Infection and Drug Resistance

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METHODOLOGY

Dengue Fever Outbreak Investigation in Werder Town, Dollo Zone, Somali Region, Ethiopia

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Background: Dengue fever (DF) is a mosquito-borne disease caused by the dengue virus. DF is endemic to many tropical and subtropical countries around the world. In Ethiopia, DF emerged in 2013 and caused a serious public health problem.

Objective: We investigated the outbreak to describe by time, place, person, and to identify risk factors associated with the outbreak in Werder town, Dollo Zone, Somali Region, Ethiopia.

Methods: Descriptive and case-control studies (1:2 ratio) were conducted. We used the World Health Organization (WHO) case definition to identify cases in Werder town from December 10, 2020, to January 4, 2021. Controls were selected from the same town that did not suffer from DF. Serum samples were tested by reverse transcription polymerase chain reaction (RT-PCR) to detect the dengue virus and to identify serotypes. A structured questionnaire was used to collect socio-demographic, behavioural, and environmental characteristics.

Results: We identified a total of 57 cases and 114 controls. The overall attack rate was 334.41/100,000 with a zero case fatality rate. Six out of twenty serum samples tested positive for the DEN-3 serotype. In multivariate analysis, not hearing of DF (Adjusted odd ratio (AOR): 2.2, 95% CI: 1.015–4.701), not knowing the mode of transmission (AOR: 2.9, 95% CI: 1.338–6.831), not using long-lasting insecticidal net (LLITN) (AOR: 4.4, 95% CI: 1.592–12.330) and not spraying insecticide (AOR: 3.6, 95% CI: 1.591–8.098) were statistically significant risk factors associated with DF outbreak. However, wearing long sleeves (AOR: 0.435, 95% CI: 0.206–0.918) was a protective factor for the DF outbreak.

Conclusion: DF outbreak in Werder town has been confirmed. The present study provides evidence-based information regarding the identified risk factors that have contributed to the occurrence of DF outbreaks. We recommended implementing vector control measures and strengthening dengue surveillance systems is strongly advised.

Keywords: case-control study, dengue fever, outbreak, risk factors, Werder

Introduction

Dengue fever (DF) is a mosquito-borne infectious disease caused by the dengue virus, belonging to the genus Flavivirus, the family Flaviviridae.[1] There are four closely related dengue virus serotypes, DENV1, DENV 2, DENV 3, and DENV4.[2] Infection with one type gives lifelong immunity to the dengue virus. However, the infection does not provide immunity to the others three types, so it is possible to contract the dengue virus again.[3]

Dengue fever is transmitted by the bite of a female Aedes mosquito infected with the dengue virus.[4] Infection can also be transmitted by blood transfusion or organ transplantation and can be transmitted vertically from mother to child.[5] The mosquito becomes infected when it bites a person whose blood contains the dengue virus.[6] Symptoms usually begin three to fourteen days after infection.[7] These can include high fever, headache, vomiting, muscle and joint pain, and a characteristic skin rash.[7] There is no effective antiviral treatment for dengue but recovery usually takes two to seven days. Dengvaxia vaccine has been licensed for use in children 9 to 16 years of age with a history of laboratory-confirmed dengue virus infection and living in a dengue-endemic area.[8] The best way to protect against the dengue virus is to avoid

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mosquito bites.[9] Early diagnosis and management of symptoms are essential to reduce the risk of complications and prevent the further spread of the virus.[10]

Dengue fever is endemic in many tropical and sub-tropical regions of the world.[4] Over 50% of the world's population in tropical and subtropical countries is at risk.[11] Approximately 3.6 billion people are currently at risk of dengue infection in more than 100 countries in Asia, America, and Africa.[3] Dengue fever infections in Africa remain largely unknown but recent outbreaks suggest that key areas of the continent may be at increased risk of dengue transmission and an estimated 390 million dengue infections occur worldwide annually.[2]

In Ethiopia, the first dengue cases were detected in the city of Dire Dawa in 2013.[12] Subsequent suspected cases were reported in the Afar Region in 2014 and in the Somali Region from January 2014 to June 2017 in different districts.[13] The Dire Dawa city administration experienced recurrent outbreaks of dengue fever between 2013 and 2017.[14] Between 2013 and 2020, sporadic cases of dengue were reported throughout the country, and this is considered a major public health problem.

On 13th December 2020, Werder town's public health surveillance officer reported the DF outbreak to the Somali Regional Public Health Emergency Management (PHEM) Directorate and Ethiopian Public Health Institute (EPHI). On 16th December 2020, the Ethiopian Public Health Institute sent a team to investigate. Therefore, we investigated the outbreak to describe by time, place, person and to identify risk factors associated with the outbreak in Werder town, Dollo zone, Somali Region, Ethiopia.

