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ORIGINAL RESEARCH

The Effectiveness of an Educational Intervention on *Helicobacter pylori* for University Students: A Quasi-Experimental Study

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Introduction: *Helicobacter pylori* infection is widespread and harmful, rendering its eradication a serious public health problem. Undergraduate students' general understanding of *H. pylori* infection is relatively poor. This was a second-phase research study to evaluate the efficacy of an educational intervention in raising awareness among university students.

Methods: A quasi-experimental approach was employed, with 108 undergraduate students at King Saud University as participants. First, during the October 2021 academic year, data were gathered using a validated survey. The survey was divided into socio-demographic characteristics and *H. pylori* knowledge. Second, we assessed the effectiveness of an educational intervention to increase university students' awareness of the topic.

Results: Before the intervention, the percentage of students that had good (9.3%), fair (28.7%) and poor (62%) knowledge of *H. pylori* infection changed to 55.6%, 41.7%, and 2.8% respectively. There was a significant increase in overall and domain-wise mean knowledge score after the educational intervention (p = 0.001). The pretest knowledge was independent of all socio-demographic variables except "whether or not they had heard about *H. pylori* infection" (χ^2= 8.666, p = 0.013).

Conclusion: Educational intervention may help increase students' awareness of *H. pylori* infections.

Keywords: awareness, infectious disease, *H. pylori* infection, education-intervention, undergraduate student, infection control

Introduction

Helicobacter pylori (*H. pylori*) is a gram-negative bacterium present in the gastric environment in approximately 4.4 billion individuals, making it the most widespread infection worldwide.[1] The primary reservoir is the stomach, and the principal mode of transmission is person-to-person contact. Many studies have reported that the prevalence of *H. pylori* is influenced by many factors, including educational level, geographical area, age, socioeconomic status, and living conditions.[2] Globally, a study showed that the infection rate in low and middle-income countries was 44.3% and 50.8%, respectively, while in the developed countries, it was 34.7%. This variation might be due to poor sanitation, crowded living conditions, lack of awareness, and poor water supply in less-developed countries.[3] However, although Saudi Arabia is a developed country, one study showed *H. pylori* prevalence of 50–80% among symptomatic patients with abdominal pain, dyspepsia, and patients who underwent endoscopic procedures.[4] The majority of those who have the organism are asymptomatic (85%), and less than 15% develop complications.[5] Since most of them remain asymptomatic, long-term colonization of the gastric mucosa with *H. pylori* might lead to several complications, including peptic ulcer, chronic gastritis, gastric cancer, and mucosa-associated lymphoid tissue lymphoma.

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Moreover, *H. pylori* infection is both pervasive and harmful, making its eradication a major public health concern. Unfortunately, general knowledge and awareness regarding *H. pylori* infection are relatively poor.[6–9] Education is an important approach for enhancing patients' understanding, promoting patient-doctor communication, and raising self-cognition and management.[10,11] A study conducted by Zha et al (2022) that aimed to determine the impact of an enhanced patient education (EPE) program for *H. pylori* infection concluded that EPE could improve eradication rates and patient compliance to some extent, which constitutes a promising addition to clinical treatment regimens.[12]

The first phase of our study,[13] which compared the knowledge of health science and non-health science undergraduate students about *H. pylori* infection, found the overall knowledge level to be relatively low. Educational interventions are needed to improve public awareness.[11,14] Hence, the implementation of an educational program for *H. pylori* infection that includes modes of transmission, complications, and prevention is imperative. Based on the findings of a low level of knowledge in the first phase of the study, the researchers felt that the need for developing an educational intervention for *H. pylori* was fundamentally important. The second phase of the study was conducted to assess the effectiveness of an educational intervention aimed at increasing university students' awareness. To our knowledge, this study is the first to examine the effectiveness of an educational intervention on *H. pylori* infection among university students in Saudi Arabia.

