Review Article

Scabies as a Neglected Tropical Disease in Iran: A Systematic Review with Meta-Analysis, during 2000–2022

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Abstract

Background: Scabies is referred to the infestation of skin by an ectoparasite, *Sarcoptes scabiei*. Having considerable financial consequences, this disease is a public health concern in several countries. In this review, we aimed to determine the current status of scabies in different provinces of Iran.

Methods: Google Scholar, PubMed, Scopus, Science Direct, Scientific Information Database (SID), Sci-explore, Civilica, Magiran, Iranian Research Institute for Information Science and Technology and Elmnet databases were searched to find the related data in the time period within 2000–2022. To have a better insight into the status of prevalence of scabies in Iran, a meta-analysis and meta-regression was performed.

Results: A total of 943 relevant studies were retrieved from the databases, and 62 eligible studies met all the needed criteria for inclusion in this systematic review. Scabies was investigated and reported in at least 22 and 21 provinces of Iran respectively. Most of the studies were conducted in Tehran, Razavi Khorasan, Hormozgan, Fars and Guilan Provinces. Positive samples of scabies belonged to humans, sheep, goats, dogs, rabbits, mice and gazelles. Meta-analysis showed that the overall estimated presence of scabies in Iran during 2000–2022 was 7% (95% CI 4.7–10.3%, P< 0.001).

Conclusion: Infestations due to *S. scabiei* in Iran occur in different geographical locations and different climates. As a neglected tropical disease, the literature about the burden of scabies in Iran is inadequate. The present review highlights the importance of development of comprehensive strategies for the diagnosis and control of scabies, especially the provinces with high infestation rates.

Keywords: Scabies; Sarcoptosis; *Sarcoptes scabiei*; Ectoparasites; Iran

Introduction

Ectoparasites, such as fleas, lice, ticks and some species of mites, flies and hemipteran bugs, use vertebrates as feeding and breeding grounds to survive and complete their life cycles. Scabies, caused by an obligate microscopic parasitic mite, *Sarcoptes scabiei* (Linnaeus, 1758) (Acarina: Sarcoptidae), also named sarcoptic mange in cases referring to animals, is a contagious and common skin parasitic disease (1). The members of the genus *Sarcoptes* generally are referred to as scabies mites. Scabies is also known as sarcoptosis based on the standardized nomenclature for parasitic diseases (SNOPAD) (2). Scabies is considered to

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be a neglected ectoparasite progressing to secondary bacterial skin infection that may lead to serious complications including septicemia, renal disease and rheumatic heart disease, resulting from the burrowing of *S. scabiei* in the epidermis of humans and animals (3). Adult *S. scabiei* digs burrow tunnels and lays 2 to 3 eggs each day. Despite several reports of scabies in different countries, little is known about the biology and host-parasite interactions of *S. scabiei* (4).

The disease is spread around the world and is a public health concern in several countries and is mainly related to poverty and overcrowding. More than 200 million people all around the world suffer from scabies (5). Global prevalence estimate ranges from 0.2% to 71% with an average of 5–10% in children. Meanwhile, *S. scabiei* infects more than 100 mammalian species, including domestic animals, leading to cross-species transmission (6). Scabies covers a wide range of clinical manifestations, presenting three main forms: classic, nodular, and contagious crusted variant also called Norwegian scabies, containing millions of *S. scabiei* on a single infested individual (7). Scabies is a disease of public health importance and is formally designated as a neglected tropical disease (NTD) by World Health Organization (WHO) in 2017, to encourage the efforts for its eradication (8).

Having considerable financial consequences, this disease is a public health concern for underprivileged communities in several low and middle-income countries, and also in some developed countries (9). Transmission of *S. scabiei* occurs through skin-to-skin contact with a person who is infested with the mite. This skin disease is more prevalent among vulnerable groups such as children and young people (7). People infested with *S. scabiei* require rapid identification and treatment, as a misdiagnosis subsequently may lead to an outbreak and an increased economic burden (10). Infestation in the elderly and people with immunodeficiency disorders often manifests as general dermatitis that affects many parts of the body, accompanied by scaling and sometimes blistering and cracking of the skin. Scabies is usually transmitted through close contact with an infected person. The disease is more common among people that are forced to live together as a group. Different studies have shown a significant relationship between the prevalence of the disease and densely populated areas (11). Hence, the spread of this ectoparasite is more likely in crowded families, soldiers, and school children. Less frequently, contaminated clothing and bedding can transmit the mite to other people.

To date, different studies have shown the prevalence of scabies in Iran. However, a comprehensive review and analysis on published data seems to be essential in order to have a better insight on the distribution of scabies in different hosts in all provinces of Iran, to understand the latest situation of the disease in the country, and development of a national program by health authorities for regular diagnosis and control of the disease in provinces with high infestation rates. In this systematic review and meta-analysis, the latest available literature on the prevalence of *S. scabiei* in humans and hosts in different provinces of Iran was investigated.

Materials and Methods

Searching strategy

The present systematic review and meta-analysis was accomplished on the basis of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. A comprehensive literature search was conducted using databases: Google Scholar, PubMed, Scopus, Science Direct, Scientific Information Database (SID), Sci-explore, Civilica, Magiran, Iranian Research Institute for Information Science and Technology and Elmnet from 2000 until May 2022. Selected keywords used for the search were based on previously published studies comprising: scabies, *Sarcoptes scabiei* and

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Iran. In addition, all provinces of Iran were searched specifically with a similar protocol. The search was conducted in both English and Persian languages with similar keywords.

Paper selection

Studies' Quality assessment were developed according to CoCoPop structure [Co (Condition)= infestation by mites; Co (Context)= provinces of Iran; Pop (Population)= animals and human].

Inclusion and exclusion criteria

Author's names, publication year, host, geographical region, positive samples and sample sizes were retrieved and then added to predesigned forms. All animal and human studies reporting infestation with the mite in different parts of Iran with respect to publication year were included. Papers with no full-text availability, from other countries, review articles, unpublished data, as well as studies conducted before 2000 were excluded.

Meta-analysis and meta-regression

Random Model was used to calculate pooled prevalence with 95% confidence intervals. Cochran Q test ($P< 0.05$ shows statistically significant heterogeneity) and I^2 test [< 25% (low), 30% < x < 60% (moderate), and > 75% (high) heterogeneity] were used to determine heterogeneity. Also, a forest plot was employed to visualize the heterogeneity among the studies. In addition, heterogeneity was explored through meta-regression using some moderators. Egger's and Begg's tests ($P> 0.05$ indicate a reasonable publication bias) as well as Funnel plot and Trim and Fill test were applied to investigate the publication bias. The subgroup analysis was conducted according to the publication year, host and geographical location. In this meta-analysis, each row of Table 1 was considered a separate study. Data were analyzed with Comprehensive Meta-Analysis Version 3 Software (Biostat, USA).

Results

Search output

A total of 943 relevant studies were retrieved from the databases, of which 140 studies were screened and 132 full-text articles were assessed for eligibility. Furthermore, 62 eligible studies met all the needed criteria for inclusion in this systematic review. In the final step, 44 studies were included in the meta-analysis (Fig. 1). Our results show that during the period of 2000 to 2022, scabies was studied and reported in humans, sheep, dogs, goitered gazelles (*Gazella subgutturosa*), white rabbits, house mice, and second-hand clothes, in at least 22 and 21 provinces, respectively. Most of the studies were conducted in Tehran (10), Razavi Khorasan (8), Hormozgan (6), Fars (6) and Guilan (5) Provinces (Table 1).