Materials and Methods

Study Area

The study was conducted in Werder town, which is located in the Dolo zone, Somali Region (Figure 1). Werder has a latitude and longitude of 6°58′N 45°21′E coordinates: 6°58′N 45°21′E with an elevation of 541 meters above sea level. It is the administrative centre of Werder woreda. Werder town is located 1243 km far from Addis Ababa and 693 km from Jigjiga town capital of the Somali Region. The climate is hot and dry with low rainfall. The town is divided into 4 administrative kebele. It is the administrative centre of the Dolo zone and woreda. According to the health office, the total population of the town is 27,511 people, of which 13,338 (48.48%) are males. The town's health care infrastructure consists of one primary hospital and one health centre. In addition, there are two private drug vendors. According to the Werder town education office, there is an elementary primary school and a high school in the town. Moreover, the majority of the residents are illiterate. Due to the low rainfall in the area, many man-made wells and ponds have been

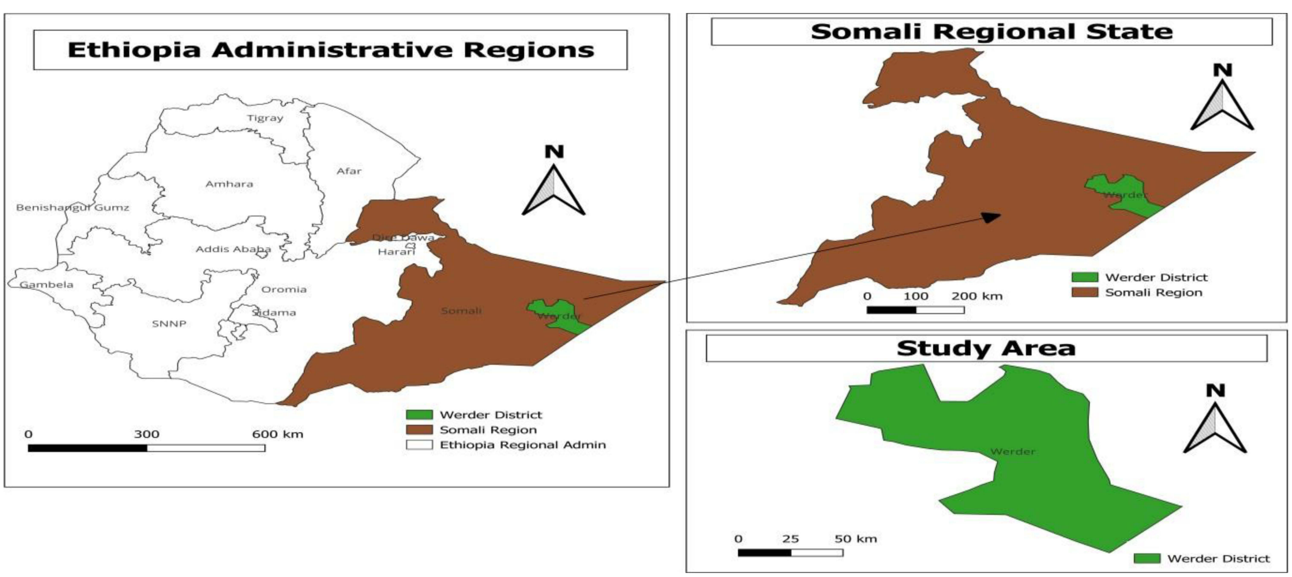

Figure 1 Geographical location of the study area.

built to collect water during the rainy season and to serve as drinking water for people and animals. At present, most man-made wells and ponds contain water, which is suitable for vector breeding and other disease-causing insects. In the town, there is no suitable waste disposal area or sewage system in the area. The area is rich in shrubs.

Sample Size Determination

We calculated the sample size using Epi-info statistical computing software with a power of 80%, odds ratio of 2.776 for no use of LLINs, exposed control percentage of 23.6%,[12] and the case-to-control ratio of 1:2. The total sample size was 171, with 57 cases and 114 controls.

Study Design and Period

We conducted a descriptive analysis followed by an unmatched (1:2) case-control study from December 10, 2020, to January 4, 2021.

Case Definitions

The case definition of the World Health Organization (WHO) was used. Suspected DF; is any person who has developed a sudden fever of more than 38°C for 2 to 10 days with at least two of the following signs and symptoms: headache, retro-orbital pain, myalgia, arthralgia, rash, haemorrhagic manifestations, or leukopenia. Confirmed DF; a suspected case with laboratory confirmation.[8]

Cases and Controls Selection

We obtained a line list of all cases from Werder primary hospital and we used it for the selection of cases. An active case search in the community was performed and all cases that met the case definition were recruited as a case. Controls were selected from the neighborhood of cases in the same community. For each case, two controls were recruited from the same residence of the cases and interviewed after interviewed the cases on the same day as the cases.

