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**Original Research**

# An evaluation of pharmacy students' knowledge, attitudes and risk perceptions about HIV/AIDS

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**Abstract**

**Background:** Despite considerable progress in diagnosis, treatment, and prevention, human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) remain major public health issues in Saudi Arabia. Pharmacists must possess adequate knowledge and professional attitudes towards HIV/AIDS in pharmacy practice. This study aimed to examine pharmacy students' level of HIV knowledge, their attitudes toward people living with HIV/AIDS (PLWHA), and their risk perceptions when providing services to PLWHA. **Methods:** A descriptive cross-sectional survey tool was developed and administered to pharmacy students during their final academic year at Taibah University in Saudi Arabia. Descriptive and Pearson's Chi-Square Test or Fisher's Exact Test as appropriate, were performed to find the difference with a p-value of 0.05. **Results:** A total of 130 pharmacy students responded to the questionnaire (89.6% response rate). While descriptive results showed students' knowledge about HIV/AIDS was low (the mean knowledge score was 8.22 out of 15). Post-exposure prophylaxis was only known by 36.2% of pharmacy students, and the time it takes HIV to become AIDS was only known by 11.5%. More than half of the students (60.8%) did not realize that antivirals could not treat HIV/AIDS. Only 18.5% of students agreed they could counsel and treat HIV-positive people. A survey of pharmacy students found that 46.2% believed that they did not receive enough education on working with PLWHA in a safe and responsible manner, and 20% were unwilling to assist PLWHA. Among pharmacy students, 54.6% recommended HIV testing for healthcare professionals and 53.9% for patients before surgery. **Conclusion:** The study highlighted inadequate students' knowledge, modest attitudes, and negative risk perceptions toward HIV/AIDS. Saudi Arabian educational institutions and health care planners should perform educational interventions to enhance HIV/AIDS understanding among healthcare students.

**Keywords:** pharmacy student; saudi arabia; acquired immunity deficiency syndrome; human immunodeficiency virus; attitude; knowledge

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## INTRODUCTION

Globally, the Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) are acknowledged as major public health problems. As of 2021, almost 38.4 million individuals worldwide are estimated to be living with HIV and 650 thousands have died from AIDS-related illnesses.[1]

The first HIV case in Saudi Arabia was reported in 1984[2], and rates increased steadily until 2006, when they stabilized. By the end of 2018, 6,744 people were living with HIV and knowing their status.[3] While the prevalence of HIV in Saudi Arabia is one of the lowest globally[4], the actual prevalence may be higher than that due to slow reporting in Saudi Arabia as a result of societal, cultural, taboo, and religious factors.[5]

Several efforts and resources are coordinated by the Joint United Nations Program on HIV/AIDS (UNAIDS) in partnership with governments and non-governmental organizations around the world to help minimize the spread of the infection and to provide medications to those already infected.[6] A study conducted by Seacat et al in 2009 aimed to examine the potential link between the attribution of HIV infection and dental students' personal and professional attitudes towards those living with HIV/AIDS (PLWHA), and their level of knowledge about the condition.[7] The study found that dental students who attributed HIV infection to personal responsibility and had less knowledge of HIV were more likely to hold negative attitudes towards PLWHA. As a result of this association, HCPs

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have been required to review their practices to learn about current HIV/AIDS knowledge, including transmission methods, diagnosis, treatment options, and monitoring.[8-10]

As PLWHA care activities increase, pharmacists have the opportunity to engage more actively with this community.[10] Studies found that pharmacists are involved in HIV-positive patients' care, it leads to better patient outcomes. This includes improved adherence, reduced pill burden, and dosing frequency, higher viral suppression rates, and fewer medication errors.[11-13] The American System-Health Pharmacists (ASHP) added pharmacists can help connect PLWHA to their community, improving adherence to care and antiretroviral therapy.[14] Thus, pharmacy students should know all aspects of HIV/AIDS treatment, including infection control.[15] Furthermore, pharmacy and other healthcare students should remain knowledgeable about HIV/AIDS, given the current HIV/AIDS epidemic.[16-18]

Saudi health professions students' knowledge, attitudes, practices, or behaviors regarding HIV/AIDS have been assessed in numerous studies so far.[17-19] However, it remains unclear whether negative attitudes among Saudi pharmacists and pharmacy students affect their willingness to treat HIV/AIDS patients.