Materials and Methods

Study Design, Setting, and Participants

This study used a quasi-experimental one-group pre- and post-test design to evaluate the effectiveness of an educational program regarding *H. pylori* infection and its prevention. This research was conducted at King Saud University, which includes undergraduate students from four colleges: two health colleges (College of Applied Medical Sciences and College of Nursing) and two non-health colleges (College of Science and College of Computer Science). Second-year (levels III and IV) and third-year (levels V and VI) undergraduate students participated in the study. These levels describe the semesters in the yearly program. A nonprobability convenience sampling technique was used. A total of 108 students who consented to participate in this study were selected. The inclusion criteria were as follows: i) full-time students registered in an undergraduate program and ii) willing to participate in the study. Students enrolled in the preparatory year were excluded from this study.

Development and Description of the Educational Package on *H. pylori*

Before establishing the content of the educational package on *H. pylori* (EPHP) and methods to be used for delivering the sessions, an extensive review of the literature on *H. pylori* was conducted. The educational package consisted of four parts: i) the EPHP objectives, ii) the content: the topics specified in the development section of the knowledge questionnaire, iii) the teaching method: lecture and discussion, and iv) audio-visual aids: PowerPoint slides and a video developed by the authors. The draft EPHP was developed based on a literature review. Furthermore, it was submitted to five experts from the fields of community nursing and medicine for content validation, who agreed on the relevance and appropriateness of the content. All aspects of the EPHP had over 80% agreement among the experts. Therefore, no further modifications were made. The total duration of the EPHP was 1 h, which predominantly had lecture discussions as the teaching method.

Data Collection

The data were collected in October 2021 using a two-part questionnaire; the first section assessed the socio-demographic factors, and the second section measured knowledge regarding *H. pylori* through 14 single-response multiple-choice items. The content areas of the survey were "meaning/perception of *H. pylori* infection and complications" (three items; items 1, 13, and 14), "signs and symptoms and risk factors" (four items; items 2–5), "mode of spread and prevention" (two items; items 6 and 8), and "diagnosis, treatment, and self-care" (five items; items 7, 9–12). A correct response was scored one, and an incorrect answer was zero. A score ranging from 0–14 was converted into a percentage score and classified into three levels: good (> 75%), fair (50–75%), and poor (< 50%). The instrument was developed by the

researchers in the first phase of the study. This instrument is valid and reliable. The instrument's psychometric properties were described in a previous publication.[13] A pilot study conducted on a sample of students who were not part of the main study (n = 10) demonstrated that the study was feasible.

After explaining the purpose and procedure for data collection, participants who fulfilled the inclusion criteria and consented to participate were invited by each of the course's faculty coordinators. On Day 1, participants completed the demographic and knowledge questionnaire (pre-test) through an online Google Forms survey, which was sent to their registered emails. After the students responded to the questionnaire, the educational intervention was conducted online through the Zoom platform. The educational session lasted 1 h in total, with a lecture and discussion session lasting 55 min and a video lasting 5 min. On Day 8, the post-test was conducted using the same structured knowledge questionnaire as used for the pre-test. The post-test was completed by all 108 students who took the pre-test.

Ethical Considerations

This study was conducted in accordance with the guidelines of the Declaration of Helsinki and ethical approval was granted by the Institutional Review Board of King Saud University (approval of Research Project No. E-19-4102). Implied informed consent at the beginning of the questionnaire was obtained from all participants. The confidentiality of the data collected was ensured, and its usage was solely intended for the researchers.

Statistical Analyses

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0 (Armonk, NY: IBM Corp). Frequencies and percentages were used to describe the sociodemographic data and knowledge of *H. pylori* infection among the students. The range (minimum and maximum), mean, standard deviation (SD), and median were calculated. To determine the normality of the distribution of pre-test and post-test data, the Kolmogorov–Smirnov test was used. The significance of the obtained results was determined at the 5% level. The Wilcoxon signed-rank test was used to analyze the effectiveness of the educational program.

