



Original Research Article

Evaluation of environmental health and safety status in public primary schools in southern Thailand

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Water, sanitation, and hygiene in primary schools are important for child health. This cross-sectional study was conducted in 22 public primary schools in Nakhon Si Thammarat province, southern Thailand. The objective was to assess the environmental health and safety status as well as the teachers' perception of this status in primary schools. Data were collected using a standard school environmental health questionnaire. Parameters assessed included water source, hand washing, toilet and classroom facilities, waste management, food service areas, fire control (extinguishers and alarms), dangers from animals, floods and vectors/pests and buildings/infrastructure around the schools. Data were analysed by descriptive statistics and Student's t-test. The results revealed that participant's perceived environmental health and safety status in primary schools was 78.1% high and 21.90% moderate. The factors that correlated with perceived environmental health and safety were worker training experience on environmental health and safety ($p = 0.002$) and length of time worked ($p = 0.025$). Therefore, school headmasters should initiate preventive measures and promote awareness in order to cope with environmental health and safety, stimulus perception and provide sufficient safeguard to the environment health and safety in primary schools.

Key words: Evaluation, environmental health and safety, public primary schools

INTRODUCTION

Adequate drinking water, sanitation and hygiene are crucial concerns for non-household settings, such as health care facilities, work places and schools (UNICEF, 2018a). Protecting children's health and advancing environmental health and safety justice are critically important goals for the Environmental Protection Administration (EPA), as reflected in EPA's strategic plan (WHO, 2018) when the school environment is of a poor condition (US EPA, 2018; Shaughnessy et al., 2006). Poor indoor environments can affect a child's health; dirt, allergens, chemicals and other contaminants can trigger or further aggravate allergies and illnesses (Hauptman and Phipatanaku, 2015; Permaul et al., 2012; Baxi et al., 2013). Foodborne illnesses are the major food safety concern in primary schools. In Southeast

Asia, non-typhoid *Salmonella*, pathogenic *Escherichia coli* and norovirus (WHO, 2015) can occur in storage facilities for food items generated under poor food handling conditions and training, with the use of untreated water for non-drinking purposes and/or poor sanitation and hygiene; these factors are the primary risks for food poisoning (Malm et al., 2015; Michaels et al., 2004; Lunestad and Borlaug, 2009). Many schools in developing and developed countries lack adequate water and sanitation services, and this phenomenon has potential detrimental effects on health and school attendance (UN, 2011; Freeman et al., 2011). Thus, there is a high prevalence of water-borne diseases that cause particularly children to fall ill or even die (UNICEF, 2018b; WHO, 2018).

Improved sanitation conditions include access to enhanced latrines, latrine upkeep and faecal sludge management (Kotingo, 2014). Additionally, waste management is one of the most important environmental aspects with regards to educational institutions (Sales et al., 2006). Waste management, related to resource and water consumption, can help reduce waste quantity (Dascalak and Sempetzoglou, 2011), depending on students and educational staff numbers, site and infrastructure technical characteristics (including buildings) and institutional management (Maddox et al., 2011; Patel and Handu, 2010).

A safe school is physically and psycho-socially secure. The most visible aspects of a school's physical environment are the quality of the security and maintenance of school buildings and grounds. Adequate facilities indicate a clean and safe environment that is conducive to education and has protected property, adequately maintained buildings, furniture and equipment, clean toilets, water, a green environment and the happy school atmosphere (Squelch, 2001). Thus, the teachers in the primary schools must be concern and increasing interest in promoting student's health by modifying the school environment because that can be increasing the quality of life's students (Jamal et al., 2013).

In Thailand, the Ministry of Education and the Thai Health Promotion Foundation are making efforts to promote health education in schools. They are attempting to promote a state of perfect happiness in four dimensions: physical, mental, social and intellectual. In particular, the Thai government has begun promoting healthy schools. This shift towards a greater emphasis on health education and environmental sanitation in schools follows World Health Organization (WHO) guidelines (SAMEO, 2015). This study aimed to evaluate the status of environmental health and safety in the public primary schools in Nakhon Si Thammarat province and to study how individual factors such as sex, education and length of work and training time affected perceived levels of environmental health and safety status in the teachers who are partially responsible for environmental health in public primary schools.