Researchers worldwide have discovered that many educational and practical programs have shown promising results regarding increasing knowledge of HIV/AIDS and rising confidence in counseling patients.[20-22] Kamiru et al. demonstrated that an HIV/AIDS training program increases HCPs' knowledge about antiretroviral therapy and their positive attitudes toward PLWHA.[23]

The introduction of antiretroviral therapy, along with better educational efforts aimed at the public and healthcare professionals, may have led to changes in the knowledge and attitudes of pharmacy students towards people living with HIV/AIDS over the past decade. Therefore, this study aims to expand existing research by examining pharmacy students' level of HIV knowledge, their attitudes toward PLWHA, and their risk perceptions when providing services to PLWHA.

## MATERIAL AND METHODS

### Study Design and Study Population

A cross-sectional study was conducted among final-year pharmacy students at Taibah University in Saudi Arabia. The survey was not based on any formal sampling technique. Instead, all pharmacy students in their final academic year were invited to participate in an online survey. A link to the questionnaire was shared with the participants through pharmacy student WhatsApp groups.

During the first semester of the academic year 2022/2023, approximately 150 pharmacy students were in their final year of study. The required target size was determined using the Raosoft sample size calculator.[24] To achieve a 50% response rate, a 95% confidence interval, a 5% margin error, and a design effect of 1.0, a minimum sample size of 109 was calculated. Taibah University's College of Pharmacy offers a 5-year bachelor's program that spans 15 semesters. In the 4th year of the program, students learn about managing and treating HIV/AIDS patients in pharmacy practice through the course "Infectious Diseases Applied Pharmacotherapy."

### Survey Instrument and Data Collection

The survey questionnaire used for this study was built and refined through an iterative process, using existing literature, clinical expertise of the research team and discussions with collaborating infectious diseases researcher from other health institutions across Saudi.[7, 15, 19, 25] The survey was conducted in English using the Google Forms platform, consisting of four sections, to gather information on students' demographics, knowledge, attitude, and risk perception about HIV/AIDS. The first section collected data on age and gender. The second section comprised 15 questions in a "Yes," "No," or "I don't know" format to evaluate the student's knowledge of HIV/AIDS. The third section had five items in a "Strongly Disagree," "Disagree," "Neutral," "Agree," or "Strongly Agree" format to assess the student's overall attitude toward HIV/AIDS. The fourth section had five items in a "Strongly Disagree," "Disagree," "Neutral," "Agree," or "Strongly Agree" format to evaluate their risk perception of HIV/AIDS.

In the knowledge section, a score of 1 was assigned for each correct response (yes), while a score of 0 was given for incorrect answers (no and I do not know). The student's overall knowledge score was then categorized using Bloom's cut-off point of 1968[26], with a score of 12 to 15 being considered good, 9 to 11.9 being moderate, and less than nine being poor.

The attitude and risk perception sections had five questions with a total score of 25. Scores were calculated based on the student's responses to each attitudinal or risk perception statement, with one indicating "strongly disagree" and five indicating "strongly agree." The total score ranged from 5 to 25, with a high score indicating positive attitudes or risk perception.[26] For negatively phrased attitude or risk perception items, scores were re-coded, with five indicating "strongly disagree" and one indicating "strongly agree."

