Original Article

Outreach Vector Control Worker's Knowledge, Attitude and Practices Towards Mosquito Control and Associated Diseases

***Shafia Saba[1], Unsar Naeem-Ullah[1], Shafqat Saeed[1], Ishtiaq A. Rajwana[2], Alamgir Akhtar Khan[3]**

[1]Institute of Plant Protection, Faculty of Agriculture and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture Multan, Pakistan
[2]Department of Horticulture, Faculty of Agriculture and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture Multan, Pakistan
[3]Department of Agriculture Engineering, Faculty of Agriculture and Environmental Sciences, Muhammad Nawaz Shareef University of Agriculture Multan, Pakistan

***Corresponding author:** Dr Shafia Saba, E-mail: sabashafia@yahoo.com

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Abstract

Background: Mosquito Control Programs are articulated to control Mosquito Borne Diseases and success of such programs depends on the activities of field workers, and their adherence to the standard operating procedures (SOP's) is governed by their knowledge, attitudes, and practices (KAP). Present study was intended to assess the KAP of mosquito control workers of Pakistan to get an exact depiction of prevailing situation.

Methods: A cross-sectional descriptive study was conducted in March-April 2020. Questionnaire containing 30 closed and open-ended questions were administrated to participants. Knowledge and practices were evaluated using a scoring system i.e., by giving 1 point to each correct answer while attitude questions were analyzed individually and expressed in percentage for each response.

Results: Total 639 workers were interviewed, mean age was 29.8 (SD ±7.87) years, majority (65.1%) was in age group of 18–30 years. Mean knowledge score was 6.96±1.28 (range 0–9) with 77.36% correct answers (P= 0.073). Mean practices score was 7.00±1.62 (range 2–9) with 77.83% appropriate answers (P< 0.001). Both knowledge and practices scores were higher for permanent employees, practices score increased with increase in job experience. Very weak positive correlation (r= 0.127) was observed between knowledge and practice scores.

Conclusion: Appropriate practice correlates with better knowledge and positive attitude towards control activities. Hence, training on protection and protective measures for having a positive attitude among healthcare workers is necessary against the fight with mosquitoes.

Keywords: Culicidae; Mosquito control; Vector borne diseases (VBDs); Health knowledge; Health personnel

Introduction

Mosquitoes are tiny flies that bite animal hosts to get blood as nutrient source and develop their eggs. They transmit a wide range of pathogens such as viruses and parasites to the host's body through their blood meal, consequently, disseminate several mosquito-borne diseases (MBDs) like malaria, dengue, Zika, yellow fever and chikungunya in animals and humans. Since last many years, the epidemics of MBDs have been observed as regular phenomenon hitting living societies over the globe which puts a significant burden on world health systems. Vector borne diseases (VBDs) including MBDs, account for 17% of the infectious diseases and cause a death toll of 700,000 annually (1) throughout the world. Such an alarming trend of infectious diseases including MBDs in terms of deaths and lodging to new areas has

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caused it to be registered among the top ten high risk issues in the Global Risks Reports 2015 (2). In Pakistan, malaria and dengue are currently two major MBDs, however chikungunya, Zika, yellow fever and Japanese encephalitis are also emerging mosquito borne threats (3).

Among all the known arboviruses, dengue infections are known to be the deadliest because of high mortality rate around the world. As per World Health Organization statistics, one-third of the world is affected by the same (1). Among continents, Asia remains at the top in terms of disease burden. South and South-East Asia, the warmer and humid regions, are reported for high incidence of dengue with increased mortality rates annually (4). In South Asia, the countries badly affected by the infection are Bangladesh, Pakistan, India, and Sri Lanka. Dengue fever can be counted as the most rapidly establishing arboviral infection in Pakistan since 2005 (3) as continuous outbreaks occurred from 2010 to 2019 in different parts of the country (5–7). The disease possessing complex epidemiology is continuously expending to new areas and many factors including climatic changes, health care policies and vector preferences are responsible for this pattern of disease spread.

Similarly, malaria being another fatal MBD has been reported to cause more than 445,000 mortalities almost every year and the children are more exposed to the disease (8). Pakistan pulls 95% of the regional malaria burden (Grouped with Afghanistan, Somalia, Sudan, and Yemen) and report about 300,000 confirmed cases every year (9).

Mosquito control programs (MCPs) are being devised and implemented to control and overcome the menace of MBDs in almost all countries of the world. The main objective of these programs is to suppress mosquito populations which not only serve as disease vectors but also cause nuisance among people. Success of these programs depends on better planning and control strategies along with implementation of these strategies and Standard Operating Procedures (SOP's) in field conditions (10). The anthropogenic control of mosquito populations is often carried out at a local administrative scale, and it is applied based on the relevant agency's experimental knowledge rather than systematic analysis of spatial and temporal data (11). Field workers serve as the backbone of all these activities. The triumph of such programs principally depends upon the strong Knowledge, Attitude and Practices (KAP) of associated communities (12, 13) including field workers.

Efforts in these programs are conventionally based on the protocols and the SOPs devised by the funding or governing agencies. The protocols are usually established after a series of research and field trials and are assumed to be effective for a longer period (14). On the contrary mosquito being a living entity is continuously changing its biology, habitat characterization and requirements in different stages of their lives (15). In Pakistan some of the principal challenges for sustainable management of vector borne diseases (VBDs) include skilled and stirred human resource along with well executed surveillance system (3). These aspects make it obligatory to update and assess the knowledge of control workers regarding biological and non-biological features of mosquito (14).

