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Healthcare Entrepreneurship Innovation Among Young Health Professionals

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In public health entrepreneurship, an entrepreneur uses their commercial expertise to solve a public health issue or start a health-related company. This can take the kind of creating a new product, funding a public health organisation or even investing a portion of a company's income into research and development for health-related projects and activities. In order to improve outcomes, economic development, and society well-being, healthcare entrepreneurship is acknowledged as crucial. Startups in the healthcare industry have faced structural, regulatory, organisational and behavioral challenges in the past but new business owners are looking for ways to improve access, affordability and quality. Despite a sluggish investment market healthcare venture capital managed to raise $19 billion in 2023 to fund new initiatives. Many things including consumer demand, local competition and business concepts go into determining the most lucrative healthcare benefits company. However medicines, medical technology, cosmetic, surgery, specialized clinics, telemedicine and laboratories have all demonstrated substantial profitability as a result of high demand and distinctive products. In order to reduce the learning curve especially when building the evidence base for the service, it is advisable for venture teams to have members with expertise in both healthcare and entrepreneurship. One way to get in touch with entrepreneurial accelerators or university tech transfer and commercialisation offices that one might have worked with before is to ask for their help in assembling the team. When developing new healthcare solutions, entrepreneurs should think about ways to involve patients or end-users. One strategy that may improve the solution's applicability and focus on the patient is to collaborate with appropriate patient advocacy groups. New revenue streams and business models may need to be developed by entrepreneurs in the healthcare industry. Healthcare is a fundamental human right but it cannot be provided indefinitely without adequate funding. Participating in healthcare entrepreneurship groups, accelerators and other community initiatives that encourage and facilitate entrepreneurial healthcare participation is one way to fortify one's "business and calling" mentality. Not only do we provide these useful insights for healthcare entrepreneurs but we also include them for other important players. Partnerships that standardise co-produced ideas may be incentivised by corporations. Entrepreneurs with venture capitalists may come up with new ways to finance projects that are tied to unconventional results. By bringing together experts from different fields, non-profits may bring attention to the need for healthcare entrepreneurs. Politicians should think about how to foster business climates that are competitive while maintaining appropriate pricing and cost structures.

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Review Article

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Cyber Security and Privacy Safeguarding Pharmaceutical Innovation in a Digital Age

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ABSTRACT

In order to improve efficiency and creativity, the pharmaceutical sector is going through a major digital revolution that contains the broad use of digital technologies including cloud computing, IoT devices, EHR systems, and artificial intelligence. Although this change presents new prospects, it also makes the industry more susceptible to sophisticated and frequent attacks. For preserving trust, comply with laws like GDPR and possibly HIPAA, and preserving pharmaceutical innovation, organizations in this sector must protect the vast and sensitive datasets they handle, such as patient medical histories, financial records, research findings, and rational property. In order to protect pharmaceutical innovation and uphold investor confidence, this review paper attempts to give a thorough overview of the digital transition in the pharmaceutical sector and stress the vital significance of strong cybersecurity protections and data privacy rules. It will look at future trends, cybersecurity risks, privacy issues, digital transformation, safeguarding strategies, regulatory frameworks, and policy and industry propositions.

INTRODUCTION

The pharmaceutical industry is undergoing a profound digital revolution, leveraging technologies like IoT, cloud computing, EHRs, big data, and AI to enhance operations, patient care, and drug development [1]. This digital transformation, while offering opportunities for innovative service models, has simultaneously increased the industry's vulnerability to sophisticated cyberattacks. Given the sensitive data managed by pharmaceutical organizations including patient records, financial information, research data, and intellectual property robust cybersecurity and data privacy are paramount [2]. Protecting this information is crucial for maintaining patient trust, adhering to regulations (e.g., GDPR, potentially HIPAA), and safeguarding vital research. Cybersecurity breaches can lead to significant reputational damage, financial losses, legal repercussions, and, critically, compromise drug integrity and patient safety. The escalating threat landscape, including ransomware and phishing, further emphasizes the need for strong security measures [3]. This review aims to: Summarize the ongoing digital transformation within the pharmaceutical industry. Highlight the critical role of robust cybersecurity and data privacy in preserving pharmaceutical innovation and stakeholder trust. The paper will first analyze the digital transformation in the pharmaceutical sector, followed by an examination of cybersecurity threats and data privacy concerns. It will then review relevant legal frameworks and explore solutions for protecting pharmaceutical innovation through strong cybersecurity frameworks [4]. Finally, the

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paper will discuss emerging cybersecurity trends and technologies relevant to the industry before concluding with recommendations for strengthening cybersecurity and safeguarding innovation in the digital age.

Cybersecurity Threats to Pharmaceutical Innovation

Because pharmaceutical breakthroughs are so valuable, intellectual property (IP) theft is a significant cyber threat [5]. Because pharmaceutical firms spend a lot of money on research and development, their intellectual property such as vaccine formulae, clinical trial findings, and drug development data is essential to preserving their competitive edge [6]. To try to steal this important data, cyberattacks like as spear-phishing, cyber espionage, and insider threats are frequently employed. For example, Moderna faced cyber espionage attempts, perhaps by state actors, to obtain vaccine development data, and Pfizer was the victim of a spear-phishing assault directed at its clinical research [7]. In another case, an insider revealed trade secrets at GlaxoSmithKline (GSK), and a hack stole the COVID-19 vaccine formula from Pfizer and BioNTech [8]. Successful IP theft can have serious repercussions, such as diminished competitive advantage, serious harm to one's image, possible legal repercussions, postponements of research and projects, and monetary losses. The danger to intellectual property is even seen by the US as a widespread cyber threat that can undermine national competitiveness and military efficacy [9]. The need of safeguarding intellectual property against cyber-attacks is recognized by several national cybersecurity policies [10].

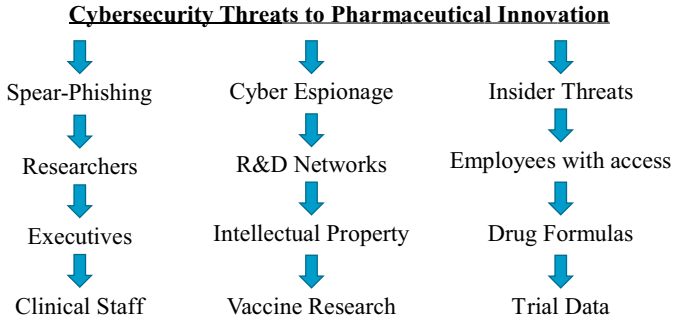

Figure 1: Cybersecurity Threats to Pharmaceutical Innovation: Illustrating the risks of IP theft through spear-phishing, cyber espionage, and insider threats targeting drug formulas, clinical trial data, and vaccine research.

Data Breaches and Ransomware Attacks: Data breaches and ransomware attacks pose significant threats to the healthcare and pharmaceutical sectors [11]. These breaches involve unauthorized access to sensitive information like patient data and intellectual property. Causes include cybersecurity incidents, unauthorized access, internal threats, third-party vulnerabilities, and phishing attempts. The financial impact is substantial, with the average cost of a healthcare data breach reaching $10.1 million in 2023 [12]. Reputational damage and regulatory penalties, such as GDPR fines, also result from these incidents. The sector experiences a high volume of breaches, with 754 reported in 2023 affecting over 52 million individuals [13].

Ransomware: Ransomware attacks encrypt data and demand cryptocurrency payments for decryption keys, severely disrupting healthcare services. The healthcare industry, including pharmaceuticals, is a prime target due to the critical nature of its data. Notable incidents include the 2020 Universal Health Services attack and the 2017 NotPetya attack on Merck & Co., which caused significant financial and operational losses [14]. In 2022, ransomware attacks on the healthcare sector surged by 74%, with average breach costs reaching $10.1 million. These attacks exploit weaknesses in outdated software and inadequate security [15]. Robust cybersecurity measures, including proactive risk prevention, enhanced security infrastructure, data encryption, employee training, and incident response plans, are crucial for the pharmaceutical industry [16].

Insider Threats and Human Errors: Insider threats, both malicious and unintentional, pose significant risks to the pharmaceutical industry [17]. Malicious insiders may steal sensitive information or sabotage systems, while unintentional threats often stem from human errors like accidental disclosures or phishing attacks. Many pharmacies lack effective employee training programs, making them vulnerable to risks like vishing [18]. Implementing cyber hygiene programs, which include password security, access control, and safe data handling, is essential to prevent data breaches and promote cybersecurity awareness [19].

Supply Chain Vulnerabilities: The pharmaceutical industry's increasing reliance on outside vendors for services like cloud storage, software solutions, and medical device integration exposes it to new cybersecurity threats through supply chain vulnerabilities [20]. The number of supply chain attacks targeting healthcare IT systems via these third-party weaknesses is rising. The Target data breach illustrates how weak third-party security can lead to dangerous system breaches. Cyber attackers often find and exploit weaknesses in third-party systems to break into healthcare networks [21]. Healthcare organizations need to perform comprehensive third-party risk assessments and verify that their security meets regulatory and organizational criteria before choosing vendors. Implementing security audits, contractual security terms, and live monitoring of third-party system access helps maximize security protection [22]. Strengthening third-party cybersecurity practices and including detailed security requirements with penalties for non-compliance in contracts are essential to decrease external security threats [23]. In figure 2 major key

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challenges in pharmaceutical supply chain are discussed.

Cyber-espionage by Nation-State Actors: Cyber espionage, often conducted by state-sponsored actors, is an evolving threat targeting pharmaceutical companies to steal valuable intellectual property and sensitive research data [24]. Examples include the cyber espionage attempts against Moderna during the COVID-19 pandemic, aimed at stealing vaccine development data and potentially giving competitors access to proprietary information. These attacks can also lead to the exposure of confidential communications and cause diplomatic tensions due to state-sponsored hacking [25]. Pharmaceutical firms need to invest heavily in protecting patient data and keeping such cyberattacks at bay.

Emerging Threats in Cloud-Based Pharmaceutical Systems: The increasing adoption of cloud computing platforms for data storage, processing, and application deployment in the pharmaceutical industry introduces new cybersecurity risks [26]. While cloud services offer scalability and cost-effectiveness, they also present attack vectors that need careful consideration. Organizations must be aware of the risks within cloud computing and understand the attack vectors that can cause threats [27]. Data stored and transmitted via cloud services must be adequately protected through measures such as data encryption both at rest and in transit. Performing thorough vendor risk assessments and ensuring that cloud providers meet stringent security standards and regulatory requirements are crucial for mitigating these emerging threats [28].

Open-Source and Public Data Sharing Risks: Although open-source software has advantages like customization and openness, it can also take in flaws that hackers could take advantage of if they are not well measured and fixed [29]. Similar to this, disclosing public data may result in unexpected data breaches or give attackers useful knowledge, particularly if it unintentionally contains private or sensitive information [30]. To reduce these possible hazards, the pharmaceutical sector must use open-source mechanisms with prudence and put strong security actions in place when sharing data publicly [31].

IoT and connected medical device risks in the pharmaceutical industry: There are serious cybersecurity threats linked with the growing integration of connected medical devices and the Internet of Things (IoT) into pharmaceutical operations and healthcare delivery [32]. These gadgets, which include implantable and wearable systems, are vulnerable to intrusions as they frequently lack built-in security protections or do not obtain routine maintenance and upgrades. Examples include Bayer's production-related compromised IoT devices, which might allow remote access to industrial systems, interfere with automated processes, cause delays in the creation of drugs, and result in financial losses [33]. Access to strategic information can make pharmacies that are part of hospitals and bigger health networks susceptible. It's also crucial to secure AI systems that could be connected to these gadgets. To ensure patient safety and the integrity of pharmaceutical operations, these devices and the sensitive data they handle must be protected by strong security measures [34].

Privacy Challenges in Pharmaceutical Digitalization and Compliance with Data Protection Regulations: The digital transformation of the pharmaceutical industry offers opportunities for productivity, quality, and compliance improvements. However, it also brings complex privacy issues, especially concerning sensitive data like health information and intellectual property [35]. Healthcare organizations must expand their digital infrastructure while ensuring patient data privacy and combating cybersecurity risks. Noncompliance with data protection regulations like GDPR, HIPAA, and CCPA can result in financial fines and increased vulnerability to cyber threats [36]. HIPAA provides guidelines for securing electronic health information, requiring strong security measures and potentially incurring penalties for noncompliance. GDPR, applicable in the EU, imposes strict penalties for mishandling EU citizens' data and demands transparent data governance [37]. Healthcare organizations face challenges in meeting regulatory requirements due to financial, operational, and evolving security issues. They should integrate compliance into their cybersecurity frameworks. The pharmaceutical industry, vital for life-saving drugs, is increasingly at risk of cyber-attacks and data breaches, making the protection of sensitive data crucial for intellectual property and pharmaceutical safety and effectiveness [38].

Secure Data Sharing in Research Collaborations: Efficient collaboration and information exchange among stakeholders (R&D, manufacturing, quality control, regulatory affairs, supply chain partners) are crucial for data accuracy and operational efficiency [39]. Digital transformation technologies like cloud computing and secure data-sharing platforms facilitate this while ensuring data protection and confidentiality. Blockchain technology can also establish a secure and transparent data infrastructure for collaboration in the pharmaceutical supply chain, enhancing data integrity and minimizing conflicts [40]. However, data privacy, security, and governance concerns must be addressed for ethical and secure blockchain use. Sharing clinical trial data also requires careful consideration of patient privacy, including informed consent and legal aspects of Data Sharing Agreements (DSAs) [40].

Anonymization and Data Integrity: Maintaining data integrity (accuracy, consistency, and reliability throughout

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its lifecycle) is critical for drug safety and regulatory decision-making. Anonymization or de-identification of patient-level data is a key recommendation for sharing clinical trial data for third-party research. Data holders employ strategies to minimize the risk of patient re-identification when sharing de-identified data, considering relevant legislation and data security controls. However, 100% confidentiality cannot be guaranteed, especially with increasing data availability in the public domain. Digital transformation initiatives, including electronic data capture systems and automated data validation, can significantly enhance data precision and dependability, bolstering data integrity by reducing manual errors and unauthorized modifications. Block chain can also contribute to data originality in pharma manufacturing[41] Ethical Issues with the Use of Patient Data: Using sophisticated analytics in pharmaceutical research and development presents ethical issues with regard to protecting patient privacy. It's critical to strike a balance between upholding strict ethical standards, patient privacy, and technical innovation. To guarantee that innovation supports the larger healthcare purpose without jeopardizing individual privacy rights, a persistent dedication to both technological excellence and ethical monitoring is necessary. A patient-centered strategy that gives patients authority over their medical records via cryptographic keys in blockchain systems is consistent with the moral precepts of informed consent and autonomy[42].

