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Targeting the Blood–Brain Barrier: A New Frontier in Alzheimer's Therapeutics

OPEN ACCESS

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Currently, there is a need for novel therapeutic strategies for Alzheimer's disease (AD) due to the rising global burden. Although some drugs can target amyloid-β and tau pathologies, but still cognitive decline has not been resolved. Advanced research focusing on the Blood-Brain Barrier (BBB) as a therapeutic target for AD, because BBB dysfunction significantly contributes to AD pathogenesis.

Emerging evidence shows that BBB dysfunction leads to AD through alterations of endothelial tight junctions, pericyte loss, basement membrane degradation, and impaired clearance mechanisms of amyloid-β waste from the brain and increases the permeability of neurotoxins inside the brain. This dysfunction leads to severe neurodegenerative events [1].

Possibly, the integrity of the BBB can be restored by protecting or repairing the structural and functional components of the BBB for homeostasis purposes, reducing the infiltration of peripheral inflammatory mediators, and supporting the normal clearance of soluble amyloid. Another key issue in AD treatment is the very low penetration of the drug inside the central nervous system (CNS). If the drug delivery system becomes better and a maximum amount of the drug can be penetrated inside the brain, it will also be a big milestone against AD progression. A recent study shows that nanomedicine engineered to engage the BBB transport mechanisms led to robust amyloid clearance and memory recovery in AD model mice [2].

Meanwhile, some studies also focus on finding new biomarkers and therapeutic targets to treat AD. There is a need to search for new targets that are associated with neurodegeneration [3]. There is a need to resist BBB dysfunction; once BBB damage becomes irreversible, then many challenges will become hurdles in AD treatment. Researchers should work to protect the BBB from irreversible damage.

In conclusion, we may get proper therapy for Alzheimer's Disease if we focus on seeking new therapeutic targets, restoring the BBB integrity and developing novel therapeutic strategies that can increase the availability of drugs inside the brain.

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Review Article

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A Review on the Impact of Superfoods on Cognitive Performance, Physical Resilience, and Mental Health

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ABSTRACT

Nutrition and lifestyle factors, especially diet and physical activity, significantly impact cognitive health throughout life. Cognitive health encompasses various aspects, including thinking, learning, and memory, as well as motor functions related to movement control and emotional balance. Cognitive performance and physical well-being are critical to success. Dietary strategies, particularly the inclusion of super-foods, have garnered significant attention for their potential to improve brain function and overall physiological health. This comprehensive review examines the impact of key super-foods on cognitive and physical health in students and professionals subjected to prolonged mental exertion. Updated scientific literature on nutrient-dense foods such as dark chocolate, omega-3-rich fish, walnuts, moringa, fermented foods, and high-quality proteins is evaluated for their neuroprotective properties and health-promoting effects. Evidence suggests that integrating multiple super-foods yields synergistic benefits for mental clarity, endurance, cardiovascular fitness, and metabolic balance. The review emphasizes a multidisciplinary dietary approach and offers a framework for future research and evidence-based dietary guidelines.

INTRODUCTION

Nutrition and lifestyle factors, particularly diet and physical activity, play a crucial role in cognitive health across the life course. Cognitive health involves thinking, learning, and remembering, besides other aspects such as the motor function of making and controlling movements, including emotional balance so the rising cognitive and physical demands placed on professionals necessitate strategies that promote sustained mental alertness and resilience[1-2]. The Diet is a modifiable lifestyle factor, offers a practical means of supporting both brain and body functions [3-4]. Superfoods, recognized for their concentrated nutritional value and functional bioactive compounds, have been implicated in enhancing memory, learning, stress regulation, and physical endurance [5-8]. Modern lifestyles often neglect nutritional adequacy, resulting in cognitive fatigue, mood fluctuations, and metabolic imbalances [9-12]. Scientific literature increasingly supports the integration of superfoods such as dark chocolate (polyphenols and flavonoids), omega-3-rich fish (DHA and EPA), moringa (anti-inflammatory phytochemicals), and fermented foods (probiotics) for their comprehensive impact on cognitive performance and physiological vitality

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[10-12]. This review aims to elucidate the scientific basis of these effects, with a focus on practical implications and f future directions [12]. The objective of this study is to evaluate the neurocognitive benefits of superfoods in enhancing brain health. To analyze the physical health benefits of superfoods, including cardiovascular, immune, and metabolic functions. To explore the combined effects of multiple superfoods and to identify research gaps and propose evidence-based recommendations for dietary interventions. This review is highlighted the importance and scope which is particularly relevant to populations engaged in sustained cognitive activity, such as students and high-performance professionals. The scope encompasses superfoods with demonstrated impacts on cognitive processes, emotional stability, and physical robustness [6, 13]. It includes molecular pathways, clinical outcomes, and comparative assessments of dietary interventions[6, 14]. Superfoods, defined as foods of high nutritional and biological value with adequate bioavailability and bioactivity within the body due to their extraordinary concentrations of nutrients and bioactive ingredients, can play a crucial role in a global arena where the identification of healthier and cleaner nutrient sources is practically mandatory [8, 15-18]. Superfoods are specific types of foods that offer various health benefits, including the prevention of certain ailments, support for the immune system, and essential macro- and micronutrients in sufficient quantities[8, 15, 16, 18-20]. This review is going to further discuss the literature on the different superfoods, which are quite beneficial for health. The Dark Chocolate is rich in flavonoids that cross the blood-brain barrier, enhancing cerebral blood flow and cognitive flexibility [21]. This systematic review summarizes the beneficial effects of acute and chronic cocoa intake on cognitive functions and brain health in young adults, highlighting increased cerebral blood flow and neurotrophins as mechanisms, and suggests cocoa flavanols as a preventive approach against cognitive decline [22]. Moringa oleifera, known as the "miracle tree," is a versatile plant with significant nutritional and medicinal properties [23]. Moringa oleifera has nutritional and pharmacological potencies, including antidiabetic, antimicrobial, anti-inflammatory, and hepatoprotective properties [24-26]. The Lycopene, a carotenoid found in tomatoes, has neuroprotective effects by reducing oxidative stress and inflammation, and it can cross the blood-brain barrier, making it effective in treating various neurological disorders [27, 28]. Walnuts may have significant benefits for brain health and cognitive function, which are rich in omega-3 fatty acids and polyphenols, which support memory consolidation and neuron preservation [29, 30]. Consumption of a walnut-rich breakfast improves executive function throughout the day in healthy young adults [31]. Walnuts contain compounds that can reduce oxidative stress, inflammation, and protein aggregation in the brain, potentially benefiting brain health with age [31-33]. A 6% or 9% walnut diet significantly reduces polyubiquitinated protein accumulation and inflammation in the brain of aged rats, potentially improving memory and cognitive performance [30, 31, 34]. Raisins and boron have been linked to various health benefits, particularly for cognitive function and hormonal balance. Raisins contain a wide range of hormones, minerals, vitamins, and antioxidant enzymes [35]. Consuming 50g of raisins per day improves cognitive performance, quality of life, and functional activities in healthy older adults. Raisin water contains resveratrol and boron, which are linked to improved alertness and hormonal balance [36-38]. Protein intake and dietary antioxidants may protect against depression and neurodegeneration by regulating tryptophan metabolism [39]. An anti-inflammatory diet rich in fruits, vegetables, whole grains, legumes, and fatty fish may benefit individuals with mental and neurodegenerative disorders by modulating inflammation, promoting gut health, and enhancing neuroplasticity [40]. Omega-3 fatty acid metabolites like resolvins and maresins have anti-inflammatory effects and therapeutic potential for psychiatric, neurodegenerative, and neurological disorders [41]. Omega-3-Rich Fish (e.g., Salmon, Mackerel): Critical for synaptic integrity, plasticity, and anti-inflammatory signaling [42]. The potential of fermented foods and dietary fiber to modulate the microbiota-gut-brain axis, impacting cognitive and emotional health. Fermented foods contain beneficial microbes and bioactives that can shape gut microbiota composition and influence gut-brain communication pathways [43]. Short-chain fatty acids produced by gut microbiota play a key role in modulating the gut-brain axis and may influence brain physiology and behavior [44, 45]. A greater intake of high-antioxidant foods like berries, Concord grapes, and walnuts may increase "health span" and enhance cognitive and motor function in aging individuals [46]. Flavonoids and isoflavones from fruit and vegetables may slow cognitive aging and potentially reverse it by reducing free radical production and enhancing brain performance [47, 48]. Dietary interventions may help slow or reverse age-related cognitive decline. Flavonoids and isoflavones from fruits and vegetables can potentially reduce free radical production and enhance brain performance [34, 48]. Tree nuts, particularly walnuts, almonds, pistachios, and pecans, show promise in reducing age-related brain dysfunction by providing essential nutrients,

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phytochemicals, and fatty acids [49]. Blueberries may help prevent or reverse age-related neuronal deficits by lowering oxidative stress and inflammation [34, 50]. Studies have demonstrated that dietary supplementation with fruit or vegetable extracts high in antioxidants, such as blueberries and spinach, can decrease vulnerability to oxidative stress in aging rat brains [34, 51].

Despite growing evidence that superfoods can enhance cognitive performance, emotional resilience, and physical health, modern lifestyles often fail to provide adequate nutrition, leading to cognitive fatigue, mood fluctuations, and metabolic imbalances. While numerous studies highlight individual superfoods' neuroprotective and physiological benefits, there is limited research on the long-term effects of combined superfood consumption, dose-response relationships, and their interaction with genetic, epigenetic, and lifestyle factors. Furthermore, clinical validation in high-cognitive-load populations, such as students and professionals, remains sparse, indicating a critical gap in translating laboratory findings into practical, evidence-based dietary recommendations.

Brain Health Benefits

Superfoods contribute to improved neurocognitive function through several mechanisms: Reduction of neuroinflammation and oxidative damage [6]. Enhanced neurogenesis and hippocampal plasticity [52]. Increased synaptic efficiency and neurotransmitter balance [53]. Gut microbiota modulation improves systemic and central immune responses [54].

Physical Health Benefits

Cardioprotective effects via lipid regulation and arterial flexibility [55]. Anti-inflammatory and immunomodulatory actions [56-57]. Probiotic support for digestion and nutrient bioavailability [56]. Anabolic support for muscle maintenance and metabolic function [58].

Mechanism of Action

Antioxidant Pathways: Mitigation of oxidative stress via SOD and glutathione [59]. Neurotransmitter Synthesis: Dopaminergic and serotonergic regulation via amino acid intake [60]. Anti-inflammatory Mediators: Regulation of TNF-α, IL-6, and CRP levels [61, 62]. Gut-Brain Axis: SCFA production influencing CNS signaling and emotional resilience [63-64]. Combined Effects of Superfoods: Cumulative benefits of superfoods demonstrate enhanced efficacy in maintaining health and productivity [7, 20]. Synergistic interactions between omega-3 fatty acids and polyphenols amplify BDNF expression [65, 66]. Probiotics and antioxidants jointly optimize gut-brain communication [45]. Amino acids and flavonoids together support mood regulation and cognitive vigor [67, 68] (Table 1).