The studied provinces included Tehran (10 studies, reporting scabies in humans, sheep, dogs and second-hand clothes), Razavi Khorasan (8 studies, reporting scabies in humans, sheep and dogs), Hormozgan (6 studies, reporting scabies in human), Fars (6 studies, reporting scabies in humans and dogs), Guilan (5 studies, reporting scabies in humans and dogs), Isfahan (4 studies, reporting scabies in humans), Khuzestan (4 studies, reporting scabies in humans and dogs), West Azerbaijan (4 studies, reporting scabies in humans, sheep, goats and white rabbits), Mazandaran (4 studies, reporting scabies in humans and dogs), Bushehr (3 studies, reporting scabies in humans and goitered gazelles), Kermanshah (3 studies, reporting scabies in humans and dogs), Kerman (3 studies, reporting scabies in humans and house mice), Hamadan (3 studies, reporting scabies in humans), Alborz (2 studies, reporting scabies in humans), East Azerbaijan (2 studies, reporting scabies in humans and white rabbits), Ardabil (1 study, reporting scabies in humans), Qazvin (1 study, no evidence of scabies in dogs), Golestan (1 study, reporting scabies in humans), Kurdistan, Lorestan, Qom, and Sistan and Baluchistan (1 study, reporting scabies in humans), and

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two studies in the country without specifying the details of the rates of infestation in each province, where the positive cases of humans were found. On the other hand, the status of mite infestation was not clear in Chahar Mahal and Bakhtiari, Ilam, North Khorasan, South Khorasan, Zanjan, Semnan, Kohgiluyeh and Boyer-Ahmad, Yazd, Qazvin and Markazi Provinces (Fig. 2).

Pooled effect size, heterogeneity and bias meta-analysis

Random effect model showed that the total prevalence of mite infestation in Iran during 2000–2022 was 7% (95% CI 4.7%–10.3%, P< 0.001). A forest plot determined the prevalence of infestation rate across the country (Fig. 3). Results showed a strong significant heterogeneity (Q= 4859.445, df= 47, I^2= 99.03%, P< 0.001). Begg and Mazumdar Rank Correlation Test as well as Egger's Test of the Intercept illustrated that the publication bias was not substantial (2-tailed P> 0.05). In line with the results of both Egger and Begg's tests, Funnel plot showed symmetry in the presence of negligible publication bias (Fig. 4). Duval and Tweedie's trim and fill test initially trims the asymmetric studies from the left-hand side to locate the unbiased effect (in an iterative procedure), and then fills the plot by re-inserting the trimmed studies on the left as well as their imputed counterparts to the right of the mean effect.

Subgroups' meta-analysis

The subgroup analysis was conducted according to publication year, host, and geographical location (Table 2). In terms of publication year, subgroup meta-analysis indicated a higher prevalence of infestation in published literature from 2015 until the present time (8.1% 95% CI: 0.046–0.139) in comparison to years before this time point (6.2%; 95% CI: 0.037–0.103). Location-based analysis suggests that the highest (14.6%; 95% CI: 0.072–0.272) and lowest (3.9%; 95% CI: 0.025–0.059) prevalence belonged to south and north, respectively. Hosts' subgroup analysis showed the prevalence of infestation was higher among animal (8.5%; 95% CI: 0.053–0.134) in comparison to human cases (6.2%; 95% CI: 0.036–0.104).

Meta-regression analysis

A meta-regression was performed, pooling all studies across location (geographical latitude), publication year, and sample sizes. A significant heterogeneity was associated with sample size, according to the method of the moments test (P= 0.000), with a R^2 of 39% (Fig. 5). In terms of publication year, method of moments showed that some heterogeneity can also be related to the publication year (R^2= 13%; P= 0.133), however this was not statistically significant. An increase in the publication year was in line with an increase in the prevalence, which indicates that recently published studies had reported higher infestation rates in comparison to older ones (but this relationship was not also statistically significant) (Fig. 5). Maximum likelihood model was assessed to perform the meta-regression for the location moderator and the geographical latitude. R^2 showed that a very small heterogeneity might be justified due to latitude. Though, this was not statistically significant (4%; P= 0.06).

Table 1. Details of investigations carried out and reported the occurrence of scabies in Iran, during 2000–2022

	Province	Description	Prevalence		Host	Year	Reference (s)
			Positive/Total	(%)			
1	**Alborz**	Prevalence of scabies among prisoners	31/1404	2.2	Human	2006	(12, 13)
2	**Ardabil**	Frequency of scabies[#]	51/NA	NA	Human	NA	(14)
3	**Azerbaijan, East**	Ectoparasites of white rabbits	9/50	18	White rabbit	2020	(15)
		A case of scabies in a sheepherder[*]	1/1	100	Human	2014	(16)

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Table 1. Continued ...

4	**Azerbaijan, West**	Ectoparasites of white rabbits	9/50	18	White rabbit	2020	(15)
		Ectoparasites of sheep and goat flocks	2/77	2.6	Sheep	2006	(17)
		Ectoparasites of sheep and goat flocks	0/119	0	Goat	2006	(17)
		Scabies among police forces [#]	NA/NA	NA	Human	2002	(18)
		Ectoparasites of goats	12/403	2.97	Goat	2011	(19)
5	**Bushehr**	Study on the sarcoptic mange of gazelle	7/8	87.5	*Gazella subgutturosa*	2007	(20)
		Scabies in primary schools	84/3913	2.14	Human	2001	(21)
		Scabies among police forces [#]	NA/NA	NA	Human	2002	(18)
6	**Fars**	A 40-year-old man[*]	0/1	0	Human	2021	(22)
		Scabies in HIV/AIDS Individuals	4/240	1.66	Human	2018	(23)
		Scabies in people	51/203	25.12	Human	2012	(24)
		A case of crusted scabies[*]	1/1	100	Human	2018	(25)
		A case with low-vision problem[*]	0/1	0	Human	2021	(22)
		Scabies in dogs	16/16	100	Dogs	2005	(26)
7	**Golestan**	Scabies among primary school children [#]	NA/NA	NA	Human	2001	(27)
8	**Guilan**	Ectoparasites of Stray Dogs[*]	1/35	2.85	Dog	2016	(28)
		Prevalence of skin diseases among prisoners	95/2100	4.5	Human	2003	(29)
		Scabies among police forces[#]	194/NA	NA	Human	2002	(18)
		Scabies among primary school children	50/3656	1.36	Human	2003	(30)
		Skin disorders among elder patients	19/440	4.31	Human	2013	(31)
9	**Hamadan**	Prevalence of scabies among prisoners	10/384	2.6	Human	2015	(32)
		Parasitic investigation among patients	0/124	0	Human	2006	(33)
		Scabies in West of Iran[#]	7/NA	NA	Human	2014	(34)
10	**Hormozgan**	Study on primary school children	15/480	3.1	Human	2021	(35)
		Prevalence of scabies among prisoners	38/67	56.71	Human	2007	(36)
		Cases of skin diseases were studied	277/6841	4.04	Human	2005	(37)
		Prevalence of scabies in soldiers	95/763	12.45	Human	2002	(38)
		Scabies among police forces [#]	262/NA	NA	Human	2002	(18)
		Scabies in human community [#]	122/NA	NA	Human	2018	(39)
11	**Isfahan**	An 85-year-old man[*]	1/1	100	Human	2021	(40)
		A family, all infected	5/5	100	Human	2018	(41)
		Scabies in patients	817 /2899	28.18	Human	2009	(42)
		Scabies in patients	28/129	21.7	Human	2017	(43)
12	**Kerman**	Scabies in patients [#]	NA/87	NA	Human	2017	(44)
		Prevalence of scabies among prisoners	32/2851	1.12	Human	2000	(45)
		Scabies in house mouse	2/2	100	*Mus musculus*	2018	(46)

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Table 1. Continued ...

