



## Survey of Knowledge, Attitudes, and Practices Toward Typhoid Fever among Students at Amran University Institute of Continuing Education, Yemen

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### Abstract

**Background:** Typhoid fever (TF) is a febrile global health problem caused by *Salmonella enterica* serovar Typhi (*S. Typhi*) with relatively high prevalence in low- and middle-income countries, including Yemen. The World Health Organization recommends identifying local prevalence and gaps in knowledge, attitude, and practice (KAP) towards TF to implement preventive measures. Therefore, this study aimed to determine the knowledge, attitudes, and practices toward typhoid fever among students at the Amran University Institute of Continuing Education. **Methods:** This cross-sectional study was conducted among 121 students between December 2024 and May 2025. Demographic, transmission route, and behavioral data were collected using questionnaires through face-to-face interviews. **Results:** A total of 121 students were enrolled in this study. Most of the data were collected from students aged 21–40 years (49.6%) residing in urban areas (81.8%) who were single (79.3%), had a parent's university certificate (47.1%), were in their first year of the academic year (35.5%), and drank from trucks (42.1%). According to this finding, "TF can be transmitted by contact with humans" (mean = 2.52) had the highest score for knowledge, attitudes, and practices regarding the disease's aetiology. The item with the highest score for knowledge of the symptoms was "Fever is a symptom of typhoid" (mean = 2.81). The item with the highest score in terms of disease preventive knowledge was "Insect and fly control" (mean = 2.85). **Conclusion:** Access to clean water, vaccination, and health education shapes university students' knowledge and practices regarding typhoid fever. Targeted interventions addressing these factors can help reduce the burden of typhoid fever in academic settings.

**Keywords:** Survey, Typhoid fever, Knowledge, Transmission, Prevention, Yemen.

**الخلفية:** حمى التيفوئيد مشكلة صحية عالمية حموية، تُسببها بكتيريا السالمونيلا المعوية المصلية التيفية (*S. Typhi*)، وتنتشر بشكل واسع نسبياً في البلدان منخفضة ومتوسطة الدخل، بما في ذلك اليمن. توصي منظمة الصحة العالمية بتحديد الانتشار المحلي والفجوات في المعرفة والمواقف والممارسات تجاه حمى التيفوئيد لتطبيق التدابير الوقائية. لذلك، هدفت هذه الدراسة إلى تحديد المعرفة والمواقف والممارسات تجاه حمى التيفوئيد بين طلاب معهد التعليم المستمر بجامعة عمران. **المنهجية:** أُجريت هذه الدراسة المقطعية على 121 طالباً وطالبة بين ديسمبر 2024 ومايو 2025. جُمعت البيانات الديموغرافية، ومسارات انتقال العدوى، والسلوكية باستخدام استبيانات من خلال مقابلات شخصية. **النتائج:** بلغ عدد الطلاب المسجلين في هذه الدراسة 121 طالباً وطالبة. جُمعت معظم البيانات من طلاب تتراوح أعمارهم بين 21 و40 عاماً (49.6%)، يقيمون في المناطق الحضرية (81.8%)، وهم عزّاب (79.3%)، والديهم حاصلون على شهادة جامعية (47.1%)، وفي السنة الدراسية الأولى (35.5%)، ويشربون من شاحنات (42.1%). ووفقاً لعينة البحث، كان "يمكن أن تنتقل حمى التيفوئيد عن طريق الاتصال بالبشر" (المتوسط = 2.52) هو البند الذي حصل على أعلى درجة في المعرفة والمواقف والممارسات المتعلقة بمسببات المرض. وكان البند الذي حصل على أعلى درجة في معرفة الأعراض هو "الحمى أحد أعراض التيفوئيد" (المتوسط = 2.81). وكان البند الذي

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حصل على أعلى درجة في المعرفة الوقائية من المرض هو "مكافحة الحشرات والذباب" (المتوسط = 2.85). الخلاصة: تتشكل معرفة وممارسات طلاب الجامعات فيما يتعلق بحمى التيفويد من خلال الوصول إلى المياه النظيفة والتطعيم والتقييد الصحي. إن معالجة هذه العوامل من خلال التدخلات المستهدفة يمكن أن تساعد في تخفيف عبء حمى التيفويد في الأوساط الأكاديمية

## Introduction

Typhoid fever (TF) is a febrile, life-threatening disease caused by the bacterium *Salmonella enterica* serovar *Typhi* (*S. Typhi*). *S. Typhi*, where humans are the only host and reservoir, remains a major public health issue in low- and middle-income countries, with millions of cases annually. [1-3] Typhoid fever is mainly transmitted through food and water contaminated with human feces. The spread of this disease is associated with unsafe water use and poor sanitation and hygiene at the personal and community levels [4-5], The disease is infectious for as long as the infected person releases *Salmonella typhi* and *Salmonella paratyphi* in the urine or feces [6], and the intensity of infection in the population depends on the number of doses of infection and virulence of the organism [7].

