CHIKUNGUNYA AMONG OUTPATIENTS IN DAR ES SALAAM AND ZANZIBAR, TANZANIA: A CROSS-SECTIONAL HOSPITAL-BASED STUDY

Abstract

Background: The current shift of the burden of infectious diseases from malaria to arbovirus diseases such as chikungunya and dengue is a public health concern. Community understanding and awareness of particular febrile illnesses are essential, especially in controlling and managing such diseases. Therefore, change in Knowledge, Attitude, and Practices are key focus areas for intervention to prevent the disease. We investigated knowledge and prevention practices regarding dengue and chikungunya amongst outpatients in two hospitals in Tanzania.

Method: A cross-sectional study was conducted with 166 individuals from Temeke Referral Hospital and 166 from Mnazi Mmoja Referral Hospital. The knowledge score was calculated by adding all positive responses to items. Each item was assigned 10 for the positive response and 0 for the negative response, and then all items were included by applying a 10-point scale. The total knowledge scores ranged from 0 to 100, where scores <50 were considered low, while scores ≥ 50 were considered high.

Results: Overall, only 10.2% of all participants had high knowledge of dengue and chikungunya, while 89.8% had low knowledge. Concerning preventive practices, only 4.5% of all participants had good preventive practices, while the majority, 95.5%, had poor practices regarding dengue and chikungunya.

Conclusion: The study shows respondents have insufficient knowledge and risk practices regarding dengue and chikungunya fever. Regular assessments should be conducted using SEM and the KAP approach, which will help improve awareness among community members about the disease's signs and symptoms, mode of transmission, and improved preventive practices.

Keywords: Chikungunya, Dengue, Knowledge, Practices, Tanzania

Introduction

Dengue and chikungunya, both arbovirus diseases, present significant and increasing public health challenges in tropical and subtropical regions worldwide [1]. The main vector of dengue and chikungunya is *Aedes aegypti* [2]. Dengue and chikungunya viruses are genetically different, although they have a similar transmission mode, the same vector, pathogenesis, and clinical presentations. These overlapping clinical symptoms can complicate diagnosis and delay targeted treatment [3]. Febrile diseases are characterised by acute joint pain, high body temperature above 40^{o} C, muscle pain and eye pain, head, backache, and skin rashes [4]. There is no specific treatment, although symptom-based treatments to alleviate unexpected clinical conditions are available [5].

The burden of febrile illnesses such as chikungunya and Dengue has increased and expanded globally. Recent reports from the CDC show that the outbreak has spread worldwide, including Asia, the Pacific, and Europe [6–8]. Brazil has reported many dengue outbreaks and other arboviral infections [9]. A retrospective study conducted in Southern America between 2015 and 2000 shows that despite progress made to understand these diseases better, the scenario is still complex, with increasing outbreaks in the period described, with dengue remaining the most common arbovirus infection [10]. Available data suggest that dengue is endemic to 34 African countries and that *Aedes aegypti* mosquitoes – the primary vector for dengue transmission – are known to be present in all but five countries [11]. The recent epidemics caused by these arboviruses have been associated with many factors, including urban expansions, population growth, and international travel and trade. These factors facilitate the spread of vectors and arboviruses into new niches, followed by amplification through the human-vector-human cycle [12]. In sub-Saharan African countries, the frequency and severity of epidemics have also increased [13]. As malaria cases decline, the rise in non-malarial febrile illnesses such as dengue and chikungunya presents new challenges for public health systems in Tanzania [14]. In 2019, the dengue outbreak was confirmed in several parts of Tanzania's mainland and most areas of Zanzibar, of which 2019 were suspected cases and 1018 were confirmed cases [15]. In areas suspicious of arboviral circulation,

socioeconomic positions like population density, low water management, and poor housing conditions may exacerbate vector abundance and high risk of infections.

The risks of infection transmission depend on many factors, including the population's level of knowledge, attitude, and practices [16]. Education and health programs focus on enhancing dengue and chikungunya knowledge awareness and preventive practices among the targeted population. [17] Understanding and improving Knowledge Awareness Practices within the community can enhance preventive behaviors and reduce transmission risks [18]. Furthermore, a change in (KAP) is one of the key focus areas for disease control interventions [19]. Although some studies have assessed KAP regarding arboviral diseases in Tanzania, they reveal significant knowledge gaps and limited community awareness [18]. KAP survey can strengthen local knowledge and behavior related to mosquito control and prevention measures at the individual and community level [17],[18]. This hospital-based study assessed the knowledge, attitudes, and practices regarding dengue and chikungunya among outpatients at Temeke and Mnazi Mmoja Hospitals. These insights will inform targeted public health interventions and enhance community resilience to arboviral diseases.