### Validity and Reliability of the Study Questionnaire

The questionnaire used in the study underwent a thorough review by three experienced researchers who specialize in researching infectious diseases. These researchers, consisting of two clinical pharmacists and one academic pharmacist, assessed each item's relevance using a Likert scale ranging from 1 to 5, with 1 indicating unimportance and five denoting high importance. Any items deemed irrelevant by all three researchers were excluded, while those considered relevant or highly relevant were preserved. If there were any ambiguous items, the researchers resolved them through discussion and agreement.

Before the official survey, six pharmacy students were randomly selected to test the questionnaire for clarity and comprehension. However, these students were not involved in the final study. The questionnaire was found to be clear, and no



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changes were necessary. To ensure the stability of the scores, the test-retest method was used. Nine pharmacy students were asked to answer the questions twice, with a short interval of 30 minutes to 1 hour between rounds. Previous studies showed that acceptable coefficients were set a prior as >80%.[27, 28] Cronbach's alpha statistics were used to assess the internal consistency of the study tool, with a value of 0.6 to 0.8 deemed acceptable.[29]

### Statistical Analysis

Before conducting any analysis, we ensured that the collected data was thoroughly checked for completeness and cleaned. SPSS version 27 was used to analyze the data. For descriptive analysis, we employed frequency, percentage, mean, and standard deviation, while for categorical analysis, we used Pearson's Chi-Square ($\chi^2$) or Fisher's Exact Test as appropriate. We considered a P-value of less than 0.05 statistically significant for comparing the association between variables.

### Ethical Approval and Consent to Participate

The students participated in the study voluntarily without any incentive offered. The ethical research committee of the College of Pharmacy at Taibah University granted ethical clearance with the identification number (COPTU-REC-52-20220110). Prior to enrolling in the study, all participants provided written informed consent and were briefed on the study's purpose. Only those who consented were included in the study.

## RESULTS

### Stability of Scores and Internal Consistencies

After conducting pilot testing, it was determined that the questionnaire had consistently stable scores over a brief period. This was demonstrated by Pearson's correlation coefficient of over 94% (95% CI= 0.90-0.97) and a P value of <0.01. According to Cronbach's alpha, the knowledge attitude and risk perception scales also scored above 0.68.

### Demographic Characteristics

Of 190 final-year pharmacy students, 130 completed an online questionnaire, making up 68.42% of the study population. Among these students, 82 (63.1%) were male, and 48 (36.9%) were female, with a mean age of 22.5 years (range: 20 to 25 years). Tables 1 and 2 presents a summary of the demographic characteristics of the participants.

### Pharmacy Student's knowledge of HIV/ADIS

Pharmacy students' knowledge of HIV/AIDS was assessed using 15 questions with scores ranging from 1 to 15 points. Students with scores between 12 and 15 points were considered to have good knowledge. The mean knowledge score was 8.22 ± 2.74, whereas the median knowledge score was 8 (range = 0-15). The percentage of correct answers to the 15 questions on the HIV/AIDS knowledge questionnaire was 54.8% (8.22/15*100), which indicated a low level of HIV/AIDS knowledge (Table 1). One student earned the lowest total knowledge score (0), while the other received the highest score (15). The most correct responses (96.9%) were in response to question $K_4$ question. The lowest percentage of correct responses (10%) was observed in $K_{12}$ question. In addition, more than 70% of the students supplied the correct answer to only 4 of the 15 questions in the knowledge section (Tables 3-5). Male students scored significantly higher for items $K_1$, $K_3$ and $K_6$ questions than female students, while female students had significantly higher scores for $K_9$ question. Age group 23-25 are more knowledgeable and statistically significant for questions $K_1$, $K_4$, $K_5$, $K_6$, and $K_8$ than those age group 20-22 (Table 6).

