Research Article

The Changing Landscape of Clinical Chemistry in Pakistan: Roles, Training Experiences, and Career Pathways- a National Survey

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Keywords

Clinical Chemistry, Training, Leadership

Abstract

Background: Chemical pathology is a fast-growing field, with an even greater demand for pathologists in Pakistan. This study aims to evaluate the current landscape of FCPS-certified chemical pathologists in Pakistan, evaluating their training experiences and current leadership roles in their field.

Methods: This was a nationwide cross-sectional survey conducted of FCPS-trained chemical pathologists. The study was conducted via an online questionnaire (Google Forms) containing questions regarding the demographics, training experiences and current roles.

Results: A total of 82 respondents were included in the study and most of them were females (68%, n=56). Over half of the respondents were aged 31–40 years (51%). Most participants were from Punjab (57%) and were employed full-time (79%), primarily in government (38%) or private (43%) sectors. The majority worked in urban areas (89%), and the type of work setting varied significantly by gender ($p = 0.034$). 63% practised solely in chemical pathology, while 70% reported that their work involved other pathology disciplines as well. Research involvement was high overall (85%), with all male participants engaged in research compared to 79% of female participants ($p = 0.011$). The majority of the participants rated their training experience positively as either excellent (30%) or very good (29%).

Conclusion: FCPS-certified chemical pathologists are overall satisfied with their training experiences. This study highlights the need for structured mentorship and institutional support to strengthen the future chemical pathology workforce.

Introduction

Chemical pathology is an essential field of medicine that provides essential diagnostic and management tools for understanding and treating diseases through advanced biochemical analysis. Pathology supports clinical decision-making across various medical specialities, making it an indispensable component of modern healthcare [1]. In Pakistan, the discipline commonly referred to internationally as clinical chemistry is formally recognized as chemical pathology and is practiced and regulated under this nomenclature.

To complete postgraduate medical training in chemical pathology in Pakistan, the College of Physicians and Surgeons Pakistan (CPSP) primarily oversees and awards the Fellowship of the College of Physicians and Surgeons (FCPS) in this speciality [2]. Training programs are offered in major tertiary care teaching hospitals across the country, including the Aga Khan University Hospital, Armed Forces Institute of Pathology, Liaquat National Hospital, and Dow University of Health Sciences, among others. These programs typically span four to five years and are structured to provide residents with comprehensive exposure to all aspects of laboratory medicine, including clinical biochemistry, endocrinology, toxicology, immunology, and quality management systems. The CPSP curriculum emphasises competency-based training, incorporating both formative and summative assessments, and some tertiary care centres, such as the Aga Khan University, have recently integrated workplace-based assessments (WBAs) and structured feedback systems to enhance clinical and professional development [3]. Globally, laboratory medicine is undergoing rapid transformation with expanded consultative, leadership, and academic roles for clinical chemists, making workforce evaluations increasingly relevant.

Chemical pathology as a structured subspecialty of pathology in Pakistan developed through postgraduate fellowship training programs accredited by CPSP. Formal FCPS training in chemical pathology was initiated primarily through military academic institutions, particularly the Armed Forces Institute of Pathology (AFIP), which served as the earliest training centre. The first formally trained chemical pathologists in Pakistan graduated in the early 1990s, since then, the specialty has expanded into multiple academic and private sector institutions across the country.

The number of qualified chemical pathologists in Pakistan remains relatively small reaching the 100 landmark a few years ago and now approximately 200, because training positions were limited and concentrated in a small number of accredited centres, resulting in a small professional community compared with other pathology disciplines. This limited workforce makes national surveys particularly valuable for understanding professional experiences and training needs. Despite the expanding responsibilities, limited empirical data exist regarding how FCPS-certified chemical pathologists in Pakistan perceive their training and define their current professional roles. Furthermore, variations in training experiences, institutional resources, and assessment practices across teaching hospitals may contribute to inconsistent preparedness among graduates. This study seeks to bridge this knowledge gap by systematically assessing the careertrajectories, professional roles, and perceived competencies of FCPS-certified chemical pathologists, thereby providing evidence to strengthen future training and workforce planning in laboratory medicine.