MATERIALS AND METHODS

This cross-sectional study was performed in public primary schools in four districts including Phipun, Chawang, Chang Khang, and ThamPhannara district in Nakhon Si Thammarat province, Thailand were 88 public primary schools to determine the sample size by using the 25 percent of the population. 100 percent of the subject workers (22 primary schools) agreed to participate in this study. A purposive method was used to sample the 22 primary schools from October 2017 to July 2018. This research was approved by the Ethics Committee of the Institute of Research and Development, Thaksin University (TSU 2018-002). The 22 public primary schools contained 2,895 students. Schools were evaluated with a list that contained 20 environmental

health items adapted from "Environmental Health in the School", Department of Health, The Ministry of Public Health Thailand (2013) to assess water source, hand washing, toilet and classroom facilities, waste management, food service areas, fire control (extinguishers and alarm), exposure to dangers (animals, floods and vectors/pests) and whether the building was near a main road, market and/or factory. The criteria for following: appropriate and non-appropriate toilet condition that refer to running water in toilets, have paper in some toilets, and liquid soap provided in all blocks. Adequate and not adequate type of ventilation that refers to stipulates the provision of adequate mechanical ventilation rates. Most local authorities requires extract fan with automatic in toilets. Adequate and not adequate food service area was concerning the delimitation of its frontiers or boundaries, cleaning and support increased water consumption by all students. Adequate and not adequate sports facilities that provided of adequate of facilities, supplies, equipment, and safe areas.

Evaluation of environmental health and safety were collected by survey contained 21 items. Scores were divided into 2 categories: adequate and not adequate/yes and no/ appropriate and not appropriate, respectively.

Data collection

Data on participants (teachers) were collected to assess the perception 3 section; environmental health and safety management in primary schools, cultural environmental health and safety, and social environmental health and safety, total 30 items. The cumulative scores were agreed and disagree, measured on a 2-point, scoring 0 and 1, respectively. Scores were divided into three categories: > 80% (high), 60-79.99% (intermediate) and < 60% (low). Validity of equipment was approved by five experts. The content had a validity of 0.95 and a Kuder-Richardson 20 (KR-20) reliability of above 0.97 for environmental health and safety survey equipment and the content had a validity of 0.94 and a KR-20 reliability of above 0.94 for perception of environmental health and safety status questionnaire.

Data were analysed using SPSS version 17 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to present the results. The means of normally distributed data groups were compared using Student's t-test. Multiple regression analyses were conducted separately for participants to predict the environmental health and safety status associated with participant sociodemographics.

RESULTS

Of the 22 schools in this study, 63.63% were small (less than 120 students), while 36.37% had more than 120 students. A majority of the schools (77.28%) had less than 10 teachers, while 9.10% had 10-20 and 13.62% had more than 20. Experience about environmental and safety work

Table 1. Characteristics of the public primary schools (n = 22).

Items	Number (n)	Percentage
Students number		
≤ 120	14	63.63
> 120	8	36.37
Teacher number		
≤ 10	17	77.28
10-20	2	9.10
> 20	3	13.62
Environmental health and safety training experience		
Yes	7	31.81
No	15	68.10
Years' experience for an environmental health and safety specialist in the school		
≤ 10	8	36.36
> 10	14	63.64

in the school was divided into less than 10 years (36.36%) and more than 10 years (63.64%). Only 31.81% of the schools offered environmental health and safety training experience (Table 1).

