ORIGINAL ARTICLE

Domestic and peridomestic risk factors associated with transmission of cutaneous leishmaniasis in three hypo endemic, endemic, and hyper endemic areas: A randomized epidemiological study

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Background: Leishmaniasis is an infection caused by leishmania protozoa. Knowledge about health effects associated with environment situation and human behavior in national and local levels seems to be very necessary. **Materials and Methods:** This cross-sectional case-control study was carried out in three adjacent counties of Isfahan province in Iran. Data were collected by face-to-face interviewing and recorded structured questionnaire. Statistical analysis was performed using Chi-square test and logistic. $P < 0.05$ was considered as significant. **Results:** The economic level had significant association with cutaneous leishmaniasis (CL) transmission ($P < 0.05$). However, there was no significant association between existence of food storage and transmission of CL. We, however, found significant reduction of CL transmission following use of insect control measures ($P < 0.05$). The odds ratio for peridomestic transmission was 0.420 for houses that weren't round with any old or ruined houses. **Conclusion:** We conclude that among aforementioned risk factors, the impact of peridomestic factors is stronger in CL transmission when compared with domestic and behavioral factors.

Key words: Cutaneous leishmaniasis, domestic, human behavior, peridomestic, risk factors

How to cite this article: Nilforoushzadeh MA, Hosseini SM, Heidari A, Bidabadi LS, Siadat AH. Domestic and peridomestic risk factors associated with transmission of cutaneous leishmaniasis in three hypo endemic, endemic, and hyper endemic areas: A randomized epidemiological study. J Res Med Sci 2014;19:928-32.

INTRODUCTION

Leishmaniasis is an infection caused by special protozoa named leishmania protozoa, and are usually transmitted by the bite of phlebotomine sand flies.[1] Leishmaniasis is endemic in 88 countries nearly throughout all worlds. Cutaneous leishmaniasis (CL) occurs in the new world and in the old world. In the old world, the disease is primarily caused by Leishmania tropica in urban areas (dry type) and leishmania major (wet type) in dry desert areas.[2] CL is still considered and growing as an important health problem and concern in especially the Mediterranean region, some countries of Africa, and almost all countries of the Middle East, including Iran.[3-6] The prevalence of infection is high in some provinces of Iran such as Isfahan. Isfahan is a well-known endemic area of zoonotic cutaneous leishmaniasis. In north east of Isfahan, the disease incidence is high.[7,8] Interventions for decreasing sand fly abundances and biting rates in domestic and peridomestic transmission foci, may reduce outbreak. In a study by Campbell-Lendrum *et al*., it was shown the significantly decrease in CL incidence in protected houses during the trial.[9] Also some activities such as working or helping in an agricultural area or water collection could be associated with an increased risk of CL.[10] Because most time of people are spent in residential and work environment a knowledge about health effects associated with environment situation and human behavior in seems to be necessary. This study is designed to determine association of domestic and extra domestic characteristics, human behaviors and occupational activities with CL transmission.

MATERIALS AND METHODS

This study was carried out in three adjacent counties of Isfahan province: Borkhar, Malekshahr and Isfahan counties, which are hyper endemic, endemic, and hypo endemic for leishmanisis, respectively.

This was a cross-sectional case-control study that cases and controls were matched by sex, age, resident duration and census tract.

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Received: 24-07-2013; **Revised:** 15-12-2013; **Accepted:** 20-05-2014

Study cases were selected from patients with positive direct smear for CL and from the three areas of Isfahan province during 2007-2008 and have had positive direct smear for leishmaniasis parasite or had positive clinical approve from skin specialist and if were positive, they were created record.

Controls consisted subjects living in the study areas and had no clinical signs of CL or its scar and were selected among residents of households in the same patients' census tract.

Sample size was calculated to be 200 for each group using the following formula (with $\alpha = 0.05\ p1 = 0.5\ p2 = 0.5\ d = 0.1$).

