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Original Article

Pharmacovigilance Education in Pharmacy: An Evaluation of Knowledge, Attitude and Perception Among Future Pharmacists

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ABSTRACT

Background: Pharmacovigilance (Pv) comprises the detection, valuation, understanding, as well as inhibition of adverse drug events or drug related glitches. Following the thalidomide tragedies of the 1950s and 1960s, pharmacovigilance became a formal discipline. In India, challenges like under- recording of (ADRs) with lack of awareness among healthcare professionals led to the launch of Pharmacovigilance Program of India (PvPI)**,** 2010. This research intended to assess the Knowledge, Attitude, and Perception (KAP) of pharmacy students across different streams through an educational intervention to improve their involvement in patient safety and ADR reporting. **Materials and Methods:** The study included 517 pharmacy students (B Pharm 200, D Pharm 116, M Pharm 52, Pharm D 149). Demographic details were collected, and participants were assessed on KAP using a 15-question survey before and after an educational intervention. The internal consistency and reliability of the questionnaires were evaluated using IBM SPSS 27.0 and cronbach's alpha. **Results:** Post-intervention, there was a significant improvement in KAP. Knowledge on Pv increased from 52.24% to 93.83%, while the Attitude towards the benefits of ADR reporting rose from 76.4% to 94%. Perception regarding the need for greater awareness of Pv increased from 77.58% to 94.42%. **Conclusion:** The educational intervention significantly improved the KAP of pharmacy Students towards pharmacovigilance. Despite some variations among different student groups, the study concludes that such interventions are crucial for enhancing understanding and participation in Pharmacovigilance activities, essential for public health and drug safety.

Keywords: Knowledge, Attitude, Perception, Pharmacovigilance, PvPI, ADR.

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INTRODUCTION

While being used normally for therapeutic purposes, any substance or medication has the potential to cause an adverse reaction. Obtaining a completely safe medication is really challenging. Around the world, Adverse Drug Reactions (ADRs) account for a sizable portion of morbidity and mortality.[1] Patient safety, regulatory compliance, and the quality of healthcare are all significantly improved by reporting adverse drug reactions. As ADRs considerably increase morbidity and mortality and are estimated to be the cause of 0.2-24% of hospitalizations, ADR reporting plays a critical role in identifying and managing medication-related hazards. Moreover, underreporting continues to be a major problem, with rates as low as 1% in India compared to 5% worldwide, underscoring the urgent need for patients' and healthcare professionals' enhanced awareness and education.[2]

Since its establishment in the middle of the 1980s, pharmacovigilance in India has undergone substantial change, mostly due to the necessity of keeping an eye on adverse drug reactions in the midst of the worldwide thalidomide disaster. The (IPC) Indian Pharmacopoeia Commission as well as Ministry of Health and Family Welfare supported the 2010 launch of the PvPI, which marked an official start of a pharmacovigilance system after difficulties with a monitoring initiative in 1986.[3-5]

Over 567 ADR Monitoring Centres (AMC) are now part of the PvPI nationwide, greatly enhancing ADR reporting and safety protocols in spite of early setbacks like underreporting and shortage of qualified personnel.[6] In 1998, India became a member of the WHO Programme for International Drug Monitoring, which allowed it to further integrate its pharmacovigilance efforts globally. However, pharmacovigilance in India will continue to grow only if persistent issues like awareness, training,

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and regulatory compliance are resolved.[7] Based on research, it is evident that pharmacy students have a solid foundation of knowledge and a favourable attitude toward pharmacovigilance. More than half of final-year pharmacy students exhibit high comprehension and attitudes about this topic.[8,9] As the demand for skilled pharmacovigilance professionals is growing due to increasing regulatory requirements and the complexity of new therapies, the pharmacy students are well-positioned to fill these roles, ensuring the safety and efficacy of medications in clinical settings. Thus, their involvement is essential for advancing pharmacovigilance efforts in healthcare.[10]

MATERIALS AND METHODS

Study site

The research study was carried out at KLE College of Pharmacy, Vidyanagar, Hubballi.

Study design

This study was self-designed and cross-sectional, with the aim of assessing the Knowledge, Attitude, and Perception of pharmacy students about PvPI.

Ethical Approval

Ethical clearance was obtained from institutional ethical committee, at KLE College of Pharmacy, Hubballi. The IEC No. KLECOPH/IEC/2023-24/01.

Study period

Study was carried out for a time span of 6 months at KLE College of Pharmacy, Vidyanagar, Hubballi, Karnataka.

Study criteria

Inclusion criteria: Students enrolled in various pharmacy streams at KLE College of Pharmacy, Hubballi.

Exclusion criteria: Pilot study participants and students who are not willing to contribute in the learning.

Study Procedure

A Total of 15 questionnaire were developed by the faculty of department of Pharmacy Practice, assessing three domains: Knowledge, Attitude, and Perception, each containing 5 questions. All questions within the Knowledge domain were dichotomous (coded as 'Yes' as 1 and 'No' as 0). The questions in the Attitude and Perception domains used as 5.0- score point using Likert scale indicating ('Strongly Agree,'' Agree,' 'Not sure,' 'Disagree' 'Strongly Disagree,' matching to standards 1 to 5 respectively).