Risks to Privacy in Remote and Telemedicine Services: As IoT is used more and more to create innovative healthcare applications, privacy (access control), confidentiality, and integrity especially with regard to patient records are the main issues. Security and privacy issues are brought up by remote and telemedicine services, even if they save costs and enhance patient satisfaction[43].

International Difficulties with Cross-Border Data Transfers: Pharmaceutical businesses that operate internationally have to manage and abide by a number of legal obligations in several jurisdictions, each of which has specific standards for data integrity. Establishing uniform and harmonized data integrity procedures across the global supply chain may be made more difficult by national variations in laws, norms, and expectations. To ensure smooth market access and speed up approval procedures, it is essential to harmonize international regulatory standards. Establishing global rules to streamline regulatory submissions across borders is a critical function of organizations such as the International Council for Harmonization(ICH)[44].

Risks to Privacy and Third-Party Data Processing: Healthcare organizations frequently depend on outside suppliers when looking to expand their digital infrastructure, which might pose privacy problems if these partners fail to sufficiently secure patient data. In accordance with HIPAA, organizations must make sure business associates set up strong security measures for ePHI[45].

Strategies for Enhancing Cybersecurity in Pharmaceutical Innovation: The pharmaceutical industry, undergoing rapid digital transformation, faces increasing and sophisticated cyber threats that can jeopardize sensitive data, intellectual property, and patient safety. Enhancing cybersecurity is therefore crucial to protect the innovation pipeline, maintain regulatory compliance, and foster trust. A multi-layered and proactive approach, incorporating advanced technologies, robust practices, and a strong security culture, is essential to build resilience against evolving cyber risks[46].

Implementing Robust Encryption and Access Controls: Implementing robust encryption is a fundamental policy for protecting sensitive pharmaceutical data both in transit and at rest. This comprises using advanced encryption algorithms like AES and ensuring secure key managing. Strong access controls, based on the belief of least privilege, are vital to limit data access only to official personnel. This involves multi-factor verification, role-based access control, and regular reviews of user permissions. Cyber hygiene programs that syndicate password security training with access control methodology education are also crucial to defend against employee-caused data breaks[47].

AI and Machine Learning for Threat Detection: Artificial intelligence (AI) and machine learning (ML) are developing as powerful tools for improving threat detection in the pharmaceutical industry. AI/ML can analyze vast amounts of data to identify patterns and anomalies that may specify security breaches, enabling real-time threat detection and response. AI-driven systems can learn from historical data and adapt to emerging threats, cultivating risk management. Integrating AI with mathematical optimization techniques can further enhance the detection and neutralization of threats[48].

Zero Trust Architecture in Pharmaceutical Security: The sources do not explicitly detail the implementation of a Zero Trust architecture in pharmaceutical security. However, the principles of Zero Trust, which assume no user or device is inherently trustworthy and require continuous verification, align with the need for stringent access controls and monitoring discussed within the sources. Applying Zero Trust principles would necessitate strict identity verification, micro-segmentation of networks, and continuous monitoring of all activity within the pharmaceutical IT ecosystem[49].

Cybersecurity Training and Awareness for Employees: Cybersecurity training and awareness programs for

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employees are critical in creating a security-conscious culture and mitigating insider threats and employee-caused data breaches. Every employee needs to develop a cybersecurity awareness culture that understands their responsibility to guard sensitive data. Training should cover password security, phishing awareness, safe data handling procedures, and the importance of reporting suspicious activities. Regular updates and cybersecurity drills for handling IP breaches can further enhance employee preparedness [50].

Regulatory Compliance and Risk Management: Pharmaceutical cybersecurity relies heavily on proactive risk management and regulatory compliance. Strict laws like GDPR and HIPAA, which need strong security requirements, govern how the sector functions. Detecting, evaluating, and reducing cyber threats at every stage of the supply chain and research and development process is part of a proactive approach to risk management. Regular penetration tests, vulnerability scans, and security assessments are all part of this [51].

Enhancing Plans for Incident Response and Recovery: To lessen the effects of cyberattacks and guarantee company continuity, incident response and recovery plans must be strengthened. Procedures for identifying, evaluating, containing, eliminating, and recovering from security issues should be described in these plans. To guarantee the efficacy of these programs, regular testing and updating are necessary. A proactive approach to cybersecurity also includes developing operational continuity plans to minimize disruptions [52].

Regulatory Frameworks and Compliance in Cybersecurity: A key component of cybersecurity, especially in the pharmaceutical and healthcare industries, is regulatory compliance. Strict regulatory frameworks are in place for pharmaceutical businesses and healthcare institutions to secure sensitive patient data and maintain the integrity of their operations. The National Institute of Standards and Technology (NIST) Cybersecurity Framework, the General Data Protection Regulation (GDPR) in the European Union, and the Health Insurance Portability and Accountability Act (HIPAA) in the United States are among the important laws cited in the sources. Organizations are required by these frameworks to set up technological, administrative, and physical security measures for sensitive data, including electronic health records. Compliance is not merely a checklist exercise but a fundamental aspect of ensuring data privacy, maintaining patient trust, and avoiding significant financial penalties and reputational damage. For example, GDPR allows EU citizens to receive compensation equivalent to 4% of an organization's global annual turnover for non-compliance. Similarly, HIPAA non-compliance can lead to millions of dollars in fines [53].

Case Study in Pharmaceutical Cybersecurity The Incident: In 2017, pharmaceutical giant Merck & Co. was hit by a significant ransomware attack. This attack caused substantial operational disruptions across the company.

Impact: The ransomware attack led to a total IT outage for Merck. The attack caused significant operational disruptions for the company. Merck experienced delays and impacted production quality due to the cyberattack on IoT devices in its production systems. The company faced financial losses from production downtime as a consequence of the attack. Interestingly, Merck's insurance initially denied their claim for the losses, citing a war exclusion clause.

Type of Attack: The Merck incident is identified as a ransomware attack. Ransomware is a type of malware that encrypts a victim's files and demands a ransom payment to restore access.

Remediation and Lessons Learned: The instance highlights how important it is for the pharmaceutical industry to have a thorough and proactive tactic to cybersecurity in order to reduce risks and lessen the effect of potential attacks. As established by the insurance dispute, it draws attention to the possibility of serious financial consequences that go beyond the expense of recovery. The assault highlights how vulnerable IoT devices and production systems are to cyberattacks in the pharmaceutical manufacturing industry. This calls for particular security protocols for situations including operational technology (OT). Finally, the ransomware assault on Merck is a clear reminder of the serious financial and operational repercussions that cyberattacks may have on large pharmaceutical firms. It emphasizes how significant it is to have strong cybersecurity measures, such as proactive risk management, preparing for operational continuity, and paying close attention to protecting production systems [54].

Future Directions and Emerging Trends in Cybersecurity for Pharmaceutical and Healthcare Industries

Digital transformation and evolving threats are shaping cybersecurity trends in the pharmaceutical and healthcare sectors. Key developments include:

Machine Learning and AI: These technologies enhance threat detection by analyzing large datasets and identifying anomalies, leading to more precise and proactive threat mitigation.

Blockchain: Provides robust data security and integrity, particularly for pharmaceutical supply chains, to ensure transparency and prevent counterfeiting.

Medical Device Security: Focus on securing connected devices (IoMT) to protect patient safety and healthcare system integrity.

Emerging Trends: Integrating security into the Software Development Lifecycle (SDLC) for secure medical device

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design. Developing quantum-resistant encryption methods to safeguard against future threats. Strengthening regulatory frameworks and compliance requirements. Adopting proactive and adaptive security systems that evolve with new threats. Incorporating cybersecurity into Industry 5.0, emphasizing human-machine collaboration and resilience. Converging AI and blockchain for advanced cybersecurity solutions. These trends reflect a proactive and technology-driven approach to enhance resilience against evolving threats and protect sensitive data and critical operations [55].

CONCLUSIONS

The digital transformation of the pharmaceutical industry, while offering significant opportunities for innovation and efficiency, has also exposed it to a range of cybersecurity threats and privacy challenges. Intellectual property theft, data breaches, ransomware attacks, insider threats, supply chain vulnerabilities, and cyber-espionage are among the critical issues that necessitate robust cybersecurity measures. Compliance with data protection regulations like GDPR and HIPAA is essential to protect sensitive data and maintain stakeholder trust. Strategies such as implementing strong encryption, adopting AI and machine learning for threat detection, enforcing zero trust architecture, and enhancing employee training are crucial for safeguarding pharmaceutical innovation. Future trends, including the integration of AI and blockchain, the security of IoT devices, and the development of quantum-resistant encryption, will shape the industry's cybersecurity landscape. A proactive and adaptive approach, combined with stringent regulatory compliance, is vital to ensure the integrity and safety of pharmaceutical operations in the digital age.

Authors Contribution

Conceptualization: NAK
Methodology: MRS
Formal analysis: DH
Writing, review and editing: NAK, MRS, DH, MR, SRD

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Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

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Subcentimeter Ureteric Calculi on Plain Computed Tomography KUB in Patients Presenting with Renal Colic

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ABSTRACT

Renal colic, often caused by ureteric stones, is a common and painful condition. Subcentimeter ureteric stones are frequently identified using CT KUB. Understanding the demographics, pain levels, and distribution of these stones can help in better diagnosing, managing and treating the condition. **Objective:** To determine the prevalence of subcentimeter ureteric calculi in patients who have renal colic. **Methods:** Between September and December of 2024, a four-month descriptive cross-sectional study was carried out at the Diagnostic Center of CMH, Lahore. The target population included all patients presenting with renal colic, undergoing CT KUB. Sample size of 266 was calculated using WHO calculator and Cochran's formula. Data were collected using proforma and CT KUB reports, and analyzed using IBM SPSS version 26.0. 95% confidence intervals were provided for the results, and statistical tests including the Kruskal-Wallis, Shapiro-Wilk, Mann-Whitney U, and Normality tests were employed. Findings: Patients ranged in age from 18 to 71 years old, with an average age of 43. **Results:** The majority of patients were between the ages of 20 and 35, with more men (59.8%) than women (40.2%). Pain levels varied, with an average of 5.36 on the visual analog scale. Moderate pain was the most common, experienced by 38.33% of patients. Intermittent pain was more common (68.8%) than continuous pain (31.2%). Dysuria was the most common urination issue (35.71%). Ureteric stones were present in 77.82% of patients, with the right and left renal locations being the most common sites. The most common type of stones found were subcentimeters (60.9%). **Conclusions:** The distribution of subcentimeter ureteric stones and pain levels in patients with renal colic are described in this study on the identification of ureteric calculi in patients presenting with renal colic on CT KUB. The findings mostly seen in middle aged male patients with intermittent pain, right and left renal calculus were the most common sites and subcentimeter ureteric calculi were frequently observed category. Also describes the other findings like Hydronephrosis, cyst, and peripheral fat.

INTRODUCTION

Ureteric calculi is the formation of stones present in the ureter. It is found that these stones contain mainly calcium in about 80%. Ureteric calculi is one of the most frequently diagnosed urologic diseases worldwide. It is estimated that there will be a 12% lifetime incidence of the disease, usually occurring in patients aged 20 to 50 years [1, 2]. Acute flank discomfort brought on by renal colic is a typical clinical presentation in the accident and emergency room. Renal colic patients usually have radiating, intense flank discomfort that is colicky, either with or without hematuria. To evaluate patients with acute renal colic pain, two imaging modalities are used: computed tomography (KUB), ultrasound, and standard radiography of the kidneys, ureters, and bladder [3, 4]. It is now possible to reliably diagnose ureteral calculi on plain computed tomography CT KUB because to technological advancements [5]. Conventional abdominal radiography of the kidney, ureter, and bladder (KUB) is less sensitive than CT KUB in detecting subcentimeter ureteral calculi because small ureteral calculi are invisible on ultrasonography or abdominal radiography. Therefore, many patients who come with flank pain first have plain CT KUB in order to diagnose subcentimeter ureteral calculi [6]. Renal colic pain can be caused by a number of reasons, including pressure from

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the proximal stone, inflammation and edema surrounding the stone, smooth muscle spasms in the ureter, kidney stone restriction of urine flow, and elevated pressure on the urinary tract wall. The primary mechanisms of pain in these patients are urethral smooth muscle contractions and increased pressure in the urinary system as a result of an increase in local blood flow. Furthermore, there is heightened pain sensitivity. Tension in the renal pelvis initiates prostaglandin synthesis, production, and local release. Vasodilation and diuresis result from this, increasing intrarenal pressure. The ureter has a limited channel, and measuring its diameter can provide information about its status, particularly in relation to obstructive pathologies caused by compressive abdominal mass, ureterolithiasis, congenital aetiologies, or any other distal blockage. Long-term blockage may result in hydronephrosis and consequent kidney injury. Accurately diagnosing ureteral dilatation is essential for patient care, particularly in situations of low-density stones, periureteral calcifications, small non-obstructive stones, ureteral calculi, and surrounding inflammations that are mild or borderline [7]. Many research articles have limited literature on subcentimeter ureteral calculi in Pakistan however much of the literature is present in patients with plain CT KUB reporting on renal calculi and patients with suspected ureteral calculi with a history of renal colic pain. This study will contributed to improve patient outcomes in the diagnosis, prognosis and treatment of disease, reduces the risk of further complications and lessen patient sufferings.