Table 1. Bloom's Cutoff Categories for the Total Knowledge, Attitudes, and Risk Perception scores

| | Category | Sores (%) | n (%) |
|---|---|---|---|
| **Knowledge** | High level<br>Moderate level<br>Low level | 12-15 (80%-100%)<br>9-11 (60%-79%)<br>< 9 (< 60%) | 17 (13.1)<br>43 (33.1)<br>70 (53.8) |
| **Attitude** | Positive<br>Neutral<br>Negative | 20-25 (80%-100%)<br>15-19 (60%-79%)<br>< 15 (< 60%) | 10 (7.7)<br>80 (61.5)<br>40 (30.8) |
| **Risk Perceptions** | Positive<br>Neutral<br>Negative | 20-25 (80%-100%)<br>15-19 (60%-79%)<br>< 15 (< 60%) | 22 (16.9)<br>54 (41.5)<br>54 (42.5) |
| **Total** | | | 130 (100) |

Table 2. Demographic Characteristics of the Pharmacy Students (n = 130)

| Variable | Mean | SD | Min | Max | n (%) |
|---|---|---|---|---|---|
| Knowledge score | 8.22 | 2.74 | 0.00 | 15.0 | |
| Attitude score | 16.02 | 2.90 | 10 | 23.0 | |
| Risk perception score | 15.29 | 3.93 | 6.0 | 25.0 | |
| Age<br>20-22<br>23-25 | | | | | <br>65 (50)<br>65 (50) |
| Gender<br>Male<br>Female | | | | | <br>82 (63.1)<br>48 (36.9) |

Table 3. Frequencies and Percentages of Pharmacy Students' HIV/AIDS Total Knowledge

| Survey Questions/ Statements | Yes n (%) | No n (%) | Don't Know n (%) |
|---|---|---|---|
| $K_1$. Can HIV/AIDS be transmitted from infected mother to child? | 101 (77.7) | 14 (10.8) | 15 (11.5) |
| $K_2$. Can HIV be transmitted via air and contact with water? | 10 (7.7) | 110 (84.6) | 10 (7.7) |
| $K_3$. Can HIV be transferred through social contacts like sharing clothes? Cups/ plates/ spoon/ glass, bathrooms, shaking hands & kissing? | 41 (31.5) | 78 (60.0) | 11 (8.5) |
| $K_4$. Major transmission routes are unprotected sex, unscreened blood, occupational exposure, and intravenous drug use. | 126 (96.9) | 1 (0.8) | 3 (2.3) |
| $K_5$. Do you think HIV can be completely cured with available antiretroviral therapy? | 23 (17.7) | 80 (61.5) | 27 (20.8) |



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| | | | |
|---|---|---|---|
| $K_6$. Nonnucleosides (NRTI) / Nucleosides reverse transcriptase inhibitors (NNRTI), and Protease inhibitors (PI) are the most widely available classes of HIV medications. | 74 (56.9) | 3 (2.3) | 53 (40.8) |
| $K_7$. Can antivirals like, e.g. (Acyclovir, Ribavirin, and Amantadine) be used to treat HIV/AIDS? | 46 (35.4) | 51 (39.2) | 33 (25.4) |
| $K_8$. Can HIV/AIDS patients donate blood? | 4 (3.1) | 114 (87.7) | 12 (9.2) |
| $K_9$. Is post-exposure prophylaxis using antiretroviral recommended? | 47 (36.2) | 18 (13.8) | 65 (50.0) |
| $K_{10}$. Are HIV and AIDS the same thing? | 34 (26.2) | 80 (61.5) | 16 (12.3) |
| $K_{11}$. Does avoiding mosquito bites prevent HIV? | 27 (20.8) | 61 (46.9) | 42 (32.3) |
| $K_{12}$. Osteomyelitis, Typhoid, and Endocarditis are the major infections in HIV patients, causing deaths. | 43 (33.1) | 13 (10.0) | 74 (56.9) |
| $K_{13}$. Can food shared with HIV-infected individuals transmit HIV? | 32 (24.6) | 65 (50.0) | 33 (25.4) |
| $K_{14}$. Can HIV infection develop into AIDS within a year? | 46 (35.4) | 15 (11.5) | 69 (53.1) |
| $K_{15}$. Can contact feces, urine, and saliva cause HIV? | 58 (44.6) | 53 (40.8) | 19 (14.6) |

