Knowledge of chikungunya and mosquito avoidance and control practices among newly admitted students at an offshore medical University in the Caribbean

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ABSTRACT

Objective

To assess knowledge of chikungunya and the pattern of implementation of mosquito avoidance and control practices among new students admitted to Trinity Medical Sciences University (TMSU), St. Vincent and the Grenadines

Methods

A cross sectional study was conducted, where a pilot tested questionnaire was surveyed among all newly admitted students for a period of one year. The participants who were aware of the disease were included in the knowledge score analysis. Knowledge level of each participant was determined to be good (score ≥ 70%), fair (score 50.1–69.9%) or poor (score ≤ 50%). The study also evaluated the participants' implementation of WHO-recommended mosquito avoidance and control practices.

Results

Among the 129 students surveyed, 102 participants responded (response rate: 79.06%). Of 102 participants, only 39 (38.2%) were aware of the disease with 30.77% having good knowledge, 28.21% fair knowledge and 41.03% poor knowledge of the disease. Of the eight mosquito avoidance and control practices evaluated, none were implemented by 2 (1.96%) of the participants while one or more, but not all, were used by the remaining 100 (98.04%) participants. The association of these practices with awareness of the disease as well as levels of knowledge was statistically non-significant (P>0.05).

Conclusion

A large percentage of newly admitted students at TMSU did not have adequate knowledge of chikungunya. However, implementation pattern of mosquito avoidance and control practices varied among them. The new students need early education about the disease and should be encouraged to practice as many recommended strategies as possible to avoid mosquito bites and control of mosquito vectors.

Keywords: Knowledge, chikungunya, mosquito control, new students

INTRODUCTION

Chikungunya is a viral disease transmitted to humans by infected mosquitoes. The disease is caused by chikungunya virus which is a positive sense RNA virus belonging to alphavirus genus of the Togaviridae family.[1] The virus is transmitted by the same mosquitoes (*Aedes aegypti* and *Aedes albopictus*) involved in the transmission of the dengue and zika viruses. These three viral diseases also share some clinical features and can be misdiagnosed in areas where these viruses are endemic.[2]

The name "chikungunya" comes from a word in the Kimakonde language, meaning "to become contorted", and describes the stooped appearance of sufferers with joint pain (arthralgia).[3] Severe joint pain and fever are the most obvious presentations of the disease and may persist for weeks, months, or years. Other symptoms include muscle pain, headache, nausea, fatigue and rash.[2,4,5] The disease may lead to complications such as myocarditis, hepatitis and ocular and neurological disorders.[6]

The disease was first described during an outbreak in southern Tanzania in 1952, but has now been identified in over 60 countries in Asia, Africa, Europe and the Americas.[7] An estimate indicated that 3.6 billion people living in 124 countries are at high risk of contracting this disease.[8]

It was reported that the disease reached the American region by the end of 2013 and has been spreading around the region. By July 2014, it had caused more than 440,000 cases of disease in more than 20 countries of the Caribbean and Central and South America.[9] In 2017 alone, there were over 180,000 cases of chikungunya in this region.[10]

The disease affected St. Vincent and Grenadines primarily in 2013 and 2014. According to the Pan American Health Organization (PAHO), a regional branch of the WHO, a total of 1,220 suspected cases (1,352 per 100,000 population) and 173 laboratory confirmed cases were reported in these years.[11] In 2015, no cases were reported. However, in 2016, a total of 154 suspected cases and one laboratory-confirmed case (152 cases per 100,000 population) were registered in PAHO.[11]

Three important factors have been highlighted by PAHO to explain the rapid transmission of the disease in the American region: 1) it is a new virus in the Americas; 2) since it is a new virus, defenses have not been built against it and the entire population is susceptible to chikungunya; 3) the *Aedes* mosquito is widely distributed in the region due to the climatic, temperature, and moisture conditions of tropical countries.[12]

Although the disease is often self-resolving and has a low fatality rate (~0.1%)[12], it leads to acute and chronic disability has considerable implications, including a substantial impact on quality of life for infected patients as well as considerable impacts on the economy and community health.[14,15]

Since there is no licensed vaccine or specific drug treatment for chikungunya infection, the United States Center for Disease Control and Prevention (CDC) has focused on raising awareness among both healthcare providers and the traveling public.[16] However, the level and extent of awareness remain unknown.[17] The CDC has also encouraged residents and travelers to areas in the tropics where chikungunya disease was prevalent to adopt personal protective behaviours and mosquito avoidance strategies to prevent infection.

