Community knowledge, attitude and practices on mosquitoes and mosquito-borne viral diseases in Kinshasa, Democratic Republic of the Congo

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kennedy makola mbanzulu  mbanzulu.kennedy@sacids.org
Universite de Kinshasa
Corresponding Author

Leonard E.G. Mboera
Sokoine University of Agriculture, SACIDS ACE

Roger Wumba
Universite de Kinshasa

Josué K. Zanga
Universite de Kinshasa

Flory K. Luzolo
Universite de Kinshasa

Gerald Misinzo
Sokoine University of Agriculture, Faculty of Veterinary Medicine, SACIDS ACE

Sharadhuli I. Kimera
Sokoine University of Agriculture Faculty of Veterinary Medicine

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Abstract

Background Mosquito-borne viral diseases (MBVD) are among the important human and animal health threats globally. Gaining insights on behaviours and practices of local population on MBVD can improve understanding of socio-demographic and cultural factors to be addressed in intervention packages. This study was carried out to explore community knowledge, attitudes and practices regarding mosquito and MBVD in Kinshasa, the Democratic Republic of the Congo (DRC).

Methods A cross sectional survey involving heads of household was carried out in Kinshasa, DRC, between January and April 2019. Information on socio-demographic characteristics, knowledge, attitudes and practices on mosquito and MBVD was collected through a questionnaire. Data analysis was performed using Epi Info 7 software.

Results A total of 1,464 individuals were involved in the study. Of these, 69% were under 44 years of age, 60.7% were females and the majority (90.2%) were educated. One-third of the houses had insect window screens, 61.2% had open garbage cans, 33.4% had outdoor water storage units, 25.1% had stagnant water collection and 22.5% water containers. The majority (80.3%) of the respondent mentioned polluted water bodies as the main mosquito breeding places. Yellow fever (86.6%) was the most commonly known MBVD. Overall, 12% of the respondents knew that mosquitoes are vectors of these viruses. Majority of respondents (72.5%) felt to be at risk of contracting MBVD. Drainage and blocked draining water channels, dirty, agriculture, house and road construction, animal rearing and automobile garages were associated with mosquito abundance. Health professionals, family member, radio/television and/or school/university were the main source of information. Cleaning environment (58%) and/or use of insecticides (25%) were the main measures implemented in controlling of mosquitoes. Mosquito net ownership (87.4%) and use (67%) were high.
Conclusion Most of the residents of Kinshasa had limited knowledge on the roles of mosquitoes in the transmission of pathogenic viruses in both humans and animals. Raising awareness and educational sessions are essential in empowering the community on the correct attitudes and practices in order to effectively manage the risk posed by MBVD.

Introduction

Mosquitoes transmit different pathogens that affect human and animal health and impact negatively on food security and socio-economic wellbeing [1-4]. In addition to malaria and lymphatic filariasis, mosquitoes are vectors of several viruses. The most important mosquito-borne viral diseases (MBVD) include Yellow fever, Zika, Dengue, Chikungunya, Rift valley fever and West Nile virus [5]. These infections are mostly transmitted by Aedes mosquitoes. Transmission of MBVD to humans and animals includes multifaceted processes; which are influenced by mosquito and viral genetics, environmental, socio-demographic and anthropological factors [6,7].

For effective interventions, in addition to knowledge on biomedical aspects of the diseases, information on socio-anthropological aspects is equally important. It is critical to explore different local socio-cultural and demographic driving factors of MBVD in order to design appropriate interventions. In the current context of increasing insecticide resistance, limited vaccine options and lack of curative resources; integrated approach based on community and individual participation are inescapable for the prevention and control of MBVDs.

There is limited information on community knowledge, attitude and practices (KAP) on mosquito-borne viral diseases in Sub-Saharan Africa, which bears the one of the largest burden of MBVDs [8]. Studies outside Africa have shown that KAP on MBVD varies widely across populations and countries [9-12]. Inadequate knowledge is a significant barrier for appropriately empowering local communities and individual interventions against MBVD.
Lack of or inadequate community knowledge is likely to be an obstacle in adopting of specific prevention and control measures against some specific mosquito species and MBVD [13]. Indeed, mosquito species express different biting behaviour and breeding preferences.

