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Research Article

Knowledge, Attitudes, and Practices Relating to Dengue Fever Prevention and Control among Governmental School Students in Seeb District in Muscat Governorate in Oman

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ABSTRACT

Dengue is currently the most common mosquito-borne disease globally. In Oman, all reported dengue cases were travel-related until 2018 dengue outbreak in Seeb district. The aim of the study was to assess students' level of knowledge about dengue fever, its symptoms, mode of transmission and prevention, attitudes and practices regarding DF in Seeb district in Muscat Governorate in Oman.

Materials and Methods: A cross-sectional study was conducted among students of 13 governmental schools in Seeb district. Multistage stratified random sample method was used and1209 students participated in this study using a pre-structured and self-administered questionnaire.

Results: We found that 92% of students have heard about the Aedes aegypti mosquito & 85% reported it as serious disease. 56.9% reported they don't feel at risk of Dengue fever. The most common source of information was social media, Friends & relatives and TV. Almost half of students answered incorrectly for the mosquitoes' bite time and most respondents were not able to correctly identify typical symptoms of DF apart from fever. 52% agreed it is important health problem in Muscat and can contribute to the fight of the Aedes aegypti mosquito. Majority of students stated good attitude in terms of importance of preventive and protective measure except for using mosquito repellent.

In conclusion: Massive educational campaign targeting school students in addition to incorporating dengue preventive measures into school curriculum should be planned by the concerned stakeholders to enhance level of knowledge, attitude and practice regarding dengue as well as other vector borne diseases in Oman.

Keywords

Viral infections, Dengue Fever, Vector borne diseases.

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Introduction

Dengue is a mosquito-borne viral disease caused by dengue virus [1]. It is currently the most common mosquito-borne disease globally. The virus was estimated to cause 390 million (284–528 million) infections per year [2]. Almost 3.9 billion people are at risk of infection [3]. In Eastern Mediterranean Region (EMR), nine countries have reported dengue epidemics and four serotypes were identified (EMR, 2019). The total annual global cost was estimated to be US$ 8.9 billion (95% US$ 3.7-19.7 billion) [4].

The virus is transmitted mainly by female mosquitoes of the species Aedes aegypti and, to a lesser extent, Aedes albopictus; the same mosquito vectors that transmit Chikungunya, Yellow fever and Zika infections [5]. The illness ranges from mild febrile illness to classic dengue fever (DF), to potentially fatal but rare haemorrhagic fever (DHF) and dengue shock syndrome (DSS). Almost three-fourth of dengue cases are asymptomatic [5].

According to MOH statistics, the total number of dengue cases (travel-related) reported from 2001 until the end of 2017 was 173, including five deaths (CFR 0.03%) [6]. from 1st January to mid-December 2018, 30 travel-related dengue cases were reported to the national level, including nationals who travelled to areas affected by the disease [7]. Between November 1, 2018 and May 15, 2019, fifty-nine confirmed cases acquired dengue infection locally was reported during the outbreak with the geographical distribution of the clearly indicated that the outbreak was confined to particular area within Seeb district [8]. Since the establishment of Communicable Disease Surveillance and Control Department (CDSC) until the 2018 outbreak, no local transmission of dengue has been reported in Oman [7].

Dengue is a severe yet preventable disease and community involvement is critical in dengue control programs [9,10]. The World Health Organization and Centres for Disease Control and Prevention recommends wide-ranging community educational campaigns aiming for breeding sites reduction. With local outbreak documented and with high risk of importation, it is important that this community level intervention for DF prevention is implemented in Oman. This can be achieved through assessment and improvement of people's knowledge, attitude, and practice (KAP) regarding dengue [9,10] as good knowledge of dengue will predict good practices of dengue prevention [10].

Schools can serve as training centres and meeting sites for dengue prevention initiatives targeting communities [11]. It was also used for communication and assessment of knowledge, attitudes, and practices (KAP) of students, families and communities [11]. School-based health education is a good instrument for knowledge and awareness enhancement between school children about dengue carrier vectors and symptoms of the diseases and has an impact on vector control at schools, households and communities as it is shown by previous studies from India, Thailand, KSA [9], Sri Lanka and Malaysia [12].

So far, no previous study was carried out in Oman to assess knowledge, attitude and practice of school children towards dengue fever infection and prevention. The aim of the study is to assess students' level of knowledge about dengue fever, its symptoms, mode of transmission and prevention, in addition to their attitudes and practices regarding DF in Seeb district in Muscat Governorate in Oman. Therefore, our study will considerably contribute to improving risk awareness and establishing educational evidence-based curricula.

