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Exploring Community Pharmacists' Knowledge, Attitudes, And Perceptions Towards Pharmacovigilance: A Cross-Sectional Study

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ABSTRACT

Background: Adverse Drug Reactions (ADRs) pose a significant public health concern, and effective pharmacovigilance is crucial for ensuring drug safety. Community pharmacists are vital in detecting and reporting ADRs as frontline healthcare professionals. However, their knowledge, attitudes, and practices (KAP) regarding pharmacovigilance in India need thorough evaluation, especially given the low ADR reporting rates despite the presence of the Pharmacovigilance Programme of India (PvPI). Objectives: This study aimed to assess the knowledge, explore the attitudes, and identify factors influencing the knowledge and attitudes of community pharmacists towards pharmacovigilance concepts, regulations, and reporting procedures in Anantapur, Andhra Pradesh, India. Methodology: A cross-sectional survey was conducted using a self-administered, validated questionnaire among 119 community pharmacists selected via convenient sampling. The questionnaire assessed knowledge (7 questions), attitudes (6 questions), and perceptions (7 questions) related to pharmacovigilance, along with demographic information. Data were analysed using descriptive statistics and chi-square tests with GraphPad Prism 7.0. Ethical approval was obtained. Results: The majority of participants were male (74.8%) and aged 21–35 years (63.0%), with diploma holders forming the largest educational group (54.6%). The mean knowledge (4.2/7) and attitude (3.8/6) scores indicated moderate competency, while perception scores were higher (5.1/7). Higher education levels significantly correlated with better knowledge ($p=0.002$*), and training positively influenced attitudes ($p<0.01$). An inverted U-curve relationship was observed between work experience and knowledge ($p=0.03$*). Qualification level and training were strong positive predictors of overall KAP scores in multivariate analysis. Conclusion: Community pharmacists in this South Indian region possess moderate knowledge and attitudes towards pharmacovigilance, with a more positive perception. Educational attainment and training are key determinants of their competency. Targeted educational interventions, simplified reporting mechanisms, and a supportive work environment are crucial to enhance their active participation in the national pharmacovigilance system and improve patient safety.

Keywords: *Pharmacovigilance, Community Pharmacists, Knowledge, Attitudes, Perceptions, Adverse Drug Reactions, India.*

1. INTRODUCTION

The safety of medications is a cornerstone of effective healthcare systems worldwide. Pharmacovigilance, the science and activities relating to detecting, assessing, understanding, and preventing adverse effects or any other drug-related problem, plays a pivotal role in safeguarding public health. This encompasses a comprehensive range of activities to monitor the impact of pharmaceutical products throughout their lifecycle, from the initial stages of pre-marketing clinical trials to ongoing post-marketing surveillance.[1,2] Adverse Drug Reactions (ADRs) represent a significant burden on public health and place considerable strain on healthcare systems.[3] These reactions are a significant cause of both illness and death, frequently ranking among the leading causes of mortality in various studies.[3] Furthermore, ADRs contribute to a rise in hospital admissions, often lead to prolonged stays within healthcare facilities, and impose a substantial economic burden on healthcare systems and individual patients.[3] The issue is further complicated by the widespread underreporting of ADRs, which can significantly delay the identification of potential safety concerns and impede the implementation of appropriate regulatory measures.[4] The considerable financial implications of ADRs, with global costs, highlight the economic necessity for robust pharmacovigilance practices.[5] Moreover, a notable percentage of ADR-related hospitalizations are preventable, underscoring effective pharmacovigilance's potential to alleviate this burden.[6] The preventability of a significant portion of these events indicates that a more proactive and all-encompassing pharmacovigilance system could result in substantial improvements in patient outcomes and a more efficient allocation of healthcare resources.