$N = [z\ (1 - \alpha/2)]^2\ [p1\ (1 - p1) + p2\ (1 - p2)]/d^2\ N = 200$ per group.

Sample population was selected by simple randomization technique according to filed patient record numbers. First, all of residential addresses of patients referred to skin diseases and leishmaniasis research center were coded in SPSS software (SPSS Inc. 233 South Wacker Drive, 11th Floor Chicago, IL 60606-6412), then study area selected codes were evaluated in ratio followed by randomized, in order to these patient addresses, they were extracted according to their record numbers. If the chosen patient record was not eligible for study the next ones were evaluated for eligibility.

Data collected by face to face interviewing in a structured questionnaire applied by a team of trained primary health workers. Interviewers observed domestic and peridomestic environment of cases and controls and filled the questionnaires.

The questionnaire contained several sections including:

1. Sociodemographic characteristics: Age, sex, level of education, economic level, address code, and duration of residency
2. Domestic (indoor) factors: Family size, number of rooms, construction materials, type of main entrance, food storage, domestic animals, garbage collection, type of floor and roof, preventive activities (insecticide spraying)
3. Peridomestic factors: Presence and distance to any construction, location of garbage, animal sheds, sources of water, roadway and agricultural areas around the houses
4. Human behavior: Sleep location in summer and spring, swimming and occupational activities and dealing with soil and animals.

Its validity and reliability were confirmed through consulting with a panel of experts (hygiene professionals and statisticians) and pilot study performance.

Statistical analysis was conducted using Chi-square test for qualitative (categorized) variables for finding the significant variables related to leishmaniasis involving, and for some variables associated with leishmanisis, a multivariate analysis (logistic regression) was conducted to detect interactions between variables. This binary logistic analysis performed by forward conditional method defined categorical variables with simple contrast and with selection of first category as reference category. $P < 0.05$ was assumed as significant.

RESULTS

The distribution of cases and controls did not differ by age, sex, duration of residency, and census tract. Overall the ratio of cases-controls was 1. The lowest frequency of age group was 1-3 years (4%), and highest was 18-40 years old (43.3%).

Sex of total population in this study included 60.3% of the patients were male and 39.8% of them were females and maximum frequency of residential duration range was in 5 or <5 years.

In other sociodemographic characteristics, the level of education and the type of endemic area weren't significant in related to CL transmission ($P > 0.05$) and the economic level was significant, which cases included 17% high, 54% medium, 29% low economic level, and controls included 8.5% high, 62% medium, 29.5% low economic level ($P = 0.03$). The risk of CL transmission related to economic level is shown in Table 1. High economic level became reference category and the odds ratio (ORs) associated with this variable were statistically significant. The ORs of the association between medium and low compared with high economic levels showed that ratio of low level (2.034) for CL transmission was less than medium level (2.296).

Factors that were significantly associated with domestic (indoor) and peridomestic leishmaniasis transmission ($P < 0.05$) are shown in Table 2.

Some domestic variables contributed significantly in the multivariate analysis remained [Table 3]: House measurement (square meter), type of floor, insect control by members of the household, and food storage. In houses measurement variable, we can be noted that cases houses

Table 1: Risk of CL transmission related to economic level

Economic level	*P* value	OR	95% CI	
			Lower	Upper
High (base)	0.038			
Medium	0.011	2.296	1.215	4.341
Low	0.042	2.034	1.025	4.039

CI = Confidence interval; CL= Cutaneous leishmaniasis; OR = Odds ratio

were wider than controls. The risk of CL transmission related to house measurement between 100 and 200 m² (0.589) was more than other categories compared with 100 m² or <100 m² house measurement as reference category. In food storage variable, the risk was 0.247 and also in insect control variable was 0.120 in those who didn't have any storage and insect control compared with those who have had these variables. Furthermore, in the categories of floor types variable, the risk of CL transmission related to floors, which made up mosaic and gatch (1.033) was more than ceramic category compared with floors made up sun-dried bricks.