In DRC, climatic and ecological conditions are optimal for almost all major MBVD of public health importance. The country is known to be at high risk of YFV transmission, morbidity and mortality [14]. More than 400 people died during the yellow fever outbreak that occurred between 2016 and 2017 [7,15]. Kinshasa, the capital city, has experienced four chikungunya outbreaks during the past two decades [16–18]. Recently, reports on Dengue occurrence have increased [17, 19–21], presence of Zika virus (ZIKV) has been documented [21] and the overall sero-prevalence of Rift Valley fever virus (RVFV) has increased [22]. To date, Aedes albopictus has been reported in Kinshasa [23]. These threats of MBVD are not only to the local population but also to visitors to DRC. For instance, the majority of Chikungunya virus infections in Belgium between 2007 and 2012 were imported from DRC [24] and recently, a Japanese traveller returning from DRC was diagnosed with DENV [25]. The evidence of West Nile virus (WNV) were documented in Kinshasa among dogs, horses and mosquitoes [26–28]. In the context of inadequate resources for control, there is an immediate need to increase community awareness on MBVD in DRC. This study was therefore carried out to determine community knowledge, attitudes and practices on mosquito and MBVDs in Kinshasa, DRC.

Methodology

2.1. Study area and design

In this cross-section study, a questionnaire survey was conducted in four districts in Kinshasa, the capital city of DRC, between January and April 2019. Kinshasa has 24
communes (municipalities) grouped into four districts and each commune is divided into
neighbourhoods. It has an estimated of 11,855,000 urban population [29]. The head of
household or his representative was systematically selected from neighbourhoods to
guarantee a good coverage of geographical, demographic and socio-economic profiles of
the population.

The questionnaire was developed in English, translated in French and administered by
face-to-face interview in either Lingala or French depending on the language proficiency
of the respondent. The questionnaire contained both closed and opened questions with
possibility for the respondent to provide more than one answer. The questionnaire and
covered information related to socio-demographic characteristics of respondents,;
knowledge about mosquito (breeding places, activities, behavior, vector role, control
measures) and MBV diseases; attitudes and practices towards mosquito and MBVD.

2.3 Data Analysis

The data were entered into Microsoft Excel spreadsheet and statistical analysis was
performed using Epi Info software Version 7 (CDC, Atlanta). Summary of statistics were
presented as frequencies and proportions in Tables or figures.

Results

Socio-demographic and environmental characteristics

A total of 1,464 participants were involved in the study. Of these the majority (60.7%) were females. About 69% of respondents were under 44 years of age and 43.2 % had
university education. Almost half of respondents were married (Table 1). Approximately
half of respondents (47.8%) were home owners and 48.2% of households had at least six
to 10 members. Children under five years were present in 52.7% of the households. Most
participants (94.6%) were living in houses built with cement bricks and metal roofs
(93.6%), but only 36.4% of houses had insect window screens. About 70% of households were supplied with tap water in their home premises. Majority of the houses (61.2%) had opened garbage cans and 38.7% had vegetation in their surroundings. One-third (33.4%) of the houses had storage water units set outdoors, 25.1% had stagnant water collections, 22.5% had potential artificial or natural water container outdoor (tires, flower pot, small can, box, coconut shell, plastic plate). Domestic animals were found in approximately one third of the respondents’ homes (Table 2).

Knowledge

The majority of respondents stated that stagnant and drain polluted water (80.3%) and garbage (35%) were the major mosquito breeding sites. As regards to mosquito biting time, 39% considered mosquitoes to bite during the night, 31% during sundown while 30.5% stated anytime of the day (Table 3). Yellow fever was the most frequently (86.6%) mentioned mosquito-borne viral disease. Others included Chikungunya (13.9%), Zika (7.5%) and Dengue (3.7%). Only a few respondents mentioned that YFV (12.2%), CHIKV (5.4%), ZIKV (1.8%), DENV (1.5%) and RVFV (0.6%) were transmitted by mosquitoes. Almost all respondents (97.2%) identified malaria as a disease that is spread by mosquitoes. A few respondents inappropriately mentioned typhoid fever, HIV/AIDS, Ebola and trypanosomiasis as mosquito-borne diseases (Table 4).