Internal consistency was evaluated using IBM SPSS 27.0, and Cronbach's alpha (α) was employed, which ranges from 0 to 1. A higher alpha value indicates stronger relationships among scale items. An α falling within the range of 0.8 to 0.9 specifies a 'good internal consistency.' The questionnaire forms were distributed among 21 random Pharmacy students as a part of a pilot survey resulting in an internal consistency α of 0.827. Hence, the questions showed acceptable internal consistency.

The questionnaire was then provided to the study participants and they were asked to answer the questions (pre-test). Later, a brief educational session using power point presentation on Pharmacovigilance was provided to the study participants which included key information on the definitions, aim, regulatory body, history, whom to report, where to report, how to fill ADR reporting forms etc. After the education session, the same set of questions was re-distributed to the study participants through google forms again and the responses were recorded (post-test).

Statistical Analysis

The data was fed to Microsoft Excel spreadsheet. Continuous data were presented by way of Mean±Standard Deviation. The variances amongst groups were evaluated via data analysis using *t*-test. Suitable descriptive and inferential statistical analyses were conducted using Excel and SPSS version 27. We used several *t*-tests to compare pre- and post-intervention results. However, we did not apply a correction for multiple comparisons because it might increase the chance of finding false positive results (Type I error).

RESULTS

Demographic details

The study includes a larger number of female participants (293) compared to male participants (224). In below Figure 1, the gender distribution may reflect the gender composition of the pharmacy student population or may be influenced by other factors such as recruitment methods or societal norms. Participants' ages range from 18 to 25 and shown in Figure 2. The highest number of participants falls in the 21-year-old category (107), indicating a significant representation of young adults in this age group. The distribution across other age categories provides insights into the age diversity within the study population. Participants are enrolled in various years of pharmacy programs, including Pharm D, B Pharm, M Pharm and D Pharm.

The distribution depicted in Figure 3, across different academic years reflects the progression of students through their respective programs, with varying numbers in each year. The majority of participants are undergraduates (309), indicating a higher representation of students pursuing bachelor's degrees in pharmacy compared to postgraduates (127) pursuing master's degrees shown in Figure 4. Participants' parents predominantly come from non-medical backgrounds (454), indicating that a significant proportion of participants may not have direct exposure to healthcare professions within their immediate family. However, there is also a smaller group with parents from medical

backgrounds (63), which could influence participants' familiarity with healthcare-related concepts.

Participants come from diverse socioeconomic backgrounds, with varying annual incomes. The distribution across different socioeconomic categories provides insights into the economic diversity within the study population.

The majority of participants reside in urban areas (341), while a smaller proportion come from rural areas (176). This distribution reflects the urbanization trend seen in many regions, where more individuals are concentrated in urban centres compared to rural areas.

Overall, in Table 1, demographic insights provide a nuanced understanding of the study population, including factors such as gender, age, academic progression, parental background, socioeconomic status, and residential location, which may influence participants' perspectives and experiences related to pharmacovigilance.

Assessing the Knowledge, Attitude and Perception of PV within Pharmacy students Knowledge domain

In Table 2, the pharmacy students, where both before i.e., (Pre) and after (Post) a specific educational intervention or program. Each question focuses on different aspects related to pharmacovigilance, ADR, and related concepts. Before the intervention, students showed varying levels of understanding. For instance, regarding knowledge of the full form of PvPI, 270 students answered correctly, while 247 students answered incorrectly. Similarly, with the question about knowing what AMC stands for, 192 students responded correctly, with 325 giving incorrect answers. After the intervention, there were noticeable improvements across all questions. The number of correct responses increased significantly, indicating enhanced understanding among the students. For example, the correct responses regarding the full form of PvPI rose to 485, with only 32 incorrect responses. Similarly, for understanding the difference between ADR and ADE, correct responses increased from 272 to 479, accompanied by a decrease in incorrect responses. These results suggest that the educational intervention effectively improved students' knowledge of pharmacovigilance and related concepts. The significant increase in correct responses indicates a positive impact of the intervention in enhancing students' understanding of these crucial aspects of pharmacy practice.

Attitude domain

From the above Table 3, Before the intervention, the attitudes of pharmacy students towards ADRs recording and programme of pharmacovigilance practices varied. For instance, in response to the question "Do you think that ADR reporting is beneficial?" the count for "Strongly Agree" (SA) responses increased from 226 to 282 post-intervention, indicating a shift towards a stronger belief in the benefits of ADR reporting. Similarly, in response to "Do you think reporting of an ADR is important/necessary?" there was an increase in SA and A responses from 211 to 272 post-intervention, suggesting a greater acknowledgment of the importance of ADR reporting. Regarding the perception of ADR reporting form complexity, the number of students who found the form complex decreased from 156 to 142 post-intervention, indicating a more favorable perception. These changes reflect a positive shift in attitudes towards ADR reporting and pharmacovigilance practices among pharmacy students following the intervention.

