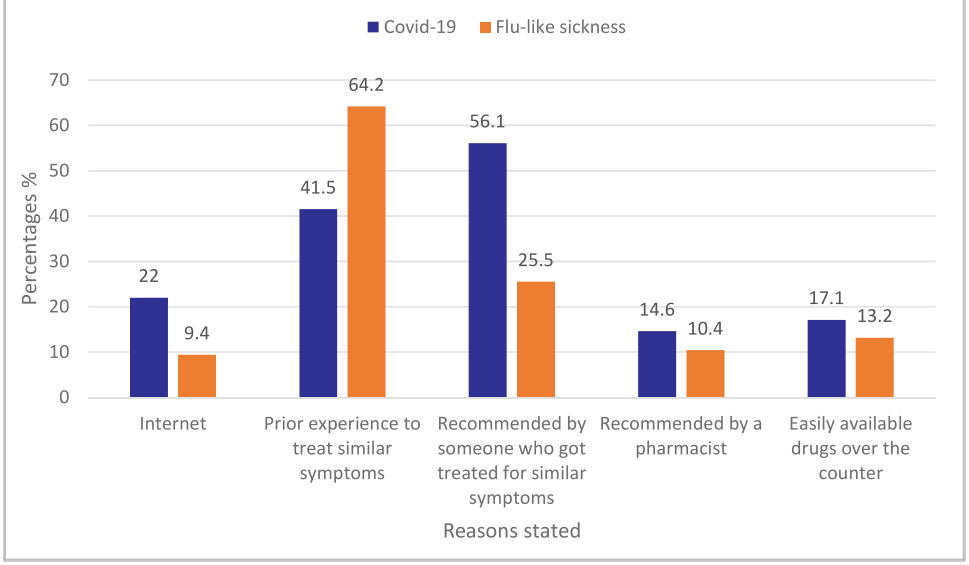


Figure IV: *Reported Reasons for Self-Medication During COVID-19 and Flu-like Illness*

medicating with painkillers. A research paper from Lahore also reported painkillers as the most frequently used drugs for self-medication. It further highlighted the internet's role in providing treatment options, as well as people's fear of contracting COVID-19 at hospitals and the ease of obtaining over-the-counter drugs.[10]

A study from Multan on self-treatment practices during COVID-19 reported that 53.6% of the participants self-medicated with painkillers, 13% used antipyretic pills, 11.6% used anti-tussive, 5.8% used anti-allergy medications and 5.8% used antibiotics.[11] In this sample, among those who self-medicated, 56.1% used painkillers, 85.37% used antipyretics, and 34.15% used antibiotics. Although the percentage of participants who were self-medicating with painkillers was considerably similar, significantly higher percentages of self-treatment with antipyretics and antibiotics were reported in our sample. In this sample, 85.37% of those who had COVID-19 self-medicated with paracetamol. Self-prescription of paracetamol in such high numbers was also reported in another study from Pakistan, where 54.9% chose paracetamol for fever experienced during COVID-19 infection.[12] The most prevalent symptoms among COVID-19 patients were fever (92.8%), headache (77.14%), muscle pain (71.42%), cough (67.14%) and flu (60%) in the respective order. Another study from Pakistan reported fever (86.6%), cough (85.05%), fatigue and dyspnoea to be the most common symptoms among COVID-19 patients.[13] Similar results were reported in a study from Karachi, where the common symptoms prompting self-medication during COVID-19 were fever (67.9%), muscle pain (54.0%), fatigue (51.7%), sore throat (46.6%), and cough (44.4%).[14] A study from Multan concluded that body aches (40.6%) , fever (17.4%) and cough (10.14%) were the most reported symptoms leading to self-medication during COVID-19.[11]

COVID-19 testing among females was less common compared to males which led to a conclusion that more males were affected by the disease although there was a gender bias.[15] In our sample, among those who reported a COVID-19 infection, only 34.3% were males and 65.7% were females. This disparity may be because the majority of the health professional students in Pakistan are females. However, among the COVID-19–positive individuals in our study, most males underwent a COVID-19 test, while many infected females did not get tested. According to the data collected, 94.28% of the participants who contracted COVID-19 experienced a mild to moderate infection. Similarly, a study conducted on COVID-19 patients in Pakistan reported that 87.6% of the patients had a mild to moderate infection.[16] The magnitude of self-medication among COVID-19 individuals in the present study was 58.57%. The findings align with those of a previous investigation, which reported a prevalence of 53%.[16] Other regional and international studies have also documented high rates of self-medication during the COVID-19 pandemic. For example, research from Bangladesh reported a prevalence of 71.4%, whereas a study conducted in Togo found a comparatively lower rate of 74.2%. These variations highlight how self-medication practices differed across populations during the pandemic, with Bangladesh showing notably higher prevalence and Togo comparatively lower levels.[17,18]

In the current study, 72.73% of the individuals infected with COVID-19 were prescribed antibiotics. The findings are similar to a survey conducted on COVID-19 patients in several hospitals of Punjab, where it was found that antibiotics were prescribed to 88.1% of the COVID-19 patients even without any diagnosis of any bacterial co-infection. The most frequently prescribed antibiotic was azithromycin either due to the experiences of the physicians in treating respiratory infections using azithromycin or due to its widespread use for the treatment of COVID-19 in other countries.[16] Third world countries like Pakistan are likely to suffer more from antimicrobial resistance (AMR) due to the misuse of antibiotics in COVID-19 infections.[19,20]

Conclusion

More than half of the health professional students in Lahore reported self-medicating during the COVID-19 pandemic, with paracetamol, painkillers, and antibiotics being the most common drugs used. The widespread practice, largely influenced by prior experiences, fear, and easy drug availability, underscores the need for stricter regulation of over-the-counter drugs and awareness programs targeting medical and dental students to mitigate future risks such as antimicrobial resistance.

Limitation and Recommendations:

Limitations of the study include that the sample size was only from the city of Lahore. Convenience samp-ling was used, which reduces generalizability. There is also a possibility of recall bias or self-reporting bias among the population. The information was collected when COVID-19 was still active, so the response from the population might be different now, as the fear of COVID-19 may have diminished. Further research is therefore recommended to explore other factors, along with the implementation of improved health policies for the timely management of such emergencies.