Table 1: Cognitive Effects of Key Superfoods

Superfood	Active Compounds	Cognitive Effects	References
Dark Chocolate	Flavonoids, caffeine	Improved memory and attention	[21]
Moringa	Quercetin, kaempferol	Anti-stress, neuroprotective	[26]
Walnuts	ALA, polyphenols	Memory and neurogenesis	[33]
Fish	DHA, EPA	Synaptic plasticity, cognition	[42]
Fermented foods	Probiotics	Gut-brain signaling, mood	[45]

DISCUSSION

Superfoods have emerged as critical dietary components due to their rich bioactive profiles and their potential to mitigate cognitive and physical challenges associated with high cognitive load environments. Numerous studies indicate that the intake of superfoods can enhance neuroplasticity, improve neurotransmitter function, and protect against oxidative stress factors closely linked with mental resilience and performance [69]. Dark chocolate, due to its high flavonoid content, improves cerebral blood flow and supports memory formation [21]. Regular consumption has been linked to enhanced executive function and mood stabilization. Similarly, walnuts, abundant in alpha-linolenic acid and polyphenols, contribute to improved working memory and cognitive processing speed in young adults [33]. Fermented foods such as kimchi, kefir, and yogurt have shown promising results in modulating the gut-brain axis. These foods contribute to the production of short-chain fatty acids and neurotransmitters, such as serotonin and GABA, which are instrumental in regulating emotions and cognition [45, 70]. Moreover, omega-3 fatty acids from fish oils not only reduce neuroinflammation but also play a crucial role in synaptic function and neurogenesis, particularly in the hippocampus [42]. Moringa oleifera, rich in quercetin and kaempferol, has shown neuroprotective effects in animal models, reducing markers of inflammation and enhancing learning and memory [26]. Tomatoes, through their lycopene content, mitigate oxidative stress, contributing to cognitive preservation in aging populations [28]. Physical health, closely tied to cognitive outcomes, also benefits from superfood consumption [5]. High-quality proteins are essential for neurotransmitter synthesis and muscle integrity, while resveratrol in raisins contributes to hormonal balance and energy regulation [6]. The synergistic use of these superfoods offers a holistic dietary model, enhancing both physiological and psychological resilience [6]. Despite the promising findings, gaps remain in clinical validation, especially regarding the long-term and combinatory effects of multiple superfoods. Future research should focus on controlled trials that evaluate

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dose-response relationships and the influence of genetic, epigenetic, and lifestyle variables.

This review is limited by the scarcity of long-term, controlled clinical trials evaluating the combined effects of multiple superfoods on cognitive and physical health, as most evidence is derived from short-term studies or animal models. Additionally, variations in dosage, bioavailability, and individual lifestyle or genetic factors make generalization challenging. Future research should focus on well-designed, longitudinal human trials to determine optimal intake, synergistic effects, and personalized dietary strategies, while exploring the mechanisms underlying superfoods' impact on brain and body health to provide evidence-based nutritional guidelines.

CONCLUSIONS

Superfoods offer a promising, evidence-based approach to improving mental clarity, emotional stability, and physiological health. Their multifaceted benefits align well with the demands of students and high-performance professionals. Strategic incorporation of these foods, supported by further clinical validation, may represent a cornerstone in personalized nutrition strategies.

Authors' Contribution

Conceptualization: FA
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Formal analysis: FA
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Review and Editing: FA, KS, RH, HT, MR, SE

All authors approved the final manuscript and take responsibility for the integrity of the work.

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Original Article

Transvaginal Ultrasound: Current Practices and Barriers in Pakistani Sonographers

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ABSTRACT

Transvaginal ultrasound (TVUS) is an important diagnostic medium in the evaluation of female pelvic pathology because it can be performed without invasiveness, is real-time, and has diagnostic accuracy. Its use in low and middle-income countries, particularly in gynecological practice, has significant difficulties regardless of the international suggestions to use it regularly. **Objective:** To explore the current practices, perceived barriers, and influential factors associated with the routine implementation of TVUS among Pakistani sonographers. **Methods:** This cross-sectional descriptive survey was conducted among 162 accredited sonographers across Pakistan using a 35-item structured questionnaire. Data on demographic characteristics, clinical experience, confidence levels, protocol adherence, and perceived barriers were collected. Data were analyzed using descriptive statistics and chi-square tests. **Results:** The findings revealed strong patient preference for female sonographers across all regions, with statistically significant differences based on practice location ($p<0.001$). Adherence to standardized TVUS protocols was highest in public hospitals and among practitioners with over 15 years of experience ($p<0.001$). Key barriers included cultural taboos, inadequate training, limited institutional support, and legal/ethical concerns, particularly in rural and semi-urban areas. Practitioners' confidence was positively associated with years of experience. **Conclusion:** The study highlights critical gaps in training, infrastructure, and cultural acceptability that hinder effective TVUS utilization in Pakistan. Targeted interventions such as gender-sensitive training, protocol standardization, and policy-level reforms are essential to bridge these gaps and enhance the delivery of equitable, high-quality gynecological care.

INTRODUCTION

The transvaginal ultrasound (TVUS) is widely considered the first-line imaging modality for the assessment of the female pelvis due to its dynamic functions, high-resolution images, and non-ionizing radiation [1]. With the growth in the dependence on pelvic imaging, TVUS has demonstrated itself to be a significant diagnostic tool for the assessment of various gynecological conditions, such as endometriosis, ovarian cysts, and early pregnancy difficulties. While laparoscopy has traditionally been regarded as the diagnostic gold standard, it remains invasive, carries surgical risk, and is resource-intensive, especially in low- and middle-income countries. Thus, the European Society of Human Reproduction and Embryology (ESHRE) has recommended transvaginal ultrasound (TVUS) as the first-line diagnostic tool for various gynecological conditions, owing to its accessibility and diagnostic accuracy. Given the diagnostic utility and effectiveness of TVUS, the British Medical Ultrasound Society also advocates that the procedure should be accessible to all eligible patients to provide equitable and high-standard

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care [2]. Although the attitude of patients towards TVUS has been studied in numerous studies, revealing a variety of reactions across different clinical setups and cultural backgrounds, there is a significant gap in the literature regarding the perspective of sonographers about transvaginal ultrasound (TVUS) [3, 4]. This gap is especially relevant, as the successful implementation of TVUS is required beyond the acceptance by the patient, but also the training, technical confidence and attitudes of the healthcare professionals involved [5-7]. The broader application of Transvaginal Sonography (TVUS) in low-resource countries like Pakistan is a big challenge. These include the insufficiency of training and ergonomic capacity of the sonographers, the cultural ideologies that shape the attitude of the patients, the unavailability of the medical equipment in question, and the infrastructures and insufficient healthcare funding. In addition to that, the problem associated with the working conditions of the TVUS use, ergonomic load, and inability to cope with technically complex cases are discussed [8]. Moreover, the successful collaboration with the sonographers would help to recognize the barriers to the TVUS implementation that may improve the clinical guidelines and policy formulation, and might make a significant contribution to the facilitation of patient care, women's health, and healthcare system sustainability [9-11]. Moreover, to efficiently tackle the challenges on a larger scale, it is necessary to adopt an all-inclusive approach, which should be aimed at raising the awareness about the procedure by means of education, offering the comprehensive training to sonographers, addressing the cultural beliefs and stigmas, making the necessary medical equipment accessible, optimizing the overall healthcare system, and enhancing the finances to implement and support the programs.

Transvaginal ultrasound (TVUS) is a vital, non-invasive diagnostic tool for female pelvic health, yet its adoption in Pakistan faces multiple challenges, including cultural sensitivities, limited training opportunities, inadequate institutional support, and inconsistent adherence to standardized protocols, particularly in rural and semi-urban areas. Despite its recognized clinical utility, there is a notable lack of research exploring Pakistani sonographers' perspectives, confidence, and barriers in routine TVUS practice, highlighting a gap in understanding the professional, institutional, and socio-cultural factors affecting its implementation. This study aims to investigate the current practices, perceived barriers, and influential factors associated with TVUS utilization among Pakistani sonographers to inform targeted interventions, training programs, and policy reforms that can enhance equitable and high-quality gynecological imaging services.

METHODS

This cross-sectional descriptive survey was conducted among 162 accredited sonographers across Pakistan. Ethical approval was obtained from the research ethics committee of Green International University, Lahore, Pakistan (Ref. No. 25-10). The study was conducted at Green International University in Lahore, Pakistan, from August 2024 to August 2025. The survey instrument consisted of 35 questions, which were created in accordance with the literature and professional advice. The questionnaire was divided into five parts: demographic variables; clinical practice; training; self-perceived confidence to undertake transvaginal ultrasound (TVUS); perceived barriers and facilitators to routine TVUS use; and reporting and referral practices. The questionnaire was subject to the review of three sonographers who achieved the face and content validity of the questionnaire. The alpha of Cronbach was not determined because of time and resource limitations. The feedback allowed minor corrections to improve language clarity and structure. The data from pilot testing by three experienced sonographers was not added to the final results of the study. The first page of the survey included a participant information sheet, and informed consent was obtained from each sonographer before the data collection. Participants were recruited through convenience sampling. Recruitment strategies included the dissemination of the survey via professional social media groups for sonographers and radiologists, as well as poster advertisements in ultrasound departments across various hospitals in Pakistan. A convenience sampling technique was used, which may limit the generalizability of the findings. The minimum required sample size was estimated using Cohen's guidelines for chi-square tests of association, assuming a medium effect size (w=0.25), a significance level of 0.05, and a power of 0.80. The calculation, performed using G*Power version 3.1.9.7, indicated that a minimum of 126 participants would be sufficient. To account for potential nonresponse and incomplete data, a target sample of 162 was selected [12]. This sample size also aligns with similar cross-sectional studies conducted among the radiologists and sonographers investigating the practices, training, and related barriers [13-14]. The inclusion criteria required participants to hold a minimum qualification, such as a Diploma, BS, MS, MBBS with ultrasound certification, or FCPS in Radiology. Participants aged 18 years or older who were involved in performing gynecological ultrasound procedures in Pakistan were included in the study. Individuals not meeting the age criteria and those affiliated with the field were excluded. Data were analyzed using IBM SPSS Statistics version 26.0. Categorical and demographic

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variables were summarized using frequencies and percentages, while continuous variables were reported as means and standard deviations. Inferential analyses included chi-square tests and logistic regression to examine associations between variables, with a significance level set at $p<0.05$.

RESULTS

A total of 162 responses were included in the final analysis. Categorical and demographic data are reported as frequencies and percentages in Table 1. The majority of respondents were female (103, 63.6%), with most in the 25–34 age group (78, 48.1%). Over half of the participants, 107 (66%), were single. Regarding education, 101 (62.3%) held a Bachelor's degree in Radiography or Ultrasound, 26 (16%) an FCPS in Radiology, and 25 (15.4%) an MBBS.