Methodology:

Study design and setting:

This health facility-based cross-sectional study was conducted in two selected hospitals, Mnazi Mmoja Hospital in Zanzibar Island and Temeke Hospital in Dar es Salam, from November to December 2020. Dar es Salaam is among the coastal regions of Tanzania, which lies 16m above sea level with an average temperature of 26.1 C/ 79.1 ^{o} F and an annual precipitation amount of 1,150 mm. The long rain season occurs from March to May, while short rains occur from October to December. Both climate and rain patterns are similar in the Zanzibar Archipelago, but Zanzibar receives more than 1,600 mm per year. The climatic conditions in both study sites are favourable conditions for mosquitoes' survival and growth. Again, the region has experienced several outbreaks of dengue and chikungunya. Zanzibar and Dar es

Salaam are close, which means the movement and the people's interaction provide the chances of inter-crossing diseases.

Study population and sample size:

The study enrolled all individuals who reported at the Outpatient registration desk at Temeke and Mnazi Mmoja hospitals during the study period. Individuals who were critically ill and needed immediate care and those who didn't consent to participate were excluded from the study. Temeke in Dar es Salaam and Mnazi Mmoja Hospital in Zanzibar were purposively selected due to the frequent outbreaks of arbovirus in the country and their proximity to the Indian Ocean, leading to frequent flooding and rising temperatures. A total of 332 patients were enrolled using a systematic random sampling technique. The patients were chosen from the registry's patients by selecting every 5th participant at the outpatient clinic—332, 166 from Temeke Hospital, and 166 from Mnazi Mmoja. Participants were informed about the study and invited to participate voluntarily. Individuals aged <18 were accented, and their parents or guardians were asked to complete the questionnaire.

Data collection methods and tools:

Face-to-face interviews were structured questionnaires constructed in English and then translated into Swahili to make it easy for participants to understand the questions. We interviewed participants and recorded their responses to each question. The interviewers were trained and encouraged to follow the interview manual to reduce biases. The questionnaire included participants' socio-demographic and economic information (age, sex, educational level, and assets owned). Knowledge of dengue and chikungunya, risk factors, signs and symptoms, breeding sites, and preventive practices (Using a net when sleeping day or night, clearing the nearby bush, closing the window during the day, cutting down bushes). After completion, all questionnaires were checked for completeness, and all unfilled questionnaires were excluded from statistical analysis. The questionnaires were cross-checked and then translated back into English for statistical analysis.

Assessment of Knowledge and Practices of the Participants:

Modified Bloom's cut-off points [20][21] were used to assess the knowledge with few modifications. Good knowledge was assessed as participants correctly answered questions about signs, symptoms, and diagnostic practices for dengue or chikungunya. Correct answers for each knowledge item were coded as 10, while incorrect answers were coded as 0.

The total knowledge scores ranged from 0 to 100, where scores < 50 were considered low, while scores ≥ 50 were considered high.

Discussions were based on a semi-structured topic guide on knowledge and prevention practices regarding dengue and chikungunya. The following were significant themes: knowledge regarding dengue and chikungunya, Conducive environment for breeding and survival of mosquitoes, and Preventive regarding dengue and chikungunya.

Statistical analysis:

All completed questionnaires were double-checked and verified on the same day for completeness and consistency. The dependent variables (outcome variables) were knowledge and practices, while the independent variables were age, sex, education level, employment status, marital status, and economic status. Descriptive statistics were summarised using frequencies and percentages for categorical variables, while the mean and standard deviation were used for continuous variables. All categorical variables were cross-tabulated and tested using the Chi-square test. Multivariate analysis provides deeper insight into data by considering the interaction of multiple variables. It seeks to understand complex relationships between variables. We used prevalence ratio (PR), which measures the strength of the association between outcome and a suspected risk factor. It's estimated using logistic models with random effects. The knowledge differences were considered statistically significant if P is ≤ 0.05 and the 95% confidence does not include one. All data analyses were done using SPSS v.21 (IBM SPSS, College Station, Texas, USA).