Laboratory Investigation

Blood samples were collected from 20 patients who met the case definition and centrifuged at Werder primary hospital before being shipped to the National Reference Laboratory of the Ethiopian Public Health Institute (EPHI). The serum specimens were shipped with their accompanying case investigation forms to the National Reference Laboratory of the Ethiopian Public Health Institute (EPHI). Appropriate implementation of triple packaging of the samples to maintain the cold chain was ensured and each completed case reporting form was also included. The serum was then subjected to ribonucleic acid (RNA) extraction using a QIAGEN RNA extraction mini kit (QIAamp Viral RNA Mini Kit). Amplification was conducted using the invirtrogen super script III platinum one-step qualitative RT-PCR Kit. The total reaction volume was 25ul and composed of 10ul of the RNA extract elute and 15ul of the prepared master mix from the invirtrogen kit (Super Script III). Each sample was tested for dengue viruses using the triplex real-time RT-PCR assay.[15]

The triplex real-time RT-PCR assay was developed for the identification of dengue at a single RT-PCR well by assigning different detection channels and human specimen control at a separate well for each sample. The corresponding thermocycler conditions were adjusted as follows: reverse transcription to cDNA at 45°C for 10 minutes, Taq activation and denaturation at 95°C for 10 min, and amplification at 45 cycles of 95°C for 15 seconds, 55°C for 60 seconds. Specimens were considered positive if exponential curves with logarithmic, linear, and plateau phases were produced. Concurrently, a valid individual human specimen control (extraction control), along with positive and negative controls must have also been present. As per the kit manufacturer's recommendation, amplification curves with cycle threshold values ≥38 from the total reaction cycle of 45 were considered to be positive. All samples identified as dengue virus-positive were then retested for differentiation of the four dengue serotypes. The dengue-positive samples were selected and analyzed for serotype using the fast track diagnostics (FTD) kit strictly following the manufacturer's procedure.[16] The master mix contained mixes of primer and probes of dengue serotype 1–4 within the same tube but designated to different detection channels. Detection channels FAM, JOE, Cy5, and ROX were designated for dengue virus type 1, 2, 3, and 4 respectively. A total reaction volume of 25ul, 15ul master mix, and

10ul of the extracted RNA elute, was utilized. The corresponding thermo cycler conditions were adjusted as follows: reverse transcription to complementary deoxyribonucleic acid (cDNA) at 50°C for 15 min, Taq activation and denaturation at 94°C for 1 min, and amplification at 45 cycles of 94°C for 8 seconds, 60°C for 60 seconds.

Environmental Investigation

The environmental survey was carried out in all four kebeles in Werder town from December 10, 2020, to January 4, 2021. The investigation team observed mosquito breeding sites from house to house, sanitation practices, presence of standing water, water collection habits, drainage systems, and personal protection measures against mosquitoes, as well as the presence of uncovered water containers, screening of windows, and empty containers inside and outside the homes. All identified mosquito breeding sites were examined for the presence of mosquito larvae. The entomologist collected adult mosquitoes from homes to identify the genus and species of mosquito using a standard morphological identification key developed by Rueda, 2004.[17]

Data Collection

The structured questionnaires have been adapted from previous studies[12,18] and used to collect data. The investigators used to collect data on socio-demographic variables, presence of open water container, presence of larvae in the container, having of the long-lasting insecticidal net (LLITN), use of long-lasting insecticidal net (LLITN), types of clothing usually worn, house spraying of the past 6 months and travel histories of cases and controls were collected from the study participants. Trained healthcare workers (PHEM officers and nurses) collected data through face-to-face interviews with the cases and controls using structured questionnaires.

Statistical Analysis

Data from questioners were entered into a Microsoft Excel spreadsheet, edited, and coded. For analysis, Statistical Package for the Social Sciences (SPSS) version 23.0 was used. We performed logistic regressions to compare exposure cases and controls. Each variable with a P-value ≤ 0.25 was kept in the multivariable analysis. A P-value of less than 0.05 at the 95% confidence intervals was considered significant.

Results

Descriptive Analysis

The dengue outbreak started on December 10, 2020. The epidemic curve showed multiple peaks that indicated a propagated outbreak (Figure 2). The first case was a 50-year adult male patient from kebele 03. He presented with headache, high-grade fever, vomiting, and peri-orbital pain and he visited the primary hospital on December 11, 2020. No cases were reported after January 4, 2021.

