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Knowledge, Practice, and Behavior of University Students Concerning Sandfly Vectors of Leishmaniasis in Fez City, Central North Morocco

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ABSTRACT

Sandflies are proven vectors of several viruses, bacteria, and parasites, causing many vector-borne diseases like leishmaniasis. Morocco aims to eliminate the disease by 2030. However, this disease continues to be a public health issue in the country despite all the efforts to limit its spread. The present study evaluated the knowledge, practices, and behaviors of university students regarding sandflies as leishmaniasis vectors. From April to July 2018, 385 students were interviewed using a pretest questionnaire. A score of 1 was assigned to every correct answer concerning knowledge and practice variables, and a mark of 0 was assigned to any incorrect answers or unanswered questions. Pearson's Chi-square (X^2) test was used to analyze the association between the independent variables and the level of knowledge and practices. A statistically significant association is demonstrated when $p < 0.05$. Students had an intermediate level of understanding of leishmaniasis vectors, with a knowledge score of 5.61 out of 10. The level of prevention practices, however, only received a 1.63 out of 4 rating. The field of study in high school and knowledge, as well as prevention methods and demographic factors, such as the field of study in high school and academic level, were also found to be significantly correlated (p = 0.000). The findings of this study demonstrate the significance of implementing various levels of awareness-raising and educational initiatives among university students, as it represents a crucial step to enhancing knowledge, attitudes, and preventive actions regarding this disease.

***Keywords*:** Behavior, Fez, Knowledge, Leishmaniasis, Morocco, Practice, Sandfly, Students.

Introduction

Insect vectors are leading causes of morbidity and mortality worldwide, as more than 80% of the world's population is exposed to one of the vector-borne diseases.[1] Sandflies (*Diptera*: Psychodidae) are active vectors of several diseases, including leishmaniasis, a group of human and animal diseases caused by kinetoplast protozoa of the genus *Leishmania*.[2-5] They have an effect on human health due to the severity of some of their clinical forms, their occurrence, and the vulnerability of the communities they affect. Clinical leishmaniasis (CL), visceral leishmaniasis (VL), and cutaneous-mucosal leishmaniasis (CML) are the three forms that this parasite can cause.[6,7] These diseases are distributed ubiquitously, affecting 98 countries, and approximately 350 million people are at risk of infection.[8] According to the World Health Organization (WHO), the number of new cases per year is estimated at 1.3 million, with an annual mortality of 20,000 to 30,000 people.[3,4] Poor housing conditions, environments that are conducive to the vector, immunosuppression, and a lack of personal safety precautions all contribute to the disease's propagation.[9,10]

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Environmental changes might also affect the dynamics of the disease's vectors and reservoirs, thereby increasing human exposure to the condition.[11,12]

Leishmaniasis, whether zoonotic or anthroponotic, visceral or cutaneous, is a serious public health concern in Morocco, as it is in the majority of Mediterranean countries.[12-15] Nevertheless, despite great efforts made to address this problem, recent statistics from the Ministry of Health indicate an increase in leishmaniasis incidence, with the proportion of cases discovered at medical facilities only accounting for up to 35% of the estimated cases.[16] To effectively prevent and control these health issues, it is crucial to evaluate the knowledge, attitudes, and habits of the people affected by these diseases and their vectors.[17,18] It is essential to have adequate and accurate information on community participation in primary healthcare, as well as its knowledge and practices regarding the causes, transmission, prevention, treatment, and means of the fight against these diseases before an effective intervention strategy can be put into place.[19] Despite the fact that leishmaniasis information is readily available, additional information on human behavior and the way it is treated has to be collected. A number of studies,[20,21] have widely explored people's knowledge of and attitudes concerning leishmaniasis, and some of these studies have focused on particular groups, including physicians, nurses, and health professionals.[22,23] It has also been shown that knowledge and attitudes toward leishmaniasis and its vectors may vary according to individuals' social and socioeconomic characteristics.[24,25]

Within this context, a research study was conducted to evaluate for the first time the knowledge, practices, and behaviors of the university student population in Fez in relation to sandflies as leishmaniasis vectors.