RESULTS:

Socio-demographic characteristics of study respondents:

A total of 322 participants were enrolled, whereby 166 (50%) were from the Tanzania mainland, and 166 (50%) were from the Zanzibar archipelago. Of the total participants, females were 177 (53.3%). Participants mean age [Standard Deviation) (SD)] was 34.2 (0.8) years. The majority, 202 (60.9%), had secondary education, and 174 (52.4%) were married. A total of 73 (22%) of the participants were housewives, followed by businesses 68 (20.5%), and the least were fishermen, 4 (1.2%). Among all participants, 163 (49.1%) were in the medium class of economic status (**Table 1).**

Responses on Current illnesses

Participants' responses to questions on signs and symptoms resembling dengue and chikungunya included fever 157 (47.3%), muscle pain 82 (24.7%), headache 157 (47.3%), and joint pain 135 (40.7%) (**Table 2).**

Knowledge and practices regarding dengue and chikungunya among outpatients participated in the study.

Of all participants, about three-quarters of 252 (75.9%) had heard of dengue, while only 102 (30.7%) had heard of chikungunya. 73 (28.5%) had heard through the radio, followed by 63 (24.6%) who had heard through the newspapers. Most participants recognised fever as a symptom of dengue and chikungunya, followed by joint pain 62 (18.7%) and headache 60 (18.1%), and about 10 (3%) recognised bleeding as a symptom of dengue and chikungunya. We found that 159 (47.9%) knew mosquitoes were the transmitting vectors, and an equal number of 159 (47.9%) didn't know the transmission mode. Only 88 (26.5%) knew that the mosquitoes that transmit dengue and chikungunya are day biters. A few participants, 16 (4.8%), mentioned car tyres as breeding sites for mosquitoes, while the majority, 125 (37.6%), didn't know the

mosquitoes' breeding sites. Regarding preventive practices, 79 (23.8%) used a bed net, and only 9 (2.9%) had a Windows screen (**Table 3).**

Overall, only 10.2% of all participants had high knowledge of dengue and chikungunya, while 89.8% had low knowledge. Concerning preventive practices, only 4.5% of all participants had good preventive practices. In contrast, the majority, 95.5%, had poor practices regarding dengue and chikungunya (**Figure 1).**

Association between socio-demographic and economic factors with Knowledge and Practices of the participants

We observed that Dar es Salaam participants had significantly associated low knowledge and poor practices regarding dengue and chikungunya compared with the Zanzibar archipelago's participants (p-values of 0.01 and 0.001, respectively). No/primary education, self-employment, and low economic status increased the odds of low knowledge and poor practices regarding dengue and chikungunya (p-values of 0.01 and 0.001, respectively) (**Table 4).**

Association between socio-demographic and economic factors, low knowledge, and poor practices of the participants using multivariable analysis

When we used a multiple logistic regression model where the unadjusted and adjusted odds ratios were reported, we observed that participants from Dar es Salaam were 1.1 (95% CI 1.03-1.2) the odds of knowing those from Zanzibar, which was also true when we looked at poor practice. Our results also showed that level of education was associated with low knowledge, with those having none or primary education odds of having low knowledge than those with secondary and above education level APR 1.1(1.05-1.2). Economic status was another factor that we found to be associated with low knowledge and poor practices. (**Table 5**).

DISCUSSION

The present study assessed the knowledge and practices regarding dengue and chikungunya virus infection among the outpatients attending Temeke and Mnazi Mmoja hospitals in Dar es Salam and Zanzibar, Tanzania, respectively. The study showed insufficient knowledge and poor practices about dengue and chikungunya. Knowledge and practice studies are limited in many African countries. The average knowledge scores for dengue and chikungunya were 10.2%, similar to a survey conducted in Kilimanjaro, Tanzania, which found that only 15.2% had good knowledge scores [19]. Among all participants, only 4.5% reported having good preventive practices for dengue and chikungunya. This result could reflect either a lack of awareness of infections other than malaria or because dengue and chikungunya are relatively new diseases in Tanzania [18], [22]. Good knowledge of the signs and symptoms of dengue and chikungunya, mode of transmission, and a good understanding of preventive practices are essential in identifying the diseases and seeking appropriate medical treatment to save lives [19]. The ministry needs to take immediate action to tackle the situation. Different means of communication should be used to ensure that society gets adequate knowledge regarding arbovirus infection. It will also enable them to gain insight into preventive measures and awareness. This result contradicts previous studies conducted in countries with higher knowledge than ours. Studies in Malaysia and the Philippines indicated that 64.3% and 61.45% of all participants had good knowledge, respectively [21], [22]. Insufficient knowledge amongst the study population signifies that arboviral diseases, including dengue and chikungunya, may be easily misinterpreted with other common diseases like malaria among the community members.