Among peridomestic factors that were suitable for multivariate analysis, four factors were significantly associated with CL [Table 4]. The ORs of peridomestic transmission were 0.420 for houses that didn't round with any old or ruined houses, but it was different for peridomestic animal sheds or kennels and water sources. The risk of peridomestic roadways >50 meter was higher other categories related to this variable.

Table 2: Significant domestic (indoor) and peridomestic factors associated with CL transmission

Domestic and peridomestic factors	Cases counts (%)	Controls counts (%)	Pearson Chi-square Asymptotic significant (2-sided)
House measurement			
100 m² or <100 m²	27 (30.7)	61 (69.3)	<0.001
Between 100 and 200 m²	77 (46.4)	89 (53.6)	
200 m²	52 (75.4)	17 (24.6)	
Between 200 and 300 m²	30 (66.7)	15 (33.3)	
300 m² or >300 m²	14 (43.8)	18 (56.3)	
Food storage			
Storage existence	4 (20.0)	16 (80.0)	0.006
No storage	196 (51.6)	184 (48.4)	
Insect control			
Control perform	13 (15.7)	70 (84.3)	<0.001
No control	187 (59.0)	130 (41.0)	
Floor type			
Sun-dried bricks	10 (62.5)	6 (37.5)	<0.001
Ceramic	29 (96.7)	1 (3.3)	
Mosaic and gatch	161 (45.5)	193 (54.5)	
Peridomestic unutilized land			
Yes	167 (54.4)	140 (45.6)	0.001
No	33 (35.5)	60 (64.5)	
Peridomestic old or ruined houses			
Yes	60 (40.8)	87 (59.2)	0.005
No	140 (55.3)	113 (44.7)	
Peridomestic animal sheds or kennels			
Yes	165 (57.1)	124 (42.9)	<0.001
No	35 (31.5)	76 (68.5)	
Agricultural lands distants to house			
>200 m	106 (56.1)	83 (43.9)	0.003
<200 m	52 (54.2)	44 (54.8)	
No agricultural lands	42 (36.5)	73 (63.5)	
Water sources distants to house			
>150 m	96 (57.5)	71 (42.5)	<0.001
<150 m	23 (85.2)	4 (14.8)	
No water source	81 (39.3)	125 (60.7)	
Roadways distants to house			
>50 m	70 (68.6)	32 (31.4)	<0.001
<50 m	9 (27.3)	24 (72.7)	
No roads	121 (45.7)	144 (54.3)	

CI = Confidence interval; CL = Cutaneous leishmaniasis

Table 3: Risk of CL transmission (ORs) related to domestic (indoor) factors with 95% CIs

Domestic (indoor) factors	*P* value	OR	95% CI	
			Lower	Upper
House measurement				
100 m² or <100 m² (base)	0.003			
Between 100 and 200 m²	0.088	0.589	0.321	1.083
200 m²	0.000	0.235	0.109	0.509
Between 200 and 300 m²	0.012	0.330	0.139	0.786
300 m² or >300 m²	0.076	0.416	0.158	1.096
Food storage				
No storage	0.038	0.247	0.066	0.924
Storage existence (base)				
Insect control				
No control	0.000	0.120	0.056	0.255
Control perform (base)				
Floor type				
Sun-dried bricks (base)	0.002			
Ceramic	0.001	0.021	0.002	0.226
Mosaic and gatch	0.953	1.033	0.352	3.028

CI = Confidence interval; CL = Cutaneous leishmaniasis; OR = Odds ratio

Table 4: Risk of CL transmission (ORs) related to peridomestic factors with 95% CIs

Peridomestic factors	*P* value	OR	95% CI	
			Lower	Upper
Peridomestic old or ruined houses				
No	0.000	0.420	0.263	0.671
Yes (base)				
Peridomestic animal sheds or kennels				
No	0.001	2.467	1.466	4.151
Yes (base)				
Water sources distants to house				
>150 m (base)	0.002			
<150 m	0.019	0.255	0.082	0.798
No water source	0.029	1.679	1.054	2.674
Roadways distants to house				
>50 m (base)	0.000			
<50 m	0.001	0.195	0.075	0.505
No roads	0.091	0.465	0.192	1.129

CI = Confidence interval; CL = Cutaneous leishmaniasis; OR = Odds ratio

In human behavior factors, job and professional behavior have significant affects on CL transmission [Table 5].