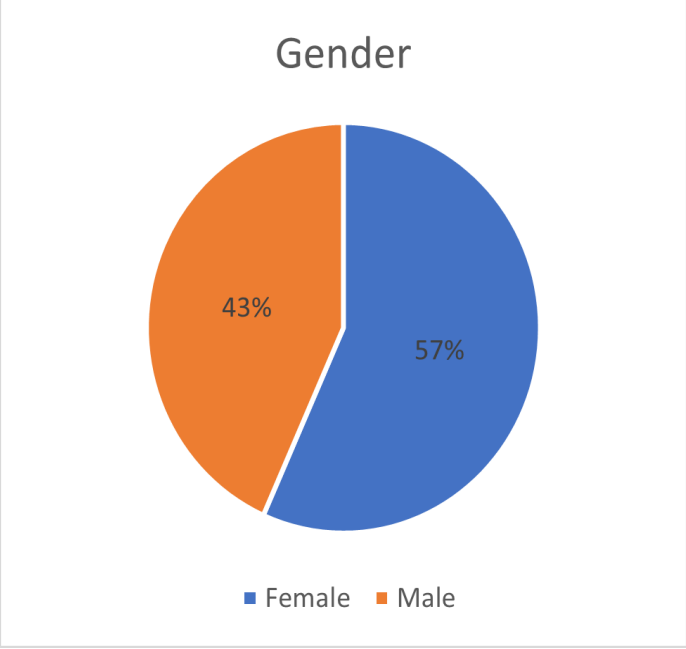

Figure 1: Gender distribution in percentage.

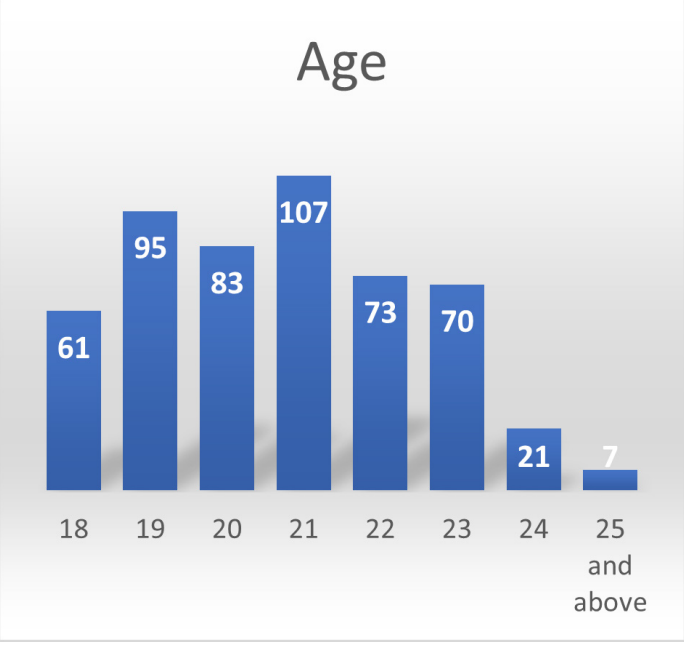

Figure 2: Age category distribution in number.

Table 1: Demographic characteristics of study participants.

Demographics	Categories	*n*=517 (%)
Gender	Female	293 (56.67%)
	Male	224 (43.32%)
Age in years	18	61 (11.79%)
	19	95 (18.37%)
	20	83 (16.05%)
	21	107 (20.69%)
	22	73 (14.11%)
	23	70 (13.53%)
	24	21 (4.06%)
	25	7 (1.35%)
Year of study	B Pharm	200 (28.68%)
	D Pharm	116 (22.43%)
	M Pharm	52 (10.05%)
	Pharm D	149 (28.82%)
Education Level	Post Graduate	127 (24.56%)
	Under Graduate	309 (59.76%)
Parents profession	Non-medical background	454 (87.81%)
	Medical background	63 (12.18%)
Socioeconomic status	Lower class (<1 lakh Rupees per year)	146 (28.23%)
	Lower middle class (2 to 5 lakh Rupees per year)	138 (26.69%)
	Upper class (>10 lakh Rupees per year)	36 (6.96%)
	Upper lower class (1 to 2 lakh Rupees per year)	62 (11.99%)
	Upper middle (5 to 15 lakh Rupees per year)	135 (26.11%)
Residence	Rural	176 (34.04%)
	Urban	341 (65.95%)

Perception domain

Here, in Table 4, there were varied perceptions among pharmacy students regarding pharmacovigilance practices. Following the intervention, notable shifts in perceptions were observed. For instance, in response to the question "Do you consider a need for greater awareness and understanding of Pv among pharmacy students?" the count for "Strongly Agree" (SA) responses increased from 191 to 281 post-intervention, indicating a heightened recognition of the need for greater awareness and understanding. Similarly, in response to "Do you believe that Pv can positively impact the drug development process?" there was an increase in SA and A responses from 158 to 246 post-intervention, suggesting a stronger belief in the positive impact of Pv on drug development. Moreover, regarding the perception of healthcare professionals' seriousness towards ADR reporting, there was a notable increase in SA and A responses from 104 to 208 post-intervention, indicating a more positive perception. These changes suggest a significant improvement in perceptions related to Pv and ADR reporting among pharmacy students following the intervention.