The current study was planned to provide an insight into the fact that whether the workers are genuinely involved in proper and necessary practices or there is need of some updated knowledge and protocols. The expected outcome is the evidence-based information which will bridge the gaps and short comings. This will ultimately pave the way to a restored prevention and control strategy of these disease vectors. And can be used as a milestone for policy makers. It is also worth mentioning here that this study is one of its kind and not carried out in the study area before.

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Published Online: June 30, 2023

Materials and Methods

Site description and target population

The survey took place in Multan District of Punjab Pakistan. Multan is the 7th largest city of Pakistan and is considered the center and main transport hub of the country with a population of 4.75 million (16). Mosquito borne epidemics (malaria, dengue and so on) have started being reported from last decade and got severe in past few years. After the countrywide dengue epidemic of 2011, specific program for vector borne disease control was initiated at government level under health department. This initiative aimed to directly control the mosquito population to prevent MBDs, through dedicated trained personnel (3). The mosquito control workers (MCWs) involved in surveillance and prevention/control activities are designated as Sanitary Patrol (SP) and Lady Sanitary Patrol (LSP). These MCWs belong to different educational and social backgrounds with varied job experiences.

Study design and Information collected

A cross-sectional questionnaire based KAP study was conducted in March–April 2020 among the professional mosquito control workers (SP, LSP) of Health Department of district Multan. These personnel move door to door and conduct vector surveillance/prevention/ control activities. All the 639 MCWs involved in mosquito control activities in Multan district were interviewed and included in the study. All of them agreed to be part of the study and participated voluntarily through informed written consents (MNS-UAM/EIBR/22/40). Confidentiality of the participants was maintained, and the data was de-identified by assigning an ID number to each participant in data base. Structured questionnaire covering several aspects of mosquito biology, mosquito borne diseases and control strategies was designed and translated into national language (Urdu). The questionnaire comprised of four sections containing information regarding the socio-demographics, knowledge, attitude and practices on mosquitoes, their associated diseases and control. A pre-run trial of questionnaire (n= 20) was conducted among a group of volunteers before actual data collection.

KAP survey content

The questionnaire comprised of two sections, first section contained respondent's demographics including age, gender, qualification, job experience and job category. Second section comprised of 30 questions (Knowledge= 09, Attitude= 12, Practices= 09). Knowledge about identification of common mosquitoes (larvae and adult), breeding places, biting habits, awareness of diseases associated with different species and breeding seasons was evaluated. Some questions were included to assess the KAP of respondents towards reasons of MBDs and strategies to control these vectors and diseases, perceptions of mosquito control responsibility (personal and governmental), insights into different factors associated with spread and control of mosquitoes and MBDs. Given the recent outbreaks of dengue fever in Pakistan questions were added to target the attitude of respondents about reasons for epidemics and the governing factors.

Statistical analysis

The data was collected by authors and a team of trained volunteers. Respondents were thoroughly briefed about the structure of questionnaire and the purpose of study before data collection. The data collected was shifted on Excel 2016 and then transferred to the SPSS (version 22.0) for further analysis. Descriptive statistics were used to describe mean, standard deviation (SD), frequency and percentages for all study variables. One-way ANOVA and Chi-square test were applied for continuous and categorical variables respectively to determine significant differences between the groups. A $P< 0.05$ was considered as indicator of statistical significance. Knowledge and practices were evaluated using a scoring system, each correct

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and appropriate response was given "1" point while "0" for incorrect/unknown response, total points for both sections were aggregated separately and higher scores were associated with good knowledge and practices. Attitude questions were analyzed individually.

Results

Socio-demographic characteristics

Total 639 MCWs with 322 (50.4%) males and 317 (49.6%) females were included in the study. The mean age of participants was 29.8 (SD ±7.87) years, the majority (65.1%) was in the age group of 18–30 years and no one was above 50 years. Forty percent of the participants (n= 255) had a secondary school level of education followed by 27.8% (n= 178) of middle standard, only 2.5% (n= 16) had a master's degree. Detailed demographics are given in Table 1.

Knowledge scores

Correct responses for knowledge and practices are mentioned in Table 2. The mean knowledge score was 6.96±1.28 (range 0–9) with 77.36% correct answer rate. Mean knowledge score for male and female participants was 6.87±1.32 and 7.05±1.22 respectively, with no statistical significance (P= 0.073). Majority of the respondents (65.1%) was in the age group of 18–30 years and had mean knowledge score of 6.9±1.23 while the second group (31–50 years) had 7.01±1.28, it was found that there was no statistically significant difference in the participants' knowledge score and their age groups (P= 0.460). For education the mean knowledge score was highest for bachelor's level (7.31±0.93) followed by intermediate group (7.21±1.18) and there was found a significant difference among the knowledge score and education level of the respondents (P= 0.003). Considering the job type (permanent and non-permanent), no statistically significant difference was observed among the two groups (P= 0.316). None of the participants had working years more than ten and mean knowledge score was highest (7.02± 1.17) for the group with work experience of 2–5 years. There was no correlation (P= 0.067) between the working years and knowledge score (Table 3).

