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RISK ASSESSMENT OF ZOONOTIC CUTANEOUS LEISHMANIASIS CASES AMONG MANUAL WORKERS IN EGYPT

By
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Abstract

The Egyptian endemic foci of cutaneous leishmamasis were mainly in the Sinai Peninsula. To study the epidemiological characteristics of zoonotic cutaneous leishmaniasis cases in special groups in endemic area in Sinai, a descriptive study was conducted to assess the risk of cutaneous leishmania within spreading places in Sinai among special groups working in endemic areas, during the study period from January- December 2015. All patients in the study setting described before were submitted to clinical examination and history taking based on epidemiologically linked diagnosis. Their total number was (124) cases divided into (85) patients locally treated and (39) patients referred to central hospital.

The results showed that (85.5%) was in middle education class, had stable work (87%) and working in manual services (91.1). A total of 58.1% slept outdoor at the dusk time (54%). Three quarters (75.8%) didn't use insect repellant and 56.55 didn't use bed nets. Sandy ground, mountain and desert surrounds geographic environment (100%, 97.6% & 96%) respectively. They lived in one floor buildings (85%), dormitories habitat (98%), soiled (92%), have cracks on the wall (60%), ceiling made of wood (74%) and fence was not available in majority of buildings (96.8%). Disfiguring was commonest complain in 55% of cases. The lesions (85%) were ulcers (2x2cm in size (51%), at lower limb (55%) and two in numbers in (50%). All cases were treated with fluconazole and 8.9% was cured. Stibogluconate was given to 91% and with cure rate of 53%. Both Cryotherapy and laser therapy was applied to 16% of cases. Treatment cured 87% but 39.5% suffered scar complications with main sequelae (15.3%).

Key words: Egypt, ZCL, Workers, Geographic factors, Ulcers, Cryotherapy, Stibogluconate

Introduction

Leishmaniasis infection was listed by the WHO among the six most important tropical diseases, being endemic in many different countries worldwide with global estimate of 350 Million individuals at risk (WHO, 2013). CDC (2004) reported more than 12 million chronic cases worldwide. But, there was an increased incidence partially attributed to geographical expansion, population migration, international travel and/or deployment of military forces. Zoonotic cutaneous leishmaniasis (ZCL) was endemic in almost all the Eastern Mediterranean countries countries (Postigo, 2010) as well as in the nearby countries as Jordan (Morsy and el Ajlouny, 1984), Lybia (Fathy *et al*, 2009), Saudi Arabia (Mohammadi and Alhussainy, 2014), Palestine (Al-Jawabreh *et al*, 2016), Israel (Ben-Shimol *et al*, 2016), and Sudan (Karimkhani *et al*, 2016).

In Egypt, the endemic foci of the zoonotic cutaneous leishmaniasis were reported North and South Sinai and Suez Canal Zone (El Gibali and El Mansouri, 1979; Morsy, 1983; 1996; Bassili *et al*, 1983; Abdel Wahab *et al*, 1986; Mansour *et al*, 1987; Faris *et al*, 1986, 1988; Amer and Morsy, 1995: Hamadto *et al*, 2003; 2007; Morsy, 1996; 2012; 2013; Morsy *et al*, 1995; 1997). *Leishmania major* was the Culprit parasite (Wahba *et al*, 1990; Dawoud, 2004), and *Phlebotomus papatasii* proved to the main vector (Merdan *et al*, 1992; Fahmy *et al*, 2009). Hanafi *et al*. (2001) reported *Ph. sergenti* the vector of *L. tropica* as a new record in the southern Nile valley and Shehata *et al*. (2009) reported the first case of *L. tropica* from a classical focus of *L. major* in North Sinai Governorate.

As to ZCL reservoir(s), Morsy *et al.* (1996)

reported that in the Middle East, the fat rat *Psammomys obesus* is the most important reservoir animal of ZCL were identified in Sinai, *Meriones sacramenti* (Morsy *et al.* (1993) and *Gerbillus pyramidum* (Morsy *et al.* (1994) as well as the red fox *Vulpes O. aegyptica* is a new reservoir host (Morsy *et al*, 2002).

Rationale and significance: Based on the information recorded and noticed, there was an increased referral and admission of cutaneous leishmanial cases, in a general military hospital, so it was necessary to study the ecological factors for spread of this disease, Hence assessing the situation of the problem and diminishing the burden of the disease on the affected at risk group.

The work aimed to minimize or even control the spread of zoonotic cutaneous leishmaniasis in the spreading places in Egypt especially among the manual workers.

Objectives: 1- To study the prevalence of cutaneous leishmaniasis cases among manual workers along the year of 2015. 2- To identify the ecological factors favoring its spread. 3- To study the socio-demographic characteristics and predisposing factors serving as a risk factors for distribution of cutaneous leishmaniasis. 4- To describe the lines of proper prevention and management of that disease. 5- To know the potential variables that might set leishmaniasis hazards to be scattered all over Egypt and its neighboring countries and vice versa. 6- To set recommendations that should be followed for prevention of the disease.

Subjects and Methods

The study assessed the risk of cutaneous leishmania transmission within spreading places in Egypt aiming to minimize or even control its spread especially among the manual workers.

Technical design: This design entails description of the research design, setting subjects and data collection tools.

Study Design: A descriptive study design was conducted to achieve the aim of the study among the manual workers, over the period of one year.

