



## AWARENESS ABOUT SCABIES SYMPTOMS, TRANSMISSION WAYS AND PREVENTION AMONG POPULATION IN AL-MADINAH ALMUNAWARH, SAUDI ARABIA

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### ABSTRACT

**Objective:** The aim of this study was to assess the awareness of scabies infection manifestation and the ways of treatment and preventive measurements among the general population in AL-MADINAH ALMUNAWARAH, SAUDI ARABIA. **Methods:** This was a cross sectional study which used validated questionnaires that were collected by the authors from random general public places in Al-Madinah Almunawarah city. **Result:** The total of 622 questionnaires were collected. Majority of them were female (70%). Most of the study participants (67%) were academic in their education, and their source of information about scabies was mainly (33%) online social media. 58% of them believed that scabies is a parasitic disease due to mites. 39% believed that scabies cause persistent skin itching, but 37% did not know the incubation period of the disease. 62% believed that the most affected by scabies have been children. 13% believed that scabies had no complications. 21% thought that avoiding people with itching, avoiding touching or using their tools or clothes have been the most effective preventive measures. 5% believed that there was no cure for scabies, and 8% did not know about it. 52% believed that the treatment of scabies can be done through consultation with a doctor. While 32% did not believe that treatment should be given to all family members of the person with scabies. 23% did not know when they should go back to work after starting the scabies treatment. **Conclusion:** This examination showed satisfactory levels of awareness about scabies and its symptoms and transmission ways among the study participants. However, the population's awareness and health education should be increased to fill the gaps existing in their knowledge about the scabies' preventive measures.

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### Introduction

Skin as the largest living member of the body, in fact, it is also considered as one of the most complex, most interesting and most prolific member [1]. A skin disease which is called scabies, has been discovered by human since 2500 years ago [2,3]. It is a skin disease which is known as an ecto-parasitic and highly contagious disorder. Moreover, the infestation of the skin by the Sarcoptes, Scabiei Var Hominis and the other human itch mites are all those cause the disease [4-5]. Worldwide, there are more than 300 millions of cases suffering from scabies every year, regarding the World Health Organization [6-9]. Between the years of 1971 and 2001, many prevalent studies have been conducted, which reported scabies with different incidences. Also, at the intervals of 10 to 15 years, cyclical epidemics have been occurring [10]. Countries with tropical and hot weather showed the most elevated global rates of scabies (71.4%) [11,12]. In addition, scabies has been detected in institutional outbreaks with a seasonal variation and sporadic individual cases in the developed countries [13]. Once the itch mite *S. scabiei* burrows into the host's skin, and consumes the epidermis, the infestation occurs [2,4,7].

The symptoms appear with itching, which increases at night, especially before sleeping, and its severity increases according to the prolonged periods of the disease. It causes tiny red bumps or rashes on particular places in the body, namely abdomen

(around the navel and sides), webbing between fingers, wrist, armpits, thighs, and genitals. Intense itching and therapy negligence may lead to some complications, such as sores and inflammations [4,5,8].

The mode of transmission of scabies mite sometimes, is by the direct contact of the affected skin for a long period of time. It can be treated by scabicides such as permethrin 5%, personal hygiene, avoidance of crowded places and the use of others' clothes. Moreover, to ensure the cleanliness of bedclothes, especially in crowded places, such as boarding homes, prisons and camps, disinfecting, boiling and ironing the patients' clothes is an important method. Also, for controlling the disease, adequate water supply is mandatory [6,9].

In Saudi Arabia, there was an increased incidence of scabies in 1996, there were 248 scabies cases in Riyadh, with the female to male ratio of 1.5: 1. There were affected children as the following, 4 children who aged 0-4 (14.3%), 12 children who aged 5 to 14 (42.8%) and 12 persons who aged 15 or older (42.9%). Among the affected families, 76.5% were Saudis and 23.5% were non-Saudis [14].

In April 2018, the number of new cases of scabies increased in different areas specially in Makkah and southern regions [15]. Also, in the same year, the health related affairs in Madinah confirmed 9 cases of scabies [16].

WHO recently set scabies as a neglected tropical disease [17]. However, the identification of scabies on the global health, would increase the awareness, education and motivation of further researches into the diagnosis, prevention and treatment [18].