Materials and Methods

This was a cross-sectional, questionnaire-based study conducted among chemical pathologists who had obtained the Fellowship of the College of Physicians and Surgeons Pakistan (FCPS) in Chemical Pathology. This nationwide study was conducted via a circulating Google Forms questionnaire containing questions regarding current practices. The survey was conducted between July to August 2025. The approximate number of FCPS-trained Chemical Pathologists is estimated to be around 200.

Study Population and Sampling

The study included FCPS-certified Chemical Pathologists who were practicing in Pakistan or abroad, as well as retired FCPS Chemical Pathologists. Individuals currently undergoing FCPS training were excluded from participation. Additionally, responses with incomplete questionnaire data were excluded from the final analysis to ensure data completeness and reliability. The sampling approach was convenience-based, using digital survey dissemination through professional networks and institutional mailing lists of pathology professionals. Participation was voluntary and anonymous, with no financial incentives.

Data Collection Tool

Data were collected using a structured, self-administered online questionnaire developed in Google Forms. The Google Forms link was piloted with three senior consultants and revisions were made based on their feedback to ensure clarity and comprehension. Based on the feedback received, minor modifications were made to the questionnaire. Responses obtained during the pilot phase were excluded from the final analysis**.** The survey was then circulated through alumni WhatsApp group. The survey included the following sections: demographic characteristics (age group, province of residence, year of graduation, and year of FCPS-II completion), educational background (medical school, institution of FCPS training, additional academic qualifications), employment details (current designation, organization, work sector, type of work setting, job relation to chemical pathology, and involvement in other pathology disciplines), International practice and professional affiliations (membership in PSCP, IFCC, AACC, or CAP; participation in PSCP conferences; working outside Pakistan), research and academic engagement (involvement in publications, year of latest publication, publication index category), training evaluation using Likert-scale items assessing mentorship quality, lab management exposure, research opportunities, professional growth, and confidence/leadership development during FCPS training and overall satisfaction with the training program.

Data Analysis

Responses were exported to IBM SPSS Statistics (Version 26) for analysis. Descriptive statistics (frequencies, percentages) were calculated for categorical variables. Associations between categorical variables (e.g., gender, research involvement,

indexcategory, training evaluation scores) were tested using the Fisher's exact test, with $p < 0.05$ considered statistically significant.

Ethical Considerations

The survey questionnaire was approved by the Pakistan Society of Chemical Pathologist (PSCP) for ethical considerations. As this study involved healthcare professionals only and no patient data, formal institutional review board approval was not required. Participation was voluntary, and respondents provided informed consent before completing the survey. No identifying personal data were collected. To ensure data accuracy, all entries were double-checked, and discrepancies were resolved through cross-verification with source records by two independent reviewers.

Results

Participant Demographics and Practice Characteristics

A total of 82 respondents (56 females, 26 males) were included in the study. There was a gender difference that appeared, with most of the respondents in our study being females (p=0.049). Given the relatively small number of practicing chemical pathologists and trainees in Pakistan, this represents a substantial proportion of the national professional community. The majority of participants (51%) were between 31 and 40 years of age and graduated between 2010 and 2020 (56%). Most of the participants were based in Punjab (57%) and their educational backgrounds were varied, with AFIP Rawalpindi (32%) and Quaid-e-Azam Medical College (17%) contributing the highest number of FCPS-trained chemical pathologists. The majority of respondents were full-time employed (79%), mainly in government (38%) and private (43%) sectors, and a few in armed forces (12%), academia (4%) and self-employed (4%). Females were employed more in the government sector (41%) as compared to males (31%); however, the association was not significant. (p = 0.47). All the respondents who were self-employed were females. *(*Figure 1*)* Most of the respondents were working largely in urban settings (89%), and the type of work setting differed significantly by gender (p=0.034). Many of the respondents were employed full-time (79%), while 13% reported working part-time.

Regarding current positions, the majority held academic or consultant-level roles, with the most frequently reported designations being Assistant Professor (24%) and Consultant Chemical Pathologist (23%). For most respondents (73%), their current employment was directly related to chemical pathology. (Table 1) While 63% reported practising exclusively in chemical pathology, 70% indicated that their professional responsibilities also encompassed other pathology disciplines.

