

Assessing the levels of HIV-related knowledge and attitudes toward HIV-infected patients among undergraduate dental students: a cross-sectional study

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Purpose: Worldwide, in the last decade, the numbers of new HIV infections and AIDS-related deaths have drastically decreased. Despite that, around 18 million infected individuals receive antiretroviral therapy and thus tend to live longer. This cross-sectional study was conducted to assess the level of HIV-related knowledge among undergraduate dental students at Ain Shams University (ASU) in Cairo, Egypt and to determine their attitudes toward treating HIV-positive patients.

Methods: The study sample included 247 undergraduate dental students of third, fourth, and fifth academic years at the Faculty of Dentistry, ASU who were randomly selected to participate in this survey. Data were collected using a self-administrated anonymous questionnaire. Chi square and ANOVA tests were used to measure differences in the level of knowledge and attitudes among students of the 3 years. Multiple linear regression analysis was performed with 95% confidence interval.

Results: Within the students' population, around 94% incorrectly considered dentists to be at high risk of acquiring HIV infection and 47% believed that saliva is a vehicle for its transmission. Moreover, the majority of students were unaware of the association between HIV and common oral manifestations such as oral candida, Kaposi sarcoma, and leukoplakia. Although 69% of the students were willing to deliver oral care to people living with HIV (PLHIV), only 33% perceived themselves knowledgeable enough to do so.

Conclusion: Dental students were not adequately prepared to recognize and manage HIV-positive individuals. Thus, better education and training are required to raise their levels of HIV-related knowledge and enhance their capabilities to treat PLHIV.

Keywords: HIV, dental students, behavior, willingness to treat, Egypt

Introduction

Globally, HIV and AIDS epidemics pose huge public health challenges. According to the global summary of the AIDS epidemic of WHO, in 2016, the number of people living with HIV (PLHIV) was 36.7 million of which 2.1 million were children aged 15 years and under.¹ In Egypt, while <0.02% of the total population lives with HIV, the incidence of new infections is exponentially growing among key populations who are at high risk of exposure including drug users, sex workers, and men who have sex with men.²

It is well known that HIV infection negatively affects oral health wherein 40%–70% of HIV-positive individuals develop oral complications such as Kaposi sarcoma, oral

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candidiasis, and leukoplakia during disease progression.^{3,4} Due to dry mouth symptoms and lack of cleansing action of saliva, these patients also suffer from multiple carious lesions and periodontal problems.^{5,6} It is not uncommon that in individuals with unknown positive HIV status dentists are the first to detect oral manifestations signaling infection.^{7,8} Whereas dental practitioners are morally duty bound to deliver comprehensive oral care of high quality to PLHIV and denial of treatment based on HIV status is unacceptable,⁹ it has been reported that unmet dental needs are highly prevalent among this vulnerable group of patients.^{10–12}

Worldwide, stigma and discrimination (S&D) associated with the HIV epidemic are still persistent and both have exceedingly devaluated PLHIV through exclusion and marginalization.^{13,14} Accordingly, HIV-positive individuals face challenges in disclosing their health status while seeking medical care, as health care providers (HCPs) tend to deny them access to services inside various health facilities, including dental settings. Engaging in this kind of behavior could be attributed to the lack of HIV-related knowledge, especially regarding modes of transmission, among HCPs causing subsequent fear of acquiring the infection while treating PLHIV. Furthermore, the fear of being stigmatized by their families and communities and concerns about losing their HIV-free patients are primary factors that contribute to providers being reluctant to treat HIV-positive individuals.^{15,16} Based on the findings of a cross-sectional study in Egypt, out of 529 men and women living with HIV who were interviewed on their experiences with HIV-related S&D, 40% asserted that on attending health care facilities, including dental settings, they do not inform HCPs about their HIV status whereas >50% stated that they were denied service upon revealing they had the infection.¹⁷