It is envisioned that health promotion activities in public or private healthcare settings would create an empowering initiative among patients to accept health information about their medical conditions [19]. There were studies done to assess the awareness of population in Azad Kashmir and Pakistan which found a general lack of knowledge and awareness about scabies. Therefore, an active intervention was required to improve their awareness [20,21].

Moreover, according to the authors' knowledge, there has been no study demonstrated or included scabies awareness, control plan and educational component of the prevention in Saudi Arabia. Therefore, the purpose of the presented investigative study was to evaluate an educational component for preventing and controlling scabies.

The aim of this study was to estimate scabies infection awareness in the population of Al-Madinah Al-Monawarh for identifying the segments of the population that would most benefit from targeted education programs.

#### **Research objective:**

To estimate the level of awareness about scabies infection in terms of definition, transmission ways, symptoms, and preventive measures.

#### **Method:**

This was a cross-sectional descriptive study in Al Madinah Al Monawarrah, Saudi Arabia. The study was started on 2-9-2018, and ended on 10-11-2018.

The following formula was used to calculate the sample size:

$$Sample\ Size = \frac{z^2 \cdot p(1-p)}{e^2} \div \left( 1 + \frac{z^2 \cdot p(1-p)}{e^2 \cdot N} \right)$$

The study sample was a convenience sample of (384), and they were selected randomly from public places (Hospitals - Clinics - Shopping Malls - Restaurants - Universities).

A validated comprehensive questionnaire was prepared in accordance to the relevant literature including questions designed to determine the community knowledge about scabies' infection in terms of definition, transmission ways, symptoms, and preventive measures.

The questionnaire included 24 questions about socio-demographics, and the knowledge about scabies infection in term of definition, transmission ways, symptoms, and preventive measures.

Each right answer was given 1 score, and a wrong answer was given a score of zero. For the knowledge scores, those who attained  $\geq 50$  percentile for the score were assigned as being knowledgeable, while those who attained  $< 50$  percentile for the score were assigned as being not knowledgeable.

Three experts tested the validity of the questionnaire for language clarity, relevancy, content, ability to understand questions, and the time needed to answer. The reliability test was conducted for the internal consistency of the items by using the reliability coefficients (Cronbach's alpha= 0.8) which was suitable for the questionnaire.

o Inclusive criteria: - Adult Male and female older than 18 years old who were currently living in Almadinah Almonawarah.

o Exclusive criteria: -Adult with mental illnesses and children.

#### **Ethical Consideration:**

This study was submitted for ethical review to the community of Almadinah Almunawara , Research Ethics Committee of Taibah university. An informed consent was obtained from the study participants. Only those who signed an informed consent were enrolled in the study.

#### **Statistical analysis plan:**

The data was collected, coded, entered and analyzed using the Statistical Package for the Social Sciences software version 23 (SPSS Inc., Chicago, IL). Descriptive analysis followed by the inferential statistics was done. Percentages, means, and standard deviations were calculated for qualitative and quantitative data; respectively. Chi-square test ( $\chi^2$ ) and Fisher's exact test were used to statistically analyze the qualitative data. Student t- test and ANOVA were used to compare the means for quantitative data when needed. A P-value of 0.05 was considered as a cut off point for the level of significance.

**Data statistical analysis:**

**Introduction:**

This section includes the statistical analysis and results which were obtained to estimate the level of awareness on scabies' symptoms, transmission ways and prevention among the population in Al-Madinah Almunawarh, Saudi Arabia

**Population Study and Sample Study:**

The study population consisted of all residents of Medina. And the sample of (622) was selected randomly from public places (Hospitals - Clinics –Shopping Malls – Restaurants - Universities).Table 1 shows their properties according to their demographic data.