Materials and Methods

The present study was conducted using a cross-sectional approach in October-November 2019 which was undertaken in Al Hail area, Seeb district in Muscat governorate in Oman. A self-administrated questionnaire in Arabic was developed from thorough literature review, reviewed by experts in education, environmental health and epidemiology. The questionnaire wasn't piloted prior to data collection. The language was selected to enhance comprehension and clarity in view of the target age group. School health nurses in each school were trained to support in the data collection. The students were allocated a reasonable time to finish answering the questionnaire.

The questionnaire is composed of 4 parts. Part A includes student's information about socio-demographic criteria of the study participants. Part B tests the students' knowledge about the disease process (symptoms, causative agent and vector) and risk factors (time of day, breeding sites) using nine questions (six are close ended, one is MCQ and two are open ended). Part C evaluate students' attitude towards disease control and prevention measures and their perception of risk using a set of nine questions. Part D addresses their practices regarding prevention and control measures and self-protective behaviours using five questions.

The minimum sample size was calculated using Rao Soft online sample size calculator [13] where confidence level is 95%, margin of error 3%, population size of 5820, and response distribution of 50%. 902 was the minimum sample size which was increased to compensate for non-respondents. an additional oversampling of 10% was done to cover unexpected issues or errors Students sample enrolled in our study were from grade 4 to 11, from the 13 governmental schools located in Seeb district –Al Hail area and were selected using multistage stratified random sample method by dividing schools according to educational grade (grade 4-11) and classes in each grade.

The study was approved by the Ethical Review Committee of Directorate General of Health Services-Muscat Governorate. Permission to conduct the survey was obtained from the Directorate General of education in Muscat governorate and from the respective school administration prior to the survey. Informed consent was taken from all the respondents' caregivers and confidentiality was ensured throughout the study. The questionnaire and consent forms were distributed to all respondents in Arabic language as all were Arabic speakers.

Data was collected and entered into entered a spreadsheet and exported to Statistical Package for Social Sciences (SPSS 20) for analysis. Further data cleaning had done on different levels by check the outliers, missing data, coding the variables and checking for inconsistent answers. Descriptive statistics for the collected data were recorded. Significance levels of 5% is considered as statistically significant. Chi-squared tests (Pearson, continuity corrected chi-squared test, chi-squared test for trend and Fisher's Exact Test) are used to compare groups defined by binary health outcomes.

Results

Socio-demographics features

The total number of study participants was 1209 students aged from 8 to 17 years, out of them 470 (39.1%) were males and 733 (60.9%) were females. The majority were Omanis (92.1%, N=1113). Table 1 showed the socio-demographic characteristics of the selected sample.

Table 1: Sample Characteristics by socio-demographic characteristics of school students in grades 4-19 in Seeb district, Muscat-Oman.

Socio-demographic Characteristics		N	%
Age Group	8-12 Years	693	58.4
	13-17 Years	493	41.6
	Total	1186	100.0
Gender	Males	470	39.1
	Females	733	60.9
	Total	1203	100.0
Grades	Grade 4-7	705	58.6
	Grade 8-10	498	41.4
	Total	1203	100.0
Nationality	Omani	1113	92.1
	Non-Omani	96	7.9
	Total	1209	100.0

Knowledge of Aedes aegypti mosquito

The results show that about 92% of the participants have heard about the Aedes aegypti mosquito where older students (13-17) years old have significantly heard more about it compared to the young students.

The most common source of information for those who heard about the mosquito was social media (22.3%) followed by Friends and relatives (21.3%) and by TV (19.4%). On the other hand, previous infection, radio and other sources were the least sources of information about the mosquito with 3.0% and 3.3% and 1.9%, respectively. The two main sources of information about the mosquito for girls were social media (25.1%), friends and relatives (22.7%) and for boys TV (approximately 21%), friends and relatives (19.2%). Younger students heard about the mosquito from TV (22.4%) as a first source, whereas older students heard from social media as a first source (26.4%). Friends and relatives were reported as a second source for both younger and older students with 19.4% and 22.8% respectively.

About half of participants answered that the mosquito is active at the daytime. The Students' knowledge about the times of a day Aedes aegypti mosquito is active shows a significant difference between the two grade groups.