Students who attend Trinity Medical Sciences University (TMSU) live in St. Vincent and the Grenadines for a few months to a few years. The country is a risk zone for the re-emergence of the disease. The students need to be well aware of the disease from the beginning of their stay on the island and promote their own personal protection. There is no information in the literature regarding knowledge of chikungunya, mosquito avoidance and control practices among newly admitted students at offshore medical universities in the Caribbean region. This allowed us to hypothesise that new students admitted to TMSU lack adequate knowledge about chikungunya disease and do not implement the recommended mosquito avoidance and control practices. Therefore, this study aimed to assess 1) knowledge about the chikungunya disease and 2) the pattern of implementation of mosquito avoidance and control practices among newly admitted students at TMSU in St. Vincent and the Grenadines, an island country in the Caribbean region.

MATERIALS AND METHODS

A cross sectional study was conducted for a period of one year (May 01, 2019 to April 30, 2020) at Trinity Medical Sciences University (TMSU). TMSU was established in 2008 as Trinity School of Medicine, an offshore medical school on the island of St. Vincent and the Grenadines, though it achieved university status in 2017. The university currently runs three programs: Doctor of Medicine (MD), Undergraduate (UG) Biomedical Sciences and Master of Health Sciences. It operates on a three-term schedule per calendar year with in-person classes beginning every September, January and May.[18] Each term consists of 15 weeks.

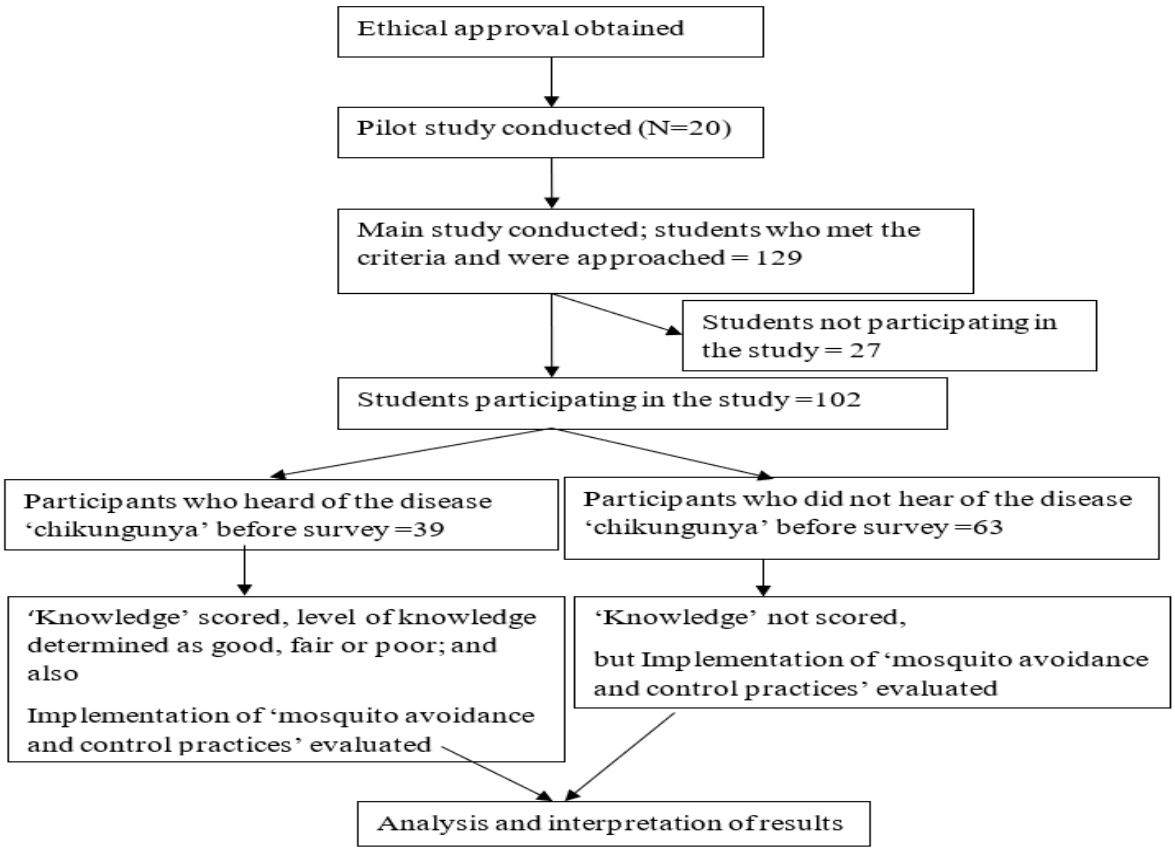
This study aimed to survey all newly admitted students (N=129) except for the students who transferred from other medical schools and the students promoted to the MD program from the UG Biomedical Sciences program at TMSU.