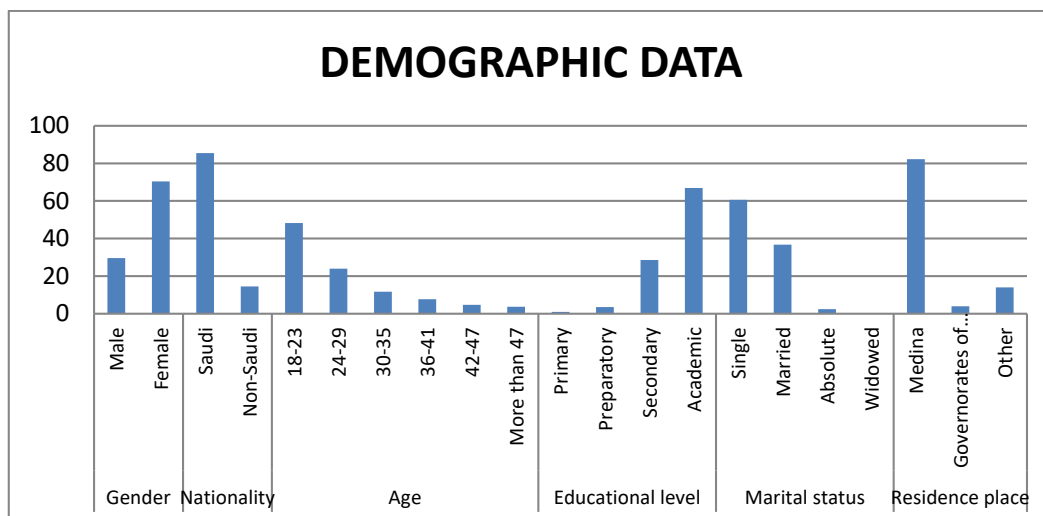
**Table1:** Distribution of the sample study based on the demographic data.

Variable		Frequency	Percent
Gender	Male	184	29.6
	Female	438	70.4
Nationality	Saudi	532	85.5
	Non-Saudi	90	14.5
Age	18-23	300	48.2
	24-29	149	24.0
	30-35	73	11.7
	36-41	48	7.7
	42-47	29	4.7
	More than 47	23	3.7
Educational level	Primary	6	1.0
	Preparatory	22	3.5
	Secondary	178	28.6
	Academic	416	66.9
Marital status	Single	377	60.6
	Married	228	36.7
	Absolute	15	2.4
	Widowed	2	.3
Residence place	Medina	511	82.2
	Governorates of Medina	24	3.9
	Other	87	14.0
<b>Total</b>		<b>622</b>	<b>100.0</b>

As table 1 clearly shows 70% of the study sample were female, while 30% were male; 86% of them Saudi, and 15% were non-saudi.

The majority of the sample (48.2%) aged between 18-23 years. And considering their distribution according to the educational level, it was found that 67% were academic, and 29% of them were secondary. And regarding their distribution according to marital status, 61% were single, 37% were married.

The vast majority of the sample (82.2%) were residents of Al-Medina. Figure.1 concluded all the previous results.



**Figure 1.** Distribution of the sample study to the demographic data.

**The study tool:**

The questionnaire contained 24 questions including questions about socio-demographics, knowledge about scabies infection in term of definition , transmission ways, symptoms, and preventive measures.

Each right answer was given the score of 1, and each wrong answer was given the score of zero. Considering the knowledge scores, those who attained  $\geq 50$  percentile for the score were assigned as being knowledgeable, while those who attained  $< 50$  percentile for the score were assigned as being not knowledgeable.

**Results:**

Table.2 shows the study sample distribution according to the number of family members permanently residing at home, where 41% of the families were of 6-8 members, 38% of families were of 3-5 members, 16% of families were more than 8 individuals, and 5% of families were of 1-2 members.

**Table 2.** The study sample distribution according to the number of family members permanently residing at home

	Frequency	Percent
1-2	30	4.8
3-5	237	38.1
6-8	257	41.3
More than 8	98	15.8
Total	622	100.0

Table.3 shows the study sample distribution according to the number of people per room, where 78% slept in a room with 1-2 persons, 19% slept in a room with 3-4 people, 2% slept in a room with 5-6, and 1% slept in a room with more than 7 people.