Research and Academic Engagement

Over half (55%) had additional health professions education training. Research involvement was notably high (85%), with all male participants contributing to research compared to 79% of females (p = 0.011). Publication activity peaked during 2024–2025, accounting for 64% of recent outputs. The index category (≥75), reflecting higher research output or quality, was significantly more frequent among participants as determined byFisher's exact test (p=0.018). One-third (32%) were members of international organisations (CAP, IFCC, AACC, etc.), with females being more involved.

Overall Training Satisfaction and Individual Training Components

Overall, respondents rated their FCPS training experience positively, with 30% rating it excellent, 29% as very good, 30% as good and 9% as fair. Most participants rated their academic and professional mentorship provided by the faculty as excellent (40%) or very good (35%) and there was no statistically significant difference across groups. In terms of confidence and leadership development during FCPS training, most participants reported very good (34%) or excellent (39%) improvement. Laboratory skills were rated as very good or excellent by 81% of participants. Ratings for laboratory management exposure were lower, with 69% describing it as very good or excellent. Male respondents were more likely to rate their laboratory management exposure favourably, although this difference did not reach statistical significance (p=0.065). Gender differences were significant in graduation year (p=0.049), work setting (p=0.034), research involvement (p=0.011), and index category (<75 vs ≥75) (p =0.018). For most other factors, such as employment, designation and training quality, no significant gender effect was observed.

Composite Domain Analysis of Training Experience

To provide a more integrated assessment of training experiences, Likert-scale items were grouped into composite domains. The Training Quality domain (laboratory skills, confidence, and leadership development) demonstrated consistently high scores across respondents, with an overall mean score of approximately 4.1 out of 5. The Academic Mentorship and Research domain (faculty mentorship, research opportunities, and professional growth support) also showed high overall ratings (mean ≈ 3.9–4.0 out of 5) as depicted in Table 2 where values are presented as mean ± standard deviation. Differences between genders were not statistically significant.

In contrast, the Laboratory Management Exposure domain consistently scored lower than other domains across all respondent groups, indicating a relative gap in management and administrative training. Gender-based comparisons showed slightly higher mean scores among male respondents across domains. The heat map further illustrated clear patterns across composite domains, with stronger training and mentorship scores among research-active respondents and persistently lower laboratory management exposure across demographic groups (Figure 3).

Graduation Cohort–Based Trends

When respondents were stratified by graduation cohort (pre-2010, 2010–2019, and ≥2020), a trend toward progressively higher training satisfaction and mentorship scores was observed among more recent graduates. Respondents graduating in 2020 or later reported the highest mean scores for both Training Quality and Academic Mentorship domains, while those graduating before 2010 reported comparatively lower scores.

These findings suggest gradual improvement in FCPS training structure and educational support over time, potentially reflecting increased emphasis on structured assessments, mentorship, and competency-based training approaches in recent years as shown in Figure 2.

Association Between Research Involvement and Training Outcomes

Respondents actively engaged in research demonstrated higher perceived training quality and stronger academic mentorship experiences compared to those not involved in research. Research-active participants reported higher mean scores for the Training Quality domain (4.13 vs 3.88) and the Academic Mentorship and Research domain (4.00 vs 3.50).

Table 1: Demographics of FCPS-trained chemical pathologists in Pakistan.

	Total	Female	Male
	N=82	N=56	N=26
Age Group	Age Group	Age Group	Age Group
31-40	42 (51%)	30 (54%)	12 (46%)
41-50	23 (28%)	16 (29%)	7 (27%)
51-60	7 (9%)	6 (11%)	1 (4%)
≥60	8 (10%)	2 (4%)	6 (23%)
Graduation year	Graduation year	Graduation year	Graduation year
1978-1988	6 (8%)	1 (2%)	5 (21%)
1999-2009	25 (35%)	17 (35%)	8 (33%)
2010-2020	40 (56%)	29 (60%)	11 (46%)
≥ 2021	1 (1%)	1 (2%)	0 (0%)
Province of residence			
Balochistan	1 (1%)	0 (0%)	1 (4%)
Gilgit Baltistan	1 (1%)	0 (0%)	1 (4%)
KPK	6 (7%)	3 (5%)	3 (12%)
Outside Pakistan	5 (6%)	5 (9%)	0 (0%)
Pakistan (Province not disclosed)	3 (4%)	2 (4%)	1 (4%)
Punjab	47 (57%)	33 (59%)	14 (54%)
Sindh	19 (23%)	13 (23%)	6 (23%)
Institution where FCPS chemical pathology training was completed?	Institution where FCPS chemical pathology training was completed?	Institution where FCPS chemical pathology training was completed?	Institution where FCPS chemical pathology training was completed?
AFIP, Rawalpindi	26 (32%)	11 (20%)	15 (58%)
Chughtai institute of pathology, Lahore	3 (4%)	2 (4%)	1 (4%)
CMH Lahore	4 (5%)	3 (5%)	1 (4%)
CMH Malir Cantt, Karachi	2 (2%)	2 (4%)	0 (0%)
DIMC, Ojha Campus, Karachi	1 (1%)	0 (0%)	1 (4%)
Dr. Ziauddin medical university & hospital	3 (4%)	2 (4%)	1 (4%)
Indus Hospital, Karachi	1 (1%)	1 (2%)	0 (0%)