Results

Socio-Demographic Characteristics of the Respondents

The socio-demographic characteristics of the respondents were analyzed (Table 1). The respondents were mostly in the 20 to 30-year age group (76.9%) and male individuals (61.1%). The university level of the respondents was higher in Year III (63.9%) than in Year II (36.1%). Two-thirds of the respondents had 4–7 siblings, and the majority (56.5%) claimed to have a monthly family income of more than 10,000 Saudi riyals (1 USD = 3.76 SR). Regarding their habits, most of them (95.4%) drank coffee or tea, and 60.2% drank < 2 cups per day. Interestingly, more than half of the respondents reported that their families consumed both bottled and tap water, and only 5.6% of respondents stated that their families used only tap water. About half of the respondents had heard about *H. pylori* infection, and their source of knowledge was similarly distributed between mass media (34%), reading articles (32.1%), and family (30.2%). Only 6.5% of the respondents had a history of *H. pylori* infection, and 57.1% of them received treatment.

Comparison of Knowledge Before and After the Educational Intervention

The level of knowledge of *H. pylori* infection was measured among the participants before and after the introduction of the educational intervention. As shown in Figure 1 the overall knowledge of *H. pylori* infection increased after the educational intervention. Before the educational intervention, less than a tenth (9.3%) of the participants had good knowledge, which increased to 55.6% after the intervention. Moreover, approximately two-thirds of the participants had poor knowledge (62.0%) before the intervention. After the intervention, this figure reduced to 2.8%, and the groups with fair knowledge increased from 28.7% to 41.7%.

Table 1 Socio-Demographic Characteristics of the Respondents (n = 108)

First Part: Socio-Demographic Data	No.	%
Age (years)		
< 20	25	23.1
20–30	83	76.9
Sex		
Male	66	61.1
Female	42	38.9
University level		
Level III and IV/(Second year)	39	36.1
Level V and VI/(Third year)	69	63.9
No. of siblings		
< 3	19	17.6
3–7	65	60.2
> 7	24	22.2
Family monthly income		
< 2500 SR	4	3.7
2500–5000 SR	11	10.2
5000–10,000 SR	32	29.6
> 10,000 SR	61	56.5
Do you drink coffee or tea?		
Yes	103	95.4
No	5	4.6
If yes, how many cups per day? (n = 103)		
< 2 cups	62	60.2
2–5 cups	37	35.9
> 5 cups	4	3.9
What sources of drinking water does your family use?		
Tap water	6	5.6
Bottled water	43	39.8
Both	59	54.6
Have you heard about *H. pylori* infection (a microbe which causes peptic ulcers)?		
Yes	53	49.1
No	55	50.9
If yes, what is the source of your knowledge? (n = 53)		
Family	16	30.2
Mass media	18	34.0
Reading articles	17	32.1
Neighborhood	2	3.8
Do you have a history of *H. pylori* infection?		
Yes	7	6.5
No	101	93.5
If yes, have you been treated? (n = 7)		
Yes	4	57.1
No	3	42.9

Abbreviations: *H. pylori, Helicobacter pylori*; SR, Saudi riyals.

The overall and domain-wise knowledge of the respondents was analyzed to determine whether the educational intervention was effective in improving their knowledge. Thus, the hypothesis "there will be a significant increase in the mean post-test knowledge score of the students compared with their mean pre-test knowledge score" was tested at a 0.05 level of significance. The findings showed a significant increase in the mean from 43.5 to 76.8 ($p < 0.001$), indicating that the educational intervention was effective in improving the knowledge of students about *H. pylori* infection (Figure 2).

Figure 1 Distribution of the respondents regarding knowledge about *H. pylori* Infection. Knowledge scores were classified into three levels based on the percentage of scores achieved by the participants: good (>75%), fair (50–75%), and poor (< 50%). Pre-test (Questionnaire administered before the educational intervention); Post-test (Questionnaire administered after the educational intervention).

