ORIGINAL ARTICLE

Awareness and knowledge of environmental health among secondary school students from Mtwara town in Tanzania

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ABSTRACT

Students are provided with education, including environmental health education that they develop throughout their lives and the education empowers them to become active participants in the transformation of their communities. Therefore, this study aimed to examine awareness and knowledge about environmental health issues among secondary school students from Mtwara town in Tanzania. A questionnaire survey was used to collect data. Pearson's chi-square and Pearson correlation (R) tests were used to determine whether there was a statistically significant difference between the gender and study variables. A greater proportion of students had awareness and knowledge of infectious diseases (99.8% vs. 97.1%, p=0.004, X^2=9.529, OR 1.028, 95% CI 1.005 – 1.051) and non-communicable diseases (98.1% vs. 95%, p=0.031, X^2 = 5.370, OR 1.033, 95% CI 1.001 – 1.067). However, awareness of the term school water, sanitation and hygiene (SWASH) was very low among all students, with no statistically significant difference (26.1% vs. 25.5%, p = 0.927). Girls had more understanding of global warming (91.7% vs. 86.2%, p=0.033) and good ventilation prevented the spread of cough and mucus (62.1% vs. 54%, p=0.041) than male students. While no statistically significant difference between students' awareness and knowledge of pollution was observed (99.5% vs. 97.9%, p=0.104), there was a higher proportion of noise and land pollution awareness among students. Female students had higher awareness of noise pollution (70.2% vs. 56.9%, p=0.001) and land pollution (86.1% vs. 78.2%, p=0.010) than their peers. The results of this study add more knowledge to the existing information on students' awareness and knowledge of environmental health problems. The study recommends that programs to disseminate information related to environmental health should be maintained to sustain high student awareness and knowledge of environmental health.

Key words:
awareness and knowledge; environmental health; infectious diseases; pollution; water; sanitation; hygiene

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INTRODUCTION

Currently, the world is witnessing an increase in environmental health problems such as air pollution, inadequate water supply, poor sanitation and hygiene, and climate change. All of these issues raise concerns about behavior change in communities. Behavioral change in individuals and societies is considered a key factor for driving each sector towards the achievement of development [1].

Behavioral change is influenced by many factors including awareness, knowledge, attitudes and practices of the relevant individuals or communities through environmental health education and sustainable practices from primary school to college. Therefore, it is important to reflect on the awareness and knowledge of individuals and communities for sustainable behavioral change. Through the development of these qualities, they can be integrated into personal values and norms to establish routine behaviors [2] that enable communities to use environmental health information to make decisions about their health.

However, as reported by He et al.[3], environmental health awareness and knowledge cannot directly change human attitudes and actions, but is required to shape human behavior related to environmental health. Furthermore, according to Meinhold and Malkus [4], awareness is a determinant of students' knowledge, attitudes and behaviors related to environmental health. Therefore, it is important to consider awareness, knowledge, attitudes and behaviors when discussing the achievement of environmental health between individuals and communities [1].

There are some studies that have been conducted to explain students' awareness, knowledge, attitudes and behaviors related to environmental health [5,6], and the results of these studies are inconclusive. The study by Naquin et al. [6] showed that about 60% of fourth-grade students in southeastern Louisiana, United States of America (USA), are aware that the environment is harmful to their health, while the study by Msengi and Doe [5] showed that inadequate literacy about environmental health was observed among high school students from the Southeast Texas School District, USA.

Various projects and programs such as the National Sanitation Campaign and Water, Sanitation and Hygiene (WASH) for schools have been introduced in Tanzania to provide students with awareness and knowledge of environmental health issues such as sanitation and hygiene [7]. The expected outcome of these programs is increased awareness, knowledge, and changed attitudes and behaviors of students related to environmental health. In addition, many schools in Tanzania have science or environmental clubs that focus on environmental and human health issues. Despite all these efforts, little is known about how these programs have changed students' awareness and knowledge of environmental health issues. Few empirical studies have compared students' awareness, knowledge and attitudes towards environmental health issues from a Tanzanian perspective [7–10], and the results of these studies vary. Therefore, there is a need to conduct an empirical study to assess the level of awareness and knowledge of societies, especially students, on environmental health issues. This study expands knowledge about environmental health education.