13	**Kermanshah**	Ectoparasites fauna of dogs	21/137	15.33	Dog	2017	(47)
		Scabies in HIV infected prisoners	9/79	11.39	Human	2003	(48)
		Scabies in West of Iran[#]	170/NA	NA	Human	2014	(34)
14	**Khuzestan**	Two cases of Norwegian scabies	2/2	100	Human	2019	(49)
		Severe case in a 4 month old child[*]	1/1	100	Human	2008	(50)
		Scabies among police forces[#]	263/NA	NA	Human	2002	(18)
		Scabies in companion dogs	7/126	5.55	Dog	2012	(51)
15	**Kurdistan**	Scabies among police forces[#]	NA/NA	NA	Human	2002	(18)
16	**Lorestan**	Scabies among police forces[#]	NA/NA	NA	Human	2002	(18)
17	**Mazandaran**	Ectoparasites of stray dogs	2/15	13.33	Dog	2016	(28)
		Scabies in primary school children	225/10737	2.09	Human	2003	(52)
		Scabies among patients	89/1140	7.8	Human	2007	(53)
		Groin pruritus in female patients	1/115	0.8	Human	2010	(54)
18	**Qazvin**	Ectoparasites of stray dogs	0/20	0	Dog	2016	(28)
19	**Qom**	Scabies among patients	68/411	16.54	Human	2015	(55)
20	**Razavi**	Suspected patients	375/ 1814	20.67	Human	2014	(56)
	Khorasan	Infestation in dogs	10 /460	2.17 %	Dog	2020	(57)
		Scabies in a herd of sheep	10/75	13.33	Sheep	2008	(58)
		Genital dermatoses	36/355	10.1	Human	2016	(59)
		Scabies among police forces [#]	NA/NA	NA	Human	2002	(18)
		A case of disseminated scabies infection[*]	1/1	100	Human	2005	(60)
		Scabies in a rehabilitation center	21/110	19.09	Human	2019	(61)
		Dermatological study on domestic doges	17/316	5.06	Dog	2013	(62)
21	**Sistan and Baluchistan**	Scabies among police forces[#]	NA/NA	NA	Human	2002	(18)
22	**Tehran**	Prevalence of skin related diseases	26/3120	0.83	Human	2021	(63)
		Study on dermatological emergencies	132 /2539	5.2	Human	2017	(64)
		Study on sheep sarcoptic mange	278/ 5603	4.96	Sheep	2009	(65)
		Infestation in dogs	37/143	25.9	Dog	2012	(66)
		Scabies among police forces [#]	NA/NA	NA	Human	2002	(18)
		A case of crusted scabies [*]	1/1	100	Human	2020	(67)
		Ectoparasites of second-hand clothes	6/800	0.75	NA	2021	(68)
		A case of Norwegian scabies[*]	1/1	100	Human	2002	(69)
		A case of scabies[*]	1/1	100	Human	2006	(70)
		A case of crusted scabies with brain astrocytoma[*]	1/1	100	Human	2010	(71)
23	**Iran**	Scabies among soldiers	66/58850	0.11	Human	2003	(72)
		Scabies in Iran's Army	5277/NA[#]	NA	Human	2014	(73)

*: These studies were not included in the meta–analysis due to the sample size less than 2
#: These studies were not included in the meta–analysis due to the insufficient data

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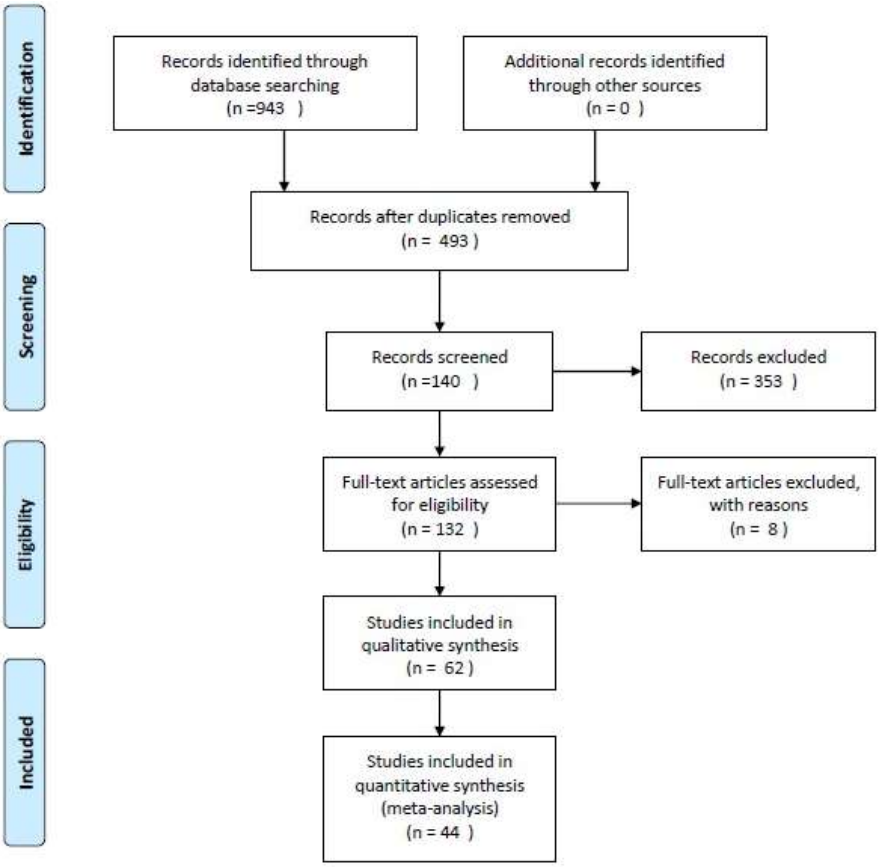

Fig. 1. Flowchart of the data selection in terms of *Sarcoptes scabiei* infestation in Iran, during 2000–2022

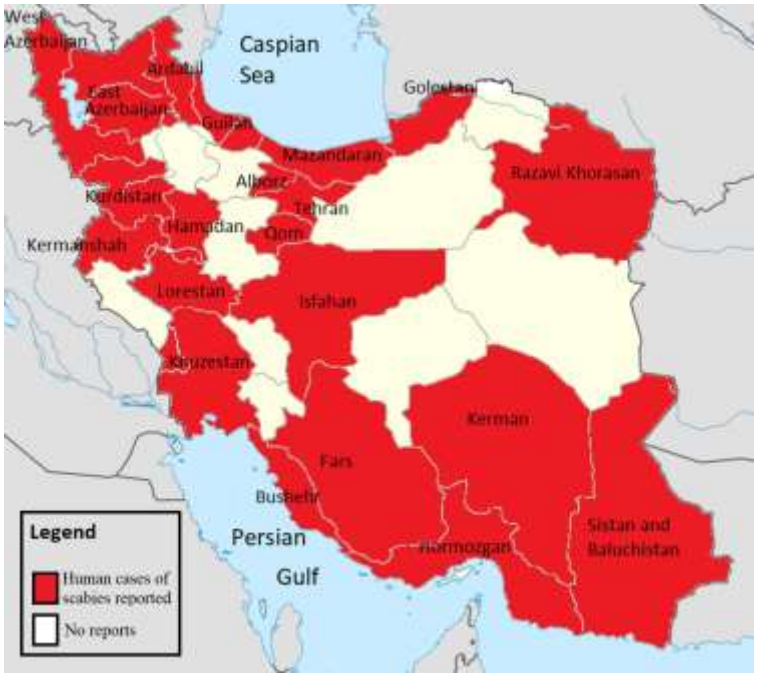

Fig. 2. Human cases of scabies reported in different provinces of Iran; Further to investigations conducted during 2000–2022, scabies has been reported in humans in at least 21 provinces