As the right to receive the highest standards of health care among PLHIV has been globally reiterated,^{18,19} it is crucial to address the determinants of HIV-related S&D in health facilities including oral health settings to ensure equitable access of those patients to all health services. The attitude of dental students toward delivering oral care for PLHIV has been widely studied in many countries such as India, the United States, the United Arab Emirates, Kuwait, Nigeria, Iran, and Sudan.^{20–26}

To date and to the best of the authors' knowledge, no studies were conducted in any dental school in Egypt on students' knowledge and skills to manage HIV-positive individuals and their willingness to treat them. In this respect, this study was conducted to assess the ability of undergraduate dental students to recognize HIV-associated oral manifestations,

their knowledge of the modes of transmission of this infection, their perceptions regarding dentists' obligations toward PLHIV as well as their willingness to treat those patients.

Materials and methods

Study design, setting, and research participants

A descriptive cross-sectional study was conducted among the undergraduate students attending the third, fourth, and fifth study years at the Faculty of Dentistry, Ain Shams University (ASU) located in Cairo, the capital of Egypt. ASU is a governmental educational institution operating under the supervision of the Egyptian Ministry of Higher Education. It is the third oldest university in Egypt having been established in 1950 and the Faculty of Dentistry is one of 15 faculties under the umbrella of the University. Within this public educational institution, preventive and curative oral health services are delivered in the outpatient clinics of the University premises by undergraduate and postgraduate dental students under the supervision of staff members. The undergraduate dental program offered by the Faculty of Dentistry at ASU lasts for 5 years. The program also includes another year of internship where students exclusively focus on working alongside qualified dentists to develop their clinical skills through exposure to patients in all the dental disciplines.

Inclusion/exclusion criteria

Only students enrolled in the third, fourth, and fifth study years represented the targeted population of this study, as according to the program specifications, students start getting introduced to basic dental sciences in year 3 and then in the last 2 years (4 and 5) they study clinical dental sciences and start treating patients in a clinical setting. Members from the students union who participated in the process of data collection were excluded from the study sample.

Questionnaire

A self-administered questionnaire partly adapted from comparable studies previously conducted to capture the level of HIV-related knowledge among dental students in other countries and measure their attitudes toward treating PLHIV^{20,25,26} was made available in English language. The questionnaire consisted of three main sections including 30 closed-ended questions. The first section included questions on dental students' demographic details including gender, age, and place of origin as well as year of study and educational background of parents. Students were also asked to indicate whether their main sources of information on HIV

and AIDS included lectures, Internet, radio and TV, friends and relatives, or reading material.

In the second section, in order to assess the dental students' knowledge on the characteristics of HIV infection and AIDS, the questionnaire included four statements on the progression of HIV infection up to the stage of AIDS among all PLHIV, HIV survival period outside human tissues, the clinical incubation period, and the average time interval between contracting HIV and producing antibodies. The level of students' knowledge regarding the modes of transmission of HIV was also determined using five questions on the risk of transmission through unprotected heterosexual and homosexual intercourse or body fluids such as blood, semen, or breast milk or after needle stick injury or occupational exposure to saliva as well as spread by touching, kissing, coughing, sharing food or drink, or through sharing public toilets and swimming pools. Two statements on dentists' risk of contracting HIV infection during practice and infection control measures required to prevent transmission in dental settings were also included.

Moreover, the knowledge section consisted of four questions pertaining to the prevalence of HIV in Egypt and availability of treatment for it, whether or not HIV medications have side effects on the virus, and whether or not infected individuals not receiving medical treatment pose higher risk for HIV transmission. All questions assessing the participants' HIV-related knowledge had simple check off answers "yes," "no," or "I do not know." In one part of this section of the questionnaire, the students had to decide which of 15 different oral manifestations could be associated with HIV infection. All of the 15 manifestations listed were correct answers and therefore marking each one would score one. In the last section, the attitudes of dental students toward treating HIV-positive individuals and their perceptions regarding the obligations of dental practitioners to provide oral care to those patients were addressed. The participants were asked to rate eight statements on a five-point Likert scale (strongly agree, agree, neutral, disagree, and strongly disagree).