Conflict of interest: None

Funding Disclosure: None

Acknowledgments: None

References

1. Kasulkar AA, Gupta M. Self Medication Practices among Medical Students of a Private Institute. Indian J Pharm Sci. 2015;77(2):178–182. doi: 10.4103/0250-474x.156569.
2. Sontakke SD, Bajait CS, Pimpalkhute SA, Jaiswal KM, Jaiswal SR. Comparative study of evaluation of self-medication practices in first and third year medical students. Int J Biol Med Res. 2011;2(2):561-564.
3. Quincho-Lopez A, Benites-Ibarra CA, Hilario-Gomez MM, Quijano-Escate R, Taype-Rondan A. Self-medication practices to prevent or manage COVID-19: A systematic review. Plos One. 2021;16(11):e0259-317. doi:10.1371/journal.pone.0259317.
4. Arain MI, Shahnaz S, Anwar R, Anwar K. Assessment of self-medication practices during COVID-19 pandemic in Hyderabad and Karachi, Pakistan. Sudan Med J. 3;16(3):347-354. doi: 10.18502/sjms.v16i3.9696.
5. Limaye D, Limaye V, Krause G, Fortwengel G. A systematic review of the literature on survey questionnaires to assess self-medication practices. Int J Community Med Public Health. 2017;4(8):2620-2631. doi: 10.18203/2394-6040.ijcmph20173192.
6. Lwanga SK, Lemeshow S. Sample size determination in health studies: a practical manual. Geneva: World Health Organization; 1991.
7. Saleem RT, Butt MH, Ahmad A, Amin M, Amir A, Ahsan A, et al. Practices and attitude of self medication during COVID 19 pandemic in university students with interventional role of pharmacist: a regional analysis. Lat Am J Pharm. 2021;40(8):1946 1953. Available from: http://latamjpharm.org/resumenes/40/8/LAJOP_40_8_1_37.pdf
8. Zafar SN, Syed R, Waqar S, Zubairi AJ, Vaqar T, Shaikh M, et al. Self-medication amongst university students of Karachi: prevalence, knowledge and attitudes. J Pak Med Assoc. 2008;58(4):214-217. PMID: 18655436.
9. Wegbom AI, Edet CK, Raimi O, Fagbamigbe AF, Kiri VA. Self-medication practices and associated factors in the prevention and/or treatment of COVID-19 virus: a population-based survey in Nigeria. Front Public Health. 2021;9:606801. doi: 10.3389/ fpubh. 2021. 606801.
10. Maroof H, Anees SK, Sarfraz M, Sultan A, Muslim D, Raza SM. Prevalence and Influencing Factors of Self-Medication during the COVID-19 Pandemic: A Case Study of academic personals from Lahore. BBE. 2023; 12(3):385-392. doi: 10.61506/01.00044.
11. Wase R, Ilyas A, Kajal R, Iqbal J. Investigating Performance of Self-Medication in Multan During the COVID-19 Pandemic. J Asian Dev Stud. 2024;13(1):29-40. doi:10.62345/jads.2024.13.1.3.
12. Baig MH, Baig IR, Afzal H, Aslam A. COVID-19 Awareness, Knowledge, and Perception in the Population of Pakistan. Int J Pharm Integr Health Sci.; 4(1): 560614. doi: 10.56536/ijpihs.v4i1.80.
13. Ahmad M, Beg BM, Majeed A, Areej S, Riffat S, Rasheed MA, et al Epidemiological and clinical characteristics of COVID-19: a retrospective multi-center study in Pakistan. Front Public Health. 2021; 9:644199. doi:10.3389/fpubh.2021.644199.
14. Yasmin F, Asghar MS, Naeem U, Najeeb H, Nauman H, Ahsan MN, et al. Self-Medication Practices in Medical Students During the COVID-19 Pandemic: A Cross-Sectional Analysis. Front Public Health. 2022;10: 803937. doi: 10.3389/fpubh.2022.803937.
15. Ghanchi NB, Masood KI, Nasir A, Islam N, Ansar Z, Hasan Z. COVID-19 diagnostic testing underestimated cases amongst females in Pakistan. Medrxiv. 2023. Available at: https://ecommons.aku.edu/pakistan_ fhs_ mc_pathol_microbiol/1526

16. Ul Mustafa Z, Salman M, Aldeyab M, Kow CS, Hasan SS. Antimicrobial consumption among hospitalized patients with COVID-19 in Pakistan. SN Compr Clin Med. 2021;3(8):1691-1695. doi:10.1007/s42399-021-00966-5.
17. Acharya A, Shrestha MV, Karki D. Self-medication among Medical Students and Staffs of a Tertiary Care Centre during COVID-19 Pandemic: A Descriptive Cross-sectional Study. J Nepal Med Assoc. 2022; 60 (245): 59-62. doi: 10.31729/jnma.7247.
18. Sadio, A.J., Gbeasor-Komlanvi, F.A., Konu, R.Y. et al. Assessment of self-medication practices in the context of the COVID-19 outbreak in Togo. BMC Public Health. 2021;21(1):58. doi:10.1186/s12889-020-10145-1.
19. Haaris SM, Ahmed H, Sarosh SM. COVID-19 and potential aggravation of antimicrobial resistance in Pakistan. Pak Med Assoc. 2023;73(1):208. doi: 10. 47391/ JPMA.6410.
20. Arshad AR, Ijaz F, Siddiqui MS, Khalid S, Fatima A, Aftab RK. COVID-19 pandemic and antimicrobial resistance in developing countries. Discoveries (Craiova). 2021;9(2):e127. doi: 10.15190/d.2021.6.

Author Contributions:

All authors have approved the final version of the manuscript and are responsible for integrity of the study.

MA contributed to conception and design; data acqui-sition, interpretation and analysis; drafted the manu-script.

WJ contributed to design; data acquisition, interpreta-tion and analysis; revision the manuscript.

HZR contributed to conception and design; data inter-pretation and analysis; Critically revised the manuscript and gave the final approval.

MNS contributed towards analysis and interpretation of the results; critically revised the manuscript.

Original Article

Comparative Quasi-Experimental Study of Pilates and Calisthenic Exercises in Snooker Players

Amna Umair,[1] Sidra Shafique,[1] Amna Shahid,[1] Saba Rafique,[1] Sumera Abdul Hameed[1]

[1]*Department of Physical Therapy, Riphah International University Lahore*

How to cite: Umair A, Shafique S, Shahid A, Rafique S, Hameed SA. Comparative Quasi-Experimental study of Pilates and Calisthenic exercises in snooker players. J Lahore Med Dent Coll. 2025; 2 (2): 76-81

DOI: 10.70384/jlmdc.v2i02.84

Abstract

Background: Snooker is a kind of cue sport in which skill plays an important role. To reach a professional level, snooker players must acquire many physical and mental skills.

Objective: To compare the effects of Pilates and Callisthenic exercises on skills and static balance among snooker players.

Methodology: A Quasi-Experimental study was approved by the ethical review board of Riphah International university. Sample size was 34 calculated by Epi tool and a convenience sampling technique was used. Pilates and calisthenic training sessions were allocated through simple random sampling (sealed opaque envelopes). Group A received Pilates 3 times per week for 8 weeks while group B received callisthenic training 3 times per week for 8 weeks. Outcomes measured through stork balance test, line-up test and foul count test at baseline and after 8 weeks.

Results: The participants had a mean age of 27.07 ± 0.70 years and a mean BMI of 22 ± 1.25 kg/m². Both Pilates and calisthenics groups showed significant improvements across all outcomes following training ($p < 0.05$). Within-group analyses demonstrated greater gains in the Pilates group for the Line-up Test, Foul Number Test, and Stork Balance Test. Between-group comparisons further confirmed that post-treatment performance was significantly better in the Pilates group, with larger mean differences in skill-based measures and static balance. Overall, Pilates training produced superior improvements compared to calisthenic training.

Conclusion: The study concluded that both Pilates and callisthenic exercises improved skills and static balance among snooker players. However, Pilates was more effective than callisthenic training.