More than half (57.8%) were aware of the place where the mosquito breeds. Examples given by those who know the place where the mosquito breeds include stagnant water (53.3%), gardens (12.6%), tires of cars (10.9%), dustbins (10.1%). Interestingly, 2.5% of the participants stated that the mosquito breeds in swimming pools and (1.3%) in flowers vase.

Around 85% reported that the Aedes aegypti mosquito can cause serious disease with no significant gender differences.

Less than 50% of students in both age groups knew the name of the disease.

More than half of the participants (55%) reported fever as the most common symptom of the disease. Other symptoms reported include headache (13.6%), rash (11.8%) and fatigue (8%). Small proportions reported vomiting, myalgia, diarrhoea, arthralgia, haemorrhage and retro-bulbar pain as symptoms caused by the mosquito.

68.4% of the participants think that they can contribute to the fight of the Aedes aegypti mosquito with no significant gender differences.

Tables 2 and 3 summarizes the most important aspects related to the knowledge of participants about the Aedes aegypti mosquito according to gender, age and grades.

Table 2: Sample Characteristics by knowledge of Aedesaegypti mosquito.

Knowledge of Aedesaegypti mosquito		N	%
Have you heard about the Aedesaegypti mosquito?	Yes	1101	91.9%
	No	97	8.1%
	Total	1198	100.0%
How did you hear about the Aedesaegyptimosquito?	TV	509	19.4%
	Newspapers	115	4.4%
	Radio	87	3.3%
	Social media	585	22.3%
	Health center	283	10.8%
	Previous infection	79	3.0%
	Friends and relatives	560	21.3%
	Visit awareness campaign teams	203	7.7%
	Awareness leaflets	156	5.9%
	Other: Mention them	49	1.9%
	Total	2626	100.0%
What times of a day Aedesaegypti mosquito are active?	Daytime	562	50.7%
	Night	547	49.3%
	Total	1109	100.0%
Do you know where this mosquito breed?	Yes	663	57.8%
	No	484	42.2%
	Total	1147	100.0%

Knowledge of Aedesaegypti mosquito		N	%
Mention examples of where this mosquito breedsa	Gardens	100	12.6%
	stagnant water	424	53.3%
	Sewages	44	5.5%
	water containers	30	3.8%
	tires of cars	87	10.9%
	Dustbins	80	10.1%
	swimming pools	20	2.5%
	flower vase	10	1.3%
	Total	795	100.0%
Is the disease caused by the Aedesaegypti mosquito serious?	No	185	15.3%
	Yes	1024	84.7%
	Total	1209	100.0%
What are the symptoms of the disease caused by this mosquito?	Fever	597	55.0%
	Headache	148	13.6%
	Arthlagia	14	1.3%
	Myalgia	24	2.2%
	Fatigue	87	8.0%
	Diarrhea	24	2.2%
	Vomiting	38	3.5%
	Rash	128	11.8%
	retrobulbar pain	10	.9%
	Hemorrhage	16	1.5%
	Total	1086	100.0%
Do you think you can contribute to the fight against this mosquito?	Yes	765	68.4%
	No	353	31.6%
	Total	1118	100.0%

Attitude towards Aedes aegypti mosquito

The distribution of the sampled participants according to their attitude towards the Aedes aegypti mosquito is represented in table 4.

More than half agreed that Dengue fever is a health issue in Muscat governorate (significantly more with older students (13-17) years but no significant gender differences), while about 57% felt that they are not at risk of Dengue fever significantly more boys (22.7%) feel they are at risk compared to 18.1% for girls.

57% of students disagreed (significantly more girls than boys) that it is important to look for mosquito breeding places at home.

However, 85.5% agreed that it is important to spray an insecticide against mosquitoes at home to reduce mosquitoes. Girls (88.5%) and students in grades (8-10) (89%) were significantly more likely to agree that it is important to spray an insecticide against mosquitoes at home to reduce mosquitoes compared to others.

In addition, 81% stated that it is important to use mosquito repellent cream to prevent its bites. Boys (73.4%) and grades (8-10) students (86%) were significantly more likely to agree on the importance of using mosquito repellent cream to prevent its bites compared to others.

Approximately, 80% agreed that is important to make mosquito net indoors and windows to prevent mosquitoes and around 83% agreed that it is important to eliminate or cover stagnant water pools to reduce mosquito breeding sites. The results also indicated that female respondents were significantly more likely to agree on the importance to make mosquito net indoors and windows to prevent mosquitoes (82.7% compared to 75.6% for boys and the importance to eliminate or cover stagnant water pools to reduce mosquito breeding sites (86.4% compared to 77.3% for boys). Moreover, older students (80.2%) were significantly more likely to agree that it is important to eliminate or cover stagnant water pools to reduce mosquito breeding sites compared to younger students (80.2%).