Environmental health is a broad field that includes food safety, air pollution, inadequate water supplies, poor sanitation and hygiene, exposure to chemicals and biological agents, ultraviolet and ionizing radiation, pollution, occupational hazards, agricultural practices, and built environments and climate change [11]. However, this study only focused on WASH, air pollution and general environmental health issues as they are

common environmental health problems faced by developing countries [12,13].

In order to achieve the goal of the study, the following questions (Q) were addressed:

Q1. What is the level of students' awareness and knowledge of environmental health issues?

Q2. Is there a statistically significant difference in awareness and knowledge about environmental health between female and male students?

Q3. What is the main source of information on environmental health issues among students?

METHODS

Research design and population sample

This cross-sectional study was designed to use a quantitative approach to assess awareness and knowledge of environmental health issues among secondary school students in Mtwara town, Tanzania. Located in Mtwara, Tanzania's Southern Region [14], it is a town with an old deep-water port built between 1948 and 1954. Most of the people working in big industries like Dangote Cement Company and natural gas exploration companies in the neighboring Mtwara Rural Council live in this town. The discovery and extraction of natural gas in the village of Madimba, as well as the construction of a pipeline leading from the village of Madimba in the Mtwara region to Dar es Salaam, has attracted many people to settle and invest in the town. The town is characterized by both formal settlements in planned areas and informal settlements in unplanned areas with poor social services. In addition, it is the headquarters of the Mtwara region. This town was chosen because it is one of the fast growing cities in Tanzania [15] with high expectations for environmental health issues.

The town has over 28,336 students (about 26% of the 108,299 total population in the Mtwara town), of which 17,705 are primary school students and 10,631 are secondary school students. In Tanzania, the education system is based on a 2-7-4-2-3+ structure. In other words: 2 years of pre-school, 7 years of primary/elementary school, 4 years of general secondary school (Ordinary Level), 2 years of advanced/upper secondary school (Advanced Level) and at least 3 years of higher education [16]. Secondary education comprises both an ordinary level and an advanced level.

The ordinary level comprises forms 1 through 4, while the advanced level comprises forms 5 and 6 [16,17]. In addition, ordinary secondary education is for the 14-17 age group, while advanced secondary education is intended for the 18-20 age group [16]. However, the age of the students in each level can be high because of delays in attending school due to illness, poverty, family conflicts, and class repetition due to failure to achieve average marks in national exams [18]. The language of instruction for primary school is Swahili, while the language of instruction for secondary and higher education is English [16].

Therefore, a sample size of the students was selected using the quantitative study formulas proposed by Israel [19].

A. The sample size for ordinary level students

Equation 1: $n = \frac{N}{1+N(e)^2}$

Where n = sample size, N = total population (9,419), e = margin of error (sampling error) set at 5% (0.05) and a 95% confidence level. Using the above formula, the sample size is calculated as follows:-

Equation 2: $n = \frac{9,419}{1+9,419(0.05)^2}$

$= 383.7$

≈ 384

B. The sample size for advanced level students

Where n = sample size, N = total population (1,212), e = margin of error (sampling error) set at 5% (0.05) and a 95% confidence level. Using the above formula, the sample size is calculated as follows:-

Equation 3: $$n = \frac{1,212}{1+1,212\ (0.05)^2}$$
$$= 300.7$$
$$\approx 301$$

Thus, the formula yielded a total sample size of 685 secondary school students.

Data collection

After receiving Ethical Clearance Certificate Number NIMR/HQ/R.8a/Vol.IX/3648 from the National Institute for Medical Research in Tanzania, the researchers applied to the Mtwara-Mikindani Municipal Council for permission to conduct the study activities. The researchers received letters of introduction from the council and were put in touch with various principals and teachers in the secondary schools. All study participants aged > 18 years provided written informed consent; Written informed consent was obtained from parents or guardians aged <18 years. Respondent consent, risks, benefits, and comfort were complied with according to research ethical guidelines.

A sample size of 685 students was used to select the subsamples from each school proportionally based on the total number of students available at the school. After visiting the appropriate schools, the researchers, with the help of teachers at each school, assigned numbers to each available individual student at the school. A random selection of a subset of the required participants was then performed. Researchers explained the purpose of the study and the method of data collection using a study questionnaire. In addition, before the questionnaires were distributed, the researchers explained the purpose of the study and informed the participants that completing the questionnaires was voluntary. The criterion for inclusion was secondary school students from Mtwara town in Tanzania. All secondary school classes except class (Form) 6, who were very busy with final exams, were eligible to be sampled and participate in the study.