Table 1: Demographic Characteristics of the Study Sample (N = 162)

Variables	Categories	n (%)
Gender	Male	59 (36.4%)
	Female	103 (63.6%)
Age (years)	18–24	12 (7.4%)
	25–34	78 (48.1%)
	35–44	51 (31.5%)
	45–54	21 (13.0%)
Marital Status	Single	107 (66.0%)
	Married	55 (34.0%)
Qualification	Bachelor's in Radiography/Ultrasound	101 (62.3%)
	Diploma in Medical Sonography	10 (6.2%)
	FCPS Radiology	26 (16.0%)
	MBBS	25 (15.4%)
Employment Status	Full-time	88 (54.3%)
	Part-time	46 (28.4%)
	Temporary/Locum	28 (17.3%)
Professional Role	Sonographer	128 (79.0%)*
	Radiologist	26 (16.0%)
	Trainee	8 (4.9%)
Years of Experience	< 2 years	11 (6.8%)
	2–5 years	15 (9.3%)
	6–10 years	25 (15.4%)
	11–15 years	53 (32.7%)
	> 15 years	58 (35.8%)
Type of Facility	Private Diagnostic Center	25 (15.4%)
	Public Hospital	83 (51.2%)
	Teaching Hospital	31 (19.1%)
	OB-GYN Specialty Clinic	23 (14.2%)
Location of Practice	Urban	52 (31.5%)
	Semi-Urban	39 (24.1%)
	Rural	72 (44.4%)

In terms of employment, 54.3% were working full-time, and most participants (69%) identified their role as a sonographer. Nearly 68.5% of the sample had more than 10 years of professional experience. More than half were employed in public hospitals (51.2%), and 44.4% reported practicing in rural areas. To explore the gender preference perception among patients receiving TVUS, the chi-square test was used, depending on the location of practice of the respondents. The results showed that the relationship between the practice location and perceived gender preference was statistically significant ($\chi^2=32.64$, $p<0.001$). The analysis also showed that in urban regions, 90.4% of practitioners said that patients favored female sonographers, and 3.8% did not favor, but 5.8% were uncertain. In the semi-urban locations, 100% of the respondents were found to prefer female practitioners. Equally, 97.2% of the participants in the rural setting expressed that a patient prefers female sonographers, where 2.8% responded that such a patient has no preference (Table 2).

Table 2: Perceived Gender Preference for TVUS by Practice Location (N=162)

Variables	Practice Location	No Preference, n (%)	Not Sure, n (%)	Yes, Prefer Female, n (%)	χ^2
Perceived Gender Preference for TVUS	Urban	2 (3.8%)	3 (5.8%)	47 (90.4%)	32.64***
	Semi-Urban	0 (0%)	0 (0%)	39 (100%)	
	Rural	2 (2.8%)	0 (0%)	70 (97.2%)	

***p < .001

Use of standard protocols in TVUS doing between various types of facilities and the years of experience were also investigated. The findings revealed that the use of standardized protocols in public hospitals was the most adhered to, as 74.7% of the respondents confirmed that they used it, and only 4.3% expressed that they did not use the protocols. Conversely, the percentage of those in private diagnostic centers who had standardized protocol usage was 36% as compared to 32.3 and 34.8% in teaching hospitals and OB-GYN specialty clinics, respectively. In terms of years of experience, the largest percentage of protocol usage belonged to professionals who have over 15 years of experience (67.2%), then to those with experience between 11-15 years (60.4%). On the other hand, respondents with less than 5 years' experience exhibited significantly low standardized protocol adherence, with only 36.4% of the respondents with less than 2 years and 26.7% with 2-5 years having low standardized protocol adherence. The chi-square test showed that the facility type ($\chi^2=52.27$) and years of experience ($\chi^2=47.07$) had a significant relationship with the protocol use ($p<0.001$ for both) (Table 3).

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Table 3: Use of Standardized TVUS Protocols by Facility Type and by Years of Sonography Experience (N = 162)

Variables	Categories	Yes, n (%)	Maybe, n (%)	No, n (%)	Not Aware, n (%)	χ^2
Use of Standardized TVUS Protocols	Private Diagnostic Centre	9 (36.0%)	11 (44.0%)	2 (8.0%)	3 (12.0%)	52.27*
	Public Hospital	62 (74.7%)	11 (13.3%)	4 (4.8%)	6 (7.2%)	
	Teaching Hospital	10 (32.3%)	2 (6.5%)	13 (41.9%)	6 (19.4%)	
	OB-GYN Specialty Clinic	8 (34.8%)	5 (21.7%)	5 (21.7%)	5 (21.7%)	
Years of Experience	> 15 years	41 (67.2%)	12 (19.7%)	3 (4.9%)	5 (8.2%)	47.07*
	11–15 years	4 (36.4%)	1 (9.1%)	2 (18.2%)	4 (36.4%)	
	6–10 years	4 (26.7%)	3 (20.0%)	3 (20.0%)	5 (33.3%)	
	2–5 years	9 (36.0%)	8 (32.0%)	5 (20.0%)	3 (12.0%)	
	< 2 years	32 (60.4%)	17 (32.1%)	2 (3.8%)	2 (3.8%)	

***p <0.001

A logistic regression was performed to identify predictors of confidence and protocol adherence in performing TVUS. The analysis revealed that sonographers with six or more years of experience were over four times more likely to demonstrate confidence and adherence (AOR=4.13, 95% CI: 1.85–9.21). Employment in public or teaching hospitals was also a significant predictor (AOR=3.29, 95% CI: 1.47–7.38). The use of standardized protocols showed a strong association with improved confidence (AOR=2.86, 95% CI: 1.22–6.69). Additionally, training availability (AOR=3.71, p=0.003) and lower gender-based barriers (AOR=2.42, p=0.047) were independently associated with positive practice behaviors (Table 4).

Table 4: Logistic Regression Analysis of Factors Associated with Confidence and Protocol Adherence in Performing TVUS

Predictor Variables	β Coefficient	Adjusted OR	95% CI (Lower–Upper)	p-value
≥6 Years of Experience	1.42	4.13	1.85 – 9.21	0.001
Public/Teaching Hospital (vs Private/Clinic)	1.19	3.29	1.47 – 7.38	0.004
Use of Standardized Protocols (Yes)	1.05	2.86	1.22 – 6.69	0.014
Low Gender-Based Barrier (vs High)	0.88	2.42	1.01 – 5.79	0.047
Training Availability (Yes)	1.31	3.71	1.56 – 8.85	0.003
Constant	-2.07	—	—	0.009

The most commonly reported barriers that hinder Sonographer from performing TVUS are illustrated in Figure 1. These included cultural sensitivities and patient consent issues, lack of training opportunities, inadequate institutional support, and legal/ethical concerns. Such barriers appeared to be more pronounced in rural and semi-urban areas (Figure 1).

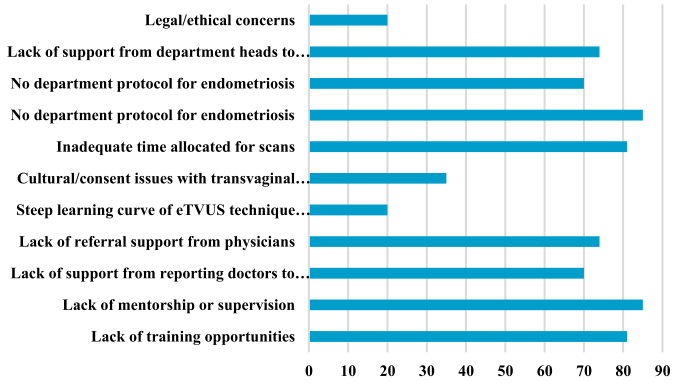

Figure 1: Barriers That Limit the Sonographer's Ability to Perform TVUS (N=162)

Sonographer confidence in performing TVUS was found to be closely linked with their years of professional experience. Confidence levels increased substantially with more years of practice. Those with over 15 years of experience reported the highest confidence, whereas those with less than 5 years of experience displayed lower levels of self-reported competence in performing the procedure (Figure 2).

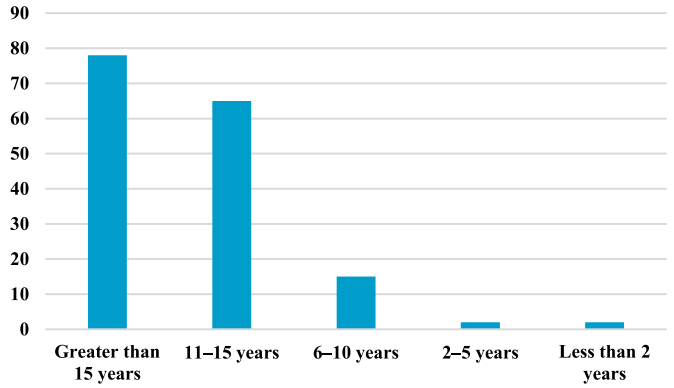

Figure 2: Confidence in Performing TVUS by Years of Experience (N=162)

DISCUSSION

The current study was the first to investigate these issues that Pakistani sonographers commonly encounter when learning and implementing TVUS in routine practice. One significant conclusion made based on the results of this

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study is that there is a high preference for female sonographers by the patients, across all demographic areas, including urban, semi-urban, and rural areas. This observation is corroborated by the literature both in South Asia and the Middle Eastern countries, where gender dynamics in the healthcare relationship have been significantly affected by the cultural and religious understanding, specifically in gynecological or intimate examinations [15, 16]. Similar results are provided in a study carried out in Lahore, Pakistan, raising high refusal rates of TVUS when provided by a male sonographer, similar to the present study [17, 18]. The significant correlation between the location of practice and gender preference of patients indicates the deep sense of cultural values present in rural and conservative areas of Pakistan. Female patients, in such settings, tend to avoid male medical practitioners because of the modesty norms, family and societal norms, and religious expectations [19]. This underscores that there is a need of skilled female sonographers, especially in the underserved rural settings. In terms of adherence to the standardized TVUS procedures, the analysis suggested that public hospitals are generally more compliant with the standardized TVUS protocols than the private centers and specialty clinics. This may be attributed to the presence of enhanced governance by the institutions, quality assurance systems, and continuing education policies that are commonly present in government facilities [16]. On the other hand, the variability in the protocol compliance in the private sector may represent an absence of a regulatory process and standardized training protocols, which was also mentioned in one of the recent audits of radiological facilities in Punjab [20]. Years of experience on the job were also discovered to have a substantial influence on the attitude towards adherence to protocol and confidence of sonographer in performing the TVUS. This observation confirms the available evidence that the clinical skills in ultrasound are enhanced with time and subsequent exposure, along with the supervision and training of the skills. A regional study suggested that senior radiologists were observed as more consistent and guideline-compliant with regard to scanning practices in comparison with junior employees or technicians [21, 22]. Similarly, the association between experience and confidence demonstrated by this study reflects similar tendencies in sonography teaching programs explained in a study conducted in Southeast Asia, indicating that organized formal training and mentorship have not only a positive effect on the practical abilities of the practitioner but also improve their self-efficacy [23]. The results of the logistic regression analysis emphasize that professional experience, institutional support, and structured training are significant factors to consider to increase confidence and compliance with TVUS protocols. The sonographers who had an experience of ≥6 years were more than four times more expected to show competent practice (AOR=4.13), a finding that corresponded with past reports that clinical seniority increases procedural confidence and guideline adherence. Working in state or teaching hospitals (AOR=3.29) also indicates the contribution of the resource availability and supervision to the improvement of the practice standards, as the prior studies have shown. The adherence was much better with the use of standardized protocols (AOR=2.86), which proves that formal guidelines can decrease the variability of ultrasound practice [24]. Further, the availability of training (AOR=3.71) and decreased gender-related barriers (AOR=2.42) demonstrate the significance of the equitable accessibility and conducive conditions in promoting professional competence. Taken together, these findings highlight the importance of specific training, institutional support, and reduction of social obstacles as the key to enhancing TVUS performance. Notably, the research also established several barriers to quality delivery of the TVUS practice, particularly in semi-urban and rural locations. Some of the key concerns in this respect are cultural taboos, lack of training opportunities, gaps in the institution, and the absence of the consent of patient. Such outcomes are consistent with the case in Pakistan, which was described in previous research, pointing to the deficiency of gynecological ultrasound education in general sonography programs and the absence of workshops or simulation training to learn the invasive procedures [25]. The issue of legal and ethical consequences in the practice of (TVUS) shows that the problem requires national guidelines that are standardized to protect both patients and professionals. One of the reviews notes that a lack of training in the field of ultrasound, and in particular in low and middle-income countries, can give rise to both ethical and clinical issues [26]. The research is among one of the earliest studies in Pakistan conducted to investigate the professional, institutional, and cultural determinants affecting the application of transvaginal ultrasound (TVUS) by sonographers and radiologists. The inclusion of various practitioners working in different healthcare settings, including public, private, and teaching institutions, contributes to the generalizability of the results in the local context.