Key words: Balance, Postural Control, Pilates Training ,Snooker , Skill

Introduction

Billiards, or cue sports, are a group of activities that may be divided into three primary categories: snooker, pocket billiards, and carom billiards. A pool table with six pockets is used to play snooker. In 1927, the global snooker championship made its debut.[1] Professional athletes possess some mental attributes including confidence, drive, dedication, and focus. However, coaches, environmental variables, psychological issues, and neuromuscular factors may all impact an athlete's performance in any given sport.[2] Snooker is a precision sport requiring high levels of concentration, fine motor skills, and excellent balance.[3] Pilates and callisthenic exercises are popular forms of exercise that improve these skill areas as these exercises concentrate on distinct

Correspondence:
Dr.Amna Shahid, *Riphah International University Lahore*
Email: *amna.shahid@riphah.edu.pk*

Submission Date: July 18, 2025
1st Revision Received: September 18, 2025
2nd Revision Received: October 21, 2025
Corrected and edited: November 17, 2025
Final revision accepted: November 20, 2025

physical concepts. Cue sports like snooker need a great level of accuracy, steadiness, and control.[4] Moreover, snooker players need excellent static equilibrium to make consistent and accurate shots. To stay steady and maintain a controlled stance during play, they must have good static balance, that is, the ability to keep their body's center of gravity within their base of support.[5] Static balance is the snooker player's ability to keep a solid stance without moving, and it has a direct influence on their overall gameplay and shot accuracy.[6,7] The players must maintain their balance both during and after each of these moves in order to go on to the next, avoid any injuries, and ensure that the following move is executed well.[8] Neuromuscular responses to continual visual, vestibular, and somatosensory feedback result in the balance and capacity to maintain the body center of gravity on the support.[9] Athletes can employ balance to improve their sporting performance as well as to avoid injury.[10] Snooker players can enhance their skill, avoid injuries, and maintain physical condition by including a regular Pilate's exercise as it helps improve core strength, flexibility, posture, focus, muscle endurance, and coordination. All of these advantages work together to improve performance and lower the chance of injury.[11] Recent evidence suggests that calisthenic training, using body weight movements, is also highly effective for improving strength, coordination, and balance.[12] While both Pilates and calisthenics exercise modality targets the motor abilities differently, there is limited research comparing their relative effectiveness in cue sports. Therefore, this study aims to compare the effects of Pilates and calisthenic exercises on skills and static balance among snooker players.

Methodology

A Quasi experimental study was designed and approved through Research & ethical committee. A sample size of 34, including a 10% allowance for attrition, was calculated from the mean and standard deviation of the balance variable using the Epi Info tool.[13] Convenience sampling technique was used and participants were selected as per the inclusion and exclusion criteria listed below. The data for this study was collected from Johar town and Central park Sports complex in Lahore. Pilates and calisthenic training sessions were allocated through simple random sampling through sealed opaque enveloped (Figure I). Group A received Pilates 3 times per week for 8 weeks. Sessions were conducted 3 times per weekas: Warm-Up: 10 minutes, Main Workout: 40 minutes Cool-Down: 10 minutes[14] while group B received callisthenic training 3 times per week for 8 weeks with sessions conducted 3 times per week Warm Up Duration: 10 minutes Workout Duration : 40 minutes Cool Down period: 10 minutes[15] Outcomes measured through stork balance test, line-up test and foul count test at baseline and after 8 weeks.

Ethical consideration: This study was approved by REC committee of Riphah University under the Ethical consideration number REC/RCR&AHS/24/0433, Dated: April 24, 2024. Written informed consent was obtained from all participants. Confidentiality of data was ensured, and participants were free to withdraw at any stage without penalty. It was single blinded study in which assessor was blind.

Inclusion Criteria:

The participants were male snooker players' age range between 18 - 40 years. Intermediate as well as advanced snooker players with a break score > 30 and who participated regularly in snooker training (minimum 3 times per week) were included in this study.

Exclusion Criteria

Athletes with current acute injuries, particularly in the lower body, History of any surgery in the past six months, especially related to musculoskeletal issues, Chronic health conditions like severe arthritis or chronic back pain, Regular use of pain medication or anti-inflammatory drugs, were excluded. Active participation in other high-impact sports (could affect the study results) and cognitive or communication barriers (that hinder understanding or adherence to study protocols) were excluded.

Statistical Analysis:

The data was analyzed using SPSS for window software version 25. Statistical significance was set at $p < 0.05$. Normality of data was assessed through Shapiro Wilks Test. Descriptive Statics like Mean, Standard deviation, minimum and maximum age and BMI of both Interventional groups were analyzed. Difference between pre-treatment and post-treatment readings was calculated by using paired sample t test for parametric data. To estimate the difference between the groups, Independent sample t test was used.

Results

Demographic information of the participants is shown in Table I. The mean age of the participants was 27.07 ± 0.70 years and mean BMI was 22 ± 1.25 kg/m^2.

Table 2 shows significant within-group improvements in both intervention groups. The Pilates Exercises group demonstrated greater gains in the Line-up Test (mean

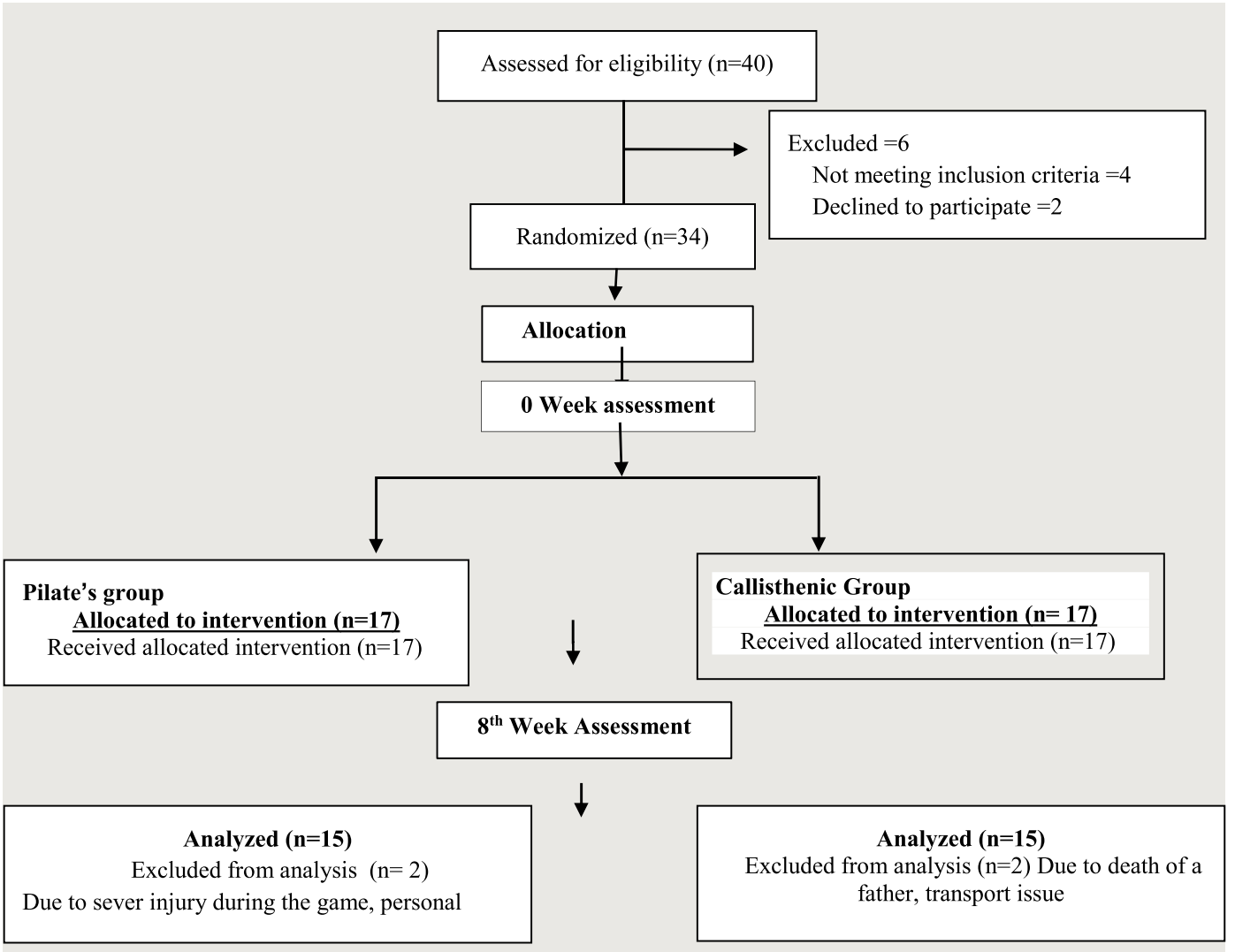


Figure I: *CONSORT Diagram*

difference = 19, p value = 0.01), Foul Number Test (mean difference = 2, p value = 0.01), and Stork Balance Test (mean difference = 14.5, p value = 0.01). value Overall, the magnitude of change was consistently greater in the Pilates Exercises group.

