PHARMACY STUDENTS' KNOWLEDGE, ATTITUDE, AND PRACTICE CONCERNING DIABETES AND ITS LONG-TERM COMPLICATIONS - A CROSS-SECTIONAL STUDY

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ABSTRACT

Objectives: The purpose of the study is to examine pharmacy students' attitudes, knowledge, and behaviors related to diabetes mellitus, pinpoint any knowledge gaps, and evaluate their preparedness for patient education and effective treatment.

Methods: Their knowledge, attitudes, and practices (KAPs) on diabetes and its long-term effects were evaluated by a cross-sectional, questionnaire-based study. A validated self-administered questionnaire was used to collect data, which was then analyzed using Statistical Package for the Social Sciences at a significance level of $p<0.05$.

Results: The study involved 310 pharmacy students, including D. Pharm (n=48), B. Pharm (n=239), and M. Pharm (n=23) students. The survey found that the majority of pharmacy students had academic exposure to diabetes, with 91.29% having studied the topic. But there are still gaps in our understanding, especially when it comes to diabetic complications, dietary misunderstandings, and medication use ($p<0.000$). Attitudinal studies revealed considerable recognition of the pharmacist's function but little support for counseling training. Students lacked practical experience, particularly in drug interaction monitoring, counseling, and adhering to rules.

Conclusion: Pharmacy students demonstrated strong support for the pharmacist's role in management, statistically significant results ($p<0.05$) in the majority of knowledge categories, and good knowledge and favorable attitudes toward diabetes care. However, major gaps in practical experience, such as patient counseling and guideline adherence, underscore the importance of hands-on training, workshops, and community engagement in improving clinical competence.

Keywords: Diabetes, Pharmacy students, Complications, Knowledge, attitude, and practice.

INTRODUCTION

Diabetes mellitus is a chronic condition characterized by hyperglycemia caused by abnormalities in insulin secretion, insulin action, or both. Diabetes has grown from a small health issue to a worldwide epidemic in recent decades, with profound effects on people's lives and healthcare systems [1-3]. India, with its rapidly urbanizing population and changing lifestyle trends, has emerged as a global diabetes hotspot. The International Diabetes Federation 2021 estimates that 74.2 million adults in India have diabetes, and by 2045, that figure is projected to increase to 124.9 million, severely taxing the country's healthcare system [4,5]. The high frequency, along with delayed diagnosis and inadequate therapy, hastens the development of irreversible consequences. What makes the situation even more troubling is that a large number of people remain undiagnosed or undertreated, particularly in rural and semi-urban areas [6]. Diabetes is well-known for its long-term consequences, which include cardiovascular disease, nephropathy, neuropathy, retinopathy, and peripheral vascular disease. These conditions can severely degrade the quality of life and raise the chance of premature mortality [7].

Pharmacists, as one of the most accessible healthcare providers, have a unique ability to affect diabetes care. Their responsibilities have grown beyond typical drug administration to include patient education, lifestyle counseling, diabetes monitoring, and drug-related issue detection [8,9]. Given this increasing role, it is critical that pharmacy students –the profession's future – have a thorough understanding of diabetes care, a proactive mindset, and practical skills that mirror real-world clinical needs. Pharmacy students, as future healthcare professionals, play an important role in understanding and managing diabetes and its long-term implications [10]. They learn about the pharmacology, treatment, and lifestyle management of chronic diseases such as diabetes through academic training.

The study's objective is to analyze pharmacy students' knowledge, attitude, and practice (KAP) of diabetes mellitus and its long-term implications, as well as to identify any gaps in their understanding and readiness for successful diabetes treatment and patient education. This study aims to fill that gap by investigating pharmacy students' current levels of awareness and preparation. Furthermore, the study's findings are intended to inform curriculum modifications, encourage diabetes-related educational interventions, and eventually contribute to the overarching goal of improving diabetes care outcomes.

METHODS

Study design

A cross-sectional, questionnaire-based study was done to assess pharmacy students' KAP about diabetes and its long-term implications. The study design was chosen to provide a snapshot of current awareness levels and behavioral patterns within the target group at a given period.

Study setting

The study was conducted in Naharkanta, Bhubaneswar, Odisha, India, at Sri Jayadev College of Pharmaceutical Sciences. The institution provides diploma, bachelor's, and master's level pharmacy programs, making it an excellent venue for evaluating KAP at various academic levels.