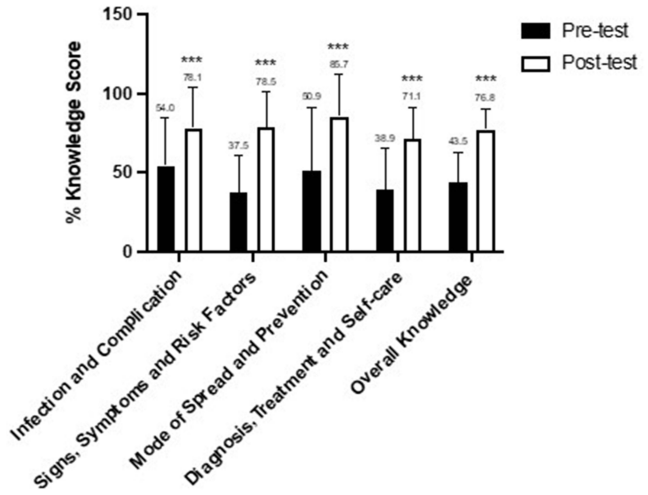

Figure 2 Descriptive Analysis of the Respondents According to Knowledge Domain about *H. pylori* Infection. Error bars represent the standard deviation, ***$p = 0.001$. Pre-test (Questionnaire administered before the educational intervention); Post-test (Questionnaire administered after the educational intervention).

The comparison of the percentage of respondents who answered each of the items correctly in the pre-test and post-test showed a significant increase in all except two items, with one denoting the meaning of *H. pylori* ("*Helicobacter Pylori* (*H. pylori*), commonly found in the stomach, is a bacterium" ($p = 0.176$) and the other related to the signs and symptoms ("A person suffering from *H. pylori* infection will experience which of the following?" ($p = 0.784$) (Table 2).

Factors Associated with *H. pylori* Knowledge Among Respondents in the Pre-test

The socio-demographic characteristics of the respondents were analyzed to assess their association with pre-test knowledge. As shown in Table 3, respondents' knowledge of *H. pylori* was independent of all except one variable; whether or not they had heard about *H. pylori* infection ($\chi 2 = 8.666$, $p = 0.013$).

Table 2 Distribution of the Respondents Regarding Knowledge About *H. pylori* Infection

Q		Pre*				Post**				*p*-value
		Incorrect		Correct		Incorrect		Correct		
		No.	%	No.	%	No.	%	No.	%	
1	*Helicobacter Pylori* (*H. pylori*) commonly found in the stomach is a bacterium	25	23.1	83	76.9	16	14.8	92	85.2	0.176
2	Which of the following is a sign/symptom of *H. pylori* infection?	59	54.6	49	45.4	15	13.9	93	86.1	< 0.001*
3	A person suffering from *H. pylori* infection will experience which of the following?	44	40.7	64	59.3	47	43.5	61	56.5	0.784
4	Which of the following is a risk factor for *H. pylori* infection?	74	68.5	34	31.5	14	13.0	94	87.0	< 0.001*
5	Which of the following is NOT a risk factor for *H. pylori* infection?	93	86.1	15	13.9	17	15.7	91	84.3	< 0.001*
6	*H. pylori* infection can be passed from one person to another through which of the following ways/routes?	59	54.6	49	45.4	15	13.9	93	86.1	< 0.001*
7	*H. pylori* can be diagnosed by examination of breath test	76	70.4	32	29.6	13	12.0	95	88.0	< 0.001*
8	Which of the following is a measure to prevent *H. pylori* infection?	47	43.5	61	56.5	16	14.8	92	85.2	< 0.001*
9	If a person has *H. pylori* infection, he/she can be treated with	66	61.1	42	38.9	15	13.9	93	86.1	< 0.001*
10	The duration of treatment for *H. pylori* infection is	59	54.6	49	45.4	44	40.7	64	59.3	0.046*
11	To avoid the recurrence of *H. pylori* infection, a person should	68	63.0	40	37.0	42	38.9	66	61.1	< 0.001*
12	If your friend or relative is suspected of having *H. pylori* infection, he/she should seek immediate medical advice in which of the following conditions?	61	56.5	47	43.5	42	38.9	66	61.1	0.023*
13	Which of the following is true regarding *H. pylori* infection?	70	64.8	38	35.2	40	37.0	68	63.0	< 0.001*
14	What complication does *H. pylori* infection cause?	54	50.0	54	50.0	15	13.9	93	86.1	< 0.001*
	Overall mean	**45.83**				**71.36**				**< 0.001***