Study setting: The study was conducted in North Sinai Governorate located in the northeastern part of Egypt (30.5°N 33.6°E) marking the point of connection between Asia and Africa. North Sinai is bordered by Gulf of Suez, Red Sea and Mediterranean Sea and is habited mainly by Bedouins. The regions comprise the following districts: El-Hassan, Beer El-Abd, Nekhel, Sheikh Zuuweid, Beer lehfen and Rafah. Beer Lehfen District was selected to conduct the study, based on its central location in North Sinai Governorate, the convenient communication and distribution of ZCL cases to understand the potential role of both sand-fly vector and rodents-reservoirs in the dynamics of zoonotic leishmaniasis transmission. This district has the diverse geographic and demographic characteristics and its "Crossroads" nature and environmental changes may create the new potential risks for disease transmission. The weather in North Sinai is characterized as hot and dry with marked differences in temperature between day and night. Dramatic weather-related changes as presented by the annual averages of environments factors during the study period from January to December 2015, as reported by the majority of patients.

All patients recruited in the study setting were included. All cases were locally submitted to clinical examination and history taken based on epidemiologically linked diagnosis, their total number was (124) cases divided into (85) patients locally treated and (39) patients referred to central hospital for treatment by the dermatologist.

Inclusion criteria were personnel with distinct skin lesion, and new arrival to Sinai.

Exclusion criteria were 1- Bedouin, 2- Subjects refuse to share in the study or confused skin lesion, could be followed-up, or with tiny small cutaneous lesion.

Data collection tools: Two tool of data collection ware adopted: I. Structured questionnaire: identifying the ecological factors enhancing leishmaniasis spread, this tool con-

sisted of two parts. First part: it includes demographic data as (age, sex, rank, occupation, education level, stay length). Second part: it includes the description of living and working environment in the study setting such as (land, building, and vegetation, and water collection, presence of insect-vector and animal-reservoir). 2. Patient sheet: finding out the epidemiology of the intended disease and consisted of: First part: included history of present illness (main complaint, lesion discovery, diagnosis, treatment, and outcome. Second part: included characteristics of skin lesion such as (type, size, site, number, complication, management of referral.

II. Operational design: 1- Pilot study to examine the clarity of language and feasibility of questionnaire validation tool and its relevance to study. It also helped to estimate the time needed for filling the questionnaire. A pilot study was conducted including 10% of cases. A final version of the tool was achieved after doing modification, addition and or omission of item of the tool. The result of the pilot study was not included in the main study data. 2- Field work: covered 12 months duration. It started from the first of January to the end of December 2015and extended to May 2016. Data were collected by personal interview by fulfilling structured questionnaire after being pre-tested in pilot study. Data were collected by well-trained interviewers under close supervision of the authors who visited the setting once every month because of security challenges. However, some data were recalled by phone.

Ill. Administrative design: The study protocol was reviewed and approved by the Committee of Military Institute of Health and Epidemiology. Once approval, an official formal letter was obtained. The aim of the study was explained to the director of the hospital, doctor and patients to obtain their written consent to conduct the study.

Ethical consideration: The permission and official approvals to carry out the study was obtained from the director of the Military Hospital for data collection. Consent was taken from the subjects of the study before the recruitment in the study sample. The questionnaire form was anonymous and only codes were used for precisions of data collection from subjects. All collected data was strictly confidential and wasn't disclosed for any reason but used only for study purposes.

Statistical analysis: Data were revised and entered into Microsoft Excel 2010 and exported to be analyzed using IBM SPSS for Windows, Version 21.0. Armonk, NY: IBM Corp. Data was summarized frequency and percentage for qualitative variables. Comparison between groups was performed using Chi square or Fisher's exact test for qualitative variables. Logistic regression was done to predict the factors with significant prediction of treatment failure. P values less than 0.05 were considered significant. Chi-Square test: to test the association between qualitative nominal variables, it was performed mainly on frequencies and determined whether the observed frequencies differ significantly from expected frequencies.

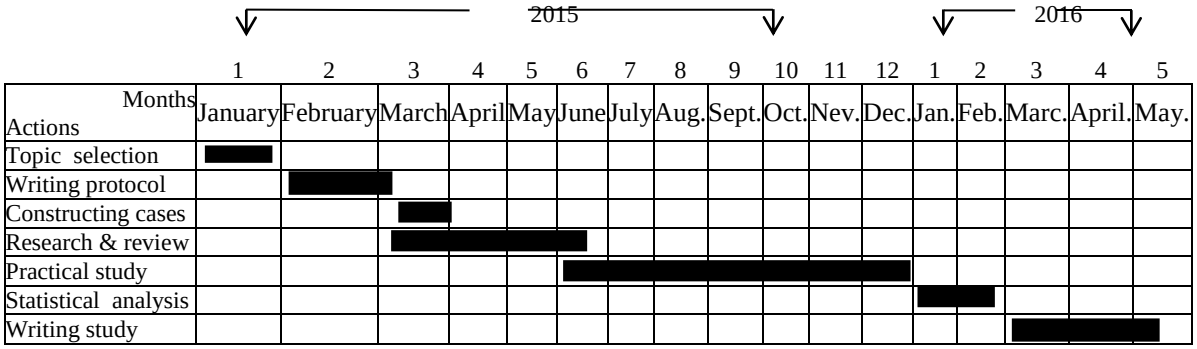
Limitations of study:1- Security threats, 2- Confidentiality defect, 3- Outreach to the place of study was very dangerous, 4- Difficulty to get sample from lesion for further diagnosed and 5-Restricting full data to obtain.