We observed that participants from Dar es Salaam had significantly low knowledge and poor preventive practices regarding dengue and chikungunya compared with the Zanzibar archipelago's participant counterpart. This could be because the archipelago of Zanzibar is a small town, with its population

concentrated in the city centre, and many of them are permanent residents; hence, it is easy for them to get information. While Dar es Salaam is a big city with many people, getting information regarding dengue and chikungunya could be difficult. Again, due to its small size, Zanzibar makes it easier for the residents to have a higher public education than the big cities like Dar es Salaam.

Also, we observed that people with no/primary education, are self-employed, and have low economic status were associated with low knowledge and poor preventive practices. This result is similar to the result obtained from a study conducted in Panama [23], which showed that having a low socioeconomic index, including low education and low economic status, could increase the likelihood of low knowledge regarding dengue and chikungunya and poor preventive practices. In our study, more than three-quarters of participants had heard of dengue, while only one-quarter had heard of chikungunya fever. This is similar to a study done in Tanzania by Debora [19], which showed that only 16% had heard about chikungunya fever, while 96.8% had heard about dengue. The low understanding of chikungunya fever is likely since Tanzania mainland has experienced frequent dengue outbreaks in recent years [24]. In contrast, chikungunya was only reported as an outbreak in the Zanzibar archipelago [25].

About one-third of participants mentioned fever as a symptom, while few mentioned vomiting, nausea, and headache. This is different from the study conducted in North India, which showed that knowledge about symptoms was good: (89%) knew about fever, (91%) had joint pain, (64%) had rashes, and (56%) had headaches [26]. Regarding preventive practices, only 23.8% of respondents reported using bed nets, while few reported using window screening. In contrast, others reported clearing bushes around their houses as preventive measures for dengue and chikungunya infection.

We observed that about 48% of respondents were able to mention mosquitoes as vectors responsible for transmitting dengue and chikungunya. This differs from a study conducted in India, where most participants knew mosquitoes transmitted dengue [26]. Only 26.5% of all participants were aware of the day-biting behaviour of the vector. We acknowledge the limitations in this study, such as only two hospitals being involved in the research and the study not including the general population, hence having limited geographical inference. However, the results are similar to other studies [18],[19]. Therefore, an extensive

survey is required to cover a representative sample of the general population's understanding of dengue and chikungunya knowledge and practice.

We identified knowledge gaps that could be addressed to enhance community and individual-level action against arboviruses by evaluating knowledge about mosquito vectors, disease transmission, and preventive measures. As we understand, frequent outbreaks of arbovirus infections around the globe have been more frequent in recent years. There is a high need for the Tanzanian government, especially the Ministry of Health, to put in their plan and prepare a policy that will mainly target emphasised understanding and capacity building among healthcare workers in diagnosis and treatments.

CONCLUSION

Our study shows insufficient knowledge and low preventive practice regarding dengue and chikungunya among the study population. Low levels of knowledge regarding dengue and chikungunya amongst the study population signify that this disease may easily be confused with other common causes of fever at the health facility and community levels. Given the emerging arbovirus outbreaks worldwide, arboviruses should be included in national campaigns against mosquito-borne infections to raise public awareness. An approach could help devise a plan to increase community members' awareness about the symptoms and mode of transmission and improve preventive practices. The government should include routine diagnosis and treatment for Malaria, especially dengue fever since it is associated with frequent outbreaks. It could circulate in our environment and easily be misdiagnosed with other diseases like Malaria. We recommend focusing on replication of the study to determine if the current study findings hold the truth. Since the cross-sectional studies have inherent limitations, especially in not allowing for the conclusion of causality as they are inherently nonrandomised, on that basis, we recommend more rigorous studies, e.g., randomised behavioural control studies, etc., may be used to improve on the findings of the cross-sectional study. Regular assessments should be conducted using SEM and KAP approaches, which will help improve awareness among individuals in the community about the disease’s signs and symptoms, mode of transmission, and improved preventive practices. Therefore, the Ministry of Health should organise more

practical health education programs. Public education based on KAP will help enhance individuals' awareness of the disease's signs and symptoms, mode of transmission, and improved preventive practices.