A total of 92 dengue cases were identified from December 10, 2020, to January 4, 2021. All cases were managed as an outpatient and there were no deaths. The overall attack rate was 334.4 per 100,000. Males were more affected 56 (60.9%) than females. Males had a higher attack rate (419.9 per 100,000) than females (254 per 100,000). Individuals aged 15–44 were the most affected 67 (72.8%) with the highest AR (477.5 per 100,000), followed by individuals aged greater than 44 years (412.1/100,000) (Figure 3). As shown in Figure 4, all 92 cases had a fever (100%). Other signs and symptoms were headache (51.1%), myalgia (20.7%), retro-orbital pain (71.47%), vomiting (26.1%), Arthralgia (5.4%), joint pain (44.6%), nasal bleeding (22.8%). In the town of Werder, four kebeles have been affected by the DF outbreak. The highest cases were reported in kebele 1 34 (36.9%) and followed by kebele 2 23 (25%). The highest AR was reported from kebele 1 (412/100,000) and followed by kebele 2 (364/100,000) (Figure 5).

Laboratory Investigation

Laboratory tests were not available at the outbreak site and it is generally not feasible to send samples to the Ethiopian Public Health Institute for analysis. Due to limited resources, only 20 serum samples were able to be tested at EPHI by RT-PCR. Of the 20 suspected cases, 6 (30%) were seropositive for dengue virus serotype 3.

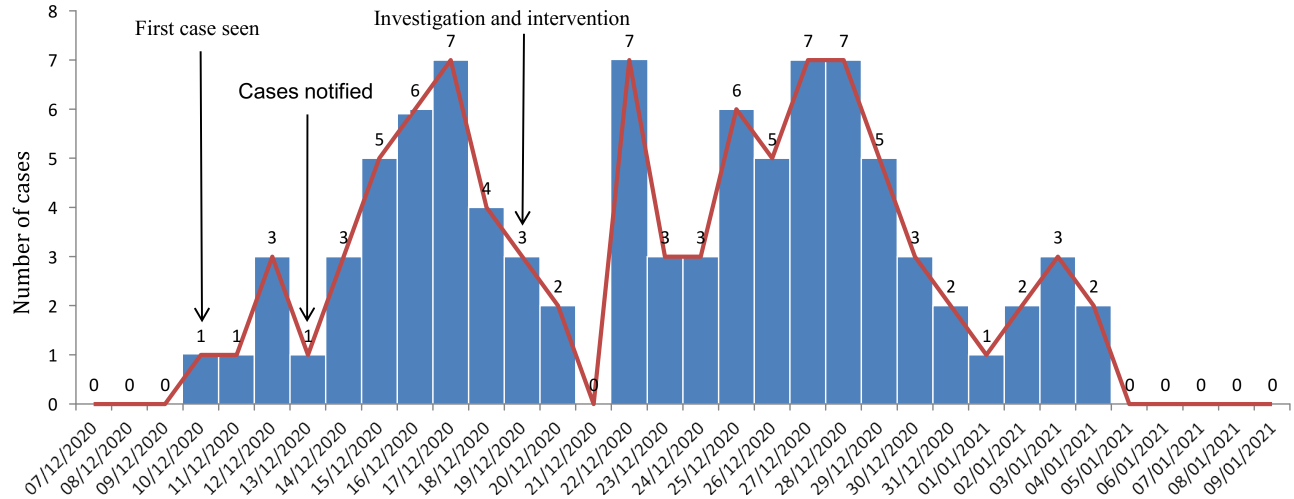

Figure 2 Epidemic curve of Dengue Fever outbreak by date of onset.

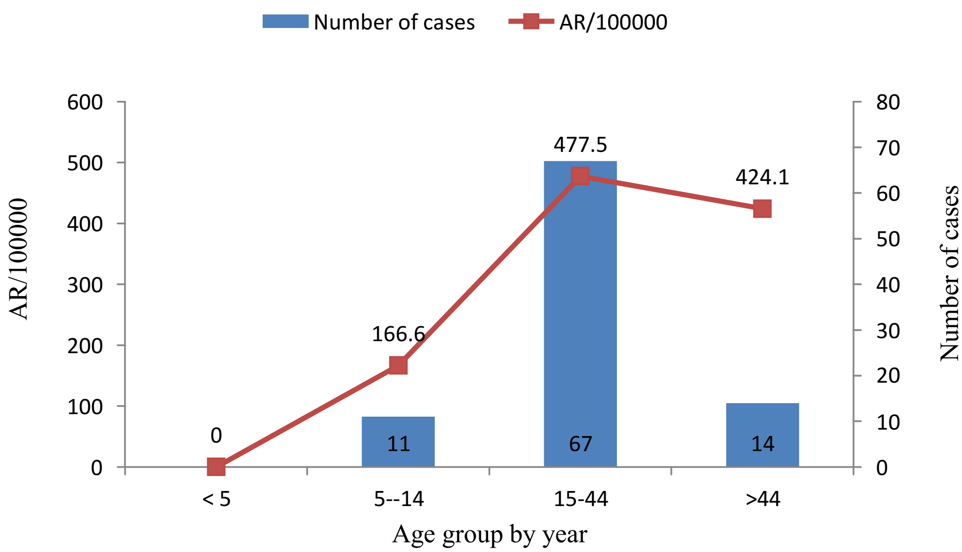

Figure 3 Attack rate and number of Dengue Fever cases by age.