METHODS

This study was descriptive cross-sectional was conducted in Diagnostic Center at Combined Military Hospital (CMH), Lahore. The trial ran for six months, from July to December 2024. The prevalence of ureteric calculi was 53% in study conducted by F G Sommer FG et al [8]. WHO calculator and Cochran, W. G. (1997) formula was used to calculate the sample size (n=266) [9]. Purposive sampling technique was used to gather the data. All patients with the history of renal colic, Participants in this study had to be at least 18 years old and be visiting the diagnostic center for CT KUB. Patients with Double J (DJ) stents (stents inserted in the ureters) were excluded, pregnant females and operated cases (all patients with history of any previously performed renal surgery between 5 years). Computed Tomography (Siemens 64 slice CT) was used to perform CT KUB. Every patient who presented with renal colic gave their written informed permission. All data and information, were kept private. Throughout the trial, patients' identities were kept anonymous. This study was carried out in compliance with the Declaration of Helsinki (Case# 87/ERC/CMH/LMC) and the ethical guidelines established by the CMH LMC and IOD ethical committees. Participants in the study had their rights upheld. Prior to examination, each patient gave their assent. Data were collected from the Diagnostic Center at CMH, Lahore, using CT KUB reports of patients with renal colic and a standardized proforma. Pain was assessed using the Visual Analogue Scale (VAS) and categorized as mild (1–3), moderate (4–6), and severe (7–10). In order to identify and measure ureteric calculi, with an emphasis on subcentimeter stones, patients received plain CT KUB in a supine posture with their arms up. This procedure involved many slices. Stones were classified according to size as subcentimeter or larger. IBM SPSS version 26.0 was used to analyze the data, and both qualitative and quantitative descriptive statistics were calculated at a 95% confidence interval ($p < 0.05$). For comparisons of gender and age groups, the Mann-Whitney U and Kruskal-Wallis tests were used, while the Shapiro-Wilk and Kolmogorov-Smirnov tests were used as normality checks.

RESULTS

This study was conducted among 266 patients presenting with renal colic. The results shows the age of patients, pain intensity, frequency of ureteric calculi, their sizes and locations. The data were analyzed using basic statistical methods. Table 1 shows the majority of participants were male (59.8%), while females accounted for 40.2%. Age groups ranged widely, with the highest proportion of participants (35.7%) aged between 20–35 years, followed by those aged 51–65 years (31.6%). The patients were 43.42 years old on average, with a standard deviation of 15.017.

Table 1: Demographics Characteristics of Study Population (n = 266)

Characteristics	Categories (Mean ± SD)	Frequency (%)
Gender	Male	159 (59.8%)
	Female	107 (40.2%)
Age Group of Patient (Years)	<20	4 (1.5%)
	20-35	95 (35.7%)
	36-50	64 (24.1%)
	51-65	84 (31.6%)
	>65	19 (7.1%)
Age of patients (Years)	43.42 ± 15.017	

Figure 1 shows the presence of ureteric calculi in patients. In 207 (77.8%) patients' ureteric calculi is present and in 59 (22.2%) patients' ureteric calculi is absent.

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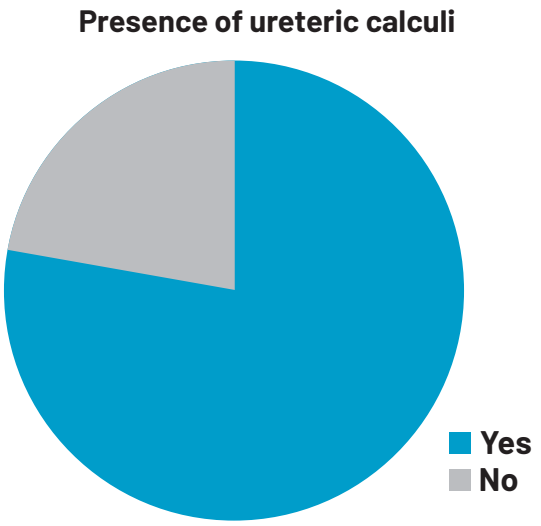

Figure 1: Presence of Ureteric Calculi in Patients

Table 2 shows the most common sites were the absence of calculi (22.2%), right renal calculi (21.8%), and left renal calculi (18.4%), with less frequent occurrences in other locations, such as right PUJ (4.1%) and bilateral ureteric calculus (0.4%). The majority of patients had one calculus (42.1%), followed by three or more calculi (22.6%), while 22.2% had no calculi detected. Regarding size, subcentimeter calculi were the most prevalent category (60.9%), with 16.9% categorized as above subcentimeter and 22.19% showing no calculi.

Table 2: Frequency Distribution of Ureteric Calculi by Site, Number, and Size Category among the Study Population (n = 266)

Characteristics	Categories	Frequency (%)
Site of Ureteric Calculi	No Calculus	59 (22.2%)
	Left Renal Calculus	49 (18.4%)
	Right Renal Calculus	58(21.8%)
	Left Ureteric Calculus	19(7.1%)
	Right Ureteric Calculus	30 (11.3%)
	Left PUJ	1(0.4%)
	Right PUJ	11 (4.1%)
	Left VUJ	14 (5.3%)
	Right VUJ	15 (5.6%)
	Bilateral Renal Calculus	9 (3.4%)
	Bilateral Ureteric Calculus	1(0.4%)
Number of Ureteric Calculi	0	59 (22.2%)
	1	112 (42.1%)
	2	35 (13.2%)
	3 or above	60 (22.6%)
Ureteric Calculi Category	Absent	59 (22.19%)
	Subcentimeter	162 (60.9%)
	Above Subcentimeter	45 (16.9%)

Figure 2 shows ureteric calculi categories as 162(60.9%) patients had subcentimeter calculi, while 59(22.19%) had no ureteric calculi. Furthermore, 45 people (16.9%) had calculi that were above centimeter.

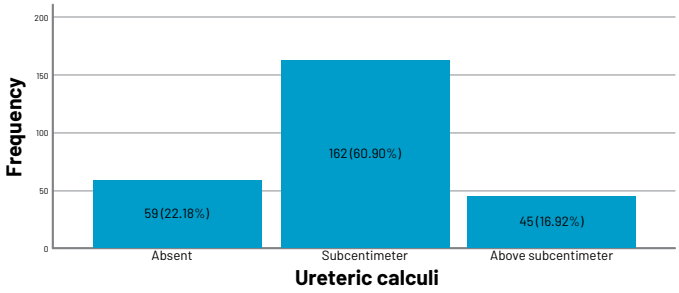

Figure 2: The distribution of Ureteric Calculi Shows a Significant Prevalence of different Categories

Figure 3 displays the size of ureteric calculi in individuals with renal colic on CT KUB by age group. The majority of stones are subcentimeter, while some larger ones are occasionally observed, particularly in the age ranges of 20–35 and 51–65. With a p-value of 0.141 from the Kruskal-Wallis test, there appears to be no discernible variation in stone size among age groups.

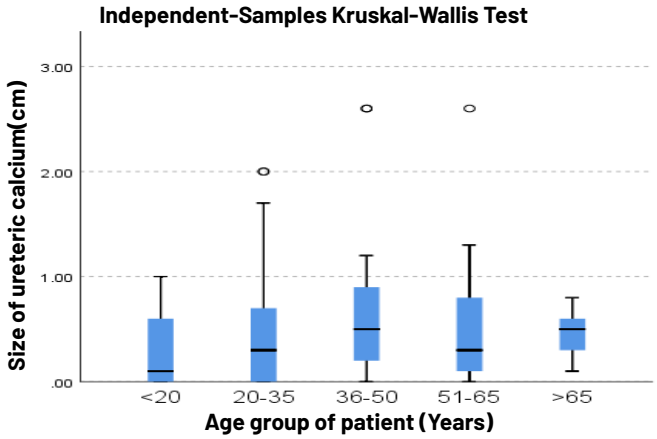

Figure 3: Association of the Size of Ureteric Calculi across different Age Groups

Figure 4 displays the outcomes of the Independent-Samples Mann-Whitney U Test. The mean rank of 107 girls in the sample is slightly higher (143.34) than that of 159 males (126.88). In contrast to female calculi, which are more likely to be smaller (1.0–2.0 cm), male calculi are more likely to be larger (2.0–3.0 cm). The level of significance is set at 0.050. The size of ureteric calculi does not differ statistically significantly across genders, according to the derived p-value of 0.085.

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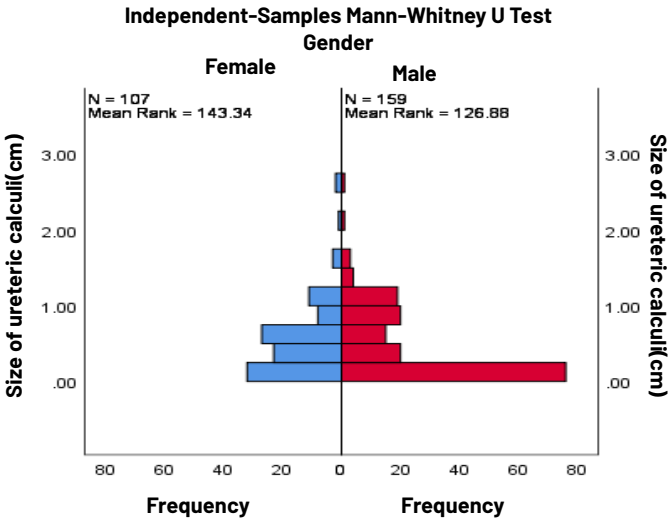

Figure 4: Association of Ureteric Calculi Size across Gender Categories

DISCUSSION

The current study reveals that the majority of 95 patients are between the ages of 20 and 35 years old (37.5%) as the age range of patients was 18-71 years old. The age group of 51–65 years old (31.6%), which has 85 patients, comes next. The age group of 36–50 years old (26.1%), which has 64 patients, comes next. According to this distribution, there are more patients in the younger age groups, especially those between 20 and 35. The distribution of patients by gender was the majority of 59.8% are (159) male and 40.2% are (107) female. These findings align with previous research, Chand RB *et al.*, was study conducted in June 2013. Gender and stone location outcome indicators were used in the prospective analysis of the data. The male to female ratio was 1.35:1, with 138 of the 240 cases being male and 102 being female. They were 9 to 83 years old. 187 patients, or 71.9% of the 240 total, were in the productive age range of 20 to 60 years. There were 345 urinary calculi in all, 208 of which were discovered in male patients and 137 in female patients. Six of the 345 calculi were in the bladder, 237 were renal stones, 47 were ureteric stones, 22 were in the Pelviureteric Junction (PUJ), and 33 were in the Vesicoureteric Junction (VUJ) [10]. The current research data show that these calculi are most frequently found in the size range of 0.3 to 0.4 cm, high frequency in this group. Most of the calculi are subcentimeter, and varying frequencies have been found in 0.1-0.2 cm and 0.2-0.3 cm size ranges. Furthermore, although their precise frequency surpasses the size of the chart, there are calculi greater than 1 cm. Medical practitioners can use this information to help choose the best course of therapy because it helps them understand the normal diameters of ureteric calculi. The study of Jeevaraman S *et al.*, in 2016 revealed some relative results in India. The age group of 21 to 49 years old had the highest incidence of ureteric calculi (60%) among the 100 participants in the research. The biggest stone measured 13 mm. For 39 in patients (39%) medical management was used. 18 patients had stones that were no larger than 5 mm. smallest stone was 4mm shown in study. Forty of the 41 patients who had retrograde ureteroscopy had their stones successfully removed. 21 patients (21%) had ureterolithotomy and pyelolithotomy, two open surgical procedures [11]. The current study demonstrates that there is a considerable variance in the frequency distribution of ureteric calculi across different urinary tract sites. Of the patients, the majority, 112 people (41.3%), had one ureteric calculus, whereas 59 people (21.8%) have none. Furthermore, 60 patients (22.5%) had three or more calculi, while 35 patients (13.6%) had two calculi. According to this data, instances with one ureteric calculus are the most common presentation, followed by those with three or more calculi. While the study performed by Yap WW *et al.*, in 2014, 201 patients' 203 ureteric calculi were examined. Scout radiography's total sensitivity was 42.3% for Observer A and 52.2% for Observer B, with an interobserver reliability κ-value of 0.78. Two groups of patients with and without visible stones were compared in terms of mean Hounsfield units and size; both variables had p-values less than 0.0001, which indicates statistical significance. The study found that calculi larger than 4 mm in the upper ureter are more likely to be visible on scout radiography [12]. In emergency urological care, the assessment of renal colic is still crucial, and imaging is essential for both diagnosis and therapy planning. The gold standard for identifying ureteric calculi, particularly those smaller than 1 cm, is non-contrast computed tomography of the kidneys, ureters, and bladder (CT KUB). When compared to traditional imaging, Chowdhury FU *et al.*, showed that unenhanced multidetector CT offers high sensitivity and specificity for the identification of ureteric stones, greatly increasing the diagnostic accuracy in cases with acute renal colic [1]. Similarly, Ekici and Sinanoglu, found that CT significantly outperformed combined ultrasonography and radiography in stone detection and localization [2]. The timeliness and efficacy of CT KUB have also been explored. Rekant EM *et al.*, and Haddad MC *et al.*, emphasized that CT not only reduces the time to diagnosis but also improves outcomes by facilitating prompt treatment decisions [3, 4]. According to Huang CC *et al.*,'s investigation, subcentimeter ureteric stones are still not very visible on scout radiographs, which supports CT's position as the preferred imaging modality [5]. The growing dependence on sophisticated imaging techniques like CT is further highlighted by recent epidemiological changes in the treatment of urinary tract calculi, as documented by Ghani KR et al [6]. Additionally, studies like that of Itanyi UD *et al.*, offer anatomical insights, such as ureteric diameter measurements on CT, which aid in predicting stone

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passage and potential obstruction [7]. Technological advancements, including reformatted and low-dose CT protocols, have improved the detection rates for subcentimeter stones, as supported by Sommer FG *et al* [8]. This is particularly relevant in younger patients and recurrent stone formers, where radiation exposure is a concern. Several large-cohort studies have investigated the most common sites of stone impaction. Chand RB et al., and Jeevaraman S *et al.*, observed that the Ureterovesical Junction (UVJ) and Pelviureteric Junction (PUJ) are frequent sites for smaller stone lodging [10, 11]. These findings support the use of focused CT assessments in suspected cases of distal obstruction. Newer literature supports the scout radiograph's limited sensitivity, as explored by Yap WW *et al.*, who concluded that CT should not be replaced by KUB radiographs, especially when evaluating small-caliber stones [12]. Meanwhile, Brisbane W *et al.*, and Dyer RB *et al.*, further refined the classification of stone visibility and its relation to size, density, and location [13, 14]. The advent of risk stratification models and clinical scoring tools, such as those developed by Smith RC *et al.*, provide a framework to guide clinicians in selecting patients who may benefit from early CT KUB imaging [15]. Additionally, Miller and Kane's work on time-to-stone passage in observation cases supports CT findings as predictors for spontaneous expulsion [16]. Catalano and Dalrymple expanded on the diagnostic capabilities of CT urography in characterizing urinary tract anatomy and pathology, reinforcing CT's multifunctional diagnostic role [17, 18]. Lastly, there is strong evidence that CT is more accurate than IVU, especially for patients with subcentimeter calculi and non-classic presentations of renal colic, according to Vieweg J *et al.*, and Smith RC *et al.* [19, 20].