Notes: *Pre (pre-test, questionnaire administered before the educational intervention); **Post (post-test, questionnaire administered after the educational intervention). *p*-value for comparison between **pre** and **post**. *Statistically significant at $p \leq 0.05$.

Table 3 Relationship Between the Socio-Demographic Characteristics and Knowledge About *H. pylori* Infection (Pre-Test) (N = 108)

Q	Socio-Demographic Data	Overall Knowledge About *H. pylori* Infection (Pre-Test)						χ^2	*p*-value
		Poor < 50% (n =62)		Fair 50–75% (n =32)		Good ≥ 75% (n =14)			
		No.	%	No.	%	No.	%		
1	**Age (years)**								
	< 20	18	29.0	5	15.6	2	14.3	2.843	0.241
	20–30	44	71.0	27	84.4	12	85.7		
2	**Sex**								
	Male	39	62.9	20	62.5	7	50.0	0.837	0.658
	Female	23	37.1	12	37.5	7	50.0		
6	**University level**								
	Level III and IV/(second year)	24	38.7	8	25.0	7	50.0	3.064	0.0216
	Level V and VI/(Third year)	38	61.3	24	75.0	7	50.0		
7	**No. of siblings**								
	< 3	10	16.1	7	21.9	2	14.3	1.607	^{MC}p =0.839
	3–7	36	58.1	20	62.5	9	64.3		
	> 7	16	25.8	5	15.6	3	21.4		

(*Continued*)

Table 3 (Continued).

Q	Socio-Demographic Data	Overall Knowledge About *H. pylori* Infection (Pre-Test)						χ^2	*p*-value
		Poor < 50% (n =62)		Fair 50–75% (n =32)		Good ≥ 75% (n =14)			
		No.	%	No.	%	No.	%		
8	**Family monthly income**								
	< 2500 SR	2	3.2	2	6.3	0	0.0	2.684	^{MC}p =0.878
	2500–5000 SR	5	8.1	5	15.6	1	7.1		
	5000–10,000 SR	19	30.6	9	28.1	4	28.6		
	> 10,000 SR	36	58.1	16	50.0	9	64.3		
9	**Do you drink coffee or tea?**								
	Yes	60	96.8	31	96.9	12	85.7	3.030	^{MC}p =0.199
	No	2	3.2	1	3.1	2	14.3		
10	**If yes, how many cups per day?**	(n = 60)		(n = 31)		(n = 12)			
	< 2 cups	36	60.0	22	71.0	4	33.3	7.093	^{MC}p =0.099
	2–5 cups	20	33.3	9	29.0	8	66.7		
	> 5 cups	4	6.7	0	0.0	0	0.0		
11	**What sources of drinking water does your family use?**								
	Tap water	2	3.2	3	9.4	1	7.1	6.512	^{MC}p =0.136
	Bottled water	22	35.5	12	37.5	9	64.3		
	Both	38	61.3	17	53.1	4	28.6		
12	**Have you heard about *H. pylori* infection (a microbe which causes peptic ulcers)?**								
	Yes	23	37.1	20	62.5	10	71.4	8.666*	0.013*
	No	39	62.9	12	37.5	4	28.6		
13	**If yes, what is the source of your knowledge?**	(n =23)		(n =20)		(n =10)			
	Family	6	26.1	8	40.0	2	20.0	3.741	^{MC}p =0.754
	Mass media	8	34.8	7	35.0	3	30.0		
	Reading articles	8	34.8	4	20.0	5	50.0		
	Neighborhood	1	4.3	1	5.0	0	0.0		
14	**Do you have history of *H. pylori* infection?**								
	Yes	3	4.8	3	9.4	1	7.1	1.106	^{MC}p =0.542
	No	59	95.2	29	90.6	13	92.9		
15	**If yes, have you been treated?**	(n = 3)		(n = 3)		(n = 1)			
	Yes	1	33.3	2	66.7	1	100.0	1.603	^{MC}p =1.000
	No	2	66.7	1	33.3	0	0.0		