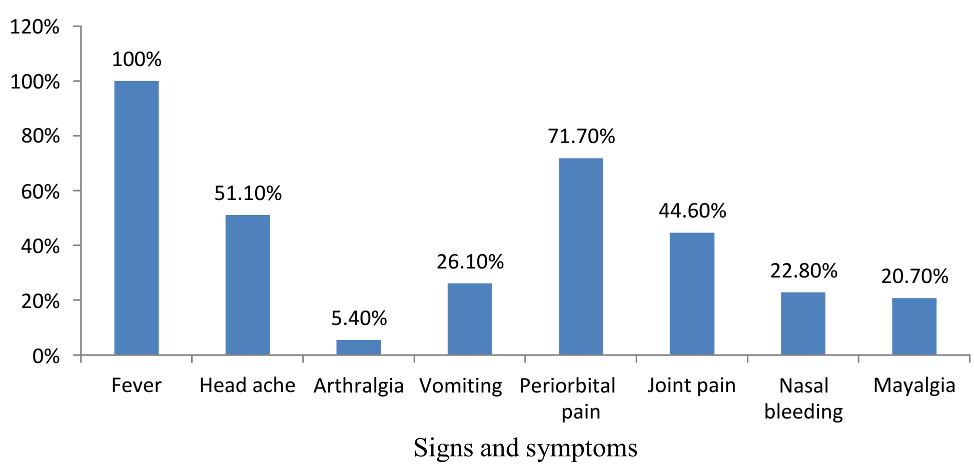

Figure 4 Signs and symptoms of Dengue Fever patients.

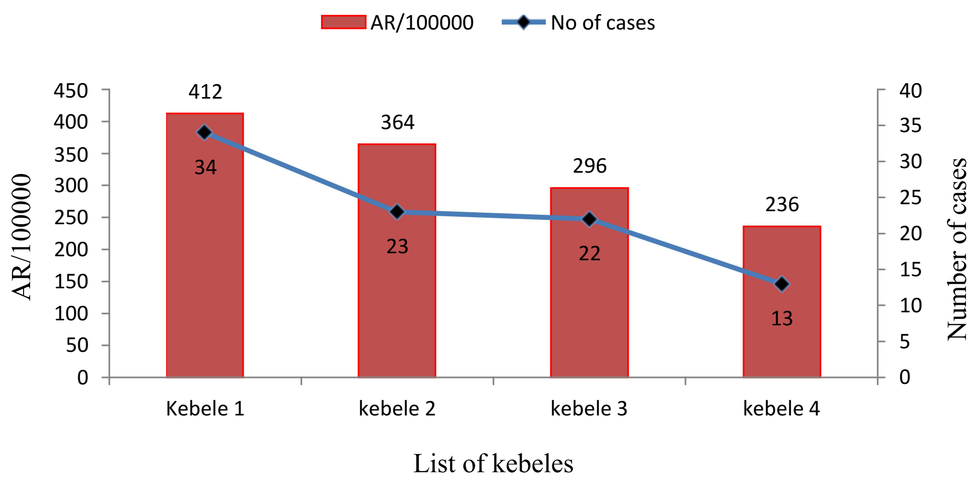

Figure 5 Attack rate and distribution of Dengue Fever cases.

Environmental Investigation

A total of 171 homes were included in the entomological investigation from December 10, 2020, to January 4, 2021. The team examined 219 water containers and the majority (70%) of the cases and control did not have proper waste disposal. Of the 171 homes examined, mosquitoes were found in 25 potential breeding sites or water-holding containers. Several mosquito breeding sites were examined and identified in the study area, such as discarded tires, plastic bottles, Jericans, Birkas, and surrounding man-made stagnant water which were common in the affected communities. Due to the hot weather in the town, most people wear short-sleeved shirts and sleep outside during the day. Aedes *aegypti* and Aedes *africanus* mosquito species were identified in the study area using the standard morphological identification key developed by Rueda, 2004.[15]

Case-Control Study

Socio-Demographic Characteristics

We interviewed a total of 57 cases (median age: 30 years; IQR: 20 years), and 114 controls (median age years: 38; IQR: 17.5 years). Of all respondents, 107 (62.6%) were males (Table 1). Of the total cases, 37 (64.9%) were males and of all the total controls, 70 (61.4%) were males. The mean age of the cases was 31.9 with a standard deviation (SD) of 14.9 years and of the control groups was 40.6 years old with an SD of 13.5 years. Of the total cases, 23 (40.4%), 34 (59.6%)