Practices scores

Mean Practices score was 7.00±1.62 (range 2–9) with 77.83% appropriate answers. The mean practices score for males and females were 7.661±1.44 and 6.39±1.56 respectively with significant statistical difference (P< 0.001). Highest mean practices score was noted in the age group of 18–30 years i.e., 7.08±1.57, which was 6.85±1.69 for the group 31-50 years of age. No statistically significant difference was found among the two age groups for practices score (p= 0.090). Comparing the means of different educational groups for practices score highest mean was recorded for intermediate (7.10±1.49) followed by matric (7.03± 1.59) and master's group (7.00±1.54), lowest mean practices score was scored by bachelor's group (6.77±1.44). There was no statistical significance among different educational groups for practices score (P= 0.752).

The group having permanent job type had greater means score (6.77±1.44) as compared to non-permanent group with statistically significant difference among two groups (P=< 0.001). Working years also had a statistically significant difference among different groups (P=< 0.001) with highest mean score of 7.56± 1.54 for 5–10 years. It was observed that the mean score increased with increase in working years (Table 3). Considering the correlation between knowledge and practice scores weak positive correlation was observed (r= 0.127, P= 0.001) (Table 4).

Attitude towards mosquitoes, their control, and associated diseases

Perception about Culicidae behavior and disease transmission

Discussing how mosquito can cause harm to human 42% (n= 268) of the MCWs claimed

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that mosquito harm human by biting only, 30 % (193) of them believed that it harms by disease transmission, all the options (biting, disease transmission, nuisance) were cited by 24 % (151) of respondents. Three percent (20) of respondents said that it doesn't cause any harm to human, while only 1% (7) claimed it to be a source of nuisance.

Inquiring about site of mosquito bite on human body maximum participants (61%) stated that mosquitoes bite equally on hands, feet and joints of hand and feet followed by 23% participants who claimed that mosquito prefer to bite only on joints of hand and feet (Fig. 1).

Participants were asked to choose which human age group is most susceptible to mosquito bites. Surprisingly, a large portion (82%) claimed that all the age groups are equally vulnerable to be bitten by mosquitoes, 13% said that children are most susceptible and 4% claimed that they don't know.

Seasonal abundance of mosquitoes and MBDs

Accounting the seasonal abundance of mosquitoes, majority of MCWs (56.0%) stated that mosquitoes are most abundant in rainy season followed by summer season (21.8%). Only two percent said that mosquitoes are plentiful in winter season, while 13.3% said that mosquitoes are equally present in all seasons and 6.9 % said that they don't know about it. Statistically significant difference was observed among male and female participant's opinion (p= 0.035). Inquiring about the abundance of MBDs similar trend was observed *i.e.*, maximum workers (51.8%) believed that MBDs are most abundant in rainy season followed by summer season (22.5%). Minimum workers (3.9%) picked winter season while 13.8% ascertained that MBDs, are equally prevalent in all seasons, 8 % said that they don't know about the seasonal abundance of MBDs (Table 4).

Prevention and control measures

When queried about the most effective preventive measure against mosquitoes, different options were discussed. A reasonable portion of the respondents (22.4%) felt that bed nets are the real agents to prevent mosquitoes trailed by the supporters of repellents (6.4%) and Mosquito Coils/mats (1.6%). It is pertinent to mention that a momentous proportion of the MCWs (61.7%) believed that all the measures listed in the questionnaire (bed nets, repellents, Mosquito Coils/mats) are equally efficient to prevent mosquitoes with a statistically significant difference (P= 0.001) among the males and females (Table 4).

Different strategies to control MBDs were argued among the participants and a substantial proportion (66.7%) stated that all the control measures should be simultaneously applied by the government and the public. Hygienic conditions were focused by 22.2% of the respondents followed by public awareness (5.9%) and mosquito control (5.2%). No statistically significant difference (P= 0.052) was found among the point of views of males and females regarding prevention strategies of MBDs (Table 4).

In terms of the preferred sites for the control measures of mosquitoes, MCWs (28.0%) believed that chemical control at the breeding sites of mosquitoes can be effective, followed by 14.7% who claimed that anti-mosquito chemical spray should be carried out in houses. But more than half participants (52.7%) stated that control measures should be carried out on all the possible places/spots to control mosquito populations. These opinions varied significantly among the participants (P=< 0.001). Similarly, the most efficient nonchemical methods for mosquito control were debated and it was concluded that cleaning of water collections to prevent mosquito breeding could serve as the best control strategy (65.6%). Chemical control was supported by 17.4% of respondents trailed by 3.9 % who claimed that removal of garbage should be carried out. A reasonable portion of workers (13.1%) suggested that all three methods should be adopted to suppress mosquito populations. Significant difference (P< 0.001) was seen between the attitudes of males and females towards different control methods (Table 4).

http://jad.tums.ac.ir
Published Online: June 30, 2023

Reasons for disease out-break and spread of mosquitoes

In terms of attitude towards the possible reasons of dengue outbreak in the country very diverse opinions were obtained. A lot of reasons were enlisted including heavy rains (27.9 %), lack of public awareness (22.7%), and poor control strategies (11.1%). A combination of all these factors was reported by the maximum participants (33%). Both heavy rains and lack of public awareness were reported by 3.8% of test population. The statistical difference was significant between males and females (P< 0.001).