All schools had a water supply. Thirteen (59.09%) schools got their water from the tap followed by filtration before drinking. While all schools had hand-washing facilities, 19 (86.37%) did not provide soap or detergents for cleaning. All schools provided separate toilets for boys and girls, and 18 (81.81%) had an appropriate person-to-toilet ratio of 40:1. Twelve (50.00%) toilets in the schools were in the poor condition (i.e., poor lighting, ventilation, et cetera). All schools had waste containers, but 12 schools (54.55%) schools did not separate waste. Ten schools (45.45%) had two to three containers for separating waste, including organic waste, general waste and recyclable waste. Ten schools (45.45%) disposed of their waste by burning, 3 (13.63%) dumped it and 9 (40.92%) transported their waste by a local waste disposal system. With regards to classroom facilities, 17 schools (77.28%) had poor lighting and 12 (50.00%) had poor ventilation. Fourteen schools (63.64%) had inappropriate (i.e., dirty) food service areas. No school had fire extinguishers or a fire alarm. Seventeen schools (77.28%) had poorly maintained sports facilities. Fourteen schools (63.64%) had dangerous animals in the area, and 15 (68.19%) were exposed to potential disease vectors (pests such as mosquitoes, rodents, cockroaches, et cetera). Eighteen schools (81.82%) never experienced a flood event. Six schools (27.27%) were established near a factory (ceramic, rubber, et cetera), market and/or main road (Table 2).

Of the teacher participants, 78.00% perceived a high level of environmental health and safety management, while 22.00% perceived an intermediate level (Figure 1). Most of participants, 43.00% perceived a high level of cultural environmental and safety (Figure 2) and 49.00% perceived an intermediate level (Figure 3). Notably, the mean level of perceived environmental health and safety status was significantly different ($p < 0.05$) based on education level,

working period and worker environmental health and safety training experience (Table 3).

Participants with ≥ 10 years' experience were more likely to report higher levels of perceived environmental health ($p < 0.01$) and safety status ($p < 0.01$) than those who worked < 10 years. Additionally, participants who were trained ≥ 9 times on environmental health and safety more likely to report higher levels of perceived environmental health ($p < 0.01$) and safety status ($p < 0.01$) than those who had less training (Table 4).

DISCUSSION

In this study, all schools obtained water from surface water. Water supplies were used for hand washing, drinking and toilet cleaning. Thirteen (59.09%) schools filtered water before drinking. This result supports a report by the WHO (2010) that Thailand achieved universal coverage for safe/improved water sources.

All of the schools had hand-washing facilities, but there was low hygiene access in the facilities (Morgan, 2017). Nineteen schools (86.37%) did not have soap or detergents, and this fact can lead to potential adverse health effects from inadequate hygiene access (i.e., diarrheal diseases) (Curtis and Cairncross, 2003). WHO recommends hand washing with water and soap followed by adequate drying (WHO, 2018). The results from this study support Vivas et al. (2010), who reported low availability rates of hand-washing materials in Ethiopia associated with poor hygiene practices. Trinies et al. (2016) reported that school-based hand-washing interventions positively reduce illness.

All schools separated toilets between boys and girls, a finding in line with Birdthistle et al., (2018), who recommend toilet separation based on sex. A large proportion (81.81%) of schools provided an adequate number of toilets for students which septic systems and/or covered pit latrines (Harvey and Adenye, 2009). Half of schools had poor facilities (visible damage, inadequate

Table 2. Distribution of environmental health and safety status variables based on school size (n = 22).