The majority (70.1%) of respondents who knew about any MBVD, stated fever as the most common symptom, followed headache (52.4%), general pain (21.2%) and joints pain (18.7%). Only a few respondents mentioned jaundice (9.9%), back pain, haemorrhage and skin rashes (Figure 1). Regarding knowledge on the role of mosquito in spreading zoonoses, about four fifth of respondents were unaware that mosquito can transmit pathogens to animals or exchange pathogens between animals and animals (Table 4). Out of 348 respondents who were aware about the role of mosquito in zoonosis transmission,
39.0% were not able to mention any zoonosis while about 14% mentioned zoonosis not vectored by mosquito (trypanosomiasis, rabies), 5% stated Ebola and inappropriately 34% answered malaria (Table 4).

Of the 1,464 respondents, the majority mentioned environmental measures such as cleaning and removal of garbage (64.2%), draining of standing water (24.8%) and proper disposal of empty containers (10.1%) as the most effective mosquito control measures. Other measures included use insecticide-treated mosquito nets (41.0%) and spraying of insecticide (22.2%). Covering of the water storage containers (10%), mosquito screen on house window (8.8%) and wearing long clothes (1.7%) were mentioned by only a few respondents (Table 3).

Attitudes and perceptions

Approximately, three quarters (72.5%) of the respondents were aware about impact of mosquitoes on their daily life. Most (60.7%) respondents reported being bitten by mosquitoes outdoor in their home places, fewer at recreational places or work places and half of respondents responded were bitten indoors. In all, 44.6% respondents were regularly bitten and 31.2% reported sometimes. Overall 90% of participants were bitten during the dark (sundown 36%, night 53%); fewer reported mentioned to be bitten during the day (7.0%). When asked about activities associated with mosquito abundance, 21% mentioned drainage and blocked draining water channels, 17.7% dirty, 14% farming activities, 10% house/road construction, 7.7% animal rearing and automobiles garage (Table 5).

Most participants (72.9%) perceived that they were responsible in the prevention and protecting themselves and their household against mosquito and MBVD, but only 37.3% were aware about their responsibility at community level. They perceived that mosquito and MBVD control and prevention to be the responsibility of the health authorities and
national Government (Table 6).

The most familiar sources of information about MBVD were health professional/hospital (40.2%), their relatives or family members (26.1%) and mass media such as radio or television (25.3%); school/university (17.7%). Church, megaphone public announcement, Government announcement, newspapers, internet, telephone short messages were less common source of information of respondents (Table 5).

**Practices regarding vector control**

Slightly above half (58.6 %) of the respondents reported cleaning environment, one quarter use of insecticides, another one quarter reported emptying garbage containers and emptying of flowers pots (11%) as the measures undertaken to reduce mosquito abundance around their homes. The draining of standing water was mentioned by 16.3% of respondents and garbage by 11.3%. Covering of water source, drinking water and/or storage containers was stated by only 10.4% of respondents.

As regards to measures undertaking to reduce or avoid mosquito bites, a large proportion of the respondents (79%) stated the use of mosquito nets when sleeping. Fumigation and spraying of insecticide (15.8%), mosquito screen on windows (13%), use of fan (10%), wearing long clothes (0.3%) and praying God (1%). High proportions of residents (67.7%) confirmed that they did not have any challenge in taking action to prevent or control mosquitoes. Among 474 (32.3%) respondents stated lack of money and other resources (42.9%), limited access to necessary items (19.3%), not having time (19%), don’t believe these preventive measures are effective (12.8%) as the most important challenges faced in mosquito control and prevention. Although 87.4% of the respondents had at least one mosquito net, only 67% confirmed to have slept under a mosquito net during the previous night. The source of the mosquito nets included national mass distribution campaign (68.8%), healthcare facilities (15%) and procurement from shop/market (18.8%). Almost
45% of these mosquito nets had holes (Table 7).

**Discussion**

The present study explored the level of community KAP with regard to mosquitoes and mosquito-borne viral diseases in Kinshasa, DRC. The focus was on Aedes-borne viruses which represent an imminent worldwide threat for human and animal health. Although majority of respondent reported that were frequently been bitten by mosquitoes either outdoors or indoors; most of them stated mosquito activities were more intense from sundown to night. Only a few participants knew about daily activity of mosquitoes. High proportion of study participants felt more concerned by health problems that are brought by mosquitoes. The observation of the residence environment of the respondents allowed taking inventory of the diverse types of man-made and natural containers that are suitable mosquito breeding places. This observation was in contrast with good level of general knowledge about environmental preventive measures noted among the majority of respondents and what they confirmed as their usual practices towards control and prevention of mosquitoes. This confirms that often people don’t understand properly the meaning of the concept of environmental management [13].