Materials and Methods

Study area

The study was carried out in Fez, a Moroccan city in the north-central region of the country, in the region of Fez-Meknes. Fez is bordered on the north by the Province of Moulay Yaâcoub and on the south by the Province of Sefrou, at an elevation of 406 m (Latitude: 34° 03′ 00″, Longitude: 4° 58′ 59″). In the summer and winter, Fez is influenced by the continental climate, with 500–600 mm of precipitation annually and an average temperature of 17.8°C, ranging from a high of 35°C in July to a low of 9°C in January.[26] The population of the city of Fez is estimated to be 1,150,768 people, with a population density of 3,464 inhabitants/km² and an average annual growth rate of 1.84%, according to statistics from the general census of population and housing.[27,28] The city of Fez is known for its population of sandflies, and the presence of sites with high potential risk whose epidemiological data are known. In addition, caves, rodent burrows, and unmanaged waste sites exist, all of which are potential biotopes for leishmaniasis vectors and reservoirs.[29]

The target population of the study

The target population of this study was composed of university students pursuing their studies at one of the public institutions in the city of Fez. In 2018, the pool of students characterizing the target population was 82,471.[30]

Study design, sample size, and sampling techniques

A quantitative approach based on a survey was used to assess students' knowledge, practices, and behaviors regarding sandflies as a vector of leishmaniasis in the city of Fez. The data were collected from April to July 2018 using a pretested questionnaire. The sample size was determined by assuming that 50% of the students were knowledgeable about the disease and its transmission vector with a 95% confidence interval and a margin of error of 0.05 due to the target population's size and difficulty in counting. Consequently, 385 people were selected as a sample from the target population using the formula (1) proposed by Wrenn, Stevens, and Loudon (2002).[31,32]

$$n = \frac{Z^2(p.q)}{(e)^2} \qquad (1)$$

$$n = \frac{1.96^2(5*5)}{(0.5)^2}$$

Where n is the sample size, Z is the value of the normal distribution table for the desired confidence level (i.e., corresponding to the alpha level for 0.05 is 1.96), p is the proportion of the population obtained (i.e., 50%), q is equal to 1-*p, and e* is desired sampling error or precision= $\pm$ 0.05.

A two-stage sampling strategy was employed to collect the required data. First, out of the 11 institutions of Sidi Mohamed Ben Abdellah University in the city of Fez, a sample size of 35 students per institution was calculated using the equal-size sampling technique. Subsequently, convenience sampling was used to select the participants based on their willingness to answer the questionnaire. In addition, these questionnaires were addressed only to master's students, Ph.D. candidates, and students enrolled in the third year of the three-year program for a license.

Data collection

All questions were obtained from previously published studies that assessed knowledge and practices related to leishmaniasis and its vectors.[33,34] The questionnaire was composed of four sections. Section 1 includes questions on student demographics and their academic level. Questions in Section 2 test the participants' understanding of leishmaniasis and its associated clinical symptoms. Section 3 consists of questions on knowledge of sandflies to determine students' ability to identify and differentiate sandflies from other flying insects, their ability to transmit disease, and their breeding locations. Section 4 contains questions to understand students' practices and behaviors regarding the preventive strategies against sandflies as vectors of leishmaniasis. Following the method used by Tesfay *et al*.,[35] a score of 1 was assigned to every correct answer, and a score of 0 was assigned to any incorrect answers or unanswered questions. Subsequently, the average score of all responses was calculated. Thus, students with a score greater than or equal to the mean score were considered knowledgeable. The students' level of practice was similarly assessed based on the mean score of the responses to the respective questions.

Quality control

A questionnaire pretest was performed by 10% of the student population not involved in the study.[36] This pre-testing allowed the observation of potential interpretations of a question and, if necessary, rephrasing it.

Ethical considerations

The Moroccan National Commission for the Control of Personal Data Protection procedure was respected for this survey, and the questionnaire administration was done anonymously and confidentially. Every participant recruited was given all the information about the study and was free to agree to participate.

Data analysis

The collected data were entered into Microsoft Office Excel 2016 software. To assess the reliability of the responses, Cronbach's alpha was calculated. This is a good indicator of the reliability and consistency of responses to a questionnaire, as it was considered reliable when Cronbach's alpha value was higher than 70%.[37,38] Pearson's Chi-square (X^2) test was also used to assess associations between independent variables with more than two categories and dependent variables. A statistically significant association was considered to exist when the *p-value* was less than 0.05 at the 95% confidence level. Data processing was performed using the Statistical Package for the Social Sciences (SPSS) version 23, and results were presented in tabular and graphical form.

Results and Discussion

Cronbach's alpha of the answers assessing university students' knowledge and practices regarding leishmaniasis vector sandflies was 86%. Thus there is a good consistency of responses and all the results discussed in this section are reliable.