Highlighted areas indicate the correct answers. Data are presented as n (%)

### Pharmacy Students' Attitudes Toward HIV/AIDS

The student's attitude toward HIV/AIDS was generally neutral; the majority (61.5%) scored 15-19. Meanwhile, 7.7% were in a positive attitude, and 30.8% were in a negative attitude toward HIV/AIDS (Table 1). The mean attitude score was 16.02 ± 2.90. Overall, 32 (24.7%) students agreed they felt competent enough to provide treatment and care for AIDS patients. 44 (33.8%) of pharmacy students favor not to care for HIV patients; however, 64 (49.2%) of the students are willing to assist or care for HIV/AIDS patients in wards and operation sites. Most students (83, 63.8%) prefer nursing patients with HIV/AIDs separately. Unexpectedly, only 32 (24.7%) of the students agreed that their professional education provided enough education and information to work safely with HIV/AIDS patients. The attitude items with frequencies and percentages for positive and negative attitudes are presented in Table 4. A chi-square test revealed no significant association between attitude items and gender and age groups (Table 7).

### Pharmacy Students' HIV/AIDS Risk Perceptions

The students' risk perception of HIV/AIDS was generally neutral, as 54 (41.2%) of the students scored < 15. Meanwhile, 22 (16.9%) of the students were in positive risk perception, and 54 (41.1%) of the students were in neutral risk perception about HIV/AIDS (Table 1). The mean risk perception score was 15.29 ± 3.93, which indicated a neutral HIV/AIDS risk perception based on Bloom's cut-off (Table 2). About 45.3% of the students disagreed that HIV-infected children should be educated in separate schools. 52.4% of student opposed stigmatizing HIV patients through quarantine. Almost one-third of students (37, 28.5%) worried about getting HIV at their working place. More than half of the students (71, 54.6%) consistently recommended voluntary testing of all healthcare providers, and 70 (53.9%) of students recommended mandatory HIV testing for patients admitted for surgery. Table 5 shows the responses to items related to risk perceptions about HIV/AIDS. A chi-square test showed no significant association between risk perception items and gender and age groups (Table 8).

## DISCUSSION

The research conducted at Taibah University in Saudi Arabia

Table 4. Pharmacy Student's Attitudes Towards HIV/AIDS

| **Statement** | **Strongly Agree n (%)** | **Agree n (%)** | **Neutral n (%)** | **Disagree n (%)** | **Strongly Disagree *n* (%)** |
|---|---|---|---|---|---|
| $A_1$. Do you feel competent enough to treat AIDS patients? | 11 (8.5) | 21 (16.2) | 42 (32.3) | 41 (31.5) | 15 (11.5) |
| $A_2$. I would prefer not to take care of HIV patients | 13 (10.0) | 31 (23.8) | 27 (20.8) | 30 (23.1) | 29 (22.3) |
| $A_3$. I am willing to assist/take care of HIV patients in wards and operation theaters | 38 (29.2) | 26 (20.0) | 40 (30.8) | 19 (14.6) | 7 (5.4) |
| $A_4$. Patients with HIV/AIDS should be nursed separately | 44 (33.8) | 39 (30.0) | 31 (23.8) | 9 (6.9) | 7 (5.4) |
| $A_5$. My professional education has provided me with enough education/ information to work safely with AIDS patients. | 8 (6.2) | 24 (18.5) | 38 (29.2) | 37 (28.5) | 23 (17.7) |