However, there are a number of limitations that need to be acknowledged. External validity is restricted due to the convenience sampling method, and lack of formal power analysis also limits the accuracy of the inferential findings. Self-reported data can also be subject to recall or social desirability bias, while the cross-sectional research design does not allow making causal inferences. Future research needs to consider employing probability-based sampling and multi-center data collection to enhance

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representativeness. The longitudinal or mixed-method approach may also be used to investigate the effect of training, gender sensitivity, as well as institutional policy reforms on practice behaviors over time. Moreover, the development and validation of standardized national guidelines and training programs in TVUS may reinforce the competence of the practitioners as well as patient trust.

CONCLUSION

This study identified major cultural, institutional, and training-related barriers that limit the adoption of TVUS in Pakistan. Confidence and protocol adherence were higher among experienced practitioners and those in public hospitals. The use of convenience sampling restricts external validity and should be considered when interpreting the results. Addressing these barriers is essential to improve the equity and quality of the transvaginal ultrasound practices across diverse healthcare settings.

Authors' Contribution

Conceptualization: SAG, SMYF
Methodology: SMYF, MU, ZH, SK, SA, MIUH
Formal analysis: SMYF, MU
Writing and Drafting: SAG, SMYF, MU, ZH, SK, SA, MIUH
Review and Editing: SAG, SMYF, MU, ZH, SK, SA, MIUH

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

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Electromagnetic Pollution and Its Health Effects: A Public Awareness and Health Symptom Survey

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ABSTRACT

In a contemporary world with a lot of electromagnetic fields (EMF) producing appliances, individuals are becoming increasingly worried about the impact that the appliances can have on their health. **Objectives:** To investigate the level of public awareness, behavior, and symptoms of health in relation to non-ionizing electromagnetic radiation of mobile phones, Wi-Fi, and 4G / 5G towers. **Methods:** The study was conducted using a cross-sectional descriptive survey (n=115) with a confirmed questionnaire that was administered online. The Chi-square test and descriptive statistics were used to test the relationships between EMF exposure and reported health symptoms. **Results:** The study revealed that mobile phone addiction is high, and over 60 percent of the respondents spent over six hours a day on the devices. Interestingly, 76 percent of them reported headaches, 66 percent complained of eye strain, and 61 percent complained of sleep problems, which indicates that the long-term exposure to EMF might be associated with neurological symptoms. The chi-square test was used to demonstrate that the association between high EMF exposure and health complaints is statistically significant ($p<0.001$). **Conclusions:** The paper gives important points on how the community education needs much improvement, policies should be made according to the situation, and more longitudinal studies are needed to understand the health risks of prolonged EMF exposure and mitigate them.

INTRODUCTION

Electromagnetic pollution (or electromagnetic smog or EMF (electromagnetic field) exposure) is the overabundance in our environment of electromagnetic radiation, mostly man-made (mobile phones, Wi-Fi routers, power lines, and microwave ovens). This paper will examine the awareness, perception, and experiences of the population concerning the exposure to EMF and their possible health impacts [1]. In the world of computers, the level of exposure to electromagnetic fields (EMFs) has become an inevitable part of our lives. As wireless technologies, mobile phones, Wi-Fi routers, power lines and smart meters, and other devices that generate and consume electromagnetic radiation spread, humans are surrounded by a cloud of electromagnetic radiation that is invisible to the human eye [2]. Though non-ionizing EMFs, including those produced by most domestic and personal devices, are generally deemed to be less harmful than ionizing radiation, increasing public concern and current research indicate that there may be health consequences [3]. The cumulative impact of convergent electromagnetic emissions of several sources is called electromagnetic pollution, or, in other terms, electro-smog [1]. Although no one can deny the industrial and technological advantages of the EMF-emitting devices, the long-term biological effects are not fully comprehended and are the subject of numerous controversies [4, 5]. The symptoms that are

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usually associated with EMF exposure are headaches, fatigue, sleeping problems, memory problems, and stress, which can be of different degrees with respect to the duration and exposure proximity [6]. It also aims at determining the level of precautionary measures taken by individuals and the level of interest of people in stricter regulations. The electromagnetic field may be further classified into ionizing EMFs, high-frequency radiation that may cause the break of molecular bonds (e.g., X-rays, ultraviolet rays), and non-ionizing EMFs, which are low-frequency radiation in communication and domestic influence (e.g., radiofrequency radiation of phones, Wi-Fi, and extremely low frequency (ELF) radiation of power lines, etc.) [7, 8]. Although the biological effects of non-ionizing EMFs are currently under study, the well-known biological effects of ionizing radiations are DNA damage and cancer [7, 8]. However, some organizations come out to say that radiofrequency EMFs are possibly carcinogenic to humans, or group 2B (IARC, n.d.), thus drawing new attention and concern [9-12]. In contemporary homes and offices, individuals are constantly exposed to EMF-emitting appliances. They are mobile phones and smartphones, 4G/5G cellular towers, Wi-Fi routers and Bluetooth devices, microwave ovens, smart home appliances, and electrical power lines and substations [13, 14]. This is unlike in the past, where exposure to EMF was restricted to certain industrial or medical settings; today, it is everywhere, continuous, and in many cases long-lasting, especially among the younger age groups and working professionals who spend a lot of time online or close to any electronic gadgets [1]. Anecdotal and clinical evidence is growing, indicating that EMF may play a role in the development of a variety of non-specific symptoms, which include headaches, sleep disturbances, chronic fatigue, eye strain, anxiety or cognitive impairment, dizziness, and memory problems [3, 14]. These symptoms have been generally referred to as Electromagnetic Hypersensitivity (EHS). Nevertheless, it is not a medical diagnosis yet, as inconsistent results have been found and standard biomarkers are lacking [14]. What is certain, despite the debate that has been taking place in the scientific circles, is the increasing national concern and ignorance of EMF pollution and the dangers therein. Especially, this is essential in urbanized and developing areas with high access to digital devices and low awareness of the local population on EMF safety [1, 13]. The existing research is mostly based on EMF exposure in developed nations, and the local or regional data is usually not available. In the regions where digital literacy is increasing and health literacy could be low; people would be unaware of the symptoms associated with EMF or take proper precautionary steps [2].

The rapid proliferation of EMF-emitting devices such as mobile phones, Wi-Fi routers, and 4G/5G towers has raised public concern regarding potential health impacts, including headaches, eye strain, sleep disturbances, and other neurological symptoms. Despite growing awareness internationally, there is limited local data on public knowledge, behavioral patterns, and self-reported health effects related to EMF exposure, particularly in urbanized regions of developing countries. Additionally, most existing studies focus on developed nations, and evidence from the general population using non-ionizing EMF devices remains sparse. This study aims to investigate public awareness, behavioral patterns, and health-related symptoms associated with EMF exposure, while highlighting the need for improved community education and precautionary practices.

METHODS

A cross-sectional descriptive survey design was employed, which was suitable for assessing the prevalence of awareness, perceptions, and symptoms at a single point in time. However, this design does not allow for the establishment of causal relationships between EMF exposure and reported health outcomes. The duration of the conducted study was 4-5 months, from January 2025 to May 2025 at Kinnaird College for Women. A questionnaire was designed using Google Forms to be answered by participants. The tool was tested for validity with expert feedback and clarified through pilot testing with a total number of (n=115) individuals to confirm it worked well. Since it consisted of 22 questions, they were divided into different sections. There were single-choice, multiple-response, and Likert-scale questions on the survey. A non-probability convenience sampling method was used because it allowed quick and practical recruitment of participants through online platforms (Facebook, WhatsApp, Instagram, and email). Adults aged 18 years and above who voluntarily participated. Individuals below 18 years and incomplete or duplicate responses. A validated Google Forms questionnaire with 22 items (single-choice, multiple-response, and Likert-scale) was used. The research was conducted between April 2025- May 2025, and 150 original responses were obtained. Following the completeness and duplicate screening, the final analysis comprised 115 valid responses. This sample size (n=115) is believed to be sufficient to conduct a preliminary cross-sectional survey, and it would be satisfactory to explore health surveys where a sample size of 100 is usually recommended to produce stable estimates to describe and draw basic inferences. Inclusion criteria included adults aged 18 years and above who were capable of accessing and filling out the online questionnaire. This was done by

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excluding those under the age of 18, incomplete, or duplicate responses. No medical exclusion criteria were implemented because the study was done to survey the general adult population. It is necessary to mention that since the recruitment process was made with the use of online sources (Facebook, WhatsApp, Instagram, email) only, the sample will most probably be biased, as the sample of all adults will not be fully represented by the sample of people with greater internet consumption. Google Forms was used to design a questionnaire. The validity of the tool was tested by the expertise of the researcher, and its comprehensibility was tested by a pilot test using another sample (n=15). The Likert-scale items that were used in the quantitative analysis were evaluated on internal consistency reliability, and Cronbach's alpha was calculated, which gave a satisfactory value of 0.78, which is good reliability. The data were cleaned and coded using Microsoft Excel. The descriptive statistics (frequencies and percentages) were conducted in Python, whereas the inferential statistics (Chi-square test) were conducted in SPSS (version 27.0) to check the relationship between EMF exposure and health symptoms. The Cramer V was used to determine the strength of association.

RESULTS

Out of the 150 responses obtained, 115 valid responses were analyzed, and this gave a mean age of 22.4 years (SD = 2.1). EMF exposure patterns, awareness, and health-related symptoms were summarized using descriptive and inferential statistics. 87 (76%, 95% CI: 68.2% to 83.8%) had headaches, 76 (66%, 95% CI: 57.7% to 74.3%) experienced eye strain, and 70 (61%, 95% CI: 52.3% to 69.7%) had sleep disturbances. Fatigue 62 (54%), anxiety or stress 60 (52%), and dizziness 48 (42%) were other characteristics frequently used. The Chi-square test demonstrated that the frequency of EMF exposure was statistically significantly associated with the prevalence of health symptoms ($\chi^2 = 24.36$, df = 6, $p<0.001$). This relationship had a moderate effect size with the Cramer V of 0.46. The Cramer V of 0.46 was a moderate relationship between high EMF exposure and the symptoms reported (Figure 1).