Points of weakness: The remote area, large scale of manual workers deployment, working under risky and stressful circums- tances, difficult referral or lack of reporting system.

Points of strengths: Easy to control groups, closed confined community, no attrition, good communication (strategic lines), availability of repeated examinations and follow up, plenty of chemotherapy in site (fluconazole, Na-stibogluconate), Medico-legal consideration (every patient received treatment), or strictly following medical rules (more compliance).

The results were given in tables (1 to 28).

Time of study (Gantt chart)



Results

Table 1: Sociodemographic characteristics of samples

Items	Variants	No	Percentage
Age	20-30	117	94.4
	>30	7	5.6
Sex	Male	124	100.0
Previous Occupation	Student	47	37.9
	Farmer	48	38.7
	Laborer	15	12.1
	Administrative worker	14	11.3
Education	Read & write	5	4.0
	Middle education	106	85.5
	Higher education	13	10.5
Blood group	A	55	44.4
	AB	1	.8
	B	29	23.4
	O	39	31.5
Original residence	Upper Egypt	76	61.3
	Lower Egypt	33	26.6
	Suez Canal Zone	15	12.1

Table 2: Work characteristics of samples

		No.	Percentage
Duration (months)	<6 month	5	4.0
	6-12 month	116	93.5
	>12 month	3	2.4
Nature of work	stable	108	87.1
	movable	9	7.3
	Variable/mix	7	5.6
Current task	military services	113	91.1
	logistic services	9	7.3
	deputy	2	1.6

Table 3: Prevention knowledge & practices/risk taking behavior

		No.	Percentage
Endemic information	No	113	91.1
	Yes	4	3.2
	didn't know	7	5.6
Sleeping pattern	Outdoor	72	58.1
	Indoor	24	19.4
	Both	28	22.6
Sleeping time	Dusk	67	54.0
	Mid night	25	20.2
	Dawn	32	25.8
Using insect repellants	No	94	75.8
	not know	30	24.2
Using bed nets or cover	No	70	56.5
	Yes	54	43.5

Table 4: Ecological factors of surrounding area of sample

Items	Variants	No.	Percentage
Geographical factors	Mountains	121	97.6
	Hills	3	2.4
Surrounding area	Desert	119	96.0
	Residential	5	4.0
Ambient ground	sandy	124	100.0
Presence of vegetation	desert plant	114	91.9
	trees	10	8.1
Presence of water collection	No	124	100.0
Presence of animal	rodent	108	87.1
	dog	18	14.5
	cat	19	15.3
Seeing sand fly	No	98	79.0
	at night	25	20.2
	Day time	1	.8
Breeding place availability	Bathroom/toilet	119	96.0
	waste	4	3.2
	vegetation	1	.8

Table 5: Housing/ building design of working places activity of samples

	Variants	No.	Percentage
Levels of buildings	One floor	113	91.1
	Multiple floor	0	0
	Underground	11	8.9
Construction materials	Cement	111	89.5
	Mud	2	1.6
	Metal	11	8.9
Household (habitat status)	Room	2	1.6
	Dormitories	122	98.4
Floor status	Soiled	115	92.7
	Tiled*	2	1.6
	Cemented	7	5.6
Wall status	Plastered	2	1.6
	Rough	47	37.9
	cracks crevices	75	60.5
Ceiling status	Cement	2	1.6
	Wood	92	74.2
	Metal	30	24.2
Surrounding defence	Low	4	3.2
	Absent	120	96.8

Table 6: Time of insect bite and onset of lesions of samples

	Months	No.	Percentage
Time of insect bite	June	76	61.3
	July	19	15.3
	August	3	2.4
	not know	26	21.0
Onset of lesion	July	2	1.6
	August	47	37.9
	September	64	51.6
	Not know	11	8.9%

Table 7: Initial complain, referral and diagnosis among samples

	Variants	No.	Percentage
Main presented symptom	Asymptomatic (painless)	39	31.5
	Painful	15	12.1
	Itching	1	.8
	Disfiguring	69	55.6
Lesion discovering	By himself	93	75.0
	By colleagues	23	18.5
	By work physician	8	6.5
who referred (n=72)	Responsible physician	40	32.2
	Himself	12	9.7
Presumptive diag-nosis	allergy	2	1.6
	Viral/bacterial infection	7	5.6
	Clinically Suspected	115	92.7
Method of definite diagnosis	Clinical	3	2.4
	Laboratory	3	2.4
	Epidemiology to confirmed case	118	95.2

Missing=52(41.9%)

Table 8: Lesion characteristics among samples

Lesion	Variants	No.	Percentage
Type	Papule	3	2.4
	Nodule	13	10.5
	Ulcer	106	85.5
	Scar	2	1.6
Size	1x1	57	46.0
	2x2	64	51.6
	More	3	2.4
Site	Upper Limb	46	37.1
	Lower Limb	69	55.6
	Face	8	6.5
	Trunk	1	.8
Number	One	24	19.4
	Two	62	50.0
	3-5	26	21.0
	>5(Multiple)	12	9.7

