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

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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 (Table1). 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 fewer 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 [32,33].

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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References

1. Abdi IH, Affognon HD, Wanjoya AK, Onyango-Ouma W, Sang R. Knowledge, Attitudes and Practices (KAP) on Rift Valley Fever among Pastoralist Communities of Ijara District, North Eastern Kenya. PLoS Negl Trop Dis. 2015; 9 (11):e0004239
2. Duman-Scheel M, Eggleson KK, Achee NL, Grieco JP, Hapairai LK. Mosquito control practices and perceptions: An analysis of economic stakeholders during the Zika epidemic in Belize, Central America. PLoS One 2018; 13(7)
3. Thuilliez J, Bellia C, Dehecq J-S, Reilhes O. Household-level expenditure on protective measures against mosquitoes on the island of La Réunion, France. PLoS Negl Trop Dis. 2014; 8(1):e2609
4. Whiteman A, Mejia A, Hernandez I, Loaiza JR. Socioeconomic and demographic predictors of resident knowledge, attitude, and practice regarding arthropod-borne viruses in Panama. BMC Public Health.2018; 18:1261
5. Statistics for Mosquito-Borne Diseases & Deaths. http://www.mosquitoreviews.com/mosquito-statistics [Accessed on 10 August 2019]
6. Asebe Gulich G. Epidemiology, Driving Factors, Transmission and Control Options of Zika Virus: A Review.J Infect Dis Ther 2016; 04(02)
7. Kraemer MUG, Faria NR, Reiner RC, Golding N, Nikolay B, Stasse S, et al. Spread of yellow fever virus outbreak in Angola and the Democratic Republic of the Congo 2015–16: a modelling study. Lancet Infect Dis. 2017; 17(3):330–8
8. Braack L., Gouveia de Almeida AP, Cornel AJ., Swanepoel R & De Jager C. Mosquito-borne arboviruses of African origin: review of key viruses and vectors. Parasites & Vectors 2018; 11: 29

9. Corrin T, Waddell L, Greig J, Young I, Hierlihy C, Mascarenhas M. Risk perceptions, attitudes, and knowledge of chikungunya among the public and health professionals: a systematic review. Trop Med Health. 2017; 45:21
10. Mouchtouri VA, Papagiannis D, Katsioulis A, Rachiotis G, Dafopoulos K, Hadjichristodoulou C. Knowledge, Attitudes, and Practices about the Prevention of Mosquito Bites and Zika Virus Disease in Pregnant Women in Greece. Int J Environ Res Public Health 2017; 14(4)
11. Potter A, Jardine A, Neville PJ. A Survey of Knowledge, Attitudes, and Practices in Relation to Mosquitoes and Mosquito-Borne Disease in Western Australia. Front Public Health 2016; 4:32
12. Liu X, Wan F, Cirendunzhu null, Cirenwangla null, Bai L, Pengcuociren null, et al. Community knowledge and experience of mosquitoes and personal prevention and control practices in Lhasa, Tibet. Int J Environ Res Public Health. 2014; 11(9):9919–37
13. Leslie TE, Carson M, van Coeverden E, De Klein K, Braks M, Krumeich A. An analysis of community perceptions of mosquito-borne disease control and prevention in Sint Eustatius, Caribbean Netherlands. Glob Health Action 2017; 10: 1350394
14. Africa WHORO for. Mapping the risk and distribution of epidemics in the WHO African Region: a technical report. W H O. Regional Office for Africa; 2016. https://apps.who.int/iris/handle/10665/206560[Accessed on 10 August 2019]
15. Otshudiema JO, Ndakala NG, Mawanda E-TK, Tshapenda GP, Kimfuta JM, Nsibu L-RN, et al. Yellow Fever Outbreak - Kongo Central Province, Democratic Republic of the Congo, August 2016.MMWR Morb Mortal Wkly Rep. 2017;66(12):335–8
16. Muyembe-Tamfum JJ, Peyrefitte CN, Yogolelo R, Mathina Basisya E, Koyange D, Pukuta E, et al. Epidemic of Chikungunya virus in 1999 and 200 in the Democratic Republic of the Congo. Med Trop Rev Corps Sante Colon. 2003;63(6):637–8
17. Ido E, Ahuka S, Karhemere S, Shibata K, Kameoka M, Muyembe JJ.Dengue virus infection during an outbreak of chikungunya virus in Democratic Republic of Congo Annales africaines de médecine. 2017. Available on: https://anafrimed.net
18. Mintela C. Epidémie de Chikungunya confirmée à Kinshasa; https://www.academia.edu/38387381 [Accessed on 9 August 2019]
19. Malekani MJ, Mccollum AM, Monroe B, Malekani V, Mulumba M, Nguete B. Karhemere SR.Cas de dengue chez les patients suspects de Chikungunya à Kinshasa. Annales africaines de médecine. 2014. https://anafrimed.net [Accessed on 10 August 2019]
20. Makiala-Mandanda S, Ahuka-Mundeke S, Abbate JL, Pukuta-Simbu E, Nsio-Mbeta J, Berthet N, et al. Identification of Dengue and Chikungunya Cases Among Suspected Cases of Yellow Fever in the Democratic Republic of the Congo. Vector Borne Zoonotic Dis Larchmt N. 2018; 18(7):364–70
21. Willcox AC, Collins MH, Jadi R, Keeler C, Parr JB, Mumba D, et al. Seroepidemiology of Dengue, Zika, and Yellow Fever Viruses among Children in the Democratic Republic of the Congo. Am J Trop Med Hyg. Sept 2018; 99(3):756–63