Study Instrument

The study used a 26-point preformed questionnaire with multiple choices that let participants select one answer from a defined list of choices. The questionnaire consisted of a) four items on demographic characteristics of the participants: age, gender, program enrolled in and participant's region of origin, b) one item on the participant's prior visit to a tropical country before coming to St. Vincent and the Grenadines, c) one item on whether the participant had heard of the disease 'chikungunya', d) 12 items to determine the participants' knowledge about chikungunya and e) eight items to assess the mosquito avoidance and control practices implemented by the participants. The questions were pre-tested in 20 students newly admitted to TMSU in the term Spring 2019.

A paper-based questionnaire and a consent form were distributed to each of the participants within two to four weeks of his/her enrollment at the University. The responses were collected and checked for completeness. An outline of the study is presented in Figure 1.

Figure 1: An overview of study conducted



Data Entry and Determination Knowledge Score

All data were entered into a Microsoft Excel Sheet. The participants who had heard of the disease name 'chikungunya' before administering the survey were considered as 'aware of disease' and were included in the knowledge score analysis.

The knowledge of participants was scored '1' for each correct answer and scored '0' for incorrect or 'not sure' answers. The maximum cumulative knowledge score (CKS) was 12 (i.e., the score was equal to the total number of the questions in the knowledge section). Total percent knowledge scores (score obtained/CKS ×100) were calculated for each participant and knowledge level of each participant was determined to be good (score ≥ 70%), fair (score 50.1–69.9%) or poor (score ≤ 50%) as per the previously published report.[19]

Data Analysis

All data were analysed with Statistical Package for the Social Sciences (SPSS) version 16.0. A significance level of 0.05 was used throughout. Categorical variables were described using counts (n) and percentage (%) whereas continuous variables were reported as a mean (standard deviation). Tests of comparison were conducted by using Pearson chi-square, independent sample t test or ANOVA wherever appropriate.

RESULTS

Of the 129 students surveyed, 102 responses were received (response rate: 79.06%). All the responses were complete and were included for analysis. The majority of participants in this study were in the age group of 16-25 years, were males, were currently enrolled in MD program, were from the United States of America and had visited tropical countries before coming to St. Vincent and Grenadines (Table 1).

Table 1: Participants' demographic characteristics and status of their prior visit to tropical countries (N=102)

		Frequency	Percentage
Age (Years)			
	16-25	67	65.7
	26-35	31	30.4
	36-45	3	2.9
	46 or more	1	1.0
Gender			
	Male	54	52.9
	Female	48	47.1
Program currently enrolled in			
	MD	70	68.6
	UG	32	31.4
Participant's region of origin			
	United States	67	65.7
	Canada	9	8.8
	India	16	15.7
	Caribbean region	6	5.9
	Other	4	3.9
Visit to a tropical country before coming to SVG			
	No	40	39.2
	Yes	62	60.8

MD: Doctor of Medicine; UG: Undergraduate Biomedical Sciences; SVG: Saint Vincent and the Grenadines

Awareness

Of the 102 participants, only 39 (38.2%) people responded positively to having heard of the disease 'chikungunya' and were considered to be aware of the disease.

Average Knowledge Score Per Question

Responses to the questions assessing participant knowledge and the corresponding average knowledge score are presented in Table 2.