Table 9: Treatment and outcome among samples

Treatment	Treatment outcome	No.	Percentage
Locally a-Fluconazole	Total received	124	100
	Cured	11	8.9
b-sodium stiboglyconate	Total received	113	91.1
	Cured	61	53.98
After referring	Surgical	2	1.6
	Cryotherapy	16	12.9
	Thermotherapy	3	2.4
	Laser	19	15.3
	No more treatment	12	9.7
Outcome	Cured	108	87.1
	Failed	15	12.1
	Adverse effect	1	.8
Follow up	No	96	77.4
	Yes	28	22.6
Complications	No complications	75	60.5
	Secondary infection	15	12.1
	Increase size	15	12.1
	Dark scar	19	15.3

Table 10: Lesion discovery and ZCL endemic knowledge among samples

Discovery	No		Yes		
By himself	86	76.1%	7	63.6%	0.249
By colleague	21	18.6%	2	18.2%	
By physician	6	5.3%	2	18.2%	
Total	113	100.0%	11	100.0%	

Table 11: Lesion size and ZCL endemicity knowledge among samples.

Lesion		No		Yes		P value
		No.	%	No.	%	
size	1x1	50	44.2%	7	63.6%	0.109
	2x2	61	54.0%	3	27.3%	
	more	2	1.8%	1	9.1%	
Total		113	100.0%	11	100.0%	

Table 12: Lesion site and ZCL endemicity knowledge among samples.

Lesion site	No		Yes		P value
	No.	%	No.	%	
Upper limb	45	39.8%	1	9.1%	0.004
Lower limb	61	54.0%	8	72.7%	
Face	7	6.2%	1	9.1%	
Trunk	0	0.0%	1	9.1%	
Total	113	100.0%	11	100.0%	

Table 13: Number of lesions and ZCL endemicity knowledge among samples.

Lesion number	No		Yes		P value
	No.	%	No.	%	
one	23	20.4%	1	9.1%	0.475
Two	55	48.7%	7	63.6%	
3-5	23	20.4%	3	27.3%	
>5 (multible)	12	10.6%	0	0.0%	
Total	113	100.0%	11	100.0%	

Table 14: Association between lesions characteristics and age groups

Lesion	Picture	20-30 year		>30		P value
Type	Papule	3	2.6%	0	0.0%	0.038
	Nodule	10	8.5%	3	42.9%	
	Ulcer	102	87.2%	4	57.1%	
	Scar	2	1.7%	0	0.0%	
Size	1x1	51	43.6%	6	85.7%	0.094
	2x2	63	53.8%	1	14.3%	
	more	3	2.6%	0	0.0%	
Site	upper limb	44	37.6%	2	28.6%	0797
	lowe limb	64	54.7%	5	71.4%	
	face	8	6.8%	0	0.0%	
	trunk	1	0.9%	0	0.0%	
No.	one	23	19.7%	1	14.3%	0.234
	two	56	47.9%	6	85.7%	
	3-5	26	22.2%	0	0.0%	
	>5(multible)	12	10.3%	0	0.0%	

Table 15: Association between lesions characteristics and patient's rank

Lesion		Officer		Warrant officer		Manual workers		P value
Type	Papule	0	0.0%	0	0.0%	3	2.7%	0.433
	Nodule	0	0.0%	3	33.3%	10	8.8%	
	Ulcer	2	100.0%	6	66.7%	98	86.7%	
	Scar	0	0.0%	0	0.0%	2	1.8%	
Size	1x1	0	0.0%	7	77.8%	50	44.2%	0.220
	2x2	2	100.0%	2	22.2%	60	53.1%	
	More	0	0.0%	0	0.0%	3	2.7%	
Site	Upper limb	1	50.0%	2	22.2%	43	38.1%	0.881
	Lower limb	1	50.0%	7	77.8%	61	54.0%	
	Face	0	0.0%	0	0.0%	8	7.1%	
	Trunk	0	0.0%	0	0.0%	1	0.9%	
No.	One	0	0.0%	1	11.1%	23	20.4%	0.411
	Two	2	100.0%	7	77.8%	53	46.9%	
	3-5	0	0.0%	0	0.0%	26	23.0%	
	>5(multible)	0	0.0%	1	11.1%	11	9.7%	

Table 16: Association between lesions characteristics and previous occupation

Lesion		Student		Farmer		Laborer		Administrative worker		P value
Type	Papule	2	4.3%	0	0.0%	1	6.7%	0	0.0%	0.421
	Nodule	7	14.9%	3	6.3%	1	6.7%	2	14.3%	
	Ulcer	38	80.9%	44	91.7%	12	80.0%	12	85.7%	
	Scar	0	0.0%	1	2.1%	1	6.7%	0	0.0%	
Size	1x1	18	38.3%	20	41.7%	9	60.0%	10	71.4%	0.302
	2x2	28	59.6%	26	54.2%	6	40.0%	4	28.6%	
	More	1	2.1%	2	4.2%	0	0.0%	0	0.0%	
Site	Upper limb	19	40.4%	19	39.6%	3	20.0%	5	35.7%	0.044
	Lower limb	28	59.6%	24	50.0%	8	53.3%	9	64.3%	
	Face	0	0.0%	4	8.3%	4	26.7%	0	0.0%	
	Trunk	0	0.0%	1	2.1%	0	0.0%	0	0.0%	
No.	One	12	25.5%	7	14.6%	4	26.7%	1	7.1%	0.353
	Two	24	51.1%	21	43.8%	7	46.7%	10	71.4%	
	3-5	9	19.1%	13	27.1%	3	20.0%	1	7.1%	
	>5(multiple)	2	4.3%	7	14.6%	1	6.7%	2	14.3%	