CONCLUSIONS

The location of subcentimeter ureteric stones and pain levels in patients with renal colic are described in this study on the identification of ureteric calculi in patients presenting with renal colic on CT KUB. The findings mostly seen in middle aged male patients with intermittent pain, right and left renal calculus were the most common sites and subcentimeter ureteric calculi were frequently observed category. Also describes the other findings like hydronephrosis, cyst, and peripheral fat. Multi-center research can enhance the quality of data in ureteric calculi studies by increasing the sample size. Future studies should control for confounding factors like chronic kidney disease and renal parenchymal disease to ensure more accurate results.

Authors Contribution

Conceptualization: TT, ZS
Methodology: TT, ZS, YK, AR, AA
Formal analysis: TT, ZS, YK, AR
Writing, review and editing: TT, ZS, YK, AR

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

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Detection of Uterine Fibroids Through Ultrasound Among Women of Reproductive Age Presenting with Abnormal Uterine Bleeding in A Tertiary Care Hospital

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ABSTRACT

Fibroids are the leading cause of abnormal uterine bleeding (AUB). **Objective:** To detect uterine fibroids through ultrasound among women of reproductive age presenting with abnormal uterine bleeding in a tertiary care hospital. **Methods:** This descriptive cross-sectional study was conducted at the Diagnostic Center of Combined Military Hospital (CMH) Lahore. Data were collected from 200 women of reproductive age (15–49 years) with AUB. Women with adenomyosis, endometrial polyps, endometriosis and other gynecological problems were excluded. A consecutive non-probability sampling method was employed, and data were analyzed using IBM SPSS version 26.0. The chi-square test was applied for the comparison of categories. **Results:** The Average age of participants was 29.50 ± 8.32 years. From the participants with fibroids, common symptoms included pelvic pain (47%), back pain (46%), frequent urination (39%), and painful bleeding (68%). Out of the total, 53.5% had bleeding from other causes, and 46.50% had fibroids. Out of all participants, 46% had one fibroid, 0.5% had multiple fibroids, and 53.5% had none at all. There were 21.5% posterior wall fibroids and 25% anterior wall fibroids. Of the fibroids, 39.5% were hyperechoic and 7% were hypoechoic. The majority of fibroids 37.5% did not cause any distortion of the endometrial cavity. The endometrial thickness was normal in 84% of patients and increased in 32%. **Conclusions:** It was concluded that uterine fibroids were a common cause of AUB in women of reproductive age, with a significant proportion of cases presenting with symptoms such as pelvic pain, painful bleeding and frequent urination.

INTRODUCTION

Uterine fibroids are common, non-cancerous growths in the uterus. While some forms may show characteristics similar to malignant tumors, they are generally classified as benign [1]. When fibroids are suspected, the first diagnostic tool used is usually ultrasonography (USG). This method has a high sensitivity for detecting these tumors and can be performed either by transvaginal (TVS) or transabdominal (TAS) scanning [2]. The different types of fibroids based on their location include: 1. Intramural fibroids, growing within the uterine wall, distorting the cavity or outer surface, 2. Submucosal fibroids, arising just beneath the uterine lining, protruding into the uterus, 3. Subserosal fibroids develop from the outer layer of the uterus, and cervical fibroids, which are located in the cervix rather than the main body of the uterus [3]. Fibroids result in heavy menstrual bleeding and painful periods can also cause pelvic pain not related to menstruation, bloating, frequent urination, and digestive disturbances [4]. Hormonal contraceptives and NSAIDs are among the treatment options for fibroids. Surgical options include hysterectomy, myomectomy, or uterine artery embolization [5]. Women of reproductive age make up 75% of this population with uterine fibroids, translating to millions around the globe [6]. Abnormal uterine bleeding

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describes irregularities in timing, volume, frequency, and consistency regarding uterine origin; it is any deviation from normal patterns of menstrual bleeding [7]. Menstrual flow is determined by factors involving vascular tone, hemostatic function, and uterine contractions. Normal menstrual bleeding occurs within 4.5 to 8 days and 24 to 38 days concerning cycles and amounts to blood loss of 5 to 80 milliliters per cycle. The research definition for heavy menstrual bleeding is blood loss over 80 milliliters per cycle; a specific amount that may be tolerated before dangerous iron deficiency anemia occurs due HMB [8]. Medical treatments for AUB include NSAIDs, anti-fibrinolytics, and birth control pills. Surgical options include myomectomy, uterine fibroid embolization, hysterectomy, and endometrial ablation [9]. HMB is considered a type of AUB and is a serious clinical concern that impacts a sizable portion of women who are of reproductive age. The exact relationship between AUB and fibroids remains unclear, although fibroids are frequently found in women who experience AUB [10]. Previous research had predominantly concentrated on exploring the etiologies, diagnostic approaches, and therapeutic interventions for abnormal uterine bleeding (AUB) and uterine fibroids. The current study, however, aimed to explore the connection between AUB (Abnormal Uterine Bleeding) and uterine fibroids, with a focus on detailed patient clinical presentations and comprehensive ultrasound findings of fibroids, seeking to better understand the relationship between these two conditions.

This study aims to detect uterine fibroids through ultrasound among women of reproductive age presenting with abnormal uterine bleeding in a tertiary care hospital.

METHODS

This descriptive cross-sectional study was conducted at the Diagnostic Center of CMH Lahore between September and December 2024. Data were collected from 200 women of reproductive age (15–49 years) [11] presenting with AUB. The sample size was calculated through the WHO Geneva Calculator. The prevalence of fibroids was found to be 45.63% in 103 patients [12]. The following Cochran formula was used to calculate the sample size [13]. n=z21-aP(1-P)/d2. Z-value=1.96 at 95% confidence level (α), anticipated population proportion (P)=0.4563, absolute precision required (d) = 0.07 and sample size (n) = 195. But data were collected from 200 patients who were selected through a non-probability consecutive sampling technique. Women of reproductive age (15–49 years) who presented with abnormal uterine bleeding and were non-pregnant were included in the study [11]. However, women with gynecological conditions such as adenomyosis, endometrial polyps, and endometriosis were excluded. Ultrasound machine, Toshiba Xario with curvilinear transducer of 3-5 MHz frequency was used to carried out this research. The study was conducted at the diagnostic center of the Combined Military Hospital after ethical approval. Patients meeting the inclusion and exclusion criteria were enrolled and assessed for associated symptoms such as back pain, pelvic pain, frequent urination, and painful bleeding. Ultrasound imaging was performed using a curvilinear transducer (3-5 MHz) in the supine position, with transverse and sagittal planes used for evaluation. Key parameters recorded included the presence, number, location, and echogenicity of fibroids, as well as endometrial thickness and cavity distortion. Data were collected using a structured proforma and ultrasound reports. Written and verbal consent was taken from eligible participants. All information and data collection were kept confidential. Participants remained anonymous throughout the study. This study was conducted in line with ethical standards set by the ethical committee of CMH LMC and the Institute of Dentistry (IOD)(Ref Case#79/ERC/CMH/LMC. The terms of the Declaration of Helsinki were followed in the conduct of this investigation. Data analysis was done with IBM SPSS version 26.0. Descriptive statistics included frequencies, percentages, mean, and standard deviation, while inferential analysis was conducted using the Chi-square test to compare the frequencies. A p-value≤0.05 was considered statistically significant.

RESULTS

The current study included 200 women of reproductive age presenting with abnormal uterine bleeding and aimed to determine the prevalence of fibroids detected through ultrasound, which are presented in table 1.

Table 1: Demographic Characteristics of Study Population (n=200)

Characteristics	Categories	n (%)
Age Groups of Participants (Years)	15-19	24 (12%)
	20-24	40 (20%)
	25-29	49 (24.50%)
	30-34	28 (14%)
	35-39	30 (15%)
	40-44	18 (9%)
	45-49	11 (5.50%)
Age of Patients (Years), Mean ± SD	29.50 ± 8.332	
Marital Status of Patients	Unmarried	78 (39%)
	Married	122 (61%)

12% lied in the 15-19 years' age group, 20% lied in the 20-24 years' age group, 24.5% lied in the 25-29 years age group, 14% lied in the 30-34 years age group, 15% lied in the 35-39 years age group, 9% lied in the 40-44 years age group, and 5.5% lied in the 45-49 years age group. The mean ± SD of the study participants were 29.50 ± 8.32 years. Additionally, it

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showed that of the 200 patients, 61% were married and 39% were unmarried. The demographic information of the study population, which included women of reproductive age (15–49 years), is shown in table 2.

Table 2: Frequency of Fibroids in Patients Diagnosed On Ultrasound

Variables	Present	Absent
	n (%)	
Fibroids	93 (46.50%)	107 (53.5%)
Total	200 (100%)	

68% of patients reported painful bleeding, 47% pelvic pain, 46% back pain, and 39% frequent urination. The clinical presentation of patients with fibroids was depicted in figure 1.

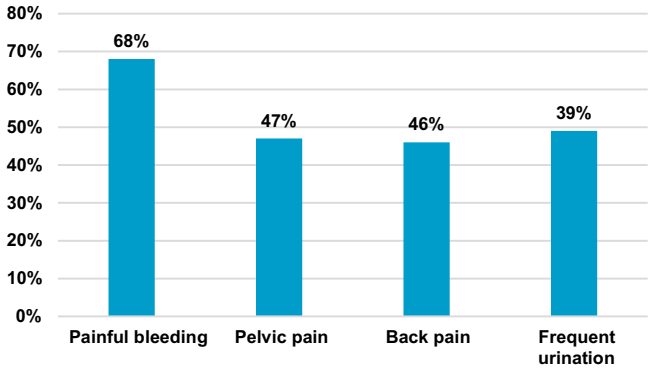

Figure 1: Frequency Distribution of Clinical Presentation of Patients with Fibroids

Out of the 200 patients, 46.5% had fibroids, while the remaining 53.5% had other reasons for their abnormal bleeding. 53.5% of cases had no fibroids, 46% had single fibroids, and only 0.5% had multiple fibroids. Of the fibroids that were found, 21.5% were on the posterior wall and 25% were on the anterior wall. Furthermore, 39.5% of the fibroids were hyperechoic and 7% were hypoechoic. 37.5% of fibroids did not result in any distortion of the endometrial cavity, while only 9% did. 32% of patients had increased endometrial thickness, whereas 84% of patients had normal endometrial thickness. Ultrasound results are shown in table 3.

Table 3: Ultrasound Findings in Patients with Abnormal Uterine Bleeding

Ultrasound Findings	Variables	n (%)
Number of Fibroids	Not Found	107 (53.5%)
	Single	92 (46%)
	Multiple	1 (0.5%)
Location of Fibroids	Not Applicable	107 (53.5%)
	Anterior Wall	50 (25%)
	Posterior Wall	43 (21.5%)
Echogenicity	Not Applicable	107 (53.5%)
	Hypoechoic	14 (7%)
	Hyperechoic	79 (39.5%)
Distortion of the Endometrial Cavity	Not applicable	107 (53.5%)
	Yes	18 (9%)
	No	75 (37.5%)
Endometrium Thickness	Increase	32 (16%)
	Normal	168 (84%)
Total	200 (100%)	

Out of those who did not experience painful bleeding, 24 (25.8%) had fibroids and 40 (37.4%) did not. Of those who experienced excruciating bleeding, 69 (74.2%) had fibroids and 67 (62.6%) did not. 3.064 is the Chi-Square value, and 0.080 is the p-value. The correlation between the fibroids and painful bleeding is displayed in Table 4.

Table 4: Association Between Painful Bleeding and the Presence of Fibroids

Painful Bleeding	Fibroids Absent	Fibroids Present	Total	Chi-Square Value	p-Value
	n (%)				
No	40 (37.4%)	24 (25.8%)	64 (32%)	3.064	0.08
Yes	67 (62.6%)	69 (74.2%)	136 (68%)		
Total	107 (100%)	93 (100%)	200 (100%)		

Out of those who did not experience pelvic pain, 44 (47.3%) had fibroids and 62 (57.9%) did not. Of those who experienced pelvic pain, 49 (52.7%) had fibroids, while 45 (42.1%) did not. 2.258 was the Chi-Square value, and 0.133 was the p-value. The correlation between pelvic pain and fibroids is displayed in table 5.

Table 5: Association Between Pelvic Pain and the Presence of Fibroids

Pelvic Pain	Fibroids Absent	Fibroids Present	Total	Chi-Square Value	p-Value
	n (%)				
No	62 (57.9%)	44 (47.3%)	106 (53%)	2.258	0.133
Yes	45 (42.1%)	49 (52.7%)	94 (47%)		
Total	107 (100%)	93 (100%)	200 (100%)		

DISCUSSION

Uterine fibroids are one of the main causes of abnormal uterine bleeding, a common symptom which usually results from underlying problems [14-16]. Because fibroids frequently result in abundant, irregular or unusual bleeding patterns, there is a significant relationship between abnormal uterine bleeding and fibroids. When a patient present with AUB, ultrasound is a useful diagnostic method for diagnosing fibroids [17, 18]. Hanan *et al.*, study examined uterine fibroid prevalence in young females using FMH radiology data. Of 55 patients, 43 (78.18%) had fibroids, characterized by prolonged heavy bleeding and severe pelvic pain, while 12 (21.81%) showed no signs. Fibroids were more common in those with irregular, prolonged menstrual flow. In the current study of 200 patients with abnormal uterine bleeding, 46.5% had fibroids, while 53.5% had other causes. It also found that 68% of fibroid patients had painful bleeding, 47% pelvic pain, 46% back pain, and 39% frequent urination. Unlike Hanan *et al.*'s study, which

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focused on young females with pelvic pain and heavy bleeding, this study included a larger sample and additional symptoms. Both studies confirmed the strong link between fibroids and abnormal bleeding, especially heavy menstrual flow [9]. Menorrhagia was the most common symptom, affecting 54.2% of participants in the study. The next most common symptoms were infertility, dysmenorrhea, metrorrhagia, and abdominal pain. Most fibroids were intramural, with the fundo-anterior region being the most common site. Similarly, in the current study of 200 women with abnormal uterine bleeding, 46.5% had fibroids. The most common symptoms were painful bleeding (68%), pelvic pain (47%), back pain (46%), and frequent urination (39%). While both studies identified abnormal uterine bleeding as the most prevalent symptom, the current study revealed a broader range of symptoms, including pelvic and back pain. It also found single fibroids (46%) primarily in the anterior and posterior walls, with the largest fibroids in these regions. While Samanta *et al.*, focused on the fundo-anterior position and fibroid size, the current study provided more detailed ultrasound findings, detecting both single and multiple fibroids and their potential to distort the endometrial cavity. Both studies highlighted the impact of fibroids on quality of life, particularly due to abnormal uterine bleeding [19, 20].