**Table3:** The study sample distribution according to the number of people per room

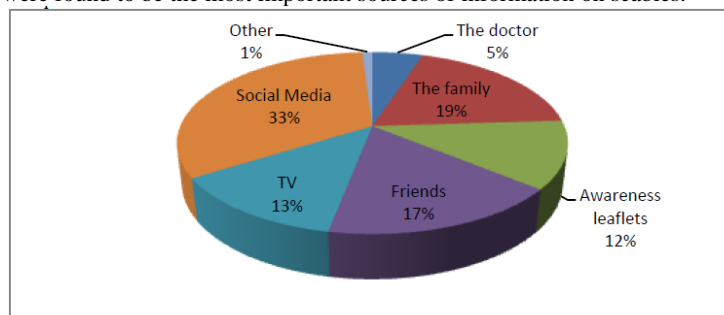
	Frequency	Percent
1-2	486	78.1
3-4	119	19.1
5-6	11	1.8
7 and more	6	1.0
Total	622	100.0

Table.4 shows the study sample distribution according to their hearing about scabies, where 97% of the study sample heard of scabies, and 4% did not hear of scabies.

**Table4:** The study sample distribution according to their hearing about scabies

	Frequency	Percent
Yes	600	96.5
No	22	3.5
Total	622	100.0

Figure.2 shows the source of the study sample information about scabies, where social media, family, friends, and publications awareness were found to be the most important sources of information on scabies.



**Figure2:** The sources of the study sample information about scabies

Table.5 shows the study sample distribution according to their concept of scabies, where 58% of them believed that scabies is a parasitic disease due to mites, 13% believed that scabies is a bacterial disease, 8% believed that scabies is a viral disease, and 8% believed that scabies is a fungal disease.

**Table5:** The study sample distribution according to their concept of scabies

	Frequency	Percent
Bacterial disease	83	13.3
Parasitic disease due to insect mites	361	58.0

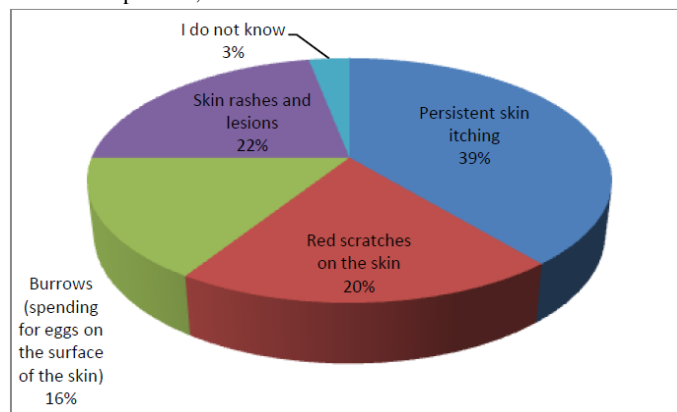
Fungal disease	48	7.7
Viral disease	51	8.2
I don't know	79	12.7
Total	622	100.0

Table.6 shows the study sample distribution according to their knowledge of incubation period for scabies, 29% of whom believed that the period of incubation for scabies ranges from 14-21 days, 28% believed that the incubation period for scabies is 7 days, and 6% thought it is 30 days.

**Table6:** The study sample distribution according to their knowledge of incubation period for scabies

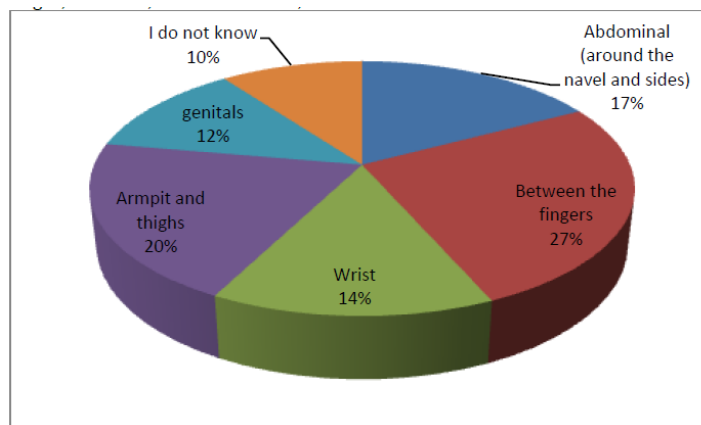
	Frequency	Percent
14-21 days	178	28.6
30 days	38	6.1
7 days	175	28.1
I don't know	231	37.1
Total	622	100.0

Figure.3 shows the distribution of the study sample according to the most important symptoms associated with scabies, where persistent itching, skin rash and patches, red scratches on the skin were found to be the most important symptoms.