Notes: χ^2, Chi square test; MC, Monte Carlo. *p*, *p*-value for comparison between pre- and post-intervention *Statistically significant at $p \leq 0.05$. Pre-test (questionnaire administered before the educational intervention). Pre-test (questionnaire before the educational intervention); Post-test (questionnaire administered after the educational intervention).

Discussion

Education is a critical component in the prevention and control of infections.[11,14] Therefore, developing and utilizing educational programs to raise awareness regarding the prevention and spread of infections, particularly *H. pylori* infection, is of fundamental importance. The educational intervention in our study was effective in improving knowledge of *H. pylori* infection among university students. The findings of this study will be particularly useful for health educators to raise awareness of *H. pylori*, specifically, as research has shown low awareness about *H. pylori*, not only in the general

population[10,15] but also among university students.[13] Furthermore, the low awareness in a recent survey among undergraduate university students in Saudi Arabia, conducted as the first phase of this study and published elsewhere, formed the basis of the current study.[13] Interestingly, the study showed low awareness among both health and non-health science university students, indicating the need for educational programs to enhance students' awareness of *H. pylori* infection, which is a public health concern.

Our finding of a significant increase in overall and domain-wise knowledge of *H. pylori* infection after the educational intervention is comparable to the findings of Ibrahiem and Saad (2021), who evaluated a health awareness package for *H. pylori* among family members in a hospital in terms of knowledge and hygienic practices in Egypt.[16] Although their findings are comparable to our study's, there are some differences. For instance, their sample involved family members, and they used face-to-face small-group education with a booklet. In contrast, our sample comprised university students registered in a baccalaureate program. Furthermore, we used online teaching that lacked face-to-face interaction. Although the specific characteristics of the individuals and teaching methods influenced the learning process, the educational intervention effectively improved learners' knowledge. Although these studies have shown the effectiveness of educational interventions, findings have been reported among patients and family members. In addition to enhancing awareness, there are other benefits of educating patients. For instance, a systematic review and meta-analysis conducted by Zha et al (2022) on the effects of enhanced education for patients with *H. pylori* infection showed benefits in terms of improvements in eradication rates and patient compliance.[12] Although our educational intervention on *H. pylori* infection was aimed at improving the knowledge of university students, the students may benefit in the long term by utilizing this information to prevent *H. pylori* infection in the future. Further research is essential to determine its long-term benefits.

There is a paucity of research on educational interventions for *H. pylori* among university students. Therefore, we compared our findings with those of studies conducted on students in other knowledge domains, such as infection control precautions and hand hygiene. Similar to our findings, previous research reporting the effectiveness of educational interventions has been shown to improve students' knowledge of hand hygiene,[17] tuberculosis infection control,[18] and infection control prevention.[19–22] For instance, Jordan's nursing schools tested the educational program's effectiveness in promoting students' knowledge of infection prevention precautions and observed that after participating in the infection prevention educational program, participants in the experimental group demonstrated significantly better knowledge than those in the control group.[20] In another study that compared the effects of two educational programs for infection control, a simulation using standardized patients and a peer role-play for the experimental group and lectures, skills training, and peer tutoring practices for the control group, the results showed that both groups had statistically significant increase in knowledge, awareness of standard precautions, and infection control performance after the intervention.[21] These studies further highlight the effectiveness of educational interventions in improving student knowledge using various methods. Similarly, our study found that online teaching was effective in improving students' knowledge.