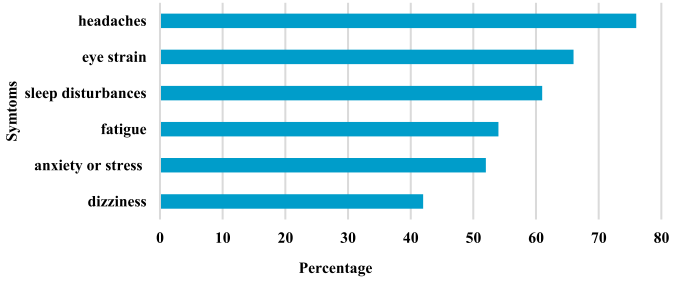

Figure 1: Reported Health Symptoms After EMF Exposure

Most participants, 72 (63%), reported using mobile phones for more than six hours per day, while 29 (25%) used them for 3–6 hours, 11 (10%) for 1–3 hours, and only 3 (2%) for less than one hour daily (Figure 2).

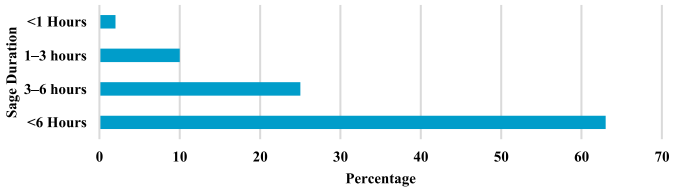

Figure 2: Daily Mobile Phone Usage among the Population

Mobile phones were identified as the main source of EMF pollution by 104 (90%) of respondents, followed by 4G/5G towers 97 (84%), Wi-Fi routers 93 (81%), and microwave ovens 86 (75%). Smart meters and high-voltage powerlines were mentioned by 69 (60%) and 46 (40%), respectively (Figure 3).

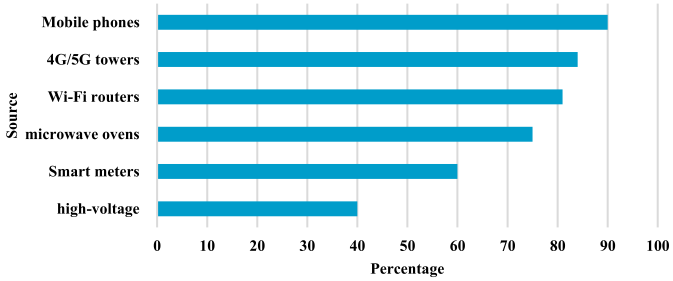

Figure 3: Perceived Sources of EMF Pollution

Overall, 75 (65%) of participants were somewhat or moderately aware, 22 (19%) were well-informed, and 18 (16%) reported no awareness regarding EMF exposure and its health effects (Figure 4).

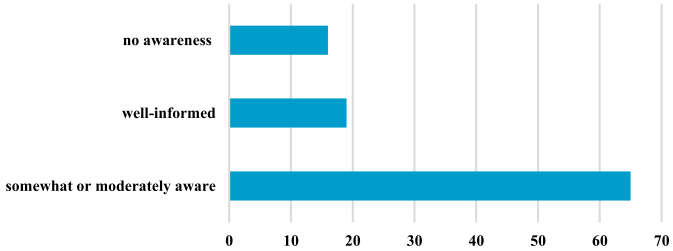

Figure 4: Knowledge of EMF Exposure and Its Health Effects

DISCUSSION

The objective of this study was to determine the awareness, behavior, and health issues regarding exposure to electromagnetic fields (EMF). The findings offer valuable information as to the interaction of different demographic and behavioral variables, especially the level of education, the time spent on phones, and precautionary practices, with the perceptions of the population and self-reported health outcomes. The findings showed that an increasing concern about EMF exposure in society is on the rise in line with the international reports by the World Health Organization [9]. These statistics indicated that high levels of EMF were measured daily, and most of them were on mobile phones and Wi-Fi routers. Moreover, a more

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educated population was more familiar with the subject of electromagnetic pollution, and it has been shown in the past that the level of awareness tends to increase with the level of education and access to scientific information [15, 16]. It is noteworthy that the higher level of awareness and the number of hours spent using the mobile phone (more than six hours per day) had a strong association with the self-reported headaches, fatigue, and sleep disturbances. Past biological and epidemiological studies have identified such similarities between protracted exposure to EMF and neurological symptoms [13]. Although the non-ionizing radiation is not so powerful that it may lead to direct damage to DNA, it was demonstrated that such oxidative stress and DNA strand breaks may be present in the case of long-term exposure [3, 7]. Although the participants were aware of the risks to their health, a large part still did not take precautions regularly, which suggests the differences between the knowledge level and the protective measures. The rising levels of international advocacy of the use of biologically based exposure limits can be seen as the product of increasing numbers of countries driving towards more restrictive regulatory policies and independent research on the health effects of EMF [17, 18]. Besides, the statistically significant association identified by using the chi-square test was supported by a moderate effect size (Cramers V = 0.46). It demonstrates that there is a significant correlation between exposure to EMF and health-related complaints, which proves earlier assumptions that the EMFs may have an influence on the well-being, even at non-ionizing proximities [19, 20]. These findings are accompanied by testimonies that describe the symptoms that belong to electromagnetic hypersensitivity [14]. But some constraints have to be admitted.

Another bias that was applied to the sample was that of highly learned individuals, which may not be the representative population. The reporting of symptoms was not clinically verified and existed as self-report; this can have introduced a bias in it. Moreover, as it is a cross-sectional study, the causal relations between the exposures of EMF and the health outcomes cannot be discussed. The future research should therefore follow longitudinal or experimental methods and objective biological measures to assist in shedding some light on the mechanisms of the latter laboratory research.

CONCLUSIONS

The paper provides valuable statements about the way in which community education should be significantly improved, policies must be adjusted in line with the circumstances, and additional longitudinal investigations should be carried out to comprehend the health hazards of sustained exposure to EMF and how they can be avoided.

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Authors' Contribution

Conceptualization: NR
Methodology: NR, MS, AR
Formal analysis: NR, MS, AR
Writing and Drafting: NR, MS, AR
Review and Editing: NR, MS, AR

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

OPEN ACCESS

Assessment of Knowledge and Attitude Towards Human Papillomavirus Vaccine among Healthcare Professionals at Tertiary Care Hospitals Karachi

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ABSTRACT

Human Papilloma virus (HPV) is a sexually transmitted infection that is leading cause of cancer among women, with 604,000 new cases and 342,000 deaths reported globally in 2020. **Objectives:** To assess the knowledge and attitude of healthcare professionals (HCPs) regarding the HPV vaccine at tertiary care hospitals Karachi. **Methods:** A cross-sectional survey was conducted into two tertiary care hospitals: 1) Dow University Hospital, Karachi, and Dr. Ruth K. M. Pfau Civil Hospital Karachi from May 2025 to July 2025. A purposive sampling technique was used to enroll a total of 384 participants in the study. All healthcare workers were included in the study (doctors, nurses, pharmacists, and technicians). The data were interpreted into SPSS version 26.0. For descriptive analysis: frequency, means, standard deviations, and percentages were calculated. A chi square test was used to assess the association of demographic information of HCPs with knowledge and attitude categories. **Results:** Out of 384, 57.5% of the participants provided correct answers and 42.2% of HCPs had moderate knowledge. About 1/3 of HCPs attitude (32.3%) agreed/strongly agreed towards HPV vaccine and nearly half (46.4%) of HCPs established a neutral attitude. There was a statistically significant association of profession with knowledge ($\chi^2 = 26.70$, df = 6, $p < 0.001$) and attitude categories ($\chi^2 = 22.90$, df = 6, $p < 0.001$) among HCPs. Moreover, doctors representing higher knowledge and positive attitude as compared to nurses and other HCPs. **Conclusions:** This study highlights that healthcare professionals possess a moderate level of knowledge and neutral attitude regarding the HPV vaccine. Doctors demonstrated comparatively higher knowledge and a more favorable attitude than nurses, pharmacists, and technicians

INTRODUCTION

Cervical cancer is the fourth most prevalent form of cancer in women worldwide. It is caused by Human papilloma virus (HPV) infection and approximately 604,000 new cases and 342,000 deaths reported globally in 2020 [1]. Approximately 70% of cervical cancer cases in the world are related to persistent infection with high-risk HPV and mostly type 16 and type 18 [2]. The prevention of HPV is also a top priority in protecting public health since it also causes other anogenital cancers and oropharyngeal cancer [2, 3]. HPV vaccination is highly encouraged in national immunization efforts as one of the major steps to cervical cancer prevention [4]. The HPV vaccine should be applied to both girls and boys [5]. Universal, gender-neutral HPV vaccination would go a long way in increasing herd immunity and further eradicating cervical cancer in the world. Moreover, it provides men with protection against the cancers linked to HPV, defines gender equality in healthcare, and assists in preventing stigma and

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misinformation related to the infection [6]. Studies have shown that cervical cancer and its related infections can be almost entirely prevented through timely screening and HPV vaccination [7]. The developed nations have managed to reduce the cases of HPV infection because of the extensive accessibility of HPV immunization schemes [8]. On the contrary, most low- and middle-income nations (LMICs) are still struggling with the great difficulties of inadequate financial sources, cultural obstacles, and low awareness levels, impeding successful prevention of HPV causing infections and control activities [9]. Countries in South Asia, such as Pakistan, still have a problem with the implementation of HPV vaccine. Although a significant burden of cervical cancer exists, screening for cervical cancer is dismal at only 2% [10]. The model study based on the prediction showed that 90% annual coverage by HPV immunization of girls older than 9 years may potentially prevent approximately 111,000-133,000 incidents of cervical cancer [1]. The HPV vaccine was launched in Pakistan in 2019 under the Expanded Program on Immunization (EPI) for girls between 9 years and 14 years of age, but has not yet been integrated into regular national immunization services [4]. The HCPs play a critical role in vaccination initiatives because their attitudes and knowledge are directly related to the percentage of vaccination within the general population [11]. In a cross-sectional study, awareness about availability of HPV vaccination was very low (20%), and only one in five tertiary care women in Karachi had received the vaccine [12]. For successful execution of HPV vaccination at a national level in Pakistan, there is crucial need to assess the healthcare professional's awareness about HPV vaccination.

Cervical cancer, largely caused by Human Papillomavirus (HPV), remains a significant public health issue in Pakistan, with low national screening rates and limited HPV vaccine coverage. Despite healthcare professionals (HCPs) being critical in promoting vaccination, evidence suggests that their knowledge and attitudes towards the HPV vaccine are moderate to neutral, and gaps exist particularly regarding vaccine schedules and recommendations. While previous studies have assessed HPV awareness, there is limited research in Pakistan focusing specifically on tertiary care HCPs' knowledge and attitudes, highlighting a need to evaluate these factors systematically. Therefore, this study aimed to assess the knowledge and attitude of healthcare professionals towards the HPV vaccine in tertiary care hospitals in Karachi to identify gaps and inform targeted educational interventions.