Comparisons across the two groups are shown in Table III. The results show that both interventions improved performance, with greater post-treatment gains in the Pilates Exercises group. The Line-up Test demonstrated a significant between-group difference at post-treatment (mean difference = 5, p valu e= 0.01), indicating superior improvement with Pilates Exercises. Similarly, the Foul Number Test showed a significant post-treatment difference (mean difference = 0.75, p value = 0.01), again favoring the Pilates group. In the Stork Balance Test, a significant post-treatment difference was also observed (mean difference = 9.5, p value = 0.01), confirming greater enhancement in balance following Pilates Exercises compared to Calisthenics Exercises.

Table I: *Demographics of the study participants*

Variable	N	Mean	St.Deviation
Age (years)	30	27.07	0.7
BMI	30	22	1.2
Years of experience		Frequency	
1-3 years		8	
4-6 years		18	
7-9 years		4	
Total		30	

Discussion

In this quasi-experimental study, eight weeks Pilates-

Table II: *Within-Group Comparison of Outcomes Following Pilates and Calisthenics Exercises*

Outcomes	Study Groups	Before Treatment	After Treatment	Mean difference	p value
		Mean ± SD	Mean ± SD		
Line-up Test	Pilate's Exercises.	35 ± 3.80	54 ± 4.30	19	0.01
	Calisthenics Exercises	34 ± 4.06	49 ± 3.99	15	0.02
Foul Number test	Pilate's Exercises.	3.75 ± 2.25	1.75 ± 1.25	02	0.01
	Calisthenics Exercises	3.50 ± 2.50	2.50 ± 1.50	01	0.03
Stork balance test	Pilate's Exercises.	27.25sec ± 4.75	41.75sec ±3.50	14.5	0.01
	Calisthenics Exercises	25.75sec ± 3.50	32.25 sec ± 5.50	6.5	0.03

Mean ± SD: Mean ± Standard Deviation, p value calculated by Paired sample T test, p value < 0.05 considered significant

Table III: *Between-Group Comparison of Post-Intervention Outcomes*

Outcomes	Variables	Pilate's Exercises.	Calisthenics Exercises	Mean difference	p value
		Mean± SD	Mean± SD		
Line-up Test	Pre-treatment	35± 3.80	34 ± 4.06	1	0.76
	Post Treatment	54 ± 4.30	49± 3.99	5	0.01
Foul Number Test	Pre-treatment	3.75 ± 2.25	3.50 ± 2.50	0.25	0.67
	Post Treatment	1.75 ± 1.25	2.50 ± 1.50	0.75	0.01
Stork Balance test	Pre-treatment	27.25sec ± 4.75	25.75sec ± 3.50	1.5	0.87
	Post Treatment	41.75sec ±3.50	32.25 sec ± 5.50	9.5	0.01

Mean ± SD: Mean ± Standard Deviation, p value calculated by Independent sample T test, p value < 0.05 considered significant

based core training and calisthenics exercises was compared in male snooker players. Both groups showed significant within-group improvements in line-up score, foul number and Stork balance time, but the Pilates group had consistently larger changes. This pattern suggests that adding structured core-focused Pilates on top of routine snooker practice may offer a more specific benefit for precision and postural control than more general calisthenics work. The findings are broadly consistent with the trial by Soflaei et al., who also studied male snooker players using the same line-up test, foul number test and Stork balance test. They reported substantial gains in improvement in the Line-up Test score and static balance after six weeks of mat Pilates, but no significant between-group difference in foul numbers compared with a control group doing routine snooker only.[13] In contrast, our Pilates group not only improved improvement in the Line-up Test score and balance but also showed a statistically significant reduction in fouls relative to the calisthenics group. This discrepancy may be due to several factors: differences in the exact exercise content and progression of the Pilates program, slightly different baseline skill levels, or simply random variation in a relatively small sample. The superiority of Pilates over calisthenics in this cohort is in line with broader evidence that core training can enhance sport-specific skill performance, particularly in accuracy and racket-type sports. A systematic review by Luo et al. reported that core training improved technical skills such as serving accuracy in volleyball, throwing velocity in handball and smash performance in badminton across several controlled trials.[15] Similarly, a more recent review on Pilates-based programs in athletes found positive effects on balance, postural control and sport-specific performance measures, especially in sports that require fine control of trunk and upper limb segments.[16] These data support the idea that targeted core stabilization, rather than general conditioning alone, contributes meaningfully to precision tasks such as cue delivery in snooker.

The calisthenics group in the present study also improved, although to a smaller extent. A study by Panihar and Rani showed that adding calisthenics to routine soccer training improved speed, agility, flexibility, balance and ball-control skills more than standard training alone.[17] Calisthenics combines multi-joint movements, body-weight resistance and some dynamic balance, so it is reasonable that snooker players also benefited from this type of training. However, snooker is a highly static and fine-motor sport; thus, training that emphasizes postural alignment, deep trunk control and controlled breathing, as in Pilates, may translate more directly to shot stability and error reduction than more global calisthenics drills. The improvements

observed in line-up and foul tests may also be linked to the way snooker skill is organized. Chung et al. developed a systematic skills test for snooker and highlighted the importance of cue power control, spin control and cue-ball positioning for advanced performance.[9] Biomechanical work on upper-limb coordination in snooker by Zhou and colleagues showed that professional players rely more on elbow-phase and wrist-phase coordination with relatively stable shoulders, whereas amateurs use more shoulder-dominant patterns.[18] Pilates-based core and scapular control may help players stabilize the trunk and shoulder girdle so that the cue action is driven more efficiently from the elbow and wrist, which is a pattern associated with higher skill. Balance findings in the present study are also consistent with what is known about static balance tests. The Stork test has been used as a simple clinical tool to assess single-leg static balance and shows acceptable association with other balance measures in healthy adults.[19] At the same time, its reliability depends on standardizing test procedures, including stance and instructions, as highlighted by Curnow et al., who reported variable outcomes when the starting stance was altered.[20] In present study, the Stork test was administered in a uniform way to all players pre- and post-intervention, so the large within-group and between-group differences are unlikely to be explained only by measurement error. Since snooker performance depends strongly on stance stability and minimal sway during cue delivery, these gains in static balance are likely to be functionally relevant, even though match outcomes were not directly measured. From a more cognitive–perceptual angle, earlier work by Koning et al. found that expert snooker players differ from novices mainly in sport-specific perceptual and cognitive skills rather than basic visual acuity or depth perception.[21] More recent case-study data from an elite snooker player also emphasise high stance stability and minimal centre-of-pressure movement during cueing, even across different shot types.[22] Taken together with the present results, this suggests that physical preparation for snooker should not only focus on general conditioning but also on fine postural control and trunk–upper-limb coordination that support these high-level perceptual–cognitive processes. Overall, therefore, the findings add to a growing body of evidence that core-oriented programs such as Pilates can produce meaningful improvements in skill-related outcomes and static balance in precision sports, and they suggest that Pilates may be more beneficial than calisthenics when the target outcome is accuracy of cue actions and reduction of fouls rather than only general fitness.