Table 1 Demographic Characteristics of Dengue Fever Cases and Controls

Variables	Category	Cases N=57	Controls N=114	Total N=171
Sex	Female	20(35.1%)	44(38.6%)	64(37.4%)
	Male	37(64.9%)	70(61.4%)	107(62.6%)
Age Groups	5–14 year	1(1.8%)	2(1.8%)	3(1.8%)
	15–44 year	38(66.7%)	68(59.6%)	106(62%)
	≥45 year	18(31.5%)	44(38.6%)	62(36.2%)
Marital Status	Single	23(40.4%)	44(38.6%)	67(39.2%)
	Married	34(59.6%)	70(61.4%)	104(60.8%)
Occupation	Jobless	35(61.4%)	63(55.3%)	98(57.3%)
	Private business	20(35.1%)	45(39.5%)	65(38%)
	Government employee	2(3.5%)	6(5.3%)	8(4.7%)
Education	Non formal education	30(52.6%)	59(51.7%)	89(52%)
	Formal education	27(47.4%)	55(48.3%)	82(48%)

were singles and married respectively and of the total control, 44 (38.6%), 70 (61.4%) were singles and married respectively. Of the total cases, 35 (61.4%) were unemployed while, of the total control, those employed in the private sector and government employees were 45 (39.5%) and 6 (5.3%) respectively. A total of 30 (53%) cases had no formal education. However, of all the total controls, 55 (48.3%) had formal education (Table 1).

Assessment of Knowledge Status Towards Dengue Fever

A total of 28 (50%) cases had heard of dengue fever, while 79 (69.3%) of the total controls had heard of the DF (Table 2). Nearly, 21 (37%) of the cases and 25 (22%) of the controls had no idea of the cause of dengue fever. On the other hand, 21 (36.8%) of the cases and 65 (57%) of the controls knew the mode of transmission. In addition, 31 (54.4%) cases were unaware of the symptoms of DF, while 55 (48.2%) of the total controls were unaware of the symptoms. Furthermore, 28 (49.1%) of the total cases and 28 (49.1%) of controls did not know when mosquito bites occurred. In addition, respondents were asked about the mosquito's need to use water for breeding and the result showed that 37 (64.9%) of cases and 80 (70.2%) of controls did not know (Table 2).

Assessment of Associated Risk Factors for Dengue Fever

In all cases, only 3 (5.3%) had ever been exposed to dengue fever. Nearly, 17 (30%) of all cases and 67 (59%) of controls used LLINs during sleep (Table 3). Availability and use of LLINs were assessed and found that 24 (42.1%) of the total cases had been used LLINS, while 66 (57.9%) of total controls had accessed to LLINs. Nearly 34 (60%) of respondents from cases and 29 (50.9%) respondents from controls had open water containers in and around their homes. Eight (14%) of cases and 12 (10.5%) of control identified the presence of larvae. In addition, 28 (49.1%) of cases and 49 (43%) of controls were exposed to stagnant water. In addition, 43 (75.4%) of case respondents and 57 (50%) of control respondents had not sprayed at their homes in the past six months. About 34 (59.6%) of the cases had close contact with the same complaint, while 71 (62.3%) of controls had a similar contact. Nearly 2 (4%) of the cases used repellent on the skins, whereas, 3 (2.6%) of the controls used a repellent. Approximately 11 (19%) of cases and 19 (16.7%) of the control groups had travelled history of dengue fever-affected areas. In addition, 34 (59.6%) of cases and 35 (30.7%) of controls were worn short-sleeved clothing (Table 3).

The bivariate analysis showed strong evidence that not hearing of DF (P:0.011), not knowing the cause of DF (P= 0.040), not knowing the mode of transmission (P:0.014), not having of LLINs (P:0.053), not using of LLINs (P:0.000), not spraying house in the past six months (P:0.002) and wearing of long-sleeved cloth (P:0.000) were found to be significant risk factors for DF infections and a variable with $p<0.25$ in bivariate analysis were included in the multivariate logistic regression model (Table 4).