Study population and sample size

The target population included pharmacy students enrolled in D. Pharm, B. Pharm, and M. Pharm courses at the college. Students of all years were eligible to participate, with the exception of those who refused consent or were absent during data collection. The study included a total of 310 students.

Study instrument

The data were collected using a standardized, self-administered questionnaire. The questionnaire was created using current research and professional advice in the disciplines of pharmacy education and diabetes. There were four sections to it demographic information The Knowledge Assessment consists of 10 closed-ended questions to assess comprehension of diabetes, its complications, and management. Attitude Assessment includes 10 questions to examine views and opinions regarding the role of pharmacists in diabetes treatment, patient counseling, and education. The Practice Assessment part includes 10 questions that analyze real-life behaviors such as counseling, checking medicines, lifestyle suggestions, and awareness activities. For simplicity and ease of analysis, each question provided "Yes," "No," and "Not Sure" response options.

Pilot testing and validation

The questionnaire was pilot-tested on a subset of 20 students to ensure its clarity, relevance, and comprehension. Minor adjustments were made in response to feedback. Cronbach's alpha was used to analyze the questionnaire's internal consistency, and it returned a result of 0.82, suggesting good reliability.

Ethical considerations

The study received ethical approval from the Institutional Ethics Committee. Participation was voluntary, and no personally identifiable information was collected.

Data analysis

The collected data was gathered and entered into Microsoft Excel, and statistical analysis was carried out using Statistical Package for the Social Sciences software version 20.0. Demographic information and KAP responses were compiled using descriptive statistics such as frequency and percentage. A $p<0.05$ indicated statistical significance.

RESULTS

A total 310 number of pharmacy students are participated in the present study.

Table 1 depicts the age distribution of pharmacy students; 49.03% of all respondents are between the ages of 20 and 22. Students under the age of twenty-one come next, making up 30.97% of the participants. A lower proportion of respondents (13.87%) are between the ages of 23 and 25, while those above the age of 25 account for only 6.13% of the total. Male respondents made up a considerable majority of the sample, including 187 out of the 310 people polled, or 60.32%. Female participants accounted for 123 of the total, or 39.68%. Notably, none of the participants chose "Prefer not to say," showing that all participants were eager to reveal their gender identification.

239 students, or 77.10% of the overall sample, were enrolled in the Bachelor of Pharmacy (B. Pharm) program, which made up the bulk of the 310 pharmacy students who participated in the study. This implies a substantial undergraduate representation, demonstrating the popularity and accessibility of the B. Pharm course. The Diploma in Pharmacy (D. Pharm) program had 48 participants, accounting for 15.48% of the total, indicating a modest but significant number of diploma-level students. At just 23, or 7.42% of the sample, the Master of Pharmacy (M. Pharm) program had the lowest representation. According to this distribution, the study largely represents the viewpoints of pharmacy undergraduate students, with relatively few observations from postgraduate and diploma programs.

Table 1: Demographic information of pharmacy students

Categories	Frequency (%)
Age	
Below 20	96 (30.97)
20–22	152 (49.03)
23–25	43 (13.87)
Above 25	19 (6.13)
Gender	
Male	187 (60.32)
Female	123 (39.68)
Prefer not to say	0 (0.00)
Course	
D. Pharm	48 (15.48)
B. Pharm	239 (77.10)
M. Pharm	23 (7.42)
Place of Residence	
Urban	101 (32.58)
Rural	209 (67.42)
Have you attended a workshop or seminar on diabetes?	
Yes	75 (24.19)
No	235 (75.81)
Do you have a close friend or family member with diabetes?	
Yes	126 (40.65)
No	184 (59.35
Did you study diabetes as part of your coursework?	
Yes	283 (91.29)
No	17 (5.48)
Not sure	10 (3.23)

Among the 310 survey participants, 209 (67.42%) reported living in rural areas. On the other hand, 101 pupils, or 32.58% of the sample, were from urban areas.

Of the 310 participants, 75 students (24.19%) said they have gone to a workshop or seminar about diabetes. 235 students, or 75.81 percent of the respondents, however, stated that they had not taken part in any such activities.

A total of 40.65% of participants reported having a family member or close friend with diabetes, indicating a high level of personal exposure to the disease. However, 59.35% of the participants reported that none of their close friends or family members had diabetes, indicating that most people had little firsthand knowledge of the condition.