METHODS

A Cross-sectional survey was conducted into two tertiary care hospitals; Dow University Hospital, Karachi, and the Dr. Ruth K. M. Pfau Civil Hospital Karachi from May 2025 to July 2025. Study includes all healthcare providers (HCPs) like doctors, nurses, pharmacists, technicians. Exclusion criterion: Those healthcare providers who were absent at the time of data collection. A self-administered questionnaire was used to collect the data after approval from IRB (Ref: IRB-3455/DUHS/Approval/2024/162), Dow University of Health Sciences, Karachi, and all the participants provided written consent. Participants were enrolled in the study through a purposive sampling technique. For sample size calculation, an Open-Epi software was used by following formula and criteria: "Sample size n = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1)+p*(1-p)] , Population size(for finite population correction factor or FPC)(N): 1000000, Hypothesized % frequency of outcome factor in the population (p):50%+/-5, Confidence limits as % of 100(absolute +/- %)(d):5%, design effect (for cluster surveys-DEFF):1" . The calculated sample size was 384. The study's sample size was divided on a 50% division rule. For example, 192 participants will be from each study setting. Data was collected through a structured questionnaire adapted from previous study (13), it has three parts: Part I consisted of demographic information of the HCPs: age, gender, profession, year of experience, working unit/department. Part II included knowledge of HPV among HCPs, it contains 07 items. 1)HPV vaccine is effective in preventing cervical cancer 2) HPV vaccine is contraindicated in pregnancy.3) HPV is a common sexually transmitted infection.4) Three-dose series is for 15–45 years & immunocompromised individuals.5) Two-dose series recommended for ages 9–14 years.6) HPV vaccine is only effective for a short period. 7) HPV vaccine is recommended for both males and females. Participants have two options to response: correct and incorrect. Each correct response =1 and incorrect response =0. It ranges from 0 to 7. The score of knowledge has divided into three categories good, moderate and poor knowledge score that is based on scoring system of correct and incorrect responses. Score categorize poor (0-2), moderate (3-4) and good knowledge (5-7). Part III included attitude towards HPV among HCP, it has 5 items 1) I believe HPV vaccine is important for preventing cervical cancer.2) I would recommend HPV vaccine to my patients.3) I believe HPV vaccine is safe.4) I believe HPV vaccine is effective.5) I would get HPV vaccine myself / for my child if I were a parent. It was consisted of five-point Likert scale like Strongly Agree =5, Agree =4, Neutral= 3, Disagree=2, Strongly Disagree=1.The score of attitudes was categorized on three scales like if the participants marked score between 18 – 25= to positive attitude, 12-17= neutral

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attitude and 5-11= negative attitude. The data was analyzed and entered on SPSS 26. For descriptive analysis frequency, means, standard deviations, and percentages were calculated. The knowledge and attitude categories were calculated by summing up the scoring system of correct and incorrect responses, Likert scale and total ranges that is assigned in each category of knowledge and attitude scores. A chi square test was used to assess the association of demographic information of HCPs with knowledge and attitude categories. A bar chart and pie chart was used for visual demonstration of HPV knowledge and attitude categories among HCP.

RESULTS

A total of 384 participants took part in the study, with a mean age of 40.1 ± 10.5. The majority were female (n=284, 73.9%), most were nurses (n=222, 57.8%), and a significant portion had 6 to 10 years of work experience (n=140, 36.5%). Additionally, a large number were working in the gynecology ward (n=120, 16.1%) (Table 1).

Table 1: Demographic Information of HCPs (n=384)

Variables	n (%)
Age	
Mean ± SD	40.1 ± 10.5
Gender	
Male	100 (26.0%)
Female	284 (74.0%)
Profession	
Doctor	140 (36.5%)
Nurse	222 (57.8%)
Pharmacist	12 (3.1%)
Other	10 (2.6%)
Years of Experience	
1–5 Years	136 (35.4%)
6–10 Years	140 (36.5%)
More than 10 Years	108 (28.1%)
Department	
Gynae	120 (31.3%)
Pediatrics	80 (20.8%)
Medicine	90 (23.4%)
Surgery	64 (16.7%)
Oncology	10 (2.6%)
Other	20 (5.2%)

Overall mean number of correct responses per item was (Mean ± SD =220.7± 63.7). Out of 384, 57.5% of the HCPs gave correct answers. The highest knowledge was reported regarding the preventive role of the HPV vaccine against cervical cancer (68.0%), its contraindication in pregnancy (70.3%), and recognition of HPV as a common sexually transmitted infection (66.9%). Similarly, misconceptions about short-term effectiveness were marked by most participants, with 67.7% answering correctly, and over 62% acknowledged that the vaccine is recommended for both male and female (Table 2).

Table 2: Knowledge of HPV Vaccine among HCPs (n=384)

Knowledge Statement	Correct (True), n (%)	Incorrect/Don't Know, n (%)
The HPV Vaccine is Effective in Preventing Cervical Cancer	261 (68.0%)	123 (32.0%)
The HPV Vaccine is Contraindicated in Pregnancy	270 (70.3%)	114 (29.7%)
HPV is a Common Sexually Transmitted Infection	257 (66.9%)	127 (33.1%)
Three-Dose Series is for 15–45 Years and Immunocompromised Individuals	132 (34.4%)	252 (65.6%)
Two-Dose Series Recommended for Ages 9–14 Years	125 (32.6%)	259 (67.4%)
The HPV Vaccine is only Effective for a Short Period. (False)	260 (67.7%)	124 (32.3%)
The HPV Vaccine is Recommended for both Male and Female	240 (62.5%)	144 (37.5%)
Per Items	220.7 ± 63.7	163.3 ± 63.7
Total	1545 (57.5%)	1143 (42.5%)

The distribution of knowledge scores is presented. The majority of HCPs (n = 162, 42.2%) were categorized as having a moderate level of knowledge. Good knowledge was observed in 118 participants (30.7%), while 104 (27.1%) demonstrated poor knowledge (Figure 1).

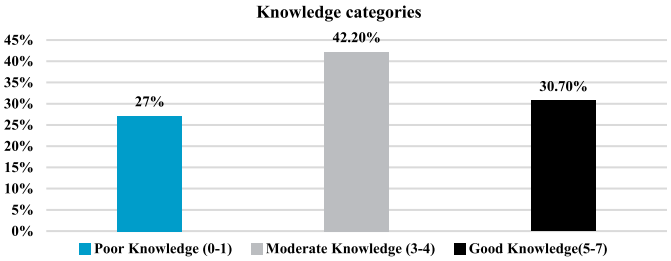

Figure 1: Knowledge Categories among HCPs (n=384)

About one-third of HCPs' attitudes (32.3%) agreed/strongly agreed with the HPV vaccine. Most of the (78.7%) HCPs acknowledged the importance of the vaccine in preventing cervical cancer, (74.2%) were hesitant about recommending it, (71.4%) considered it safe, and (70.0%) accepted it for themselves or their children (Table 3).

Table 3: Attitudes Regarding HPV Vaccine among HCPs (n=384)

Statements	Agree/ Strongly Agree (4–5)	Neutral (3)	Disagree/ Strongly Disagree (1–2)
I Believe the HPV Vaccine is Important for Preventing Cervical Cancer	210 (78.7%)	52 (13.5%)	30 (7.8%)
I Would Recommend the HPV Vaccine to my Patients	61 (15.9%)	150 (74.2%)	38 (9.9%)
I Believe the HPV Vaccine is Safe	44 (11.5%)	66 (17.2%)	130 (71.4%)
I Believe the HPV Vaccine is Effective	60 (15.6%)	230 (72.7%)	45 (11.7%)
I Would Get the HPV Vaccine Myself/ For my Child if i were a Parent	64 (16.7%)	130 (70.0%)	51 (13.3%)

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About one-third of HCPs' attitudes (32.3%) agreed/strongly agreed with the HPV vaccine. Most of the (78.7%) HCPs acknowledged the importance of the vaccine in preventing

Total (overall %)	450 (32.3%)	628 (45.1%)	294 (21.6%)

The overall attitudes of HCP's towards the HPV vaccine are shown. A neutral attitude was the most common (n=178, 46.4%), followed by a positive attitude (n=122, 31.8%), and a negative attitude (n=84, 21.8%) (Figure 2).

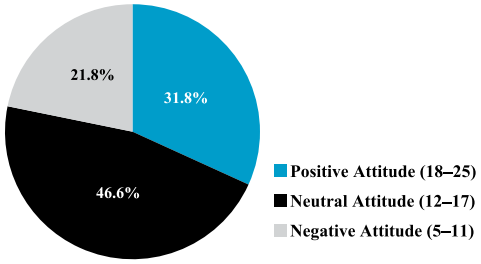

Figure 2: Attitude Categories Toward HPV Vaccine among HCPs (n=384)

There was a statistically significant association between profession and knowledge categories (χ^2 = 26.70, df = 6, p<0.001) among HCPs. Doctors demonstrated higher knowledge (50%) compared to nurses (45%), pharmacists (33%), and other HCPs (20%). Other demographic factors, such as gender, years of experience, and department, did not show significant associations with knowledge categories among HCPs (p>0.05) (Table 4).

Table 4: Association of Demographic Information with HPV Knowledge Categories among HCPs (n=384)

Variables	Categories	Poor, n (%)	Moderate, n (%)	Good, n (%)	χ^2 (df)	p-value
Gender	Male (n=100)	30 (30.0%)	40 (40.0%)	30 (30.0%)	2.45 (2)	0.294
	Female (n=284)	70 (24.6%)	120 (42.3)	94 (33.1%)		
Profession	Doctors (n=140)	20 (14.3%)	50 (35.7%)	70 (50.0%)	26.70 (6)	<0.001*
	Nurses (n=222)	52 (23.5%)	70 (31.5%)	100 (45.0%)		
	Pharmacist (n=12)	6 (50.0%)	2 (16.7%)	4 (33.3%)		
	Other (n=10)	4 (40.0%)	4 (40.0%)	2 (20.0%)		
Working Experience (Years)	1–5 (n=136)	40 (29.4%)	60 (44.1%)	36 (26.5%)	3.98 (4)	0.409
	6–10 (n=140)	35 (25.0%)	60 (42.9%)	45 (32.1%)		
	>10 (n=108)	25 (23.1%)	50 (46.3%)	33 (30.6%)		
Department	Gynae (n=120)	28 (23.3%)	50 (41.7%)	42 (35.0%)	15.85 (10)	0.105
	Pediatrics (n=80)	25 (31.3%)	30 (37.5%)	25 (31.3%)		
	Medicine (n=90)	20 (22.2%)	40 (44.4%)	30 (33.3%)		
	Surgery (n=64)	15 (23.4%)	30 (46.9%)	19 (29.7%)		
	Oncology (n=10)	3 (30.0%)	4 (40.0%)	3 (30.0%)		
	Other (n=20)	5 (25.0%)	10 (50.0%)	5 (25.0%)		

There was a statistically significant association between profession and attitude (χ^2 = 22.90, df = 6, p<0.001) among HCPs. Doctors showed a more positive attitude (60.7%) toward HPV vaccination compared to nurses (37.0%), pharmacists (16.7%), and other HCPs (30.0%). Other demographic factors, such as gender, years of experience, and department, did not show significant associations with attitude categories (p>0.05) (Table 5).