Conclusion

In this quasi-experimental study of male snooker players, both Pilates and calisthenics exercises produced significant improvements in snooker-specific skills and static balance over eight weeks, but Pilates training led to larger gains in line-up scores, greater reductions in foul numbers and greater increases in Stork balance times. Taken together with existing evidence from snooker-specific research and broader core-training literature, these findings suggest that Pilates-based core programs may be particularly well suited as an adjunct to routine snooker practice when the goal is to enhance stance stability and precision of cue actions.

Limitation and Recommendations:

This study had several limitations that should be considered when interpreting the findings. The participants' initial levels of fitness, prior exposure to Pilates or calisthenics, and snooker proficiency were not the same, which may have affected the outcomes, and uncontrolled variables, including participants' diet, sleep patterns and other physical activities, were also not evaluated. In addition, the quasi-experimental design with convenience sampling and no prior trial registration may have introduced some selection bias. Extended intervention duration is recommended to yield more convincing proof of the advantages of Pilates and calisthenic workouts, and individuals from a wider spectrum of demographics should be incorporated to enhance the relevance of the results to the whole snooker playing community. Future comparison research is also needed to ascertain which exercise intervention modalities, or which combination of them, are most beneficial in enhancing snooker players' abilities and static balance.

Conflict of Interest: None
Funding Disclosure: None
Acknowledgment: None

References

1. Liu L. Strategy of leisure sports to promote the quality of life for Putian University students [dissertation]. Nakhon Pathom: Silpakorn Univ.; 2024.
2. Harris LJ. Snooker and billiards. In: Nauright J, Zipp S, editors. Routledge handbook of global sport. London: Routledge; 2020. p. 227–237. doi: 10.4324/9781315714264.

3. Sagoo R. Exploring aspects of cognitive development and mental health awareness as part of health promotional goal in snooker. Psychreg J Psychol. 2017; 1(1): 3–18. doi: 10.5281/zenodo.1215732.
4. Givi H, Hubálovská M. Billiards optimization algorithm: a new game-based metaheuristic approach. Comput Mater Contin. 2023;74(3):5283–5300. doi: 10. 32604/cmc.2023.034695.
5. Sagoo R. Evaluating how the game of snooker can make a positive contribution to enhancing people's well-being in the later years. Psychreg J Psychol. 2019; 3(2): 21–36.
6. Kong PW, Pan JW, Chu DPK, Cheung PM, Lau PWC. Acquiring expertise in precision sport – what can we learn from an elite snooker player? Phys Act Health. 2021;5(1):98–106. doi: 10.5334/paah.111.
7. Ouertatani Z, Selmi O, Marsigliante S, Aydi B, Hammami N, Muscella A. Comparison of the physical, physiological, and psychological responses of high-intensity interval (HIIT) and small-sided games (SSG) training programs in young elite soccer players. Int J Environ Res Public Health. 2022;19(21):13807. doi: 10.3390/ijerph192113807.
8. Li S, Li B, Lu H, Xiao J. Snooker match outcome prediction using ANN with inception structure. In: 2021 International Conference on Applications and Techniques in Cyber Intelligence (ATCI). Cham: Springer; 2021. p. 351–359. doi: 10.1007/978-3-030-79200-8_51.
9. Chung DHS, Griffiths IW, Legg PA, Parry ML, Morris A, Chen M, et al. Systematic snooker skills test to analyze player performance. Int J Sports Sci Coach. 2014; 9(5):1083–1105. doi:10.1260/1747-9541.9.5.10.
10. Collingwood JAP, Wright M, Brooks RJ. Simulating the progression of a professional snooker frame. Eur J Oper Res. 2023;309(3):1286–1299. doi:10.1016/j. ejor. 2022.11.012.
11. Welsh JC, Dewhurst SA, Perry JL. The influence of mental toughness on responses to feedback in snooker: a real-time examination. Psychol Sport Exerc. 2023; 68:102466. doi: 10.1016/j.psychsport.2023.
12. Mear E, Gladwell VF, Pethick J. The Effect of Breaking Up Sedentary Time with Calisthenics on Neuromuscular Function: A Preliminary Study. Int J Environ Res Public Health. 2022;19(21):14597. doi: 10.3390/ijerph1921 14597.
13. Soflaei M, Ghanavati T, Norasteh AA, Sarbakhsh P, Oskouei AE. The Effectiveness of Core Muscle Training on Skill and Balance for Snooker Players. Asian J Sports Med. 2022;13(3):e131152. doi:10.5812/asjsm.131152.
14. O'Brien JD, Gleeson JP. A complex networks approach to ranking professional Snooker players. J Complex Netw. 2020;8(6). doi:0.1093/comnet/cnab003
15. Luo S, Soh KG, Nasiruddin NJ, Sun H, Du C, Soh KL. Effect of core training on skill performance among athletes: a systematic review. Front Physiol. 2022; 13: 915259. doi:10.3389/fphys.2022.915259.
16. Yılmaz O, Soylu Y, Kaplan T, Taşkın M. How Pilates exercises affect sports performance? A systematic review. Turkish Journal of Physiotherapy and Rehabilitation. 2023;34(3):367–373. doi:10.21653/tjpr. 1211347.
17. Panihar U, Rani D. The effect of calisthenics training on physical fitness parameters and sports specific skills of soccer players: a randomized controlled trial. Adv Rehabil. 2022;36(2):23-31. doi:10.5114/ areh. 2022. 116181.
18. Zhou Y, Han-jun L, Qu Y, Wan Xl, Song Yu. The influence of coordination between upper limbs' joints on sport level in snooker. In: Proceedings of the 36th International Conference on Biomechanics in Sports; 2018. ISBS Proceedings Archive 36(1):182.
19. Panta K, Arulsingh W, Raj JO, Sinha M, Rahman M. A study to associate the Flamingo Test and the Stork Test in measuring static balance on healthy adults. Foot Ankle Online J. 2015;8(3):4. doi:10.3827/faoj.2015. 0803.0004.
20. Curnow D, Cobbin D, Wyndham J. Reliability of the Stork Test: is starting stance important? Chiropr J Aust. 2010;40(4):137-141.
21. Koning P, Abernethy B, Neal RJ. Visual-perceptual and cognitive differences between expert, intermediate and novice snooker players. Appl Cogn Psychol. 1994; 8(3):185-211. doi:10.1002/acp.2350080302.
22. Kong PW. Acquiring expertise in precision sport – what can we learn from an elite snooker player? Phys Act Health. 2021;5(1):70-86. doi:10.5334/paah.111.

Authors Contribution Statement

All authors have made substantial contributions and are accountable for the integrity of the study. Revised manuscript has been proofread and approved by all authors.

SS, AU, and SR: Conception of idea, data acquisition and analysis, review of the manuscript

AS and SAH: Literature search, data interpretation and manuscript writing and revision

Instructions to Authors and Policy Document

About the Journal

Journal of Lahore Medical and Dental College (J Lahore Med Dent Coll) is **double-blind, peer-reviewed journal published biannually.** It serves as a medium for the latest advancement of scientific knowledge in all the branches of Medicine and its allied sciences and the publication of scientific investigation in these fields. JLMDC follows the ICMJE guidelines "Recomm-endations for the Conduct, Reporting, Editing and Publication of Scholarly work" in medical journals; available at https://icmje.org/recommendations/

Aims and Scope

Authors are invited to submit articles for publication, reporting original work in Medicine, Dentistry, Public Health, Health administration, Biological Sciences, Medical education, and Allied Health Sciences. Other regular features within the journal include systematic review articles, case reports, short communication, and letters to the editor. Editorial articles are by invitation only. However, those received and found to be of an outstanding nature will be considered for publication.