Majority of respondents emphasized on environmental cleaning though a high percentage of garbage uncovered cans, vegetation, stagnant water collections and abandoned domestics containers were present in resident’s places. In addition due probably to inadequate water supply in some homes, people have set different water storage units outdoor, being unaware of possible invasion of Aedes mosquitoes [30]. This confirms that the common Aedes breeding habitats are not well known by the majority of the respondents [31]. The most common mosquito breeding places known by the study population was polluted waters bodies. Dirty places were perceived as main drivers leading to mosquitoes abundant. This was in consistency with studies carried out in India
The mechanic automobiles activities which are taking places in the city might contribute also to mosquito abundance. Similar reports from Tanzania have indicated that tires are among the most prolific breeding sites for Aedes mosquitoes [34]. Agriculture and construction of roads and houses were also reported among the activities leading to mosquito abundance in Kinshasa. These observations were in consistency with findings reported from Kenya, Tanzania, Sudan and France and the French Antilles [1,35–37]. Therefore, the prevention messages for MBVD should raise awareness among all of the actors engaged in the design, materials and all humans resources like architects, landscapers, construction professionals, distributors and installers [37].

Nevertheless, majority of respondents in the current study were unaware about vector role of mosquitoes in spreading pathogens to animals and their involvement. Although majority of study participants have heard about an Aedes-transmitted virus, yellow fever and some few on chikungunya, Zika and dengue; the majority of them did not know that these viruses are transmitted to human by mosquitoes. Democratic Republic of the Congo has experienced four chikungunya and four yellow fever outbreaks during the recent 2 decades [16–18,38–41], this could be the reasons that majority of the respondents were aware of the diseases.

The lack of knowledge on the role of mosquito in spreading virus in both humans and animals could explain some contradictory attitudes, behaviours and practices noted among study participants. Similar observations have been reported in Jamaica, where the population had poor knowledge of MBVD and poor prevention practices [42]. Contrary in Belize more than 85% of the respondents confirmed that DENV, ZIKV, CHIKV, and YVFV are viruses transmitted by mosquitoes and that they were regularly draining standing water or use insecticides to control mosquitoes [2]. Similar observation has been reported in
Colombia, USA and China where the majority of the population were positively involved in source reduction preventive practices [12, 43, 44].

The appropriate knowledge of MBVD can empower individual to make some effort to prevent or control MBVD in their properties instead of waiting for government intervention. The poor knowledge about mosquito-borne disease has also been reported for RVF in Kenya, Tanzania, and Sudan [1,35,36]. The lack of knowledge is driving MBVD in new areas and leads to loss of life and economic losses [1,36]. The high level of dirty, multiple fortuitous markets, higher demographic pressure, inadequate urbanization of Kinshasa Metropolitan are suitable conditions to support Culex mosquito, main vector of WNV and RVFV [45–47]. In DRC, currently RVFV activities are increasing [22] and evidence of WNV in domestic dogs and horses have been documented from Kinshasa [27,28].

Regarding the number of household rearing either domestic or livestock animals in this study area, there is also urgent need to raise awareness of population about the role of mosquito in spreading zoonosis.

Participants in current study were less aware about how their involvement as local population can boost controlling mosquito and MBVD in their community. The study participants perceived that they had only the duty for self-protection and for their own household but they not responsible for local community mosquito prevention and control. Similar observations have been reported in a study in Western Australia [48]. These positive attitudes of trusting in government action offer an opportunity for decision-makers and health actors to maximize their educational activities in this community and to get closer to population through its local structures. Even practically, the respondents did not perceive the responsibility of local community and their role as source of information. It is important that the population perceive that control of mosquito-borne diseases does not only have to rely on individual or household protection but also at the
community level. Strengthening co-operation between neighbouring households can also
serve as an information channel to improve the knowledge levels of this study population.
The financial problem was mentioned as main hindrance in taking action against
mosquitoes for the majority of study population. This could be the reason that the majority
of study participants would resort less to struggling measures that incur expenditures.
Once the health risk is perceived as real threat and priority, population can run to transfer
their knowledge into action [13]. But embracing of protective behaviours is a multi-
factorial procedure influenced by socio-economic and cognitive factors [49]. In general,
household expenditure on protective measures using chemical is high [2,3]. So, in low
income region it is better to emphasize on environment measures which are more
accommodated, simple to implement and very effective too. Simple action of removing
garbage and domestic use containers can reduce over 90% of larvae abundance and
putting window screen, closing door can contribute to avoid over 80% of mosquito adults
in homes [13]. Social mobilization and communication programs including modern
channels should be developed with all national, local partners and community leaders. The
integration of awareness-raising activities on the prevention and control of mosquito-
borne diseases should be encouraged in church, school and university programs to
educate the church followers, students and use them as multipliers.