Furthermore, 76.4% agreed on the importance of getting rid of the tires collected in the yards and about 86% agreed that it is important to clean watering vessels for animal & birds weekly. Significantly more girls (79%) and older students aged (13-17) (82.8%) compared to (72%) boys and younger students aged (8-12) years (71.5%) agreed that it is important to get rid of the tires collected in the yards to reduce mosquito breeding. Conversely, significantly more boys (81%) and older students (80.2%) than girls (88.1%) agreed about the importance of cleaning watering vessels for animal & birds weekly.

Practices towards dengue fever & vector control

Approximately 86% reported that they will go to doctor if they have fever.

In addition, about 67% of the sample stated that they have got rid of stagnant water accumulated in pots and bottles and 55% reported that they got rid of stagnant water accumulated in pots and bottles over the past 4 weeks.

81% agree that it is important to use mosquito repellent cream to prevent its bites, but only 47% of the participants ever used the cream and 72% didn't use mosquito repellent over the past 4 weeks of the survey.

About 54% reported that they will wear mosquito protective clothing compared to 46% who won't. However, a high percentage (81.4%) of the participants think that they must take action when they see any stagnant water.

There was no significant difference between boys and girls in most practices. The only significant statistical difference was related to the use of mosquito repellent over the past 4 weeks where boys (31.3%) stated that they ever used the cream over the past 4 weeks compared to girls (25.6%) with a p-value = 0.047.

There were age group differences in practice, as shown in table 5, except that both age groups have similar percentages when it comes to rid of stagnant water accumulated in pots and bottles (p-value=0.517).

Discussion

This study provides the first description of KAP regarding DF transmission and its prevention in Muscat in Oman among school

Table 3: Knowledge characteristics on A.egypti mosquito by gender, age groups and grades.