All articles are copyedited professionally and typeset to ensure quality. Articles published in JLMDC are immediately made freely and permanently accessible online without any cost to readers.

Author's Guidelines

Authorship Criteria:

JLMDC follows the authorship criteria recommended by ICMJE. The ICMJE recommends that authorship be based on the following criteria:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Submission Process:

All manuscripts must be submitted online at https://jlmdc.lmdc.edu.pk/index.php/lmdc

The corresponding/principal author is responsible for the manuscript during the submission and the entire peer-review process. The corresponding author must ensure that all other authors of the manuscript have read and approved the submitted version of the manuscript. For submission of the manuscript, the author must Register and Login into the OJS and submit the following along with the manuscript according to the guidelines mentioned below.

Ethical Approval letter: Letter of approval from the relevant ethical review board, along with its reference number.

Letter of undertaking and submission statement: JLMDC Undertaking .pdf

Cover Letter: Cover letter pdf

Title Page: The complete title of the manuscript, running title (40 characters), the name of all the authors with qualifications, the affiliated department or institution, address for correspondence with telephone numbers, cell phones, email, and a short running title of the article, source of funding, and total word count.

Specimen for title page available at: Guidelines for Title Page

Instructions for Original Article:

Abstract:

All original articles must accompany a structured abstract of up to 250 words. It should include the Background, Objective, Methodology, Results & Conclusions. Emphasize new and significant aspects of the study or observations. This page should contain structured abstracts and keywords only.

Keywords: Use terms from the Medical Subject Headings (MeSH) list of index Medicus, if suitable MeSH terms are not yet available for recently introduced terms, present terms may be used.

The abstract should reflect the content of the article accurately. Abstracts for case reports, short communications, Mini Reviews, clinical notes, letters to the editor and narrative reviews should be non-structured up to 150 words.

Authors submitting review manuscript should include a section describing the methods used for locating, selecting, extracting, and synthesizing data, the databases searched, and the time period. These methods should also be summarized in the abstract.

Introduction: This manuscript part should be composed of a deductive approach. This should specify the background and the rationale for the study, with reference to national, regional and

international literature. It should also briefly describe the purpose of the study. By the end of the introduction, the author should provide a road map that outlines your main points.

Methodology: This section should include Study design, Settings and Study duration. Sampling method and sample size calculations should be mentioned and the following to be included as subheadings in an organized manner. Ethical consideration (Ethical review statement with ethical approval letter Number and date), Inclusion Criteria, Exclusion Criteria and Statistical Analysis. How the data was collected or generated, Sampling method and sample size calculations. Authors should write inclusion and exclusion criteria, details of apparatus (if applicable with manufacturer's name and address) and or drugs/chemicals used. Use generic name/s of drugs/ chemicals along with dose (s) and route(s) of administration. Statistical analysis should include the tests applied along with the statistical software package used with the version. For patients, age, and sex with mean age ±standard deviation must be given. Please specify any general computer program used.

Results: The results should justify the claims. Authors should summarize the results through text, graphs, tables and figures, to report the statistical findings. Repetitions of data should be avoided in tables and figures if already described in the text.

Discussion: Authors should describe and discuss the significance of the study findings in light of what was already known about the investigated research problem. Explain any new findings or fresh insights about the problem. Strengths and limitations should be included at the end of this section.

Conclusion(s): Authors should briefly summarize the net findings of the study without overemphasizing them. It should be in line with the results.

Ethical consideration: A statement confirming that informed written consent was obtained from all study participants, ensuring confidentiality of their information, must be included. Additionally, the letter of approval from the relevant ethical review board, along with its reference number, should be provided.

Acknowledgment: Names and contributions of people who helped in the study, but do not qualify as authors may be listed in this section with their permission.

Disclosure/Conflict of Interest: Authors should disclose if they have any conflict of interest regarding funding, honorarium, credit or promotion. It should be mentioned whether the current manuscript has been presented or published in a conference or abstract book or if it is a part of the thesis/project. All sources of funding received along with their expenditures should be disclosed. If there are no funding sources, the authors should include “none to declare”. When a manuscript is submitted by authors, then editors, reviewers, employees, or members of the editorial board must disclose all financial and personal relationships that might bias their work. Authors must state explicitly whether potential conflicts do or do not exist. They should do so in the manuscript on the title page.

Tables and Figures: These must be incorporated into the manuscript in accordance with specified requirements. They should be clear and non-redundant, avoiding repetition of already-discussed results or data in the text. Tables should be sequentially numbered in Roman numerals, featuring concise and explanatory titles at the top. Abbreviations, if employed, must be explained in a footnote. Statistical results should encompass both standard deviation and standard error of the mean. Additionally, proper attribution to published articles is required for any data or tables sourced from them. The maximum number of tables/ figures in original articles should be 6, for review articles should be 6, for case reports should be 6, and for short communication should be 2. Refer to the table number in the relevant section of your manuscript. Additional 1000 PKR./- (USD 10) will be charged for each figure & table if exceeds the maximum number.

Units of Measurement: For reporting in the text, they should be conventional with System International (SI) units given in parenthesis. The names of drugs should be written in generic terminology.

References: All references should be cited in Vancouver style and give citations in the text as superscript. While citing articles use references of published articles and avoid personal communications and unpublished observations. These references should also be marked in the text. To minimize errors, the author should verify references against the original documents. The references should be written in Vancouver style as per "Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in medical journals, updated in December 2015. Available at: https://icmje.org/recommendations. List all authors when there are six or fewer. If there are seven or more, list the first six followed by” et al” reference should

provide the following information: Author's name with initials, the full title of cited article, name of the journal(in abbreviation) in which the article appeared, Year of Publication, journal's volume number, and finally first &; the last page numbers. Write page no. like this 120-126. Add DOI number of those references where it is available.

Examples

Reference from the original article: Denny KJ, Woodruff TM, Taylor SM, Callaway LK. Complement in pregnancy: a delicate balance. Am J Reprod Immunol. 2013;69(1):3-11. doi: 10.1111/aji.12000.

Reference from books: Stronge JH. Qualities of effective teachers. 3rd ed. Ascd. 2018. [https://www.middleweb.com/38903/reflect-on-the-qualities-of-effective-teachers]

Reference from the website (Other than the original article): WHO. WHO recommendation on calcium supplementation before pregnancy for the prevention of pre-eclampsia and its complications. 2022 Apr 17 [Cited 2022 Oct 19]. Available from: https://www.who.int/publications/i/item/9789240003118https://www.who.int/publications/i/item/9789240003118

Word limits and number of references: Word limit for submission of each manuscript is as under excluding abstract & references. The maximum length of the manuscripts should be: Original Articles: 3500 words and, in exceptional cases 4000, Case Reports/Brief Communications/Mini Review: 2000 words, Review Articles: 4500 words including summary describing the methods used for locating, selecting, extracting and synthesizing data. Maximum References: Original Article 25, Mini Review 25, Case Report 12, Short Communication 20, Reviews 40. These references should also be marked in the text.

Case Reports: These consists of unique cases, either diagnosed or reporting of treatment, in general, all case reports include the following components: an abstract, an introduction, a case, and a discussion. Have an unstructured abstract of approximately 150 words, up to 12 references, six tables and figures. Figures should be submitted as sperate files. Consent needs to be obtained prior to taking any patient's photographs.

Abstract: A non-structured abstract should be written as a case statement for a case report with minimum of three keywords.