KAP of Pv among the participants

The above Table 5, where participants' knowledge, attitudes, and views regarding pharmacovigilance practices and reporting Adverse Drug Reactions (ADRs) significantly improved as a result of the Pharmacovigilance (Pv) intervention. Following the intervention, there were notable improvements in the knowledge levels of the participants, as indicated by higher mean scores and a larger percentage of right answers to knowledge-based questions. This increase highlights how well the intervention worked to improve participants' comprehension of PvPI (Pharmacovigilance Programme of India) terminology and processes. Additionally, the intervention had a favorable impact on participants' attitudes on reporting ADRs, as seen by a significant rise in the proportion of participants who expressed agreement and strong agreement after the intervention. In a similar vein, there was a notable improvement in the participants' opinions of the significance and

efficacy of Pv in producing evidence-based data and enhancing patient safety. Consistent improvements across demographic characteristics were found through subgroup analysis, underscoring the usefulness of the intervention in a variety of populations. Participants in the qualitative comments expressed gratitude for the intervention's educational value and relevance to their professional practice, which was consistent with the quantitative findings. These findings highlight the critical role that focused educational initiatives play in raising healthcare professionals' awareness of pharmacovigilance and advocating pharmaceutical safety.

Comparison of KAP Programme of Pharmacovigilance within pharmacy students

Knowledge of Pv among pharmacy students

The Table 5 and Figure 5 represents mean, standard deviation (Sd. Dev), and the significance *t*-test (Sig) of Pre-Test and Post-Test measurements regarding knowledge, attitude, and perception in the Pv study, categorized by different classes of students.

For Pharm D students (n=149), the mean knowledge scores were 3.57 in the Pre-Test also 4.81 in the Post-Test. Standard deviation for Pre-Test was 1.629, also for the Post-test were 0.682. The *t*-test indicates a highly important changes amongst the Pre as well as Post-Test ranges (p<0.001), suggesting a notable improvement in knowledge after the intervention. B Pharm students (n=200) got mean Pre-Test value with 1.95 also Post-Test value with

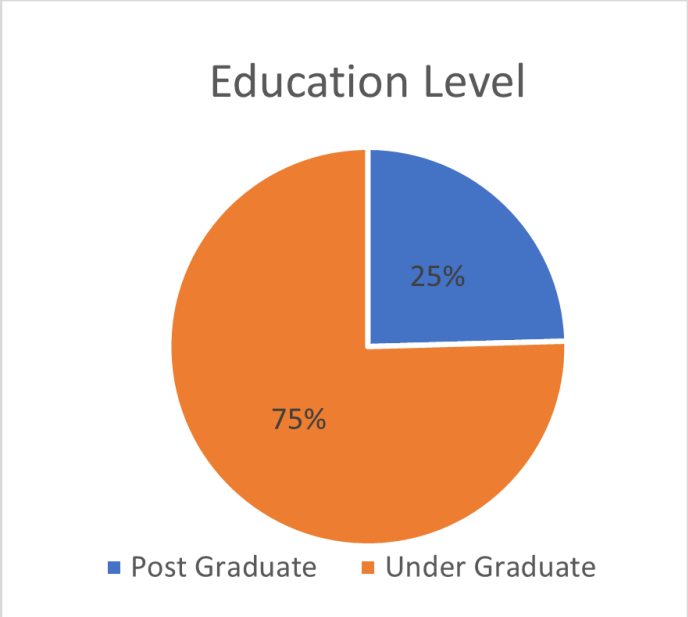

Figure 3: Education level distribution in percentage.

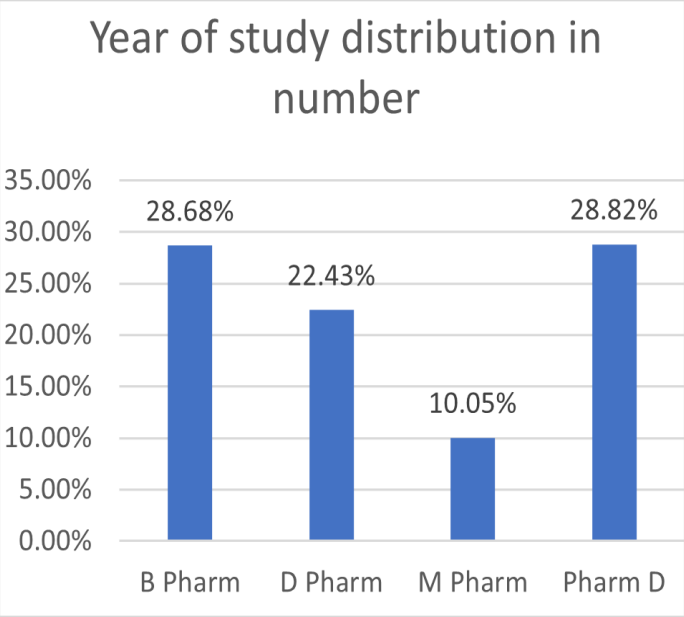

Figure 4: Year of study distribution in percentage.

Table 2: Knowledge of Pv among the participants.