Knowledge		Gender		p-value	Age Group (Years)		P-value	Grade Group		p- value
Gender & age groups		Boys	Girls		8-12	13-17		4-7	8-10	
Number & percentages		N (%)			N (%)			N (%)		
Have you heard about the Aedesaegypti mosquito?	Yes	421 (90.5)	675 (92.8)	0.187	604 (88.2)	478 (97.0)	<0.001	616 (88.4)	480 (97.0)	<0.001
	No	44 (9.5)	52 (7.2)		81 (11.8)	15 (3.0)		81 (11.6)	15 (3.0)	
How did you hear about the Aedesaegypti mosquito?	TV	201 (20.5)	305 (18.7)		273 (22.4)	228 (16.8)		287 (23.0)	219 (16.1)	
	Newspapers	49 (5.0)	63 (3.9)		76 (6.2)	35 (2.6)		74 (5.9)	38 (2.8)	
	Radio	35 (3.6)	50 (3.1)		49 (4.0)	35 (2.6)		49 (3.9)	36 (2.6)	
	Social media	175 (17.8)	408 (25.1)		221 (18.1)	357 (26.4)		220 (17.6)	363 (26.7)	
	Health centres	133 (13.5)	148 (9.1)		149 (12.2)	128 (9.5)		155 (12.4)	126 (9.3)	
	Previous infection	31 (3.2)	48 (3.0)		47 (3.9)	29 (2.1)		48 (2.3)	31 (2.3)	
	Friends & relatives	189 (19.2)	369 (22.7)		237 (19.4)	309 (22.8)		235 (18.8)	323 (23.8)	
	Awareness campaigns	89 (9.1)	114 (7.0)		81 (6.6)	118 (8.7)		91 (7.3)	112 (8.2)	
	Awareness leaflets	54 (5.5)	100 (6.1)		51 (4.2)	102 (7.5)		57 (4.6)	97 (7.1)	
	Other	26 (2.6)	22 (1.4)		35 (2.9)	13 (1.0)		34 (2.7)	14 (1.0)	
What times of a day Aedesaegypti mosquito are active?	Daytime	205 (49.3)	355 (51.7)	0.478	348 (54.5)	205 (45.4)	0.003	367 (56.6)	193 (42.4)	<0.001
	Night	211 (50.7)	332 (48.3)		290 (45.5)	247 (54.6)		281 (43.4)	262 (57.6)	
Do you know where this mosquito breed?	Yes	244 (56.0)	417 (59.1)	0.319	333 (51.0)	315 (66.5)	<0.001	347 (52.3)	314 (66.0)	<0.001
	No	192 (44.0)	288 (40.9)		320 (49.0)	159 (33.5)		318 (47.8)	162 (34.0)	
Mention examples of where this mosquito breeds	Gardens	44 (14.4)	56 (11.0)		70 (19.0)	28 (6.8)		75 (20.6)	25 (5.8)	
	Stagnant water	139 (48.8)	285 (55.9)		174 (47.2)	242 (59)		170 (46.7)	254 (58.9)	
	Sewages	19 (6.7)	25 (4.9)		26 (7.0)	18 (4.4)		29 (8.0)	15 (3.5)	
	Water containers	10 (3.5)	20 (3.9)		7 (1.9)	22 (5.4)		7 (1.9)	23 (5.3)	
	Tires of cars	33 (11.6)	54 (10.6)		36 (9.8)	47 (11.5)		32 (8.8)	55 (12.8)	
	Dustbins	23 (8.1)	57 (11.2)		39 (10.6)	41 (10.0)		35 (9.6)	45 (10.4)	
	Swimming pools	10 (3.5)	10 (2.0)		8 (2.2)	11 (2.7)		8 (2.2)	12 (2.8)	
	Flower vase	7 (2.5)	3 (0.6)		9 (2.4)	1 (0.2)		8 (2.2)	2 (0.5)	
Is the disease caused by the Aedesaegypti mosquito serious?	No	105 (22.3)	78 (10.6)	<0.01	112 (16.2)	67 (13.6)	0.256	116 (16.5)	67 (13.5)	0.178
	Yes	365 (77.7)	655 (89.4)		581 (83.8)	426		589 (83.5)	431 (86.5)	
What are the symptoms of the disease caused by this mosquito?	Fever	166 (52.5)	429 (55.9)		315 (55.4)	270 (53.8)		310 (56.0)	285 (53.9)	
	Headache	58 (18.3)	89 (11.6)		84 (14.8)	64 (12.7)		76 (13.7)	71 (13.4)	
	Arthlagia	4 (1.3)	10 (1.3)		13 (2.3)	1 (0.2)		13 (2.3)	1 (0.2)	
	Myalgia	5 (1.6)	19 (2.5)		14 (2.5)	9 (1.8)		14 (2.5)	10 (1.9)	
	Fatigue	22 (7.0)	65 (8.5)		37 (6.5)	49(9.8)		34 (6.1)	53 (10.0)	
	Diarrhea	5 (1.6)	19 (2.5)		12 (2.1)	12 (2.4)		12 (2.2)	12 (2.3)	
	Vomiting	8 (2.5)	30 (3.9)		19 (3.3)	19 (3.8)		18 (3.2)	20 (3.8)	
	Rash	40 (12.7)	88 (11.5)		64 (11.2)	63 (12.8)		65 (11.7)	63 (11.9)	
	Retrobulbar pain	6 (1.9)	4 (0/5)		7 (1.2)	3 (0.6)		8 (1.4)	2 (0.4)	
	Hemorrahge	2 (0.6)	14 (1.8)		4 (0.7)	12 (2.4)		4 (0,70)	12 (2.3)	
Do you think you can contribute to the fight against this mosquito?	Yes	280 (64.7)	481 (70.8)	0.036	428 (67.6)	329 (70.6)	0.322	432 (67.1)	329 (70.3)	0.283
	No	153 (35.3)	198 (29.2)		205 (32.4)	137 (29.4)		212 (32.9)	139 (29.7)	

children. Public knowledge and behaviour are playing a key role in transmission of dengue.

We found the majority of students have heard about the Aedes aegypti mosquito and also reported it as serious disease and important health problem in Muscat. But surprisingly less than half only reported they feel that they aren't at risk of Dengue fever. Seeb district was the hotspot outbreak area during that time where fifty-nine confirmed local cases were detected between November 1, 2018 and May 15, 2019 [8]. This finding is also similar to other studies where majority of respondent heard about it and realized the seriousness of the disease [9,14-21].

Girls were more likely to think that the disease caused by the mosquito is serious compared to boys. This was apparent in the difference between boys and girls in term of their ability to contribute to the fight against this mosquito. We found that majority of the participants think that they can contribute to the fight of the Aedes aegypti mosquito which was found by many other studies in different countries where respondent think that public can play a key role in in controlling the vectors of dengue virus [19,21-23]. This is a positive finding compared to what was found in other studies where they think it is governments or health authority staff responsibility to control DF [18,20].