Ethical considerations

Permission to conduct the study was obtained from the principals at the Faculty and ethical approval was granted by the Research Ethical Committee of the Faculty of Dentistry, ASU in February 2016. The purpose of the study was explained to all the randomly selected students who were assured that all responses were anonymous. Written informed consent was obtained from all respondents prior to participation.

Recruitment

In the Faculty of Dentistry at ASU, undergraduate students in all academic years are divided into small-sized groups for attending practical sessions. A list of all students in each academic year was accessed through the Faculty's administrative office; the total number of students in years 3, 4, and 5 was 300, 321, and 274, respectively. The following formula was used to determine the sample size, n :

$$n = \frac{P(1-P)Z^2}{E^2}$$

where

n = sample size;

Z = the value on the Z table at 95% confidence level =1.96;

E = sampling error at 5.12%;

P = maximum variability of the population at 50%, ie, (0.5).

Three hundred and sixty seven dental students were randomly selected from the third, fourth, and fifth study years. Simple random sampling of participants was performed using a digital online software (<https://www.randomizer.org/>) such that the range of serial numbers of students in every small group was entered and the software presented a set of random numbers. Approximately 10–12 students per group in each year (40% of the population) were sampled.

Data collection

Data collection was performed inside the premises of the Faculty of Dentistry, ASU from mid-March toward the end of April 2016. Members from dental students' union at the Faculty disseminated the surveys on a voluntary basis to the randomly selected students while attending their weekly practical sessions. After explaining the purpose of the study, all students who agreed to participate were given 20 minutes to read and sign the informed consent form and fill the questionnaire during the same session.

Statistical analysis

Data were entered using Epi Info™ version 7.2 (Centers for Disease Control and Prevention/Division of Health Informatics and Surveillance, Atlanta, GA, USA) and later exported to be tabulated using Microsoft Excel worksheet. The data set was imported into spreadsheets, and statistical analysis was then performed using SPSS software version 16.0 (SPSS Inc, Chicago, IL, USA). Descriptive statistics, including means, SDs, frequencies, and percentages were calculated

for variables as appropriate. Chi square test and ANOVA were used to measure differences in the level of knowledge and attitude between third, fourth, and fifth year students when applicable. Multiple linear regression analysis was performed for modeling the main determinants of the knowledge scores as well as modeling the relationship between the knowledge scores and the attitude score with 95% confidence interval.

An index for the level of HIV-related knowledge was created using the sum of all items of knowledge and internal consistency among all these items was found to be high (Cronbach's alpha =0.69). Similarly, an index for the attitudes of the students toward treating infected individuals was created using the sum of all items of attitudes and the internal consistency was low (Cronbach's alpha =0.34)

Results

Background characteristics of participants

Out of 367 dental students of both genders who were randomly selected from the third, fourth, and fifth study years, 247 filled the questionnaire with a response rate of 67.3% and >64% of the respondents were female students. As reported by 67% of participants, academic lectures were the most frequently used source of HIV- and AIDS-related information; only 37% denoted that they received information from the Internet.

HIV-related knowledge of dental students

Knowledge related to HIV/AIDS characteristics and its status in Egypt

In our study, only 30.5% knew that medical treatment for HIV is available in Egypt and 33.1% of participants correctly responded to the statement "HIV can survive up to 1 hour outside human tissues" with highly significant differences between the responses of students from the 3 years ($P<0.01$) (Table 1).

Knowledge of HIV modes of transmission

As shown in Table 2, >84% of the respondents gave the correct answer to the statement "Infection control measures to prevent hepatitis C infection can also prevent the transmission of HIV in the dental setting" and the knowledge of students in year 4 was significantly the highest ($P<0.01$).

With respect to the dental students' knowledge about HIV transmission in dental clinics, only 35% correctly agreed that "The risk for HIV infection after needle stick injury or after exposure of non-intact skin to HIV contaminated blood is <0.5%." On the other hand 71% of students in year 4 correctly disagreed with the statement "Occupational exposure to saliva in the dental setting can readily transmit HIV to the dentist;" compared to only 44% in both years 3 and 5, indicating a highly significant difference ($P<0.01$) in the level of knowledge between respondents of the 3 academic years.