22. Georges TM, Justin M, Victor M, Marie KJ, Mark R, Léopold MMK. Seroprevalence and Virus Activity of Rift Valley Fever in Cattle in Eastern Region of Democratic Republic of the Congo. J Vet Med. 2018; 8:4956378
23. Bobanga T, Moyo M, Vulu F, Irish SR. First Report of Aedes albopictus (Diptera: Culicidae) in the Democratic Republic of Congo. Afr Entomol. 2018; 26(1):234–6
24. VAN DEN Bossche D, Cnops L, Meersman K, Domingo C, VAN Gompel A, VAN Esbroeck M. Chikungunya virus and West Nile virus infections imported into Belgium, 2007–2012. Epidemiol Infect. 2015; 143(10):2227–36
25. Yamamoto SP, Yu Kasamatsu Y, Kanbayashi D, Kaida A, Michinori Shirano M et al.,Dengue Virus in Traveler Returning to Japan from the Democratic Republic of the Congo, 2015. JJID. 2019, 2018.554.Available on: https://www.jstage.jst.go.jp/article
26. Mbanzulu KM, Wumba R, Mukendi JK, Zanga JK,Shija F, Bobanga TL et al.Mosquito-borne viruses circulating in Kinshasa, Democratic Republic of the Congo Int. J. Infect. Dis. 2017; 57: 32–37. 31
27. Cabre O, Grandadam M, Marié J-L, Gravier P, Prangé A, Santinelli Y, et al. West Nile Virus in horses, sub-Saharan Africa. Emerg Infect Dis. 2006; 12(12):1958–60
28. Davoust B, Leparc-Goffart I, Demoncheaux J-P, Tine R, Diarra M, Trombini G, et al. Serologic surveillance for West Nile virus in dogs, Africa. Emerg Infect Dis. 2014; 20(8):1415–7
29. Wikipedia Kinshasa Population. https://en.wikipedia.org/w/index.php [Accessed 10 August 2019]
30. Baak-Baak CM, Arana-Guardia R, Cigarroa-Toledo N, Puc-Tinal M, Coba-Tún C, Rivero-Osorno V, et al. Urban Mosquito Fauna in Mérida City, México: Immatures Collected from Containers and Storm-water Drains/Catch Basins. Southwest Entomol. 2014; 39(2): 291–306
31. Medone P, Hernï Ndez-Suï Rez CM. «Swimming mosquitoes»: a key stepping stone to prevent Dengue, Zika and Chikungunya: an educative experience in Colima, Mexico. Health Educ Res. 2019; 34(4):389–99
32. Boratne AV, Jayanthi V, Datta SS, Singh Z, Senthilvel V, Joice YS. Predictors of knowledge of selected mosquito-borne diseases among adults of selected peri-urban areas of Puducherry. 2010 J Vector Borne Dis.47(4): 249–256
33. Tenglikar PV, Hussain M, Nigudgi S, Ghooli S. Knowledge and Practices Regarding Mosquito borne disease among people of an urban area in Kalaburgi, Karnataka. Ntl J Community Med 2016; 7(3):3
34. Mboera, LEG, Mweya, CN, Rumisha SF, Tungu PK, Stanley G, Makange MR, Misinzo G, et al.The risk of Dengue virus transmission in Dar es Salaam, Tanzania during an epidemic period of 2014. PLoS Negl Trop Dis 10(1): e004313. doi: 10.137 1/journal.pntd.0004313
35. Shabani SS, Ezekiel MJ, Mohamed M, Moshiro CS. Knowledge, attitudes and practices on Rift Valley fever among agro pastoral communities in Kongwa and Kilombero districts, Tanzania. BMC Infect Dis. 2015; 15:363
36. Hassan OA, Affognon H, Rocklöv J, Mburu P, Sang R, Ahlm C, et al. The One Health approach to identify knowledge, attitudes and practices that affect community involvement in the control of Rift Valley fever outbreaks. PLoS Negl Trop Dis 2017; 11(2)