CONCLUSIONS

It was concluded that the current study was about the detection of uterine fibroids through ultrasound among women of reproductive age presenting with abnormal uterine bleeding. It found that nearly half of the population had fibroids. This study highlighted the significance of ultrasound as the first diagnostic tool and provided insightful information about the characteristics and symptoms of fibroids.

Authors Contribution

Conceptualization: YK, SS
Methodology: AR[1], KTK, ZS, AR[2]
Formal analysis: AR[2]
Writing review and editing: ZS, AA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Quality of Life among Individuals with HIV in Lahore: The Role of Resilience

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ABSTRACT

Resilience is the ability to bounce back in difficult situations such as trauma, stress, and adversity. Being diagnosed with Human immunodeficiency virus (HIV) is an extremely traumatic and stressful experience that can also lead to stigma and discrimination. **Objectives:** To find any significant association between resilience and Quality of Life (QOL) among individuals with HIV. **Methods:** This cross-sectional study was conducted in Forman Christian College from June 2020 to December 2020. The participants were mainly selected from the 3 different HIV rehabilitation centers based in Lahore (n=300) with age ranges from 18 to 65 years (Mean=32.7, SD=7.93). **Results:** The findings of the study illustrate that there is a positive association between resilience and QOL among individuals with HIV; Resilience is also positively associated with demographic variables like income, education, and gender. Furthermore, study findings demonstrate that resilience predicts a direct positive effect on individuals with HIV's QOL. **Conclusions:** It was concluded that by cultivating resilience, individuals with HIV can improve their physical and mental health and effectively manage their illness.

INTRODUCTION

Around 4000 young individuals in many parts of the world are infected with HIV every day, 40% of all new cases are among young people aged 15-24 years [1]. In some communities, the reaction to the HIV pandemic has demonstrated remarkable resilience in adverse times, which has helped prevent the worst effects. The process of adopting positivity within any given environment is known as resilience. In addition, resilience is the result of an individual's attitudes, beliefs, and abilities taken together, allowing them to remain resilient in the face of adversity. A balance of risk and protective factors is what determines resilience in individuals [2]. It is ascertained that resilience has a genetic or biological element [3]. However. resilience is not one characteristic of personality [4]. It is associated with the outcomes of experiences in many environmental factors that contribute to resilience growth in individuals. Therefore, myriads of studies have supported that resilience is strengthened through psychosocial support [5], psychological adjustment [6], coping abilities [7], and personal belief [8]. According to the resilience theory, the collaborative model of resilience, community contribution, family, and significant others assist in developing resilience among sufferers and can help support their psychological and physical health [9]. Resilience is reported as a buffer against stress among individuals with HIV and maintains health-related issues [10]. Numerous studies support that resilience is a term widely used for survivors to cope and adopt a healthy lifestyle. Also, Peccoralo *et al.*, reported that resilience is a sufferer's capacity to bounce back from difficulties and move on with better Health [11]. QOL can be described as "mental, physical, role and social functioning, including relationships, and perception of health, fitness, life satisfaction, and well-being [12]. Therefore, an influential

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and better QOL of individuals with HIV indicates the acceptance of the disease, establishment of a safe sexual relationship, medicine adherence, and even again start of routine life. Around .19 million sufferers are living with HIV in Pakistan in 2021, and 55% of sufferers are taking Antiretroviral therapy/medicine (ART) to fight the disease and adopt a healthy lifestyle. However, many factors can positively affect sufferers' QOL, like individuals' age, education, gender, living area, family systems, monthly income, marital status, regular taking of ART, and emotional and social support from significant others [13]. The power of Resilience can challenge epidemic diseases for any sufferer. Resilience is an actual positive weapon to resist against HIV infection among different age groups and genders. However, resilience plays a significant role in stopping the spread of HIV infections in others and helps them to live a balanced life. Although previous literature has explored resilience in individuals living with HIV, there was very little information regarding resilience with QOL among individuals with HIV. The study hypothesized that there was a positive association between resilience and QOL among individuals with HIV.

This study aims to explore any association between resilience and QOL among individuals with HIV. Also, to identify any demographic factors significant association that exists between resilience and sufferers' QOL.

METHODS

This cross-sectional study was conducted in Forman Christian College after getting an ethical approval letter (ref no IRB-233/06-2020). The study duration was from June 2020 to December 2020. This study adopted a non-parametric purposive sampling strategy to select the registered participants from three different renowned HIV rehabilitation centers in Lahore, Pakistan. All the selected participants were registered with The Punjab Aids Control Program Department (PACP) and had records of regularly taking ART. The sample size was comprised of 300 individuals with HIV based on the previous literature, with age ranges from 18 to 65 years (M=32.7, SD=7.93). Under inclusion criteria those participants were selected who were taking ART, already registered with PACP, had no history of substance abuse, and did not possess any other physical illness like Hepatitis B/C and Tuberculosis. A total of 498 participants participated in this research study, and only 300 participants met the inclusion criteria. A demographic questions sheet was used to collect general information like age, marital status, number of children, participants' education, profession, family monthly income, regularly taking ART, and any other physical disease like Hepatitis B/C and tuberculosis. The Adult Resilience Measure-Revised (ARM-R) tool was used to measure individuals with HIV resilience levels. The scale had 17 items, and it was a 5-point Likert scale ranging from 1 = low to 5 = high. The test-retest reliability of ARM-R was 0.74, and Cronbach's alpha was 0.86 [14]. World Health Organisation-HIV Quality of Life (WHOQOL-HIV BREF) was used to assess the QOL of individuals with HIV. This scale had 31 items and a 5-point Likert scale from 1=strongly disagree to 5=strongly agree. WHOQOL-HIV BREF had six different domains (physical, psychological, level of independence, social relationships, environment, and personal beliefs), and every domain had different items, like 4, 5, 4, 4, 8, and 4 statements, respectively. The test-retest reliability in all 6 domains was 0.54, 0.77, 0.71, 0.76, 0.78, and .48, respectively [15]. Firstly, the pilot study was performed to ensure that the questionnaire items were conceptually simple and to rule out the average time taken to complete the questionnaires. For the piloting (n=5), respondents were selected. The study informed the participants, confidentiality and anonymity, and the expected findings. Furthermore, the participants were encouraged to provide feedback on whatever problems they faced or encountered during the administration. After the piloting, the primary study was carried out. Formal permission was taken from the Project Director of PACP to collect the data from the targeted participants without any hurdles. The written permission was submitted to all three heads of the PACP's HIV/AIDS rehabilitation centers. Also, verbally explained the study's significance to the Head of Department and other staff members of the PACP's selected rehabilitation centers. Furthermore, written and verbal informed consent were obtained and explained to the participants regarding the aim of the research study, its importance, the expected outcome, and participants' confidentiality. The data collection took almost four months to complete. Descriptive and inferential statistics were used to explore the data of 300 individuals with HIV. To begin, the psychometric properties of the study's measures were computed. Descriptive statistics were used to find out the frequencies and percentages of the study's supporting variables. Pearson product-moment correlation was run to explore the positive or negative association in resilience, QOL, education, gender, and family income. Finally, regression analysis was run to predict the resilience effect on QOL. The level of significance was set to below 0.05 for all analyses, which were all carried out using IBM SPSS version 23.0. To begin with, formal permission to conduct the research work was obtained from all concerned authorities. The authors of the assessment instruments were contacted via email for permission to use the original versions of the tools. Verbal and written permission were taken from both participants and informed participants, including research participation rights and withdraw their participation at any point without any reason. Moreover, the participants were informed about their privacy and confidentiality, and

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informed that the data sheets of the data collection were saved and coded, due to which only the researcher and supervisor had access to confidential material. Debriefing of research was provided, and it was discussed with participants to seek psychological assistance just in case they experienced any emotional difficulty after filling out questionnaires. Also, two professional clinical psychologists were kept on board for this purpose.

RESULTS

To analyze data, the psychometric properties of the study's measures were computed. The table illustrates the reliability analysis of the scales and their subscales that were used for the present study. The mean, standard deviation, and Cronbach's alpha reliability value were calculated. The first scale, Adult Resilience Measures-Revised scale (ARM-R), Cronbach's alpha reliability value was 0.76, which was a suitable reliability for the study. Lastly, the results also revealed that the WHO-HIV Quality of Life scale (WHOQOL-HIV BREF) comprised six subscales. The alpha values for the physical and personal beliefs subscales were observed to be low as compared to the other four subscales, which ranged from 0.71 to 0.78 and were in an acceptable range. Firstly, reliability analysis was executed to compute the mean, standard deviation, and Cronbach's alpha values of measuring tools (Table 1).

Table 1: Psychometric Properties of Questionnaires (Resilience and Quality of Life) in the Present Study

Measures	*K*	Mean ± SD	α
ARM-R	17	65.61 ± 7.88	0.76
WHOQOL-HIV BREF	31	116.31 ± 10.78	0.75
Physical	4	12.52 ± 1.92	0.54
Psychological	4	16.09 ± 2.3	0.77
Level of Independence	5	15.54 ± 2.51	0.71
Social Relationship	4	12.72 ± 2.79	0.76
Environment	4	28.11 ± 4.28	0.78
Personal Beliefs	8	13.19 ± 3.39	0.48

Note. K=Number of scales and subscales items; α=Cronbach's alpha; ARM-R=Adult Resilience Measures-Revised scale; WHOQOL-HIV BREF=World Health organization HIV quality of life scale.

Most of the participants living with HIV were men (77%). The participants' mean age was 32.7 ± 7.93. The majority of the participants were married and living with their spouses. Whereas, unmarried/single participants were noted to have the second-highest percentage (45%). Most of the participants had 1-3 children, and 7 males had 7-8 children. The majority of participants were uneducated or under-matriculated. A large percentage of the transgender and female participants were under-matriculated or uneducated. This can be seen that the majority of the participants were employed and doing jobs in the private sector and the government sector too. Furthermore, a countable number of participants were self-employed and running their own businesses. Whereas, around 86% of transgender people were dancing and begging to earn money for food and clothes. The majority of participants' monthly family income was low. All participants are registered with PACP and regularly take ART. Furthermore, all the participants had no significant illness other than HIV infection (Table 2).

Table 2: Demagraphic Analysis (n=300)

Variables	Male	Female	Transgender	Total
	Frequency (%)			
Age	232 (77%)	52 (17%)	16 (5%)	300 (100%)
Marital Status				
Single	117 (52.3%)	2 (3.8%)	16 (100%)	135 (45%)
Married	112 (46.5%)	26 (49.9%)	–	138 (46%)
Divorced	1 (0.4%)	3 (3.8%)	–	4 (1.3%)
Widowed	-	19 (36.4%)	–	19 (6.3%)
Separated	2 (0.8%)	2 (3.84%)	–	4 (1.3%)
Number of Children				
None	140 (60.2%)	4 (7.6%)	16 (100%)	156 (52%)
1-3 Children	59 (25.3%)	46 (88.6%)	–	105 (36%)
4-6 Children	30 (12.9%)	2 (3.8%)	–	32 (10%)
7-8 Children	7 (3%)	–	–	7 (2%)
Education				
Uneducated	46 (19.9%)	13 (24.5%)	5 (31.3%)	64 (21.3%)
Primary-Matriculation	120 (51.9%)	36 (67.9%)	11 (68.9%)	167 (55.6%)
Intermediate	31 (13.4%)	2 (3.8%)	–	33 (11%)
Graduation	29 (12.7%)	1 (1.9%)	–	30 (10%)
Professional Degree	5 (2.1%)	1 (1.9%)	–	6 (2%)
Occupation				
Unemployment	36 (15.6%)	12 (22.6%)	1 (6.3%)	49 (16.3%)
Government Job	8 (3.5%)	–	–	8 (2.6%)
Private Job	83 (35.9%)	4 (7.5%)	1 (6.3%)	88 (29.3%)
Retired	6 (2.6%)	1 (1.9%)	–	7 (2.3%)
Housewife	–	29 (54.7%)	–	29 (9.9%)
Self-Employed	53 (22.9%)	6 (11.3%)	1 (6.3%)	62 (20.7%)
Driver	13 (5.6%)	–	–	13 (4.3%)
Labor	27 (11.7%)	1 (1.9%)	–	28 (9.3%)
Dancer	–	–	9 (56.3%)	9 (3%)
Begging	–	–	5 (31.3%)	5 (1.7%)
Doctor	2 (0.8%)	–	–	8 (0.6%)
Monthly Family Income				
Bellow 25000	108 (36%)	38 (12.5%)	10 (3.3%)	156 (52%)
25001-50000	29 (9.6%)	10 (3.3%)	5 (1.7%)	44 (14.7%)
50001-75000	35 (11.7%)	9 (3%)	1 (0.3%)	45 (15%)
Above 75000	50 (16.6%)	5 (1.7%)	–	55 (18.3%)
Duration of Illness				
Less Than 1 Year	104 (47%)	21 (39.6%)	6 (37.5%)	131 (43.7%)
Above 1 Year	127 (53%)	32 (60.4%)	10 (62.5%)	169 (56.3%)
Duration of Taking ART				
Less Than 1 Year	109 (47.2%)	23 (41.5%)	7 (37.5%)	139 (45.7%)
Above 1 Year	122 (52.8%)	30 (58.5%)	9 (62.5%)	161 (54.3%)

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Significant Physical Illness Like Hepatitis/T.B				
Yes	0	0	0	0
No	222 (100%)	62 (100%)	16 (100%)	300 (100%)

To determine the association between research variables, their subscales, and demographic variables, Pearson Product-Moment Correlation was used. Resilience had a significant positive association with demographic variables such as education, gender, and family income. However, resilience had a low or weak association with the age, marital status, and occupation of the participants. QOL had a significant positive association with the education of the participants and monthly family income. Moreover, QOL was negatively associated with gender. However, low and weak associations were found with age, marital status, and occupation of the participants (Table 3).