**Figure 3:** The distribution of study sample according to the most important symptoms associated with scabies

Figure.4 shows the distribution of study sample according to their knowledge of the location of the most common scabies. Where the most important locations of emergence of symptoms of scabies were found to be between fingers, armpits, thighs, abdomen, around the navel, and the wrist.



**Figure4:** The distribution of the study sample according to their knowledge of the location of the most common scabies

Table.7 shows the study sample distribution according to their belief in the most affected by scabies, where it was found that 62% believed that the most affected by scabies are children, 9% believed that the most affected by scabies are adults, 8% believed that the most affected by scabies are the elderly, and 2% believed that the most affected by scabies are pregnant women.

**Table7:** The study sample distribution according to their belief in the most affected by scabies

	Frequency	Percent
children	388	62.4

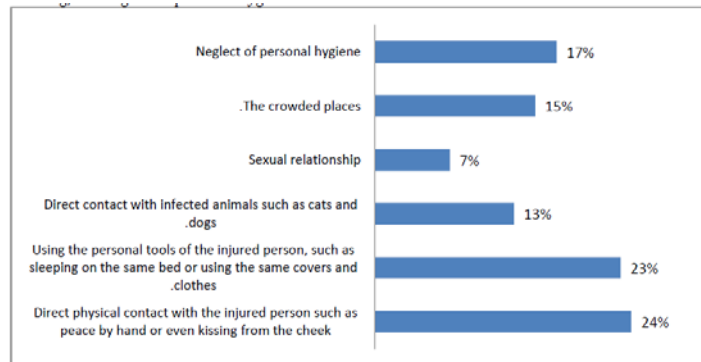
Adults	57	9.2
Pregnant women	13	2.1
Elderly	48	7.7
I don't know	116	18.6
Total	622	100.0

Table.8 shows the study sample distribution according to their belief that which group of persons are susceptible to scabies, where it was noted that 9% believed that males are more likely to have scabies, 7% believed that females are more susceptible to scabies, and 68% believed that males and females are exposed to scabies infection at the same rate.

**Table8:** The study sample distribution according to their belief that which group of persons are susceptible to scabies.

	Frequency	Percent
Male	54	8.7
Females	42	6.8
Male & Female	421	67.7
I don't know	105	16.9
Total	622	100.0

Figure.5 shows the study sample distribution according to their belief about the spread of scabies, where the most important ones were: the direct physical contact with the injured person such as patting by hand or even kissing on the cheek, and the use of personal tools of the affected person, such as: sleeping on the same bed, or using the same blankets and clothing, and neglecting personal hygiene.



**Figure5:** The study sample distribution according to their belief about the spread of scabies.

Table. 9 shows the study sample distribution according to their knowledge of complications of scabies. 29% of the study sample believed that scabies is more severe in patients with immunodeficiency virus, 23% believed that there are complications of scabies, and 13% believed that there are no complications of scabies.

**Table 9:** The study sample distribution according to their knowledge of complications of scabies

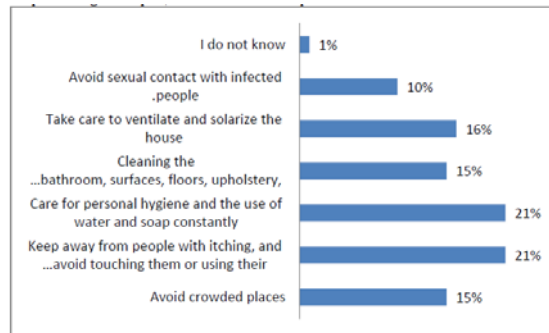
	Frequency	Percent
Increase the severity of the disease in patients with HIV	177	28.5
Secondary bacterial infection	141	22.7
There are no complications of scabies	83	13.3
I don't know	221	35.5
Total	622	100.0

Table.10 shows the study sample distribution according to their belief whether scabies lead to death or not. It was found that 52% believed that scabies don't cause death, 21% believed that scabies lead to death, while 27% didn't know.