ABBREVIATIONS

KNCHREC: Kibong'oto Infectious Diseases Hospital-Nelson Mandela African Institution of Science and Technology-Centre for Educational Development in Health, Arusha.

SUZA: The State University of Zanzibar

ZAHRI: Zanzibar Health Research Institute

DECLA RATIONS

Ethics Approval and Participants Consent:

Ethical approval was sought from the research ethics committees of the Kibong'oto Infectious Diseases Hospital and the Nelson Mandela African Institution of Science and Technology-Centre for Educational Development in Health, Arusha (KIDH-NM-AIST-CEDHA)—(KNCHREC) with certificate number KNCH REC0019 for collecting samples from Dar es Salaam. Ethical approval was obtained from the Zanzibar Health Research Institute (ZAHRI) with certificate number ZAHRI-46 for Zanzibar. Additional permission was acquired from the respective site where the samples were obtained.

Consent for publication

Not applicable

Availability of data and materials

The data used to support this study's findings are available from the authors upon special request.

Table 1: Socio-demographic characteristics of study respondents;

Variable		Number (%); (**N=332)**
Sites		
	Dar es Salaam	166(50.0)
	Zanzibar	166(50.0)
Sex	Male	155(46.7)
	Female	177(53.3)
Age		
	<18	23(6.9)
	18-30	164(49.4)
	>30	145(43.7)
Mean (SD)		32.4(0.8)
Education		
	No education	31(9.3)
	Primary	99(29.8)
	Secondary and above	202(60.9)
Marital status		
	Married	174(52.4)
	Single	130(39.2)
	Divorced	11(3.3)
	Widow	14(4.2)
	Cohabiting	3(0.9)
Occupation		
	Employed	46(13.9)
	Self-employed	48(14.5)
	Fishing	4(1.2)
	Business	68(20.5)
	Farmer	22(6.6)
	Student	55(16.6)
	Housewife	73(22.0)
	Others	16(4.8)
Economic status		
	Low	111(33.4)
	Medium	163(49.1)
	High	58(17.5)

TABLE 2: Responses on Current illnesses

Variables	Number (%); **N=332**
Fever	
Yes	157(47.3)
No	175(52.7)
Muscles pain	
Yes	82(24.7)
No	250(75.3)
Joint pain	
Yes	135(40.7)
No	197(59.3)
Back pain	
Yes	94(28.3)
No	238(71.7)
Rashes	
Yes	24(7.2)
No	308(92.8)
Stomach pain	
Yes	142(42.8)
No	190(57.2)
Headache	
Yes	157(47.3)
No	175(52.7)
Swelling of Joint	
Yes	42(12.7)
No	290(87.3)
Vomiting/Nausea	
Yes	63(19.0)
No	269(81.0)

Table 3: Awareness, source of information, knowledge, and Practices regarding dengue and chikungunya among outpatients in Zanzibar and Temeke hospital

Variables	Number (%); N=332
Have you heard about Dengue fever?	
Yes	252(75.9)
No	80(24.1)
Have you heard about Chikungunya fever?	
Yes	102(30.7)
No	230(69.3)
If Yes, where have you heard (n=256)	
Radio	72(28.5)
T. V	45(17.6)
Health facility	24(9.4)
Family member	33(12.9)
Neighbours	11(4.3)
Magazine	63(24.6)
I don't know	7(2.7)
Sign and Symptom	
Fever	105(31.6)
Headache	60(18.1)
Joint pain	62(18.7)
Nausea/Vomiting	24(7.2)
Bleeding	10(3.0)
Mode of Transmission	
Mosquitos	159(47.9)
Flies	2(0.6)
Air	12(3.6)
I don't know	159(47.9)
Mosquitos biting behaviour	
Afternoon	88(26.5)
Evening	19(5.7)
Night	41(12.4)
Morning	7(2.1)
I don't know	177(53.3)
Breeding site	
Used car tyres	16(4.8)
Clear water in bucket/tank	31(9.3)
Dirty water	101(30.4)
Waste	89(26.8)
I don't know	125(37.6)
Preventive practice	
Use bed net	79(23.8)
Mosquito repellent	46(13.9)
Window screen	9(2.7)

Clearing ponds	71(21.4)
Cutting down bushes/grasses near homes	48(14.5)