Table 5. Pharmacy Students' Risk Perceptions of HIV/AIDS

| Statement | Strongly Agree n (%) | Agree n (%) | Neutral n (%) | Disagree n (%) | Strongly Disagree n (%) |
|---|---|---|---|---|---|
| $R_1$. HIV-infected children should be educated in separate schools | 19 (14.6) | 20 (15.4) | 32 (24.6) | 31 (23.8) | 28 (21.5) |
| $R_2$. Patients with HIV should be quarantined | 12 (9.2) | 15 (11.5) | 35 (26.9) | 34 (26.2) | 34 (26.2) |
| $R_3$. I worry about acquiring HIV at my working place in my professional life | 11 (8.5) | 26 (20.0) | 35 (26.9) | 32 (24.6) | 26 (20.0) |
| $R_4$. Initial HIV tests should be conducted for all patients admitted for surgical procedures | 34 (26.2) | 36 (27.7) | 40 (30.8) | 14 (10.8) | 6 (4.6) |
| $R_5$. In my opinion, all healthcare students and professionals should go for voluntary HIV testing | 44 (33.8) | 27 (20.8) | 36 (27.7) | 19 (14.6) | 4 (3.1) |



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Table 6. Association Between Demographics and Knowledge

| Variable | $K_1$ n (%) | $K_2$ n (%) | $K_3$ n (%) | $K_4$ n (%) | $K_5$ n (%) | $K_6$ n (%) | $K_7$ n (%) | $K_8$ n (%) | $K_9$ n (%) | $K_{10}$ n (%) | $K_{11}$ n (%) | $K_{12}$ n (%) | $K_{13}$ n (%) | $K_{14}$ n (%) | $K_{15}$ n (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gender** | | | | | | | | | | | | | | | |
| **Male** | 56 (68.2) | 71 (86.6) | 55 (63.9) | 78 (95.1) | 47 (58.5) | 38 (46.3) | 31 (37.8) | 70 (85.3) | 21 (25.6) | 46 (56.1) | 34 (41.4) | 8 (9.7) | 42 (51.2) | 9 (10.9) | 35 (42.7) |
| **Female** | 45 (93.7) | 39 (81.1) | 23 (47.9) | 48 (100) | 33 (68.7) | 36 (75) | 20 (41.6) | 44 (91.6) | 26 (54.4) | 34 (70.8) | 27 (64.2) | 5 (10.4) | 23 (47.9) | 6 (7.3) | 18 (37.5) |
| **P-value** | 0.001* | 0.416 | 0.031* | 0.122 | 0.196 | 0.001* | 0.663 | 0.291 | 0.001* | 0.096 | 0.103 | 0.904 | 0.716 | 0.793 | 0.562 |
| **Age** | | | | | | | | | | | | | | | |
| **20-22** | 45 (69.2) | 56 (86.1) | 42 (64.6) | 61 (93.8) | 31 (47.6) | 30 (46.1) | 29 (44.6) | 53 (81.5) | 22 (33.8) | 35 (53.8) | 29 (44.6) | 4 (6.15) | 32 (49.2) | 7 (10.7) | 28 (43.0) |
| **23-25** | 56 (86.1) | 54 (83.3) | 36 (55.3) | 65 (100) | 49 (75.5) | 40 (61.5) | 22 (33.8) | 61 (93.8) | 25 (38.4) | 45 (69.2) | 32 (49.2) | 9 (13.8) | 33 (50.0) | 8 (12.3) | 25 (38.4) |
| **P-value** | 0.020* | 0.627 | 0.283 | 0.042* | 0.001* | 0.013* | 0.209 | 0.033* | 0.584 | 0.071 | 0.598 | 0.144 | 0.861 | 0.784 | 0.592 |

