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Investigating knowledge, attitude, and self-care behavior concerning *Aedes* mosquito bites and the knowledge of dengue fever among Hormozgan residents in the south of Iran

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Abstract:

BACKGROUND: In recent years, with the identification of the *Aedes* mosquito as a vector of dengue fever (DF) in Hormozgan province, this southern province was recognized nationwide at a great risk of DF. The present study was conducted on the *Aedes* mosquito prevention and DF knowledge in this province.

MATERIALS AND METHODS: An online survey was conducted using a self-administered questionnaire for 1 month in 2022. The sampling method was snowball. A total number of 4,004 questionnaires were completed online by the residents of Hormozgan province. Finally, the data were analyzed using descriptive statistics, statistical tests, and statistical software SPSS (Statistical Package for the Social Science) version 22.

RESULTS: The level of knowledge, attitude, and behavior concerning the self-care behavior of *Aedes* mosquito bites was as follows. Most participants were knowledgeable and correctly answered the questions related to the preventive ways of *Aedes* mosquito bites. The average rate of correct answers was 94.5%. They also mostly held a positive attitude. Regarding the attitude items, most participants (more than 85%) strongly agreed and agreed with the statements. Regarding the behavioral items, most participants (70.4%) stated they showed the aforementioned preventive behaviors to impede *Aedes* mosquito bites. As for the state of participants' knowledge of how the DF is transmitted, overall, in the nine examined items, on average, 40.6% answered "I do not know" and "false".

CONCLUSION: As the education level of the participants showed, they did not know adequately about the DF. Judging the state of knowledge, attitude, and behavior of the less privileged and less educated social classes in Hormozgan province requires further investigation of the public living in this province after some time passes since the implementation of educational and preventive interventions. It is also necessary to enrich population-based educational interventions aiming to improve knowledge and preventive behaviors of the DF and *Aedes* mosquito.

Keywords:

Aedes mosquito, attitude, dengue fever, Hormozgan, knowledge

Introduction

As reported by the World Health Organization (WHO), Dengue fever (DF) is considered a common type of arbovirus infection in the world. There are about 390 million infected cases reported annually, and 40% of the world population live in areas at risk of infection.[1,2]

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Dengue fever is local to many tropical and subtropical areas, especially in the rainy season when the *Aedes* mosquito breeds.[3] The incidence increased dramatically from 2008 to 2015 to 2 million cases in the Americas, Southeast Asia, and Western Pacific regions, and spread to some European countries through globalization and traveling.[1] Dengue fever manifests with flu-like symptoms and can lead to severe and life-threatening stages, including severe bleeding, respiratory and organ dysfunction.[4] DF-induced mortality imposes high economic costs on infected populations and countries. This disease mainly affects the young, who are the breadwinners in the family.[5–7] The knowledge, attitude, and performance (KAP) of the general population are effective factors in preventing the virus.[8-10] In addition, Al-Zurfi *et al*.[11] showed that the control of DF outbreak requires the improvement of preventive strategies. It is also necessary to investigate the behavior of DF patients seeking health services.[12] As estimated, 70% of the DF infection that occurs worldwide occurs in Asian countries.[13]

DF can be induced by any of the serotypes of dengue virus (DENV) and through the bite of two species of the female *Aedes* mosquito (*Aegypti albopictus*). Any climate change affects virus infection and transmission. Precipitation, temperature and humidity, weather changes, and the feeding behavior of these mosquitoes significantly affect the growth and survival of DF mosquitoes.[14] In order to control this condition, local authorities agreed that public involvement and cooperation in controlling *Aedes* mosquito can be effective because access to private urban areas is not possible.[15] Educational campaigns and public cooperation help control the disease.[16] As recommended by WHO,[17] encouraging people to cooperate to solve the issue requires much effort.[18] It is not clear whether educational campaigns on their own can adequately motivate people to participate in mosquito population control.[19–22]

To evaluate knowledge and attitude, questionnaire surveys have been used along with a review of KAP studies. These have shown the residents' performance in the face of the mosquito infestation. Mosquito-related training programs can contribute to population-based management.[22]

Other studies show that a multifaceted campaign can manage to improve knowledge and preventive action among individuals. Although the presence of scientists inspecting potential habitats alone may be sufficient to motivate resource reduction practices.[22–24]

A study using the KAP survey of dengue prevention showed it is necessary for the public to have adequate knowledge and a strong motivation to participate in vector control activities, and local knowledge and practices are essential to design strategies.[25,26]