Table 2: Knowledge questions and response by the participants who were aware of chikungunya (N=39)

Questions (items)		Response Frequency (%)	Average knowledge score per each item
Do you know that chikungunya outbreak occurred in St. Vincent and the Grenadines?	Yes (correct)	7 (17.9%)	0.18 ±0.38
	No	32 (82.1%)	
What is chikungunya?	A viral infection (correct)	25 (64.1%)	0.64 ±0.48
	A bacterial infection/ a parasitic infection/not sure	14 (35.9%)	
Which insect is responsible for transmitting chikungunya?	Mosquito (correct)	32 (82.1%)	0.82 ±0.38
	Tick/ fly/ not sure	7 (17.9%)	
Which of the given infections is also transmitted in the same way as chikungunya?	Dengue infection (correct)	28 (71.8%)	0.72 ±0.45
	Ebola/ not sure	11 (28.2%)	
During which season is chikungunya most common?	Rainy monsoon (correct)	28 (71.8%)	0.72 ±0.45
	Dry winter/ not sure	11 (28.2)	
Is chikungunya transmitted from human to human by direct contact?	Yes/ not sure	19 (48.7)	0.51 ±0.50
	No (correct)	20 (51.3%)	
How many days after an insect bite, does an infected person usually develop symptoms of disease?	3-7 days (correct)	11 (28.2)	0.28 ±0.45
	10-15 days/ 1-3 months/ not sure	28 (71.8%)	
What are the two most common symptoms of chikungunya?	Fever and joint pain (correct)	23 (59.0%)	0.59 ±0.49
	Sore throat and chest pain/ vomiting and diarrhea/ not sure	16 (41%)	
Is there any specific drug available to treat chikungunya?	Yes/ not sure	31 (79.5%)	0.21 ±0.40
	No (correct)	8 (20.5%)	
Is chikungunya a preventable disease?	Yes (correct)	23 (59%)	0.59 ±0.49
	No/ not sure	16 (41%)	
Is there any vaccine available now for chikungunya?	Yes/ not sure	27 (69.2%)	0.31 ±0.46
	No (correct)	12 (30.8%)	
Is there any role of insect control in preventing the disease?	Yes (correct)	33 (84.6%)	0.85 ±0.36
	No/ not sure	6 (15.4%)	

Of the 12 questions, the highest scored (average knowledge score 0.85 ±0.36) question was on the role of insect control in preventing the disease whereas the least scored (average knowledge score of 0.18 ±0.38) question was on the outbreak of chikungunya in St. Vincent and the Grenadines.

Knowledge Scores of Participants

On assessment of knowledge scores among 39 participants who were aware of the disease, the mean cumulative knowledge score was found to be 6.41 ±2.90 (range: 0-10) out of 12. Table 3 depicts the association of both demographic characteristics of participants as well as their prior visits to tropical countries with their knowledge scores. Interestingly, three (gender, program enrolled and participant's region of origin) of four demographic characteristics had statistically significant association with the knowledge scores. The association between prior visits to tropical countries and knowledge scores was not statistically significant.

Table 3: Association demographic characteristics and prior visit of a tropical country with knowledge scores

		Total participants assessed for knowledge score (N=39)	Knowledge score	P value
Age (Years)				
	16-25	27	6.89 ± 2.42	0.196[a]
	26-35	11	5.09 ± 3.75	
	36-45	1	8.00	
	46 or more	0		
Gender				
	Male	25	5.56 ±3.16	**0.003**[b*]
	Female	14	7.93 ±1.54	
Program currently enrolled in				**0.006**[b*]
	MD	20	5.20 ±3.35	
	UG	19	7.68 ±1.63	
Participant's region of origin				
	United States	17	4.88 ±3.08	**0.003**[a*]
	Canada	1	1.00	
	India	14	7.86 ±1.91	
	Caribbean region	6	7.83	
	Other	1	9.00	
Visit to a tropical country before coming to SVG				0.590[b]
	No	15	6.73 ± 2.57	
	Yes	24	6.21 ±3.13	

*MD: Doctor of Medicine; UG: Undergraduate Biomedical Sciences; SVG: Saint Vincent and the Grenadines; a: One-way ANOVA, b: Independent sample t test, *: P value significant*