*Indicates statistical significance at $p < 0.05$

Table 7. Association Between Demographics and Attitude

| Variables | $A_1$ n (%)[a] | $A_2$ n (%) | $A_3$ n (%) | $A_4$ n (%) | $A_5$ n (%) |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Male | 24 (29.2) | 26 (31.7) | 44 (53.6) | 53 (64.4) | 21 (25.6) |
| Female | 8 (16.6) | 18 (37.5) | 20 (41.6) | 30 (62.2) | 11 (25.6) |
| P-value | 0.201 | 0.180 | 0.126 | 0.749 | 0275 |
| **Age** | | | | | |
| 20-22 | 16 (24.6) | 22 (33.8) | 33 (50.7) | 40 (61.5) | 15 (23.0) |
| 23-25 | 16 (24.6) | 22 (33.8) | 31 (47.7) | 43 (66.1) | 17 (26.1) |
| P-value | 0.472 | 0.973 | 0.678 | 0.565 | 0.300 |

[a] percentage of students who answered agreed or strongly agreed.

Table 8. Association Between Demographics and Risk perception

| | $R_1$ n (%)[a] | $R_2$ n (%) | $R_3$ n (%) | $R_4$ n (%) | $R_5$ n (%) |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Male | 28 (34.1) | 19 (23.1) | 18 (21.9) | 43 (52.4) | 43 (52.4) |
| Female | 11 (22.9) | 8 (16.6) | 19 (39.5) | 27 (56.2) | 28 (58.3) |
| P-value | 0.268 | 0.363 | 0.099 | 0.070 | 0.734 |
| **Age** | | | | | |
| 20-22 | 20 (30.7) | 11 (16.9) | 16 (24.6) | 33 (50.7) | 32 (49.2) |
| 23-25 | 19 (29.2) | 16 (24.6) | 21 (32.3) | 37 (56.9) | 39 (60.0) |
| P-value | 0.455 | 0.303 | 0.516 | 0.515 | 0.420 |

[a] frequency who answered agreed or strongly agreed.

delved into pharmacy students' knowledge, attitudes, and risk perceptions concerning HIV/AIDS. The study yielded significant insights into this field, revealing that the students had a low level of HIV-related knowledge. The study findings showed that the mean knowledge score of 8.22 (54.76%) was lower than a similar study in Malaysia and South Africa.[15,21] Despite the fact that pharmacy students generally have a basic understanding of medications, 60.8% of students did not know that antiviral drugs such as Acyclovir, Ribavirin, and Amantadine cannot be prescribed to treat HIV since HIV is a retrovirus that cannot be treated with antiviral medications.[30] The findings propose that undergraduate pharmacotherapy lectures may not adequately cover HIV/AIDS management and treatment topics. What is also curious about this result is that almost 65% of pharmacy students were not aware that post-exposure prophylaxis (PEP) using antiretrovirals is recommended after considerable exposure to HIV because of a needlestick injury or unprotected sexual relationship[31], given that WHO and Saudi guidelines calling for PEP in treating accidental HIV/AIDS infections.[32,33] Moreover, 38.5% of students did not know the difference between HIV and AIDS or if they were the same, which further highlights the significant knowledge gaps in pharmacy.

Furthermore, students did not have a good understanding of how HIV is transmitted. For instance, they believed that mosquito bites are the primary means of transmission and that it can also be transmitted via food, saliva, urine, and feces. The majority (90%) of students also did not know that opportunistic infections are responsible for most HIV/AIDS deaths. It is evident from these knowledge-based assessments that pharmacy students need more comprehensive training on HIV/AIDS and antiretroviral therapy, particularly in Saudi Arabia at this time, where a pharmacy is becoming increasingly



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important in health care, primarily due to the introduction of specialized hospital ward clinical pharmacy services[34]

Regarding students' attitude toward HIV/AIDS patients, the study results indicated that students questioned their competence in treating and caring for HIV/AIDS patients, and they questioned their educational and training competency in dealing with HIV/AIDS patients safely. It appears that students are not receiving the essential information in the classroom or from hospital rotations with HIV/AIDS infected individuals. It was agreed by 63.8% of pharmacy students that separate nursing of HIV patients would minimize risk to HCPs and other patients. Nursing guidelines in Saudi Arabia.[33] state that HIV/AIDS patients should be treated like any other patient in an open ward. Unless the specialist physician recommends that the patient be isolated or restricted in a health facility. Nearly half of students (46%) opposed separate schooling for HIV-infected children, indicating they are unwilling to stigmatize or discriminate against them.