In South Africa, the KAP survey was used as the first step to provide information about the sterile insect technique (SIT) for people before the SIT on malaria in 2015.[27]

As the survey findings showed, the *Aedes* mosquito was still considered a nuisance pest rather than a potential vector of diseases. KAP questionnaires were used in previous studies to test the relationship between residents' knowledge, attitude, and performance.[23]

Effective management probably depends on the residents' knowledge, attitude, and performance.[22] People can be motivated to reduce mosquito breeding places in their backyards for many reasons, including personal experiences and perceptions.[28–31] Disgust has long been known as a basic human emotion. It motivates people to reject or avoid harmful substances, pathogenic and potentially harmful agents.[27]

Considering the climatic conditions of Hormozgan, which is prone to the settlement and proliferation of invasive *Aedes* mosquitoes, and the fact that in recent years this province has been the habitat of *Aedes* mosquitoes. The number of cities where the *Aedes* mosquito resides, and the abundance of the *Aedes* mosquito in this province is increasing. Therefore, there is a possibility of *Aedes* mosquito settling in the entire province and even transferring this mosquito to neighboring provinces. With the establishment of the *Aedes* mosquito in this province, there is a possibility of diseases such as DF. Assessing the state of knowledge and performance of the people of this province is essential for designing effective interventions.

An effective measure is to evaluate people's knowledge, attitude, and performance concerning the *Aedes* mosquito. Also, no study has been conducted so far on this topic and this effective measure in this province in the south of Iran. The present study aimed to investigate the knowledge, attitude, and behavior of local residents concerning DF and the prevention of *Aedes* mosquito bites.

Materials and Methods

Study design and setting

The present cross-sectional study was conducted for 1 month in 2022. The research population was the people living in 13 cities of Hormozgan province. Hormozgan was the first place in Iran where *Aedes* mosquitoes were spotted in recent years.

Study participants and sampling

The research population was the people living in 13 cities of Hormozgan province. The sampling method was snowball.

Data collection tool and technique

In this study, a researcher-made questionnaire was used. The questionnaire content was adapted from valid instruments used in the existing literature.[32–34] Before conducting the main study, in order to validate the first draft of the questionnaire, it was sent to field specialists whose opinions were used to revise the questionnaire. In order to estimate the reliability of the questionnaire, the researcher conducted a pilot study for 14 days on 30 participants (similar to the target population) using the Test R Test method. Cronbach's alpha of the whole questionnaire was estimated at 0.74 and the average correlation coefficient of the whole questionnaire was 0.94.[35]

The questionnaire included a demographic part with seven items, another part to measure the knowledge of DF with nine questions, another part to measure the respondents' self-care behavior of *Aedes* mosquito bites, the knowledge part with five items, the attitude part with four items and the behavior part with four items. The questions related to the knowledge of DF and knowledge of self-care behavior for *Aedes* mosquito bites were answered as true, false, and I do not know. Responses to the attitude questions about the self-care behavior of *Aedes* mosquito bites were: strongly agree, agree, undecided, disagree, and strongly disagree. The questions about the self-care behavior of *Aedes* mosquito bites were: never, sometimes, and always.

The questionnaire was completed online via WhatsApp. The sampling method was snowball. Through chats in cyberspace, the questionnaire was provided to the health staff in 13 cities of the province, and then the questionnaire was distributed among health experts, the general public, and gradually to all who were available. A total number of 4,004 questionnaires were finally completed online as self-administered. At the beginning of the questionnaire, a brief and useful explanation was provided about the content. Then the questionnaire was completed. The collected data were analyzed in SPSS (Statistical Package for the Social Sciences).

Ethical consideration and declaration of participant consent

This study was approved by the Health System Research Committee of Hormozgan University of Medical Sciences (IR.HUMS.HSR.1401.06.07). The authors certify that they have obtained all appropriate participant consent forms. In the form, the participant(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The participants understand that their names and initials will not be published, and due efforts will be made to conceal their identity.

Results

Demographic variables included the age group, gender, occupation, level of education, place of residence, having heard about DF, and the ways of gaining the required information, as summarized in Table 1. Most participants belonged to the 30–49-year age group. The percentage of women participating in the study was higher than men, and the majority of subjects were women. In total, 45.3% of the participants were freelancers or held permanent jobs. Most people (73.8%) held a diploma or higher degree. The place of residence of the majority of participants was rural.