**Table10:** The study sample distribution according to their knowledge of complications of scabies

	Frequency	Percent
Yeah	131	21.1
No	321	51.6
I don't know	170	27.3
Total	622	100.0

Figure.6 shows the study sample distribution according to their knowledge of methods of prevention of scabies. The most important methods of prevention of scabies were as follows: avoiding people with itching, avoiding touching or using their tools or clothes, , taking care of the ventilation and solarization of the house, cleaning the bathroom, surfaces, floors, furnishings, carpets using antiseptic, and avoiding crowded places.



**Figure6:** The study sample distribution according to their knowledge of methods of prevention of scabies

Table.11 shows the study sample distribution according to their belief on whether there is a cure for scabies or not. 87% of them believed that there is cure for scabies, 5% believed that there is no cure for scabies, and 8% didn't know about it.

**Table11:** The study sample distribution according to their belief on whether there is a cure for scabies or not

	Frequency	Percent
Yeah	543	87.3
No	30	4.8
I don't know	49	7.9
Total	622	100.0

Table.12 shows the study sample distribution according to their knowledge of the treatment of scabies, where 32% believed that the treatment of scabies is ointment, 9% believed that scabies is treated with antibiotics, and 52% believed that the treatment of scabies lies in the consultation with a doctor.

**Table12.** The study sample distribution according to their knowledge of the treatment of scabies

	Frequency	Percent
Taking an antibiotic	47	8.7
Use the appropriate ointment	174	32.0
doctor consultation	283	52.1
I don't know	39	7.2
Total	543	100.0

Regarding the belief that the treatment should be given to all the family members of the person with scabies, 53% believed that treatment should be given to all family members of the person with scabies, while 32% did not believe that treatment should be given to all family members of the person with scabies (Table 13).

**Table13.** The study sample distribution according to their belief that the treatment should be given to all the family members of the person with scabies

	Frequency	Percent
Yeah	290	53.4
No	175	32.2
I don't know	78	14.4
Total	543	100.0

Table.14 shows the study sample distribution according to the length of time the injured person can return to work after the treatment, and it was found that 35% of respondents believed that the injured person can return to work after a week of treatment, 17% believed that the injured person can return to work after one month of treatment, 17% believed that the injured person can return to work after 48-72 hours of treatment, and 5% believed that the injured person can return to work after 24 hours of treatment.

**Table14:** The study sample distribution according to the length of the time the injured person can return to work after the treatment.

	Frequency	Percent
After 24 hours of treatment	29	5.3
After 48 to 72 hours of treatment	94	17.3
After a week of treatment	190	35.0
After a month of treatment	94	17.3
Can't return	8	1.5
I don't know	128	23.6
Total	543	100.0

## Discussion

Scabies is an infectious disease, its related primarily to overcrowding and poverty, it spreads quickly from an individual to others especially among people with low level of hygiene [22]. World Health Organization (WHO) reported that scabies has a potential to cause about an epidemic situation in an area [23]. The estimated of scabies annual prevalence around the world is three hundred million. In many developing countries, scabies is a major health concern [24]. Scabies negatively affects the life quality of the infected person, it leads to substantial ostracism and stigmatization, it also causes embarrassment, anxiety, anger and depression, which adversely affects the various life activities [22]. Therefore, this study was performed to estimate the level of awareness about scabies symptoms, transmission ways and prevention among the population

The results of the present study showed a good awareness among the participants regarding the disease of scabies in various aspects such as causes, symptoms and methods of prevention and treatment. This is a good and promising indicator, because the disease poses a major threat to the social and psychological life of patients [22], as well as entering one case of this disease in a crowded community can result in an epidemic [25]. Bilal et al. found similar finding in their study conducted among nursing students in Jazan University, in which the participants had good knowledge about Scabies [26]. Also, ALshehri et al. found a satisfactory level of knowledge about Scabies among medical students in Kingdom of Saudi Arabia [27]. As well, Yusof et al. had similar finding in Pesantren Darul Fatwa, Jatinangor [23]. While, Singg found that (94%) were unaware about the facts regarding scabies in southwestern university, US [28]. Rathi et al., also found the lack of knowledge about different aspects of scabies in general among GPs of Karachi, Pakistan [28]. This lack of knowledge in Singg and Rathi et al. studies could be due to the neglected status of this disease [28,29].