Table 2. Prevalence of *Sarcoptes scabiei* infestation in Iran according to year, host, and location, during 2000–2022

Subgroup variable		Number of studies	Prevalence (95% CI)	I^2 (%)	Heterogeneity (Q)	*P* value
Location	**North**	16	0.039 (0.025–0.059)	97.431	583.954	0.195
	South	11	0.146 (0.072–0.272)	98.026	506.709	0.000
	West	9	0.059 (0.029–0.118)	87.016	61.614	0.000
	East	6	0.097 (0.051–0.177)	95.202	104.218	0.000
	Center	6	0.142 (0.011–0.716)	99.784	2310.669	0.000
Host	**Human**	30	0.062 (0.036–0.104)	99.349	4453.800	0.000
	Animal	18	0.085 (0.053–0.134)	94.052	285.794	0.000
Year	**≤ 2015**	30	0.062 (0.037–0.103)	99.357	4511.214	0.000
	> 2015	18	0.081 (0.046–0.139)	94.679	319.480	0.000

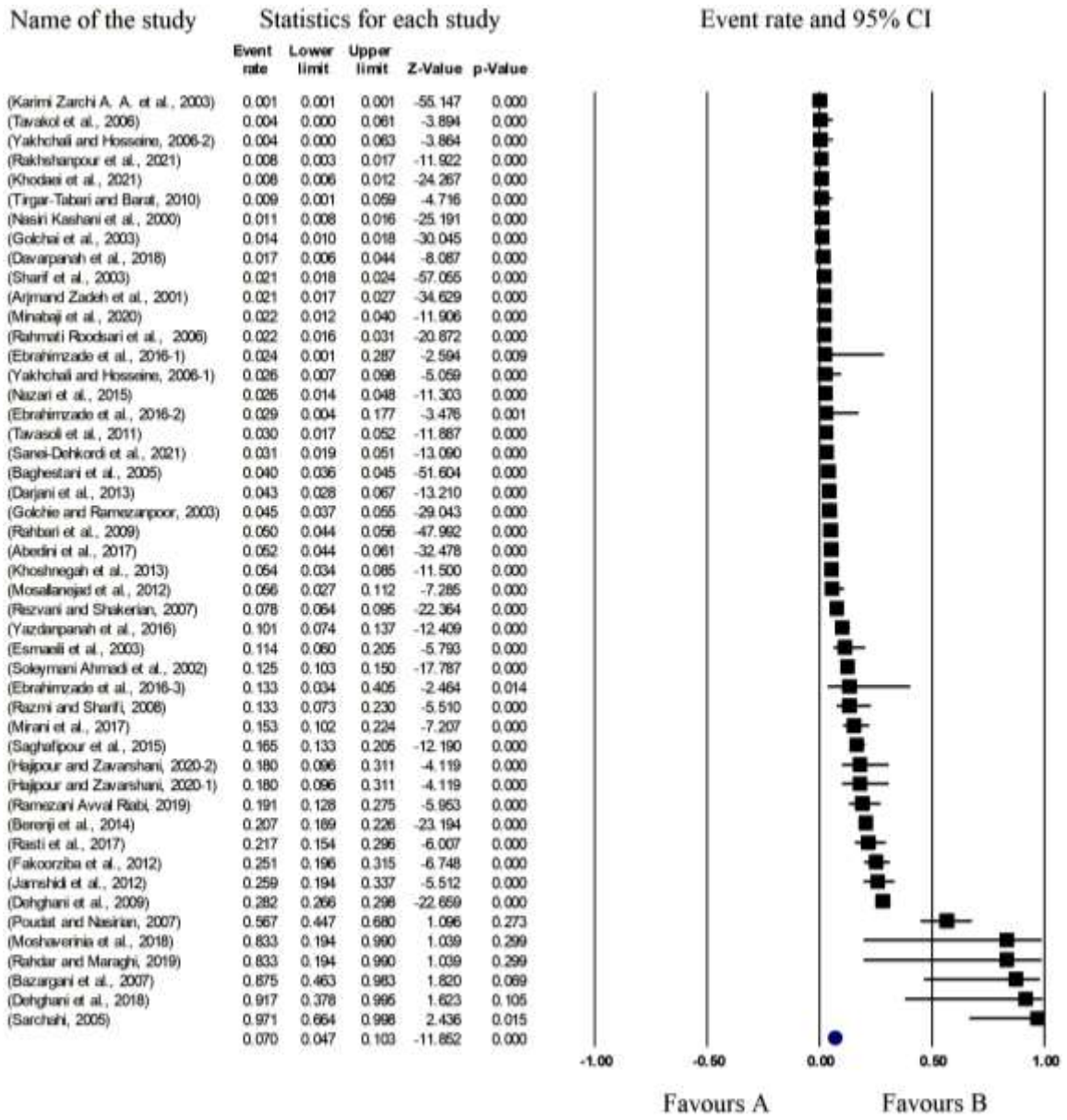

Fig. 3. Forest plot of the prevalence of *Sarcoptes scabiei* infestation in Iran during 2000–2022; Total prevalence of mite infestation in Iran during 2000–2022 was 7% (95% CI 4.7%–10.3%, P< 0.001)

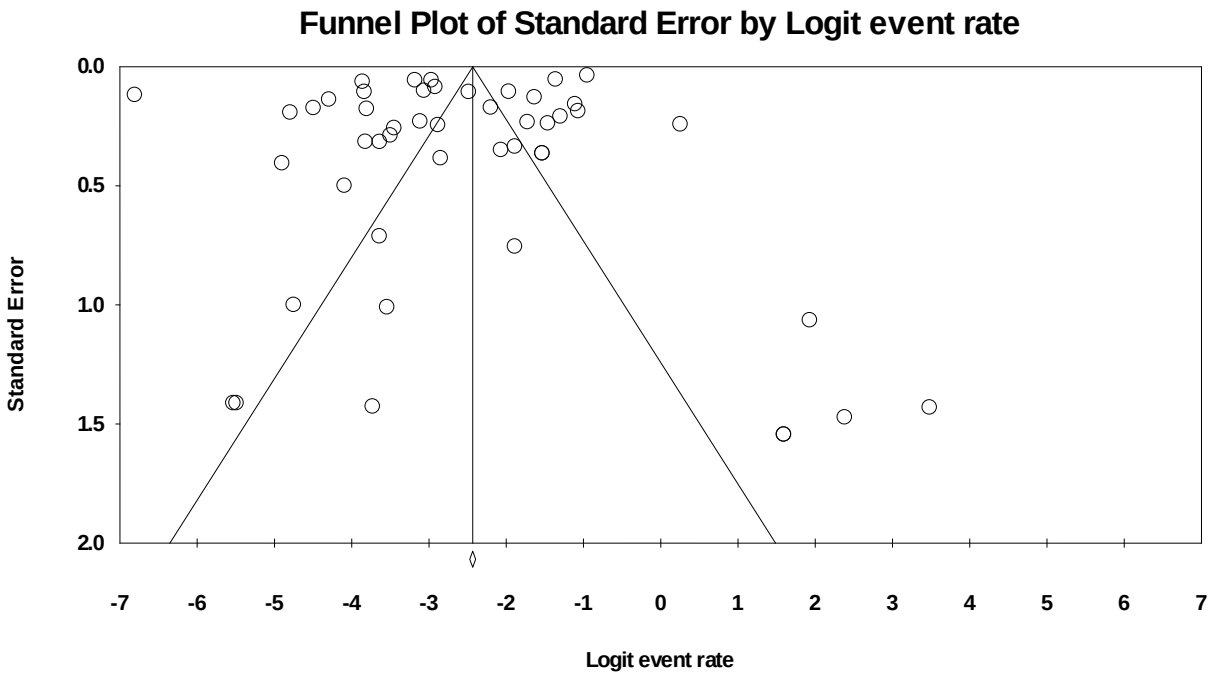

Fig. 4. Funnel plot of standard error by logit event rate for *Sarcoptes scabiei* infestation in Iran during 2000–2022; Most of the studies are distributed at the top of the graph in a balanced way, which indicates a negligible publication bias