Items	Schools with ≤ 120 students (n = 14)		School with > 120 students (n = 8)		Total N (%)
	n	%	n	%	
Environmental health status					
Source of water	14	100	8	100	22 (100.00)
Drinking water					
Tap water	10	71.43	3	37.50	13 (59.09)
Bottled water	4	28.57	5	62.50	9 (40.91)
Hand-washing facilities					
Yes	14	100	8	100	22 (100.00)
<i>Use soap or detergents</i>					
Yes	2	14.28	1	12.50	3 (13.63)
No	12	85.72	7	87.50	19 (86.37)
Toilet facilities					
<i>Separate toilets between boys and girls</i>					
Yes	14	100.00	8	100.00	22 (100.00)
<i>Person-to-toilet ratio of 40:1</i>					
Yes	12	85.72	6	75.00	18 (81.81)
No	2	14.28	2	25.00	4 (18.19)
<i>Toilet condition</i>					
Appropriate	8	57.14	3	37.50	11 (50.00)
Not appropriate	6	42.86	5	62.50	11 (50.00)
Waste management					
<i>Waste container</i>					
Yes	14	100.00	8	100.00	22 (100.00)
<i>Separated waste</i>					
Yes	6	42.86	4	50.00	10 (45.45)
No	8	57.14	4	50.00	12 (54.55)
<i>Waste disposal</i>					
Dumping	2	14.28	1	12.50	3 (13.63)
Burning	8	57.14	2	25.00	10 (45.45)
Others	4	28.58	5	62.50	9 (40.92)
Classroom facilities					
<i>Classroom ratio of 40:1</i>					
Yes	14	100.00	8	100.00	22 (100.00)
<i>Lighting (300-500 lux)</i>					
Good lighting	2	14.28	3	37.50	5 (22.72)
Poor lighting	12	85.72	5	62.50	17 (77.28)
<i>Type of ventilation</i>					
Adequate	8	57.14	3	37.50	11 (50.00)
Not adequate	6	42.86	5	62.50	11 (50.00)
Food service area					
Adequate	2	14.28	6	75.00	8 (36.36)
Not adequate	12	85.72	2	25.00	14 (63.64)
Safety status					
Fire extinguisher					
No	14	100.00	8	100.00	22 (100.00)
Fire alarm					
No	14	100.00	8	100.00	22 (100.00)
Sports facilities					
Adequate	2	14.28	3	37.50	5 (22.72)
Not adequate	12	85.72	5	62.50	17 (77.28)
Dangers from animals					
Yes	8	57.14	6	75.00	14 (63.64)
No	6	42.86	2	25.00	8 (36.36)
Vector/pest exposure					
Yes	5	35.71	2	25.00	7 (31.81)
No	9	64.29	6	75.00	15 (68.19)
Floods					
Yes	3	21.42	1	12.50	4 (18.18)
No	11	78.52	7	87.50	18 (81.82)
Building near main road/markets/factories (< 100 m)					
Yes	2	14.28	4	50.00	6 (27.27)
No	12	85.72	4	50.00	16 (72.73)

Environmental health and safety management

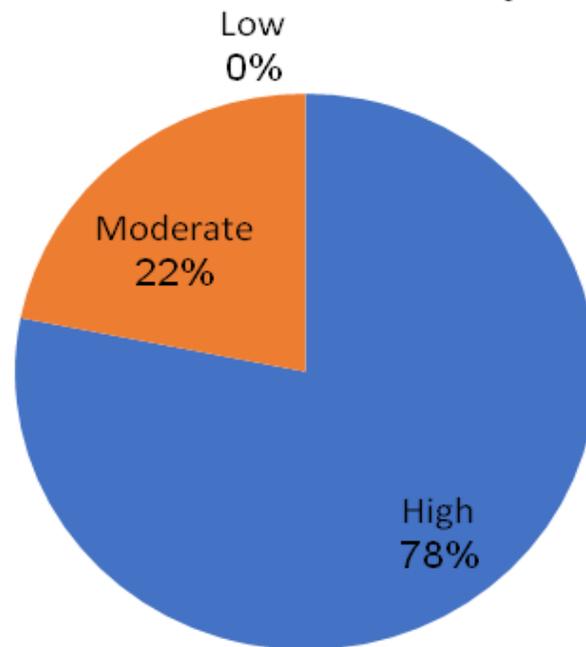


Figure 1: Percentage of perceptions of environmental health and safety management among participants