Conclusions
The findings of this study indicate that the population of Kinshasa lives in an environment
conducive for the proliferation of mosquitoes and spread of mosquito-borne diseases.
However, the overall community knowledge regarding MBVD was poor both in terms of
mosquito biology, prevention and control. Therefore, there is an urgent need to introduce
multiple education programs to raise their awareness and improve their knowledge.
Particular emphasis should be placed on environmental sanitation, as it is essential to
encourage this population to invest themselves in the hygiene of their living environment, since it is also within their reach.

Abbreviations

MBVD: Mosquito-borne viral diseases; MBD: Mosquito-borne diseases; YFV: Yellow fever virus; CHIKV: Chikungunya virus; DENV: Dengue virus; ZIKV: Zika virus; RVFV: Rift valley fever virus; WNV: West Nile virus; ONNV: O’nyong’nyong virus

KAP: Knowledge, attitude, and practice.

Declarations

Ethical Approval and consent to participate

The study protocol obtained approval from the Ethical Review Committee of Public Health School of Kinshasa, DRC (No. d’ approbation ESP/ CE/058/2019). The informed consent was obtained from all the respondents prior to survey administration.

Consent for publication

All authors consented for the publication of the manuscript

Additional file

Additional file 1: Survey Questionnaire.

Availability of data and materials

All data generated or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

There are no competing interests.

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Contributions

KMM designed the study, conducted the field works, performed statistical analysis and prepared the manuscript for publication; LM assisted in developing study questionnaire, revised critically the manuscript; RW assisted in developing study questionnaire, study design and participated in writing the manuscript; JZ participated in study design and conducted the field work, FKL participated in field and assisted in writing the manuscript; GM participated in study design and revised the manuscript; SIK participated in designing the study, assisted in developing study questionnaire. All authors read and approved the final version of the manuscript.

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Tables

Table 1: Socio-demographic characteristics of participants in mosquito and mosquito-borne viral diseases in Kinshasa
| Variable                        | No. of respondents | Percent |
|--------------------------------|--------------------|---------|
| Age Group                      |                    |         |
| 18-43 Years                    | 1008               | 68.9    |
| 44-70.Years                    | 456                | 31.1    |
| Sex                            |                    |         |
| Male                           | 575                | 39.3    |
| Female                         | 889                | 60.7    |
| District                       |                    |         |
| Tshangu                        | 509                | 34.8    |
| Mont-Amba                      | 388                | 26.5    |
| Funa                           | 207                | 14.1    |
| Lukungu                        | 360                | 24.6    |
| Marital status                 |                    |         |
| Single                         | 595                | 40.6    |
| Married                        | 727                | 49.7    |
| Divorced/widow                 | 142                | 9.7     |
| Education level                |                    |         |
| No instruction                 | 70                 | 4.8     |
| Primary                        | 73                 | 5.0     |
| Secondary                      | 688                | 47.0    |
| University                     | 633                | 43.2    |
| Occupation                     |                    |         |
| Farmer                         | 36                 | 2.5     |
| Student                        | 254                | 17.6    |
| Medical personnel              | 49                 | 3.3     |
| Housewife                      | 275                | 18.7    |
| Policeman/Soldier              | 24                 | 1.6     |
| Pastor/ Priest/Teacher         | 84                 | 5.7     |
| Businessman                    | 100                | 6.8     |
| Officer                        | 34                 | 2.3     |
| Car driver/garage hand/technician | 111               | 7.5     |
| Unemployed                     | 213                | 14.5    |
| Trader( Seller)                | 148                | 10.1    |
| Other                          | 119                | 9.3     |
| Religion                       |                    |         |
| Christian                      | 1234               | 84.3    |
| Traditional                    | 52                 | 3.6     |
| Muslim                         | 24                 | 1.6     |
| None                           | 48                 | 3.3     |
| Other                          | 106                | 7.2     |