About 58% of the participants had heard something about DF. Among the ways of gaining information, mobile phones, the internet, and the cyberspace were the most common, followed by the health staff in local centers [Table 1].

In the items exploring DF [Table 2], the lowest number of "true" answers was that of "Flies can also transmit

Table 1: Demographic variables

Variable	Level	*n*	%
Gender	Male	2796	68.9
	Female	1208	30.2
Age	<18 years	305	7.6
	18–29 years	1286	32.1
	30–49 years	2254	56.3
	50–69 years	149	3.7
	≥70 years	10	0.2
Occupation	Retired	64	1.6
	Unemployed	175	4.4
	Housewife	1463	36.5
	Freelancer	541	13.5
	Permanent job	1272	31.8
	Student	296	7.4
	University student	193	4.8
Education	Uneducated	59	1.5
	<Diploma	991	24.8
	Diploma	1249	31.2
	Associate degree	427	10.7
	≥Bachelor's degree	1278	31.9
Place of residence	Urban	1685	42.1
	Rural	2319	57.9
Having heard about the *Aedes* mosquito	Yes	2347	58.6
	No	1657	41.4
Source of information about the *Aedes* mosquito	TV	394	10.9
	Mobile phone, cyberspace	1531	42.4
	Local health staff	1486	41.1
	Other media such as radio and so on	203	5.6

dengue fever" and the highest number of "true" answers was that of "Due to the presence of *Aedes* mosquitoes in Hormozgan province, there is a possibility of disease in the residents." The mean rate of answering nine questions about DF knowledge as true was 59.4%.

The self-care knowledge-related questions in preventing *Aedes* mosquito bites were five in number. The knowledge part showed that most people answered the questions correctly [Table 3]. Assessing the attitude toward preventing *Aedes* mosquito bites with four questions showed that in three items, more than 95% of the participants held a positive attitude, and in one item, "I believe if the water container under the air conditioner and under the plant pot is cleaned on a daily basis, the risk of spreading the *Aedes* mosquito decreases," 85.7% of respondents held a positive attitude [Table 4].

The behavior of preventing *Aedes* mosquito bites was measured with four questions. On average, 70.47% of the participants answered that they always showed the aforementioned preventive behaviors. In the case of one behavior, using an insect repellant ointment or pen and putting up a fine mesh on windows, most participants answered that they sometimes showed this preventive behavior [Table 5].

Discussion

In recent years, with the identification of the *Aedes* mosquito as a vector of DF in Hormozgan province, this southern province was recognized nationwide at great risk of DF. The present study aimed to investigate the knowledge of DF and knowledge, attitude and performance in dealing with *Aedes* mosquito bites in the population of Hormozgan province. Although interventions have been made to reduce and control the *Aedes* mosquito in Hormozgan province, assessing the public views and behavior in this province concerning DF and *Aedes* mosquito is a priority in preventing the outbreak of DF.

Among the methods of gaining information about the *Aedes* mosquito, the most common was the use of mobile phones and the cyberspace. The prevalence of this method in Hormozgan province shows that the design of internet-based educational interventions can be an effective solution to increase public knowledge in Hormozgan province in dealing with the *Aedes* mosquito.

Concerning the knowledge of, the attitude toward, and the self-care behavior in the face of *Aedes* mosquito bites, most participants had adequate knowledge and

Table 2: Knowledge of the dengue fever

	Item	Response rate		
		True	Do not know	False
1	The *Aedes* mosquito can transmit DF from a sick person to a healthy person.	66.6%	25.7%	7.6%
2	Flies can also transmit DF.	39.4%	33%	36.7%
3	Contact with infected patients may transmit the DF.	48.3%	29.4%	22.3%
4	Drinking contaminated water can transmit the DF.	42.5%	26.9%	30.5%
5	Eating contaminated food can transmit the DF.	35.2%	30.8%	34%
6	DF can even cause death.	77.2%	20.2%	2.5%
7	DF is a preventable disease.	75.1%	20.2%	4.7%
8	Due to the presence of *Aedes* mosquito in Hormozgan province, the occurrence of the disease is probable	83%	15.5%	1.5%
9	Removing the breeding place of *Aedes* mosquito (usually clean and clear water, worn tires, etc.) is an effective way to prevent disease transmission.	76.6%	16%	7.4%
Mean response rate		59.4%	24.3%	16.3%