Table 4: Attitude characteristics on Aedesaegypti mosquito by gender, age groups and grades.

Attitude		Gender		P-Value	Age Group (Years)		P-Value	Grade Group		P-Value
		Boy	Girl		8-12	13-17		4-7	8-10	
		N (%)			N (%)			N (%)		
Dengue fever is an important health problem in Muscat?	Agree	213 (50.6)	366 (53.0)	0.729	288 (46.2)	283 (59.3)	<0.001	288 (45.1)	291 (61.4)	<0.01
	Neutral	126 (29.9)	194 (29.1)		177 (28.4)	144 (30.2)		183 (28.7)	137 (28.9)	
	Disagree	82 (19.5)	131 (19.0)		158 (25.4)	50 (10.5)		167 (26.2)	46 (9.7)	
You feel at risk of dengue fever	Agree	96 (22.7)	125 (18.1)	0.01	129 (20.8)	88 (18.3)	0.863	133 (21.0)	88 (18.3)	0.66
	Neutral	110 (26.1)	149 (21.5)		134 (21.6)	123 (25.6)		138 (21.8)	121 (25.2)	
	Disagree	216 (51.2)	418 (60.4)		358 (57.6)	269 (56.0)		362 (57.2)	272 (56.5)	
It is important to look for mosquito breeding places at home?	Agree	96 (22.7)	125 (18.1)	0.01	129 (20.8)	88 (18.3)	0.863	133 (21.0)	88 (18.3)	0.67
	Neutral	110 (26.1)	149 (21.5)		134 (21.6)	123 (25.6)		138 (21.8)	121 (25.2)	
	Disagree	216 (51.2)	418 (60.4)		358 (57.6)	269 (56.0)		362 (57.2)	272 (56.5)	
It is important to spray an insecticide against mosquitoes at home to reduce mosquitoes?	Agree	341 (80.6)	613 (88.5)	0.001	525 (84.8)	423 (87.0)	0.053	519 (82.8)	435 (89.0)	<0.01
	Neutral	38 (9.0)	40 (5.8)		38 (6.1)	40 (8.2)		42 (6.7)	36 (7.4)	
	Disagree	44 (10.4)	40 (5.8)		56 (9.0)	23 (4.7)		66 (10.5)	18 (3.7)	
It is important to use mosquito repellent cream to prevent its bites?	Agree	317 (73.4)	608 (87.4)	<0.001	497 (79.3)	417 (85.3)	0.003	505 (79.3)	420 (85.5)	<0.01
	Neutral	62 (14.4)	52 (7.5)		69 (11.0)	46 (9.4)		70 (11.0)	44 (9.0)	
	Disagree	53 (12.3)	36 (5.2)		61 (9.7)	26 (5.3)		62 (9.7)	27 (5.5)	
It is important to make mosquito net indoors and windows to prevent mosquitoes?	Agree	326 (75.6)	577 (82.7)	0.016	496 (78.9)	397 (81.2)	0.163	501 (78.4)	402 (82.0)	0.05
	Neutral	61 (14.2)	72 (10.3)		73 (11.6)	59 (12.1)		76 (11.9)	57 (11.6)	
	Disagree	44 (10.2)	49 (7.0)		60 (9.5)	33 (6.7)		62 (9.7)	31 (6.3)	
It is important to eliminate or cover stagnant water pools to reduce mosquito breeding sites?	Agree	331 (77.3)	604 (86.4)	<0.001	506 (80.2)	422 (87.0)	0.006	502 (78.7)	433 (88.5)	<0.01
	Neutral	52 (12.1)	59 (8.4)		74 (11.7)	36 (7.4)		77 (12.1)	34 (7.0)	
	Disagree	45 (10.5)	36 (5.2)		51 (8.1)	27 (5.6)		59 (9.2)	22 (4.5)	
It is important to get rid of the tires collected in the yards to reduce mosquito breeding?	Agree	311 (72.0)	554 (78.9)	<0.001	453 (71.5)	404 (82.8)	<0.001	463 (71.8)	402 (82.2)	<0.01
	Neutral	58 (13.4)	97 (13.9)		96 (15.1)	58 (11.9)		94 (14.6)	61 (12.5)	
	Disagree	63 (14.6)	51 (7.3)		85 (13.4)	26 (5.3)		88 (13.6)	26 (5.3)	
It is important to clean watering vessels for animal & birds weekly?	Agree	353 (81.0)	623 (88.6)	0.001	526 (82.6)	440 (89.8)	<0.001	536 (82.8)	440 (89.4)	<0.01
	Neutral	46 (10.6)	53 (7.5)		62 (9.7)	36 (7.3)		63 (9.7)	36 (7.3)	
	Disagree	37 (8.5)	27 (3.8)		49 (7.7)	14 (2.9)		48 (7.4)	16 (3.3)	
Overall Attitude	Agree	244 (55.0)	417 (58.6)	0.187	341 (52.4)	315 (64.2)	<0.001	340 (51.4)	321 (65.1)	<0.01
	Neutral	167 (37.6)	258 (36.3)		261 (40.1)	159 (32.4)		269 (40.6)	156 (31.6)	
	Disagree	33 (5.1)	36 (5.1)		49 (7.5)	17 (3.5)		53 (8.0)	16 (3.2)	