Table 2 Knowledge Towards on Dengue Fever Cases and Controls

Variables	Category	Cases N=57	Controls N=114	Total N=171
Heard about DF	Yes	28(49%)	79(69.3%)	107(62.6%)
	No	29(51%)	35(30.7%)	64(37.4%)
Cause of DF	Yes	36(63.2%)	89(78.1%)	125(73.1%)
	No	21(36.8%)	25(21.9%)	46(26.9%)
Is DF Contagious	Yes	16(20%)	33(28.9%)	49(28.7%)
	No	41(80%)	81(71.1%)	122(71.3%)
Mode of Transmission	Yes	21(36.8%)	65(57%)	86(50.3%)
	No	36(63.2%)	49(43%)	85(49.7%)
Knew symptom of DF	Yes	26(45.6%)	59(51.8%)	85(49.7%)
	No	31(54.4%)	55(48.2%)	86(50.3%)
Time of mosquito bites	Yes	29(50.9%)	58(50.9%)	87(50.9%)
	No	28(49.1%)	56(49.1%)	84(49.1%)
Water required for breeding	Yes	20(35.1%)	34(29.8%)	54(31.6%)
	No	37(64.9%)	80(70.2%)	117(68.4%)

Table 3 Risk Factors Towards Dengue Fever Cases and Controls

Variables	Category	Cases N=57	Controls N=114	Total N=171
Infected previously	Yes	3(5.3%)	6(5.3%)	9(5.3%)
	No	54(94.3%)	108(94.7%)	162(94.7%)
Availability of LLINs	Yes	24(42.1%)	66(57.9%)	90(52.6%)
	No	33(57.9%)	48(42.1%)	81(47.4%)
Utilization of LLINs	Yes	17(29.8%)	67(58.8%)	90(52.6%)
	No	40(70.2%)	47(41.2%)	81(47.4%)
Larvae identified	Yes	8(14%)	12(10.5%)	20(11.7%)
	No	49(86%)	102(89.5%)	151(88.3%)
Available of stagnant water	Yes	28(49.1%)	49(43%)	94(55%)
	No	29(50.9%)	65(57%)	77(45%)
Is the water container open?	Yes	34(59.6%)	58(50.9%)	92(53.8%)
	No	23(40.4%)	56(49.1%)	79(46.2%)
House sprayed in the last six months	Yes	14(24.6%)	57(50%)	71(41.5%)
	No	43(75.4%)	57(50%)	100(58.5%)
Available of river around Village	Yes	13(22.8%)	25(21.9%)	38(22.2%)
	No	44(77.2%)	89(78.1%)	133(77.8%)
Close contact in the last 2 weeks	Yes	34(59.6%)	71(62.3%)	105(61.4%)
	No	23(40.4%)	43(37.7%)	66(38.6%)
Travel history DF affected area	Yes	11(19.3%)	19(16.7%)	30(17.5%)
	No	46(80.7%)	95(83.3%)	141(82.5%)
Utilization of mosquito repellent in the skin	Yes	2(3.5%)	3(2.6%)	5(2.9%)
	No	55(96.5%)	111(97.4%)	166(97.1%)
Type of clothes wear	Short sleeves	34(59.6%)	35(30.7%)	69(40.4%)
	Long Sleeves	23(40.4%)	79(69.3%)	102(59.6%)

Table 4 Bivariate and Multivariate Analysis for factors Associated with Dengue Fever Outbreak

Variables	Category	Bivariate analysis			Multivariate analysis		
		COR	95% CI	P-value	AOR	95% CI	P-value
Heard about DF	Yes						
	No	2.338	1.215–4.497	0.011	2.185	1.015–4.701	0.046*
Cause of DF	Yes						
	No	2.080	1.034–4.171	0.040	2.117	0.936–4.788	0.072
Mode of Transmission	Yes						
	No	2.270	1.183–4.372	0.014	2.906	1.338–6.310	0.007*
Availability of LLINs	Yes						
	No	1.891	0.993–3.600	0.053	0.517	0.190–1.407	0.197
Utilization of LLINs	Yes						
	No	3.354	1.701–6.614	0.000	4.431	1.592–12.330	0.004*
House sprayed insecticide	Yes						
	No	3.071	1.516–6.223	0.002	3.589	1.591–8.098	0.002*
Type of clothes wear	Short sleeves						
	Long Sleeves	0.300	0.155–0.581	0.000	0.435	0.206–0.918	0.029*

Note: *statistically significant variables with p –value <0.05.

In multivariate logistic regression, we found that those who had not heard of DF (AOR: 2.185, 95% CI: 1.015–4.701), did not know mode transmission (AOR: 2.906, 95% CI: 1.338–6.8310), not using LLINs (AOR: 4.431, CI: 1.592–12.330) and not spraying insecticides in their houses (AOR: 3.589, 95% CI: 1.591–8.098) were independent risk factors for DF. Whereas, wearing long-sleeved (AOR: 0.435, 95% CI: 0.206–0.918) was protected against contracting DF (Table 4).

Public Health Actions

In the affected study area, community sensitization, social mobilization, multidisciplinary coordination and collaboration, chemical spraying, and communication were conducted to prevent and control mosquito breeding sites. In addition, communities were encouraged to undertake active case searches and enhance activities to prevent and control mosquito breeding sites such as drainage of water bodies.