Table 5: Association of Demographic Variables with Attitude Categories of HPV Vaccine among HCPs (n=384)

Variables	Categories	Negative, n (%)	Neutral, n (%)	Positive, n (%)	χ^2 (df)	p-value
Gender	Male (n=100)	25 (25.0%)	35 (35.0%)	40 (40.0%)	1.85 (2)	0.397
	Female (n=284)	50 (17.6%)	100 (35.2%)	134 (47.2%)		
Profession	Doctors (n=140)	15 (10.7%)	40 (28.6%)	85 (60.7%)	22.90 (6)	<0.001*
	Nurses (n=222)	50 (22.5%)	90 (40.5%)	82 (37.0%)		
	Pharmacist (n=12)	6 (50.0%)	4 (33.3%)	2 (16.7%)		
	Other (n=10)	4 (40.0%)	3 (30.0%)	3 (30.0%)		
Working Experience (Years)	1–5 (n=136)	30 (22.1%)	50 (36.8%)	56 (41.2%)	4.42 (4)	0.351
	6–10 (n=140)	30 (21.4%)	55 (39.3%)	55 (39.3%)		
	>10 (n=108)	15 (13.9%)	30 (27.8%)	63 (58.3%)		
Department	Gynae (n=120)	20 (16.7%)	40 (33.3%)	60 (50.0%)	14.20 (10)	0.165
	Pediatrics (n=80)	20 (25.0%)	30 (37.5%)	30 (37.5%)		
	Medicine (n=90)	15 (16.7%)	35 (38.9%)	40 (44.4%)		
	Surgery (n=64)	12 (18.8%)	25 (39.1%)	27 (42.2%)		
	Oncology (n=10)	2 (20.0%)	3 (30.0%)	5 (50.0%)		
	Other (n=20)	6 (30.0%)	7 (35.0%)	7 (35.0%)		

DISCUSSION

The current study revealed that 42.2% of HCPs had moderate knowledge, 30.7% showed good knowledge, and 27.1% demonstrated poor knowledge. The highest knowledge was reported regarding the preventive role of the HPV vaccine against cervical cancer (68.0%), its contraindication in pregnancy (70.3%), and recognition of HPV as a common sexually transmitted infection (66.9%). Misconceptions about short-term effectiveness were marked by most participants, with 67.7% answering correctly, and over 62% acknowledged that the vaccine is recommended for both males and females. Similar findings were in line with previous studies that showed study participants had greater knowledge about HPV and its vaccine potency, but they did not know the vaccination schedule, except for a few unvaccinated participants who knew about vaccine safety [16, 17]. In contrast, a study from Iran highlighted that more than 90% of the HCPs knew about HPV and its vaccine, and 76% were aware that the HPV vaccine can prevent cervical cancer. And most frequently answered by 95.7% that HPV is a sexually transmitted disease [18]. A study from Kazakhstan reported that 61.1% participants had marked correct answers about HPV and its vaccine, which was associated with a higher level of education and income status [19]. A

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Saudi Arabian study revealed that general healthcare provider awareness was at an average level, indicating that there were still gaps in various healthcare cadres [20]. One of the studies in Qatar found that 83.7% of the respondents were sufficiently informed about the HPV infection, and that only 69.1% of the study population were aware of the existence of HPV vaccination in their native country. Most of the respondents (89.4) made some observations (insight) that HPV may be asymptomatic, and 46.5% noted that the least interest was in physicians to promote the HPV vaccination [21]. Iranian research also revealed that 63.4% of the medical practitioners were well aware of HPV and its vaccine, and 71.6% offered their patients the vaccine [17]. A systematic review revealed that, in most cases, the providers of health care had sufficient knowledge of the HPV infection and its impact on health. The respondents indicated that there was a perceptible gap in their knowledge when it came to the specifics of HPV vaccines and their benefits. It was highlighted on the occasion of an educational session on the concept of HPV vaccination to push its suggestions [22]. In the current research, it was established that almost half of all participants (46.4%) showed a neutral position, and only 31.8% provided a positive attitude, and 21.8% gave a negative attitude. The majority of the (78.7%) HCPs realized the relevance of the vaccine in the prevention of cervical cancer, (74.2%) were reluctant to recommend the vaccine, (71.4%) thought it was safe, and (70.0%) accepted it personally or on behalf of their children. The majority (78.7%) of the respondents noted that the vaccine is critical in the prevention of cervical cancer. Nevertheless, neutral answers were often provided when asked about such main issues as the recommendation of the vaccine to the patients, the belief in its efficacy, and the readiness to be vaccinated or have the children vaccinated. This shows that it is not only knowledge that leads to strong positive attitudes or proactive behaviors. In the Chinese study, the largest proportion of respondents had a positive attitude towards HPV vaccination by health care professionals. Approximately 95 percent of the healthcare providers had advised their patients to receive HPV vaccination; some of them were not prepared because of its unknown side effects [14]. An overview of 65 studies found that there was a general belief that healthcare providers recommended HPV vaccination, but that they encountered barriers to their recommendations, including parental concerns regarding vaccine safety, efficacy of the vaccine, and affordability [22]. This has also been noted in other research, with the physicians being more confident about the vaccine compared to other healthcare workers. However, even the intent to prescribe or personally accept vaccination was low among doctors, indicating the presence of barriers to it, including cost, cultural, and patient misconceptions [7, 8]. A Kazakh research study found that 72.6% of HCPs were positive in recommending the HPV vaccine. The rate of recommendation of the HPV vaccine was greater among people who had heard about HPV and its vaccine, as well as those with a positive attitude toward the COVID-19 vaccine. Besides, HCPs highlighted significant obstacles to introducing HPV vaccination to the population, similarly, concerns about the safety, its efficacy, its negative impact on health, and the ignorance of HCPs [18]. The researcher established a statistically significant relation between profession and knowledge (χ^2 = 26.70, df = 6, p=0.001) and categories of attitudes among HCPs (χ^2 = 22.90, df = 6, p=0.001). The physicians exhibit better understanding and a positive mindset than the nurses and other healthcare providers. Past results showed these differences between physicians and nurses. A study in Pakistan reported that 96.5% of doctors had good knowledge compared to 77.4% of nurses and 81.6% of other healthcare staff [15]. Likewise, a Greek study discovered that 80.3% of doctors had good knowledge of HPV, but most of them had not been vaccinated themselves. Approximately 60 percent of the physicians and 35% of nurses were aware of HPV and its vaccine [23]. The survey of 1,189 healthcare workers in Kazakhstan showed that the level of knowledge among physicians was better than among nurses (66.5% vs. 44.1%), and 72.6% were willing to recommend vaccination [18]. The other observation was that physicians were found to be well informed (67.2%) and positive (90.9%) about attitudes, but only to prescribe the vaccine (37.5%). Cost, absence of time, and low patient awareness were the primary obstacles [7]. Only 42% of the gynecologists and 57% of the family physicians possessed the appropriate knowledge in Poland [24]. In the same way, a Turkish study indicated that physicians scored higher on the knowledge test than nurses, though there was still a gap in both scores [25].

This study was limited by its cross-sectional design, use of purposive sampling, and reliance on self-reported data, which may restrict causal inference and generalizability beyond tertiary care settings. Additionally, attitudes and practices may be influenced by social desirability bias. Future studies should employ longitudinal or mixed method designs with probability sampling across diverse healthcare settings to better explore determinants of knowledge and attitudes. Targeted educational interventions should also be evaluated to assess their effectiveness in improving healthcare professionals' advocacy for HPV vaccination.

CONCLUSIONS

This study revealed that healthcare professionals possess a moderate level of knowledge and neutral attitude towards HPV vaccine. Doctors showed comparatively higher

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awareness and a more positive outlook than nurses, pharmacists, and technicians. To address these gaps, it is recommended to conduct regular training sessions and workshops, integrate HPV and cervical cancer prevention into medical, nursing, and allied health curricula, and promote hospital-based awareness campaigns. National policies should also ensure vaccine accessibility and affordability. Further research is needed to identify barriers influencing healthcare professionals' attitudes and to assess the effectiveness of educational interventions in enhancing their knowledge and advocacy for HPV vaccination.

Authors' Contribution

Conceptualization: MAR
Methodology: MAR, JAH, MS, RMH
Formal analysis: RQ, TA
Writing and Drafting: MAR, JAH, RQ, MS, RMH, TA
Review and Editing: MAR, JAH, RQ, MS, RMH, TA

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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Quality of Life among Women with Pelvic Organ Prolapses After Postpartum

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ABSTRACT

Pelvic organ prolapse (POP) is the dropping of the pelvic organs as a result of the inability to hold them through weakness, especially in the aftermath of childbirth, which causes physical and emotional problems. **Objectives:** To evaluate the prevalence of POP and its effects on the quality of life (QoL) of postpartum women by administering the P-QOL questionnaire. Purposes: To establish the QoL of postpartum women who have pelvic organ prolapse. **Methods:** The study was a three-month cross-sectional study to gather information on various hospitals within Lahore. In the present study, 377 postpartum women (20 to 45 years old) in the public hospitals were evaluated by the P-QoL questionnaire, but they were not included whose prior POP treatment or were still pregnant. **Results:** The researchers established that 96.3 percent of 377 women experienced severe symptoms of POP, with the moderate-to-high performance scores consistent, and only half of them made it to the standardized analysis. **Conclusions:** The fact that severe POP symptoms occur in the majority of cases (96.3%), and moderate-to-high performance consistency highlights the fact that there is a strong necessity to enhance data inclusion and specific interventions.

INTRODUCTION

Pelvic Organ Prolapse (POP) is a common problem, as weakened pelvic support results in dropper organs such as the bladder or uterus, which can cause the effect of bladder, bowel, and sexual problems [1, 2]. It is largely associated with giving birth, aging, obesity, and hard work. POP has a strong impact on the quality of life of women, yet it is usually underdiagnosed because of its stigma and inconsistent symptoms, as well as lack of adequate care access, particularly in low-resource environments. Physiotherapy or pessaries can be used in the management of cases at an early stage [3]. The knowledge of the POP effects and especially among the postpartum women, will play a crucial role in quick intervention and subsequent improvement in health [4]. The situation is further aggravated by the fact that the condition is more common in the low-income areas with restricted access to healthcare services, including gynecological surgeries [5]. As much as the current body of research progressively increases on the prevalence of POP and its effects on the quality of life, little is known regarding the effects that the condition has on the postpartum period, a period that is already fraught with a lot of emotional and physical transformations in women [6, 7]. Symptoms of prolapse at early stages, often beginning after delivery, have not been given much attention, and the literature is predominantly dedicated to general female groups or to the cases of the

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latter stage of prolapse [8, 9]. Moreover, the limited studies of postpartum POP that are presently available are more likely to underestimate its manifold effects on daily functioning, psychology, and physical recovery. Moreover, the perspectives of physiotherapy are not fully included, particularly in the assessment of the impact of dysfunction of the pelvic floor on postpartum quality of life. Therefore, the postpartum population remains underrepresented in care paradigms and clinical research [10].

Pelvic organ prolapse (POP) is a prevalent condition among postpartum women, causing significant physical, emotional, and psychosocial challenges that negatively impact quality of life. Despite its high occurrence, particularly in low-resource settings, POP remains underdiagnosed due to cultural stigma, low awareness, and limited postpartum screening and rehabilitation services. Most existing research focuses on general female populations or advanced stages of POP, leaving the postpartum population underrepresented and the early effects of POP on daily functioning, mental health, and physical recovery largely unexplored. This study aims to evaluate the prevalence of POP among multiparous postpartum women and examine its impact on quality of life using the P-QoL questionnaire, thereby highlighting the need for enhanced postpartum screening, targeted interventions, and physiotherapy integration.