For those who heard about the mosquito, the most common source of information was social media, Friends & relatives and TV. The two main sources of information about mosquitoes for younger and older age groups were TV and social media, respectively. The study showed that the two largest sources of information about the mosquito were social media and friends and relatives for girls, while TV and family and friends and relatives were the main two sources for boys**.** Different studies had different results regarding most common sources of information of DF, which could vary according to the country, target group, educational status [14], age or public education campaigns [24] or other factors. TV was cited as one of the main sources of information in many countries like Saudi Arabia, Kuala Lumpur and Thailand [9,14,17,21,24-28]. Some other studies cited friends/relatives as one of the most common sources of information [14]. This may be due to strong communication between people and considering friend and relative as common source for exchange of information. Social media is not famous common sources of information. In contrast, many other studies reported other common sources of information e.g. newspaper [9,14,24,28], radio [17,25], printed media [25],

Table 5: Practice characteristics on Aedesaegypti mosquito by gender, age groups and grades.

Practices		Gender		P-value	Age Group		P-Value	Grade Group		P-Value
		Boy	Girl		8-12	13-17		4-7	8-10	
		N (%)			N (%)			N (%)		
Will you go to the doctor if you have fever?	Yes	374 (84.4)	618 (86.6)	0.357	581 (88.4)	400 (82.0)	0.003	592 (88.8)	400 (81.6)	0.001
	No	69 (15.6)	96 (13.4)		76 (11.6)	88 (18.0)		75 (11.2)	90 (18.4)	
Have you ever get rid of stagnant water accumulated in pots and bottles?	Yes	298(68.2)	474 (66.7)	0.638	441 (68.0)	321 (65.9)	0.517	457 (69.5)	315 (64.3)	0.075
	No	139 (31.8)	237 (33.3)		208 (32.0)	166 (34.1)		201 (30.5)	175 (35.7)	
Did you get rid of stagnant water accumulated in pots and bottles over the past 4 weeks?	Yes	236 (54.6)	385 (55.1)	0.931	387 (60.8)	227 (47.1)	<0.001	390 (60.5)	231 (47.5)	<0.001
	No	196 (45.4)	314 (44.9)		249 (39.2)	256 (53.0)		255 (39.5)	255 (52.5)	
Have you ever used mosquito repellent cream to protect you against mosquito bites?	Yes	198 (45.3)	331 (47.5)	0.512	333 (52.2)	190 (39.3)	<0.001	337 (52.0)	192 (39.5)	<0.001
	No	239 (54.7)	366 (52.5)		305 (47.8)	294 (60,7)		311 (48.0)	294 (60.5)	
Did you ever use mosquito repellent over the past 4 weeks?	Yes	136 (31.3)	179 (25.6)	0.047	223 (35.0)	92 (19.0)	<0.001	227 (35.1)	88 (18.1)	<0.001
	No	299 (68.7)	519 (74.4)		415 (65.0)	392 (81.0)		420 (64.9)	398 (81.9)	
Do you wear mosquito protective clothing in case of a health problem caused by mosquitoes?	Yes	243 (55.9)	373 (52.9)	0.362	410 (63.8)	200 (41.2)	<0.001	415 (63.7)	201 (41.2)	<0.001
	No	192 (44.1)	332 (47.1)		233 (36.2)	286 (58.8)		237 (36.3)	287 (58.8)	
Nothing should be done when you see any stagnant water containers?	Yes	88 (20.3)	120 (17.1)	0.198	142 (22.2)	68 (14.0)	0.001	139 (21.5)	69 (14.1)	0.001
	No	345 (79.7)	582 (82.9)		497 (77.8)	417 (86.0)		508 (78.5)	419 (85.9)	

health care workers (HCWs) in the Community Health Centre, internet [27] and HCWs in the hospital [27,28], primary health care centres [2], Pamphlets [27,28], neighbours, schools [28], street advertisements [24], schools [9], media [21]. This may reveal the significance targeting future in these main sites according to the country setting in order to change behaviours earlier in life [24].