The majority of participants (91.29%) reported that they have studied diabetes as part of their education, indicating significant academic exposure to the subject. In the meantime, 3.23% were unsure, and 5.48% said they had not included diabetes in their research.

When asked if they knew the usual range for fasting blood glucose levels, 76.45% of participants said "Yes," showing they were aware of the correct range. However, 15.48% answered "No," indicating a lack of understanding in this area, while 8.06% said "Not Sure," indicating confusion ($p<0.000$).

When asked whether Type 2 diabetes is an autoimmune disorder, 85.81% of participants said "Yes," suggesting a misunderstanding of the ailment. Only 8.06% correctly responded "No," and 6.13% said "Not Sure" ($p<0.000$). Since Type 2 diabetes is predominantly a metabolic disorder rather than an autoimmune one, this reveals a significant knowledge gap and points to the need for more precise education regarding the pathophysiology and classification of diabetes.

A total of 41.29% of participants correctly identified that uncontrolled diabetes can cause kidney failure, indicating some grasp of its implications. However, 24.52% of students said "No," and 34.19% said "Not Sure," suggesting that many pupils are unaware of this grave effect ($p<0.001$).

Table 2: A knowledge assessment of diabetes and its complications among pharmacy students

Question	Yes (%)	No (%)	Not sure (%)	p-value
Do you know what the normal range is for fasting blood glucose levels?	237 (76.45%)	48 (15.48%)	25 (8.06%)	0.000
Is type 2 diabetes an autoimmune disorder?	266 (85.81)	25 (8.06)	19 (6.13)	0.000
Can uncontrolled diabetes cause kidney failure?	128 (41.29)	76 (24.52)	106 (34.19)	0.001
Is neuropathy a frequent diabetic complication?	149 (48.06)	59 (19.03)	102 (32.90)	0.000
Can diabetes impair vision and lead to blindness?	98 (31.61)	113 (36.45)	99 (31.94)	0.506
Are oral hypoglycemic medications effective for all diabetes patients?	274 (88.39)	19 (6.13)	17 (5.48)	0.000
Is insulin therapy required for all Type 2 diabetics?	46 (14.84)	137 (44.19)	127 (40.97)	0.000
Is it safe to consume fruits while you have diabetes?	66 (21.29)	154 (49.68)	90 (29.03)	0.000
Is foot ulceration a dangerous side effect of diabetes?	182 (58.71)	97 (31.29)	31 (10.00)	0.000
Are you aware of the signs and symptoms of hypoglycemia?	195 (62.90)	27 (8.71)	88 (28.39)	0.000

Table 3: Attitude assessment on diabetes and its complications among pharmacy students

Question	Yes (%)	No (%)	Not sure (%)	p-value
Do you believe pharmacists play a significant role in diabetes management?	153 (49.35)	118 (38.06)	39 (12.58)	0.000
Should pharmacy students receive training in diabetic counseling?	42 (13.55)	184 (59.35)	84 (27.10)	0.000
Are you confident in advising diabetic patients on their medications?	98 (31.61)	119 (38.39)	93 (30.00)	0.159
Is it necessary to teach diabetic patients about lifestyle changes?	196 (63.23)	78 (25.16)	36 (11.61)	0.000
Do you believe community pharmacists contribute to a reduction in complications?	143 (46.13)	99 (31.94)	68 (21.94)	0.000
Should pharmacists often check for diabetic complications?	175 (56.45)	44 (14.19)	91 (29.35)	0.000
Do you believe that medications alone are sufficient for diabetic management?	173 (55.81)	91 (29.35)	46 (14.84)	0.000
Would you address a patient's misconception about diabetes?	201 (64.84)	83 (26.77)	26 (8.39)	0.000
Should diabetics be referred to a specialist for complications?	224 (72.26)	39 (12.58)	47 (15.16)	0.000
Do you think diet and exercise are as important as medications?	273 (88.06)	14 (4.52)	23 (7.42)	0.000

Table 4: Practice assessment of diabetes and its complications among pharmacy students