METHODS

The cross-sectional research design was used to identify the prevalence and related variables of pelvic organ prolapse at a given time. This design, however, was restrictive by nature in developing causal relationships between identified risk factors and the condition. The data was gathered by various hospitals in Lahore. This would be a three-month (July 2025 to September 2025) study period, which included ethical clearance of the Hajvery University with ref no: HU/FAHS/ECRB/2461, recruitment of the study participants, and data collection through the use of the P-QoL questionnaire, data analysis, and compiling of the report. A simple random sampling strategy was undertaken so that all eligible people in the sampling frame got an equal opportunity of being selected. The study sample comprised all multiparous postpartum women (20-45, up to 6 months after delivery) attending the gynecology Outpatient Departments of the study hospitals in Lahore within the four months of the study. Potential participants were assigned sequential numbers, and a computer-based random number generator was used to select the required 377 participants from this complete list. The sample size was calculated using the Raosoft Sample Size Calculator. For the calculation, an expected prevalence of pelvic organ prolapses of 50% was used, as no definitive local data was available, and this proportion maximizes the required sample size for a given margin of error. With a 95% confidence level and a 5% margin of error, the calculated minimum sample size was 377 participants. The target population was women aged 20-45 after postpartum. Inclusion criteria included women aged 20–45 years, who had delivered within the postpartum period (up to 6 months after childbirth), multiparous (having had two or more deliveries) women were included, as repeated childbirth is a known risk factor for pelvic organ prolapse, and women with the ability to understand and complete the P-QoL questionnaire (self-administered or interview-assisted). Exclusion criteria were primiparous women (first delivery) to ensure focus on multiparity-related risk factors, women with ongoing pregnancy or multifetal gestation, women with a history of prior pelvic organ prolapse treatment, pelvic floor reconstructive surgery, or hysterectomy, women diagnosed with neurological, systemic, or cognitive impairments that could interfere with questionnaire completion, women with a history of perinatal death, chronic illnesses, or mental health disorders and women currently undergoing pelvic floor physiotherapy or conservative management for prolapse. Eligible participants were informed about the study and asked to sign an informed consent form. P-QoL questionnaire was given either as a self-administered or an interview using Urdu (translated when necessary). The Prolapse Quality of Life (P-QoL) Questionnaire was a validated instrument that was employed to determine the effect of pelvic organ prolapse. A strict forward and backward translation was carried out into the Urdu language to be used in this study. First, forward translation was done by two bilinguals who are independent. The translated versions were then harmonized into one draft by a committee of health care professionals and linguists. This was then back-translated to English by two other translators who were not told what the original instrument was. The back-translated one was put against the original to verify conceptual, semantic, and content equivalency. The last Urdu version was pilot-tested by a group of 20 postpartum women (not included in the main study), to ensure that there were comprehension and cultural appropriateness, and understanding. The analysis of data was based on version SPSS version 23.0. Demographic and clinical variables were summarized using descriptive statistics (mean, standard deviation, frequencies, and percentages). The prevalence was determined as the percentage of women who had POP symptoms. Inferential statistics was used to enhance the analytical scope to go beyond description. The Chi-square test was applied to determine the connection between categorical variables, including age groups, and the severity of POP impact on QoL. The p-value was taken to be significant at less than 0.05.

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RESULTS

The number of women enrolled in the study was 377, who developed pelvic organ prolapse (POP). All the 50 participants excluded in the final analysis were those whose responses to the questionnaire were incomplete, and therefore, 327 valid cases were used to conduct the statistical analysis (86.7%). During clinical examination, the severity of POP was determined using the standardized system of Pelvic Organ Prolapse Quantification (POP-Q). This system marks prolapse centimeters of the descent of the hymen relative to the pelvic organs between 0 and 4. To make this analysis, some stages were grouped as follows: Stage 0-II was categorized as 'Moderate', and Stage III-IV was categorized as 'Severe (Table 1).

Table 1: Severity Level of POP

Severity Level	Frequency (%)
Moderate	14 (3.7%)
Severe	363 (96.3%)
Total	377 (100.0%)

The relationship between the age group and the extent to which POP affects the QoL was evaluated statistically. A Chi-square test of independence showed that there was a significant relationship between these variables, χ^2 (12, n=377) = 45.8, p<0.001. The highest percentage (31.6%) of women who were severely affected were in the age group 3640 years old, stating they experienced the highest impact (Table 2).

Table 2: Age and Severity of Respondents Affecting QoL

Age Group (Years)	Frequency (%)	Severity of Impact
20–25	50 (13.3%)	Mildly Affected
26–30	70 (18.5%)	A Lot Affected
31–35	80 (21.3%)	Moderately Affected
36–40	118 (31.6%)	Severely Affected
41–45	59 (15.3%)	Little Affected
Total	377 (100.0%)	–

Levels of symptom distress were uneven, as the results of the Pelvic Organ P-QOL questionnaire were found. The top complaints were bowel issues (10.3%), sexual discomfort (9.0%), and lower back pain with vaginal pain (8.2%). Common urinary symptoms included poor urinary stream (5.6%), straining to empty the bladder (5.8%), and urine dribbling (4.5%). Psychosocial impacts such as depression (1.1%), sleep disturbance (1.1%), and restricted social life (0.8%) were reported less frequently (Table 3).

Table 3: Distribution of P-QOL Domain Scores

Variables	Symptom/ Domain, n (%)
Bowels Do Not Feel Empty	39 (10.3%)
Vaginal Bulge Interfering with Sex	34 (9.0%)
Lower Backache with Vaginal Discomfort	31 (8.2%)
Straining to Open Bowels	27 (7.2%)
Constipation	26 (6.9%)
Straining To Empty Bladder	22 (5.8%)
Poor Urinary Stream	21 (5.6%)
Urine Dribbles After Emptying	17 (4.5%)
Other Minor Symptoms	<4% Each
Total	377 (100.0%)

Out of 377 participants, 118 women (31.6%) reported being severely affected, 80 (21.3%) were a lot affected, 70 (18.5%) were moderately affected, and 59 (15.3%) were a little affected. For the analysis of the overall quality of life impact, data from 50 participants (13.3%) were excluded. This exclusion was necessary because these participants did not complete critical sections of the P-QOL questionnaire, specifically one or more domains required to compute a valid total QOL impact score (Figure 1).

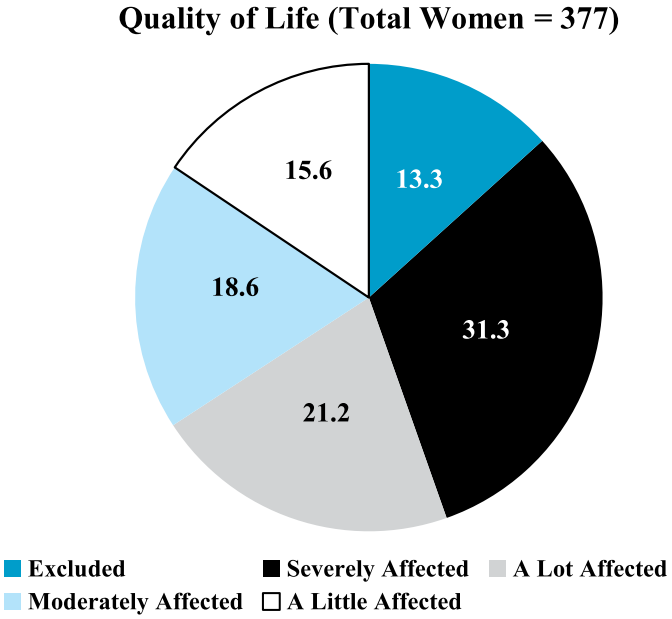

Figure 1: Quality of Life Affected by POP

DISCUSSION

The present study finds that the prevalence of pelvic organ prolapse (POP) is very high among postpartum women in Pakistan, with the majority having moderate to severe symptoms and a serious quality of life impairment, particularly in particular, physical and emotional well-being. The majority was middle-aged, and care-seeking was low due to stigma and lack of awareness. Compared to global data, the burden is higher in low-resource settings due to limited screening and postpartum support. While pelvic floor exercises have proven effective elsewhere, few women in this study practiced them, highlighting the need for greater physiotherapy integration and postpartum care improvements. Fourteen 3241-year-old women with parity 13 attended, POP Grade 13. The reports of women being dismissive or not being appreciative of the effect of their

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condition were high. Other reports involved communication with the HCPs who they believed were listening, understood the impact of their POP, positive diagnoses, and realistic treatment procedures [11]. Previous findings indicate the need to carry out larger epidemiological studies on the potential adverse reproductive health effects of heavy load-bearing exercises on third-world females [12]. Prevalence was 30.9 percent (95 percent confidence interval: 24.4-38.2 percent), (heterogeneity 12=99.8 percent). The meta-analysis of subgroups in the studies delivered the questionnaire to assess the prevalence rate and found that the prevalence was 25.0% and the physical examination was 41.8% [13]. One of the studies demonstrated the possibility of a pessary to positively influence the quality of life of women and the opportunity to considerably improve the sexual functioning and body perception [14]. High rates of LAM avulsion were detected in Chinese women with a POP of 39%. It was associated with an elevated level of POP, and these women were more handicapped in QoL. However, LAM avulsion was not an independent issue that influenced the QoL of such women [15]. POP also affects women, and the majority of them who visit the gynecology clinic in MRRH have the disease in stage II. POP is advised to be regularly screened to enable the detection and preventive action to be taken, especially with grand multiparous, peasant farmers, and people who have a history of perineal tears [16]. This was analyzed in 1426 women. There was a 4.9% prevalence of POP. POP was significantly related to the parity [17]. High rates of prevalence of depression in women with advanced prolapse of the pelvic organs were also reported by a study in comparison to the rest of the studies. The screening measures to be employed in the detection and management of depression in women who have advanced prolapse of the pelvic organs should be formulated to help identify the condition at its early stages [18]. A shared aetiology of both POP and other disorders that are related to collagen may occur at the molecular level of the collagens [19]. The awareness of the complexity of the etiology, epidemiology, and management of POP is significant in minimizing its burden and maximizing the health and well-being of the populations affected [20].

The cross-sectional design of the study limits causal and temporal inferences between potential risk factors and pelvic organ prolapse (POP), while cultural taboos, embarrassment, and low awareness may contribute to underreporting of symptoms and affect prevalence accuracy. Additionally, delayed postpartum data collection may introduce recall bias, and limited pelvic floor rehabilitation services with inconsistent postpartum screening can hinder accurate identification of POP. Future research should standardize pelvic floor assessments within routine postnatal care, examine the prevalence of depression and anxiety among postpartum women with POP, and incorporate qualitative approaches to explore women lived experiences, cultural beliefs, and barriers to accessing care.

CONCLUSIONS

This research concluded that the fact that severe POP symptoms (96.3%) were high and consistent performance moderate-high should prompt the need to improve data collection and specific interventions. A study that gauges the incidence of depression and anxiety among postpartum women with POP should be conducted. Research needs to be conducted in the future to address women lived experiences, cultural beliefs, and barriers to care using the qualitative method.

Authors' Contribution

Conceptualization: AA[1]
Methodology: NR, AA[2]
Formal analysis: MS, UI, BA
Writing and Drafting: AA, MA, RT, FM, EG
Review and Editing: AA, MA, RT, FM, EG, NR, AA[2]

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

The authors declare no conflict of interest.

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