Table 3: Correlation between Adult Resilience Measures-revised Scale (ARM-R) and WHOQOL-HIV BREF (n=300)

Variables	1	2	3	4	5	6
ARM-R						
Gender	0.15**	-	-	-	-	-
Age	-0.07	-0.01	-	-	-	-
Education	0.19**	-0.17**	-0.09	-	-	-
Marital Status	-0.03	0.16**	0.29**	-0.16**	-	-
Family Income	0.17**	-0.16**	-0.07	0.38**	-0.09	-
Occupation	-0.10	0.28**	0.19**	-0.16**	-0.04	-0.13*
WHOQOL-HIV BREF						
Gender	-0.15**	-	-	-	-	-
Age	0.03	-0.01	-	-	-	-
Education	0.25**	-0.17**	-0.09	-	-	-
Marital Status	-0.08	0.16**	.029**	-0.16**	-	-
Family Income	0.28**	-0.16**	-0.07	0.38**	-0.09	-
Occupation	0.03	0.28**	0.19**	-0.16**	-0.04	-0.13*

*p<0.05, **p<0.01

Further study indicates the result of Pearson's Moment Correlation between Adult Resilience Measure-Revised (ARM-R), World Health Organization HIV Quality of Life Scale (WHOQOL-HIV BREF) and its subscales. ARM-R had a highly positive association with WHOQOL-HIV BREF, Physical, Psychological, Level of independence, and Social relationships, It was a hypothesis that "There is a significant association between resilience and QOL in individuals with HIV". Thus, Hypothesis 1 was successfully accepted and indicated a highly positive association between resilience and QOL among individuals with HIV (Table 4).

Table 4: Correlation between Resilience and Quality of Life of Participants (n=300)

Variables	1	2	3	4	5	6	7	8	9	10	11	12
ARM-R												
WHOQOL-HIV BREF	0.53**	0.45**	0.33**	0.22**	0.42**	-	-	-	-	-	-	-
Physical	0.41**	0.31**	0.25**	0.14**	0.20**	0.83**	-	-	-	-	-	-
Psychological	0.50**	0.42**	0.32**	0.20**	0.31**	0.89**	0.73**	-	-	-	-	-
Level of Independence	0.43**	0.35**	0.27**	0.18**	0.24**	0.75**	0.67**	0.63**	-	-	-	-
Social Relationships	0.42**	0.44**	0.28**	0.16**	0.44**	0.75**	0.49**	0.61**	0.48**	-	-	-
Environment	0.46**	0.46**	0.35**	0.22**	0.33**	0.84**	0.62**	0.74**	0.60**	0.55**	-	-
Personal Beliefs	0.29**	0.18**	0.09	0.15**	0.12*	0.67**	0.42**	0.50**	0.32**	0.49**	0.39**	-

*p<0.05; **p<0.01

In order to investigate the effect size in the group, Cohen's d was used. d=0.2 or bellow was considered a small effect size, d=0.5 or above was considered a medium effect size, and d=0.8 and above was considered a large effect size between the groups. Effect size varied from small to large effect size in all domains (Table 5).

Table 5: Mean ± SD and Comparison Groups (Cohen's d) (n=300)

Variables	Male	Female	Trans-Gender	Total	Cohen's d	Cohen's d	Cohen's d
	Mean ± SD				Male-Female	Male-Transgender	Female-Transgender
ARM-R	66.22 ± 7.78	64.02 ± 7.66	61.94 ± 8.69	65.61 ± 7.88	0.28	0.51	0.25
WHOQOL-HIV BREF	98.18 ± 15.88	90.77 ± 14.62	93.81 ± 15.97	95.66 ± 15.88	0.48	0.27	0.21
Physical	15 ± 3.74	13.58 ± 3.45	14.63 ± 4.24	14.73 ± 3.75	0.39	0.09	0.27
Psychological	17.32 ± 3.22	15.83 ± 2.91	17.38 ± 3.05	17.07 ± 3.20	0.48	0.02	0.52
Level of Independence	13.06 ± 2.30	12.79 ± 2.55	12.69 ± 2.09	13 ± 2.33	0.11	0.17	0.04
Social Relationships	12.94 ± 2.84	11.90 ± 2.48	12.19 ± 2.69	12.72 ± 2.79	0.39	0.27	0.11
Environment	28.41 ± 4.19	26.81 ± 4.59	28.06 ± 4.04	28.11 ± 4.28	0.36	0.08	0.29
Personal Beliefs	11.45 ± 3.73	9.87 ± 3.27	8.88 ± 2.75	11.04 ± 3.69	0.45	0.78	0.33

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Regression analyses was applied to investigate the impact of independent variables (Resilience) on the dependent variable (Quality of life). The model of regression was found to be a highly significant positive prediction ($F(1,298) = 115.76$, $p<.001$, $R^2=0.28$) and accounted for 28% of the variance in QOL. The Durbin-Watson value was 2.11, and the model was found to be significant (Table 6).

Table 6: Regression Resilience as Predictor of Quality of Life of Participants (n=300)

Variables	Model 1			
	A	B	*t*	*p*
(Constant)	26.71	–	–	–
Resilience	1.06	0.41***	10.76	0.0001
R^2	0.28	–	–	–
F	115.76	–	–	–
ΔR^2	0.28	–	–	–
ΔF	115.76	–	–	–

A=Predictors: Resilience. B=Dependent Variable, Quality of Life (QOL). ***p<0.001

DISCUSSION

The current research is one of the investigations on the role of resilience amongst individuals with HIV and their QOL; and how internal and external factors affect it. The study specifically examined the association between resilience and demographic variables to identify if any significant association exists. The findings of the study are discussed in light of recent literature, indigenous studies, and Pakistani culture. As a novel finding, analyses revealed that resilience is positively associated with QOL among individuals with HIV. The result of the present study supported the hypothesis as resilience was found to have a direct positive association with QOL among individuals with HIV. Similarly, Chmitorz *et al.*, and Shi *et al.*, found that higher levels of resilience were positively associated with better QOL [16, 17]. Our study has also examined the association between resilience and demographic factors such as gender, education, and income among individuals with HIV and found a significant association. This result can be related to previous research, such as a study conducted by Girma *et al.*, in Ethiopia and Moyo *et al.*, in South Africa, which found that resilience was significantly positively associated with higher education and income [18, 19]. For instance, a study conducted by Bärnighausen et al., found that resilience has a positive impact on QOL among HIV in Eswatini [20]. Similarly, a study by Rutter *et al.*, found that resilience was positively associated with better mental health among individuals with HIV who had experienced stressful life events [21]. Analysis revealed that the majority of the participants were male with low family income and education. Whereas, they registered with the Punjab AIDS Control Program (PACP) and regularly took ART to save their partners from HIV infections. According to WHO (2021), the prevalence of HIV infection among sex workers (3.8%), gay or other men who have physical contact with men, 3.7%), injection drug users (21%), transgender (5.5%), and prisoners (2%) in Pakistan [22]. Moreover, NACP established the Punjab AIDS Control Program (PACP) in Punjab province, and a total of 26 centers are working under the PACP in 16 districts of Punjab, as of March 2021 [23]. The prevalence of HIV/AIDS infection among high-risk groups, as well as preventing the epidemic from developing between the bridging communities and the general population. Therefore, research has suggested that ART/intervention aimed at enhancing resilience may be effective in improving QOL among individuals with HIV regardless of demographic factors. A study by Jiang *et al.*, found that intervention improved QOL and mental health among individuals with HIV in Iran, regardless of gender, education, and income level [24].

CONCLUSIONS

It was concluded that this study revealed a significant association between resilience and QOL among individuals with HIV that was determined by demographic factors.

Authors Contribution

Conceptualization: MA
Methodology: MA, AN
Formal analysis: AN
Writing review and editing: HY

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Compare the Educational Environment and Prevalence of Myopia in Public and Private Schools

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ABSTRACT

Myopia is a major cause of worldwide avoidable blindness, and its prevalence is increasing rapidly. **Objectives:** To investigate the relationship between myopia and educational environmental characteristics in public and private sectors. **Methods:** A cross-sectional study was conducted from August to December 2024, implementing a stratified sampling technique. Two schools were chosen at random from each of the public and private school strata. From each grade level, students were then selected at random. Individuals with ocular problems or those who declined to participate were not included. 621 students between the ages of 8 and 15 took part. Ocular examination included refraction and visual acuity. A self-structured questionnaire was utilized to assess the home and school educational environment variables. SPSS version 26.0 was used for data analysis. **Results:** Among 621 students (mean age 13 ± 1.89 years), 46.53% were male and 53.46% were female. 387 students attend public schools, while 234 attend private. 33.8% myopia prevalence, with 10% having high, 33.33% having moderate and 56.66% having mild myopia. There were 109 myopes from private schools and 101 from public schools. 109 out of 234 students in private schools (46.58%) have myopia. A pleasant study area and the amount of time spent on homework are all factors linked to myopia in public and private school types. **Conclusions:** It was concluded that a notable difference was found in the public and private sectors' educational environments. More artificial lighting, fewer outside activities, and a stronger focus on digital learning resources like laptops and tablets are features associated with private schools.

INTRODUCTION

Refractive error, mainly myopia, is primarily the reason for around one-fifth of all blindness cases worldwide [1]. About 30% of people worldwide are affected by myopia, a serious and sometimes unrecognized public health issue that is defined as a spherical equivalent refraction of ≤ −0.50 diopters (D) [2]. It starts early in infancy, impairs vision and lasts the entirety of a person's life [3]. Myopia can have a significant socioeconomic impact, which varies depending on age, the severity and geographic location (e.g., urban versus rural settings). The prevalence of myopia is predicted to increase dramatically over the next few decades due to existing trends [4]. 50% of people worldwide are expected to develop myopia by 2050, with 10% having serious myopia [2]. High myopia is thought to be a disease caused by a complicated interaction between environmental and hereditary variables [5]. Studies have linked environmental factors, such as less outdoor exposure, overly near employment, and higher educational attainment, to changes in genetic risk [6-8]. Furthermore, there may be a connection between the development of myopia and iris colour [9]. The global burden of myopia-related vision impairment and blindness is predicted to increase significantly due to the strong correlation between myopia, particularly high myopia and sight-threatening consequences like retinal detachment, myopic maculopathy and glaucoma [10, 11]. Furthermore, a

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variety of factors, such as living environment [12], screen usage [13] and particular personality traits [14] have been connected to the prevalence of myopia. The relationship between myopia and education additionally attracted a great deal of interest. The evidence is currently limited and inconclusive, but some studies suggest that reducing the pressure to perform well in school may help lower the prevalence of myopia [15, 16]. Prior research has demonstrated a connection between myopia and level of education as well as educational level [17]. Additional aspects of the learning environment, however, have not gotten as much attention. So, it's very necessary to find successful school-based myopia prevention techniques.

This study aims to investigate the relationship between the prevalence of myopia and a wider range of educational environmental characteristics in public and private sectors.

METHODS

The cross-sectional study was carried out in Faisalabad in 2024 between August and December. This study was carried out according to the Declaration of Helsinki's rules for biomedical research involving human subjects. A letter of ethical approval for this research (TUF/IRB/316/24) was issued by the University of Faisalabad, Ethical Institutional Review Board. The parents of the children provided their informed consent before they participated in the study. A stratified sampling procedure was used to guarantee the accurate representation of the children's sample. A sample size of 621 students was calculated with a 95% confidence interval, 80% power of the test and an expected percentage of prevalence of 33%. The population was separated into two strata, private and public, based on the kind of school. Two public and two private schools were selected at random from each stratum. After that, study participants were chosen at random from each grade level in each of these schools. People with ocular conditions such as strabismus, amblyopia, hyperopia, systemic diseases, ocular infections, and syndromes were excluded, as were those who chose not to participate. In each, 621 students between the ages of 8 and 15 were included in the study. An empirical method and a review of the literature were used to establish the sample size. Ocular examinations were conducted as follows: First, the children's visual acuity (VA) was assessed using the Snellen Chart. Pinhole visual acuity was also measured; individuals whose visual acuity decreased or remained unchanged were excluded from the experiment due to the possibility of pathology or amblyopia. Those whose pinhole visual acuity improved to 6/6 were considered to have uncorrected refractive error and underwent subjective refraction. If a child's visual acuity was less than 6/6 in either eye and their spherical equivalent refraction was greater than 0.5 diopter, they were classified as myopic. Conversely, children were classified as non-myopic if their visual acuity was 6/6 or better and their spherical equivalent refraction was 0.5 D or less. Demographic data, including age, gender and the prevalence of myopia and nonmyopia, was additionally gathered following the eye examination. A self-structured questionnaire was used for data collection. The type of school, the artificial and natural lighting in the classroom, outdoor activities and the usage of digital learning tools like computers and tablets are all aspects of the educational environment in both public and private schools. The participants' home study environment was investigated as well in the survey, including whether they have a specific area at home where they study or complete assignments. It also evaluated the comfort and ventilation of the study space at home, including the presence of a suitable table and chair. Additionally, the daily amount of time spent on non-educational digital devices. Statistical Package for the Social Sciences (SPSS) software version 26.0 was used to analyze the data. Frequency distribution and descriptive statistics were used for statistical analysis.

RESULTS

The demographic data of this study include age, gender and the distribution of myopic and non-myopic individuals. The mean age of the participants was 13 years with a standard deviation of 1.89. Of the 621 participants, 332 (53.46%) were female and 289 (46.53%) were male. In terms of refractive status, a total of 210 individuals were diagnosed with myopia, while 411 were non-myopic, indicating a 33.8% myopia prevalence in the study population. The degree of myopia was as follows: 21(10%) of the 210 myopic people had high myopia, 70 (33.33%) had moderate myopia, and 119 (56.66%) had mild myopia. Descriptive statistics and frequency distribution were applied to the demographic data (Figure 1).