Sl. No.	Knowledge Based Questions	*n*=517			
		Pre [N (%)]		Post [N (%)]	
		Correct	Incorrect	Correct	Incorrect
1.	Do you know the full form of PvPI?	270 (52.24)	247 (47.76)	485 (93.83)	32 (6.17)
2.	Do you know what is AMC?	192 (37.17)	325 (62.83)	447 (86.52)	70 (13.48)
3.	Do you know the difference between ADR and ADE?	272 (52.65)	245 (47.35)	479 (92.68)	38 (7.32)
4.	Do you know how to report ADR?	276 (53.45)	241 (46.55)	481 (93.04)	36 (6.96)
5.	Have you heard any drug banned due to ADR?	297 (57.48)	220 (42.52)	448 (86.72)	69 (13.28)

Table 3: Attitude & Perception towards Pv among the participants.

Attitude towards Pv among the participants											
Sl. No.	Attitude Based Questions	*n*=517									
		Pre [N (%)]					Post [N (%)]				
		SA	A	N	D	SD	SA	A	N	D	SD
1.	Do you think that ADR reporting is beneficial?	226 (43.71)	169 (32.69)	111 (21.47)	10 (1.93)	1 (0.19)	282 (54.54)	204 (39.46)	27 (5.22)	1 (0.19)	3 (0.58)
2.	Do you think reporting of an ADR is important/ necessary?	211 (40.81)	191 (36.94)	104 (20.12)	11 (2.13)	-	272 (52.61)	212 (41.01)	28 (5.42)	4 (0.77)	1 (1.09)
3.	Do you believe that health care workers/professionals/ public should be trained about PvPI?	188 (36.37)	191 (36.94)	123 (23.79)	12 (2.32)	3 (2.32)	256 (49.52)	226 (43.71)	27 (5.22)	4 (0.77)	4 (0.77)
4.	Do you think ADR reporting form is complex to fill?	57 (11.03)	156 (30.17)	245 (47.39)	53 (10.25)	6 (1.16)	142 (27.470	203 (39.26)	96 (18.57)	73 (14.12)	3 (0.58)
5.	Do you think establishing ADR monitoring Centre in every hospital will be useful?	177 (34.24)	201 (38.87)	123 (23.79)	12 (2.32)	4 (0.77)	251 (48.55)	223 (43.14)	36 (6.96)	4 (0.77)	3 (0.58)
Perception towards Pv among the participants											
Sl. No.	Perception Based Questions	n=517									
		Pre [N (%)]					Post [N (%)]				
		SA	A	N	D	SD	SA	A	N	D	SD
1.	Do you consider a need for greater awareness and understanding of Pv among pharmacy students?	191 (36.95)	210 (40.63)	106 (20.52)	8 (1.55)	2 (0.39)	281 (54.36)	207 (40.06)	23 (4.45)	2 (0.39)	4 (0.78)
2.	Do you believe that Pv can positively impact drug development process?	158 (30.59)	203 (39.29)	140 (27.10)	16 (3.10)	-	246 (47.66)	232 (44.89)	33 (6.39)	3 (0.58)	3 (0.58)
3.	Do you consider that Health care professionals take ADR reporting seriously?	104 (20.12)	195 (37.72)	187 (36.18)	26 (5.03)	5 (0.97)	208 (40.23)	229 (44.34)	63 (12.20)	15 (2.90)	2 (0.39)
4.	Do you consider that Pv will help in generating evidence-based data?	133 (25.73)	212 (41.05)	158 (30.60)	133 (25.730	1 (0.19)	213 (41.24)	251 (48.64)	44 (8.52)	6 (1.16)	3 (0.58)
5.	Do you feel that there are any barriers in reporting ADRs?	63 (12.20)	166 (32.13)	251 (48.64)	37 (7.16)	-	169 (32.71)	199 (38.53)	120 (23.23)	24 (4.64)	5 (0.97)

4.32. Standard deviation related to the Pre-Test were 1.826, also with Post-Test was 1.302. Similar to Pharm D students, B Pharm students also showed a highly significant improvement in knowledge, after the intervention (p<0.001). M Pharm students (n=52) had a relatively higher mean Pre-Test range with 4.33, that increased up-to 4.87 enclosed in Post-Test. Standard deviation regards to the Pre-Test were 1.133, also with Post-Test was 0.525. The t-test indicated substantial modification amongst Pre as well as Post-Test values (p=0.003), suggesting an improvement in knowledge after the intervention, although the effect size may be smaller compared to other groups. D Pharm students (n=116) had the lowest mean pre-test score of 1.38, which increased to 4.37 during Post-Test. Standard deviation during Pre-Test were 1.723, also during Post-Test was 1.234. Similar to other groups, D Pharm students also showed a highly significant improvement in knowledge after the intervention (p<0.001).

Attitude of Pv among pharmacy students

Pharm D students exhibited the highest mean Pre-Test value 20.95, that increased up-to 22.11 during Post-Test, represented with noteworthy improvement ($p<0.001$). B Pharm students also showed a substantial improvement from mean Pre-Test value 19.73 to 21.26 in the post-test ($p<0.001$). M Pharm students demonstrated a slight increase with mean Pre-Test value 21.83 to 22.40 in the post-test, although development wasn't analytically considerable ($p=0.214$). D Pharm students displayed the lowest mean Pre-Test value 17.70, grew to 20.73 during Post-Test, showing a significant improvement ($p<0.001$) depicted in Table 5.