Demographics of participants

The choice of university students as a target population for this study is primarily justified by the fact that students represent future leaders. If they are well informed about the disease and preventive practices, they can use their knowledge and experiences to educate their families and social circles and help eradicate leishmaniasis. In the present study, most respondents (71.9%; n = 277) were female, while 28.1% (n = 108) were male. They were also young adults under 30 (n = 348, 90.4%). Regarding the field of study in high school, 47.8% of the respondents had a major in the sciences, 34.3% in literature, and 17.9% in economics and social sciences. Regarding the academic level of the participants, the results revealed that 79.7% were enrolled in the third year of the licensed program, 13.2% were master's students, and 7.1% were Ph.D. candidates. Because there were 38.98 males for every 100 females, so our study interested women, people between the ages of 18 and 30, students who had high school diplomas in science, and students who were in their last year of the licensed program ~~women were particularly interested in the study~~ (Table 1).

Students' knowledge of leishmaniasis diseases

Almost 56.4% of the 385 students who participated in the survey were aware of leishmaniasis, compared to 43.6% who were unaware of what it was. Additionally, 46% of respondents agreed that leishmaniasis is a parasitic disease, while 42.3% did not respond to this question (Table 2). These findings are mediocre in comparison to those of a knowledge, attitude, and practice survey carried out in Ethiopia, where the majority of participants (87.4%) had a general understanding of leishmaniasis and 89.4% were well-informed.[39] Among the respondents, 40.3% identified the mosquito as the leishmaniasis transmission vector, whereas 21% stated that other means, such as animals, water, food, air,

or contact, can carry the disease (Table 2). These findings are consistent with the study of Lobo *et al*., as they reported many incorrect answers concerning the mode of transmission of leishmaniasis.[40] In contrast, studies in Bangladesh and Iran ascertained a higher level of knowledge of leishmaniasis transmission.[41,42] Regarding the symptoms, the skin lesion was the most cited by 29.1% of the participants, while nearly half of the students surveyed (43.6%) stated that they were unsure of the answer (Table 2).

Students' knowledge of sandflies as vectors of leishmaniasis

Based on the answers collected through the questionnaire, 92.5% of the participants asserted that insects are dangerous, and more than half of the respondents (54.5%) stated that they knew that mosquitoes are vectors of leishmaniasis. In contrast, 45.5% of the students surveyed were unaware that mosquitoes are vectors of leishmaniasis. About 35.3% of the participants perceived sandflies as leishmaniasis vectors, whereas 52.5% of the students did not have information about leishmaniasis vectors (Table 3). These findings demonstrated the relative obscurity of the leishmaniasis transmission vector. The knowledge levels obtained in this study are, therefore, far lower than those discovered in an Iranian study, where 97.9% of participants had a good understanding of the transmission of leishmaniasis by sandflies.[43] Concerning the students' knowledge of the breeding places of leishmaniasis vectors, 20.5% of the participants noted that sandflies breed in water. On the other hand, 60.3% of the participants reported that they did not know the breeding places of the vectors (Table 3). The information gathered indicated that the students in the survey need to understand more about the breeding grounds. These findings were also reported by Lobo *et al*., who noticed that 29% of participants mentioned water as a breeding habitat and 31.89% mentioned sandflies as leishmaniasis vectors.[40] About the food of the vectors, 39.2% of the students cited blood, while 44.9% reported that they did not have any information on the topic. And regarding sandflies' activity period, 39.7% of the participants stated that leishmaniasis vectors are active during the summer, while 46.2% stated that they had no idea about this topic (Table 3). These results corroborate the findings of the study carried out in Brazil, which revealed that the student population knew about the disease and that only a small percentage was aware of sandfly vector characteristics.[40]

Perception of the means of prevention and control of leishmaniasis vectors

Concerning the methods of mosquito control, 44.7% of the interviewed students answered that the chemical method is the most widely known and used for anti-vector control. However, 26.5% mentioned not having information on this topic (Table 4). Mosquito nets are recognized as the most effective method of mosquito control by the students who were interviewed (21.8%), followed by insecticides (18.7%%), sanitation, and wearing long clothes in similar amounts (14% of instances). However, 12.5% of the students claimed they were unsure of the response to this query (Table 4). The results of this study's research showed that the practice level for leishmaniasis transmission vector prevention and control needs to be raised. The findings of this study demonstrate that the respondents have a higher level of control method knowledge than the study subjects of Kiniffo *et al*., who reported that just 2% of their participants had some control method knowledge. [44] However, the results of this study fall well short of those obtained by a study in India, where 93.7% of respondents stated that they were using nets.[36]