Knowledge of oral manifestations associated with HIV infection

The difference in the level of dental students' knowledge regarding some HIV-related oral manifestations was highly significant ($P<0.01$), such that those in the third year were the least knowledgeable that oral conditions such as Kaposi sarcoma (20%), non-Hodgkin's lymphoma (8.8%), hairy leukoplakia (17.3%), thrombocytopenic purpura (9.9%), and human papilloma virus (14.8%) could signal HIV infection (Table 3).

Dental students' attitudes toward management of HIV-infected individuals

Using Chi square test, a highly significant difference was found between the attitudes of students from the 3 academic years when asked about the moral and legal obligation of dentists to treat PLHIV, their willingness to perform mouth-

Table 1 Knowledge regarding HIV status in Egypt and infection/AIDS disease characteristics

Statement	Correct responses (%) (95% confidence interval)			Total (%) (95% CI)	P-value
	Third year	Fourth year	Fifth year		
Percentage of HIV-infected individuals in Egypt is above 1% of the total population	16 (8, 24)	7 (1.6, 12.4)	15.2 (7.3, 23.1)	12.6 (8.7, 16.7)	0.148
Medical treatment is available in Egypt for HIV-infected individuals*	47.5 (36.6, 58.4)	11.9 (5.1, 18.7)	32.9 (22.6, 43.2)	30.5 (24.8, 36.2)	<0.001
HIV can survive up to 1 hour outside human tissues*	17.5 (9.2, 25.8)	41 (30.6, 51.4)	40.5 (29.7, 51.3)	33.1 (27.2, 39)	0.001
Every HIV-infected individual develops AIDS	38.5 (28, 49.1)	55.4 (44.9, 66)	49.4 (38.4, 60.4)	47.9 (41.7, 54.1)	0.094
The average time interval between contracting HIV and producing antibodies is 6–12 weeks**	31.6 (21.5, 41.7)	51.8 (41.2, 62.4)	50.6 (39.6, 61.6)	44.9 (38.7, 51.1)	0.016
For most HIV-infected individuals, clinical incubation period can extend to 8 years*	32.5 (22.3, 42.7)	38.8 (28.5, 49.1)	61 (50.3, 71.7)	43.8 (37.6, 50)	0.001

Note: *Significant at level 1%; **significant at level 5%.

Table 2 Knowledge of HIV modes of transmission

Statement	Correct responses (CI)			Total (%) (CI)	P-value
	Third year (%)	Fourth year (%)	Fifth year (%)		
Dentists are among the high-risk groups to contract HIV infection	8.8 (2.6, 14.9)	1.2 (-1.1, 3.5)	8.8 (2.5, 15)	6.1 (3.1, 9.1)	0.065
Infection control measures to prevent hepatitis C infection can also prevent the transmission of HIV in the dental setting*	70.4 (60.5, 80.3)	100 (100, 100)	82.3 (73.9, 90.7)	84.3 (79.8, 88.8)	<0.001
AIDS is a contagious disease; it can be transmitted through sharing public toilets and swimming pools*	48.1 (37.5, 59)	81.2 (72.9, 89.5)	55.7 (44.8, 66.6)	62 (55.9, 68.1)	<0.001
HIV can spread by touching, kissing, coughing, sharing food or drink*	50.6 (39.7, 61.5)	79.5 (71, 88)	53.8 (42.9, 64.7)	61.5 (55.4, 67.6)	<0.001
HIV can be transmitted from the infected mother to her newborn infant during breastfeeding	42.5 (31.7, 53.3)	41 (30.6, 51.4)	29.1 (19.1, 39.1)	37.6 (31.6, 34.6)	0.162
Body fluids that contain high concentrations of HIV and have been linked to transmission of the virus are blood, semen, vaginal secretions, breast milk**	70 (60, 80)	86.7 (79.5, 93.9)	73.1 (63.4, 82.8)	76.8 (71.5, 82.1)	0.026
The risk for HIV infection after needle stick injury or after exposure of non-intact skin to HIV contaminated blood is <0.5%*	20 (11.3, 28.7)	34 (23, 44)	52.6 (41.7, 63.5)	35.4 (29.4, 41.4)	<0.001
Occupational exposure to saliva in the dental setting can readily transmit HIV to the dentist*	44.4 (33.6, 55.2)	70.6 (61, 80)	44.3 (33.4, 55.2)	53.5 (47.3, 59.7)	<0.001