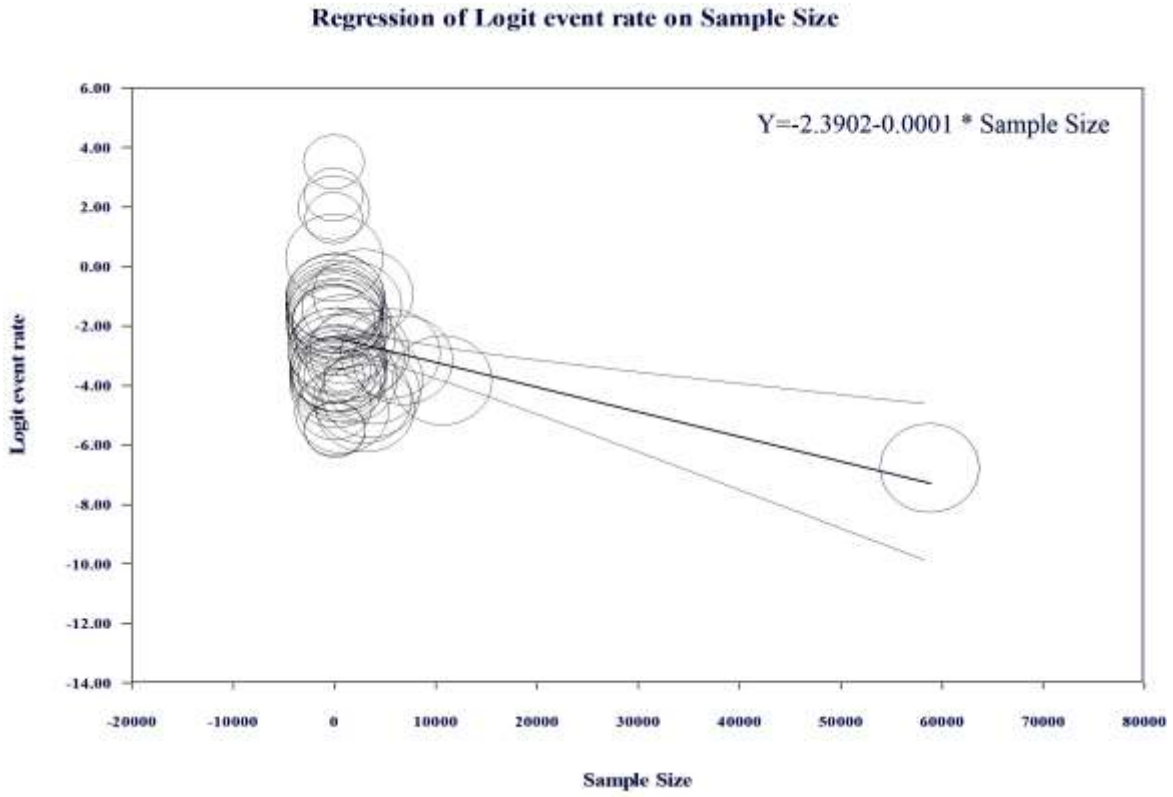

Fig. 5. Meta-regression chart showing the logic event rate of *Sarcoptes scabiei* infestation in Iran according to sample size during 2000–2022; A significant heterogeneity was associated with sample size (the number of mites)

Discussion

Scabies caused by *S. scabiei* may be one of the first reported human diseases with a well-known etiology (74). Such an infestation significantly impacts the quality of life in vulnerable people with adverse sequelae, especially in low-resource settings (9). To our knowledge, the present meta-analysis is the first large-scale study that examined the prevalence of scabies in different provinces in Iran. Further to our review, the occurrence of scabies has been reported in at least 21 provinces out of 31 provinces. Pooled prevalence of mite infestation in Iran was calculated as 7% (95% CI 4.7%–10.3%, P< 0.001). Meanwhile, the subgroups' meta-analysis showed that the prevalence of infestation was higher in the south (14.6%; 95% CI: 0.072–0.272) and center [14.2%, 95% CI: 0.011–0.716] of Iran. Also, meta-regression analysis suggested that lower latitude have higher prevalence of mite infestation, suggesting that the humidity and climate may be associated with the spread of *S. scabiei* (but the latter result was not statistically significant). A previous investigation has shown that the mites have better survival and fertility rates in humid conditions (75); However, some other studies have concluded that cold weather favors the population dynamic of mites (76, 77). Meta-regression illustrated that an increase in the publication year was in line with an increase in the prevalence which indicates that recently published studies had reported higher infestation rates in comparison to older ones. This may be justified due to the improvements in the knowledge of health workers or health system.

During the period of the present review (2000–2022), scabies was recorded in humans, sheep, dogs, goitered gazelles, white rabbits, house mice and second-hand clothes in Iran; however, there are some records of scabies in cattle, cats, horses and pigs in older documents (78). Also, there are few unpublished documents on scabies in camels in the country (79). In the present study, based on the searching criteria and the eligible documents, the presence of scabies was shown in 21 provinces of Iran (out of 31); thus, there were not eligible documents for final analysis for 10 remaining provinces including Chahar Mahal and Bakhtiari, Ilam, North Khorasan, South Khorasan, Zanjan, Semnan, Kohgiluyeh and Boyer-Ahmad, Yazd, Qazvin and Markazi. On the other hand, there are some documents on the occurrence of scabies in some of the aforementioned provinces such as Ilam (80), Qazvin (79) and Zanjan (73) that did not meet our criteria.

Following by an increased occurrence of scabies in some countries in Europe, Asia and Africa, scabies cases have recently been increased in Turkey (81) and Saudi Arabia (82). In contrast with the results of our meta-regression analysis, in Turkey, located in the northwest of Iran, the prevalence of scabies was reported as 10.9%, showing that there was an increase in the cases of scabies both before and during the COVID-19 pandemic. This situation was considered an epidemic of scabies (83, 84). Studies on scabies during the COVID-19 pandemic in Iran was limited to a few investigations (published during the pandemic), showing a prevalence of 0.83% in patients referred to a hospital in Tehran (63), 0.75% in second-hand clothes studied in Tehran (68), and 3.1% in primary school children in Hormozgan (35), suggesting that the pandemic has not resulted in a higher frequency of scabies compared to former investigations.

In Iraq, Alsamarai (2008) has reported scabies in a dermatology clinic in Tikrit with a frequency of 1.1% among 1,194 studied patients. Among the positive cases, prisoners were identified as the high-risk group (85). Different studies have shown that scabies is more frequent among prisoners in Iran with 56.71% in Hormozgan (36), 2.2% in Alborz (12, 13), 11.39% in Kermanshah (HIV infected) (48), 1.12% in Kerman (45), 4.5% in Guilan (29) and 2.6% in Hamadan (32) Provinces. Furthermore, a study

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carried out on the incidence of scabies in 1,300 displaced people who visited the dermatology clinics and health care centers in Duhok Governorate, located in the Kurdistan Region of Iraq bordered with Kermanshah and Kurdistan Provinces of Iran, the prevalence of scabies was reported in 45% of studied people (86).