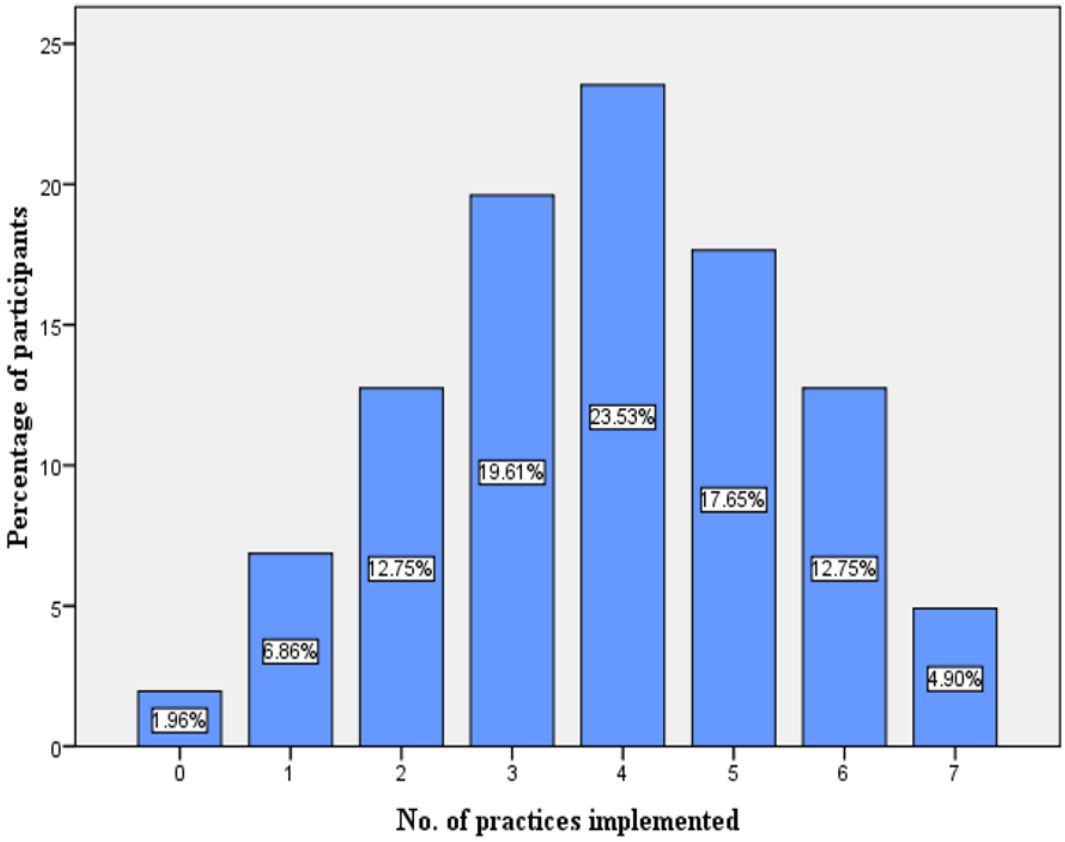
Knowledge Level of Participants

Of the 39 participants, 12 (30.77%) reported to have good knowledge, 11 (28.21%) fair knowledge and 16 (41.03%) reported to have poor knowledge.

Mosquito Avoidance and Control Practices Implemented by the Participants

Of eight mosquito avoidance and control practices evaluated among 102 participants, two (1.96%) participants implemented none. Only 1 practice was used by seven (6.86%) participants, 2 practices by 13 (12.75%) participants, 3 practices by 20 (19.61%) participants, 4 practices by 24 (23.53%) participants, 5 practices by 18 (17.65%) participants, 6 practices by 13 (12.75%) participants, 7 practices by five (4.90%) participants and all 8 practices were used by none of them (Figure 2).

Figure 2: No. of mosquito avoidance and control practices implemented by the participants (N=102)



Out of 102 participants, 79 (77.5%) covered water containers around their houses, 77 (75.49%) lived in a room with window screening, 69 (67.6%) eliminated standing water (pools of water) around their houses, 57 (55.9%) used insecticide sprays at their homes, 46 (45.1%) wore long sleeved clothes, 44 (43.1%) used insect repellants on their skin, 17 (16.7%) used coils to repel insects and 15 (14.71%) used bed nets.

The mosquito avoidance and control practices implemented by the participants had no statistically significant association with their awareness of chikungunya (Table 4).

Table 4: Association between mosquito avoidance and control practices and awareness of chikungunya

Mosquito avoidance and control practices		Participants not aware of chikungunya (N=63)	Participants aware of chikungunya (N=39)	P value*
Do you live in a room with window screening?	No	15	10	0.834
	Yes	48	29	
Do you use a bed net?	No	52	35	0.318
	Yes	11	4	
Do you use coils to repel insects?	No	56	29	0.056
	Yes	7	10	
Do you use insect repellants on your skin?	No	33	25	0.245
	Yes	30	14	
Do you eliminate standing water (pool of water) around your house?	No	23	10	0.254
	Yes	40	29	
Do you use long sleeved clothes?	No	38	18	0.162
	Yes	25	21	
Do you use insecticide sprays at your home?	No	29	16	0.621
	Yes	34	23	
Do you cover water containers around your house?	No	23	12	0.553
	Yes	40	27	

**P value: based on Pearson Chi-Square test*

The association of various mosquito avoidance and control practices and levels of chikungunya knowledge was statistically non-significant (Table 5).