Contrary to our expectations, two items on the questionnaire did not show a significant increase in knowledge after the intervention: "*Helicobacter Pylori* (*H. pylori*), commonly found in the stomach, is a bacterium", and "A person suffering from *H. pylori* infection will experience nausea." This finding suggests that future educational programs should place greater emphasis on this content. Concerning the association between socio-demographic factors and pre-test knowledge of *H. pylori*, all except two factors, university level and having heard about *H. pylori* infection, were independent of the level of knowledge. The finding of a significant association between the knowledge level of *H. pylori* and university level of the students was similar to that of a previous report.[13] In our study, a larger proportion of students in levels V and VI/ (third year) had fair knowledge than those in levels III and IV (second year). It seems possible that these results are due to the upward curricular movement of the students, suggesting that they acquired better information about *H. pylori* in their curricular advancement. Further studies with larger sample sizes are required to understand the relationship between these variables.

The strength of this study is that, to the best of our knowledge, this is the first study to develop and evaluate an educational intervention for *H. pylori* knowledge among Saudi university students. The respondents were recruited by convenience sampling from one university. Thus the findings may not be generalizable to all university students in Saudi Arabia. As this study used a small-sized convenience samples, selection bias is possible. Using a self-reported questionnaire rendered it difficult to avoid response bias. Furthermore, the quasi-experimental design with one group can affect internal validity. Future studies with control groups will be beneficial. This study did not assess the long term effects of the educational intervention,

such as retention of knowledge and implementation of preventive measures of *H. pylori* infection. Future research efforts should not only use larger sample of schools, adolescents, and other vulnerable groups, but also examine the intervention effects on preventing *H. pylori* infection. Despite these limitations, the study was effective in improving university students' knowledge. The implication of this finding is that educational intervention can be used as an adjunct to the regular education of students to enhance their knowledge of *H. pylori*. Moreover, a program such as this might boost adherence to *H. pylori* infection control practices and, as a result, reduce the prevalence and complications of *H. pylori* infection.