In Saudi Arabia, located in the south of Iran, high temperature is explored as a leading factor for the occurrence of scabies (87). In Iran, Khuzestan, Bushehr and Hormozgan are among the provinces with a high temperature. The prevalence of scabies in Khuzestan Province in companion dogs has been reported as 5.55% (51). Furthermore, in Hormozgan Province, the prevalence of scabies among primary school children, prisoners, people with skin diseases, and soldiers, have been reported as 3.1% (35), 56.71% (36), 4.04% (37) and 12.45%, respectively (38). In Bushehr Province, an investigation on gazelles (*Gazella subgutturosa*) showed that 7 of 8 studied animals were infested with *S. scabiei* (20). Another study showed that 2.14% of 3,913 of primary school children in this province were positive for *S. scabiei* (21).

Previous findings in Pakistan have identified "inadequate bathing", "infrequent changing of clothes", "low education", "sharing beds, clothes, towels" and "being away from the barracks" as the most important risk factors for scabies (88). Prevalence of scabies in soldiers has been studied in some provinces of Iran: Soleymani Ahmadi et al. (38) have reported a prevalence of 12.45% in 763 studied soldiers in Hormozgan Province. Another large-scale investigation on 58,850 soldiers conducted in Iran showed a prevalence of 0.11% (72). Meanwhile, 5,277 positive cases among Iran's army (the prevalence rate was not identified) were reported in 2014 (73). In another investigation carried out by Tufail and Khan in 2021 on patients who visited a hospital in Pakistan, they showed that the risk of scabies was higher in crowded places. Furthermore, the risk was lower in people having acceptable living and hygiene conditions (89). Meanwhile, molecular analysis of *S. scabiei* in Pakistan has shown the presence of different varieties of mites in different hosts and different geographic regions (90), suggesting the possibility of the occurrence of different varieties of *S. scabiei* in different regions of Iran.

In most parts of the meta-analysis the results indicated high heterogeneity (I^2> 80%). Subgroup meta-analysis of separate moderators, also revealed high heterogeneity. We tried to justify this heterogeneity by meta-regression. Accordingly, it was concluded that almost 50% of the reported heterogeneity might be related to different sample sizes, locations and publication year. Also, some other factors may be the reason behind the high heterogeneity that were not included in this meta-regression (for example different detection methods, populations of interest, and seasons). Publication bias is a considerable problem for the integrity of a meta-analysis, as it illustrates overestimated and underestimated effects.

Conclusion

With an overall estimated presence of scabies in Iran during 2000–2022 as 7% (95% CI 4.7–10.3%, P< 0.001), *S. scabiei* infestation is considered a health concern. In the first step, diagnosis and treatment of the infestations caused by this species are among the key factors for prevention of its distribution. Meanwhile, scabies is preventable by identification of risk factors that should be characterized in different regions and different groups of people. The literature on the identification of scabies, molecular analysis of *S. scabiei* collected in different groups of people in different provinces, and the burden of scabies in Iran is not adequate. The present systematic review highlights the need for development of a national program for regular diagnosis of scabies in high-risk places such as schools, prisons, and regions with inadequate health facilities, and the importance of adopting effective strategies for control and prevention of scabies in the provinces with high infestation rates.

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Conflict of interest statement

We declare that we have no conflict of interest.

References

1. Moroni B, Rossi L, Bernigaud C, Guillot J (2022) Zoonotic episodes of scabies: a global overview. Pathogens. 11(2): 213.
2. Ashford R (2001) Current usage of nomenclature for parasitic diseases, with special reference to those involving arthropods. Med Vet Entomol. 15(2): 121–125.
3. Burgess I (1994) *Sarcoptes scabiei* and scabies. Adv Parasitol. 33: 235–292.
4. Arlian LG (1989) Biology, host relations, and epidemiology of *Sarcoptes scabiei*. Annu Rev Entomol. 34: 139–161.
5. Anderson KL, Strowd LC (2017) Epidemiology, diagnosis, and treatment of scabies in a dermatology office. J Am Board Fam Med. 30(1): 78–84.
6. Pisano SR, Ryser-Degiorgis M, Rossi L, Peano A, Keckeis K, Roosje P (2019) Sarcoptic mange of fox origin in multiple farm animals and scabies in humans, Switzerland, 2018. Emerg Infect Dis. 25(6): 1235–1238.
7. Gilson R, Crane J (2021) Scabies In: StatPearls [Internet]. StatPearls Publishing, USA. Available at: https://pubmed.ncbi.nlm.nih.gov/31335026/
8. WHO (2020) Scabies. Available at: https://www.who.int/news-room/fact-sheets/detail/scabies.
9. El-Moamly AA (2021) Scabies as a part of the World Health Organization roadmap for neglected tropical diseases 2021–2030: what we know and what we need to do for global control. Trop Med Health. 49 (1): 1–11.
10. Swe PM, Christian LD, Lu HC, Sriprakash KS, Fischer K (2017) Complement inhibition by *Sarcoptes scabiei* protects *Streptococcus pyogenes*-An in vitro study to unravel the molecular mechanisms behind the poorly understood predilection of *S. pyogenes* to infect mite-induced skin lesions. PLoS Negl Trop Dis. 11(3): e0005437.
11. Currier RW, Walton SF, Currie BJ (2011) Scabies in animals and humans: history, evolutionary perspectives, and modern clinical management. Ann N Y Acad Sci. 1230(1): E50–E60.
12. Roodsari R, Malekzad F, Ardakani ME (2007) Skin diseases in male prisoners. Indian J Dermatol Venereol Leprol. 73 (1): 55–56.
13. Roodsari MR, Malekzad F, Ardakani ME, Alai BA, Ghoraishian M (2006) Prevalence of scabies and pediculosis in Ghezel Hesar prison, Iran. J Pakistan Assoc Dermatologists. 16(4): 201–204.
14. Adham D, Vatandoost H, Moradi-Asl E (2021) A Comprehensive Database and Geographical Distribution Model of Vectors and Vector Borne Diseases in Ardabil Province, Borderline of Iran and Azerbaijan Republic 2001–2018. J Arthropod-Borne Dis. 15(3): 287–299.
15. Hajipour N, Zavarshani M (2020) Ectoparasites and endoparasites of New Zealand white rabbits from North West of Iran. Iran J Parasitol. 15(2): 266–271.
16. Yagoob G (2014) A case-report of Sarcoptes scabiei var. hominis in a 55-year-old male sheepherder in Tabriz, Iran. Indian J Fundam Appl Life Sci. 4(3): 228–230.
17. Yakhchali M, Hosseine A (2006) Prevalence and ectoparasites fauna of sheep and goats flocks in Urmia suburb, Iran. Vet Arh. 76(5): 431–442.