Overall, from below Figure 6, Pharm D and D Pharm students showed the most substantial improvements in attitude scores from pre to post-tests, followed by B Pharm students. While M Pharm students also showed improvement, it was not statistically significant compared to the other groups. These findings suggest variations in the effectiveness of the intervention across different classes of students, with Pharm D and D Pharm students benefiting the most.

Perception of Pv among pharmacy students

The Table 5 and Figure 7, displays the outcomes of a t-test analysis contrasting pre- and post-intervention mean scores (Pv) across four classes: Pharm D, B Pharm, M Pharm, and D Pharm. Notably, all classes exhibited significant differences flanked by Pre- as well as Post-intervention values. In Pharm D set ($n=149$), the mean score slightly decreased from 19.86 to 19.24 ($p<0.001$). Likewise, the B Pharm cohort ($n=200$) experienced a decrease from 19.24 to 21.40 ($p<0.001$). In the M Pharm class ($n=52$), while here were the important variances ($p=0.009$), change was less pronounced,

Table 4: KAP of Pv among the participants.

Sl. No.	Total KAP	*n*=517			
		Pre (%)		Post (%)	
		Correct	Incorrect	Correct	Incorrect
1.	Knowledge	28.58	82.42	82.71	16.62
2.	Attitude	66.63	34.3	78.52	23.99
3.	Perception	55.33	44.17	76.18	23.8

Table 5: T-test analysis KAP in Pv among pharmacy students.

T-test analysis of Knowledge among Pharmacy students					
Sl. No.	Class	N	Mean±SD		*p*-value
			Pre	Post	
1.	Pharm D	149	3.57 ±1.629	4.81±.682	<0.001*
2.	B Pharm	200	1.95 ±1.826	4.32 ±1.302	<0.001*
3.	M Pharm	52	4.33 ±1.133	4.87± .525	.003*
4.	D Pharm	116	1.38 ±1.723	4.37 ±.525	<0.001*
Sl. No.	Class	N	Mean±Sd. Dev		Sig (*t*-test)
			Pre	Post	
T-test analysis of attitude among pharmacy students					
1.	Pharm D	149	20.95±2.880	22.11±2.249	<0.001*
2.	B Pharm	200	19.73 ±2.992	21.26±3.004	<0.001*
3.	M Pharm	52	21.83 ±2.307	22.40±2.378	.214
4.	D Pharm	116	17.70 ±3.610	20.73±2.575	<0.001*
T-test analysis of perception between Pharmacy students					
Sl. No.	Class	N	Mean±SD		Sig (*t*-test)
			Pre	Post	
1.	Pharm D	149	19.86±2.895	21.60 ±2.760	<0.001*
2.	B Pharm	200	19.24±3.008	21.40 ±.883	<0.001*
3.	M Pharm	52	21.54 ±2.429	22.62 ±2.180	0.009*
4.	D Pharm	116	12.21 ±3.202	20.24 ±3.009	<0.001*

*Significantly significant $p<0.05$

with the mean score shifting from 21.54 to 22.62. Conversely, the D Pharm group (n=116) saw a substantial increase from 12.21 to 20.24 (p<0.001). Results recommended presentable measures with substantial influence within the participants' values across all classes, with varying degrees of effect observed in each.

DISCUSSION

The predominance of female participants (56.67%) in this study is consistent with similar research in the field of pharmacy education, where women often represent a higher proportion of students. The age distribution, with a majority of participants being 21 years old, reflects the typical age range of pharmacy students as seen in the study by John *et al.*, which observed that the bulk of pharmacy students fell within the 20-22 age bracket.[11] The academic distribution, showing a greater number of undergraduate participants, is also aligned with findings by Suyagh *et al.*, who noted that undergraduate students often outnumber postgraduate students due to the larger cohort size in undergraduate programs.[12]

Our findings regarding knowledge improvement are consistent with Ramesh *et al.*, our study uniquely includes multiple pharmacy education levels and explores perception differences, providing broader insight into pharmacovigilance education in Indian pharmacy curricula. For instance, whereas study by Ramesh *et al.*, demonstrated a significant increase in pharmacovigilance awareness among pharmacy students after a structured educational program, with knowledge scores rising from 48% to 88% post-intervention.[13] This is comparable to the knowledge enhancement seen in our study, where correct responses for the full form of PvPI increased from 52.24% to 93.83%. Similarly, Rajesh *et al.*, reported a marked improvement in students' understanding of ADR reporting, which increased by nearly 40% after an educational intervention,[14] aligning closely with the 39.59% increase observed in our study. These comparisons strengthen the effectiveness of educational interventions in significantly enhancing pharmacovigilance knowledge among pharmacy students.