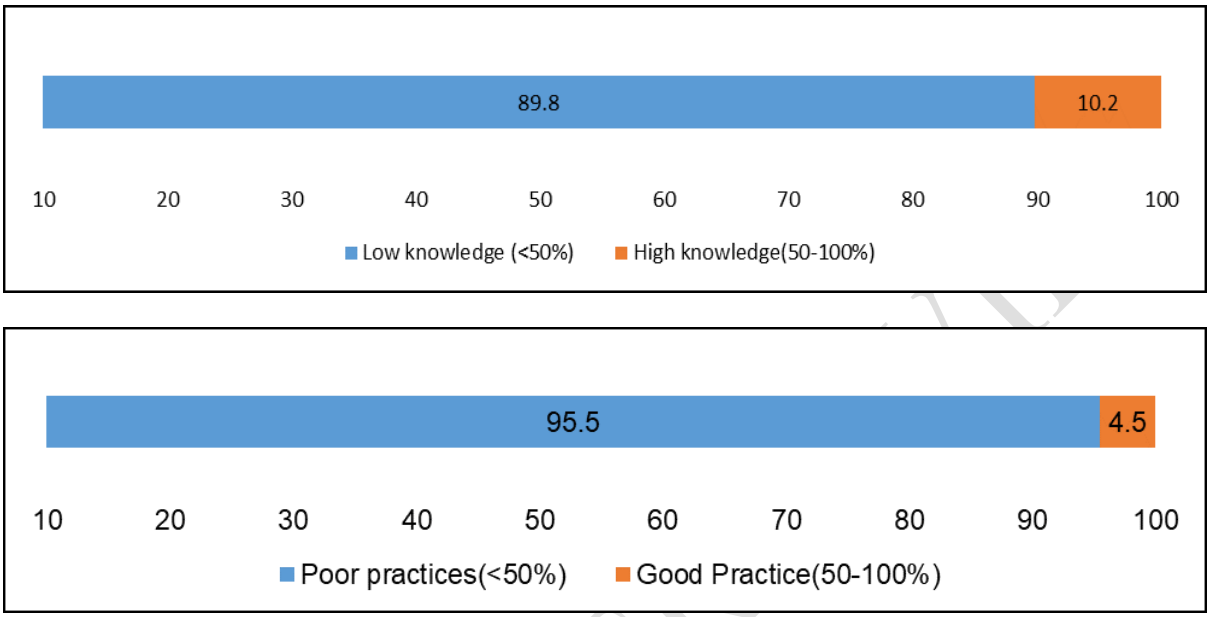

Figure 1: Knowledge of and practices towards prevention of Dengue and Chikungunya diseases (n=332)

Table 4: **Association between socio-demographic and economic factors with Knowledge and Practices of the participants**

Variable		Total, n (%)	Low knowledge, n (%)	Poor practices, n (%)
Sites	Dar es Salaam	166(50.0)	157(94.6)**	166(100)***
	Zanzibar	166(50.0)	141(84.9)	151(91.0)
Sex	Male	155(46.7)	140(90.3)	50(96.8)
	Female	177(53.3)	158(89.3)	167(94.4)
Age (years)	<30	174(52.4)	153(87.9)	163(93.7)
	30+	158(47.6)	145(91.8)	154(97.5)
Education	Non/Primary	130(39.2)	125(96.2)**	130(100)**
	Secondary/above	202(60.8)	173(85.6)	187(92.6)
Marital status	Married	177(53.3)	159(89.8)	168(94.9)
	Not married	155(46.7)	139(89.7)	149(96.1)
Occupation	Employed	46(13.9)	35(76.1)	40(87.0)
	Self-employed*	142(42.8)	137(96.5)***	142(100)***
	Others	144(43.4)	126(87.5)	135(93.7)
Economic status	Low	111(33.4)	107(96.4)***	108(97.3)*
	Medium	163(49.1)	147(90.2)	158(96.9)
	High	58(17.5)	44(75.9)	51(87.9)

**P-value<0.05, **P-value<0.01 & ***P-value<0.001*

Table 5: **Association of socio-demographic and economic factors with low knowledge, and poor practices of the participants using multivariable analysis**