Table 5: Association of mosquito avoidance and control practices with level of chikungunya knowledge (N=39)

Mosquito avoidance and control practices		Level of knowledge			
		Good	Fair	Poor	P value*
Do you live in a room with window screening?	No	3	3	4	0.989
	Yes	9	8	12	
Do you use a bed net?	No	11	11	13	0.278
	Yes	1	0	3	
Do you use coils to repel insects?	No	7	8	14	0.214
	Yes	5	3	2	
Do you use insect repellants on your skin?	No	8	5	12	0.283
	Yes	4	6	4	
Do you eliminate standing water (pool of water) around your house?	No	1	2	7	0.084
	Yes	11	9	9	
Do you use long sleeved clothes?	No	4	6	8	0.549
	Yes	8	5	8	
Do you use insecticide sprays at your home?	No	6	5	5	0.571
	Yes	6	6	11	
Do you cover water containers around your house?	No	2	3	7	0.294
	Yes	10	8	9	
**P value: based on Pearson Chi-Square test*					

DISCUSSION

Chikungunya is considered a re-emerging viral disease.[9,20] It has been of great concern in the Caribbean region since 2013.[9] Therefore, for prevention and control, having knowledge of the disease is very important for new students admitted to a medical University located in the Caribbean region that has experienced outbreaks of chikungunya in the past.

This study revealed that only 38.2% (39) of the participants were aware of the disease before coming to St. Vincent and the Grenadines. Our observation is much lower than the findings (56.7-82.6%) of similar studies previously conducted in Pakistan.[19,21] The discrepancy is most likely due to the involvement, in previous studies, of study participants who had already been engaged in medical education or practice which may have provided them an opportunity to familiarize with the disease. The lack of awareness of chikungunya seen in a large proportion of new students in this study is alarming and suggests that the majority of participants might put themselves at risk of acquiring the infection during their education on the island. Based on this finding, providing appropriate health education about chikungunya and other vector-borne diseases such as dengue and Zika for newly admitted students before or immediately after their arrival to medical

schools located in the Caribbean should be prioritized. Educational classes can be provided to new students via in-person lectures immediately after their arrival to the Island. Educational materials about those diseases can also be incorporated into the website of medical schools/universities. Students should also be encouraged to follow the guidelines provided by standard agencies such as the WHO and CDC.

On evaluation of responses to the 12 questions assessing knowledge of the participants in this study, average knowledge score per item (question) varied. The variations in the rate of responses to various questions used for scoring knowledge were also observed by previous studies.[19,22] After assessment of knowledge scores of 39 participants who were aware of chikungunya in the present study, the mean cumulative knowledge score was found to be 6.41 ±2.90 (range: 0 -10) out of 12. Regarding the level of their knowledge about chikungunya, only 30.77% (12) had good knowledge whereas 28.21% (11) had fair knowledge and 41.03% (16), poor knowledge. Our data are comparable to the findings of Mallhi et al who observed that the proportion of participants with good knowledge was 31% (99), while 36.4% (116) and 32.6% (104) respondents had fair and poor knowledge respectively.[19]

In this study, three demographic characters (gender, program enrolled and participant's region of origin) had statistically significant association with the knowledge score. The exact reason for association between gender and knowledge (p=0.003) score remains unclear. However, the association of the knowledge score with the latter two is most likely due to the following reason. Most of the undergraduate (UG) students at TMSU were from the Caribbean and India. Previous outbreaks have been reported from both of these places.[9-11,23] Therefore, those students might have been familiar with the disease in the past and have shown higher knowledge scores than the MD students in this study. On the other hand, age of the participants and their prior visit to tropical countries had no significant association with the knowledge scores.