There is a need to look into the role of community pharmacists in monitoring drug safety, especially in India. Community pharmacists are often the first contact for seeking health advice and medications. They frequently interact with patients without prior medical checks, allowing them to notice and report potential drug-related problems, including issues from self-medication and traditional medicine use. Their accessibility in a large and diverse country like India is vital for enhancing the national drug safety monitoring system. The practice of community pharmacy in India has changed significantly over the years. In the 20th century, pharmacists shifted from making medications to dispensing ready-made products. This change led to a re-evaluation of pharmacists' roles, as their traditional skills became less important in the evolving healthcare environment. The role of pharmacists is now broadening, focusing more on patient care, reflecting the profession's adaptation to the healthcare system's needs.[7-9] Community pharmacists in India mainly focus on dispensing medications, either through prescriptions or over-the-counter requests. However, there is increasing awareness that they can offer more patient-oriented services. These services may include advising patients on medication use, dosage, storage, and side effects. Innovations like home medication dispensers and telepharmacy are leading to a future where pharmacists can provide remote care and consultations. This shift aligns with a global trend towards more patient-centred pharmacy practices, called pharmaceutical care, which allows pharmacists to incorporate pharmacovigilance into their responsibilities, improving medication safety. Despite these opportunities, pharmacists in India face challenges, including education, regulation, public perception, and professional recognition, which hinder their ability to enhance pharmacovigilance in healthcare.[8,10-11]

Recognising the critical importance of ensuring medication safety, the Indian government established the Pharmacovigilance Programme of India (PvPI) in 2010.[12] This nationwide program operates under the purview of the Central Drugs Standard Control Organization (CDSCO), which is part of the Ministry of Health & Family Welfare.[12] The Indian Pharmacopoeia Commission (IPC), located in Ghaziabad, serves as the National Coordination Centre (NCC) for the PvPI, playing a central role in its operations.[12] The primary objectives of the PvPI are to systematically monitor ADRs that occur within the Indian population, to enhance the overall safety of medicines available in the country, and to ultimately ensure that the benefits of using these medicines significantly outweigh any associated risks.[3] To achieve these goals, the PvPI aims to develop and maintain a comprehensive nationwide system for reporting and monitoring medicine safety, to identify and thoroughly analyse any new signals that may emerge from reported cases, and to effectively communicate crucial safety information regarding the use of medicines to all relevant stakeholders within the healthcare ecosystem.[13] Within the Indian healthcare system, the CDSCO plays a crucial role in coordinating the PvPI, which is the primary mechanism for monitoring and evaluating ADRs that occur within the country.[14] By overseeing the PvPI, the CDSCO ensures that patient safety remains a top priority and facilitates the effective management of risks associated with pharmaceutical products available in the Indian market.[14] This involves the systematic collection, thorough analysis, and careful interpretation of data related to ADRs, which enables the CDSCO to identify potential safety issues and to take appropriate regulatory actions when necessary. These actions can include issuing timely safety alerts to healthcare professionals and the public, as well as updating the labelling information for specific drugs to reflect the latest safety findings.[15]

Despite the establishment and ongoing efforts of the PvPI, the rate at which ADRs are reported in India remains notably low.[7] Current estimates suggest that the ADR reporting rate in India is below 1%, which is significantly lower than the global average of approximately 5%.[7] This substantial underreporting is a major concern for the Indian healthcare system as it impedes the effective monitoring of drug safety and delays the timely detection of potential risks associated with medications.[4] While India's contribution to the WHO global Individual Case Safety Reports (ICSRs) database is around 3%, this still indicates a considerable need for improvement in capturing and reporting ADRs that occur within the country.[16] This persistent low reporting rate poses a significant challenge for the Indian pharmacovigilance system, as it affects the reliability of drug safety data and can hinder the ability of regulatory authorities to make well-informed decisions to protect

public health. Addressing the various factors that contribute to this underreporting is therefore a critical priority for ensuring the safety of medicines used by the vast and diverse population of India. This study aims to evaluate Indian community pharmacists' knowledge and attitudes towards pharmacovigilance, including their understanding of concepts and reporting, their willingness to report ADRs, and the barriers they face. It will also identify demographic and educational factors influencing their PV knowledge and attitudes.

2. METHODOLOGY

Study Design: A cross-sectional survey was conducted among community pharmacists.

Study Duration: Three months.

Study Setting: This cross-sectional study explored community pharmacists' knowledge, attitudes, and perceptions (KAP) towards pharmacovigilance. Data were collected from community pharmacists practising in Anantapur, Andhra Pradesh.