Question	Yes (%)	No (%)	Not sure (%)	p-value
Do you find drug interactions in diabetic prescriptions?	63 (20.32)	94 (30.32)	153 (49.35)	0.000
Have you ever counseled a patient with diabetes?	51 (16.45)	167 (53.87)	92 (29.68)	0.000
Do you educate consumers about the adverse effects of medications?	109 (35.16)	89 (28.71)	112 (36.13)	0.220
Do you explain to patients how to treat hypoglycemia?	156 (50.32)	74 (23.87)	80 (25.81)	0.000
Do you recommend that people monitor their glucose levels frequently?	214 (69.03)	61 (19.68)	35 (11.29)	0.000
Do you talk to patients who have diabetes about foot care?	137 (44.19)	152 (49.03)	21 (6.77)	0.000
Have you taken part in events promoting diabetes awareness?	99 (31.94)	127 (40.97)	84 (27.10)	0.010
Do you recommend lifestyle adjustments for diabetic patients?	231 (74.52)	22 (7.10)	57 (18.39)	0.000
Do you follow the latest diabetes guidelines?	7 (2.26)	244 (78.71)	59 (19.03)	0.000
Do you educate patients about drug adherence?	217 (70.00)	51 (16.45)	42 (13.55)	0.000

When asked if neuropathy is a common consequence of diabetes, 48.06% of participants said "yes," indicating some awareness of the issue. However, 19.03% said "No," and 32.90% said "Not Sure," suggesting that a sizable portion of students are either ignorant of or unsure about this well-known dilemma (p<0.000).

Participants' inadequate knowledge of diabetic retinopathy and associated eye issues like impaired vision, and blindness is evident from the fact that only 31.61% of them properly answered "Yes" when asked if diabetes can impair vision and cause blindness. Of those who responded, 36.45% said "No," and 31.94% said "Not Sure" (p<0.506).

The majority of participants, 88.39%, answered "Yes" to the question of whether oral hypoglycemic medications work for all diabetic patients, demonstrating a widespread misperception. These drugs work best for Type 2 diabetes and are not appropriate for Type 1 diabetes in particular. Only 6.13% correctly responded, "No," whereas 5.48% said "Not sure" (p<0.000).

Just 14.84% of participants thought that all Type 2 diabetic patients needed to receive insulin therapy, whereas 44.19% of participants correctly replied "No," realizing that insulin is not always necessary and is typically taken into consideration when oral drugs are not enough. However, a sizable percentage – 40.97%—said "Not Sure," indicating significant uncertainty (p<0.000).

When asked if a diabetic can eat fruits, only 21.29% of participants said "yes," highlighting a frequent misperception regarding dietary limitations in diabetes. A higher percentage (49.68%) thought that fruits should be avoided, whereas 29.03% said they were "Not Sure" (p<0.000). This demonstrates a severe lack of understanding regarding good nutritional control, as fruits, when chosen intelligently and consumed in moderation, can be part of a healthy diabetic diet.

58.71% of participants correctly identified foot ulcers as a significant complication of diabetes, suggesting a moderate level of awareness. While 10.00% said they were "Not Sure," and 31.29% said "No," it appears that many students are either ignorant of or undervalue the seriousness of diabetic foot issues (p<0.000). This emphasizes the importance of including diabetes-related problems in their instruction.

According to the majority of participants (62.90%), they are fairly aware of the symptoms and indicators of hypoglycemia, an acute consequence of diabetes. However, 28.39% said they were "Not Sure," and 8.71% said they "No," indicating that a sizable percentage of pupils might not be confident or knowledgeable enough to recognize hypoglycemia (p<0.000) (Table 2).

Participants acknowledged the pharmacist's involvement in patient education, medication adherence, and lifestyle counseling, with 49.35% of the participants agreeing that pharmacists are useful in managing diabetes. However, 38.06% said "No," and 12.58% said "Not Sure,"

suggesting that a sizable percentage of students might not recognize or appreciate the pharmacist's potential contribution to comprehensive diabetes care (p<0.000).

Only 13.55% of participants agreed that diabetes counseling should be taught to pharmacy students, whereas 59.35% of respondents said "No," and 27.10% said "Not Sure." The significance of counseling skills in managing diabetes is not well understood, as evidenced by this (p<0.000). Given the pharmacist's increased role in patient education and chronic disease management, our findings highlight the importance of promoting and integrating diabetic counseling training within the pharmacy curriculum.

Only 31.61% of participants said they were confident in their ability to advise diabetic patients about their medication, compared to 38.39% who said "No" and 30.00% who said "Not Sure" (p<0.159). This suggests that most students are either insecure or unsure about giving advice regarding medications, underscoring the need for greater hands-on experience and education in diabetes care to increase competency and confidence in patient counseling.