Participants were asked to rate their perception of the roles of vegetation and sewerage drains/ filth depot for spreading mosquito populations on a scale from "no" to "very little", "little", "high" and "very high". For the role of vegetation maximum people (37.1%) stated that it has a very high level of role in spreading of mosquitoes followed by 34.6% whose opinion was high level of role. Only 8.3% stated that vegetation has no role in spreading mosquitoes. Similarly taking into consideration the role of sewerage drains or filth depot in spreading of mosquitoes was scored and 55.1% participants claimed that it has a very high role followed by 28.0% with high level of role. 5.2% thought that it has no part in spreading of mosquitoes (Fig. 2).

Table 1. Demographic Characteristics of the respondents (n= 639), Multan District of Punjab Pakistan, 2020

Variable	Category	No. of Respondents	Proportion (%)
Gender	Male	322	50.4
	Female	317	49.6
Age (Years)	18–30	416	65.1
	31–50	223	34.9
	Middle	178	27.8
Education	Secondary School	255	40
	Intermediate	123	19.2
	Bachelor	67	10.5
	Masters	16	2.5
Job Category	Permanent	2	0.3
	Contract	161	25.2
	Daily wages	476	74.5
Experience	< 2	54	8.5
(Years)	2–5	455	71.2
	5–10	130	20.3
	> 10	0	0

Table 2. Correct responses on knowledge and practices about mosquitoes, their control, and associated diseases (n= 639), Multan District of Punjab Pakistan, 2020

Knowledge Questions		Correct response
1.	**Can you identify different mosquito species?**	621 (97.2%)
2.	**Where do mosquitoes lay eggs?**	557 (87.2%)
3.	**Can you identify mosquito larvae?**	620 (97.0%)
4.	**From following mosquitoes, which are daytime biters?**	155 (24.3%)
5.	**Which diseases are caused by *Culex* mosquitoes?**	467 (73.1%)
6.	**Which diseases are caused by *Aedes* mosquitoes?**	557 (87.2%)
7.	**Which diseases are caused by *Anopheles* mosquitoes?**	427 (66.8%)
8.	**What is spreading method of dengue fever?**	482 (75.4%)
9.	**Do you know about recent 2019 D.F. outbreak in Pakistan?**	563 (88.1%)
Practices Questions		

http://jad.tums.ac.ir
Published Online: June 30, 2023

Table 2. Continued ...

10. Do you adopt personal protective measures during survey/ collection/ removal of mosquito larva/ adult?	578 (90.5%)
11. Do you adopt personal protective measures during IRS/ Fogging?	639 (100%)
12. Do you use any mosquito repellent during field work?	405 (63.4%)
13. Which insecticide is used for mosquito larval control?	346 (54.1%)
14. Which insecticides are used to control adult mosquitoes?	480 (75.1%)
15. What is the capacity of the provided spray pump?	492 (77.0%)
16. What is the standard pressure of the provided spray pump?	548 (85.8%)
17. What is the capacity of the provided fogging machine?	458 (71.7%)
18. Which stage of mosquito is vulnerable to fogging?	530 (82.9%)

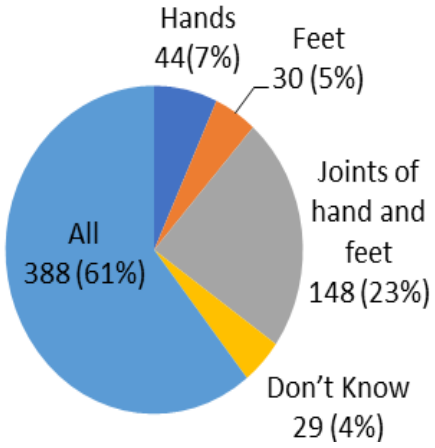

Fig. 1. Preferred sites for mosquito bite on human body described by respondents in Multan District of Punjab, Pakistan, 2020

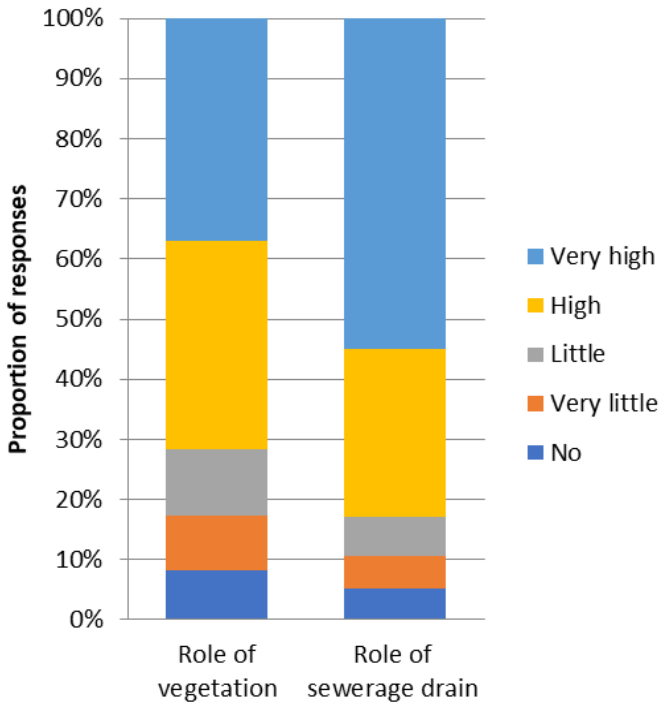

Fig. 2. Participant's perception about role of vegetation (forests and crops) and sewerage drain/filth depot in spreading of mosquitoes (n= 639), Multan District of Punjab Pakistan, 2020

http://jad.tums.ac.ir
Published Online: June 30, 2023

Table 3. Knowledge and practices about mosquito species, their control, and associated diseases by demographic variables (n= 639), Multan District of Punjab Pakistan, 2020