The positive shift in attitudes towards pharmacovigilance observed in this study is consistent with the findings of various

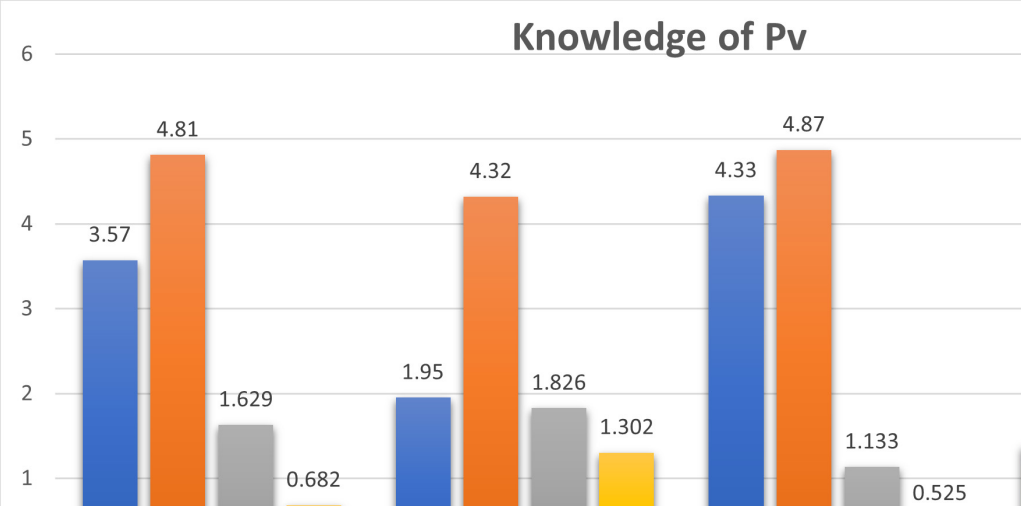

Figure 5: Knowledge of the Pharmacy students.

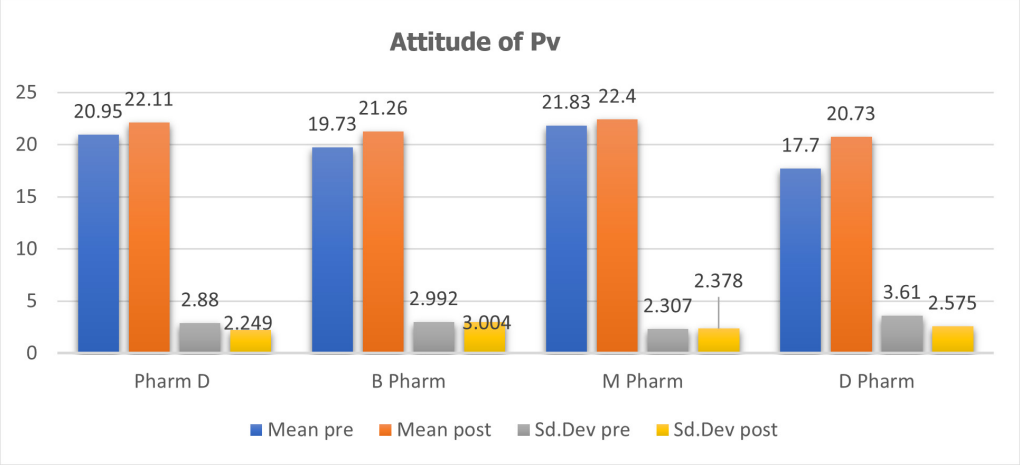

Figure 6: Attitude of the Pharmacy students.

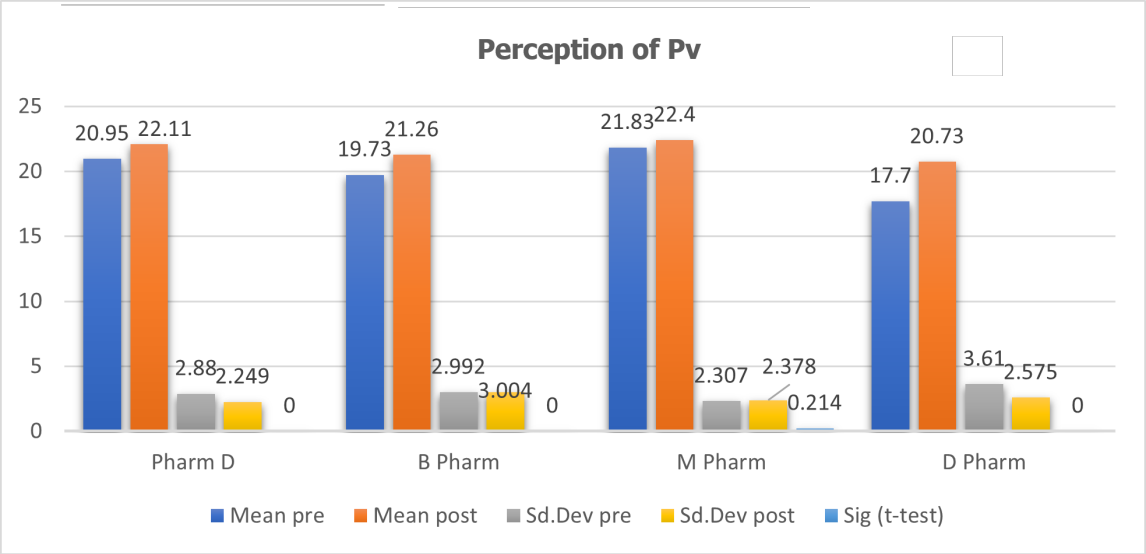

Figure 7: Perception of Pharmacy students.

other studies. For example, a study by Gupta *et al.*, reported that educational interventions led to a 15% increase in the number of students who strongly agreed that ADR reporting is beneficial,[15] a trend similar to the 10.83% increase observed in our study. Moreover, the reduced perception of ADR reporting forms as complex following the intervention in our study is boomed in the research by Inamdar *et al.*,[16] which found that training sessions significantly reduced the perceived difficulty of ADR reporting, thereby encouraging more active participation in pharmacovigilance activities.