In the early presentation of signs and symptoms, the clinical diagnosis is not specific because it is similar to those of other common tropical infections such as enteric fever, dengue, malaria, leptospirosis, and typhus fever. The nonspecific and wide range of clinical features causes several problems in the diagnosis of enteric fever. Early diagnosis is essential for their treatment [8].

Studies in tertiary educational institutions have highlighted that unsafe drinking water is a significant factor in typhoid transmission among students and staff. Poor vaccination coverage and self-medication practices contribute to the persistence and complications of the disease, including the development of multidrug resistance to antibiotics commonly used for treatment. These findings underscore the need for targeted health education and improved public health measures in university communities [9-10].

It takes information to achieve good health. Essentially, the process of acquiring knowledge—rather than the quantity of information received—determines attitude development. Furthermore, raising community knowledge about TF is a powerful strategy for promoting positive attitudes and the adoption of preventative actions among the general public. Therefore, a comprehensive grasp of the knowledge and practices within any group is required to avoid the transmission of TF [11].

One of the developing countries without strategies or policies in place to control or prevent the spread of dangerous microorganisms among its people is Yemen [12–14]. The prevalence of *Salmonella typhi* infection among students at Amran University Institute of Continuing Education is not well documented. Therefore, the current study's objective was to assess Amran University Institute of Continuing Education students' knowledge, attitudes, and behaviors (KAP) regarding typhoid disease.

## Materials and Methods

### Study area and period

This cross-sectional survey was carried out among Amran University Institute of Continuing Education students between December 2024 and May 2025

### Sample size

The sample size was estimated based on the WHO's practical manual for sample size determination in health studies [15]. Sample size estimated according to the prevalence of *S. typhi* in Ibb governorate of Yemen (18.4%). The sample size was calculated by using the following formula:

$$N = \frac{Z^2 P (1 - P)}{d^2}$$

Where:

$N$  = sample size required,  $Z$  = confidence level at 95% (95%;  $Z = 1.96$ ),  $P$  = expected prevalence or proportion ( $p = 18.4\%$ ) according to the prevalence of *S. Typhi* in Ibb city [16], and  $d$  = relative precision (margin of error at 5%) ( $d = 5\%$ ). Therefore, the minimum sample size was 121 students.

#### **Data collection**

This study involved 121 people in all, and the participants in this study were randomly selected. Each student included in the current study was given a structured questionnaire to complete in order to gather data. In addition to questions on clinical and demographic data, the questionnaire also asked about age, marital status, parental education levels, academic years, number of family members, and source of alcohol. Typhoid fever symptoms, prophylaxis, and transmission were also covered in the questionnaire.

#### **Inclusion and exclusion criteria**

Students enrolled at the institute who agreed to answer the questionnaire and were in excellent health were included in the study. Conversely, this study excluded students not enrolled at the institute, those who refused to answer the questionnaire, and those exhibiting symptoms of typhoid fever.

#### **Ethical statement**

The Research Ethics Committee of Amran University approved this study, which was conducted in accordance with the Helsinki Protocol. The objectives and significance of the study were explained to all participants who expressed their willingness to participate. Written informed consent was obtained from all participants before distributing the questionnaire. Participants were interviewed and the questionnaire was completed by the participants with the assistance of the researchers. The questionnaire was designed in Arabic and translated into English during data entry and analysis. Participants' data were processed and analyzed anonymously to preserve their identity and privacy.

#### **Statistical Analysis**

The data were analyzed using the Statistical Package for Social Sciences, SPSS Version 22 (IBM Corporation, USA). Categorical variables are reported as frequencies and percentages in the tables and figures. Furthermore, associations between variables and categorized scores were assessed using the chi-square test ( $\chi^2$ ). All probability values were considered statistically significant at  $P$ -values  $< 0.05$ .