The majority of participants (63.23%) agreed that educating diabetic patients about lifestyle modifications is vital, indicating a strong knowledge of the value of non-pharmacological therapies in diabetes care. However, 25.16% responded "No," and 11.61% said "Not Sure," implying that a sizable proportion of students may be unaware of the role of lifestyle changes such as diet, exercise, and stress management in diabetes management (p<0.000).

Community pharmacists are moderately recognized for their role in providing continuous care and support, as seen by the 46.13% of participants who thought they helped diabetic patients avoid complications. However, 31.94% responded "No," and 21.94% said "Not Sure," indicating that a large proportion of students may be unaware of the role community pharmacists can play in reducing problems through patient education, medication management, and routine monitoring (p<0.000).

The majority of participants (56.45%) agreed that pharmacists should consistently monitor for diabetic complications, demonstrating an understanding of the proactive role pharmacists should play in diabetes care. However, 14.19% responded "No," and 29.35% said "Not Sure," implying that a sizable proportion of students may not completely understand the necessity of regular monitoring in preventing or managing issues (p<0.000).

A total of 55.81% of participants believed that medicine alone was adequate for diabetes control, indicating a frequent misperception. On the other hand, 29.35% of respondents accurately said "No," acknowledging that lifestyle modifications, consistent monitoring, and patient education are also necessary for optimal diabetic care. Furthermore, 14.84% said they were "Not Sure," which suggests some hesitancy (p<0.000).

The majority of participants (64.84%) said they would correct a patient's misconception regarding diabetes, demonstrating a positive attitude toward patient education and advocacy. However, 26.77% said "No," and 8.39% said "Not Sure," implying that a sizable proportion of students may lack confidence or be unsure about intervening in such situations (p<0.000).

A large majority of participants (72.26%) agreed that diabetics should be referred to experts for complications, indicating a good understanding of the necessity of multidisciplinary treatment in diabetes management. However, 12.58% responded "No," and 15.16% said "Not Sure," showing that some students may not completely understand the importance of specialist involvement in addressing complex or advanced cases (p<0.000).

A large percentage of participants (88.06%) agreed that diet and exercise are just as important as medication in diabetes care, suggesting a good understanding of the importance of lifestyle changes in addition to pharmacological treatment. Only 4.52% said "No," while 7.42% said "Not Sure," showing that a small percentage of students may still underestimate the importance of non-medication solutions (p<0.000) (Table 3).

Only 20.32% of participants said they check for drug interactions in diabetic prescriptions, demonstrating a lack of interest in this important component of pharmaceutical management. The majority of respondents—49.35%—were "Not Sure," but a bigger percentage (30.32%) said "No," indicating a critical awareness or practice gap (p<0.000).

Only 16.45% of participants claimed having ever counseled a diabetic patient, whereas 53.87% said "No," and 29.68% said "Not Sure." This suggests that the students have minimal hands-on experience with patient counseling, which is critical for good diabetes control (p<0.000).

Only 35.16% of participants reported that they educate patients about drug side effects, indicating that a small minority actively participates in this critical area of patient care. Meanwhile, 28.71% answered "No," and 36.13% said "Not Sure," indicating a significant lack of interest or confidence in discussing medication safety (p<0.220).

Half of the participants (50.32%) said they explain how to control hypoglycemia to patients, indicating a moderate level of involvement in patient education about this important aspect of diabetes management. However, 23.87% responded "No," and 25.81% said "Not Sure," implying that a sizable proportion of students may lack the confidence or knowledge to properly counsel patients on treating low blood sugar episodes (p<0.000).

The majority of participants (69.03%) said they would recommend regular glucose monitoring to patients, indicating a solid understanding of its usefulness in effective diabetes care. However, 19.68% responded "No," and 11.29% said "Not Sure," indicating that a significant proportion of pupils may not consistently highlight or comprehend the importance of routine monitoring (p<0.000).

Only 44.19% of participants reported discussing foot care with diabetic patients, implying that fewer than half address this critical aspect of diabetes management. A significantly higher number, 49.03%, answered "No," while 6.77% said "Not sure" (p<0.000). This shows that foot care – a critical preventive step against catastrophic consequences such as ulcers and amputations – is frequently missed in patient counseling, emphasizing the need to incorporate this topic more prominently into pharmacy training programs.