Introduction: Provided a clear statement of the problem, the relevant literature on the subject,

Case Report: This section should provide the details of the case in the following order: Patient description, Case history, Physical examination results, Results of pathological tests and other investigations, Treatment plan, Expected outcome of the treatment plan, Actual outcome.

The author should ensure that all the relevant details are included, and unnecessary ones excluded.

Discussion: Describes detailed interpretation of data. Pertinent literature support is provided for any statement, and no assumption is made.

Table/Figures: Either three concise tables or three figures. Figure legends should be typed in numerical order.

References: References are listed at the end of the paper in numerical order. Journal names are according to Vancouver style. The number of references for the Case Report should be 12. Preferably, fifty percent references should be from the last five years.

Review Article

Overview and analysis of the topic with background and latest updates must be addressed in all kind of reviews i.e. systematic review, narrative review and evidence based review in line with the original article. It should include original work of author on the similar subject. The suggested length for review article is 2500 to 3000 words with 40-50 references. The abstract should be non-structured with 150 words and at least 3 keywords.

Letter to the Editor

The letter to the editor should be Objective, constructive and purposeful. It should offer Novel or useful information and be worth publishing, either in addition to or in lieu of on previous opinions or experience to previous published articles. Letters should be short and concise, with clear and specific points. It may not often exceed 500 words and 5-7 references.

Guest Editorials

Guest Editorials should comprise of 600-700 words (maximum 1000) with 5-8 references. There can be maximum 3 authors. It is mandatory to state acknowledgment and funding disclosure if any.

Policy of Screening Plagiarism: JLMDC follows the standard definition and description of plagiarism and we endorse The COPE, ICMJE, & Higher Education Commission (HEC) Pakistan policies regarding plagiarism. JLMDC is equipped with Turnitin (text-matching/anti-plagiarism software

provided by the Higher Education Commission of Pakistan). This is used to check for plagiarism and redundancy in submitted manuscripts. All submitted manuscripts are first checked for similarity index on Turnitin.

A manuscript derived from an author's M.Phil. or Ph.D. thesis must explicitly state the "title of the thesis," "Supervisor name," Department and University name, and "year of submission" on the title page as part of the submission process.

Note: Authors must not check plagiarism through unreliable or unauthentic websites or softwares.

Allegation of Misconduct: Individuals found guilty or implicated in publication misconduct may face blacklisting. It is imperative to explicitly state the source of funding for the study. Authors engaged in scientific misconduct may be subject to blacklisting and could be prohibited from making further submissions.

Processing and Publication Charges:

All manuscripts from Pakistan should be accompanied with a payment of Rs. 7,000/- FOR overseas (US$ 55)/- (Non-refundable). APC charges, once submitted, are non-refundable. Once the manuscript is accepted for publication, the authors are required to pay publication charges of Rs.18,000/- For Overseas US$ 200/- in the name of (Journal of Lahore Medical and Dental College), Lahore; send us on the address given below.

Lahore Medical and Dental College, Lahore
Email: editorjlmdc@lmdc.edu.pk .
Website:
https://jlmdc.lmdc.edu.pk/index.php/lmdc

Note: The Journal has adopted a fee waiver policy to support authors and encourage submissions (until recognition by any of the two regulatory bodies i.e. PMDC and HEC).

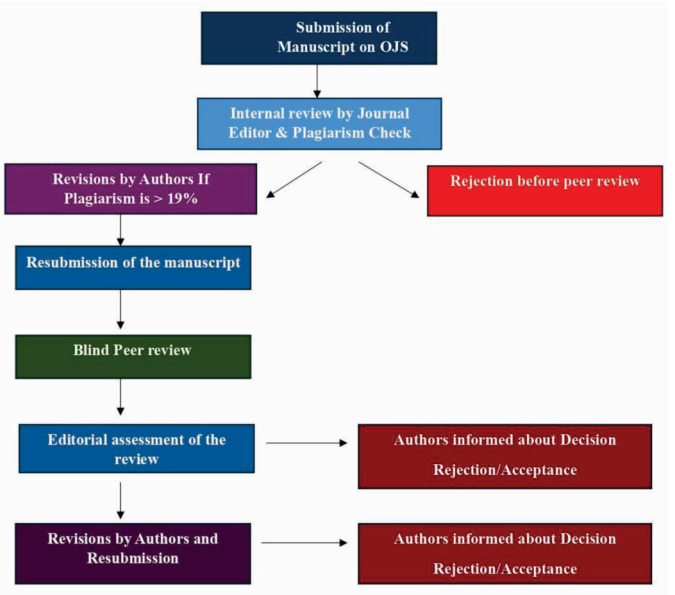
Bank Name: Bank Alfalah
Account Title: Lahore Medical and Dental College
Account Number: 1009598114
IBAN Number: PK31ALFH0812001009598114
Editing Charges (Optional) Rs. 7000/- For overseas (US$ 100)

- It will cover the following aspects of the manuscript
- Focus on the logic and flow of the manuscript's content
- Manuscript formatting meets the requirements
- Check for consistency, completeness, and structure
- Language Check

Printed Copy: One printed copy will be supplied to the correspondence author. Authors can order additional copies at the rate of Rs. 1000/- per copy which includes courier charges and US$ 20/- per copy for overseas. Payment for additional copies should be added in the publication charges.

Annual Subscription Rates for Print Copy Annual Subscription:Rs. 2500/-3 Year's Subscription:Rs. 5000/-5-Year's Subscription:Rs. 8000/-**Fast Track Processing of Manuscript:** The duration of the fast-track processing is approximately 40 days. If the author wants to get his/her manuscript through fast-track, He/she should clearly mention it on the cover letter. Rs. 10,000 additional fees will be charged (other than the processing fee of Rs. 7000/- US$ 50 for overseas) at the time of submission (Due to the increasing cost of publication, the management has imposed a fast-track fee of Rs. 10,000/- US$ 200 for overseas). The fast-track charges are non-refundable. The rest of the terms and conditions will remain constant. There is no guarantee of acceptance or publication in fast-track. Authors are requested not to opt for fast-track processing unless it is extremely essential.

Waiver Policy: Editor in Chief is responsible for the final decision.



Eligibility criteria to apply for waiver:

- The waiver policy will not be applicable if the research is funded.
- Applicable for Undergraduate students.

Editorial Processing:

Peer Review Policy:

Once a manuscript clears the initial screening, it is sent for peer review.

Double-blind: We use a review process in which, the names of reviewers and authors are not revealed to each other. Generally, we send the article to 2-3 reviewers. The peer review is completed once all the reviewers send a detailed report to the journal with their comments on the manuscript and their recommendations. We request the reviewers to complete their reviews within 3-4 weeks.

Final decision: The journal editor or editorial board considers the feedback provided by the peer reviewers and arrives at a decision. The following are the most common decisions that are made:

Accept without any changes (acceptance): the journal will publish the paper in its original form.

Accept with minor revisions (acceptance): the journal will publish the paper and asks the author to make small corrections.

Accept after major revisions (conditional acceptance): the journal will publish the paper provided the authors make the changes suggested by the reviewers /or editors.

Revise and resubmit (conditional rejection): the journal is willing to reconsider the paper in another round of decision making after the authors make major changes.

Reject the paper (outright rejection): the journal will not publish the paper or reconsider it even if the authors make major revisions.

The first option (accept without any changes) is rare. The second decision (accept with minor revisions) is typically the best outcome authors should hope for. Once a journal rejects a paper outright, authors are well-advised not to resubmit to the same journal. If the journal wanted to reconsider the paper, they would have issued a conditional rejection. An outright rejection means the journal thinks the paper will not meet its publication standards or interests even after heavy revisions.