Characteristics	Category	N (%)	Knowledge score		Practices Score	
			(Mean ± SD) (0–9)	P value	(Mean ± SD) (2–9)	P value
Gender	Male	322 (50.4)	6.87±1.32	0.073[a]	7.661±1.44	<0.001[a]
	Female	317 (49.6)	7.05±1.22		6.39±1.56	
Age (Years)	18–30	416 (65.1)	6.9±1.23	0.460[b]	7.08±1.57	0.090[b]
	31–50	223 (34.9)	7.01±1.28		6.85±1.69	
	> 50	0 (0)				
Education	Middle	178 (27.8)	6.75±1.40	0.003[b]	6.98±1.80	0.752[b]
	Matric	255 (40)	6.89±1.23		7.03±1.59	
	Intermediate	123 (19.2)	7.21±1.18		7.10±1.49	
	Bachelor	67 (10.5)	7.31±0.93		6.77±1.44	
	Masters	16 (2.5)	6.88±1.97		7.00±1.54	
Job Category	Permanent	163 (25.5)	7.04±1.37	0.316[b]	7.45±1.52	<0.001[b]
	Non-Permanent	476(74.5)	6.93±1.25		6.85±1.62	
Years Working	< 2	54 (8.5)	6.60±1.71	0.067[b]	6.42±1.40	<0.001[b]
	2–5	455 (71.2)	7.02±1.17		6.91±1.62	
	5–10	130 (20.3)	6.93±1.40		7.56±1.54	
	> 10	0	0			

a- Independent t-test
b- one way ANOVA test
*P< 0.05 are considered significant

Table 4. Respondents attitude towards different features of mosquito control, biology, and Mosquito Borne Diseases (MBDs), Multan District of Punjab Pakistan, 2020

	Status	Male (%) N= 317	Female (%) N= 322	Total (%) N= 639	P-value
Mosquito abundant seasons	Summer	70 (22.1)	69 (21.4)	139 (21.8)	0.035
	Winter	8 (2.5)	5 (1.6)	13 (2.0)	
	Rainy	181 (57.1)	177 (55.0)	358 (56.0)	
	Don't know	12 (3.8)	32 (9.9)	44 (6.9)	
	All	46 (14.5)	39 (12.1)	85 (13.3)	
Mosquito borne diseases abundant seasons	Summer	73 (23.0)	71 (22.4)	144 (22.53)	0.037
	Winter	9 (2.84)	16 (4.96)	25 (3.91)	
	Rainy	178 (56.2)	153 (47.5)	331 (51.8)	
	Don't know	17 (5.4)	34 (10.6)	51 (8.0)	
	All	40 (12.6)	48 (14.9)	88 (13.8)	
Most suitable preventive measures against mosquitoes	Chemicals	14 (4.4)	31 (9.6)	45 (7.0)	0.001
	Bed nets	86 (27.1)	57 (39.9)	143 (22.4)	
	Repellents	25 (7.9)	16 (5.0)	41 (6.4)	
	Fan	5 (1.6)	1 (0.3)	6 (0.9)	
	Mos. Coils / mats	3 (0.9)	7 (2.2)	10 (1.6)	
	All	184 (58.0)	210 (65.2)	394 (61.7)	
Most effective control measures to control mosquito borne diseases	Mosquito control	13 (4.1)	20 (6.2)	33 (5.2)	0.052
	Public awareness	14 (4.4)	24 (7.5)	38 (5.9)	
	Hygienic conditions	82 (25.9)	60 (18.6)	142 (22.2)	
	All	208 (65.6)	218 (67.7)	426 (66.7)	

http://jad.tums.ac.ir
Published Online: June 30, 2023

Table 4. Continued ...

Where are the control measures most effective in controlling mosquitoes	Outdoor	16 (5.0)	13 (4.0)	29 (4.5)	<0.001
	Spray in houses	65 (20.5)	29 (9.0)	94 (14.7)	
	Spray on breeding sites	86 (27.1)	93 (28.9)	179 (28.0)	
	All	150 (47.3)	187 (58.1)	337 (52.7)	
Reasons for dengue outbreaks	Heavy Rains	73 (23)	105 (32.6)	178 (27.9)	0.001
	Poor control strategies	41 (12.9)	30 (9.3)	71 (11.1)	
	Public awareness	85 (26.8)	60 (18.6)	145 (22.7)	
	All	108 (34.1)	103 (32)	211 (33)	
	Heavy Rains+ Poor control strategies	3 (0.9)	2 (0.6)	5 (0.8)	
	Heavy Rains+ Public awareness	4 (1.3)	20 (6.2)	24 (3.8)	
	Poor control strategies+ Public awareness	3 (0.9)	2 (0.6)	5 (0.8)	
Most efficient method to control mosquito populations	Cleaning of water collections	220 (34.4)	199 (31.1)	419 (65.6)	0.001
	Removal of garbage	18 (5.7)	7 (2.2)	25 (3.9)	
	Chemical control	52 (16.4)	59 (18.3)	111 (17.4)	
	All	27 (8.5)	57 (17.7)	84 (13.1)	