	Total	Female	Male
Liaquat national hospital	2 (2%)	2 (4%)	0 (0%)
Nishtar Hospital, Multan	1 (1%)	1 (2%)	0 (0%)
PNS Shifa	2 (2%)	2 (4%)	0 (0%)
Current employment status	Current employment status	Current employment status	Current employment status
Employed full-time	65 (79%)	41 (73%)	24 (92%)
Employed part-time	11 (13%)	9 (16%)	2 (8%)
Homemaker	1 (1%)	1 (2%)	0 (0%)
In Training	1 (1%)	1 (2%)	0 (0%)
Not Employed	2 (2%)	2 (4%)	0 (0%)
Visiting Faculty	1 (1%)	1 (2%)	0 (0%)
Current designation	Current designation	Current designation	Current designation
APWMO	4 (5%)	4 (7%)	0 (0%)
Assistant Professor	20 (24%)	15 (27%)	5 (19%)
Associate Professor	3 (4%)	2 (4%)	1 (4%)
CEO/Principal/Professor	1 (1%)	0 (0%)	1 (4%)
Chemical Pathologist	1 (1%)	1 (2%)	0 (0%)
Consultant	19 (23%)	15 (27%)	4 (15%)
HOD	5 (6%)	1 (2%)	4 (15%)
Pathologist	6 (7%)	5 (9%)	1 (4%)
Type of work setting	Type of work setting	Type of work setting	Type of work setting
Rural	3 (4%)	0 (0%)	3 (12%)
Semi-Urban	6 (7%)	4 (7%)	2 (8%)
Urban	73 (89%)	52 (93%)	21 (81%)

**Percentages are calculated column-wise within gender categories unless otherwise stated. Percentages may not total 100% due to rounding. APWMO: Assistant Professor / Women Medical Officer.*

Figure 1: Comparison between the current employment sector stratified by gender.