June	December
January - June Issue	July - December Issue

Publication Timeline

Publishing Schedule:

Open Access Statement:

Journal of Lahore Medical & Dental College, JLMDC, is the official peer-reviewed Journal of Lahore Medical & Dental College. JLMDC is an open-access journal being published biannually. The work is licensed under Creative Commons License. The journal only publishes open access content and legacy. These articles are published in open-access under CC BY (Creative Commons Attribution 4.0 International License).

Ethical Approval of Research: Ethical approval from the organization overseeing the study participants is mandatory. Examples of research which has implications requiring ethical approval include in particular:

- Any form of data collection involving individuals, including surveys, interviews, clinical trials, or direct observation.
- Investigations encompassing the following areas, incorporating questionnaires and surveys: minors (individuals under 18), those incapable of providing informed consent, minority populations, vulnerable demographics, expectant mothers or mothers in labor, and individuals with physical or mental disabilities.
- Any study that entails gathering personal data, whether directly from individuals or through individual records.
- Studies concerning human tissue or entailing direct physical interventions.
- Research on animals.

Strict compliance to ethical standards should be observed while dealing with subjects. Studies on human subjects must indicate explicitly that the procedures followed were in line with the revised "Helsinki Declaration" of 1983. Detailed guidelines are available from the following link: https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/doh-oct1983. Manuscripts of animal studies should clearly indicate that WMA Statement on Animal Use in Biomedical Research were followed. The guidelines on animal research ethics are available from; https://www.wma.net/policies-post/wma-statement-on-animal-use-in-biomedical-research/ to safeguard the rights and welfare of human subjects participating in biomedical research, ethical approval must be obtained for all manuscripts from the Hospital/

Institutional Ethical Committee(s) of the concerned organization(s). All the ethical approval(s), in the case of multicenter studies, should accompany the manuscript in writing. Conflict of interest any conflict of interest should be declared. It may include honorarium, funding, credits, and promotion which are not unethical but should be declared.

Artificial Intelligence and AI-Assisted Technology in Manuscript Preparation:

When authors incorporate Artificial Intelligence or AI-assisted tools in drafting their manuscripts, their use should be limited to enhancing language and readability. These technologies should not replace essential research tasks such as data interpretation or drawing scientific conclusions. It is crucial that AI is employed under human supervision and control, with careful review and editing of the output, as AI-generated content may appear credible yet still contain errors, omissions, or biases.

AI or AI-assisted tools cannot be credited as an author or co-author, nor should they be cited as an author. Authorship entails specific responsibilities that only humans can fulfill. Authors must disclose any use of AI in manuscript writing and preparation. If AI has been utilized, a statement reflecting this will be included in the published work. Nonetheless, the authors remain fully responsible and accountable for the content of their manuscript.

Conflict of interest: Any conflict of interest should be declared. It may include honorarium, funding, credits, and promotion which are not unethical but should be declared.

Complaint Process: The Journal of Lahore Medical & Dental College prioritizes transparency at all stages. Authors retain the right to raise concerns and seek clarification regarding any perceived ethical misconduct or policy breaches. JLMDC will promptly acknowledge receipt of any email correspondence sent to complaintjlmdc@lmdc.edu.pkwith in 2 weeks. The decision is taken in and the same is forwarded to the concerned scholar through his submitted email ID. If the author wishes to pursue their complaint further, they may contact COPE directly. Information can be found on the COPE website: Facilitation and Integrity Subcommittee | COPE: Committee on Publication Ethics.

Complaints may pertain to undisclosed conflicts of interest, plagiarism, multiple or duplicate publications, simultaneous submissions, unethical research practices, falsification of results, breaches of research standards, reviewer bias, or any contributions to JLMDC that infringe upon copyright or other intellectual property rights.

Advertisement Policy: We accept advertisements from pharmaceutical companies for our print editions. The decision to accept these advertisements lies with the Editor-in-Chief. They are displayed randomly throughout the publication. For advertising inquiries, please contact: editorjlmdc@lmdc.edu.pk .

Withdrawal Policies: According to JLMDC's copyright policy, the copyright belongs to JLMDC submission. Furthermore, it is considered unethical to submit the same manuscript to more than one journal at the same time. Withdrawal of the manuscript during its editorial workflow has been divided into parts.

Manuscript Withdrawal (Before Acceptance): Authors are permitted to request the withdrawal of their manuscript after submission but before its acceptance, provided they provide a compelling reason. Withdrawal requests received before the initiation of the peer-review process (typically within three days of submission) will be promptly considered without requiring justification. However, once the review process has commenced, authors must send an email indicating their intention to withdraw, accompanied by a compelling ethical rationale. If any unethical reasons for manuscript withdrawal are detected (even after complete withdrawal), appropriate ethical actions may be taken. A manuscript is considered officially withdrawn only upon receipt of a formal withdrawal letter; failure to provide such a letter renders the manuscript not withdrawn, and any subsequent use of the article elsewhere will be deemed unethical misconduct. Please note that processing charges are non-refundable. For details regarding processing charges, please visit the following link processing charges.
https://jlmdc.lmdc.edu.pk/index.php/lmdc/Policy_Document#charges

Manuscript Withdrawal (After Acceptance): Once an article has been accepted and publication charges have been submitted (regardless of whether it has been published in galley/early version or not), it cannot be withdrawn. For details regarding publication charges, please visit the following link:

https://www.jumdc.com/index.php/jumdc/guidelines#chargesPublication charges. In cases where manuscripts accepted for publication contain scientific errors, accidental duplications of other published articles, or violate our publishing ethics guidelines (such as multiple submissions, false claims of authorship, plagiarism, reviewer bias, fraudulent use of data, or research misconduct), appropriate actions will be taken according to the COPE guidelines

Refund Policy: The author bears the responsibility for payment, and refunds will not be provided. Once the payment for APC/Fast Track is confirmed and processed, no refunds will be issued. Should you encounter any difficulties with online payment, we advise reaching out to us for assistance. It's important to note that the APC for each paper is applicable only once and is non-refundable. In the event of paper withdrawal from the journal, APC will not be reimbursed to the author.

Journal of Lahore Medical and Dental College is sponsored by Lahore Medical and Dental College.

Privacy Statement:

The names and email addresses entered in this journal site will be used exclusively to administer and personalize the website, facilitate access to its services, process and publish manuscripts, communicate about submissions, and send marketing communications and will not be made available for any other purpose or to any other party.

Information that JLMDC collects may be stored, processed, and transferred between any of the countries in which JLMDC operates, in accordance with this privacy policy.

Additionally, personal information submitted for publication on the website will be published online and may be accessible worldwide.

The journal website contains links to other websites. JLMDC is not responsible for the privacy policies or practices of any third party.

Copyright Notice:

All articles in the journal will be licensed under CC-By 4.0. We only consider original submissions for publication, ensuring that apart from abstracts, no data has been published or is under consideration elsewhere prior to appearing in this journal. While the Editorial Board strives for accuracy and authenticity, views expressed in the material belong solely to the authors and may not necessarily reflect those of the Editorial Board.

Authors retain copyright and grant the journal right of first publication with the work will be simultaneously licensed under a creative common license that allows others to share the work with an acknowledgment of the work's authorship and initial publication in this journal.

Authors are able to enter into separate, additional contractual arrangements for the non-exclusive distribution of the journal's published version of the work (e.g., post it to an institutional repository, in a journal or publish it in a book), with an acknowledgment of its initial publication in this journal.

Authors are encouraged to post their work online (e.g., in their institutional repositories or on their website) only after publication online.

When uploading, disseminating or repurposing Open Access publications, the journal should be clearly identified as the original source and proper citation information provided. In addition to the