The questionnaire consisted of two parts. The first part included general demographic characteristics such as gender and class of study of the respondents (Table 1). The second section consisted of specialized questions on students' awareness and knowledge of environmental health issues (Table 2). The questionnaire was developed using questions and variables from the literature review of the most similar studies [6,20] adapted to the context of the participants in Tanzania. A total of 685 students from 13 secondary schools answered the questionnaires. 9 out of 13 schools were public while the remaining (4) were private schools. The study was conducted from May to September 2021.

Validation and pre-testing of questionnaires

The pre-testing process was conducted at the Mtwara Technical School in Mtwara town. This school consists of both ordinary and advanced level students with a mix of girls and boys. The main purpose of the pre-test is to verify that the target group understands the questions and suggested answer options as intended by the researcher and is actually able to answer meaningfully [21]. In addition, the questionnaire was pre-tested by distributing the questionnaires to some environmental and health professionals from local communities of the surveyed areas and government officials.

Data analysis

All data from the questionnaire survey were extracted and analyzed using

SPSS software version 20.0. Data on demographics and responses to awareness and knowledge were compiled and analyzed using descriptive statistics. Descriptive statistics helps to provide basic information about variables in a dataset and to highlight potential relationships between variables. A cross tabulation using the X^2-test was performed to assess the relationship between dependent variables and explanatory variables, while a univariate analysis was performed to examine the likelihood of an outcome for an explanatory variable that includes students' background characteristics. Pearson's correlation (R) was used to see if there was a linear relationship between gender and awareness of environmental health issues. The level of statistical significance was set at $p < 0.05$ in a two-tailed test. In addition, students' awareness and knowledge of environmental health were measured using objective or subjective knowledge. Objective knowledge refers to how much a person actually knows about something, and subjective knowledge (also known as perceived or self-assessed knowledge) refers to how much a person thinks he/she knows about something [22].

RESULTS

Participant profile

Of 685 responses received, 672 (98.5%) were valid while 13 (1.5%) were invalid due incomplete information. 64.4% of the participants were females, 56% were ordinary level students, and 299 (44%) were advanced level students (Table 1).

Table 1: Gender of participants and their class of study

Variable	Scale	Number	Percent
Gender	Female	433	64.4
	Male	239	35.6
Class in school	Form 1	99	14.7
	Form 2	90	13.4
	Form 3	86	12.8
	Form 4	98	14.6
	Form 5	299	44.5

Students' awareness and knowledge of environmental health issues

Table 2 provides information on the awareness and knowledge of environmental health issues among the students.

WASH

94.5% and 97.2% of respondents were aware of water supply and food hygiene and safety, while 95.5% of respondents had heard of water pollution, with no statistically significant difference between female and male students. Also, 87.2% of students understood that toilets must be clean to keep flies away. In addition, a greater proportion of students had awareness and knowledge of infectious diseases (99.8% vs. 97.1%, p=0.004, X^2=9.529, OR 1.028, 95% CI 1.005 – 1.051) and non-communicable diseases (98.1% vs. 95%, p=0.031, X^2 = 5.370, OR 1.033, 95% CI 1.001 – 1.067). Female students had more understanding of these issues than males. However, awareness of

the term school water, sanitation and hygiene (SWASH) was very low among all students, with no statistically significant difference (26.1% vs. 25.5%, p = 0.927). Other variables showed no statistically significant difference.

Air pollution

Girls had more understanding of global warming (91.7% vs. 86.2%, p=0.033) and good ventilation prevented the spread of cough and mucus (62.1% vs. 54%, p=0.041) than male students. However, there was no statistically significant difference in awareness and knowledge about climate change (p=0.191) and air pollution (p=0.139) between female and male students. However, 96.4% and 93.6% of the students had heard of climate change and air pollution, respectively. But with no statistically significant difference between female and male students (p=0.191 and p=0.139).

General environmental health

97.5% and 74.3% of the students, respectively, understood that environment can be defined as our surroundings and health as the state in which we are free from disease or injury, while 79.8% understood environmental health management as a practice to evaluate and control over factors in the environment that have the potential to affect health.