Note: *Significant at level 1%; **significant at level 5%.

Table 3 Dental students' knowledge of HIV-associated oral manifestations

Oral manifestation	Yes (%) (95% CI)			Total (%) (CI)	P-value
	Third year (%)	Fourth year (%)	Fifth year (%)		
Oral candidiasis	45.7 (34.9, 56.5)	62.1 (51.8, 72.4)	60.8 (50.1, 71.5)	56.3 (50.1, 62.5)	0.063
Recurrent aphthous ulcer**	21 (12.1, 29.9)	23.3 (14.4, 32.2)	38 (27.4, 48.6)	27.2 (21.7, 32.7)	0.032
Kaposi's sarcoma*	20 (11.3, 28.7)	36.8 (26.6, 47)	54.4 (43.5, 65.3)	37 (40, 43)	<0.001
Necrotizing ulcerative periodontitis	13.6 (6.1, 21.1)	19.8 (11.4, 28.2)	28.8 (18.9, 38.7)	20.6 (15.6, 25.6)	0.057
Non-Hodgkin's lymphoma*	8.8 (2.6, 15)	25.3 (16.1, 34.5)	41.8 (31, 52.6)	25.2 (19.8, 30.6)	<0.001
Cytomegalovirus ulcers**	18.5 (10, 27)	28.7 (19.1, 38.3)	37.5 (26.9, 48.1)	28.2 (22.6, 33.8)	0.028
Linear gingival erythema**	8.6 (2.5, 14.7)	7 (1.6, 12.4)	20 (11.2, 28.8)	11.7 (7.7, 15.7)	0.019
Xerostomia	44.4 (33.6, 55.2)	34.5 (24.5, 44.5)	40.5 (29.7, 51.3)	39.7 (33.6, 45.8)	0.412
Oral hairy leukoplakia*	17.3 (9.1, 25.5)	51.2 (40.6, 61.8)	57.5 (46.7, 68.3)	42.1 (35.9, 48.3)	<0.001
Salivary gland enlargement**	30.9 (20.8, 41)	16.1 (8.3, 23.9)	17.5 (9.2, 25.8)	21.4 (16.3, 26.5)	0.039
Herpes zoster	23.8 (14.5, 33.1)	26.7 (17.3, 36.1)	35.4 (24.9, 45.9)	28.6 (22.9, 34.2)	0.237
Herpes simplex**	29.6 (19.7, 39.5)	32.6 (22.7, 42.5)	47.5 (36.6, 58.4)	36.4 (30.4, 42.4)	0.041
Lichen planus	39.5 (28.9, 50.1)	36 (25.9, 46.1)	28.8 (18.9, 38.7)	34.8 (28.9, 40.7)	0.343
Immune thrombocytopenic purpura*	9.9 (3.4, 16.4)	29.1 (19.5, 38.7)	22.8 (13.6, 32)	20.7 (15.6, 25.8)	0.008
Human papilloma virus lesions*	14.8 (7.1, 22.5)	39.1 (28.8, 49.4)	38.8 (28.1, 49.5)	31 (25.2, 36.8)	0.001

Note: *Significant at level 1%; **significant at level 5%.

to-mouth resuscitation, or deliver emergency dental care to those patients when necessary as well as the obligation of patients to reveal their HIV status to dentists. The students' perceptions of their capabilities to identify HIV-related oral lesions and properly manage infected individuals also varied significantly ($P<0.01$) (Table 4). On comparing the level of HIV-related knowledge and attitudes toward treating infected individuals between students in the 3 academic years, a highly significant difference could be observed as shown in Table 5.