Only 31.94% of participants reported having taken part in diabetes awareness events, with 40.97% saying "No" and 27.10% saying "Not Sure" (p<0.010). These findings show a lack of involvement in diabetes outreach or education activities, highlighting the need for increased opportunities and incentives for students to participate in community awareness programs that improve both public health impact and professional growth.

The majority of participants (74.52%) said they recommend lifestyle changes to diabetic patients, indicating a strong understanding of the value of non-pharmacological therapies in diabetes care. The fact that 7.10% of students said "No," and 18.39% said "Not Sure," suggests that although the majority of students understand the need for lifestyle advice, a small but significant percentage may still be unsure or unclear about how to give it (p<0.000).

Only 2.26% of participants reported staying current with the latest diabetic recommendations, while the great majority—78.71%—responded "No," and 19.03% said "Not Sure." This demonstrates a major gap in keeping up with changing clinical practices, which is critical for providing evidence-based care (p<0.000).

70.00% of participants said they teach patients how to take their medications as prescribed, demonstrating a high commitment to encouraging diabetics to receive consistent and efficient care. However, 16.45% responded "No," and 13.55% said "Not Sure," implying that some students may still lack confidence or experience in dealing with this critical part of diabetes management (p<0.000) (Table 4).

DISCUSSION

In our study, nearly half (49.03%) of pharmacy students were between the ages of 20 and 22, with the majority being under the age of 21; males made up 60.32% of the respondents. According to a 2015 estimate, nearly half of pharmacy students (48%) were 25 or younger, with females accounting for 61.4% of the student population [11]. Similarly, a 2017 research found that 62.5% of Pharm. D. students were female [12]. In addition, 65.7% of pharmacy students in their last year were female, according to 2021 research [13]. Demographic compositions vary across locations and institutions, influenced by recruitment methods and societal trends.

The study found that 77.10% of participants were B. Pharm students, showing a significant undergraduate representation. The percentage of D. Pharm and M. Pharm students was 15.48% and 7.42%, respectively. As of 2007, India has 854 B. Pharm institutions that admitted over 52,000 students each year, compared to 583 D. Pharm institutes that admitted over 34,000 students each. This demonstrates the B. Pharm course's accessibility and popularity [14]. The study's low M. Pharm student representation (7.42%) reflects a larger trend of fewer students seeking advanced pharmacy degrees than undergraduate programs.

In a recent study, 67.42% of participants were from rural areas, versus 32.58% from urban regions. This differs from national trends in India, where only about 23% of healthcare workers service rural areas, which account for nearly 71% of the population [15]. Your study's larger percentage of rural participants might be the result of focused recruiting or certain institutional characteristics.

The study found that just 24.19% of participants attended a diabetes-related workshop or seminar, while 75.81% did not, which is consistent with previous studies indicating poor participation in diabetes education programs. Work commitments, family duties, transportation challenges, and inconvenient session hours were among the reasons for non-attendance. Low attendance rates are also caused by those who undervalue the seriousness of diabetes or think they already know enough about it [16,17]. Studies indicate that experiential learning initiatives enhance pharmacy students' proficiency and self-assurance in managing diabetes; nonetheless, enrollment remains low. Including systematic diabetes education in the pharmacy curriculum may increase student involvement and preparation [18].

According to a 2009–2014 National Health and Nutrition Examination Survey (NHANES) study, around 29.5% of American adults said they had a family history of diabetes [19]. Individuals with a family history of diabetes had significantly increased odds of having the disease themselves, highlighting the importance of family history as a risk factor [20]. Similarly, a study of Sri Lankan adults found that people with a family history of diabetes had a higher prevalence of the disease (23.0%) than those without (8.2%). According to the study, the more family members who were impacted, the higher the risk [21]. In this study, 40.65% of participants had a family member or close acquaintance with diabetes, indicating a high level of exposure to the condition.

In a recent study, 91.29% reported studying diabetes during their education, showing extensive academic exposure; 5.48% did not, and 3.23% were unsure. This is consistent with data from Canadian pharmacy schools, where diabetes education ranged from 18 to 43.5 h, with an average of 25.3 h, indicating its importance in the curriculum [22]. Furthermore, incorporating diabetes certificate programs into pharmacy curricula has been found to increase students'

knowledge and confidence in diabetes treatment, highlighting the relevance of comprehensive diabetes education in educating future pharmacists [23].