Awareness of environmental health as an area of public health that deals with all aspects of the natural and built environment that affect human health was higher among male students than their peers (75.7% vs. 67.7%, p=0.034). While no statistically significant difference in students' awareness and knowledge of pollution was observed (99.5% vs. 97.9%, p=0.104), there was a higher proportion of noise and land pollution awareness among students. Female students had higher awareness of noise pollution (70.2% vs. 56.9%, p=0.001) and land pollution (86.1% vs. 78.2%, p=0.010) than their peers.

In addition, there was a higher proportion of students who understood that litter thrown on the street is harmful to health. The female students showed a higher awareness than the male students (99.1% vs. 94.6%, p=0.001, X^2 =5.370, OR 1.048, 95% CI 1.015 1.082). 96.8% and 93.3% of students, respectively, reported having taken an environmental health course at school, while 92.8% and 91.2% thought they were very sensitive to environmental health issues.

Sources used by the students to obtain environmental health information

The student's awareness and knowledge of environmental health issues are influenced by various factors, including the mass media. Mass media are used as a means of communication for all socio-economic, environmental and political issues in order to reach the public at the right time. However, as shown in Figure 1, 47.5% of students indicated that their main source of information about environmental health is school through studies, campaigns and seminars. 27.4% of the students obtained information from television and radio. 18.5% also used all of the media mentioned to acquire information. Internet use also appears to influence students, with 4.9% of students being informed about environmental health issues via the Internet. Also, 1.8% of the students (1.8%) received information on environmental health topics from their relatives and parents.

Table 2: Awareness and knowledge of environmental health among students

Variable	Female n (%)	Male n (%)	Overall responses (%)	P-value	X^2 value	Pearson's R	OR (95% CI)
Water, Sanitation and Hygiene (*WASH*)							
I've heard of housing and water supply before	409 (94.5)	225 (94.6)	94.5	1.000	0.003	-0.002	0.999 (0.962 - 1.038)
I've heard of food hygiene and safety before	424 (97.9)	229 (95.8)	97.2	0.144	2.485	0.061	1.002 (0.992 - 1.053)
I've heard of water pollution before	414 (95.6)	228 (95.8)	95.5	1.000	0.017	0.005	1.002 (0.968 – 1.037)
I've heard of communicable diseases before	432 (99.8)	232 (97.1)	98.8	0.004	9.529	0.119	1.028 (1.005 – 1.051)
I've heard of non-communicable diseases before	425 (98.1)	227 (95)	97.0	0.031	5.370	0.099	1.033 (1.001 – 1.067)
I've heard about the prevention and control of infectious/communicable diseases before	422 (97.5)	228 (95.4)	96.7	0.176	2.068	0.055	1.022 (0.990 – 1.055)
I've heard of *SWASH* before	113 (26.1)	61 (25.5)	25.9	0.927	0.026	0.006	1.022 (0.782 – 1.337)
I understand toilets need to be clean to keep flies out	385 (88.9)	201 (84.1)	87.2	0.091	3.198	0.069	1.057 (0.991 – 1.128)
Air pollution							
I've heard about climate change before	421 (97.2)	227 (95)	96.4	0.191	2.263	0.058	1.024 (0.990 – 1.058)
I heard about global warming	397 (91.7)	206 (86.2)	89.7	0.033	5.044	0.087	1.064 (1.004 – 1.127)
I've heard of air pollution before	410 (94.7)	219 (91.6)	93.6	0.139	2.462	0.060	1.033 (0.989 – 1.080)