Since there is no licensed vaccine to protect against chikungunya virus infection, the only strategy to control or prevent the transmission of chikungunya virus as recommended by the WHO is taking steps to avoid mosquito bites and control of mosquitoes.[24] Mosquito bites can be avoided by having secure screens/nets on windows and doors to keep mosquitoes out, using mosquito nets to protect babies, the elderly and others who may rest during the day, using mosquito coils and electric vapor mats during the daytime to prevent mosquito bites, applying mosquito repellents to exposed parts of the body and wearing long-sleeved shirts and long trousers.[24] Vector control, which is regarded as one of the important strategies to interrupt or reduce transmission, is commonly achieved by the use of chemical insecticides (such as for indoor sprays and thermal fogging) that may eliminate adult mosquitoes and by the elimination of breeding sites of mosquitoes (such as by removing standing water around the house, covering containers around the house, removing, disposing, burying or burning of all unused tins, cans, jars, bottles, tires, coconut shells and husks and other items that can collect and hold water and keeping tires, metal boxes, discarded appliances, sinks, basins, cement tanks, pots and parts of other items in industrial and commercial premises in sheltered areas protected from rainfall).

On evaluation of eight of the recommended mosquito avoidance and control practices among the participants in this study, it was observed that 1.96% (2) of the participants used none of the practices whereas others were quite variable in their implementation patterns. None of the participants used all eight practices. Although the current study noted no statistically significant association of these practices with the awareness of chikungunya or with the level of knowledge among the participants, they should still be encouraged to implement as many practices as possible to protect themselves from infection.

In the past, Caribbean countries have experienced outbreaks of not only chikungunya, but also other vector-borne diseases such as Zika and dengue.[25,26] One suspected and two laboratory-confirmed cases of Zika in pregnant women were reported to PAHO by the Saint Vincent and the Grenadines in 2016.[11] However, unlike the Zika virus, dengue is considered endemic in Saint Vincent and the Grenadines.[27] The annual average number of dengue fever cases in the country over a period of 7 years until 2019 was 15. However, the country experienced an outbreak of dengue in 2020 and recorded 514 laboratory confirmed cases.[28] Since Zika and dengue are also transmitted by the same species of mosquito (*Aedes aegypti* and *Aedes albopictus*) that transmit chikungunya, these diseases can also be prevented and controlled by the

implementation of the strategies used for prevention and control of chikungunya. The government of St. Vincent and Grenadines has been implementing 1) Integrated Vector Control Strategies (IVC) such as source reduction strategies including increased fogging, the clearing of river mouths and debushing and 2) health promotion activities, with the engagement of communities, churches and other non-governmental organizations to control vector-borne diseases in the country.[28]

Our study had a few limitations. It did not include a control group of participants (such as students previously enrolled at the institution) to compare the awareness and knowledge level of the study participants. This study also did not evaluate participants' prior travel clinic consultation before arrival to the island. Furthermore, it did not assess whether the participants were staying in rental apartments, school dormitories or any other accommodation facilities.

To the best of our knowledge, this is the first study assessing the knowledge of chikungunya and pattern of implementation of mosquito avoidance and control practices among newly admitted students at an offshore medical university in the Caribbean. We hope that the findings of our study will be useful to 1) the prospective students (such as the ones from United States and Canada who plan to move to Caribbean for their studies) and the general public to increase their awareness and promote their personal protection and 2) the medical universities in the Caribbean that may require baseline data to implement a program to educate their newly admitted students about vector-borne diseases.

CONCLUSION

Knowledge of chikungunya among newly admitted students at TMSU was not adequate. However, the implementation pattern of recommended mosquito avoidance and control practices varied among them. In the future, newly admitted students should be educated about this disease before or immediately after their arrival to the island. Further, they should be encouraged to practice as many of the recommended strategies as possible to avoid mosquito bites and to control mosquito vectors. These strategies will not only prevent them from contracting the chikungunya virus, but also from contracting other mosquito-borne diseases such as dengue and Zika.

Ethical Approval statement: Ethical approval to conduct this study was obtained from the research committee of TMSU.
Conflict of Interest statement: None
Informed Consent statement: The purpose of study was explained to all participants and written informed consent was obtained from each of them.
Funding statement: No sources of funding to declare
Author Contributions: Hari P. Nepal and Wezenet Tewodros conceived the design of the study. Hari P. Nepal, Amanda Evans, Leoncio Diaz and Rama Paudel took part in data acquisition, processing and analysis. Hari P. Nepal and Rama Paudel prepared the manuscript. All authors critically reviewed the manuscript during preparation and approved the final version.

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