Even though majority have heard about the Aedes aegypti mosquito, yet several misconceptions were identified. Surprisingly, almost half of students answered incorrectly for the mosquitoes' bite time. According to WHO guidelines on DF, it typically bites during the day [29,22]. Though this result was consistent with findings from other studies [14,20-23,25] but his misconception is worrying because this may indicate that preventing measure for mosquito bites such as mosquito coils and bed netting will be used at night which will impact its effectiveness [18]. Bridging this gap in knowledge is essential by designing focus educational programs and activities for students.

The results of this study stated that more than half of the participants reported fever as the most common symptom of the disease and less frequently headache, rash and fatigue and minority reported vomiting, myalgia, diarrhoea, arthralgia, haemorrhage and retro-bulbar pain. Most respondents were not able to correctly identify typical symptoms of DF apart from fever which was recognize as symptoms of DF and few recognised headache and rash. This is considered somewhat in-adequate. During the outbreak which occurred in Seeb district during 2018, all patients had fever, arthralgia and/or myalgia and some had gastrointestinal symptoms [8]. Good knowledge of DF symptoms is critical in ability to recognize the possibilities of DF and seeking early health care to protect life [17]. Fever and headache were also the most frequently stated symptoms in similar studies conducted in India, Thailand, Laos, Nepal, the Philippines and Jamaica [17]. Other studies showed higher percentage of participants who recognised the DF symptoms than our results [17,18,20,21,23,25,29,30]. This was probably due to inadequate educational message from the mass media directed towards school students.

Most of the participants reported that they will go to doctor if they have fever. This is compatible with findings from other studies [20,21] and could lead to early medical diagnosis before complication.

Majority of students stated good attitude in terms of importance of preventive and protective measure like making mosquito indoors &windows net to prevent mosquitoes, eliminating or covering stagnant water pools to reduce mosquito breeding sites, getting rid of the tires collected in the yards to reduce mosquito breeding and cleaning watering vessels for animal & birds weekly. They also showed good practice for getting rid of stagnant water accumulated in pots and bottles, spraying an insecticide against mosquitoes at home to reduce mosquitoes, wearing mosquito protective clothing in case of a health problem caused by mosquitoes and act when they see any stagnant water containers. More than half of students knew that stagnant water is a potential breeding site for Aedes aegypti. This good knowledge accompanied with good attitude and good practice as majority of students think it is important to eliminate or

cover stagnant water pools to reduce mosquito breeding sites, that they must take action when they see any stagnant water (81.4%), and that they have really got rid of stagnant water accumulated in pots and bottles (67.2%).

In contrast, majority agreed to the important to use mosquito repellent cream to prevent its bites, but less than half of participants ever used the cream and surprisingly, majority didn't use mosquito repellent over the past 4 weeks of the survey when it comes to practice. This indicate there is a gap between attitude and practice in term of using repellent creams and need to be focused on when planning educational program. Some studies reported majority of participants are aware and using measures to reduce mosquito-man contact: tightly covering water containers [17,21,25] removal of stagnant water, using mosquito repellents,) and the use of windows screen [17,21], using insecticide sprays, disposing of water holding containers like tyres [17]. Some measure were less frequently given in some studies like use repellent [17,20] or spraying insecticide indoors [20] to prevent mosquito bites. Whereas in one study, the majority of participants used mosquito repellents [25]. Other studies reported minority reported using preventive measures against mosquitoes, such as mosquito nets, window screens or door screens [20].

Limitations

The study was conducted in confined area in Muscat, further studies are required in other parts of Oman. This is a school-based study and results may not reflect the general public perspective.

In conclusion

Massive educational campaign targeting school students in addition to incorporating dengue preventive measures into school curriculum should be planned by the concerned stakeholders to enhance level of knowledge, attitude and practice regarding dengue in Oman.

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