Variable	Female n (%)	Male n (%)	Overall responses (%)	P-value	X^2 value	Pearson's R	OR (95% CI)
I understand that good ventilation (keeping windows and doors open) prevents the spread of cough and mucus	269 (62.1)	129 (54)	59.2	0.041	4.236	0.079	1.151 (1.002 – 1.322)
General environmental health							
Environment can be defined as our surroundings	425 (98.1)	230 (96.2)	97.5	0.197	2.298	0.058	1.020 (0.992 – 1.049)
Health can be defined as the state of being free from disease or injury	319 (73.7)	180 (75.3)	74.3	0.712	0.217	-0.018	0.978 (0.892 – 1.072)
Environmental health can be defined as the field of public health that deals with all aspects of the natural and built environment that affect human health	293 (67.7)	181 (75.7)	70.5	0.034	4.819	-0.085	0.894 (0.811 – 0.984)
I've heard of pollution before	431 (99.5)	234 (97.9)	99.0	0.104	3.970	0.077	1.017 (0.997 – 1.037)
I've heard of noise pollution before	304 (70.2)	136 (56.9)	65.5	0.001	12.058	0.134	1.234 (1.087 – 1.400)
I've heard of land pollution before	373 (86.1)	187 (78.2)	83.3	0.010	6.921	0.101	1.101 (1.020 – 1.189)
I've heard of environmental health education before	401 (92.6)	214 (89.5)	91.5	0.193	1.870	0.053	1.034 (0.983 – 1.088)
I understand that environmental health management can be defined as a practice of evaluating and controlling factors in the environment that have the potential to affect health	345 (79.7)	191 (79.9)	79.8	1.000	0.005	-0.003	1.034 (0.983 – 1.088)
I understand that litter thrown on the street is harmful to health	429 (99.1)	226 (94.6)	97.5	0.001	12.735	0.138	1.048 (1.015 – 1.082)

Variable	Female n (%)	Male n (%)	Overall responses (%)	P-value	X^2 value	Pearson's R	OR (95% CI)
I understand that maintaining a healthy environment is central to increasing the quality of life and years of healthy living	405 (93.5)	219 (90.8)	92.6	0.220	1.677	0.050	1.030 (0.983 – 1.080)
I once studied an environmental health course at school	419 (96.8)	223 (93.3)	95.5	0.050	4.326	0.080	1.037 (0.998 – 1.077)
I think I'm very sensitive about environmental health issues	402 (92.8)	218 (91.2)	92.3	0.454	0.571	0.029	1.081 (0.971 – 1.067)

Note: n = number of the responses; p-value = probability value; X^2 value = chi-square value; Pearson's R = Pearson correlation; OR = odds ratio; CI = confidence interval

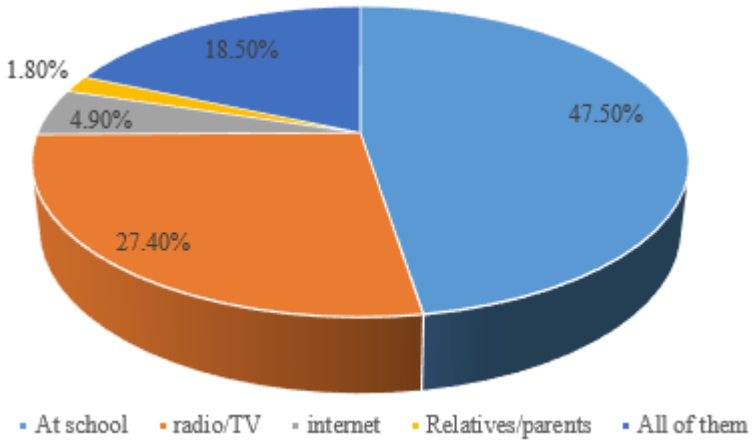

Figure 1: Sources used by the students to obtain environmental health information

DISCUSSION

The current study was conducted on an exploratory basis to examine the level of awareness and knowledge of secondary school students regarding environmental health issues. In addition, students' practices related to environmental health behaviors were examined. The overall results of this study indicated that most students had a basic level of awareness and knowledge about environmental health issues. Students were aware of sanitation, water supply, food hygiene and safety, and communicable and non-communicable diseases. These results are in contrast to Gamage and Jayawardana [23] who found low level of knowledge about non-communicable diseases and healthy lifestyles among school children aged 17-19 in Sri Lanka and Mushota et al. [24] who reported that only 27% of secondary school students in Ujjain District, Madhya Pradesh, Central India had knowledge of infectious diseases, especially diarrhea.

The prevention and control of infectious diseases is one of the tools to promote sanitation and hygiene. In contrast to Wang et al. [25] who reported that the students of Gansu Province in China had insufficient knowledge of infectious disease prevention, most of the students had heard of the prevention and control of communicable diseases in Mtwara town. Infection prevention and control aim to prevent susceptible patients from becoming infected with pathogenic (disease-causing) microorganisms and to limit the spread of antimicrobial-resistant infections [26,27].