Data Sharing Statement

All data are available on reasonable request from the corresponding author.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Alzahrani S, Lina TT, Gonzalez J, et al. Effect of Helicobacter pylori on gastric epithelial cells. *World J Gastroenterol*. 2014;20(36):12767–12780. doi:10.3748/wjg.v20.i36.12767
2. de Brito BB, Silva FAFD, Soares AS, et al. Pathogenesis and clinical management of Helicobacter pylori gastric infection. *World J Gastroenterol*. 2019;25(37):5578–5589. doi:10.3748/wjg.v25.i37.5578
3. Hooi JKY, Lai WY, Ng WK, et al. Global Prevalence of Helicobacter pylori Infection: systematic Review and Meta-Analysis. *Gastroenterology*. 2017;153(2):420–429. doi:10.1053/j.gastro.2017.04.022
4. Al-Hussaini AA, Al Jurayyan A, Bashir S, et al. Where are we today with Helicobacter pylori infection among healthy children in Saudi Arabia? *Saudi J Gastroenterol*. 2019;25(5):309. doi:10.4103/sjg.SJG_531_18
5. Lee YC, Dore MP, Graham DY. Diagnosis and Treatment of Helicobacter pylori Infection. *Annu Rev Med*. 2022;73:183–195. doi:10.1146/annurev-med-042220-020814
6. Wynne A, Hastings EV, Colquhoun A, et al. Untreated water and Helicobacter pylori: perceptions and behaviors in a Northern Canadian community. *Int J Circumpolar Health*. 2013;72:704–705.
7. Novelli P. Knowledge about causes of peptic ulcer disease - United States, March-April 1997 (Reprinted from MMWR, 46, 985-987, 1997). *J Am Med Assoc*. 1997;278(21):1731.
8. Xia P, Ma MF, Wang W. Status of *Helicobacter pylori* Infection among Migrant Workers in Shijiazhuang, China. *Asian Pacific J Cancer Prevention*. 2012;13(4):1167–1170. doi:10.7314/APJCP.2012.13.4.1167
9. Oh DY, Choi KS, Shin H-R, et al. Public Awareness of Gastric Cancer Risk Factors and Disease Screening in a High Risk Region: a Population-Based Study. *Cancer Res Treatment*. 2009;41(2):59–66. doi:10.4143/crt.2009.41.2.59
10. Driscoll LJ, DeYoung SE, Harris CA, et al. Population Knowledge, Attitude, and Practice Regarding Helicobacter pylori Transmission and Outcomes: a Literature Review. *Front Public Health*. 2017;5:5. doi:10.3389/fpubh.2017.00005
11. Ward DJ. The role of education in the prevention and control of infection: a review of the literature. *Nurse Educ Today*. 2011;31(1):9–17. doi:10.1016/j.nedt.2010.03.007
12. Zha J, Li -Y-Y, Qu J-Y, et al. Effects of enhanced education for patients with the Helicobacter pylori infection: a systematic review and meta-analysis. *Helicobacter*. 2022;27(2). doi:10.1111/hel.12880.
13. Hafiz TA, D'Sa JL, Zamzam S, et al. Helicobacter pylori Infection: comparison of Knowledge between Health Science and Non-Health Science University Students. *Int J Environ Res Public Health*. 2021;18(15):8173. doi:10.3390/ijerph18158173
14. Ward KA. EDUCATION AND INFECTION-CONTROL AUDIT. *J Hospital Infect*. 1995;30:248–252. doi:10.1016/0195-6701(95)90026-8
15. Stone MA, Mayberry JF. Helicobacter pylori: an assessment of public awareness and acceptance of screening. *Health Soc Care Community*. 1998;6(2):78–83. doi:10.1046/j.1365-2524.1998.00102.x
16. Ibrahiem DA, Saad AM. Health Awareness Package to Avert Helicobacter Pylori Infection among Family Members. *Egyption J Health Care*. 2021;12(1):448–470. doi:10.21608/ejhc.2021.142233

17. Korhonen A, Vuori A, Lukkari A, et al. Increasing nursing students' knowledge of evidence-based hand-hygiene: a quasi-experimental study. *Nurse Educ Pract*. 2019;35:104–110. doi:10.1016/j.nepr.2018.12.009
18. Westhuizen VD, Kotze K, Narotam H, et al. Knowledge, attitudes and practices regarding TB infection control among health science students in a TB-endemic setting. *Int J Infection Control*. 2015;11(4):22–27.
19. Wu C-J, Gardner G, Chang AM. Nursing Students' Knowledge and Practice of Infection Control Precautions: an Educational Intervention. *J Adv Nurs*. 2009;65:2142–2149. doi:10.1111/j.1365-2648.2009.05079.x
20. Al-Hussami M, Darawad M. Compliance of nursing students with infection prevention precautions: effectiveness of a teaching program. *Am J Infect Control*. 2013;41(4):332–336. doi:10.1016/j.ajic.2012.03.029
21. Kim E, Kim SS, Kim S. Effects of Infection Control Education for Nursing Students Using Standardized Patients vs. Peer Role-Play. *Int J Environ Res Public Health*. 2021;18. doi:10.3390/ijerph18010107
22. Calabro K, Bright K, Kouzekanani K. Long-term Effectiveness of Infection Control Training among Fourth-year Medical Students. *Med Educ*. 2000;5:65.