37. Claeys C, Robles C, Bertaudiere-Montes V, Deschamps-Cottin M, Megnifo HT, Pelagie-Moutenda R, et al. Facteurs socio-écologiques contribuant à l'exposition des populations humaines aux piqûres des moustiques vecteurs de la dengue, du chikungunya et du zika : une comparaison entre France métropolitaine et Antilles françaises. Environ Risques Santé. 2016; 15(4):318–25
38. WHO | Yellow fever in the Democratic Republic of the Congo WHO. https://www.who.int/csr/don/2010_07_19a [Accessed on 9th August 2019]
39. WHO | Yellow fever in the Democratic Republic of Congo. WHO. https://www.who.int/csr/don/2013_06_14.[Accessed on 9th August 2019]
40. WHO | Yellow fever in the Democratic Republic of Congo. WHO. [Accessed on 9th August 2019]. Available on: https://www.who.int/csr/don/2014_04_24
41. WHO | Yellow Fever—Democratic Republic of the Congo. WHO. [Accessed on 9th August 2019]. Available on: http://www.who.int/csr/don/11-april–2016
42. Alobuia WM, Missikpode C, Aung M, Jolly PE. Knowledge, Attitude, and Practices Regarding Vector-borne Diseases in Western Jamaica. Ann Glob Health. 2015;81(5):654–63
43. Ramírez GIJ, Álvarez LSB. Knowledge, Attitudes and Practices Regarding Dengue, Chikungunya, and Zika and their Vector Aedes Aegypti in Villavicencio, Colombia.The Open Public Health Journal, 2017, 10, 80–89
44. Morse W, Izenour K, McKenzie B, Lessard S, Zohdy S. Perceptions and practices of mosquito-borne diseases in Alabama: is concern where it should be? BMC Public Health 2019; 19: 987
45. Karch S, Asidi N, Manzambi Z, Sa-Laun J. Culicidianfauna and its nuisance in Kinshasa (Zaire).Bulletin de la Société de la Pathologie Exotique. 1993; 86: 68–75
46. Herrington JE.Pre-West Nile virus outbreak: perceptions and practices to prevent mosquito bites and viral encephalitis in the United States. Vector Borne Zoonotic Dis. 2003; Winter; 3(4):157–73
47. Mweya CN, Kimera SI, John Bukombe JK, Mboera LEG (2013). Predicting distribution of Aedes aegypti and Culex pipiens complex, potential vectors of Rift Valley fever virus in relation to disease epidemics in East Africa.Infection Ecology and Epidemiology 3: 21748
48. Mainali S, Lamichhane RS, Clark K, Beatty S, Fatouros M, Neville P, et al. "Looking over the Backyard Fence": Householders and Mosquito Control. Int J Environ Res Public Health. 2017; 14: 246
49. Fritzell C, Raude J, Adde A, Dusfour I, Quenel P, Flamand C. Knowledge, Attitude and Practices of Vector-Borne Disease Prevention during the Emergence of a New Arbovirus: Implications for the Control of Chikungunya Virus in French Guiana. PLoS Negl Trop Dis. 2016; 10(11):e0005081