Table 3: Self-care knowledge of the prevention of *Aedes* mosquito bites

	Item	Response rate		
		True	Do not know	False
10	The water container under the air conditioner, under plant pots, as well as the water in the bird and pet bath containers should be replaced daily to prevent *Aedes* mosquito bites.	95.6%	3.6%	0.8%
11	*Aedes* mosquito bites can be prevented by covering the windows with small nets that prevent insects from entering the house.	96.7%	2.6%	0.7%
12	*Aedes* mosquito bites can be prevented by wearing light-colored clothes and long-sleeved shirts and pants.	87.8%	9.8%	2.4%
13	Avoiding littering, including cans, water bottles, and containers that collect water will prevent *Aedes* mosquito bites.	95.2%	4%	0.8%
14	When on a picnic and setting up a tent, choosing a place away from stagnant water and using a mosquito net will prevent *Aedes* mosquito bites.	95.4%	3.8%	0.8%
Mean response rate		94.1%	76.4%	1.08%

Table 4: Self-care attitude toward the prevention of *Aedes* mosquito bites

	Item	Response rate				
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
15	I believe if you avoid discarding things like cans, water bottles and water containers, the probability of *Aedes* mosquito bites will decrease.	70.2%	24.8%	3.6%	0.9%	0.4%
16	I believe it is necessary to train family members to prevent *Aedes* mosquito bites.	76.4%	19.9%	2.7%	0.6%	0.3%
17	I recommend using small nets to prevent insects from entering the house.	74.4%	21.2%	3.2%	0.7%	0.5%
18	I believe if the water container under the air conditioner or plant pots is cleaned or replaced daily, the risk of spreading the *Aedes* mosquito is lowered.	61.2%	24.5%	8%	5.2%	1.1%
Mean response rate		70.5%	0.22%	2.3%	1.85%	0.5%

Table 5: Self-care behavior to prevent *Aedes* mosquito bites

	Item	Response rate		
		Never	Sometimes	Always
19	Using an insect repellant ointment or pen and installing a fine mesh in the windows	15.7%	47.8%	36.5%
20	Changing the water under the pot on a daily basis	5.8%	22.2%	72%
21	Sanitary disposal of waste in the correct way	3.1%	9.7%	87.2%
22	Putting lids on water storage containers	4.5%	9.3%	86.2%
Mean response rate		7.27%	22.25%	70.47%

correctly answered the questions of how to deal with the *Aedes* mosquito. The rate of correct answers was 94.5%. Also, most participants had a positive attitude, as most of them (>85%) agreed and strongly agreed (regarding the attitude items). As for the behavioral items, most participants (70.4%) contended that they showed preventive behaviors to face *Aedes* mosquito bites. In the present study, although 58.6% of the participants answered *yes* to whether they had heard about DF, they did not have a high and satisfactory knowledge of how DF is transmitted. Responses to four out of nine questions to measure knowledge of how DF is transmitted showed that the percentage of "do not know" and "false" answers were more than "true" answers. In a similar study in Malaysia, despite hearing about DF, the overall knowledge of the participants was not satisfactory.[36]

Alyousefi's study in Yemen showed that despite people's awareness and good attitude towards DF, the performance of people in the prevention of this disease was normal, and the implementation of educational intervention programs was concluded. In the present study, people's awareness of DF was not very good, so the implementation of educational intervention programs is needed.[37]

The percentage of public knowledge of DF in countries like Yemen (97%) and Nepal (77%) is relatively high.[37,38] Another study in South India showed that people's knowledge of DF was high, in contrast to the current study, which did not show a high level of knowledge of DF.[39]

In the present study, the participants' knowledge of the ways of transmitting DF was not adequate, but similar study showed a high level of knowledge of how DF is transmitted among people.[40] Compared to the present study, in Malaysia and Laos, people's knowledge of DF was at a higher level.[41,42] However, in some areas, such as Pune, India, people's knowledge of this disease reached 40%.[43]

The participants' attitude was positive towards preventing *Aedes* mosquito bites as a way to prevent DF, except for one item (i.e., "I believe if the water container under the air conditioner and the plant pots is cleaned and replaced on a daily basis, the risk of spreading *Aedes* mosquito decreases"). In other items, more than 90% of the participants held a positive attitude. In another study in India, 50% of the participants held a positive attitude[44] and in two other studies in India, 75% of the population had a positive attitude towards AEDs (Aedes mosquito-borne diseases) prevention methods to prevent DF.[44,45] Krishnamoorthy and her colleagues conducted a study on the knowledge and attitudes of people about DF in India and concluded that only one-third of the people had adequate knowledge about DF and recommended the implementation of educational interventions in this field. Based on the results of the current research in the field of DF, it is necessary to implement appropriate educational campaigns in this field.[44]