Discussions

Mosquitoes from three main genera (*Aedes*, *Anopheles* and *Culex*) are considered of public health concern. All these entities have diverse life histories and ecologies, ultimately complicating the strategies of their control. These strategies include control tactics (chemical, mechanical, physical, and biological) or mosquito avoidance practices. *Culex* mosquitoes are considered the main source of nuisance in Pakistan and breed in all type of natural or man-made water bodies including sewerage or stagnant water. *Anopheles* are associated with malaria and tend to breed in rural swamps. *Aedes* (causal agent of dengue and many other diseases) prefers to breed in man-made containers, such as air coolers, tires, water tanks and flowerpots (17). Additionally, *Anopheles* and *Culex* are crepuscular such as they tend to feed at dawn and dusk while *Aedes* is diurnal and bites in daytime. These varied ecologies demand an assembled and coordinated approach to reduce mosquito populations including awareness and implementation of perfect strategies.

This cross-sectional study was conducted to assess the KAP (knowledge, Attitude and Practices) among MCWs towards the biology, prevention and control of mosquitoes and mosquito borne diseases (MBDs). It was clearly depicted that the participants (n= 639) which were professional mosquito control workers inducted in provincial epidemic control program, had a strong knowledge about mosquitoes and the related diseases. Almost all of them (97.2%) can easily identify common mosquito genera by their physical appearance and the same volume (97.0%) can identify and differentiate *Aedes*, *Anopheles* and *Culex* larvae with its siphon tube which is a general method of identification in field conditions.

It is worth mentioning here that *Aedes* and *Anopheles* are the vectors of noticeable diseases. The main objective is to control their population through different practices, one of which is detection and identification of larvae in potential breeding sites, mechanical removal of breeding site followed by chemical control activities. For all these activities, proper identification of the mosquito larvae, understanding of its ecology and breeding habitats and knowledge of MBDs is essential (18). In the current study participants were aware of the breeding places and disease spread of different mosquito species but didn't know about their biting times. The overall mean knowledge and

http://jad.tums.ac.ir
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practices scores were 6.96±1.28 and 7.00± 1.62 with 77.36% and 77.83% correct answers respectively. Knowledge score for females was slightly higher than males with no statistical significance (P= 0.073) while the practices scores was higher for males with statistically significant difference (P=< 0.001), the reason may be that males are more involved in physical and practical activities like indoor residual spray and fogging than females. It indicates that all the participants had equal level of knowledge regardless of their gender and age groups (P= 0.460), the practices score varied among male and female participants (P=< 0.001) but different age groups didn't affect the practices scores (P= 0.090).

The knowledge score varied significantly among different education levels (P= 0.003) with bachelor level having highest score. It shows that the higher the education level, the higher the knowledge scores (19), but these education levels had no association with practices score (P= 0.752), which point to proper professional training. The refresher trainings are conducted by the department on regular basis and ensure proper dissemination of latest knowledge among all the participants regardless of their age or education. In current study a positive effect of the trainings has been observed.

Permanent staff had slightly higher knowledge scores than non-permanent which specifies an element of job security and concern towards the duty by permanent staff, but no significant difference was observed (P= 0.316). The practices score varied significantly among the two job categories (P=< 0.001) with permanent group having higher scores the reason again may be concern and seriousness towards job being senior and permanent employees. While non-permanent may have feeling of being rejected or dismissed. Working years had no effect on knowledge score (P= 0.067) but practices score varied significantly for different experiences (p=< 0.001) with more experience more practices score.

It is worth mentioning that participants were very aware of dengue fever spreading method (75.4%) and the diseases spread by *Aedes* mosquito (87.2%) than the diseases associated with *Culex* (73.1%) and *Anopheles* (66.8%) mosquitoes. A fair proportion of participants (88.1%) was aware of the recent dengue outbreak in the country. These figures are pretty good but not perfect; it could be 100% as the participants were trained professional mosquito control workers not general public.

It was observed that the participants were very much concerned about the personal protection measures during the field work as 90.5 % adopted personal protection (mask, gloves, goggles, long boots) during survey/collection/ removal of mosquito larva/adult and 100% of the staff adopted personal protection during IRS (indoor residual spray) and fogging. This behavior could be an outcome of proper trainings and awareness about the importance of personal protection and adverse effects of insecticides used to control mosquitoes. These insecticides can cause acute and chronic effects on humans (20). Very low use of mosquito repellents during filed work (63.4%) was alarming because the filed force is more prone to mosquito bites than others. It can cause serious issues, especially in epidemics when infected mosquitoes are in abundance and the persons performing chemical or mechanical removal of breeding sites can quickly get infected (14).