Table 2: Household and immediate environment characteristics of participants residences in in Kinshasa
| Variable                                      | No. of respondents | Percent |
|-----------------------------------------------|--------------------|---------|
| Household size                                |                    |         |
| ≤ 5                                           | 632                | 43.1    |
| 6-10                                          | 706                | 48.2    |
| >10                                           | 126                | 8.6     |
| Presence of Child under 5 years old           | 772                | 52.7    |
| Home Ownership                                |                    |         |
| Tenant                                        | 764                | 52.2    |
| Owner                                         | 700                | 47.8    |
| Source of water supply                        |                    |         |
| Tap water on the home premise                 | 1024               | 69.9    |
| Tap water away from home premise              | 382                | 26.0    |
| Well on the home premise                      | 17                 | 1.2     |
| Well away from home premise                   | 49                 | 3.3     |
| Types of house                                |                    |         |
| Cement brick                                  | 1385               | 94.6    |
| Sheet metal                                    | 53                 | 3.6     |
| Straw, Clay, Timber (wood)                    | 26                 | 1.8     |
| Types of house roof                           |                    |         |
| Sheet metal                                    | 1370               | 93.6    |
| Straw                                         | 94                 | 6.4     |
| Presence of net (insect screens) on windows   | 533                | 36.4    |
| Immediate surrounding house description       |                    |         |
| Vegetation                                    | 567                | 38.7    |
| Stagnant water collection                     | 368                | 25.1    |
| Storage water unit set outdoor                | 490                | 33.4    |
| Any potential artificial or natural water container outdoor | 330 | 22.5 |
| An opened garbage can                         | 897                | 61.2    |
| Animals keeping (rearing)                     | 459                | 31.3    |
Table 3. Knowledge related to mosquito biology, vector role and preventives measures
| Variable                                           | No. of respondents | Percent |
|----------------------------------------------------|--------------------|---------|
| Breeding places for mosquitoes                     | 1178               | 80.3    |
| Drain and stagnated polluted water                 | 526                | 35.9    |
| Garbage                                            | 137                | 9.3     |
| Unsafe waste disposal compost pit                  | 141                | 9.6     |
| Pits, drainage open underground soakage pits       | 66                 | 4.5     |
| Clean water collection Water supply safe           | 148                | 10.1    |
| Ditches, Ponds                                     | 80                 | 5.4     |
| Water storage tanks                                 | 24                 | 1.6     |
| Small container                                    | 26                 | 1.7     |
| Storage and other water storage jars               | 72                 | 4.9     |
| Vehicle tires                                      | 35                 | 2.3     |
| Coconut shells and broken utensils                 | 63                 | 4.3     |
| Cracks in walls, Tree hole                        | 62                 | 4.2     |
| I don’t know                                       | 28                 | 1.9     |
| Times of the day mosquito can bite                 |                    |         |
| Daily (morning, afternoon)                         | 63                 | 4.3     |
| Sundown                                            | 454                | 31.0    |
| Night                                              | 571                | 39.0    |
| Anytime                                            | 447                | 30.5    |
| I don’t know                                       | 36                 | 2.4     |
| Season of the year mosquito are most frequent      |                    |         |
| Rain season                                        | 704                | 48.0    |
| Dry season                                         | 354                | 24.1    |
| Both season                                        | 350                | 23.9    |
| I don’t know                                       | 56                 | 3.8     |
| Can mosquitoes transmit disease to animals?        |                    |         |
| Yes                                                | 288                | 19.7    |
| No                                                 | 1134               | 77.4    |
| I don’t know                                       | 42                 | 2.9     |
| Can mosquitoes spread disease between animals and humans |                |         |
| Yes                                                | 348                | 23.7    |
| No                                                 | 1090               | 74.5    |
| I don’t know or don’t believe                      | 26                 | 1.8     |
| Preventive measures                                |                    |         |
| Hold the environment clean, remove garbage or any uncovered container | 1090 | 74.4 |
| Use Mosquito bed net                               | 601                | 41.0    |
| Keep cover over the water source/storage unit container | 151             | 10.3    |
| Remove standing water/stagnant water               | 363                | 24.8    |
| Spray insecticide                                  | 326                | 22.2    |
| Fumigation                                         | 102                | 6.2     |
| Use repellent                                      | 50                 | 3.4     |
| Use fan                                            | 67                 | 4.5     |
| Put mosquito screen (net) on house window          | 130                | 8.8     |
| Wearing long clothes                               | 25                 | 1.7     |
| I don’t know                                       | 33                 | 2.2     |
| Other (gasoline oil, detergent, ...)                | 22                 | 1.8     |