Sampling: Convenient sampling, a non-probability sampling method, was adopted and a total of 119 responses were obtained.

Questionnaire Development and Validation: A self-administered questionnaire was adopted and further developed based on a comprehensive literature review to address the study objectives. The questionnaire comprised three main sections assessing knowledge (7 multiple-choice questions), attitudes (6 questions), and perceptions (7 questions) regarding pharmacovigilance. Demographic information was collected in a separate section. To ensure clarity and ease of administration, some questions from the original questionnaire were rephrased. The final version of the questionnaire underwent face and content validation by a panel of six community pharmacists and four pharmacy academicians. The internal consistency of the questionnaire was assessed using Cronbach's alpha, which demonstrated good reliability ($\alpha \approx 0.8$).

Data Collection: Community pharmacists were invited to participate in the study through on-site visits to their respective pharmacies. Participation was voluntary, and all participants were provided with detailed information regarding the study's purpose and objectives prior to their enrolment.

Data Analysis: The collected data were analysed using GraphPad Prism 7.0. Descriptive statistics, including frequencies and percentages, were calculated for all study variables. Chi-square tests were employed to compare differences between variables and the participants' KAP scores.

Ethical Considerations: This study was conducted in accordance with relevant ethical guidelines and regulations. Ethical approval was obtained from the Institutional Ethics Board (RD/2024/BPH/026).

3. RESULTS

The study involved 119 participants, predominantly male (74.8%) and in the 21-35 age group (63.0%). Over half were Diploma holders (54.6%), and 50.4% worked 40-48 hours weekly. Most (58.8%) had less than 5 years of work experience. These demographics suggest a young, male-dominated workforce with varied education and experience, potentially impacting their pharmacovigilance knowledge, attitudes, and practices.

Table 1: Demographic Characteristics of Participants (n=119)

Variable	Category	Frequency	Percentage
Gender	Male	89	74.8%
	Female	30	25.2%
Age Group	21–35	75	63.0%
	36–50	25	21.0%
	≥51	19	16.0%
Qualification	Diploma	65	54.6%
	Bachelor’s	30	25.2%
	Postgraduate	12	10.1%
	Doctoral	12	10.1%
Workload (Hours)	<40	35	29.4%

	40–48	60	50.4%
	>48	24	20.2%
Work Experience	<5 years	70	58.8%
	5–10 years	30	25.2%
	>10 years	19	16.0%

The demographic data reveals several key characteristics about the participant population. The gender distribution shows a significant majority of males (74.8%) compared to females (25.2%), indicating a male-dominated sample. Age-wise, most participants are young professionals, with 63% aged 21-35, suggests the study primarily reflects perspectives from early and mid-career individuals.

Regarding qualifications, over half (54.6%) hold diplomas, while bachelor's degrees are the next most common (25.2%). Postgraduate and doctoral qualifications are less represented (10.1% each), showing that higher education levels are the minority in this group. The workload distribution appears balanced, with half (50.4%) working 40-48 hours weekly, a standard full-time schedule. Work experience data shows most participants (58.8%) are relatively new to their fields with less than 5 years of experience, while about a quarter (25.2%) have 5-10 years of experience. Only 16% are seasoned professionals with over 10 years of experience.

Table 2: Overall KAP Scores (Max: Knowledge=7, Attitude=6, Perception=7, Total=20)

Component	Mean Score	Median	SD	Range
Knowledge (K)	4.2/7	4	1.3	2–7
Attitude (A)	3.8/6	4	1.1	1–6
Perception (P)	5.1/7	5	1.4	2–7
Total KAP	**13.1/20**	**13**	**2.8**	**9–20**

The KAP (Knowledge, Attitude, and Perception) scores in Table 2 reveal moderate overall competency among participants, with notable variations across components. Participants showed a moderate understanding of pharmacovigilance (PV), with an average knowledge score of 4.2/7. Attitudes towards PV were also moderate (3.8/6), but with a wider range, suggesting more diverse opinions. Perception of PV systems was the highest (5.1/7), indicating generally favourable views. Overall, the Total KAP score was 13.1/20, reflecting a mid-tier performance with some individual variability.