Table 17: Association between lesions characteristics and patient's education level

Lesion		Read & write		Middle education		High education		P value
Type	Papule	0	0.0%	3	2.8%	0	0.0%	0.937
	Nodule	0	0.0%	11	10.4%	2	15.4%	
	Ulcer	5	100.0%	90	84.9%	11	84.6%	
	Scar	0	0.0%	2	1.9%	0	0.0%	
Size	1x1	3	60.0%	43	40.6%	11	84.6%	0.048
	2x2	2	40.0%	60	56.6%	2	15.4%	
	More	0	0.0%	3	2.8%	0	0.0%	
Site	Upper limb	1	20.0%	38	35.8%	7	53.8%	0.718
	Lower limb	4	80.0%	59	55.7%	6	46.2%	
	Face	0	0.0%	8	7.5%	0	0.0%	
	Trunk	0	0.0%	1	0.9%	0	0.0%	
No.	one	1	20.0%	21	19.8%	2	15.4%	0.706
	two	3	60.0%	52	49.1%	7	53.8%	
	3-5	0	0.0%	22	20.8%	4	30.8%	
	>5 (multiple)	1	20.0%	11	10.4%	0	0.0%	

Table 18: Association between lesions characteristics and sleeping pattern

Lesion		Outdoor		Indoor		Both		Total		P value
		No.	%	No	%	No	%	No	%	
Type	Papule	2	2.8%	0	0.0%	1	3.6%	3	2.4%	0.077
	Nodule	5	6.9%	5	20.8%	3	10.7%	13	10.5%	
	Ulcer	65	90.3%	19	79.2%	22	78.6%	106	85.5%	
	Scar	0	0.0%	0	0.0%	2	7.1%	2	1.6%	
Size	1x1	36	50.0%	11	45.8%	10	35.7%	57	46.0%	0.660
	2x2	34	47.2%	13	54.2%	17	60.7%	64	51.6%	
	More	2	2.8%	0	0.0%	1	3.6%	3	2.4%	
Site	Upper limb	29	40.3%	9	37.5%	8	28.6%	46	37.1%	0.620
	Lower limb	36	50.0%	15	62.5%	18	64.3%	69	55.6%	
	Face	6	8.3%	0	0.0%	2	7.1%	8	6.5%	
	Trunk	1	1.4%	0	0.0%	0	0.0%	1	0.8%	
No.	One	14	19.4%	4	16.7%	6	21.4%	24	19.4%	0.692
	Two	36	50.0%	14	58.3%	12	42.9%	62	50.0%	
	3-5	17	23.6%	4	16.7%	5	17.9%	26	21.0%	
	>5 (multiple)	5	6.9%	2	8.3%	5	17.9%	12	9.7%	

Table 19: Outcome and sequellae treatment with sleeping pattern

Treatment	Outdoor		Indoor		Both		Total		P value
Outcome	No.	%	No.	%	No.	%	No.	%	
Cured	63	87.5	22	91.7	23	82.1	108	87.1	0.410
Failed	9	12.5	2	8.3	4	14.3	15	12.1	
Adverse effect	0	0.0	0	0.0	1	3.6	1	0.8	
No side effect	42	58.3	16	66.7	17	60.7	75	60.5	0.985
2ry infection	10	13.9	2	8.3	3	10.7	15	12.1	
Increase size	9	12.5	3	12.5	3	10.7	15	12.1	
Scar	11	15.3	3	12.5	5	17.9	19	15.3	

Table 20: Association between work characteristics and outcome

		Cured		Failed		Adverse effect		Total		P value
		No	%	No	%	No	%	No	%	
Original/ residence	Upper Egypt	68	63.0	7	46.7	1	100.0	76	61.3	0.384
	Lower Egypt	26	24.1	7	46.7	0	0.0	33	26.6	
	Suez canal zone	14	13.0	1	6.7	0	0.0	15	12.1	
Length of stay in months	<6mo	5	4.6	0	0.0	0	0.0	5	4.0	0.867
	6-12mo	106	93	15	100.0	1	100.0	116	93.5	
	>12mo	3	2.8	0	0.0	0	0.0	3	2.4	
Nature of work	Stable	94	87.0	13	86.7	1	100.0	108	87.1	0.996
	Movable	8	7.4	1	6.7	0	0.0	9	7.3	
	Variable/ mix	6	5.6	1	6.7	0	0.0	7	5.6	
Current task	Manual services	98	90.7	14	93.3	1	100.0	113	91.1	0.983
	Logistic services	8	7.4	1	6.7	0	0.0	9	7.3	
	Deputy	2	1.9	0	0.0	0	0.0	2	1.6	

Table 21; Prevention ZCL knowledge and practices and treatment outcome

Prevention ZCL knowledge		Cured		Failed		Adverse effect		Total		P value
		No	%	No	%	No	%	No	%	
	No	99	91.7	13	86.7	1	100.0	113	91.1	0.651
	Yes	4	3.7	0	0.0	0	0.0	4	3.2	
	Didn't know	5	4.6	2	13.3	0	0.0	7	5.6	
Sleeping pattern	Outdoor	63	58.3	9	60.0	0	0.0	72	58.1	0.410
	Indoor	22	20.4	2	13.3	0	0.0	24	19.4	
	Both	23	21.3	4	26.7	1	100.0	28	22.6	
Sleeping time	Dusk	57	52.8	9	60.0	1	100.0	67	54.0	0.876
	Mid-night	22	20.4	3	20.0	0	0.0	25	20.2	
	Dawn	29	26.9	3	20.0	0	0.0	32	25.8	
Repellant	No	82	75.9	12	80.0	0	0.0	94	75.8	0.194
	Not Know	26	24.1	3	20.0	1	100.0	30	24.2	
Bed nets or cover	No	63	58.3	7	46.7	0	0.0	70	56.5	0.361
	Yes	45	41.7	8	53.3	1	100.0	54	43.5	