Conversely, most students are less familiar with the term SWASH. However, in our opinion, they knew the sanitation and sanitation messages, that are part of SWASH. So, the failure here is marketing the SWASH name and brand, but not necessarily the SWASH message. SWASH has gained a lot of excitement in the global society. SWASH programs aim to improve the health and academic achievement of students, their parents and communities by reducing or eliminating incidences of water and sanitation-related diseases [28]. It is important to consider sanitation and hygiene education, home and school connectivity, community participation, appropriate and affordable technology, and operational and maintenance arrangements to achieve sustainable SWASH [29]. However, environmental health education is an integral part that can connect the suggested reflections above, but it also provides opportunities for students to express their views and to apply the information learned [6].

Most students were aware of climate change, global warming and air pollution. These results are in contrast to Naquin et al. [6], which revealed that only about 50% of the students were aware of global warming in Malaysia. However, they agree with Conor [30] and Njoku [31], who revealed that about 80% of secondary school students in Tanzania and Nigeria respectively knew about climate change. Nevertheless, there was a high level of understanding of global warming among the students.

Also in this study, most students were aware of pollution in contrast to the insufficient awareness of students about pollution in Turkey [32] and West Bengal, India [33]. However, these results add to the study conducted by Nzilano [34], which showed that more students were aware of noise pollution in Dar es Salaam and the students identified welding machines, motor vehicles and other areas such as public bars, weddings and cultural activities as the main sources of noise pollution. Therefore, it is easy to change their attitudes and behaviors related to environmental health, although less attention is paid to environmental education in schools [35].

Mass media are used as a means of communication for all environmental, socio-economic and political issues in order to reach the public at the right time. This is because many people rely on media information to understand environmental health risks [36]. However, the main source of information about environmental health among students has been the school through studies, campaigns and seminars. This implies that school-level environmental health education is delivered in a variety of ways, including classes, campaigns or seminars. As television and radio have become the potential way for awareness raising and knowledge dissemination in Tanzania [37], about a quarter of the students gained information through television and radio listening. These results support Altin et al. [38], who reported that 35% of students follow environmental health issues in the mainstream media. Likewise, the use of television as a source of information about the coronavirus disease (COVID-19) has significantly influenced the knowledge and behavior of students and health workers regarding COVID-19 in Ethiopia [39] and Vietnam [40], respectively. In general, mass media is strongly associated with environmental health knowledge and behavior in society. It is also interesting that parents and relatives also play a role in conveying information to the students.

This study revealed statistically significant differences between female and male students in terms of awareness and knowledge of some environmental health issues. Female students had higher awareness and knowledge than their peers. These present results agree with Wang et al. [25] who revealed the statistically significant difference in the general character of female and male students, with the females being more sensitive than male students and paying more attention to personal health care. However, they contrast with Danielraja [41] who reported that there was no statistically significant difference in mean environmental awareness scores between secondary school students in relation to gender in India.

Gender inequalities in environmental health issues, particularly WASH, deserve attention [42]. For example, girls are less likely to attend classes when they have low awareness and knowledge of personal hygiene and when there are inadequate sanitation facilities in schools. Therefore, when examining environmental health issues, one should consider the significant

implications of gender and environmental health concerns [43].

This study adds more knowledge to the existing information about students' awareness and knowledge of environmental health. However, it should also be noted that a small sample was used in this study, meaning that secondary school students are not representative of the general student population in Tanzania. Therefore, more nationwide studies are needed to capture large numbers of students, including primary, secondary, and college/university students. Finally, this study used only one research technique (a questionnaire survey). More techniques such as focus group discussions, interviews, and observations need to be employed to capture the new insights of the participants.

CONCLUSION AND RECOMMENDATIONS

The aim of this study was to determine the awareness and knowledge of environmental health among secondary school students. The researchers discovered a high understanding rate, with 84.1% to 94.6% of the students having insights on the WASH topics. However, only a few (25.9%) were familiar with the term SWASH. Over 59% of students were aware of air pollution related issues such as climate change, global warming and air pollution. Awareness and knowledge of general environmental health topics such as the importance of the environment, health, environmental health and pollution were high among students, ranging from 56.9% to 99.0%. Likewise, this study revealed statistically significant differences between female and male students in terms of awareness and knowledge of some environmental health issues. In addition, the main source of information on environmental health has been the school through studies, campaigns and seminars. Therefore, the study recommends that programs to disseminate information related to environmental health should be continued to maintain high levels of environmental health awareness and knowledge among students.

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