Most surveys have determined the critical importance of nets and insecticides in vector control and leishmaniasis transmission.[25,45] In a nutshell, most students need more information regarding the habitats of vectors and must improve their use of preventive measures. This can be explained by the non-transfer of information and the need for more guidance by the educational system. Additionally, failure of preventive measures may result from ignorance of the tiny size of sandflies, their nocturnal habits, and their stealthy flights. In order to raise the level of knowledge of university students, it is necessary to educate them about the foods that mosquitoes consume, the locations where they reproduce, and the periods when they are active. It is also essential to make instruction about this vector more rigorous and thorough.[46] The most practical methods of prevention to predict and stop the development of leishmaniasis are education (30.4%), vaccine (15.6%), communication and awareness-raising activities (14.3%), information (13%), and scientific research (9.4%), as presented in Table 4. According to the survey's findings, students believe that raising awareness (26%) and information education and communication (IEC) (18%) are the greatest ways to advance their knowledge and act as preventative measures, while 17% claimed they had no ideas (Figure 1).

Table 1: Demographic composition of respondents

Demographic variable	Number (n = 385)	Percentage (%)
Gender		
Male	108	28.1%
Female	277	71.9%
Age group		
18-30	348	90.4%
30-40	30	7.8%
40-50	5	1.3%
50+	2	0.5%
Field of study in High school		
Sciences	184	47.8%
Literature	132	34.3%
Economics & social sciences	69	17.9%
Academic level		
3rd year of licensed programme	307	79.7%
Master	51	13.2%
Ph.D	27	7.1%

Table 2: Students' knowledge and belief about leishmaniasis.

Question	Number	Percentage (%)
Knowledge of leishmaniasis		
Yes	217	56.4%
No	168	43.6%
Origin of leishmaniasis		
Viral	18	4.7%
Fungal	3	0.8%
Parasitic	177	46%
Bacterial	24	6.2%
No idea	163	42.3%
Means or vector of transmission of leishmaniasis		
Air	2	0.5%
Soil	4	1%
Surface	4	1%
Food	5	1.3%
Contact	13	3.4%
Water	14	3.6%
Blood	16	4.2%
Animals	23	6.0%
Mosquito	155	40.3%
No idea	149	38.7%
Symptoms of leishmaniasis		
Skin lesion	112	29.1%
Nervous disorders	11	2.9%
Febrile state	39	10.1%
Cough	4	1%
Vomiting	15	3.9%
Diarrhea	31	8.1%
Other	5	1.3%
No idea	168	43.6%

Since knowledge and attitudes play a crucial role in both preventing and controlling infectious diseases, numerous studies have demonstrated that improving these factors is the most effective method to fight them.[47,48] In addition, a study on the change in knowledge level and practice rate after health education on visceral leishmaniasis in Xinjiang showed that the percentage of correct responses increased from 0.7 and 0 to 54.2 and 70.7%, respectively, indicating that health education is an excellent way to raise awareness about disease prevention and control.[49] These findings corroborate those of other researchers who came to the conclusion that, in order to successfully prevent and control vectors, it is essential to start the awareness process among the student population. This will serve as a source of knowledge and enable the establishment of a foundational network of primary and community care.[40,50] Therefore, it follows that education is necessary to enhance students' knowledge of leishmaniasis vector prevention and control measures. The data gathered indicated that students had an intermediate degree of understanding of leishmaniasis vectors, with a total knowledge score of 5.61 (range 0-10). On the other hand, preventative practices yielded poor results (score of 1.63, range 0-4).

Concerning the relationship between the demographic variable and students' knowledge and practice levels, 159 females and 57 males of the respondents had a good awareness of leishmaniasis and sandflies. However, no statistically significant association ($p = 0.412$) between gender and knowledge level was deduced. Also, no statistical differences between age category ($p = 0.300$) and academic level ($p = 0.127$) with knowledge were observed (Table 5). In contrast, there was a significant correlation ($p = 0.000$) between the field of study in high school and the knowledge level of the disease and its vectors. Additionally, it was found that while 228 participants (59.22%) had poor illness prevention and control behaviors, 157 students (40.78%) of the respondents, had good ones. A significant association between the field of study in high school ($p = 0.000$) and the respondents' academic level ($p = 0.000$) concerning how ~~often~~ they practice leishmaniasis and sandfly prevention ($p = 0.000$) was observed, as illustrated in Table 5. The statistical analysis of the demographic variable and the knowledge and practice levels of the students in the survey revealed a significant association with the subjects of study in high school. Students with high school diplomas in the sciences had better practices and greater knowledge of these diseases than students from another area of study. This underlines the need for continuous and targeted health education and surveillance actions by focusing on the least informed students, which include students with high school diplomas other than scientific. The fundamental goal of these initiatives will be to help students develop the skills needed to function as future members of society and leaders.