Table 3: KAP Score Distribution

Score Category	Frequency	Interpretation
Knowledge		
≤3 (Poor)	25	21.0%
4–5 (Moderate)	65	54.6%
≥6 (Good)	29	24.4%
Attitude		
≤2 (Negative)	20	16.8%
3–4 (Neutral)	70	58.8%
≥5 (Positive)	29	24.4%
Perception		
≤4 (Unfavorable)	30	25.2%
5–6 (Neutral)	60	50.4%
7 (Favourable)	29	24.4%

The data in Table 3 reveals important patterns in the distribution of Knowledge, Attitude, and Perception (KAP) scores among participants: More than half of participants (54.6%) demonstrated moderate pharmacovigilance knowledge, while nearly a quarter (21.0%) showed poor understanding. Neutral attitudes (58.8%) were most common, with negative attitudes present in 16.8%. Perceptions were evenly split between neutral (50.4%), unfavorable (25.2%), and favourable (24.4%) views.

Table 4: Knowledge Scores by Demographic Variables

Variable	Subgroup	Mean Knowledge Score	p-value
Qualification	Diploma	3.8	0.002*
	Bachelor's	4.6	
	Postgraduate	5.2	
	Doctoral	5.8	
Work Experience	<5 years	3.9	0.03*
	5–10 years	4.5	
	>10 years	4.1	

The data in Table 4 reveals significant relationships between demographic variables and pharmacovigilance knowledge levels, highlighting two key findings: Higher qualifications correlate significantly with increased pharmacovigilance (PV) knowledge (p=0.002), with doctoral holders demonstrating the highest scores (5.8/7) and a clear stepwise improvement with each educational level. Conversely, work experience shows an inverted U-curve pattern (p=0.03), where mid-career professionals (5-10 years' experience) possess the highest PV knowledge (4.5), while both newer entrants and more senior staff show slightly lower scores. This suggests formal education strongly boosts PV understanding, whereas practical experience peaks in the mid-career, potentially due to a lack of updated training for long-term professionals.

Table 5: Attitude Scores by Key Variables

Variable	Subgroup	Mean Attitude Score	p-value
Age Group	21–35	4.1	0.01*
	36–50	3.5	
	≥51	2.8	
Training Received	Yes	4.5	0.001*
	No	3.2	

The findings presented in Table 5 uncover age and training significantly influence attitudes toward pharmacovigilance (PV). Younger professionals (21-35 years) exhibit the most favourable attitudes (4.1/6), which decline considerably in older age groups. Crucially, formal PV training dramatically improves attitudes, with trained individuals scoring 4.5/6 compared to 3.2/6 for untrained personnel, a substantial 41% improvement.

Table 6: Regression Analysis for KAP Scores

Predictor	Knowledge	Attitude	Perception	Total KAP
Qualification	0.42**	0.28*	0.15	0.38**
Workload (40–48 hrs)	0.31*	0.19	0.24*	0.29*
Training Received	0.36**	0.45**	0.18	0.41**
Gender (Male)	-0.12	-0.08	-0.05	-0.10

**p<0.01, *p<0.05

Multivariate analysis reveals qualification level is the strongest predictor of pharmacovigilance (PV) knowledge and overall competency (β=0.42 and β=0.38 respectively, p<0.01), indicating that higher education significantly enhances PV capabilities. Training received is a key catalyst for positive attitudes (β=0.45, p<0.01) and has the second-highest impact on total KAP (β=0.41, p<0.01). A moderate workload (40-48 hours) optimizes both PV knowledge (β=0.31, p<0.05) and perception (β=0.24, p<0.05), suggesting that both underwork and overwork hinder engagement. Gender showed minimal impact, and perceptions were less influenced by measured factors.

Table 7: Correlation Analysis (Pearson/Spearman)

Variable Pair	Correlation (r)	p-value	Interpretation
Age vs. KAP Score	-0.32	0.001**	Older age → Lower KAP scores.
Prescriptions/Day vs. Patients/Day	0.98	0.000**	Near-perfect correlation (expected).
Workload vs. KAP Score	0.18	0.06	Weak positive trend (not significant).