Variables in this section in the equation for OR comparing, were bite exposure in job and involvement with soil [Table 6]. Individuals who didn't have any bite exposure had higher risk of CL (OR = 10.314) as compared with those who didn't involve with soil in their jobs (OR = 2.133).

DISCUSSION

This study has shown the impact of economic level, which the risk of CL transmission for low and medium economic level was more than high level. In domestic factors, it was indicated that cases houses had higher measurement than controls. However, it wasn't consistent with economic level and it was possibly because of other criteria consideration (such as income level). Although floors and plinths of houses, soil at the edges and at the bases of stone walls are good sites for the sandflies breeding,[11] but in this study floors made up sun-dried bricks weren't strongly associated with CL transmission. This isn't interpreted for insect control, that there was relationship between insect control (spray implementation) for CL prevention.

In a study by Yadon *et al*., it was also shown that the adjusted OR of the association between products stored with no-storage showed a small decrease compared with the crude OR.[10] This is consistent with our study.

Among peridomestic factors, presence of old or ruined houses and roadway around the house were most associated with CL transmission.

The importance of domestic transmission is reconsideration of the view that CL can be considered occupational diseases since they are directly related to professional activities.[12] In spite, our results showed that the percent of jobs that involve with soils, animals and farms and also drivers in cases were more than controls. However, it was opposite for impact of these variables in risk of CL transmission that the ORs of involvement with soil and bite exposure in job were very less than no involvement with soil or no bite exposure.

These results illustrate the need for the peridomestic prevention of CL transmission in these study areas. We conclude that among aforementioned risk factors, the impact of peridomestic factors is stronger in CL transmission as compared with domestic and behavioral factors. Hence, according to many studies investigated these factors,[9,10,13-15] we recommend to select and compare these factors in other areas specially two type of urban and rural areas.

Table 5: Significant professional behavior factors associated with CL transmission

Professional behavior factors	Cases counts (%)	Controls counts (%)	Pearson Chi-square Asymptotic significant (2-sided)
Job			
Free jobs	34 (44.7)	42 (55.3)	0.003
House holders	124 (47.3)	138 (52.7)	
Drivers	12 (100.0)	0 (.0)	
Governmental jobs	18 (58.1)	13 (41.9)	
Workers and farmers	12 (63.2)	7 (36.8)	
Involvement with animals			
Yes	23 (74.2)	8 (25.8)	0.005
No	177 (48.0)	192 (52.0)	
Involvevement with soil			
Yes	94 (66.7)	47 (33.3)	<0.001
No	106 (40.9)	153 (59.1)	
Bite exposure in job			
Yes	57 (90.5)	6 (9.5)	<0.001
No	143 (42.4)	194 (57.6)	

Table 6: Risk of CL transmission (ORs) related to professional behavior factors with 95% CIs

Behavior factors	*P* value	OR	95% CI	
			Lower	Upper
Involvevement with soil				
No	0.001	2.133	1.349	3.373
Yes (base)				
Bite exposure in job				
No	0.000	10.314	4.278	24.870
Yes (base)				

CI = Confidence interval; CL = Cutaneous leishmaniasis; OR = Odds ratio

ACKNOWLEDGMENT

To all researchers and participants contributed our study. Research Project Number: 286046.

AUTHORS CONTRIBUTION

MAN contributed in the work, conducting the study, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work. SMH contributed in the conception of the work, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work. AH contributed in the conception of the work, conducting the study, drafting and revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work. LSB contributed in the work, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work. AHS contributed in the work, revising the draft, approval of the final version of the manuscript, and agreed for all aspects of the work.

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Source of Support: Nil, **Conflict of Interest:** None declared.