Table 3: Students' knowledge and belief about sandflies

Question	Number	Percentage (%)
Knowledge of how dangerous the insects are		
Yes	356	92.5%
No	29	7.5%
Knowledge of mosquito vectors of leishmaniasis		
Yes	210	54.5%
No	175	45.5%
Transmitting vectors of leishmaniasis		
Culex	5	1.3%
Aedes	11	2.9%
Anopheles	31	8.1%
Sandflies	136	35.3%
No idea	202	52.5%
Food of leishmaniasis vectors		
Blood	151	39.2%
Plants	22	5.7%
Organic stuff	39	10.1%
No idea	173	44.9%
Breeding places of leishmaniasis vectors		
Soil	30.	7.8%
Tree hollows	13	3.4%
Water	79	20.5%
Caves	8	2.1%
Stables	9	2.3%
Manures	14	3.6%
No idea	232	60.3%
Activity period of leishmaniasis vectors		
Summer	153	39.7%
Autumn	21	5.5%
Winter	9	2.3%
Spring	24	6.2%
No idea	178	46.2%

Table 4: Students' practice and behavior concerning the prevention and control of insect vectors

Question	Number	Percentage (%)
Methods of mosquito control		
Chemical	172	44.7%
Mechanical	39	10.1%
Biological	62	16.1%
Genetic	10	2.6%
No idea	102	26.5%
Means of control		
Mosquito repellent plug	34	8.8%
Plant / Herb	9	2.3%
Repellent / Sprays	30	7.8%
Insecticides	72	18.7%

Wearing long clothes	54	14%
Hygiene	54	14%
Mosquito nets	84	21.8%
No idea	48	12.5%
Means of prevention according to students		
Education	117	30.4%
Intra and inter-sectoral collaboration	20	5.2%
Communication and awareness-raising	55	14.3%
Information	50	13%
Vaccination	60	15.6%
Scientific research	36	9.4%
Sanitation	8	2.1%
No idea	39	10.1%

Table 5: Pearson's Chi-square (X^2) test analysis of demographic variables and students' knowledge and practice.

Variable	**Knowledge status**		X^2	***p-value***	**Practice status**		X^2	***p-value***
	Good	***Poor***			***Good***	***Poor***		
Gender								
Male	57	51	0.674	0.412	47	61	0.466	0.495
Female	159	118			110	167		
Age groups								
18-30	190	158	3.666	0.300	139	209	1.440	0.696
30-40	20	10			14	16		
40-50	4	1			3	2		
50+	2	0			1	1		
Field of study in high school								
Sciences	137	47	62.363	0.000*	99	85	83.680	0.000*
Literature	39	93			32	100		
Economic & social sciences	40	29			26	43		
Academic Level								
3rd year of Licence	132	125	4.130	0.127	100	157	23.456	0.000*
Master	45	27			28	44		
Doctorate	39	17			29	27		

*: Significant correlation at 95% confidence interval (*p-value*< 0.05).

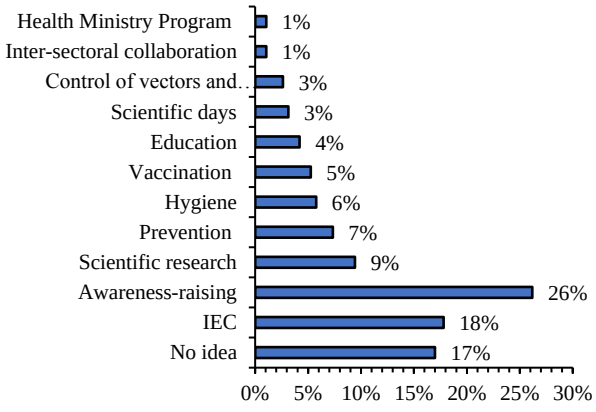

Figure 1: Students' suggestions for improving knowledge in the context of prevention relating to vectors of infectious diseases.

Conclusion

The findings of the present study reveal that students have little understanding of leishmaniasis, sandflies, their relationship to the infection, and control methods. In addition, a significant association between the demographic variable (field of study in high school) and knowledge, as well as practice levels was discovered. These findings support previous studies and demonstrate the necessity of health education and awareness campaigns for students, who will be future leaders, to eliminate this disease epidemics transmitted by insects and achieve the country's goal of eradicating leishmaniasis by 2030.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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