Table 4: Awareness on Knowledge of MBDV diseases and vector role of mosquito in their spreading to human and animals
Disease can be transmitted by mosquito (N=1464)  Have being aware Prior to survey any MBVD (N=1464)  MBD that can be transmitted between human and animals (N=348)

| Disease          | n (%) | n (%) | n (%) |
|------------------|-------|-------|-------|
| Malaria          | 1423(97.2) | 119(34.2) | |
| Yellow fever     | 179(12.2)  | 1269(86.6) | 9(2.5)  |
| Chikungunya      | 79(5.4)    | 204(13.9) | 3(0.8)  |
| Zika             | 27(1.8)    | 111(7.5)  | 0.4     |
| Dengue           | 22(1.5)    | 55(3.7)   |         |
| Rift valley fever| 9(0.6)     | 26(1.7)   | 3(0.8)  |
| West nile fever  |         | 11(0.7)   |         |
| O’nyong O’nyong  | 2(0.1)     | 8(0.5)    | 3(0.8)  |
| Arbovirus        | 14(0.9)    |         |         |
| Filariasis       | 1(0.07)    |         | 3(0.8)  |
| Trypanosomiasis  | 17(1.2)    |         | 29(8.3) |
| Typhoid fever    | 69(4.7)    |         | 11(3.1) |
| Ebola            | 28(1.9)    |         | 20(5.7) |
| HIV              | 17(1.1)    |         | 3(0.8)  |
| Rabies           |         |         | 16(4.6) |
| Others           | 49(3.4)    |         | 8(2.2)  |
| I don’t know     | 22(1.5)    |         | 136(39.0) |

Table 5: Attitudes related to mosquito and mosquito-borne viral diseases
| Variable                                                                 | No. of respondents | Percent |
|-------------------------------------------------------------------------|--------------------|---------|
| Main Source of the information                                          |                    |         |
| Health professional/hospital                                            | 529                | 40.2    |
| Family                                                                  | 344                | 26.1    |
| Radio/Television                                                         | 333                | 25.3    |
| School, college, university                                             | 233                | 17.7    |
| Neighbours                                                              | 117                | 8.9     |
| Community leaders and volunteers                                        | 100                | 7.6     |
| Megaphone public or Government announcement                             | 74                 | 5.0     |
| Internet, Newspapers, SMS                                              | 74                 | 5.0     |
| Church/Mosque                                                           | 15                 | 1.2     |
| Other (traditional healer, )                                            | 25                 | 1.9     |
| Impact of mosquitoes on daily life                                      |                    |         |
| Health risk                                                             | 1061               | 72.5    |
| Nuisance                                                                | 380                | 25.9    |
| No concern                                                              | 7                  | 0.4     |
| I don’t know                                                            | 30                 | 2.0     |
| Other (disease, malaria, death)                                         | 103                | 7.0     |
| In which locations are you often bitten?                               |                    |         |
| Indoor                                                                  | 741                | 50.6    |
| Outdoor while I am at home                                              | 890                | 60.7    |
| At work place indoor                                                    | 14                 | 0.9     |
| Outdoor while at work place, Recreational place                         | 119                | 8.1     |
| Everywhere                                                              | 62                 | 4.2     |
| No                                                                      | 24                 | 1.6     |
| How often do you get bitten?                                            |                    |         |
| Rarely                                                                  | 343                | 23.4    |
| Sometimes                                                               | 468                | 31.9    |
| Regularly                                                               | 653                | 44.6    |
| During which times of the day are often bitten?                         |                    |         |
| Daily time (morning, afternoon)                                         | 102                | 7.0     |
| Sundown                                                                | 528                | 36.0    |
| Night                                                                   | 778                | 53.8    |
| Any time                                                                | 177                | 12.0    |
| Activity in your community leading to mosquito abundance                |                    |         |
| Agriculture                                                             | 206                | 14.0    |
| Animal rearing                                                          | 113                | 7.7     |
| House building, Road construction                                       | 157                | 11.6    |
| Drainage and all blocked draining water channels                        | 310                | 21.1    |
| Dirty                                                                   | 260                | 17.7    |
| Mechanic or automobile garage                                           | 12                 | 0.8     |
| Church services/Prayers                                                 | 14                 | 0.9     |
| Witchcraft/sorcery                                                     | 14                 | 0.9     |
| Absence sewage water draining system                                    | 29                 | 1.9     |
| Erosion, flooding, Proximity to the river                               | 15                 | 1.1     |
| Market, High population density                                         | 5                  | 0.3     |
| None                                                                    | 279                | 19.0    |
| I don’t know                                                            | 223                | 15.2    |