Table 22: Prevention ZCL knowledge and practices and site of lesion

Prevention ZCL knowledge	Upper limb		Lower limb		Face		Trunk		Total		P value
	No	%	No	%	No	%	No	%	No	%	
No	45	97.8	61	88.4	7	87.5	0	0.0	113	91.1	0.002
Yes	1	2.2	3	4.3	0	0.0	0	0.0	4	3.2	
Didn't know	0	0.0	5	7.2	1	12.5	1	100.0	7	5.6	

Table 23: Sleep pattern and time with site of lesion

	Upper limb		Lowe limb		Face		Trunk		Total		P value
	No	%	No	%	No	%	No	%	No	%	
Sleeping Outdoor	29	63.0	36	52.2	6	75.0	1	100.0	72	58.1	0.620
Sleeping Indoor	9	19.6	15	21.7	0	0.0	0	0.0	24	19.4	
Both	8	17.4	18	26.1	2	25.0	0	0.0	28	22.6	
Time Dusk	31	67.4	33	47.8	2	25.0	1	100.0	67	54.0	0.182
Time Mid-night	8	17.4	15	21.7	2	25.0	0	0.0	25	20.2	
Time Dawn	7	15.2	21	30.4	4	50.0	0	0.0	32	25.8	

Table 24: Using bed-nets or cover and lesion's size

Lesion		No		Yes		Total		P value
		No	%	No	%	No	%	
Size	1 x 1	27	38.6	30	55.6	57	46.0	0.093
	2 x 2	42	60.0	22	40.7	64	51.6	
	More	1	1.4	2	3.7	3	2.4	

Table 25: Using bed nets or cover and lesion's site

Lesion		No		Yes		Total		P value
		No	%	No	%	No	%	
Site	Upper limb	25	35.7	21	38.9	46	37.1	0.668
	Lower limb	40	57.1	29	53.7	69	55.6	
	Face	5	7.1	3	5.6	8	6.5	
	Trunk	0	0.0	1	1.9	1	0.8	

Table 26: Using bed nets or cover and number of lesion

Lesion	No		Yes		Total		P value
	No.	%	No.	%	No.	%	
One	14	20.0	10	18.5	24	19.4	0.394
Two	36	51.4	26	48.1	62	50.0	
3-5	16	22.9	10	18.5	26	21.0	
>5(multiple)	4	5.7	8	14.8	12	9.7	

Table 27: Surrounding area and vector breeding place

Breeding site	Desert		Residential		Total		P value
	No.	%	No.	%	No.	%	
Bathroom/toilet	115	96.6	4	80.	119	96.0	0.000
Waste	4	3.4	0	0.0	4	3.2	
Vegetation	0	0.0	1	20	1	0.8	

Table 28: Predictors of treatment failure among samples.

	B	Sig.	Exp. (B)
Constant	-18.090	.999	.000
Occupation (administrative worker/ students)	3.388	.002	29.595
Education (middle education/ read and write)	-2.923	.017	.054
Building design (underground/one floor	1.331	.050	3.784
Lesion discovering (by colleague or himself)	1.215	.044	3.369
Complications (increase size/ none)	2.319	.005	10.160

Discussion

Zoonotic cutaneous leishmaniasis is a neglected clinical form that is highly prevalent in the northern Sinai in Egypt. This is true since the last studied on the rodents (Morsy *et al*, 1987) on man (Morsy *et al*, 1992) and on the sand fly vector (Hamadto *et al*, 2007). It represented one of the important public health problems in many parts of the world, especially the Mediterranean and Middle East Countries (Shehata *et al*, 2009). Studies of (CL) in Egypt were relevant and important for the following reasons: 1- Egypt presents district environmental, geographic and demographic contexts as compared to other regional countries that are more frequently studied. 2- Egypt represents the regional crossroads of many countries and a potential source of infection from and to neighboring countries. 3- Egypt has experienced extreme weather events in recent years. 4- Wide deployment of manual workers coming from the Nile Vallry mainly in North Sinai, a known endemic district.

Risk assessment was defined as a systematic process of evaluating and measuring the potential risks that may be involved in acquiring cutaneous leishmaniasis, so, the present study planned to meet the following inquiries: 1- Is there potential risk or not? 2- What are the major risk factors? 3- Estimating the existing risks as in frequent, frequent or more frequent and 4- Who are at risk and rating them as low, moderate or high risk groups.

The present study results showed that the great majority of cases (94%) were aged between (20-30) years old, all were males, the most affected cases originally residing in rural areas in Upper Egypt (61%), and then Lower Egypt. These finding were essential without significant age, sex or residence bias, Also, it was found that the majority of cases (85%) were in middle education class, previously working as farmers and students with about 38% for each, these results agreed with Ranjan *et al.* (2005) in India and Abdellatif *et al.* (2012) and Ahmed and Abou Faddan (2013) in Libya where CL was significantly associated with illiteracy and farm working as occupational disease.