Cultural environmental health and safety

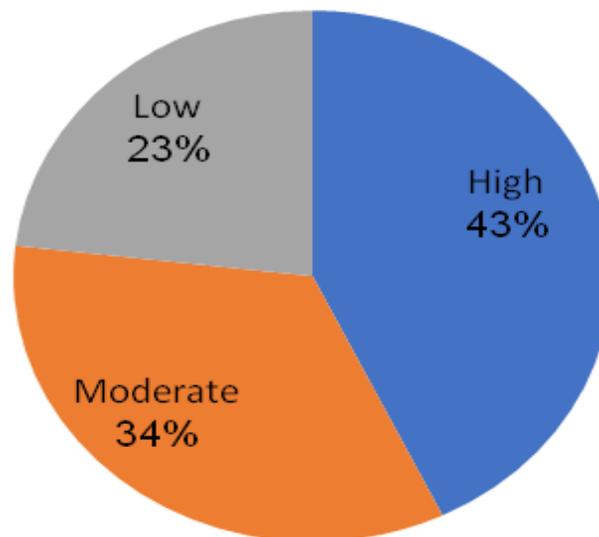


Figure 2: Percentage of perceptions of culture environmental health and safety among participants

ventilation and/or a lack of cleanliness) that would not provide equitable sanitation and hygiene for all (UNICEF, 2018a; UNICEF, 2018b). These results are similar to a study by Madepet et al. (2013), who reported 56% of Indonesian

schools did not have clean and odorless toilets.

All schools had visible waste containers. However, 54.55% did not have waste-selective collection systems for recycling, reducing and reusing. Half of the schools had no

Social environmental health and safety

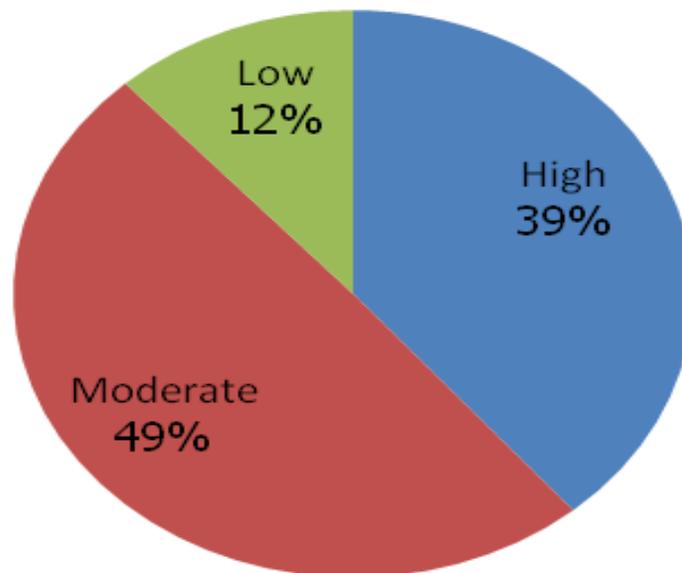


Figure 3: Percentage of perceptions of social environmental health and safety among participants

waste pickup, and participants stated that they did not have the time for waste separation. Additionally, misinformation about overflowing landfills, depleted resources and climate change convinced some participants that recycling does not make a difference. Practicing recycling, reducing and reusing every day in primary schools can be a fun way to maintain a healthy environment. Thus, it is important to increase staff education about waste and waste management to ensure primary schools are safe and healthy places.

In this study, the classroom space per student was adequate (Dargahi and Jangjoo, 2013; Jaen et al., 2005; Veitch, 2005). All schools used fluorescent lighting in classrooms; surprisingly, however, 17 (77.28%) had poor light (less than 300 lux), which can impair visual performance, health and comfort (Jaen et al., 2005; Veitch, 2005). Fluorescent lighting also causes headaches and impairs visual performance (Wilkins and Clark, 1990). Thus, schools should consider replacing low frequency ballasts with high frequency control circuitry, and lamps with a colour temperature of 3500 K should be used instead. Half of schools had poor ventilation that can lead to poor indoor air quality (IAQ) (US.EPA, 1989); the considered factors included indoor CO₂ concentrations, temperature and relative humidity. (Simons et al., 2010; Rosbach et al., 2013) reported that low ventilation rates are associated with increased absenteeism and more respiratory symptoms in school children.