Correlation analysis (Table 7) indicates an inverse relationship between age and KAP scores ($p < 0.01$), meaning older professionals tend to have lower scores. There's a near-perfect positive correlation between prescriptions per day and patients per day ($r = 0.98$, $p = 0.000$). A weak, non-significant positive trend was observed between workload and KAP scores ($r = 0.18$, $p = 0.06$), suggesting a slight tendency for moderate workloads to correlate with better KAP, though this isn't statistically conclusive.

Table 8: Group Comparisons

Variable	Subgroup	Mean KAP Score	p-value	Insight
Gender	Male (n=89)	13.5	0.02*	Males score slightly higher.
	Female (n=30)	12.1		
Workload	<40 hrs (n=35)	12.3	0.04*	Moderate workload (40–48 hrs) scores highest.
	40–48 hrs (n=60)	13.8		
	>48 hrs (n=24)	12.9		
Training Received	Yes	14.1	0.001**	Training significantly improves scores.
	No	11.9		

Analysis showed males scored slightly higher than females in PV knowledge (13.5 vs. 12.1, p=0.02). A "sweet spot" workload of 40–48 hours yielded the best performance (13.8, p=0.04). Most significantly, trained staff dramatically outperformed untrained peers (14.1 vs. 11.9, p<0.001), highlighting the strong impact of training on PV competency.

Table 9. Regression Analysis (Predicting KAP Score)

Predictor	Coefficient (β)	p-value	Interpretation
Qualification (Higher)	0.42	0.002**	Doctoral holders score 0.42 points higher.
Workload (40–48 hrs)	0.29	0.03*	Optimal workload improves scores.
Training Received (Yes)	0.41	0.001**	Training boosts scores by 0.41 points.
Age (≥51)	-0.38	0.01*	Older age reduces scores.

The regression analysis identifies four key predictors of KAP scores: Higher qualifications (β=0.42, p=0.002) and training (β=0.41, p=0.001) strongly improve performance, while older age (β=-0.38, p=0.01) negatively impacts scores. A 40–48-hour workload (β=0.29, p=0.03) also shows modest benefits. Together, these explain significant variance in PV competency, with education and training being the most powerful levers. This implies prioritize advanced training for senior staff and workload management to maximize PV engagement.

The cluster analysis reveals three distinct pharmacovigilance (PV) performance groups: High Performers (n=35) with advanced degrees, moderate workloads and less experience score exceptionally well (18.2). The Overworked group (n=50), predominantly diploma holders with heavy workloads, show moderate performance (12.7). Most concerning is the Low Engagement cluster (n=34) - older, experienced professionals with light workloads score poorly (9.5). This suggests workload extremes and career stage significantly impact PV participation, with overqualified newcomers outperforming both overworked mid-career staff and underutilized veterans. The time efficiency analysis reveals: Higher prescription volumes significantly reduce time per patient (β=-0.2, p=0.003), suggesting workflow adaptations for busier clinicians. Conversely, experienced staff (β=0.15, p=0.04) dedicate marginally more time per case, potentially reflecting thoroughness or mentoring roles. These competing effects highlight the tension between productivity and quality in pharmacovigilance.

4. DISCUSSION

Community pharmacists, as frontline healthcare professionals who directly engage with patients and dispense medications, play a crucial role in an effective pharmacovigilance system. Their position enables them to observe and identify potential ADRs and contribute valuable information to national pharmacovigilance programmes.[17-28] However, pharmacovigilance in India remains underdeveloped compared to global standards, with reporting rates significantly lower.[26] The cross-sectional study involved 119 participants, predominantly male (74.8%, n=89) compared to female (25.2%, n=30). Most participants were young professionals. In terms of educational qualifications, diploma holders made up the largest group (54.6%, n=65), while bachelor's degree holders accounted for 25.2% (n=30), and postgraduate and doctoral degree holders each constituted 10.1% (n=12). The workload distribution indicated that half of the participants (50.4%, n=60) worked 40–48 hours weekly. Work experience was skewed towards early-career professionals, with 58.8% (n=70) having less than 5 years of experience, 25.2% (n=30) with 5–10 years, and 16.0% (n=19) with more than 10 years. Comparing these demographics with other studies conducted in South India reveals some consistent trends. Several studies [29] also reported a higher proportion of male pharmacists in the community, with one study finding that 90% of the surveyed community pharmacists were male.[29] Another study involving 150 community pharmacists documented that 77.33% were male.[30] Regarding educational qualifications, the predominance of diploma holders in the current study is echoed in other research, with one study noting that a Diploma in Pharmacy was the highest qualification for 47.33% of their participants.30 However, some studies provide contrasting data, suggesting that many community pharmacists might not even hold a diploma.[29] The work experience data from the current study, showing a majority with less than 5 years of experience, is also supported by other regional findings.[31] This demographic profile of the study participants, characterised by a predominantly young, male workforce with a significant proportion of diploma holders and early-career professionals, offers crucial context for interpreting their knowledge, attitudes, and perceptions towards pharmacovigilance.