Variable	UPR,95%CI	APR,95%CI	UPR, 95%CI	APR,95%CI
Hospital				
Dar es salaam	1.1(1.03-1.2)	1.1(1.03-1.2)	1.1(1.05-1.2)	1.1(1.03-1.2)
Zanzibar	Ref	Ref	Ref	Ref
Sex				
Male	Ref		Ref	
Female	1.0(0.9-1.1)		1.0(0.9-1.02)	
Age (years)				
<30	1.0(0.9-1.03)		1.0(0.9-1.01)	1.0(0.9-1.1)
30+	Ref		Ref	Ref
Education				
Non/Primary	1.1(1.05-1.2)	1.1(1.001-1.1)	1.1(1.04-1.1)	1.1(1.0-1.1)
Secondary/above	Ref	Ref	Ref	Ref
Marital status				
Married	1.0(0.9-1.1)		1.0(0.9-1.03)	
Not married	Ref		Ref	
Occupation				
Employed	Ref	Ref	Ref	Ref
Self-employed*	1.3(1.1-1.5)	1.2(1.01-1.4)	1.2(1.03-1.3)	1.2(1.01-1.4)
Others	1.2(1.0-1.4)	1.1(0.9-1.3)	1.1(1.0-1.2)	1.1(0.9-1.3)
Economic status				
Low	1.3(1.1-1.5)	1.2(1.04-1.4)	1.1(1.0-1.2)	1.2(1.04-1.4)
Medium	1.2(1.02-1.4)	1.2(1.02-1.4)	1.1(1.0-1.2)	1.2(1.02-1.4)
High	Ref	Ref	Ref	Ref

Unadjusted Prevalence Ratio (UPR) & Adjusted Prevalence Ratio (APR)

Disclaimer (Artificial intelligence)

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Details of the AI usage are given below:

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2.

REFERENCES

[1] N. D. Wolfe *et al.*, “Sylvatic transmission of arboviruses among Bornean orangutans.,” *Am. J. Trop. Med. Hyg.*, vol. 64, no. 5–6, pp. 310–316, 2001, doi: 10.4269/ajtmh.2001.64.310.

[2] M. U. G. Kraemer, M. E. Sinka, K. A. Duda, A. Q. N. M.- elife, and undefined 2015, “The global distribution of the arbovirus vectors Aedes aegypti and Ae. albopictus,” *elifesciences.org*.

[3] R. M. Budodo, P. G. Horumpende, S. I. Mkumbaye, B. T. Mmbaga, R. S. Mwakapuja, and J. O. Chilongola, “Serological evidence of exposure to rift valley, dengue, and chikungunya viruses among agropastoral communities in Manyara and Morogoro regions in Tanzania: A community survey,” *PLoS Negl. Trop. Dis.*, vol. 14, no. 7, pp. 1–14, 2020, doi: 10.1371/journal.pntd.0008061.

[4] S. Nimmannitya, U. T.-… and public health, and undefined 1987, “Dengue haemorrhagic fever with unusual manifestations.,” *europepmc.org*.

[5] B. Chipwaza, J. Mugasa, M. Selemani, … M. A.-Pl. N. T., and undefined 2014, “Dengue and Chikungunya fever among viral diseases in outpatient febrile children in Kilosa district hospital, Tanzania,” *journals.plos.org*.

[6] Guzmán and U. 2002, “Dengue: an update,” *Elsevier*.

[7] V. Feres, C. Martelli, M. Turchi, J. Junior, and R. Nogueira, “Laboratory surveillance of dengue virus in Central Brazil, 1994–2003,” *J Clin Virol*, vol. 37, 2006.

[8] S. Rana and P. Lunia, “Reemergence and Global Spread of Chikungunya,” *iicbe.org*, doi: 10.15242/IICBE.C0915052.

[9] R. Nogueira, M. Miagostovich, and H. Schatzmayr, “Dengue viruses in Brazil,” *Dengue Bull.*, vol. 26, 2002.

[10] R. Bezerra, “Dengue, Zika Fever and Chikungunya : Biological Aspects and Situation in South America between 2015 and 2020 Dengue, Zika Fever e Chikungunya : Aspectos Biológicos e Situação na América do Sul entre 2015 e,” vol. 2021, pp. 1–16, 2021.

[11] F. Were, “The dengue situation in Africa.,” *Paediatr. Int. Child Health*, vol. 32 Suppl 1, no. s1, pp. 18–21, May 2012, doi: 10.1179/2046904712Z.00000000048.

[12] H. J. Esser *et al.*, “Risk factors associated with the sustained circulation of six zoonotic arboviruses : a systematic review for selection of surveillance sites in non-endemic areas,” Parasite. *Vectors*, pp. 1–17, 2019, doi: 10.1186/s13071-019-3515-7.