In a poll about typical fasting blood glucose levels, 76.45% of individuals reported awareness, 15.48% said "No," and 8.06% were unsure, indicating knowledge gaps. While 85.2% of students at Maharishi Markandeshwar College of Pharmacy reported knowing about diabetes mellitus, only 70% correctly identified increasing thirst as a symptom, indicating a superficial awareness, according to a study conducted there [24]. The need for improved educational interventions was also highlighted by a study conducted by King Saud University, which found that although many pharmacy students thought they understood diabetes, a significant percentage did not [25].

Type 2 diabetes is a metabolic disorder characterized by insulin resistance and inadequate insulin, as opposed to Type 1 diabetes, which is an autoimmune disease in which the immune system attacks pancreatic beta cells. Latent autoimmune diabetes in adults, also known as Type 1.5 diabetes, might obscure the diagnosis because it shares characteristics with both types [26]. According to the study, 85.81% of people mistakenly think that Type 2 diabetes is an autoimmune disease, while just 8.06% of respondents correctly answer that it is not, and 6.13% are still unsure.

Only 41.29% of participants recognized the link between uncontrolled diabetes and kidney failure, with 24.52% saying "No" and 34.19% unclear (p<0.001). This highlights students' lack of awareness regarding the significant repercussions of diabetes. This is consistent with research showing that 60.2% of participants did not know anything about diabetic nephropathy, one of the main causes of kidney failure [27]. Similarly, studies in Poland discovered that public awareness of diabetic complications, particularly renal illness, is still poor, underlining the need for specific educational efforts [28].

According to a study done in Taif City, Saudi Arabia, 83.9% of participants had never heard of diabetic neuropathy, which suggests that the ailment is not well known [29]. Similar findings highlighted the need for improved educational activities when Type-II diabetics in Khartoum, Sudan, were found to have little understanding about diabetic neuropathy [30].

For example, a study conducted in Riyadh, Saudi Arabia, found that a significant majority of diabetic patients were unaware of diabetic retinopathy and its potential to induce visual impairment [31]. Similarly, a study in North India discovered a lack of awareness among diabetic patients about the ocular consequences of diabetes, underlining the need for improved educational activities [32].

According to our research, a lot of people erroneously believe that oral diabetes drugs are effective for all diabetic patients. Only 6.13% said "No," and 5.48% said they were not sure. This suggests that diabetes treatment education has to be improved. Individuals with Type 1 diabetes require insulin, but Type 2 diabetics can control their illness with a variety of drugs, including oral treatments. 33. This emphasizes the need for focused educational programs to make clear the various treatment modalities for diabetes types. Insulin therapy is often indicated for Type 2 diabetics when lifestyle adjustments and oral drugs fail to control blood glucose levels [32]. It indicates that insulin therapy is not required for all people with Type 2 diabetes.

This study highlights a significant misunderstanding regarding diabetes nutrition, even though fruits, when eaten in moderation, are a component of a balanced diabetic diet. According to a different survey, 64% of diabetic patients think that all fruits and fruit drinks are beneficial. They might not be aware, however, that some fruits with a high sugar level need to be avoided [33-35]. Another study indicated that 61.3% of physicians advised diabetes patients to avoid fruits such as mangoes, bananas, and grapes, indicating widespread

misconceptions even among healthcare providers [36]. The study found that eating more fruit is linked to a lower incidence of type 2 diabetes, highlighting the fact that, when eaten in moderation, fruits can complement a diabetic's diet [37].

This finding was verified by a study that revealed that, while many patients were aware of foot care, a thorough grasp of diabetic foot problems was absent [38]. These findings highlight the critical need to include careful education on diabetes-related complications, particularly foot care, in medical college curriculum to ensure that healthcare personnel are well-equipped to successfully manage and prevent such difficulties. According to recent studies, a large fraction may not be appropriately prepared to detect hypoglycemia. This data is congruent with a study performed in South India, which indicated that while 66.1% of type 2 diabetic patients demonstrated adequate understanding of hypoglycemia symptoms, a large percentage were uninformed of crucial factors such as target blood glucose levels and consequences [39].