Fourteen (63.64%) schools had inadequate canteens that

displayed a lack of cleanliness, inappropriate location and/or the presence of animals and disease vectors. The practical aspects of storing and handling food safely, ensuring water is fit to drink, disposing of waste and maintaining a healthy home environment must be a concern in primary schools (WHO, 2019). Food-borne diseases related to poor hygiene practices (Dablood et al., 2014) that are reported internationally in schools tend to defeat the aims of quality food provisions. An inadequate school environment favours direct transmission of diseases among individuals that may last for up to 3 to 5 days (Nhlapo et al., 2014).

A majority of the observed schools lacked security systems (alarms and surveillance equipment) due to lack of funds. This result is similar to another issue related to school security: schools are not well prepared for preventing and intervening in security problems (Geyin, 2007; Donmez and Guven, 2002). This survey revealed insufficiencies in all the security areas (e.g., spot facilities and canteens). Additionally, the location of resources and infrastructure (especially in informal settlements) around schools likely negatively impacts school safety and security. Henderson and Rowe (1998) recommend that shrubs, trees and grass, drainage, sidewalks, fencing and gates surround school grounds; the school should also have transportation for emergency procedures. During flooding, household sanitation systems may not operate as necessary. Trash and sewage pile up after floodwaters subside. A portion (18.18%) of the schools in this study was affected by these

Table 3. Comparison of participants perceived environmental health and safety status in primary schools (n=220)

Variable	Levels of perceived			
	n (%)	Mean (Standard Deviation [SD])	t	p-value
Sex				
Male	97 (44.10)	24.60 (5.18)	-1.164	0.251
Female	123(55.90)	25.25 (6.68)		
Age				
≥ 45 years	112(50.90)	26.91 (7.53)	1.061	0.282
< 45 years	108 (49.10)	25.41 (6.52)		
Education				
>Bachelor's degree	71 (32.27)	24.58 (7.90)	-2.128	0.031*
Bachelor's degree	149 (67.73)	21.75 (6.47)		
Work experience				
≥ 10 years	98 (44.54)	28.66 (7.16)	-2.981	0.002*
< 10 years	122(55.45)	23.88 (5.73)		
Number of times received environmental health and safety training				
≥ 9	58 (26.36)	33.8 (2.45)	-2.321	0.025*
< 9	162(73.64)	25.02 (7.00)		

Table 4. Participants' sociodemographic factors associated with perceived environmental health and safety status in primary schools (n = 220).

Variable	Participants in the primary schools Perceived environmental health and safety status				
	n (%)	β	p-value	β	p-value
Male	97 (44.10)	0.02	NS	0.001	NS
Age (≥ 45 years)Average (SD)45.38 (12.05)	112(50.90)	0.04	NS	0.01	NS
Bachelor's degree	149(67.73)	0.03	NS	0.02	NS
Work experience (≥ 10 years)Average (SD)16.24 (5.24)	98 (44.54)	0.15	< 0.001	0.11	< 0.001*
Number of times received environmental health and safety training (≥ 9 times) Average (SD)9.21 (3.25)	58 (26.36)	0.09	< 0.001	0.10	< 0.001*

NS: not significant.

factors and was forced to end their term early. Thus, rehabilitation of school water, sanitation and hygiene (WASH) facilities is needed to help curb the spread of WASH-related health risk WHO (2010). The results in this study, most of teacher participants have high perception of environmental health and safety (78.00%), high perception of cultural environmental health and safety (43.00%), and moderate perception of social environmental health and safety (49.00%) that supported by Jamal et al. (2013) who found positive relationships with teachers appear to be critical in promoting student wellbeing and limiting risk behavior. Conclusion based on the results in this study, primary school headmasters should implement preventive measures and educate participants in order to cope with and provide sufficient environmental health and safety in primary schools.

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Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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