Another study in Colombia showed a positive relationship between the increased knowledge of DF and the change in attitudes and showing dengue preventive behaviors.[46] Other related studies in Asian countries such as Pakistan and Malaysia also had similar findings.[47,48]

The assessment of the participants' preventive behavior of *Aedes* mosquito bites showed in the item "Using insect repellant ointment or pen and putting up fine nets on windows," the participants did not perform well. Most people only sometimes showed the aforementioned behavior to reduce or prevent the *Aedes* mosquito, and 15.7% of the participants never showed the desired behavior. Also, overall, the assessment of four behavior items [Table 5] showed that on average, 29.5% of the participants never and sometimes performed the aforementioned preventive behaviors in *Aedes* mosquito care. Considering that Hormozgan province is the habitat of the *Aedes* mosquito if DF occurs, mosquito bite preventive and protective behaviors (e.g., using insect repellant ointment or pen and putting up fine nets on windows) are among the key behaviors of the general public to reduce the transmission of the disease by the *Aedes* mosquito.

DF epidemics in other countries showed that one important factor in preventing and controlling DF is the active participation of all local residents in performing preventive behaviors against *Aedes* mosquito bites. For example, Singapore has experienced 50 years of DF, and this disease is local to this country, In 2019, Singapore also experienced a large dengue outbreak with more than 16,000 cases. An important recommendation of the national health officials as well as the WHO was to immediately ruin the potential breeding habitats of mosquitoes at home to stop the transmission of the disease.[49]

Suwanbamrung's study in Thailand showed that there is a need for routine health education programs in the community and schools about DF and the *Aedes* mosquito. Considering the situation of *Aedes* mosquito establishment, this is an essential need in Hormozgan province.[50]

Siddiqui and her colleagues in the survey of awareness about DF in Pakistan, concluded that the people studied were aware of DF, but campaign and health education in this field are needed to shape the behavior of people in the community. In the present study, this conclusion is also applicable to the general population of Hormozgan province.[51]

Countries with a successful experience of facing DF, such as Australia in the northern region of Queensland, which managed to eradicate DF from 2011 to 2018 with different strategies, reported the participation of the general public and even school students in cutting the ways of transmitting the disease.[52] Attracting people's participation requires first to inform the public and encourage them to prepare for the occurrence of DF and the cause of transmitting the disease.

Conclusion

The present findings revealed the current level of awareness of DF among people and their knowledge, attitude, and behavior in Hormozgan, the southern province of Iran, concerning the *Aedes* mosquito carrying DF. Although the health system of Iran and Hormozgan province have taken care and control measures for more than 50 years for diseases such as DF and those vector-borne such as malaria, it is noteworthy that the health system and the general public in Hormozgan province have not experienced an epidemic yet. They are not faced with the DF epidemic. Therefore, improving people's knowledge and behavior helps people prepare for and prevent this disease. According to the present findings, despite the relative knowledge and positive attitude toward the preventive strategies of *Aedes* mosquito bites, there is still a gap in people's ability of facing this disease, and there is still a need for effective measures to improve people's level of knowledge and behavior. In the case of DF, these effective interventional measures are essential to prepare the local residents of Hormozgan province. It is even necessary to hold special training courses for populations such as students, university students, and even workers because a percentage of people in the present society do not have accurate information about how the disease is transmitted. For example, in Australia, health messages about DF were designed in the media and for the general public, even in product packaging.[52] The settlement of *Aedes* mosquito in Hormozgan province is a warning about the possibility of a provincial and even national epidemic of diseases such as DF. Also, measures such as educational campaigns and attracting the participation of community members in the form of practicum and sensitizing different populations, especially the low-educated and illiterate, should be done to increase preventive behaviors against the *Aedes* mosquito. Measures that are better applicable with the participation of the public and simple and important behaviors such as improving the environment, putting up nets on windows and changing the water under plant pots, emptying the trays under the air conditioners, spotting the habitats of the *Aedes* mosquito and eradicating them lead to the reduced incidence of the disease transmitted by *Aedes* mosquitoes.

In the future, it is suggested that similar studies be conducted in Hormozgan province for a period of 1 year after interventions in this field, and similar studies should be conducted in the neighboring provinces of this province in Iran in order to investigate the situation of the general public in the field of dealing with the *Aedes* mosquito.

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Conflict of interests

There are no conflicts of interest.

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