The current study showed that most of cases (93.5%) stayed more than 6 month, they are working in stable tasks (91.1%) that enhanced the longstanding exposure of susceptible persons to sand fly vectors, which agreed with Peterson (2008) who stated that all components of disease transmission systems are required to permit long term circulation in a region.

As regards the individual practices and knowledge, the majority of cases (91%) were not informed about endemicity and more than half (58%) slept outdoor at the dusk time coinciding with preferred time of sand-fly activities. This data agreed with Klemper *et al.* (2007) who reported that the female sand-fly needs blood in order to obtain the protein necessary to develop its eggs; they bite especially at night and dusk. Ahmed and Abo Faddan (2013) in Libya reported that the involved people were engaged in the occupational activities working outdoors to night, the present study showed majority of the patients neither used insect repellent nor bed nets.

The present sites of lesions were significantly influenced by the lack of endemicity knowledge of the strict protective measures such as (bednets, insect repellent regularly and avoiding sleep outdoor especially at dusk time), which agreed with AbduIsadah (2011) in Iraq. The use of the textile fabrics whether insecticide-treated or not, as bed-

nets reduced indoor ZCL transmission in the endemic areas (Yaghoobi-Ershadi *et al,* 2006; Mossa-Kazermi *et al,* 2007). However, bed nets as protective agent dependent on whether they were insecticide impregnated, their pores per inch, size, or wear and tear (Das *et al,* 2007).

The present study found that sandy soil, mountain and desert were surrounding the work place (100%, 97% & 96%) respectively associated with the desert vegetation as *Chenopodium* species. This genus (*Chenopodium*), Family Chenopodiaceae**)** is native to Hawaii, Southern America, Asia-Tropical, Asia-Temperate, Africa, Northern America, Australasia and Europe, containing at least 150 annual or perennial species distributed worldwide (Fuentes-Bazan *et al,* 2012). The *Chenopodium ambrosioides* (Morsy *et al,* 1998) and *Ch. quinoa* Willd are the species common in the Egyptian desert (Eisa *et al,* 2014). The *Psammomys obesus* Cretzschmar 1828 proved the main animal reservoir for ZCL in the old world (Morsy *et al*, 1996). Its habitats in Egypt are saline soils and salt marches with stands of succulent halophytic vegetation chiefly of family Chenopodeiaceae Osbern and Helmy, 1980). Apart from *P. obeswus*, *Gerbillus pyramidum* proved to be other hosts of ZCL in the Sinai Peninsula (Morsy *et al*, 1987b) as well as *Meriones crassus* (Morsy *et al*, 1991) and *Meriones sacramenti* Thomas 1992 (Morsy *et al*, 1993). Moreover, natural infections of *L. major* in domestic dogs from Alexandria (Morsy *et al*, 1987c), and the red fox *Vulpes O. aegyptica* was an animal reservoir for ZCL (Morsy *et al*, 2002).

In the present study, 79% of cases did not recognize sand flies in or outdoors but reported painless bites. This agreed with Voisin *et al*. (2011). The main breeding places were within and around the area of bathroom (96%). This agreed with Lewis (1971) who found that the scattering of sand flies at a certain area, was dependent on availability of water and dampness.

In the present study, there was significantly influenced by housing condition. This agreed with Ahmed and Abou Faddan (2013) who found that CL was significantly associated with first floors and few rooms per house and their small size enables them to live in various different microhabitats such as cracks, crevices and holes (Feliciangeli *et al*, 2006). In the current study, sandfly bites were in June but lesions appeared at the end of August (37.9%) and beginning of September (51.6%). Bruce and John (2004) attributed seasonal abundance of sand files, to significant seasonal fluctuation in climate, where sand fly populations were highest toward the end of the rainy season and lowest toward the end of the dry seasons. Fahmy *et al.* (2010) in Egypt found that *L. major* infections circulated in the country through different seasons of the year with i peaks in November, March, August and few sporadic cases were reported during the rest of the year

The present study showed that ulcer was the commonest clinical presentation (85%), measuring approximately (2x2cm) in size and more common in exposed parts (upper, lower limb) with marked increasing in lower limb. The small sized lesion (1x1cm) was insignificantly associated with endemicity knowledge (63%), while larger size lesions correlated to lack of endemicity knowledge (54%) without statistical significant difference.

In this study, fluconazole treated11/124 (8.9%), while Nastiboglucanate (Pentostam) was more effective therapy 61/113 (53.9%) however, it has poor compliance because of its parenteral administration compared to fluconazole which is taken in oral way, on contrary to report of WHO (2010) as regards lines of treatment, fluconazole is considered the least effective therapy for CL. Abdel-Motagaly and Morsy (2016) in Egypt reported that a total of 126 patients with zoonotic cutaneous were referred to the Military Fever Hospital (74 in 2013; 47 in 2014 and 5 in 2015). The majority of these patients had multiplelesions 90%, on the lower limbs and

upper limbs but, rare on face, mainly on the ears. The lesions with the secondary bacterial infections were treated by the antibiotics, Fluconazole® 5mg/kg orally once per daily for four weeks. They added that some complicated lesions required another course (73%) and followed up to the liver function tests. Complicated cases of more than 2/3 lesions with 40mm diameter, cosmetic problem, LN spread. Some cases (70%) with the complicated lesions after the second course of Fluconazole® were offered sodium stibogluconate (Pentostam®) and/or the cryosurgery (Morsy *et al*, 1989).