The study participants' overall knowledge, attitudes, and perceptions towards pharmacovigilance revealed moderate competency levels. The mean knowledge score was 4.2 out of 7, indicating a mid-range understanding of pharmacovigilance principles. The attitude component showed a similar moderate mean of 3.8 out of 6, with a broader range, suggesting more varied opinions among the participants. Perception scores were the highest, with a mean of 5.1 out of 7, implying generally favourable views towards pharmacovigilance systems. The total KAP score averaged 13.1 out of 20, reinforcing the finding of moderate overall competency. The moderate mean knowledge score and a higher perception score suggests that while community pharmacists in the study generally recognize the importance of pharmacovigilance, their in-depth understanding of its principles and specific roles within the system might be limited. This gap between a positive perception and moderate knowledge underscores the need for interventions to enhance their understanding and practical application of pharmacovigilance.

Examining the score distribution within each KAP component reveals participants' competency levels. Over half (54.6%) demonstrated moderate knowledge, scoring 4 to 5 out of 7. A significant portion (21.0%) showed poor knowledge (≤3), while only 24.4% achieved good scores (≥6). This indicates that while many have a basic understanding, nearly a quarter lack adequate pharmacovigilance knowledge, highlighting the need for targeted educational initiatives. Regarding attitudes, most participants (58.8%) held neutral views (3-4 out of 6). Negative attitudes (≤2) were seen in 16.8%, while 24.4% showed positive attitudes (≥5). This clustering of neutral and negative attitudes may reflect workplace culture, perceived lack of support for reporting, or resource limitations. For perception scores, half (50.4%) were neutral (5-6 out of 7), while 25.2% had unfavourable and 24.4% favourable views. This suggests an opportunity for improvement through awareness campaigns that emphasize the benefits of pharmacovigilance for patient safety. The notable proportion of pharmacists with poor knowledge and negative attitudes raises concerns about their engagement in pharmacovigilance and underreporting of ADRs. Addressing these issues is essential for a proactive approach to pharmacovigilance in community pharmacies.

The study revealed a significant correlation between higher education levels and pharmacovigilance knowledge (p=0.002*). Doctoral holders had the highest mean knowledge score (5.8/7), followed by postgraduate (5.2), bachelor's (4.6), and diploma holders (3.8). This progression shows that higher qualifications improve pharmacovigilance understanding. The 2-point knowledge gap (29% of the total scale) between doctoral and diploma holders indicates a need to enhance pharmacovigilance education, particularly at the diploma level, where most community pharmacists in the study qualified.

This aligns with other South India research indicating that pharmacovigilance knowledge increases with education. A study found that pharmacists with a PhD had the highest knowledge scores, followed by Bachelor's or Master's degree holders, then diploma holders. The current study also noted an inverted U-curve relationship between work experience and knowledge (p=0.03*). Mid-career professionals (5-10 years) had the highest score (4.5/7), followed by newcomers (<5 years) with a moderate score (3.9), while senior staff (>10 years) showed a slight decline (4.1). This pattern suggests practical experience aids knowledge acquisition, peaking mid-career. The decline among seniors may relate to outdated training, a shift toward administrative roles, or generational differences in pharmacovigilance education quality. This underscores the need for continuous professional development to keep experienced pharmacists informed about pharmacovigilance.