As shown in Table 6, three multiple linear regression models were created. First model was used for modeling the main determinants of the knowledge index. The second model demonstrated the relationship between the total knowledge index and the attitude index while the third model determined the relationship between each of the four knowledge components (ie, HIV characteristics, modes of transmission, treatment, and HIV-associated oral manifestation) and the attitude index. Only the year of study had a significant impact on students' knowledge and attitudes.

Discussion

Within HIV-infected populations, oral health disparities prevail with respect to individuals' perception of their oral health status, their oral care seeking behavior, and the levels of unmet dental needs.²⁷ In the current study, the vast majority of undergraduate dental students at ASU depended on academic lectures as the main source of information pertaining to HIV and AIDS. Although the overall level of their knowledge was unacceptable, it improved while advancing through the program. Likewise, in a recent cross-sectional study in four universities in the United Arab Emirates the average total

score for HIV-related knowledge of both medical and dental students was 4.3 out of 7 (61%).²⁸

As revealed in our study, there was a lack of adequate information with respect to HIV modes of transmission; this is in accordance with the findings of two similar studies in which a considerable number of respondents wrongly believed that infection could be acquired through touching HIV-positive patients or sharing public toilets.^{28,29} Moreover, though it has been widely reiterated, <40% of the study participants were aware of the fact that an infected mother could readily transmit HIV infection to her infant at any point during breastfeeding.³⁰ Similarly, only half of the students from two dental schools in Kuwait and Sri Lanka realized that breast milk is a potential route of HIV transmission to children.²³

It is worth mentioning that this knowledge gap among our study participants could be attributed to the fact that the undergraduate dental program at ASU does not include any separate course on the management of patients with infectious

Table 5 Comparison of the mean knowledge and attitude scores among dental students of 3 academic years

Year of study	Knowledge index, mean \pm SD	Attitude index, mean \pm SD
Third	10.37 \pm 4.8	16.05 \pm 3.1
Fourth	13.79 \pm 3.8	16.31 \pm 2.7
Fifth	14.09 \pm 4.3	13.92 \pm 3.4
Total	12.71 \pm 4.6	15.48 \pm 3.2
ANOVA	16.82* ($P<0.001$)	13.57* ($P<0.001$)
Post hoc comparisons	Fifth year, fourth year > third year	Fourth year, third year > fifth year

Note: *Significant at level 1%.

Table 4 Dental students' attitudes toward PLHIV

Attitude statement	Mean \pm SD	Chi square	P-value
Every dentist in Egypt should be legally bound to provide routine dental care to HIV-infected individuals*	3.32 \pm 0.93	283.19	<0.001
Right now you perceive yourself capable of detecting HIV-related oral lesions and properly manage HIV-infected individuals*	1.88 \pm 1.06	151.57	<0.001
Providing dental care to HIV-infected individuals can discourage others from seeking care in a dental setting*	1.83 \pm 1.23	49.15	<0.001
Dentists should be willing to perform mouth-to-mouth resuscitation on an AIDS patient in case of respiratory arrest*	1.67 \pm 1.21	34.44	<0.001
HIV-infected individuals are obliged to reveal their HIV status to their dentists*	0.53 \pm 0.93	412.44	<0.001
Infection control measures for management of HIV-infected individuals could raise the costs for dental practice?*	1.97 \pm 1.28	49.48	<0.001
Dental health care professionals are morally bound to provide routine dental care to PLHIV*	3.15 \pm 0.87	225.71	<0.001
In your dental practice, you will deliver emergency dental care to HIV/AIDS patient if the need arises*	2.91 \pm 0.92	144.40	<0.001

Note: *Significant at level 1%.

Abbreviation: PLHIV, people living with HIV.