Generally speaking, the ZCL is a public health threatened to Egypt, particularly Sinai Peninsula. Two ZCL foci were identified in North Sinai (Faris *et al*, 1988) and presence of Egyptian ZCL patient manifested as diffuse CL (Morsy *et al*, 1997) at least nine species sandflies were encountered in Sinai (El Sawaf *et al*, 1987) and the Nile Delta (Morsy *et al*, 1990) as well as allover many Egyptian areas (Saleh *et al*, 2015). Among these sand-flies were *P. papatasii* (Scopoli), the vector of ZCL (Wahba *et al*, 1990) and *P. sergenti,* the vector of ACL (Hanafi *et al*, 2001). As to the rodents the reservoir hosts of ZCL, Order Rodentia included a total of 72 Genera according to the survey carried allover Egypt (Osborn and Helmy, 1980). Morsy *et al*. (1993) gave an illustrated key for the rodents of medical importance in Sinai Peninsula. Of interest, *Psammomys obesus* Cretzchmar, 1828 the main reservoir host for ZCL in the Eastern Mediterranean Countries was detected a in all the Egyptian deserts (Morsy *et al*, 1996) and the wild rodents *Gerbillus pyramidiun* (Morsy *et al*, 1987b), *Meriones crassus* (Morsy *et al*, 1991) and *Meriones sacramenti* Thomas, 1992 (Morsy *et al*, 1993) proved to be reservoir hosts as well allover Sinai, Suez Canal Zone and the North Costal Region. Also, endemic foci of ZCL in neighbouring countries were reported in Saudi Arabia (Morsy and Shoura, 1976, Sebai and Morsy, 1976; Morsy, 1988). On the same time, the report of ACL in Sinai (Shehata *et al*, 2009) and the endemicity of the ACL was reported in Saudi Arabia (Morsy *et al*, 1991b) Jordan (Saliba *et al*, 1997) and its presence on the Egyptian Eastern border with Palestine (Azmi *et al*, 2010; 2012), South border with the Sudan (Babiker *et al*, 2014) and the western border with Libya (Fathy *et al*, 2009; El-Badry *et al*, 2016) as well as the abundance of specific vector *P. sergenti* (Lane, 1986, 1993) in Egypt and Arab countries (El Sawaf *et al*, 2016; Sawalha *et al*, 2003; 2017) is another risk factor.

Conclusion

Based on the outcome data: 1- Indeed, there was distinct risk of acquiring zoonotic-cutaneous leishmainsis among the manual personnel in remote area in the north Sinai Governorate. 2- Fortunately, the disease was presented as a small skin lesion(s) with minimal risk of complications that limited to secondary infection or residual black scar, mainly in lower limb and rarly on face. 3- More frequent risk factors as reported, might be naturally present such as, the mountains, the desert vegetations, sandy ground and presence of wild rodents as a main reservoir host, or manmade induced such as primitive building with wall containing cracks, not paved floor, ceiling made of bumbo (arbor), places of the sand fly aggregate especially water cycles. 4- At high risk group, susceptible persons coming from ZCL-free zones to the endemic area, with lack of endemicity knowledge, inadherence to standard protective measures such as applying insect repellent or using the bed nets.

ZCL should be considered as a cause of skin lesion in relevant target groups coming from Northern Sinai. The infection was most common in the younger age group and clusters in summer months. Rodent's reservoir hosts common, bathroom area commonest breeding site for sand flies aggregate.

ZCL was constantly associated with: Residence in desert or semi-desert areas, where naturally planted with certain types of desert vegetation. Primitive building design associ

ated with decreased number of floors, crevices /cracks in the unplastered racticed wall, and ceiling constructed by arbor which considered a suitable shelter for rodents, as well as the lack of the health education. Monotherapy with Na-stibogluconate was the superior to oral fluconazole, while both laser and cryotherapy proved best among former medications.

Recommendations

The Public Health and Veterinay-Medical Authorities must take into consideration that the ZCL is more or less endemic in all the countries bordering Egypt. The quantification and the containment of the elicited risk factor for zoonotic cutaneous leishmaniasis in the light of study results are major challenges and should be considered by health policy maker and public health professionals, in order to evaluate (CL) burden and to highlight priority actions for the disease control. Thus, it was recommended to: 1- To do massive rodent control at least in and outdoors: by setting short-term control plans. 2- Vector control: combating sand fly-vectors by all the possible environmental friend means in and around human vacinity. 3- Early detection and pro-per treatment of cases, lesions must be covered with proper dressing to avoid autoinfection and infection to vectors,. 4- Decrease human-sand fly contact by simple measures as screening of widows, avoiding sleeping out-door especially in near to the bathroom, applying repellent regularly, wearing long sleeved shirts and pants. 5-Modifying natural environment in trial to eradicate the existing desert vegetation and replaced it with an asphalt, also taking into consideration, the construction of the sanitary building as high floor design, plastering wall, tiling the floor and concreting the ceiling. 6- To conduct active public health surveillance including the statistical spatial and space-time analysis for feasible planning of successful control strategy. 7- To identify *Leishmania* species of anthroponotic cutaneous leishmaniasis (ACL) in Sinai, since its specific vector by typing and/or characterization proved to be present, and 8- Health education for the immigrant workers and employees to Sinai and the endemic neihbouring countries.

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