Chemical control is considered the backbone of successful mosquito management, and for this purpose proper dose and application of recommended insecticides are imperative. It must be noted that the participants were not very attentive towards the proper use of insecticides for specific life stages of mosquito like only 54.1% and 75.1% knew about mosquito larvicides and adulticides respectively. Moreover, for accurate application and calculation of doses capacities of spray pumps and fogger machines are obligatory (20) but only 77.0% knew about the capacity of provided spray pump. 85.8% were aware of the standard pressure of the pump and 71.7% recognized the capacity

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Published Online: June 30, 2023

of fogging machine. Similarly, 82.9% could correctly identify the vulnerable stage of mosquito to fogging. It is worth mentioning here that these questions are very technical and can't be answered by lay man and the correct response ratio may seem impressive. But for a technical and trained group of participants who are directly dealing with public health it is expected to be 100% with no chance of any error or mistake (14).

After discussing the technical features participants were also interviewed for their attitude and perception towards different aspects of mosquito behavior, ecology, breeding, and control (Table 4). Conversing the season for abundance of mosquito populations and mosquito borne diseases maximum (56.0% and 51.8% respectively) opted for rainy season followed by summer season (21.8% and 22.5% respectively). Similar findings were portrayed by Naeem-Ullah and Akram (2009) (19) from Multan Pakistan, reason is the prevalence of moist and warm conditions in rainy season which is the most suitable for breeding and development of mosquitoes (6).

Talking about the preventive measures for mosquito bites many options were discussed: bed nets were given priority (22.4%) while maximum people (61.7%) said that all the methods including chemicals, bed nets, repellents, fan, and Mos. Coils/mats are equally effective. The reason may be different socio-economic backgrounds and beliefs. Another essential aspect discussed was opinion about the most effective measure to control MBDs. Hygienic conditions were preferred by majority of the participants (22.2%) Similar findings were described by Naeem-Ullah and Akram (19) but maximum (66.7%) said that all possible measures should be adopted including public awareness (5.9%) as well and government agencies such as mosquito control (5.2%). The preference for hygienic conditions indicates that participants are alert about their responsibilities as citizens. It was a good sign as the role of public is imperative for a successful mosquito control program (14). Opinions were also sorted out about the possible reasons for dengue outbreak in the country and very diverse responses were obtained. A fairly large proportion (27.9%) stated that heavy rains are main cause of the epidemics (19), which is quite logical as 2011 and 2015 dengue epidemics in Pakistan were led by a series of monsoon and pre monsoon rains in whole country and in the concerned district with 361 confirmed patients. The possible reason for this pattern is increased number of mosquito breeding sites in rainy season (6).

There is a shortfall of studies assessing the KAP of vector control workers towards MBDs, hence restraining the evaluations of our verdicts. KAP surveys being the most impotent tools are of the supreme significance in defining the evidence-based and actual prevention and control tactics. To the best of our knowledge, it is the first study conducted to assess the KAP of Pakistani MCWs. It is appropriate to mention here that the outcomes of this study disclose potential loopholes of MCP in Multan District in Pakistan and point out the necessity for further large-scale studies to be carried out for exploring the limitations for healthier generalization of the current outcomes (15).

Capacity building of specialists as well as field workers for implementation of appropriate strategies to control MBDs may lead to improved disease risk assessment and control. The proposal of standard protocols seems unrealistic at this stage by way of varying ecological and biological circumstances of different regions thus causing differences in prevention and control strategies. Hence KAP studies along with regular investigation of the glitches and limitations in MCPs are crucial for the success of these programs (21).

Our investigations recommend regular organized progressions of KAP of vector control workers, and ultimately share and implement the outcomes to overcome the complications of control strategies in different circumstances. Moreover, our study was designed in

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Published Online: June 30, 2023

an IVM (Integrated Vector Management) scenario which can be employed in any given settings and can be generalized in larger setups of public health to modernize and rationalize the policies of MCPs.

Conclusion

The findings provided a clear image of KAP regarding MBD's and vector mosquitoes in the area which can be used to improve the design and interventions of currently implemented SOP's taken by field force. It consequently can help in control of MBD's in the region and possibly the country.

There is solid evidence that the vector control workers of Multan district are aware of different mosquito genera present in the area along with almost all the associated diseases of these mosquitoes. They overwhelmingly know about the morphological differences of different mosquitoes. However, the knowledge about biting timings of different disease-causing mosquitoes is deprived. Similarly, a handsome number of workers lacked the knowledge about DF spreading and its recent outbreaks in the country which is quite disappointing for professional workers. Updated information is imperative to boost up the control activities in the field.

Moreover, not all the workers were taking personal protective measures such as mask, gloves, goggles long boots during mechanical control measures but they all were very concerned of personal protection while conducting chemical control activities like indoor residual spry and fogging. Outreach on different infections, likelihood of becoming disease carrier and the seriousness to personal protection foremost is required to be focused. Disappointingly, about half of the workers didn't use any mosquito repellent during field work. The familiarity of workers with different insecticides and equipment used for mosquito control was dissatisfying rather insufficient for proper control of disease vectors which can lead to unexpected outcomes and outbreaks in the area. This scenario represents the prime need for trainings of workers at regular intervals. Exploiting the information and the mosquito control and avoidance strategies currently being executed reconnoiters the need for enhanced education and awareness.