The study uncovered significant relationships between demographic variables and attitudes towards pharmacovigilance. A clear trend emerged with age: the youngest professionals (21-35 years) demonstrated the most favourable disposition, with an average attitude score of 4.1 out of 6. This enthusiasm waned with career progression; mid-career professionals (36-50 years) showed an 18% decline in positive attitudes (3.5/6), and senior staff (51+ years) exhibited a 32% drop (2.8/6). This decline may reflect generational differences in perceived importance of pharmacovigilance or be influenced by older pharmacists' experiences. Interestingly, this finding contrasts with some studies in South India suggesting older pharmacists might display more positive behaviour towards ADR reporting, despite lower knowledge. Significantly, there was a 41% improvement in attitude scores among trained versus untrained personnel. Those who received formal pharmacovigilance instruction averaged a score of 4.5 out of 6, compared to 3.2 for untrained counterparts, landing in the neutral-to-negative range. This 1.3-point difference emphasizes the critical role of training in fostering positive attitudes towards pharmacovigilance among pharmacists, underscoring the need for accessible training opportunities to enhance engagement in pharmacovigilance.

The multivariate analysis in this study elucidated the influence of demographic and professional factors on pharmacovigilance competencies. Qualification level is the strongest positive predictor of both knowledge ($\beta=0.42$, $p<0.01$) and total KAP score ($\beta=0.38$, $p<0.01$), supporting that higher educational attainment enhances a pharmacist's understanding of pharmacovigilance. Each step up in educational level (from Diploma to Doctoral) predicts a significant increase in knowledge scores, highlighting the need for standardized pharmacovigilance curricula, especially for diploma holders. Training had the largest impact on attitude ($\beta=0.45$, $p<0.01$) and significantly affected total KAP score ($\beta=0.41$, $p<0.01$), suggesting that it transforms passive knowledge into active engagement, improving reporting behaviors. Workload notably influenced knowledge ($\beta=0.31$, $p<0.05$) and perception ($\beta=0.24$, $p<0.05$), indicating that a balanced workload optimizes a pharmacist's capacity for pharmacovigilance activities. Gender (being male) showed negative but non-significant coefficients, indicating minimal differences in pharmacovigilance competencies. Perception had few significant predictors, suggesting it may be influenced by other factors like organizational culture or individual beliefs.

The study revealed a generational divide in healthcare professionals' perceptions of pharmacovigilance systems. Younger professionals (21-35 years) showed confidence, with a mean score of 5.4 out of 7, or 77% of the maximum. Factors contributing to this positive view include modern education on pharmacovigilance, comfort with digital reporting, and stronger alignment with contemporary patient safety cultures. This suggests younger pharmacists could champion pharmacovigilance and mentor older colleagues in modern practices. While older professionals' perceptions weren't detailed, prior findings indicated a decline in positive attitudes with age, possibly linked to their experience in the field.

The correlation analysis highlighted key relationships between various factors and their impact on the knowledge, attitudes, and practices of pharmacovigilance. A significant inverse relationship ($p < 0.01$) was found between age and KAP scores, indicating that older healthcare professionals (≥51 years) tend to have lower competency in pharmacovigilance than younger counterparts (21–35 years). This emphasises the need for targeted interventions to help experienced pharmacists stay updated on pharmacovigilance. A near-perfect positive correlation ($r = 0.98$, $p = 0.000$**) was observed between the number of prescriptions dispensed daily and the number of patients attended, reflecting the connection between patient volume and prescription volume in community pharmacies. Interestingly, the correlation between workload (hours worked per week) and total KAP score showed a weak positive trend ($r = 0.18$, $p = 0.06$), though it was not statistically significant. This suggests a slight tendency for moderate workloads (40–48 hours per week) to relate to better KAP scores, but the lack of statistical significance prevents a definitive causal conclusion. This trend hints that a balanced workload might allow pharmacists sufficient time and cognitive resources for effective engagement in pharmacovigilance activities.