This outcome is consistent with a study that highlighted pharmacists' critical role in diabetes care through patient identification, education, and monitoring [40]. According to the study, pharmacists can greatly enhance patient outcomes by educating patients about diabetes and its consequences, medication adherence, and lifestyle changes. This study demonstrates a lack of awareness regarding the need of counseling skills, despite pharmacists' rising role in diabetes management. Incorporating diabetes-focused training into pharmacy programs has also been demonstrated to improve patient outcomes. An interventional trial found that clinical pharmacist-led diabetes education significantly increased medication adherence in patients with type 2 diabetes mellitus, underlining pharmacists' vital role in patient education and chronic disease treatment [41].

This study reveals a considerable lack of confidence among pharmacy students about diabetes medication advising. Studies show that practical diabetic education can improve pharmacy students' confidence and competency. Furthermore, a study revealed no relationship between student pharmacists' confidence and understanding of diabetes self-management, indicating the need for additional training [42]. Most participants recognized the importance of educating diabetic patients about lifestyle changes, showing a strong understanding of non-pharmacological therapy. The authors emphasized that comprehensive education on lifestyle interventions is crucial for pharmacy students to counsel patients effectively. Another study highlighted pharmacists' key role in promoting lifestyle changes for diabetes management, suggesting that properly trained pharmacists can significantly impact diabetic patients. Most participants recognized the importance of educating diabetic patients about lifestyle changes, showing a strong understanding of non-pharmacological therapy. The authors emphasized that comprehensive education on lifestyle interventions is crucial for pharmacy students to counsel patients effectively. Another study highlighted pharmacists' key role in promoting lifestyle changes for diabetes management, suggesting that properly trained pharmacists can significantly impact diabetic patients.[43].

According to a study, although pharmacy students were aware of the signs and consequences of diabetes, they were ignorant about the role of pharmacists and preventative strategies. Another study found that students' awareness of obesity and diabetes was lacking, underscoring the need for specialized instructional materials to help them better comprehend and manage these disorders [44].

Participants indicated positive sentiments that were consistent with earlier findings. According to one survey, the majority of pharmacy students could recognize the main signs of diabetes. Similarly, a Ugandan study showed that 86% of college students were generally aware of the indications of diabetes [45]. However, the number of unclear or hesitant respondents demonstrates the need for increased education.

Another South Indian study showed that pharmacist counseling greatly improved patients' diabetic habits and understanding, confirming the importance of focused training to improve future pharmacists' diabetes care skills [46]. Many students were confused or uninvolved in important diabetes care areas, such as counseling, checking interactions, and teaching on side effects. This suggests significant gaps in practical training. Existing data supports the limited involvement of pharmacy students in essential areas of diabetes treatment, such as counseling, drug interactions, and side effect education. Significant gaps in students' comprehension and practice have been identified, underlining the need for greater hands-on diabetes management instruction. Furthermore, research has demonstrated that although students may have a general understanding of diabetes, they still require improvement in their attitudes and abilities regarding prevention, complications, and patient education [47].

The study found that the majority of participants had a solid awareness of diabetes treatment in areas such as medication adherence (70%), lifestyle guidelines (74.52%), and glucose monitoring (69.03%). However, there were large gaps in foot care counseling (44.19%), awareness program participation (31.94%), and adhering to guidelines (2.26%). These patterns are consistent with earlier studies, such as one conducted in the United Arab Emirates that found good attitudes toward care but low diabetes awareness among patients [48]. Similarly, studies have indicated that individuals with inadequate knowledge and habits for diabetic foot care have a higher risk of foot problems. Furthermore, research has shown that educational interventions can dramatically enhance patients' knowledge and practices about diabetes care [49].

CONCLUSION

According to our research, pharmacy students showed a generally high level of knowledge, especially about the nature of diabetes and its long-term effects, as evidenced by statistically significant answers (p<0.05) to the majority of knowledge-based questions. Their attitudes were likewise mainly positive, particularly regarding the pharmacist's involvement in diabetes management and the significance of lifestyle changes. However, practice-related responses revealed major gaps, particularly in patient counseling, awareness event attendance, and adherence to revised diabetes guidelines, with certain responses exhibiting non-significant heterogeneity. These results imply that although attitude and theoretical knowledge are positive, there is an urgent need to close the knowledge gap in clinical practice. To improve students' practical experience and self-assurance in efficiently managing diabetes patients, future initiatives should concentrate on including frequent seminars, community outreach initiatives, and hands-on diabetic care training in the pharmacy curriculum.

AUTHOR'S CONTRIBUTIONS

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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