#### **Results**

##### **Sociodemographic data**

The current study included 121 students in total. According to Table (1), the largest percentage of participants were between the ages of 21 and 24 (49.6%), female (56.2%), living in an urban area (81.8%), single (79.3%), having a parent's university certificate (47.1%), in their first year of school (35.5%), and drinking from trucks (42.1%), as summarized in Table (1).

The current results revealed that approximately 63.6% of the participants were aware that animals can transmit typhoid fever. More than 62% of the study participants knew that typhoid fever can be transmitted by houseflies, while 54.5% knew that it can be transmitted by swimming. More than 54.5% of the study participants knew that typhoid fever can be transmitted by swimming, while 61.2% knew that it can be transmitted by restaurants, with a statistically significant difference ( $P < 0.05$ ). Furthermore, the highest level of knowledge was recorded regarding humans as a source of typhoid fever transmission, with an arithmetic mean of 2.52. In contrast, the lowest level of knowledge was regarding how TF can be transmitted by animals, with an arithmetic mean of 2.16, as shown in Table 2.

**Table 1.** Sociodemographic characterization of study subjects

Variables	Subgroups	Frequency	Rate (%)	$\chi^2$	P- value
Age group	<20	42	34.7%	20.942	0.001
	21-24	60	49.6%		
	>24	19	15.7%		
Sex	Male	53	34.8%	1.859	0.172
	Female	68	56.2%		
Residency	Rural	22	18.2%	49.000	0.000
	Urban	99	81.8%		
Marital Status	Married	25	20.7%	41.661	0.000
	Single	96	79.3%		
Education Level of Parents	Illiterate	13	10.7%	35.396	0.000
	Primary	28	23.1		
	Secondary	23	19.0%		
	University	57	47.1%		
Academic year	First year	43	35.5%	0.314	0.854
	Second year	40	33.1%		
	Third year	38	31.4%		
Number of family members	0-5	33	27.3%	9.140	0.010
	6-10	56	46.3%		
	> 11	32	26.4%		
Drinking source	Water station	40	33.1%	5.471	0.064
	Trucks	51	42.1%		
	Water network	30	24.8%		

$\chi^2$  = Chi-square test  $\geq 3.84$  (significant), P value < 0.05 (statistically significant)

**Table 2.** Survey of knowledge, attitude, and practice about transmission of typhoid fever

Variables	Categories	No (%)	Means	$\chi^2$	P-value
TF can be transmitted by animals?	Yes	44 (36.4)	2.16	9.000	0.002
	No	77 (63.6)			
TF can be transmitted by houseflies and insects?	Yes	75 (62.0)	2.51	6.950	0.008
	No	46 (38.0)			
TF can be transmitted by swimming?	Yes	66 (54.5)	2.26	1.000	0.317
	No	55 (45.5)			
TF can be transmitted by eating in restaurants?	Yes	74 (61.2)	2.49	6.024	0.014
	No	47 (38.8)			
TF can be transmitted by fruits and vegetables?	Yes	67 (55.4)	2.39	1.238	0.915
	No	54 (44.6)			
TF can be transmitted by sewage?	Yes	98 (81.0)	2.42	46.487	0.0001
	No	23 (19.0)			
TF can be transmitted by contact with humans?	Yes	79 (65.3)	2.52	11.314	0.0008
	No	42 (34.7)			

$\chi^2$  = Chi-square test  $\geq 3.84$  (significant), P value < 0.05 (statistically significant)

The results indicated that the pupils' awareness of typhoid fever symptoms varied. The greatest percentage of affirmative answers revealed that fever (85.1%), weakness and exhaustion (82.6%), and headache (71.1%) were the most commonly reported symptoms. On the other hand, individuals

with unfavorable responses were more likely to have symptoms, including vomiting (57.9%), skin rash (61.2%), diarrhea, and constipation (57.9%), as shown in Table 3.