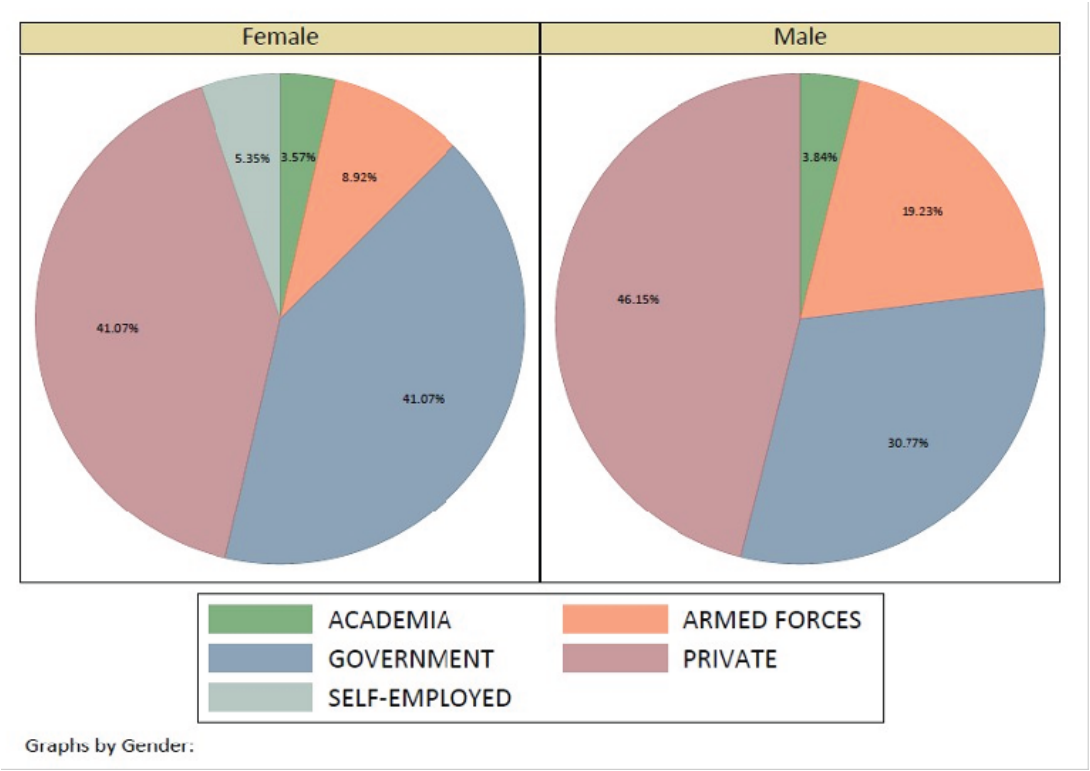

Figure 2: Training quality and academic mentorship score across graduation cohorts.

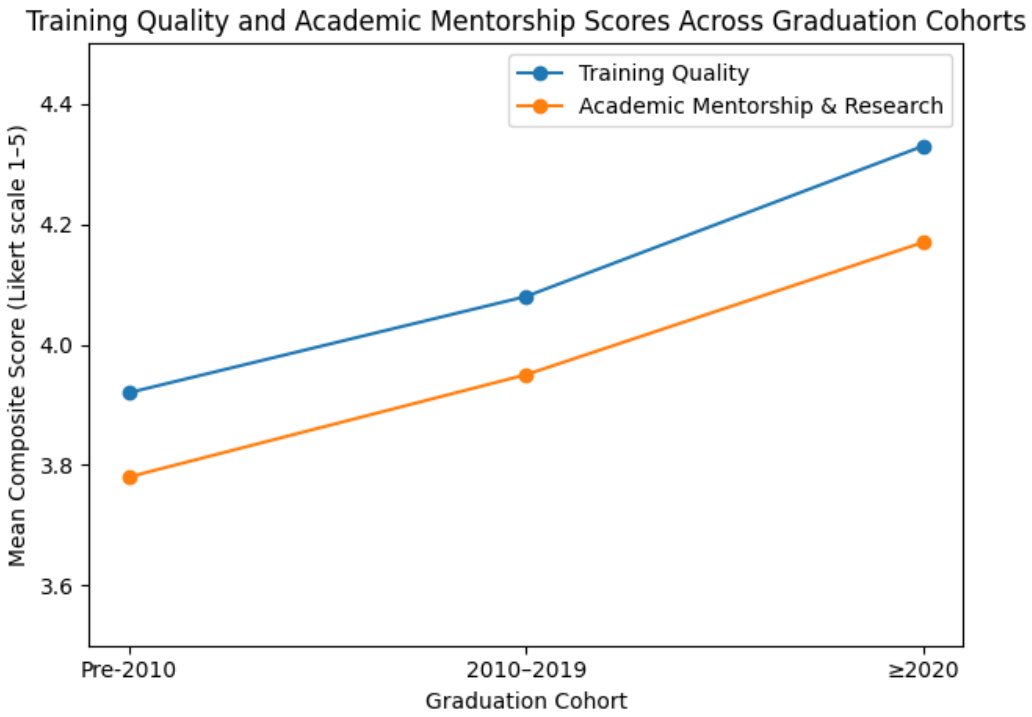

Figure 3: Heat map of composite training domain scores by gender and research involvement.