18. Jahani MR, Shirzad H, Mehrabi Tavana A (2002) Evaluation of the frequency of scabies in suspected patients and its confirmation in police units throughout the provinces of the country. J Mil Med. 3 (4): 195–199.
19. Tavasoli M, Dalir Naghde B, Sahandi A (2011) Study on gastrointestinal and external parasites of goats in West Azerbaijan- Iran. J Vet Res. 66(1): 77–155.
20. Bazargani TT, Hallan JA, Nabian S, Rahbari S (2007) Sarcoptic mange of gazelle (Gazella subguttarosa) and its medical importance in Iran. Parasitol Res. 101(6): 1517–1520.
21. Arjmand Zadeh S, Joukar M, Khatmi S, Zarenezhad M, Abd Elahzadeh H, Tahmasebi R (2001) Prevalence of pediculosis and scabies in primary schools of Bushehr; 1999–2000. Iran South Med J. 4(1): 41–46.
22. Soltan-Alinejad P, Vahedi M, Turki H, Soltani A (2021) A comprehensive entomological survey and evaluation of the efficacy of different therapies on a suspected delusional parasitosis case. Brain Behav. 11(1): e01945.
23. Davarpanah MA, Motazedian N, Jowkar F (2018) Dermatological manifestations of HIV/AIDS individuals in Shiraz, South of Iran. J Glob Infect Dis. 10(2): 80–83.
24. Fakoorziba MR, Amin M, Moemenbellah-Fard M, Najafi ME (2012) The frequency rate of scabies and its associated demographic factors in Kazerun, Fars Province, Iran. Zahedan J Res Med Sci. 14 (8): 90–91.
25. Dastgheib L, Boroujeni NH, Aslani FS (2018) Crusted scabies masquerading as psoriasis plaques in a patient suffering from burn scars. Dermatol Online J. 24 (6): 13030.
26. Sarchahi AA (2005) Effect of Trichlorfon (Neguvon) Against *Sarcoptes scabiei* var *canis*. J Appl Anim Res. 28(1): 15–16.
27. Mir Behbahani N, Vakili M, Jazayeri M (2001) Epidemiological study of common school diseases (infectious and non-communicable) in primary schools of Gorgan. Iran J Infect Dis Trop Med. 6(15): 77–77.
28. Ebrahimzade E, Fattahi R, Ahoo MB (2016) Ectoparasites of stray dogs in Mazandaran, Gilan and Qazvin Provinces, north and center of Iran. J Arthropod-Borne Dis. 10(3): 364–369.
29. Golchie J, Ramezanpoor A (2003) Prevalence of Contagious Skin Diseases in Rasht Lakan Prison. J Guilan Univ Med Sci. 11(44): 9–13.
30. Golchai J, Zargari O, Gholipour Peinondi M, Karbasi Somesaraee M (2003) The prevalence of scabies in the students of primary schools in Somea-Sara in 2000–2001: an observational cross-sectional study. Iran J Dermatol. 7(1): 29–32.
31. Darjani A, Mohtasham-Amiri Z, Mohammad Amini K, Golchai J, Sadre-Eshkevari S, Alizade N (2013) Skin disorders among elder patients in a referral center in northern Iran (2011). Dermatol Res Pract. 2013: 193205.
32. Nazari M, Moradi A, Anvari P (2015) Epidemiological survey of scabies in the central prison of Hamadan in 2013. Pajouhan Sci J. 13(3): 1–7.
33. Tavakol P, Zahirnia A, Sardarian K, Nazari M, Taherkhani H, Siavashi M, Omidinia E, Ghiasian A (2006) A study of fungal a and parasitic infections of skin, digestive and reproductive tract in patients with chronic psychiatric disorders at Sina hospital in Hamadan (2002–3). J Ilam Univ Med Sci. 14(3): 45–51.
34. Nazari M, Azizi A (2014) Epidemiological pattern of scabies and its social determinant factors in west of Iran. Health. 6(15): 1972–1977.
35. Sanei-Dehkordi A, Soleimani-Ahmadi M, Zare M, Jaberhashemi SA (2021) Risk factors associated with scabies infestation among primary schoolchildren in a

low socio–economic area in southeast of Iran. BMC Pediatr. 21(1): 1–10.
36. Poudat A, Nasirian H (2007) Prevalence of pediculosis and scabies in the prisoners of Bandar Abbas, Hormozgan Province, Iran. Pak J Biol Sci. 10(21): 3967–3969.
37. Baghestani S, Zare S, Mahboobi AA (2005) Skin disease patterns in Hormozgan, Iran. Int J Dermatol. 44(8): 641–645.
38. Soleymani-Ahmadi M, Safa O, Zare S (2002) Prevalence of scabies in soldiers of Bandar Abbas air force base, 2001. Hormozgan Med J. 6(1): 15–19.
39. Jaberhashemi SA, Khosravani M, Rafatpanah A, Nodez SMM (2018) The characteristics of scabies in human community in Bashagard District, Iran. J Entomol Zool Stud. 6(2): 2859–2862.
40. Soleimanifard S, Hejazi SH, Abtahi SM (2021) A Case of Crusted Scabies in Isfahan, Iran. J Isfahan Med Sch. 39(647): 821–825.
41. Dehghani R, Talaee R, Mostafaeii G, Takhtfiroozeh S, Salehishahrabi A, Sepehri M, Bakhtiyari Z, Arani ZR (2018) Reporting family contamination by parasitic mite, *Sarcoptes scabiei*. J Entomol Res. 42(2): 301–304.
42. Dehghani R, Vazirianzadeh B, Hejazi SH, Jalayer N (2009) Frequency of *Sarcoptes scabiei* infestation in patients referred to the parasitology laboratory in Isfahan, Iran (1996–2002). Jundishapur J Microbiol. 2 (2): 65–70.
43. Rasti S, Nazeri M, Kaveh E, Talaee R, Abbas Mousavi SG (2017) Frequency and clinical manifestations of scabies in suspected patients referred to health centers of Kashan, central Iran (2010–2014). Zahedan J Res Med Sci. 19(2): e7034.
44. Yousefzadeh S (2017) The prevalence of scabies in patients referred to the clinic, especially in the first 6 months of 1395. School of Medicine, Kerman University of Medical Sciences, Kerman, Iran.
45. Shamsaddini S, Nasiri Kashani M, Sharifi I, Khajeh Karam Aldini M, Pourlashkari M (2000) Prevalence of infectious skin diseases in the central prison of Kerman. Iran J Dermatol. 4(1): 19–25.
46. Moshaverinia A, Jadidoleslami A, Nourani H (2018) Sarcoptic mange in house mouse (*Mus musculus*). International Conference on Integrative Approaches of Rodent Studies, 2018 January 27, Ferdowsi University of Mashhad, Mashhad, Iran.
47. Mirani F, Yakhchali M, Naem S (2017) A study on ectoparasites fauna of dogs in suburban of Ghilanegharb, Kermanshah Province, Iran. J Vet Res. 72(1): 7–14.
48. Esmaeili N, Safaei Pourzamani M, Rahimi F (2003) Cutaneous manifestations in HIV seropositive male prisoners in Kermanshah. Iran J Dermatol. 6(3): 24–26.
49. Rahdar M, Maraghi S (2019) Norwegian scabies in two immune-compromised patients: a case report. Iran J Public Health. 48(6): 1169–1173.
50. Rahdar M, Vazirianzadeh B, Maraghi S (2008) A case report of *Sarcoptes scabiei* infection in Ahwaz, Iran. J Arthropod-Borne Dis. 2(1): 44–48.
51. Mosallanejad B, Alborzi A, Katvandi N (2012) A survey on ectoparasite infestations in companion dogs of Ahvaz District, South-West of Iran. J Arthropod-Borne Dis. 6(1): 70–78.
52. Sharif M, Haghi F, Hezar Jaribi H (2003) Study on prevalence of mite contamination and the effective factors on the cause in the primary school students of sari city in 1999–2000. J Mazandaran Univ Med Sci. 13(38): 49–53.
53. Rezvani S, Shakerian M (2007) Prevalence of scabies in patients referred to department of Yahyanejad hospital (Babol; 2004–2005) dermatology. J Babol Univ Medical Sci. 8(6): 55–58.
54. Tirgar-Tabari S, Barat S (2010) Groin pruritus in female patients referred to dermatology and gynecology clinics of Yahya-