**Table 3.** Survey of knowledge, attitude, and practice about symptoms of typhoid fever

Variables	Categories	No (%)	Means	$\chi^2$	P-value
<b>Fever</b>	Yes	103 (85.1)	2.81	59.710	0.0001
	No	18 (14.9)			
<b>Headache</b>	Yes	86 (71.1)	2.64	21.495	0.0001
	No	35 (28.9)			
<b>Vomiting</b>	Yes	51 (42.1)	2.22	2.983	0.084
	No	70 (57.9)			
<b>Muscular Pain</b>	Yes	72 (59.5)	2.46	4.3719	0.036
	No	49 (40.5)			
<b>Skin rash</b>	Yes	47 (38.8)	2.20	6.024	0.014
	No	74 (61.2)			
<b>Diarrhea and constipation</b>	Yes	51 (42.1)	2.27	2.9835	0.084
	No	70 (57.9)			
<b>Stomach ache</b>	Yes	60 (49.6)	2.33	0.008	0.927
	No	61 (50.4)			
<b>Weakness and fatigue</b>	Yes	100 (82.6)	2.77	51.578	0.0001
	No	21 (17.4)			

$\chi^2$  = Chi-square test  $\geq 3.84$  (significant), P value  $< 0.05$  (statistically significant)

The results indicated that the current findings revealed that a high rate of knowledge about typhoid fever prevention was reported among students who always washed their hands before eating (76.9%; P = 0.001), always washed their hands after using the bathroom (79.3%; P = 0.0001), always washed their hands after eating (75.2%; P = 0.0001), always washed their hands before preparing food (76.9%; P = 0.0001), disposed of sewage (81.0%; P = 0.0001), controlled insects and flies (90.1%; P = 0.0001), treated the sick (65.3%; P = 0.0001), boiled water, and prepared foods throughout (89.3%; P = 0.0001), as listed in Table 4.

**Table 4.** Survey of knowledge, attitude, and practice about the prevention of typhoid fever

Variables	Categories	No (%)	Means	$\chi^2$	P-value
<b>Wash hands before eating</b>	Always	93 (76.9)	2.69	34.917	0.0001
	Sometimes	28 (23.1)			
<b>Wash hands after using the bathroom</b>	Always	96 (79.3)	2.71	41.661	0.0001
	Sometimes	25 (20.7)			
<b>Wash hands after eating</b>	Always	91 (75.2)	2.63	30.752	0.0001
	Sometimes	30 (24.8)			
<b>Wash hands before preparing food</b>	Always	93 (76.9)	2.68	34.917	0.0001
	Sometimes	28 (23.1)			
<b>Dispose of sewage</b>	Yes	98 (81.0)	2.73	34.917	0.0001
	No	23 (19.0)			
<b>Control of insects and flies</b>	Yes	109 (90.1)	2.85	77.760	0.0001
	No	12 (9.9)			
<b>Treat the sick</b>	Yes	79 (65.3)	2.82	11.314	0.0008
	No	42 (34.7)			
<b>Boil water and prepare foods throughout</b>	Yes	108 (89.3)	2.83	74.586	0.0001
	No	13 (10.7)			

$\chi^2$  = Chi-square test  $\geq 3.84$  (significant), P value  $< 0.05$  (statistically significant)

**Discussion**

The growing burden of typhoid fever in low- and middle-income countries continues to pose a significant threat to public health [17], straining already overburdened healthcare systems and exacting a devastating toll on vulnerable populations who are disproportionately affected by this preventable and treatable disease [17-19]. The current study was established to evaluate the knowledge, attitudes, and practices toward typhoid fever among students at Amran University Institute of Continuing Education, Yemen.

A total of 121 participants were collected from students during the study period. The majority of data was collected from students aged 21–40 years (49.6%), students residing in urban areas (81.8%), single individuals (79.3%), parents with university certificates (47.1%), first-year students (35.5%), and trucks as a drinking source (42.1%).

In the current study, the level of knowledge of Amran University students regarding the transmission of typhoid fever showed about 63.6% of study participants did not know that typhoid fever is transmitted by animals, and more than 62% and 54.5% of study participants know that typhoid fever can be transmitted by Houseflies and insects and swimming, and this is non consistent with other studies [21-22].

In our study, a significant association was observed between a survey of knowledge, attitude, and practices about transmission of typhoid fever: TF can be transmitted by contact with animals? ( $P = 0.002$ ), TF can be transmitted by houseflies and insects? ( $P = 0.008$ ), TF can be transmitted by eating in restaurants? ( $P = 0.014$ ), TF can be transmitted by sewage? ( $P = 0.0001$ ), TF can be transmitted by contact with humans? ( $P = 0.0008$ ). This finding is consistent with other studies [23-24]. Environmental factors, such as water quality, hygiene, and sanitation, are among the most important variables affecting the spread of typhoid fever. Similarly, inadequate water and sanitation infrastructure contribute to outbreaks of infectious diseases.