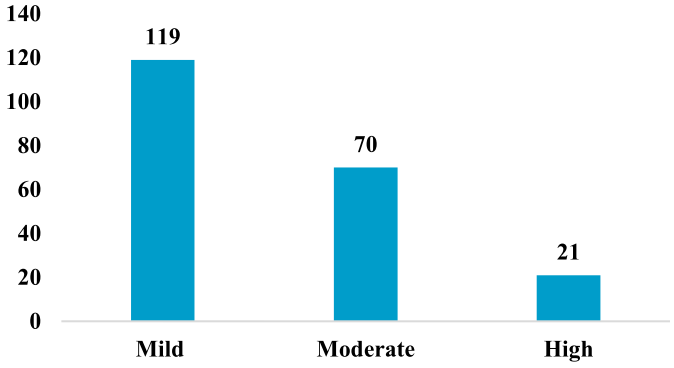

Figure 1: Frequency of Degree of Myopia

The educational environment in both public and private schools consists of components like the school type, classroom lighting (artificial and natural), outdoor activities and the use of digital learning aids like computers and tablets. Frequency followed by percentage calculations was used in a statistical analysis to evaluate

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these parameters. According to the participants' school type, 234 participants (37.68%) attend private schools, while 387 participants (62.31%) attend public schools (Figure 2).

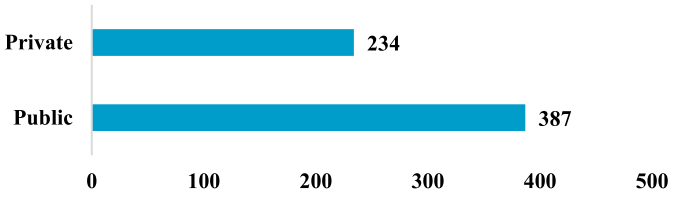

Figure 2: Frequency of School Type

Responses to the questionnaire about classroom lighting revealed significant variations between private and public schools. Regarding classrooms with adequate natural lighting, 231 public school respondents (59.61%) said "Yes," whereas 156 respondents (40.31%) said "No." Conversely, just 61 private school respondents (26.06%) selected "Yes," while 173 (73.94%) selected "No." Public schools revealed that 298 respondents (77.01%) lacked adequate artificial illumination, whereas 89 respondents (22.9%) had enough lighting for reading and writing. However, 189 replies (80.76%) indicated appropriate artificial illumination, compared to just 45 responses (19.23%) suggesting insufficient lighting, indicating a higher percentage of favourable responses in private institutions. Based on these findings, it has been discovered that private schools typically employ artificial lighting more effectively, using LEDs, bulbs and other contemporary lighting options. Public schools, on the other hand, frequently feature bigger, airier classrooms with wider windows that bring in more natural light (Table 1).

Table 1: Frequency of Classroom Lighting (Artificial and Natural)

Lighting Conditions		Private Schools	Public Schools
Adequate Natural Lighting	Yes	61 (26.06%)	231 (59.61%)
	No	173 (73.94%)	156 (40.31%)
Adequate Artificial Illumination	Yes	189 (80.76%)	89 (22.9%)
	No	45 (19.23%)	298 (77.01%)

There is a notable difference between public and private schools, according to survey data about outdoor physical activities or breaks during school hours. 180 participants (3–4 times a week) and 119 participants (greater than 30 minutes every day) in public schools reported routinely participating in outdoor activities. Comparatively, 91 private school participants participate in outdoor activities three to four times a week, compared to just 34 who do so for more than 30 minutes each day. Furthermore, 39 participants from public schools and 41 from private schools reported no outdoor activities at all, whilst 49 participants from public schools and 68 participants from private schools reported engaging in outdoor activities less frequently than once per week. According to these findings, private schools tend to engage in fewer outdoor activities than public schools, which may be owing to a lack of open areas or a preference for more digitalized learning environments (Figure 3).

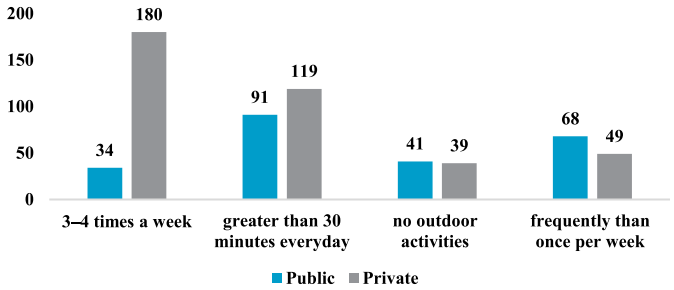

Figure 3: Frequency of Outdoor Physical Activities

Participants' daily usage of digital devices (such as computers and tablets) for learning differed between public and private institutions. 314 individuals (84.13%) from public institutions and 65 people (27.77%) from private institutions were among those who used digital devices for less than two hours a day. In contrast, 169 (72.22%) of participants who employed digital devices for more than two hours a day were from private institutions, while 73 (18.86%) were from public institutions. This suggests that private school learners are more likely than public school students to use digital devices for academic achievement (Table 2).

Table 2: Frequency of Daily Usage of Digital Devices for Educational Purposes

Lighting Conditions		Private Schools	Public Schools
Usage of Digital Devices (Such as Computers and Tablets)	Less Than Two Hours a Day	65 (27.77%)	314 (84.13%)
	More Than Two Hours a Day	169 (72.22%)	73 (18.86%)

According to findings, students attending private schools had a greater number of myopic cases than students attending public schools. This difference may be attributed to several factors, including reduced outdoor activities, increased use of digital devices such as computers and tablets and greater exposure to artificial classroom lighting with limited natural light. Out of the 210 myopic individuals identified, 109 (51.90%) were from private schools, while 101 (48.09%) were from public schools. A total of 621 participants were screened in the study, with 234 attending private schools and 387 attending public schools. Notably, 109 out of the 234 private school students (46.58%) were found to be myopic. The possible influence of the home study environment on myopia has been evaluated. This addressed whether or not participants regularly study or do their schoolwork at home, if a dedicated study room was available and the study area's ergonomic comfort (e.g., suitable chair and table) and ventilation quality. The amount of time spent using digital

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devices for non-educational purposes each day was also noted because extended usage of screens and near work may accelerate the development of myopia. Participants were asked if they had a specific area at home for studying that was well-ventilated and comfortable, with a suitable table and chair. 161 students (41.60%) from public schools and 171 students (77.07%) from private schools responded that they have a dedicated study space at home. However, 63 students (26.92%) from private colleges and 226 students (58.39%) from public institutions reported that they lacked a pleasant, defined study area at home (Table 3).

Table 3: Frequency of Myopic Individuals and Dedicated Study Room at Home

Variables		Public	Private
Frequency of Myopic Individuals	Myopic	101 (48.09%)	109 (51.90%)
	Non-Myopic	286	125
Dedicated Study Room at Home	Yes	171 (77.07%)	161 (41.60%)
	No	226 (58.39%)	63 (26.92%)

The amount of time spent studying or completing homework at home each day was an additional inquiry introduced to the participants. Among students attending public schools, 131 (33.85%) reported studying for more than three hours a day, while 256 (66.14%) reported studying for less than three hours. Comparably, 161 students (68.80%) in private schools reported studying for fewer than three hours a day, while 73 students (31.19%) said they studied for more than three hours (Table 4).

Table 4: Amount of Time Spent Studying or Completing Homework at Home

Amount of Time Spent		Private	Public
Studying or Completing Homework at Home	>3 Hours/Day	73 (31.19%)	131 (33.85%)
	<3 Hours/Day	161 (68.80%)	256 (66.14%)

The duration of time that participants spent using digital devices at home for purposes other than studying was a question that was asked of respondents. Among children attending public schools, 267 (68.99%) reported using digital devices for more than four hours a day, while 123 (31.78%) reported using them for less than four hours. While 189 students (80.76%) reported using digital gadgets for more than four hours a day, 45 students (19.23%) in private universities reported using them for less than four hours. The findings show that teenagers generally spend a significant amount of time on screens, indicating a growing trend in the use of digital devices by those in this age group (Figure 4).

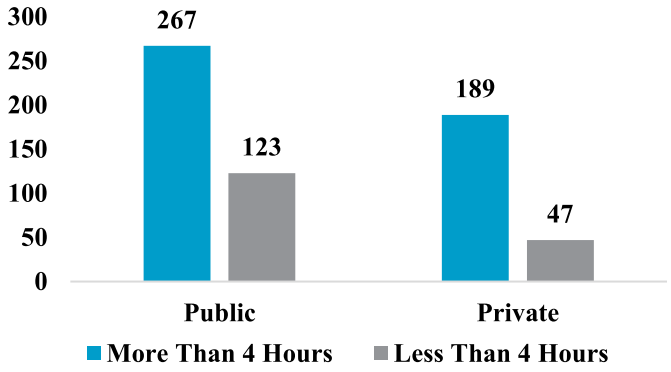

Figure 4: Frequency of Time Spent Using Digital Devices for Non-Educational Purposes

DISCUSSION

There were significant differences in the educational settings in the public and private sectors. Private schools tend to emphasize digital learning tools like computers and tablets, have more artificial lighting, and engage in fewer outside activities. On the other hand, public schools currently tend to provide more opportunities for outdoor play, rely less on technology, and use more natural light in their classrooms. Myopia has increased in prevalence as society has developed [18]. The development and progression of myopia are greatly impacted by outdoor activities, a lack of activity and excessive near work [19, 20]. By maximizing natural sunlight exposure, classroom design can significantly reduce myopia, according to a study by Wang *et al.*, [21]. Their study showed the advantages of architectural elements that increase daylighting, indicating that classrooms with sufficient illumination may lower the risk of myopia in school-age children. The study additionally determined that students in both private and public schools used digital devices for non-educational purposes for a considerable period. According to the study, a deeper comprehension of such behaviours may help us understand how myopia emerges. Reducing mobile phone use and overall screen time in schools is the main goal of current public health programs. Anti-addiction programs are a prime instance of a technology-based solution that supports these strategies. Healthcare providers have a crucial duty to evaluate children's screen-time patterns and offer evidence-based recommendations for treating and preventing myopia. Longitudinal studies that examine the combined effects of multiple environmental factors may help design more effective preventive strategies.

CONCLUSIONS

It was concluded that myopia is more likely to be caused by the private sector's educational environment than by the public sector's. This comprises fewer outdoor activities, artificial lighting in the classroom, and an excessive use of

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digital learning tools like computers and tablets. One of the contributing causes was the excessive amount of time spent daily using digital devices for non-educational purposes in both public and private settings, as prolonged screen time and close work may accelerate the development of myopia.

Authors Contribution

Conceptualization: MJ
Methodology: MJ
Formal analysis: FA
Writing review and editing: MJ, FR, SS, MMB, KMI

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

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Association of Screen Time and Headache and Its Impact on ADLs in Freelancers

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ABSTRACT

Freelancers are especially vulnerable to Cervicogenic headaches and migraines as a result of prolonged screen time because of inadequate cervical neck curvature and over-illumination. Persistent migraine and Cervicogenic headaches can have a significant impact on a person's activities of daily life. **Objectives:** To evaluate the relationship between screen time and headaches and their effects on activities of daily living. **Methods:** The data of 200 freelancers were collected within 3 months of age 18-45, and descriptive statistics and correlation analysis were done to explore the associations between screen time, headaches, and activities of daily living. Usually, throughout seven days, participants log their screen utilization in real-time or at regular intervals. **Results:** The mean age of participants was 25, with 77% of freelancers having Cervicogenic headaches and 23% Migraine, among which 25.5% had mild pain, 49.5% had moderate pain, and 25% had severe headaches. The HALDI score of 60.77% showed that freelancers had severe impairments in activities of daily living caused by migraine or Cervicogenic headaches. A p-value of 0.00 showed that screen time was significantly associated with headaches, and a p-value of 0.017 revealed a significant impact of headaches on freelancers' activities in daily life. **Conclusions:** It was concluded that screen time is significantly associated with headaches, and freelancers suffering from migraine or Cervicogenic headaches can have a severe impact on activities in daily life.

INTRODUCTION

Over the past three years, the worldwide market for electronic labor has expanded by almost 50% as millions of independent freelancers increasingly use online platforms to find work [1]. Music, typing, computer programming, website design, graphic design, photography, translation, editing, and other tasks are among the most popular marketing-related tasks performed by freelancers who perform eight hours a day of work [2]. According to a study, headaches were experienced by 65.72% of people who spent more than three hours in front of a screen [3]. According to studies, computer users are increasingly experiencing Cervicogenic headaches and neck pain, primarily as a result of poor sitting position [4]. In young adults, screen time was also linked to migraine [5]. According to the Global Burden of Disease Study 2017, migraine is an acute illness that impacts over 1 billion people globally [6]. A study found that, with no discernible difference in screen time, 25.2% of participants had migraine without aura, 23.0% had migraine with aura, 28.1% had tension-type headaches, 15.8% experienced a combination of headaches, and 7.9% had an unclassified headache [7]. Additionally, it was revealed that the

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prevalence of headaches linked to screen usage increased during COVID-19 [8, 9]. In general, those with migraine symptoms were able to carry out work and other social tasks, although they indicated that their headache episodes impacted their everyday life [10]. Furthermore, a considerable percentage of headaches in patients with cervical pathology may be related to migraine or primary headache disorders instead of Cervicogenic headache, and the prevalence of Cervicogenic headache in the general population was reported to be 0.17%. Cervicogenic headaches also often co-occur with migraine or medication overuse [11]. Cervicogenic headaches can have a major negative influence on a person's quality of life and productivity in their everyday life and at work [12]. The Biopsychosocial Model provides a useful framework to examine how physical (e.g., screen-induced neck strain), psychological (stress and fatigue), and social factors (work demands) converge to affect headache incidence and activities of daily living (ADLs) in freelancers [13]. Previous studies have shown that the increase in screen use has raised concerns about health impacts, notably headaches, which can affect the ADLs.

This study aims to examine the correlation between daily screen time with headache intensity, and the impact of headache severity on ADLs in freelancers. It highlighted the potential hazards of excessive screen time in the booming freelancing industry, as chronic headaches can significantly impact quality of life, productivity, and concentration. The study aims to provide recommendations for workplace improvement and reducing headache risk.

METHODS

A cross-sectional survey study was conducted after getting ethical approval from the institutional research board of the Medical Teaching Institution, Bacha Khan Medical College, Mardan, No. 515/BKMC. The study duration was June 2024 to December 2024. The patients' informed consent was taken before the data collection. A sample size of 200 freelancers was calculated based on power analysis for detecting a moderate correlation ($r \approx 0.3$) with 80% power and alpha level (commonly 0.05). Data were collected using non-probability convenience sampling during the period of three months after taking informed consent from the patients with Cervicogenic headaches and migraines, aged 18-45 years. Usually, throughout seven days, participants log their screen utilization in real-time or at regular intervals. The patients with Migraines were diagnosed using standard International Classification of Headache Disorders, 3rd edition (ICHD-3) Criteria [14], and the Cervicogenic headaches (pain starting from the neck and spreading to the oculo-frontal and temporal areas) were diagnosed using clinical tests [15], including a decrease in cranio-cervical flexion with decreasing craniovertebral angle [16]. The people with systemic diseases, past spinal problems, psychiatric disorders, or spinal procedures were removed from the study. Data collected includes demographics, screen time, pain type, and intensity using NPRS, aggravating or relieving factors, and ADLs using the HALDI score [17]. The HALDI and NPRS scales were pre-tested on 20 freelancers to interpret reliability using Cronbach's alpha values of 0.839 and 0.811, respectively. Data were analyzed using IBM SPSS V23.