Nejad Hospital in Babol. J Dermatol Cosmetic. 1(4): 195–200.
55. Saghafipour A, Arsang S, Mohammadbaygi A, Shamsodini (2015) Determining the prevalence rate of scabies and its associated social and demographic factors among patients attending health centers in the Qom Province (2005–2013). J Mil Med. 17(1): 41–45.
56. Berenji F, Marvi-Moghadam N, Naghibozakerin Meibodi P (2014) A retrospective study of ectoparasitosis in patients referred to Imam Reza Hospital of Mashhad, Iran. Biomed Res Int. 2014: 104018.
57. Minabaji A, Moshaverinia A, Khoshnegah J (2020) Frequency of ectoparasite infestation in dogs in Mashhad, northeast Iran. J Vet Res. 75(3): 280–287.
58. Razmi G, Sharifi K (2008) Report of a case of occurrence of simultaneous contamination of *Sarcoptes scabiei* and *Psoroptes ovis* mites in a herd of sheep. Vet Res Biol Product. 21(3): 154–155.
59. Yazdanpanah M, Ahmadnia H, Livani F, Shargi M, Vosoughi E, Rahmani S, Shakeri MT (2016) Genital dermatoses in circumcised men: A cross-sectional study from Mashhad, Iran. Iran J Dermatol. 19 (4): 131–135.
60. Javidi Z, Fata A, Kiafar B (2005) Disseminated scabies infection in a renal transplant recipient. Med J Mashhad Univ Med Sci. 48(87): 99–102.
61. Ramezani Avval Riabi H (2019) The outbreak of classic and Norwegian type scabies, in mentally handicapped persons in a rehabilitation centre-Iran. J Clin Diagnostic Res. 13(3): 7–12.
62. Khoshnegah J, Movassaghi AR, Rad M (2013) Survey of dermatological conditions in a population of domestic dogs in Mashhad, northeast of Iran (2007–2011). Vet Res Forum. 4(2): 99–103.
63. Khodaei B, Seyedpour S, Gholami B, Garmarudi G, Nasimi M (2021) Seasonal and gender variation in skin disease: A cross-sectional study of 3120 patients at Razi hospital. Int J Womens Dermatol. 7(5): 799–802.
64. Abedini R, Matinfar A, Sasani P, Salehi A, Daneshpazhooh M (2017) Evaluation of patients visiting the dermatology emergency unit of a university dermatology hospital in Tehran, Iran. Acta Med Iran. 55(11): 705–711.
65. Rahbari S, Nabian S, Bahonar A (2009) Some observations on sheep sarcoptic mange in Tehran Province, Iran. Trop Anim Health Prod. 41(3): 397–401.
66. Jamshidi S, Maazi N, Ranjbar-Bahadori S, Rezaei M, Morakabsaz P, Hosseininejad M (2012) A survey of ectoparasite infestation in dogs in Tehran, Iran. Rev Bras Parasitol Vet. 21(3): 326–329.
67. Azizpour A, Nasimi M, Ghanadan A, Mohammadi F, Shakoei S (2020) Crusted scabies complicated with herpes simplex and sepsis. Indian J Dermatol. 65(4): 304–306.
68. Rakhshanpour A, Shirazy AA, Shafiei R, Rahimi MT (2021) Second-hand clothe, a new threat for acquiring parasitic infection. Iran J Publ Health. 50(1): 211.
69. Namazi MR, Barikbin B (2002) Atypical Norwegian scabies in an Iranian man. Dermatol Online J. 8(2): 17.
70. Ansarin H, Jalali MHA, Setarehshenas R, Mazloomi S, Soltani-Arabshahi R (2006) Scabies presenting with bullous pemphigoid-like lesions. Dermatol Online J. 12 (1): 19.
71. Mortazavi H, Abedini R, Sadri F, Soori T, Vasheghani-Farahani A (2010) Crusted scabies in a patient with brain astrocytoma: report of a case. Int J Infect Dis. 14(6): e526–e527.
72. Karimi Zarchi A, Merabi Tavana A, Vatani H, Khoobdel M, Esmaili D (2003) Investigation of prevalence rate and relate factors of scabiei in training barrachs of land force of islamic revolrutionary guard corps in 1999–2000. J Mil Med. 5(3): 189–193.

73. Hosseini-Shokouh S, Rahimi-Dehgolan S, Noorifard M, Dabbagh-Moghaddam A, Barati M, Tabibian E (2014) The assessment of epidemiologic aspects of scabies in Iran's Army during 2004 to 2010. Ann Mil Health Sci Res. 12(4): 163–167.
74. Green MS (1989) Epidemiology of scabies. Epidemiol Rev. 11(1): 126–150.
75. Arlian L, Runyan R, Achar S, Estes S (1984) Survival and infestivity of *Sarcoptes scabiei* var. *canis* and var. *hominis*. J Am Acad Dermatol. 11(2): 210–215.
76. Liu JM, Wang HW, Chang FW, Liu YP, Chiu FH, Lin YC, Cheng KC, Hsu RJ (2016) The effects of climate factors on scabies. A 14-year population-based study in Taiwan. Parasite. 23: 54.
77. Niedringhaus KD, Brown JD, Ternent MA, Peltier SK, Yabsley MJ (2019) Effects of temperature on the survival of Sarcoptes scabiei of black bear (Ursus americanus) origin. Parasitol Res. 118(10): 2767–2772.
78. Rak H (1975) Mites of medical and veterinary importance in Iran. Bull Soc Pathol Exot. 68(5): 507–511.
79. Sazmand A, Joachim A (2017) Parasitic diseases of camels in Iran (1931-2017)-a literature review. Parasite. 24: 21.
80. Babaahmady E (2016) A clinical case sarcoptic mange in sheep. Rev Electrón Vet. 17(11): 111116.
81. Baykal C, Atcı T, Kutlay A, Baykut B, Türkoğlu Z (2021) Scabies outbreak in Turkey in 2018–2019. J Eur Acad Dermatol Venereol. 35(6): e384–e385.
82. Jastaniah MWA, Zimmo ZFK, Bakallah MWS, Hantoush MSM, Abdal-Aziz M (2019) Clinical presentation and risk factors of increased scabies cases in the western region of Saudi Arabia in 2016–2018. Saudi Med J. 40(8): 820–827.
83. Karaca Ural Z, Çatak B, Ağaoğlu E (2022) Prevalence of Scabies in the Covid-19 pandemic period and determination of risk fctors for scabies: a hospital-based cross-sectional study in northeast Turkey. Acta Parasitol. 67(2): 802–808.
84. Özden MG, Ertürk K, Kartal SP, Yayli S, Göktay F, Doğramacı CA, Bayramgürler D, Özgen Z, Önder S, Kaçar N, Melikoğlu M, Tamer F, Şentürk N, Alpsoy E (2020) An extraordinary outbreak of scabies in Turkey. J Eur Acad Dermatol Venereol. 34(12): e818–e820.
85. Alsamarai AM (2009) Frequency of scabies in Iraq: survey in a dermatology clinic. J Infect Dev Ctries. 3(10): 789–793.
86. Alberfkani MI, Mero WM (2020) The incidence of scabies and head lice and their associated risk factors among displaced people in Cham Mishko Camp, Zakho City, Duhok Province, Iraq. Pol J Microbiol. 69(4): 463–469.
87. Ahmed AE, Jradi H, AlBuraikan DA, AL-Muqbil BI, Albaijan MA, Al-Shehri AM, Al-Jahdali H (2019) Rate and factors for scabies recurrence in children in Saudi Arabia: a retrospective study. BMC Pediatr. 19(1): 1–6.
88. Raza N, Qadir S, Agha H (2009) Risk factors for scabies among male soldiers in Pakistan: case-control study. East Mediterr Health J. 15(5): 1105–1110.
89. Tufail M (2021) Risk factors and diagnostic criteria for scabies in a population of Khyber Pakhtunkhwa, Pakistan: Unmatched Case-Control study. J Pakistan Assoc Dermatologists. 31(3): 459–463.
90. Naz S, Chaudhry FR, Rizvi DA, Ismail M (2018) Genetic characterization of *Sarcoptes scabiei* var. *hominis* from scabies patients in Pakistan. Trop Biomed. 35(3): 796–803.