Discussion

The current investigation showed that all DF patients in Werder town had 100% fever. This is consistent with the investigation conducted at Dire Dawa city administration, Ethiopia,[14] University of Malaya Medical Centre Kuala Lumpur, Malaysia,[19] and Bihar, Eastern India.[10] The current study indicated that males were more affected than females. This finding is consistent with a study conducted in Bihar, Eastern India,[10] rural areas of Islamabad, Pakistan,[20] a teaching hospital in North India,[21] Phuntsholing, Chukha District,[22] and Zhejiang, China.[7] This observation might be related to outdoor activities and males wearing short-sleeved clothes.

In our study, the overall attack rate was 334.4 per 100,000 which is higher than the studies conducted in the Kabridahar District, Somali Region, Ethiopia,[23] and rural areas of Islamabad, and Pakistan.[24] This difference might be due to the poor implementation of prevention and control strategies in the study area. In our findings, the age-specific attack rate in the 15–44 age groups was 477.5 per 100,000. This attack rate is lower than in a study conducted in Asyaita and Dupti districts, Afar Region.[25] This might be because the age group 15–44 years of residents in the latter study used long sleeves clothing.

Werder town residents' awareness of DF was assessed and as a result, 69.3% of participants had heard of DF, of which 49% were cases. However, in a study conducted in Dire Dawa, only 40% of participants had heard of DF.[12] This difference might be due to the recurrent occurrence of DF in Werder town. Fifty-four percent of cases had no idea of the symptoms of DF, while the rest of the cases had a considerably good awareness of DF symptoms. This result is in contrast with a study conducted in Gujrat, Pakistan.[26] This difference may be due to a lack of dengue awareness campaigns in the study area.

Thirty-five percent of cases had an idea that water was required for mosquitoes to breed. However, the study conducted in Dire Dawa[12] showed that nearly a quarter of the patients knew stagnant water was a favourable breeding site. This difference may be due to people who have been exposed to a previous outbreak of DF. The current study showed that people who have not heard of DF were 2.2 times more likely to be exposed to DF than those who have heard of it. This finding contrast with the study conducted in the Pwani Region of Tanzania.[27]

The present study showed an association between DF and knowledge of the mode of DF transmission; those people who have no knowledge of the mode of DF transmission were 2.9 times more likely to be affected by DF than those who have knowledge of DF transmission. This finding is consistent with the study conducted in Malaysia.[28] The present study showed a significant association between DF and LLIN use, showing that people who have not used LLINS were 4.4 times more likely to be exposed to DF infection than those who use it. Similar findings were reported by other studies conducted in Dire Dawa, Ethiopia,[12] Kabridahar, Somali Region, Ethiopia,[16] and Mombasa, Kenya.[2] This might be due to the unavailability and distribution of mosquito bed nets.

The current study showed that the people who did not spray insecticides in their homes were 3.6 times more likely to be getting DF infection than those who spray insecticides. This finding is, in contrast, to study conducted at the Union Council (UC) Bhara kahu, Islamabad, Pakistan.[29] This may be due to the poor coverage of insecticide spray in the present study area. This study showed wearing long-sleeved was found to be a protective factor against DF infection, with a nearly 56% reduction in infection. This finding agrees with the study conducted in rural areas of Islamabad, Pakistan.[24]

Conclusion and Recommendations

The DF outbreak in Werder Town was confirmed. More cases were reported in males than females. No deaths have been reported. Individuals aged between 15 to 44 years old were more affected by age groups. High cases and AR were reported in Kebele 1. Not hearing about DF, not knowing the mode of transmission, not using Long Lasting Insecticide

Nets, and not spraying insecticide were independent risk factors for the occurrence of dengue fever whereas wearing long-sleeved was an independent protective factor. Therefore, community education and awareness, capacitating regional laboratories, and strengthening the surveillance system should be essential methods to control future outbreaks.

Abbreviations

AOR, Adjusted odd ratio; AR, Attack rate; CI, Confidence interval; COR, Corrected cdd ratio; DF, Dengue fever; LLINs, Long lasting insecticide nets; PCR, Polymerase chain reaction; SD, Standard deviation; WHO, World Health Organization; RNA, Ribonucleic acid; cDNA, complementary deoxyribonucleic acid; RT-PCR, reverse transcription polymerase chain reaction.

Data Sharing Statement

Data is available upon request from the corresponding author.

Ethical Approval and Consent to Participate

Ethical clearance was obtained from the Institution Review Board (IRB) of the Ethiopian Public Health Institute. Official permission was also obtained from Werder town health office, Dollo Zone, Somalia Region. Written informed consent was obtained from the study participants. For those aged, less than 18 years, informed written consent was obtained from respective parents or guardians and it was performed in accordance with the Declaration of Helsinki. The individual results of any investigation remained confidential.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and accountable for all aspects of the work.

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Disclosure

All authors declare that they have no conflicts of interest in this work.

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