Table 6 Determinants of knowledge score and attitude score

Independent variables	Dependent variables		
	Model (1) knowledge	Model (2) attitudes	Model (3) attitudes
	Coefficients (95% CI)	Coefficients (95% CI)	Coefficients (95% CI)
Age	-0.02 (-1.1, 1.1)	0.27 (-0.51, 1.05)	0.26 (-0.53, 1.04)
Year of study			
Third year (reference)			
Fourth year	3.41* (1.75, 5.07)	-0.48 (-1.7, 0.8)	-0.70 (-1.98, 0.6)
Fifth year	4.13* (1.74, 6.53)	-2.95* (-4.7, -1.2)	-3.01* (-4.8, -1.2)
Place of origin			
Urban governorates (reference)			
Lower Egypt	0.17 (-1.9, 2.2)	0.73 (-0.8, 2.2)	0.66 (-0.8, 2.1)
Upper Egypt	1.29 (-1.4, 3.9)	1.14 (-0.9, 3.2)	1.32 (-0.79, 3.4)
Frontiers region	-1.98 (-10.7, 6.7)	1.23 (-1, 3.8)	1.37 (-1.1, 3.9)
Not Egyptian	2.24 (-2.6, 7.04)	1.90 (-1.5, 5.3)	1.56 (-1.9, 5)
Father's education			
Illiterate (reference)			
Less than high school	0.51 (-4.3, 5.3)	-4.04 (-12.5, 4.4)	-4.09 (-12.5, 4.3)
High school	-0.49 (-4.5, 3.5)	-5.43 (-13.5, 2.6)	-4.96 (-13, 3.09)
Two years academy	-1.94 (-4.6, 0.7)	-5.51 (-13.4, 2.4)	-5.09 (-13.03, 2.8)
University and above	-2.32 (-9.2, 4.1)	-4.09 (-11.7, 3.5)	-3.99 (-11.6, 3.6)
Mother's education			
Illiterate (reference)			
Less than high school	-4.45 (-13.3, 4.4)	1.68 (-2.4, 5.8)	1.61 (-2.5, 5.7)
High school	-1.97 (-9.4, 5.5)	-0.17 (-2.1, 1.7)	-0.20 (-2.1, 1.7)
Two years academy	-4.98 (-12.3, 2.4)	0.76 (-1.1, 2.6)	0.83 (-1.01, 2.7)
University and above	-2.57 (-9.7, 4.6)	1.71 (-2.5, 5.9)	1.85 (-2.8, 6.1)
Gender			
Female (reference)			
Male	0.61 (-0.68, 1.9)	-0.31 (-1.3, 0.65)	-0.25 (-1.2, 0.71)
Knowledge on HIV characteristics	-	-	0.19 (-0.21, 0.59)
Knowledge on modes of HIV transmission	-	-	0.38 (0.04, 0.7)
Knowledge on HIV treatment	-	-	0.04 (-0.5, 0.6)
Knowledge on oral manifestations associated with HIV	-	-	0.03 (-0.13, 0.2)
Knowledge	-	0.13 (0.02, 0.23)	-
Constant	13.281 (-9.7, 36.2)	13.3 (-5, 31.5)	12.8 (-5.6, 31.2)
R ²	0.20	0.16	0.18
ANOVA	F=3.34*	F=2.37*	F=2.19*

Note: *Significant at level 1%.

diseases. However, because in year 4 students start their clinical practice, this year's curriculum included 10 hours of lectures and practical sessions on infection control which provided them with some theoretical and practical knowledge on infectious diseases such as hepatitis C and HIV. This explains why year 4 students were found to be significantly the most knowledgeable about the modes of transmission of these conditions.

Although dental clinics are good settings for identifying HIV-positive individuals based on multiple oral manifestations which appear at the early stages of infection,³¹ it was

obvious that unlike Indian dental students,²⁰ the undergraduate students at ASU were not well trained to identify potential HIV patients and the majority perceived themselves incapable of detecting HIV-related oral lesions.