Table 6/. Awareness about responsibility in the control and prevention of mosquitoes and mosquito-borne diseases
|                          | Self protection and household | Community   |
|--------------------------|-------------------------------|-------------|
|                          | n (%)                         | n(%)        |
| Individual responsibility| 1068(72.9)                    | 546(37.3)   |
| Household head           | 128(8.7)                      | 114(7.7)    |
| Family members           | 40(2.7)                       | 7(0.5)      |
| Local Community population| 17(1.2)                      | 62(4.2)     |
| Health authorities       | 223(15.2)                     | 326(22.2)   |
| Local government administration| 24(1.6)                  | 50(3.4)     |
| National government      | 173(11.8)                     | 245(11.8)   |
| Both government and population| 18(1.2)                    | 153(10.4)   |
| God                      | 8(0.5)                        | 2(0.1)      |
| None one                 | 18(1.2)                       |             |
| I don’t know             | 84                            | 5.7         |

Table 7: Practices related to mosquito and mosquito-borne diseases
| Measures undertaking to reduce mosquito abundance in property | No. of respondents | Percent |
|---------------------------------------------------------------|-------------------|---------|
| Put cover over the water source/drinking water/ storage unit/container | 153 | 10.4 |
| Empty flower pots/vases regularly | 160 | 10.9 |
| Cleaning environment | 858 | 58.6 |
| Emptying other water containers served by garbage collection | 363 | 24.8 |
| fumigating | 95 | 6.5 |
| Removing garbage | 166 | 11.3 |
| Use of insecticides | 380 | 25.9 |
| Remove standing /stagnant water | 239 | 16.3 |
| Nothing | 42 | 2.9 |
| Use bed net | 166 | 11.3 |
| Close the house door | 68 | 4.6 |
| Measures undertaking to reduce or to avoid mosquito bites | | |
| Put mosquito screen on house windows | 197 | 13.4 |
| Sleep under bed net during day | 138 | 9.4 |
| Sleep under bed net during night | 1158 | 79.1 |
| Use of mosquito repellent during day | 19 | 1.3 |
| Use of mosquito repellent during night | 44 | 3.0 |
| Stay indoors | 34 | 2.3 |
| Use of fans | 153 | 10.4 |
| fumigating and spraying my home | 232 | 15.8 |
| Pray God | 15 | 1.0 |
| Nothing | 48 | 3.2 |
| Wear long clothes | 5 | 0.3 |
| Other | 48 | 3.2 |
| Household having at least a mosquito bed net | 1280 | 87.4 |
| Slept under mosquito bed net last night | 982 | 67.0 |
| Source of mosquito bed net supply | | |
| Mass distribution campaign | 873 | 68.8 |
| Shop/Market | 239 | 18.8 |
| Health facilities | 191 | 15.0 |
| Other | 26 | 2.0 |
| Mosquito bed net with hole on it | 538 | 43.4 |
| Any challenges in implementing preventive measures | | |
| Yes | 474 | 32.3 |
| No | 990 | 67.7 |
| Types of challenges | | |
| Have no time to apply these preventive measures | 72 | 15 |
| Lack of money and resources | 204 | 42.9 |
| Limited access to necessary items | 92 | 19.3 |
| Not priority for me | 34 | 7.1 |
| I don’t believe these preventive measures are effective | 61 | 12.8 |
| Risk is less | 15 | 2.9 |
| Other | 13 | 2.7 |

**Figures**
Figure 1: Number of respondents on the knowledge of symptoms of Mosquito-borne viral diseases

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