[13] B. Wahid, A. Ali, S. Rafique, and M. Idrees, “Global expansion of chikungunya virus: mapping the 64-year history,” *Int. J. Infect. Dis.*, vol. 58, pp. 69–76, 2017, doi: 10.1016/j.ijid.2017.03.006.

[14] M. A. Ali, O. C. James, A. A. Mohamed, A. Joachim, M. Mubi, and O. Omodior, “Etiologic Agents of Fever of Unknown Origin Among Patients Attending Mnazi Mmoja Hospital, Zanzibar,” *J. Community Health*, May 2020, doi: 10.1007/s10900-020-00832-w.

[15] T. Ward *et al.*, “Dengue data and surveillance in Tanzania: a systematic literature review,” *Tropical Medicine and International Health*, vol. 22, no. 8. Blackwell Publishing Ltd, pp. 960–970, Aug. 2017. doi: 10.1111/tmi.12903.

[16] A. C. Alves, A. L. dal Fabbro, A. D. C. Passos, A. F. T. M. Carneiro, T. M. Jorge, and E.

Z. Martinez, “Knowledge and practices related to dengue and its vector: A community-based study from Southeast Brazil,” *Rev. Soc. Bras. Med. Trop.*, vol. 49, no. 2, pp. 222–226, 2016, doi: 10.1590/0037-8682-0240-2015.

[17] M. F. Cardozo, E. Balaji, A. Francis, A. Dias, and L. Dias, “Assessment of knowledge, attitude, and practices regarding dengue among the general population of Goa,” vol. 10, no. 3, pp. 1232–1238, 2023.

[18] B. Chipwaza, J. P. Mugasa, I. Mayumana, M. Amuri, C. Makungu, and P. S. Gwakisa, “Community Knowledge and Attitudes and Health Workers ’ Practices regarding Non-malaria Febrile Illnesses in Eastern Tanzania,” vol. 8, no. 5, 2014, doi: 10.1371/journal.and.0002896.

[19] D. C. Kajeguka *et al.*, “Knowledge and practice regarding dengue and chikungunya: a cross-sectional study among Healthcare workers and community in Northern Tanzania,” *Trop. Med. Int. Heal.*, vol. 22, no. 5, pp. 583–593, 2017, doi: 10.1111/tmi.12863.

[20] A. Itrat *et al.*, “Knowledge, awareness and practices regarding dengue fever among the adult population of dengue hit cosmopolitan,” *PLoS One*, vol. 3, no. 7, Jul. 2008, doi: 10.1371/journal.pone.0002620.

[21] B. M. N. Al-Zurfi *et al.*, “Knowledge, attitude and practice of dengue fever and health education program among Alam Shah science school students, Cheras, Malaysia,” *Malaysian J. Public Heal. Med.*, vol. 15, no. 2, pp. 69–74, 2015.

[22] B. C. Yboa and L. J. Labrague, “Dengue Knowledge and Preventive Practices among Rural Residents in Samar Province, Philippines,” *Am. J. Public Heal. Res.*, vol. 1, no. 2, pp. 47–52, 2013, doi: 10.12691/ajphr-1-2-2.

[23] P. K. Bhatnagar, S. K. Garg, T. Bano, and S. Jain, “Knowledge, Attitude and Practice Regarding Dengue and Chikungunya in Secondary School Children in a City of North India,” *Eur. J. Pharm. Res.*, vol. 3, no. 11, pp. 423–428, 2016.

[24] C. Sindato, E. Karimuribo, L. Mboera, K. Njenga, C. Choby, and Y. Karsan, “Dengue outbreaks in Tanzania: recent trends and importance of research data in disease surveillance About,” vol. 4, no. 7, p. 6, 2019.

[25] H. S. Shauri, E. Ngadaya, M. Senkoro, J. J. Buza, and S. Mfinanga, “Seroprevalence of Dengue and Chikungunya antibodies among blood donors in Dar es Salaam and Zanzibar, Tanzania : a cross-sectional study,” *BMC Infect. Dis.*, pp. 4–9, 2021, doi: 10.1186/s12879-021-06549-y.

[26] P. Ray *et al.*, “Chikungunya infection in India: results of a prospective hospital-based multi-centric study.,” *PLoS One*, vol. 7, no. 2, p. e30025, 2012, doi: 10.1371/journal.pone.0030025.