One possibility reason why pharmacy students are less concerned about acquiring HIV/AIDS is that they interact with infected patients less than physicians do. Wijesinghe and Alexander mentioned that primary care physicians interact more with patients with infection than other HCPs.[35] The study results found that 28.5% of students were concerned about becoming HIV-infected through occupational practice, which is lower than in other studies.[15,36] However, to minimize occupational risks for HCPs, more than half of students (53.9%) recommended mandatory HIV testing for all patients admitted to hospitals or undergoing surgical procedures and about 55% of the student recommended that HCPs undergo voluntary HIV testing.

Demographic characteristics were also considered in the study. Male and female students showed significant differences in the study. There was a greater knowledge of mother-to-child transmission, transmission via social contact, and HIV medications (NRTIs, NNRTIs, PIs) among male students. Only female students knew more about post-exposure prophylaxis (PEP) than male students. A significant difference was also found between the age groups in the study. Mother-to-child transmission, major routes of transmission, available HIV medications (NRTI, NNRTI, PI), and HIV blood donors were significantly better known by older students. Possibly, this is because students in later years have the opportunity to attend courses on HIV/AIDS as part of their curriculum, which exposes them to more information. As far as risk perceptions and attitudes are concerned, the study found no significant differences. Although the pilot study was conducted, it is possible that some respondents misunderstood some statements or questions.

The study findings hold significant implications for pharmacy education and the healthcare system. By assessing pharmacy students' understanding, attitudes, and willingness to provide care for PLWHA, the research can identify gaps in education, highlight potential barriers to optimal patient care, and address the issue of stigma associated with the disease. The findings can inform curriculum enhancements, training programs, and policy development to improve the knowledge and attitudes of future pharmacists, ultimately leading to better care for PLWHA and promoting a more inclusive and supportive healthcare environment.

This study has several limitations. First, a cross-sectional study was done only at Taibah University; thus, the results cannot be generalized to all Saudi pharmacy students. A national survey might help determine the generalizability of our data to other pharmacy students throughout the country. Second, is the cross-sectional design, so we can only analyze the results at one point in time. Thus, a longitudinal study could be conducted to observe the change in students' knowledge and attitude over time. Finally, values may be overestimated as a result of recall bias and social-desirability bias since the measurement relies on self-reported data.

## CONCLUSION

The findings revealed significant gaps in knowledge about HIV/AIDS treatment, ways of transmission, time for HIV to develop into AIDS, and postexposure prophylaxis. Lack of confidence in competencies, doubts about educational training, and unwillingness to treat PLWHA may have pointed to negative attitudes and misconceptions about HIV/AIDS. A more generalized evaluation can be conducted by examining a broader sample of students based on the findings and recommending an optimal education plan and practical intervention. PLWHA may benefit from a modified educational program and continued practical experiences in order to minimize fears, misconceptions, and other barriers to healthcare.

## AUTHOR CONTRIBUTIONS

Fahad Alzahrani: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Resources, Visualization, Supervision, Writing – original draft, Writing – review & editing; Abdulrahman Almohammadi: Supervision, Methodology, Writing – original draft; Moayad Alhejaili:Conceptualization, Methodology, Writing – original draft; Saad Almukhlifi: Investigation, Methodology, Writing – original draft; Emad Aloufi: Conceptualization, Methodology, Writing – original draft, Writing – review & editing; Ahmed Alhudhayban:Methodology, Visualization, Writing – original draft, Writing – review & editing; Abdulrahim Khan: Conceptualization, Methodology, Writing – original draft, Writing – review & editing; Faris S.Alnezary: Project Administration, Methodology, Writing – original draft, Writing – review & editing.

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