Yemen has suffered from the insecurity of clean water for decades. Moreover, the air strikes launched by the coalition countries on Yemen in 2015 destroyed the central drinking water reservoirs in the majority of Yemeni governorates [25-27]. Yemen faces numerous challenges, including a weak healthcare infrastructure and widespread epidemics. However, universities provide a suitable environment for promoting health awareness among young people, which can contribute to reducing the spread of infectious diseases. Enhancing the knowledge and practices of university students is a crucial step in preventing this disease. Through effective educational and awareness strategies, universities and health institutions can play a pivotal role in combating typhoid fever and promoting community health. Environmental factors, such as water quality, hygiene, and sanitation, are among the most important variables affecting the spread of typhoid fever. Similarly, inadequate water and sanitation infrastructure contribute to outbreaks of infectious diseases.

In the current study, to know the level of knowledge, behaviors, and practices towards the symptoms of typhoid fever, the highest paragraph was "fever is a symptom of typhoid," which obtained an arithmetic mean of 2.81, and the lowest paragraph was "skin rash is a symptom of typhoid," which obtained an arithmetic mean of 2.20. For knowledge towards the prevention of typhoid fever, the highest paragraph was "control of insects and flies," which obtained an arithmetic mean of 2.85, and the lowest paragraph was "wash hands before preparing food," which obtained an arithmetic mean of

2.20. Economic restrictions directly impact access to health services and medical information, leading to lower levels of awareness and knowledge about preventing infectious diseases [20, 28], and the highest paragraph for the level of knowledge regarding the causes of transmission of typhoid fever was (TF can be transmitted by contact with humans?) with an arithmetic mean of (2.52), and the lowest paragraph was: (TF can be transmitted by contact with animals) with an arithmetic mean of (2.16), environmental hygiene and sanitation are critical in preventing infectious diseases. Factors such as the availability of adequate waste disposal facilities, access to clean drinking water, and personal hygiene significantly influence the incidence of disease [22, 28].

In our study, a significant association was observed between the survey of knowledge, attitude, and practices about symptoms of typhoid fever and fever ( $P = 0.0001$ ), headache ( $P = 0.0001$ ), muscular pain ( $P = 0.036$ ), skin rash ( $P = 0.014$ ), and weakness and fatigue ( $P = 0.0001$ ). This finding is consistent with another study [29 The level of knowledge, practices, and behavior among .[ participants regarding the symptoms of typhoid fever was good, which is consistent with another ] study conducted in Yemen23].

This finding presents an integrated vision of the basic concepts associated with typhoid disease in terms of its causes, transmission mechanism, and symptoms, as well as highlighting the theoretical dimensions of basic health concepts, such as health knowledge and preventive practice. A profound understanding of these concepts forms the basis for developing research tools and interpreting the results extracted from the assessment of university students' knowledge and practices regarding typhoid fever. Therefore, health awareness is one of the main tools for reducing the spread of typhoid disease, especially in communities with limited resources [30]. Supporting scientific research and applying its results in public health policies contributes to the development of more effective preventive programs that meet the needs of the local community [31-32].

The World Health Organization provided several tips to avoid infection with typhoid fever, including washing hands thoroughly with soap and water before and after eating, before preparing food, and after using the bathroom; washing vegetables and fruits before eating them; avoiding ready-made food from unknown brands; drinking only pasteurized milk; boiling water properly or using clean, boiled water; and getting vaccinated against typhoid fever, especially for travelers visiting endemic areas [1].

Finally, our study concluded that educational level and misconceptions about typhoid transmission are contributing factors to its prevalence. Therefore, healthcare facilities should more effectively integrate topics on typhoid and its transmission into their health education programs, both within the facilities and in the community. Further cultural studies are recommended to gain a clearer understanding of the knowledge, behaviors, and practices of university students across all governorates of Yemen.

### **Conflict of Interest**

The authors have no conflict of interest.

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## Author Contributions

Al-Hadheq A and Al-Wajeeh T conceived and designed the experiments; Al asbahi A and Al-Sabae A performed the experiments; Abo-Hatem M and Edress W analyzed the data and wrote the first draft of the manuscript. Al-Shehari A contributed to writing the manuscript. Al-Hadheq A and Al-Arnoud M agreed with the results and conclusions of the manuscript. All authors read, revised, and approved the final manuscript.

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