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
Lukunga	360	24.6
Marital status		
Single	595	40.6
Maried	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		
Drain and stagnated polluted water	1178	80.3
Garbage	526	35.9
Unsafe waste disposal compost pit	137	9.3
Pits, drainage open underground soakage pits	141	9.6
Clean water collection Water supply safe	66	4.5
Ditches, Ponds	148	10.1
Water storage tanks	80	5.4
Small container	26	1.7
Storage and other water storage jars	24	1.6
Vehicle tires	72	4.9
Coconut shells and broken utensils	35	2.3
Cracks in walls, Tree hole	63	4.3
I don’t know	62	4.2
Other	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 mosquito(N=1464)	Have being aware Prior to survey any MBVD(N=1464)	MBD that can be transmitted between human and animals (N=348)
	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		96(6.6)
God	8(0.5)	2(0.1)
None one	18(1.2)	153(10.4)
I don’t know	84	5.7

Table 7: Practices related to mosquito and mosquito-borne diseases

Variable	No. of respondents	Percent
Measures undertaking to reduce mosquito abundance in property		
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	68	4.6
Close the house door	6	0.4
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

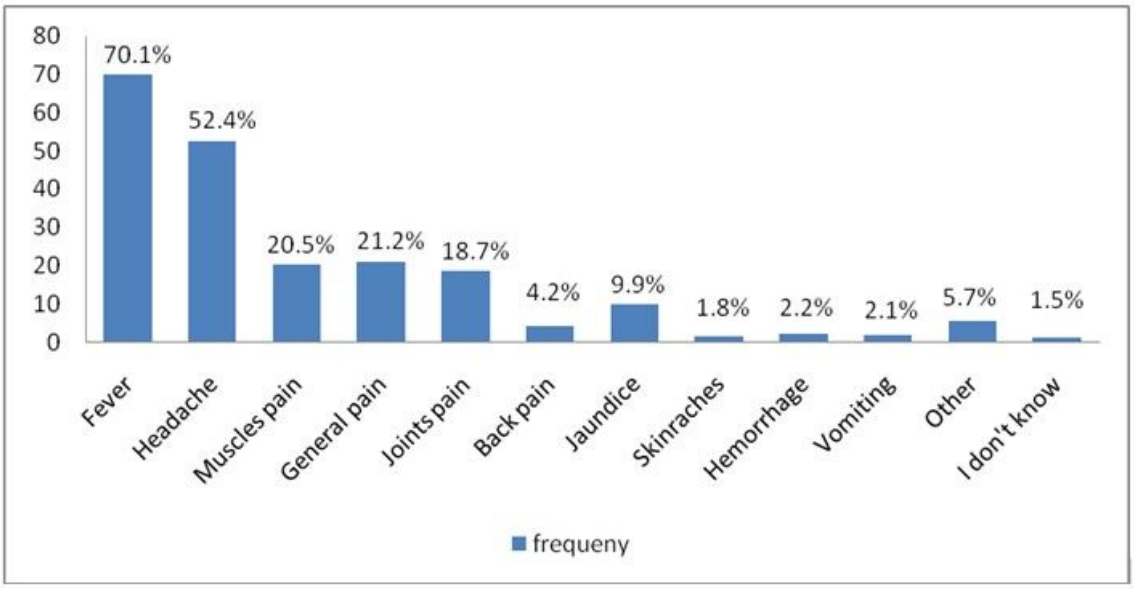

Figure 1: Number of respondents on the knowledge of symptoms of Mosquito-borne viral diseases

Figure 1

Number of respondents on the knowledge of symptoms of Mosquito-borne viral diseases

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