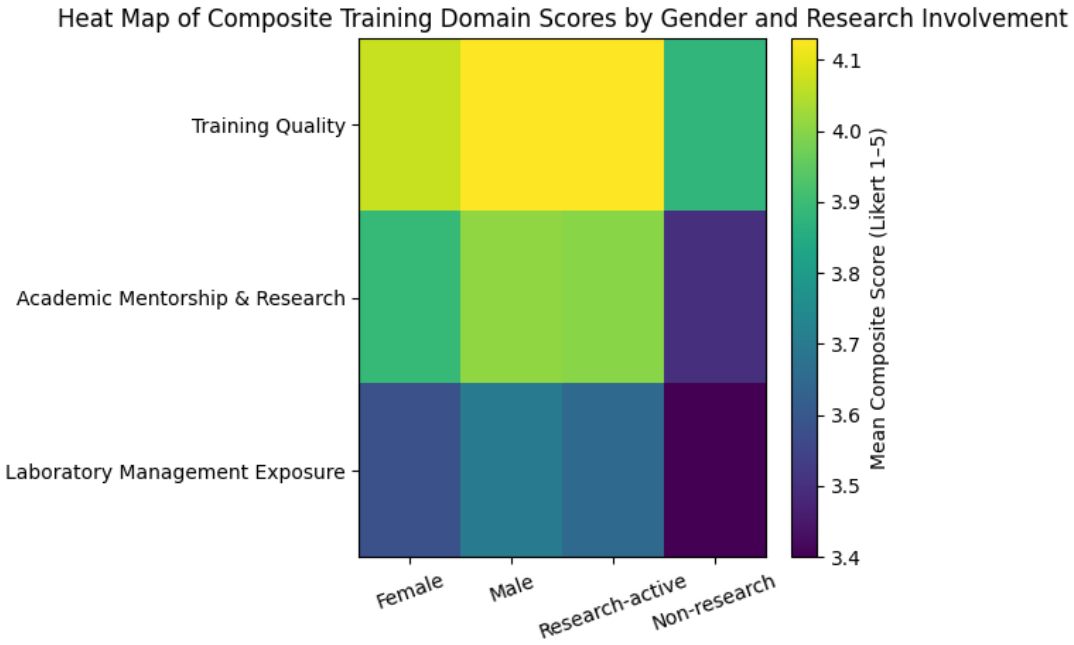

Table 2: Composite Domain Scores of FCPS Training Experience (Likert scale: 1 = very poor, 5 = excellent).

Composite domain	Total (N = 82) Mean ± SD	Female (n = 56) Mean ± SD	Male (n = 26) Mean ± SD
Training Quality*	4.10 ± 0.52	4.07 ± 0.54	4.13 ± 0.49
Academic Mentorship & Research†	3.95 ± 0.60	3.89 ± 0.62	4.01 ± 0.57
Laboratory Management Exposure‡	3.62 ± 0.71	3.58 ± 0.73	3.71 ± 0.63

**Training Quality domain includes laboratory skills, confidence development, and leadership development. †Academic Mentorship & Research domain includes faculty mentorship, research opportunities, and professional growth support. ‡Laboratory Management Exposure domain includes exposure to laboratory administration and management responsibilities.*

Discussion

This cross-sectional study provides an overview of the training and current practices among FCPS-certified chemical pathologists in Pakistan. A higher proportion of responses were obtained from early- and mid-career professionals. This likely reflects greater engagement of younger consultants and trainees with digital communication platforms through which the survey was distributed. Senior consultants, particularly those in administrative or leadership roles, may be less active on social media or electronic survey platforms, leading to under-representation. In addition, the specialty of chemical pathology in Pakistan has expanded primarily over the past three to four decades, and historically only a limited number of training positions were available; consequently, the number of senior practitioners is relatively small compared with the growing cohort of recently trained specialists. Similar response patterns have been reported in other web-based physician surveys. Our study revealed that there is a female predominance, comprising nearly two-thirds of the respondents, which is consistent with the literature that pathology is a female-dominant speciality with thethird-greatest female-to-male proportion of any medical speciality [3]. A study by Samkari et al. reported that female medical students showed more interest in pursuing pathology as compared to their male counterparts [4]. Pathology is well sought after by women due to the reduced number of working hours, fewer on-call responsibility and the flexibility [5]. Most respondents in our study were based in urban centres, consistent with previous reports of uneven distribution of specialists across Pakistan [6]. This disparity stems from the lack of resources, proper living conditions and opportunities and personal career advancement in the rural areas, forcing physicians to work in urban centres [7]. Expanding postgraduate training and employment opportunities in under-represented provinces may help address regional workforce imbalances. Interestingly, our study revealed that females were the only ones working in the self-employed sector. This may reflect the limited availability of flexible institutional positions for women in this speciality in Pakistan, prompting some to pursue independent practice or a preference for self-directed work environments that accommodate personal and family responsibilities. Most of therespondents were employed full-time and pursuing their

careers, highlighting the ever-growing need for chemical pathologists in Pakistan.