The chi-square tests revealed two key findings about demographic variables. Firstly, qualification significantly impacted workload distribution ($\chi^2=15.6$, $p=0.01$), with diploma holders overrepresented in high-workload groups. This suggests inequities in work allocation in community pharmacies, where diploma-holding pharmacists, who typically have lower pharmacovigilance knowledge, may face challenges in engaging with pharmacovigilance activities due to time constraints and increased workload. Secondly, no significant association was found between gender and age groups ($\chi^2=8.4$, $p=0.08$), indicating consistent gender distribution among community pharmacists across career stages. This shows a stable workforce demographic structure regarding gender across age cohorts.

The regression analysis identified four key predictors of KAP scores among community pharmacists. Higher educational

qualifications (β=0.42, p=0.002) and pharmacovigilance training (β=0.41, p=0.001) strongly influence KAP scores, highlighting the importance of formal education and training in improving pharmacovigilance competency. Conversely, older age (β=-0.38, p=0.01) negatively impacts KAP scores, underscoring the need for continuous learning. A workload of 40–48 hours per week (β=0.29, p=0.03) also has a modest positive effect on KAP scores, suggesting that balanced workloads enhance engagement with pharmacovigilance activities. These factors together explained a significant portion of the variance in pharmacovigilance competency, with education and training being the most powerful levers for improvement.

Cluster analysis identified three groups of pharmacists by performance. "High Performers" (n=35), with advanced degrees and moderate workloads, scored well (18.2/20), showcasing the impact of recent education. The "Overworked" group (n=50), mainly diploma holders with heavy workloads, displayed moderate performance (12.7), indicating high workloads limit PV engagement for those with less training. Most concerning was the "Low Engagement" cluster (n=34), consisting of older, experienced professionals with light workloads who scored poorly (9.5), suggesting underutilisation due to outdated knowledge or lack of motivation. These findings emphasise that workload and career stage significantly influence PV participation, with qualified newcomers outperforming overworked mid-career staff and underutilised veterans.

As seen in the current study, the male predominance in community pharmacies in South India is consistently reported in other research.[29] Furthermore, the positive association between higher education and awareness of ADR reporting mechanisms, as found in the current study, is also supported by other findings in the region.[33] The tendency for younger pharmacists to have better knowledge, as suggested by the inverse relationship between age and KAP in the present study, also echoes findings from other South Indian studies.[32] Overall, the comparison with existing literature highlights the consistency of several key findings regarding community pharmacists' knowledge, attitudes, and perceptions towards pharmacovigilance in South India, underscoring the persistent challenges and the need for targeted interventions.

Several recommendations are crucial to enhance pharmacovigilance among community pharmacists in South India. Pharmacy curricula, especially diploma programs, need strengthened PV education to cover both theoretical and practical aspects of ADR identification and reporting. Mandatory, regular PV training programs are essential for all registered pharmacists, tailored to experience levels and including modules for senior pharmacists and diploma holders. User-friendly ADR reporting mechanisms should be developed, simplifying the process and ensuring easy access to physical and digital forms, alongside regular awareness campaigns on the importance of reporting. Furthermore, fostering a reporting culture through incentives and emphasizing PV as a professional responsibility can boost engagement. Addressing workload imbalances, particularly for diploma holders, will ensure pharmacists have adequate time for PV activities. Finally, leveraging the positive attitudes of younger professionals as PV champions and providing targeted interventions like refresher courses for older professionals can update their knowledge and address negative perceptions. Future qualitative research can offer deeper insights into ADR reporting barriers and facilitators, informing more effective interventions.

5. CONCLUSION

In conclusion, the cross-sectional study provides valuable insights into community pharmacists' knowledge, attitudes, and perceptions towards pharmacovigilance in South India. The findings reveal a moderate overall competency, with higher perception scores than knowledge and attitude. Educational qualifications and training are significant predictors of pharmacovigilance competency, while age and workload also play essential roles. The study's findings are broadly consistent with existing literature from South India, highlighting persistent challenges in knowledge levels and ADR reporting rates. Implementing the recommended strategies, enhancing education and training, simplifying reporting mechanisms, promoting a culture of reporting, addressing workload issues, and leveraging the strengths of different experience groups can significantly contribute to strengthening pharmacovigilance practices among community pharmacists in South India. Ultimately, this will lead to improved medication safety and better regional public health outcomes, moving India towards a more robust national pharmacovigilance program.

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