RESULTS

In the study, 154 patients had Cervicogenic headaches, with a mean and SD of age 25.64 ± 6.70, whereas 46 patients had migraines, with a mean and SD of age 25.13 ± 5.92. 93 (46%) were female, and 107 (53%) were male, among whom 154 (77%) had Cervicogenic headaches and 46 (23%) had Migraines, as shown in table 1.

Table 1: Types of Headaches and Gender Distribution

Variables		Type of headache		Total
		Cervicogenic Headache	Migraine	
Gender	Female	64	29	93 (46%)
	Male	90	17	107 (53%)
Total		154 (77%)	46 (23%)	200

The devices used for freelancing are given in figure 1.

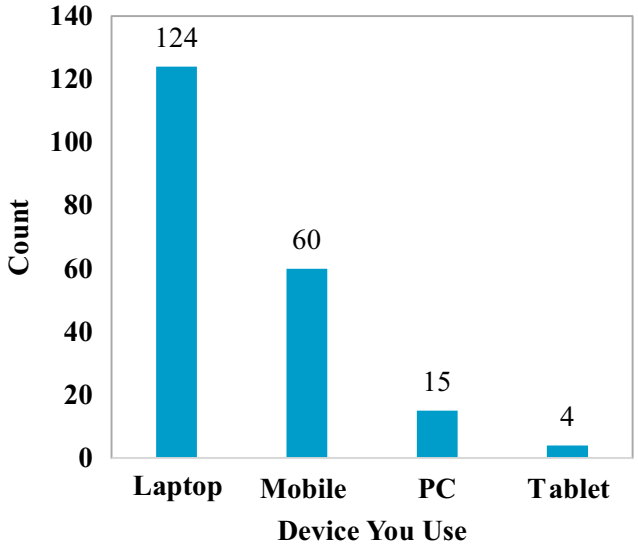

Figure 1: Devices Used for Freelancing

Screen time is depicted in Figure 2.

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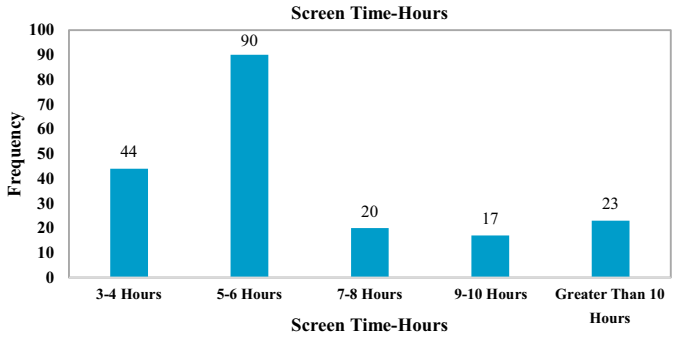

Figure 2: Screen Time (Hours)

The types of pain are illustrated in figure 3.

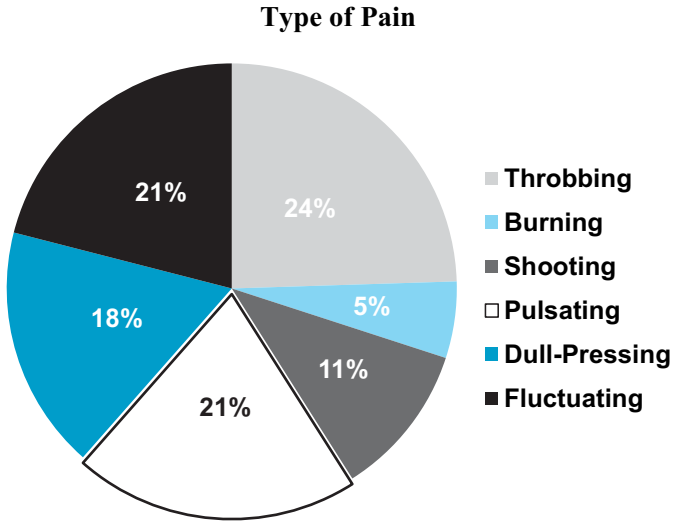

Figure 3: Types of Pains

Headache intensity for the participants were measured using the Numeric Pain Rating Scale (NPRS). The study showed that (121) 60.5% had their pain aggravated due to head movement, (79) 39.5% had their pain while staying long in a static posture, among which (131) 65.5% had pain relieved by rest and medicines, and (69) 34.5% had pain relieved only by taking medicines and shown in figure 4.

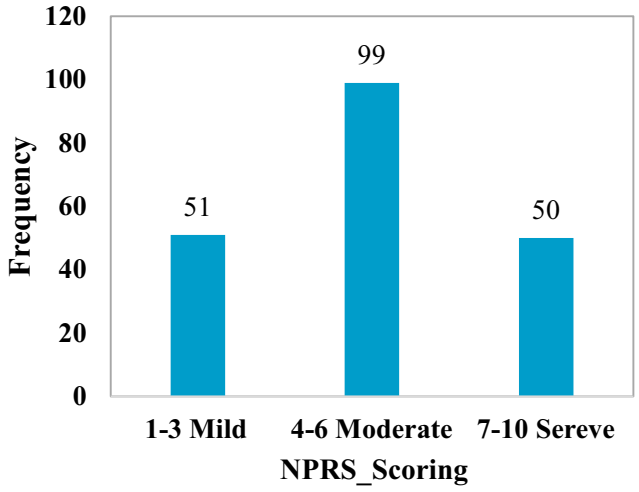

Figure 4: Headache Severity Using NPRS Scoring

For activities of daily living with headaches, the headache activities of daily living index (HALDI) was used, with a total score of 45, having nine questions (5 marks for each question). The score of 0-25% (0-11.25) mild, 26-50% (11.7-22.5) moderate, 51-75% (22.95-33.75) severe, 76-100% (34.2-45) complete impairments in activities of daily living. The HALDI score of 60.77% (27.35) falls into the "severe" group. The typical ratings for personal care, lifting, reading, sleeping, exercise, social activities, job, driving, and leisure range from 54.4% to 71.4%, as in table 2.

Table 2: Headache activities of daily living Index (HALDI)

Variables	n (%)	Mean ± SD	SD. Error Mean
Personal Care	200 (57.8%)	2.89 ± 1.129	0.080
Lifting Something	200 (54.4%)	2.72 ± 1.242	0.088
Reading from a Book or Device	200 (70.4%)	3.52 ± 1.252	0.089
Sleeping	200 (63.6%)	3.18 ± 1.275	0.090
Exercise	200 (55.2%)	2.76 ± 1.363	0.096
Social Activities	200 (60.2%)	3.01 ± 1.228	0.087
Work	200 (71.4%)	3.57 ± 1.217	0.086
Driving or travelling	200 (58.8%)	2.94 ± 1.210	0.086
Recreating Activities Like Sports, Fun, or Leisure	200 (55%)	2.75 ± 1.246	0.088
HALDI Total Score	200 (60.77%)	27.35 ± 6.642	0.470

The HALDI Score across the severity of Headache (NPRS) are represented in table 3.

Table 3: HALDI Score and Headache Severity (NPRS)

Descriptive	NPRSS Scoring	Statistic	SD. Error
HALDI Total Score (Mean ± SD)	1-3 (Mild)	25.55	1.080
		7.716	
	4-6 (Moderate)	27.66	0.603
		5.997	
	7-10 (Severe)	28.58	0.910
		6.434	

While results suggest that at the mean screen time of 5.42 hours, there was an average of 5 (NPRS) headache score, depicting that increased screen time causes an increase in headache in Freelancers and shown in figure 5.

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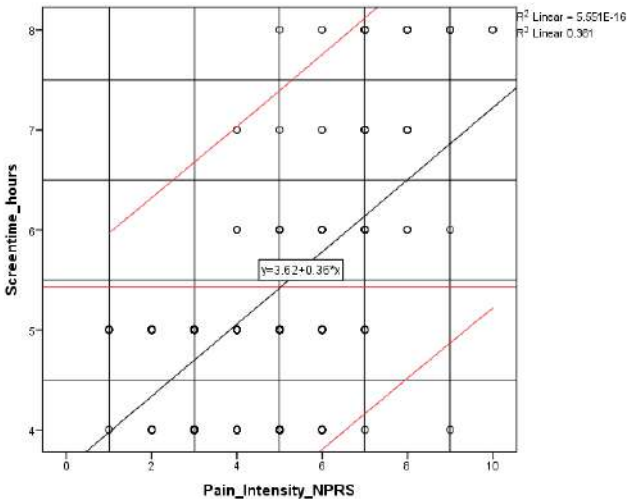

Figure 5: Correlation between Screen Time (Hours) and NPRS Score(95% CI)

The correlation analysis between the screen time and headache (NPRS) reveals a statistically significant positive relationship, with a Spearman's correlation coefficient of 0.562 (p=0.000). This indicates that as the screen time increases, individuals tend to report higher headaches, suggesting that greater screen time is associated with increasing headaches. The correlation analysis between the HALDI Total Score and Headache (NPRS) also reveals a statistically significant positive relationship, with a Spearman's correlation coefficient of 0.168 (p=0.017). This indicates that as pain intensity increases, individuals tend to report higher HALDI scores, suggesting that greater headache is associated with greater difficulties in daily activities, as shown in table 4.

Table 4: Correlation of Intensity of Headache with Screen Time and HALDI Score

Correlations			Pain Intensity NPRS
Spearman's rho	Screen Time Hours	Correlation Coefficient	0.562*
		Sig. (2-tailed)	0.000
		N	200
	HALDI Total Score	Correlation Coefficient	0.168*
		Sig. (2-tailed)	0.017
		N	200

*Correlation is significant at the 0.05 level (2-tailed)

DISCUSSION

The study results revealed that 77% of the participants suffered from Cervicogenic headaches, while 23% were diagnosed with migraines. Among the participants experiencing migraines, 25.2% experienced migraine with aura, 23% experienced migraine without aura, and others reported mixed headache types. Javed et al., highlighted reduced craniovertebral angles and impaired cervical flexion as underlying causes of Cervicogenic headaches among computer users [4,]. The significant exacerbation of headache with neck movements observed in the current study further supports these biomechanical theories. Among the migraineurs, 45% had throbbing or pulsatile pain, while 17.5% had dull pressing pain. Migraine-type headaches are triggered by static postures in freelancers who work in ergonomically suboptimal conditions. A previous study found that individuals with excessive computer use experience migraines with aura more frequently [3]. In another study, the majority of the participants (56.3%) reported no headaches, while 29.4% reported migraines, and a small number of participants also reported non-migraine headaches [5]. Freelancers are often devoid of ergonomically optimal workplaces, creating ideal scenarios for manifesting biomechanical and psychological stressors. Applying the biopsychosocial model helps us understand headache etiology in this cohort [13]. The study found that freelancers with a mean age of 25 were particularly prone to developing headaches, with daily screen time ranging from 3 to 10 hours, and 65.72% of the participants who had more than 3 hours of screen time [3]. Headache intensity and excessive screen time are positively correlated, with those having more screen time experiencing more headache symptoms [18] and higher intensity of pain [19]. Although the prevalence of Cervicogenic headache was greater in our study, a study found that increased exposure to screen time is more likely to be associated with migraine as compared to low screen time. The association was more pronounced in migraine without aura [5]. Meanwhile, another study found a significant association between screen time and migraine with aura in the pediatric population. Tension-type headache was reported by 28.1% of participants, 25.2% reported migraine without aura, 23% reported migraine with aura, while 15.8% and 7.9% reported mixed and unclassified headache, respectively [7]. The higher incidence of migraine could be attributed to participants' work-related stress and anxiety. Depression alone could increase the risk of moderate to severe migraine by 56%, while anxiety alone could increase this risk by 39%. Notably, the coexistence of both depression and anxiety could aggravate the symptoms further, with a 79% rise in risk [20]. In the current study, headache was found to be aggravated with head movement, while rest and medications alleviated pain. Pain intensity was quantified as per the numeric pain rating scale; the majority of the participants (49.5%) reported moderate pain, while 25% reported severe pain, indicating that a vast majority of the participants suffer moderate to severe pain due to excessive screen time. The current study also found a highly significant positive association between screen time and headache severity (Spearman's r=0.562, p=0.000), which aligns with the findings from Montagni *et al.*, and Roy et al., who reported increased migraine pain with increased

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screen time [5, 20]. The current study also highlights functional impairment due to screen time-related headaches, with average HALDI score placing most of the participants in the 'severe' impairment category. Ghaffar *et al.*, and Awaki *et al.*, reported that productivity loss and decreased quality of life were major consequences of chronic headaches [6, 21]. Headache-related functional disability has physical, psychological, and financial consequences, impacting the social, academic, professional, and personal lives of people [6]. Another study focusing on migraine-related disability found that 52.7% of participants had experienced disrupted sleep cycles, while 37.4% had severe mental impairment [21]. The study findings highlight the necessity for ergonomic education, behavioral adjustments, structured breaks, and the availability of a mental health support program. These measures are critical to preserving the well-being and productivity of the freelance workforce. The study limitations include a cross-sectional study design, which limits the causal inference, and reliance on self-reported data, which may introduce recall and reporting bias. Additionally, the non-probability sampling may limit the generalizability of the study findings. Further longitudinal and interventional studies could provide deeper insights into the causality and efficacy of ergonomic or behavioural interventions.

CONCLUSIONS

It was concluded that in addition to identifying a higher incidence of screen time-related headaches, the study revealed that Cervicogenic headaches are far more common than migraine among freelancers, and the higher screen time is significantly associated with headaches. The current study's findings also suggest that headaches have a negative impact on the activities of daily living of freelancers.

Authors Contribution

Conceptualization: SH
Methodology: SA, MT, AZ
Formal analysis: SA
Writing review and editing: SH, RSA, NQ

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

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