Research involvement was notably high (85%), with all male participants contributing to research compared to 79% of females ($p = 0.011$). This imbalance could be associated with differential access to mentorship and institutional support for female residents [8.9]. Evidence has shown that institutional support and structured research exposure during residency play an important role in empowering and fostering a culture of academic excellence, ultimately helping the residents in career preparation [10]. Encouraging structured research mentorship and equitable access to research infrastructure could therefore help bridge this gender gap. These findings provide evidence to inform CPSP and training institutions on targeted improvements in mentorship and leadership development.

More than half of the participants had additional qualifications in health professions education, suggesting a strong interest in academic and pedagogical development. This trend aligns with the evolving role of chemical pathologists as both educators and consultants, integrating laboratory science with clinical decision-making [11]. The majority of respondents reported high satisfaction with their FCPS training experience and mentorship quality, reflecting the strength of the College of Physicians and Surgeons Pakistan (CPSP) training framework. This is in contradiction to the finding reported by Mahmood et al. that most of the postgraduate trainees were not satisfied with the facilities and mentorship regardless of the training specialities [12]. High ratings in laboratory skills, confidence, and leadership development suggest that current training programs are effectively equipping trainees for independent professional roles. The composite domain analysis provides a more nuanced understanding of FCPS training experiences and highlights important strengths and gaps within current training frameworks. While overall training quality and academic mentorship were rated highly, the consistently lower scores for laboratory management exposure suggest an area requiring targeted enhancement [13]. Similar gaps in management and administrative training have been reported internationally and may limit preparedness for leadership roles in laboratory medicine. The observed improvement in training and mentorship scores among more recent graduates further supports the notion of a progressively evolving FCPS training structure, likely reflecting the increasing incorporation of structured assessments, competency-based education, and formal mentorship models. Collectively, these findings emphasize the need to strengthen laboratory management training and research mentorship within postgraduate chemical pathology programs to ensure comprehensive workforce development.

Although detailed income data were not formally collected in this survey due to sensitivity and anticipated response bias, anecdotal and institutional observations suggest differences between public and private sector employment. In Pakistan, public sector consultants often have structured pay scales with greater job security but limited financial incentives, whereas private sector positions may offer higher compensation but with greater workload variability and performance-based expectations. Thesedifferences may influence career preferences and job satisfaction but require a dedicated workforce economic study to evaluate objectively. Future studies focusing specifically on compensation, job security, and workload distribution across laboratory specialties would be valuable.

This study has several limitations. The participation bias is possible, with respondents more involved in research being more likely to respond. The response rate could not be formally calculated because the survey was disseminated through professional networks and alumni messaging platforms; therefore, the true denominator of eligible participants could not be ascertained, introducing a potential risk of non-response bias. Nevertheless, despite these limitations, our study is one of the only few studies evaluating the current practices and roles in the under-represented, evolving profession of chemical pathology in Pakistan. It underscores the importance of equitable gender participation, structured research mentorship, and continuous professional development in laboratory medicine. Future studies could explore longitudinal outcomes of FCPS trainees, including career trajectories, academic productivity, and international collaborations, to guide evidence-based reforms in postgraduate medical education.

Conclusion

This study highlights the evolving landscape of chemical pathology in Pakistan, characterised by strong female representation, high research engagement, and overall satisfaction with FCPS training. The findings emphasise the need to strengthen institutional support for research activities, especially for women, and promote equitable opportunities for mentorship and leadership, which would further prepare chemical pathologists for leadership roles in clinical diagnostics and academia. Future initiatives should focus on benchmarking local training outcomes against international standards and fostering global collaborations to further strengthen the role of chemical pathologists in clinical care, research, and education.

Ethical Consideration

The survey questionnaire was approved by the Pakistan Society of Chemical Pathologist (PSCP) for ethical considerations. Participation was voluntary, and respondents provided informed consent before completing the survey. No identifying personal data were collected.

Funding

None.

Conflicts of Interests

All authors declare no conflicts of interests.

Author Statements

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Imran Siddiqui: Methodology, Data curation, Writing – review & editing.

Data Availability Statement
Anonymized Data is available on request from the corresponding author.

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