The intervention's impact on changing perceptions, particularly regarding the need for greater awareness and the role of pharmacovigilance in drug development, aligns with findings from other studies. For instance, a study by Sharma *et al.*, reported a 20% increase in students' awareness of the importance of pharmacovigilance after an educational program,[17] closely matching the 17.41% increase in strong agreement observed in our study. Similarly, the enhanced perception of pharmacovigilance's impact on drug development in your study is supported by Jain *et al.*,[18] who found that students' recognition of the critical role of pharmacovigilance in ensuring drug safety increased significantly post-intervention.

The finding that PharmD students showed the highest levels of improvement across knowledge, attitude, and perception domains is consistent with existing literature. For example, a study by Patil *et al.*,[19] found that Pharm D students, due to their more extensive curriculum and clinical exposure, typically show greater improvements in pharmacovigilance-related knowledge and attitudes compared to B Pharm and M Pharm students. This trend is also seen in the research by Thomas *et al.*, which reported that Pharm D students demonstrated a more significant increase in understanding and engagement with pharmacovigilance practices following educational interventions than their peers in other pharmacy program.[20] PharmD students showed the highest improvement, likely due to their extended exposure to clinical settings and pharmacotherapeutic modules. This reflects the importance of integrating hands-on clinical training with pharmacovigilance education.

LIMITATIONS

A limitation of this study is the absence of a control group, which restricts the ability to conclusively attribute improvements to the educational intervention, as external learning influences cannot be ruled out. The sample was from one college, mostly urban and female, which limits generalizability. Future studies should include diverse, multi-centre populations.

CONCLUSION

This study emphasizes the value of targeted educational interventions in improving pharmacovigilance knowledge, attitudes, and perceptions among pharmacy students. The findings are consistent with numerous studies across different contexts, highlighting the universal applicability and effectiveness of such programs. The observed demographic trends and their influence on baseline knowledge, attitude and perceptions suggest that tailored approaches might be necessary to address specific needs within different student groups. Forthcoming study must last to discover various subtleties, predominantly directing the lasting retention of knowledge as well as its practical application in clinical field.

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ABBREVIATIONS

Pv: Pharmacovigilance; **ADRs:** Adverse Drug Reactions; **B Pharm:** Bachelor of Pharmacy; **D Pharm:** Diploma in Pharmacy; **WHO:** World Health Organization; **IPC:** Indian Pharmacopoeia Commission; **CDSCO:** Central Drugs Standard Control Organization; **NCC:** National Coordination Centre; **AMCs:** Adverse Drug Reaction Monitoring Centre; **ADEs:** Adverse Drug events; **PvPI:** Pharmacovigilance program of India; **KAP:** knowledge, attitude, and perception; **PvPI-Q:** Pharmacovigilance Questionnaire; **Pharm D:** Doctor in Pharmacy; **M Pharm:** Master of Pharmacy; **MoHFW:** Ministry of the Health and family Welfare; **SPSS:** Statistical Package for the Social Sciences; **Sd. Dev:** Standard Deviation; **SD:** Strongly disagree; **D:** Disagree; **N:** Neutral; **A:** Agree; **SA:** Strongly Agree; **N:** Number of participants.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

Pharmacovigilance (Pv) plays a vital role in ensuring drug safety by detecting and preventing (ADRs) i.e., Adverse Drug Reactions. Inside India, under-reporting as well as limited awareness among healthcare professionals led to the launch of the PvPI during 2010 into strengthen drug safety measures.

This study assessed 517 pharmacy students (B Pharm, D Pharm, M Pharm, and Pharm D) before and after an educational intervention on Pv. The results demonstrated a significant improvement in their knowledge, attitudes, and perceptions. Knowledge about PvPI increased from 52.24% to 93.83%, a finding consistent with previous studies. Similarly, the positive attitude towards ADR reporting rose from 76.4% to 94%, and awareness of pharmacovigilance's importance in drug safety improved from 77.58% to 94.42%.

The study also observed trends in participant demographics, with a higher proportion of female students (56.67%) and a predominant age group of 21 years, aligning with existing research in pharmacy education. Among different student groups, PharmD students showed the highest improvement, likely due to their clinical exposure and comprehensive curriculum.

These findings underscore the effectiveness of educational programs in enhancing pharmacovigilance awareness and reinforcing the need for structured training. Future examinations must be discovered long-standing understanding maintenance and practical submission in clinical settings to ensure continued improvements in ADR reporting and patient safety.

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