In the present study, the dental students' poor knowledge regarding this infectious disease could be partly attributed to conservative cultures and the deeply entrenched HIV- and AIDS-related phobia in the Middle East and North Africa region generally.³² In the Egyptian society, the sociocultural taboos around discussions related to sexuality, reproductive health, and sexually transmitted diseases might lead to limited

access to information on HIV not only among lay people but also within HCPs' populations.^{33–35} This has been revealed in one qualitative study conducted in a public hospital in Egypt where the participating physicians and nurses indicated that their fear of getting infected or being stigmatized, their inadequate knowledge about proper infection control measures, and their beliefs that HIV infection is acquired only due to inappropriate sexual behaviors validated their discriminatory attitudes toward those patients.¹⁵ Furthermore, owing to the very low prevalence of HIV in Egypt,² inclusion of adequate knowledge pertaining to oral manifestations of HIV infection, its modes of transmission, and management of PLHIV in undergraduate dental program curricula might not have been considered an urging priority.

Whereas 85% of the respondents in our survey had the correct knowledge that adhering to a standard set of infection control measures adequately prevents both hepatitis C and HIV transmission, 42% of them compared to 32% in Crossley's study in South Cheshire in the United Kingdom believed that preventing transmission of HIV infection while treating affected patients would increase the costs of dental treatment.³⁶ Owing to this misconception, in the future, dental students might preclude HIV-positive patients from receiving dental treatment in their private practice to avoid any additional financial burdens. Surprisingly, around 90% of students who participated in our survey rejected the view that HIV-infected individuals should reveal their health status to dentists. A plausible explanation for their response could be that it is generally agreed that in any dental facility strict barrier techniques should be used routinely in consideration that any patient could be potentially infectious.³⁷

It is worth mentioning that the dental students who participated in this study were randomly selected and invited to respond to a self-administered anonymous questionnaire to eliminate the possibility of any bias due to any external pressure on the participants. Although the response rate was not low, it is important to highlight that our study addressed a disease that is "culturally sensitive" in conservative communities due to its direct link to sexuality and this might have discouraged some students to participate. One limitation that should be considered is that the findings of our study reflect the knowledge and views of students at one public dental school and thus cannot be generalized to all undergraduate Egyptian dental students considering that generally studied curricula vary from one school to another. Moreover, private schools and those in different geographical contexts within the country might attract students of different socioeconomic backgrounds and cultural beliefs which might impact their responses.

Conclusion

In conclusion, even though the majority of undergraduate dental students at ASU exhibited some positive attitude toward PLHIV, the overall level of HIV-related knowledge among the students was quite unsatisfactory and the failure of the majority of them to identify oral manifestations commonly associated with HIV is worrisome. Consequently, it is crucial to instill more confidence in dental students in their ability to recognize oral problems of PLHIV and deliver quality oral care to patients whenever required. Hence, the undergraduate dental program curricula need to be redesigned to ensure provision of adequate, consistent, and up-to-date information on HIV to students throughout all years of study.

It is also highly recommended that future dentists should receive training that promotes direct interaction between students and PLHIV to allow them to share their perspectives as patients and thus help combat stigma around them and eliminate any sociocultural barriers that could restrict their access to oral care. This could be done through partnership with civil society organizations and other stakeholders who are dedicated to improving the lives of HIV-infected individuals using different teaching approaches such as role playing, video acting, or innovative case-based group learning exercises. In addition, similar studies need to be conducted in other public and private universities in Egypt to assess and compare the knowledge and attitudes of dental students toward PLHIV.

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Author contributions

All authors contributed toward data analysis, drafting and critically revising the paper, gave final approval of the version to be published, and agree to be accountable for all aspects of the work. RKA EF, AA, and ZF developed the concept for this research. RKA EF and AA designed the survey tool and supervised the process of data collection; ZF conducted the software programming for data management; and MAH carried out the statistical analysis of the study data. RKA EF wrote

the study protocol and the manuscript; AA participated in writing the initial draft; and MAH, AA, and ZF reviewed and edited the final manuscript independently until a consensus was reached about the final version.

Disclosure

The authors report no conflicts of interest in this work.

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