Capitalizing the capacity building of outreach workers will allow them to strategically perform mosquito prevention and control activities correlating the biological and chemical factors associated with control measures in the concerned area. Enhancement and expansion of outreach activities from health department and local government who are primarily responsible for vector control will be a proper next step. The findings of this research can pave the way in modifying the misapprehensions about effectiveness and interpositions of mosquito control and avoidance activities. These interventions can ultimately serve key role to the strengthen public health approach.

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Conflict of interest statement

The authors declare there is no conflict of interests.

References

1. World Health Organization (2020) Vector Borne Diseases-Key Facts. Geneva: World

http://jad.tums.ac.ir
Published Online: June 30, 2023

Health Organization. Available at: http://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases
2. Global Risks Insight Report, 10th Edition (2015) World Economic Forum. Available at: http://reports.weforum.org/global-risks-2015
3. Directorate of Malaria, Dengue and Other VBDs Control-Pakistan (2020) Management of Vector-Borne Diseases (VBDs) In Pakistan. Ministry of National Health Services, Regulations and Coordination Government of Pakistan.
4. Harapan H, Rajamoorthy Y, Anwar S, Bustamam A, Radiansyah A, Angraini P, Fasli R, Salwiyadi S, Bastian RA, Oktiviyari A, Akmal I (2018) Knowledge, attitude, and practice regarding dengue virus infection among inhabitants of Aceh, Indonesia: a cross-sectional study. BMC Infect. Dis. 18(1): 1–6.
5. Ali Z, Zahra G, Khan B, Ali H, Bibi F, Khan A (2015) Prevalence of dengue fever during 2011-2012 in Punjab. J Anim Plant Sci. 25(3): 348–354.
6. Saba S, Khan A, Naeem-Ullah U, Bokhari S (2019) Clinical profiles of dengue fever patients, during an outbreak. J Arthropod Borne Dis. 13(2): 126–134.
7. World Health Organization (2019) Dengue fever-Pakistan. Available at: https://www.who.int/emergencies/disease-outbreak-news/item/dengue-fever-pakistan
8. World Health Organization (2017) World Malaria Report. Available at: https://reliefweb.int/report/world/world-malaria-report-2017?gclid=EAIaIQobChMI0e79n6rr_wIVk4jVCh3bjg67EAAYAiAAEgJmF_D_BwE
9. World Health Organization (2018) World Malaria Report. Available at: http://apps.who.int/iris/bitstream/handle/10665/275867/9789241565653-eng.pdf
10. Conlon J (2011) Control of mosquitoes in the United States. Outlooks Pest Manag. 22(1): 32–37.
11. DeGroote J, Mercer D, Fisher J, Sugumaran R (2007) Spatiotemporal investigation of adult mosquito (Diptera: Culicidae) populations in an eastern Iowa county, USA. J Med Entomol. 44(6): 1139–1150.
12. Gratz N (1994) Education and employment of medical entomologists in *Aedes aegypti* control programmes. Gaoxiong Yi Xue Ke Xue Za Zhi. 10 Suppl: S19–27.
13. Alobuia W, Missikpode C, Aung M, Jolly P (2015) Knowledge, attitude, and practices regarding vector-borne diseases in Western Jamaica. Ann Glob Health. 81 (5): 654–663.
14. Impoinvil D, Ahmad S, Troyo A, Keating J, Githeko A, Mbogo C, Kibe L, Githure J, Gad A, Hassan A, Orshan L (2007) Comparison of mosquito control programs in seven urban sites in Africa, the Middle East, and the Americas. Health Policy. 83(2–3): 196–212.
15. Patz J, Graczyk T, Geller N, Vittor A (2000) Effects of environmental change on emerging parasitic diseases. Int J Parasitol. 30 (12–13): 1395–1405.
16. Pakistan Bureau of Statistics (2018) Provisional summary results of 6th population and housing census. Ministry Of Statistics, Islamabad, Islamic Republic of Pakistan.
17. Sultana A, Hasan S, Hossain M, Alim A, Al-Mamun M, Bashar K (2017) Larval breeding habitats and ecological factors influence the species composition of mosquito (Diptera: Culicidae) in the parks of Dhaka City, Bangladesh. Bangladesh J Zool. 45(2): 111–122.
18. Morse W, Izenour K, McKenzie B, Lessard S, Zohdy S (2019) Perceptions and practices of mosquito-borne diseases in Alabama–is concern where it should be? BMC public health. 19(1): 1–9.

http://jad.tums.ac.ir
Published Online: June 30, 2023

19. Naeem-Ullah U, Akram W (2009) Dengue knowledge, attitudes and practices in Multan, Pakistan: an urban area at the verge of dengue infestation. Public Health. 123 (6): 452–453.
20. Saeed M, Shaheen M, Ahmad I, Zakir A, Nadeem M, Chishti A, Shahid M, Bakhsh K, Damalas C (2017) Pesticide exposure in the local community of Vehari District in Pakistan: an assessment of knowledge and residues in human blood. Sci Total Environ. 587(1): 137–144.
21. Naranjo D, Qualls W, Jurado H, Perez J, Xue R, Gomez E, Beier J (2014) Vector control programs in Saint Johns County, Florida and Guayas, Ecuador: successes and barriers to integrated vector management. BMC Public Health. 14: 674.

http://jad.tums.ac.ir
Published Online: June 30, 2023