In the present study, most of the participants(96.5% ) heard about scabies, while Yusof et al. found a lower proportion (62.2%) of participants who had heard of scabies [23]. In general, it is expected that a high proportion of people heard of this disease because, Scabies is one of the most common skin diseases, it represents a fundamental proportion of skin disease in developing countries, and performs a public health problem in these countries [22].

Scabies is caused by the mite *Sarcoptes scabiei* which causes a pruritic skin eruption [30]. About 58% of the participants knew that scabies is a parasitic disease due to insect mites. In a study, conducted by Bilal et al. among students of the Faculty of Nursing in Jazan University, it was found that 83% of the participants mentioned that the cause of scabies is scabies mites [24]. The high rate of knowledge of this information in the study of Bilal et al. might be due to fact that the cases participating in this study were from the Faculty of Nursing and not from the general population as in the present study. While , Yusof et al. found that only 31.1% knew that scabies is caused by *Sarcoptes Scabiei* [23].

The incubation period for scabies is about 3 weeks, but reinfestation of scabies can occur much faster [31]. Only 28.6% of the participants knew this fact. Regarding scabies' symptoms, itching is the main symptom that is caused by sensitization to the feces and proteins of the parasite, and gets worse at night [28, 31]. In the current study, the most common symptoms reported by the participants were persistent itching followed by skin rash and patches and then red scratches on the skin.

In the present study, the majority of the participants thought that children are most affected by scabies. The current literature has indicated that, scabies is more prevalent in young children compared to adults [24]. According to WHO, the estimated average prevalence of Scabies in children has been 5 – 10% [32]. The overcrowding environment in schools and greater opportunities for mixing and playgrounds could be the reason for the high incidence of scabies among school age children [31].

The majority of participants in this study believed that males and females get exposed to scabies infection at the same rate. This was consistent with what Karimkhani et al. [19] and Nair et al.[20] found that males were almost equally affected as females. But the results were not consistent with what Das et al. [31], Mahmood & Nur [34], Rasool et al. [32] and Vazirianzadeh et al [35] who found that males were more susceptible to scabies than females

With regard to the causes of scabies and ways to avoid it, the participants in the present study showed a good levels of knowledge on this issue. As the most common reasons of scabies that were reported by the participants were direct physical contact with the injured person followed by using personal tools of the affected person, and then the neglect of personal hygiene. And the most common ways of prevention of scabies were avoiding people with itching and avoiding touching or using their tools or clothes followed by taking care of the ventilation and insolation of the house.

87% of the participants believed that there is a cure for scabies, and almost half of the participants reported that scabies treatment lies in consultation with a doctor. Regarding the scabies treatment, WHO reported that scabies management consist of primary management and Secondary management. Primary management includes the application of a topical scabicide such as 5% malathion in aqueous base, 5% permethrin, 5–10% sulphur ointment or 10–25% benzyl benzoate emulsion. Oral ivermectin is also highly efficient, and is approved in many countries. While, secondary management includes quick treatment of scabies' complications such as impetigo using suitable antiseptics or antibiotics [30].

Preventive treatment is necessary for all members of the affected person's family, especially because scabies' signs may not appear for 2– 3 weeks after the contact [29]. This was agreed by more than half of the participants in this study, as almost 53% believed that the treatment should be given to all family members of the person with scabies.

## Conclusion

This study showed satisfactory levels of awareness about scabies and its symptoms, transmission ways and prevention among the population in Al-Madinah Almunawarh, Saudi Arabia. However, health education should be performed because there were some participants who did not know about scabies, its causes, symptoms, how to prevent, and methods for treating it.



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## References

1. Hertel, J. K. H., Johansson, S., Midthjell, K., Nygård, O., Njølstad, P. al R., & Molven, A. (2013). Type 2 diabetes genes—Present status and data from Norwegian studies. *Norsk Epidemiologi*, 23(1).
2. Shaw JE, Sicree RA, Zimmet PZ (2009). Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract*, 87 (1): 4-14.
3. Pociot, F., & McDermott, M. F. (2002). Genetics of type 1 diabetes mellitus. *Genes and Immunity*, 3(5), 235–249. <http://doi.org/10.1038/sj.gene.6363875>.
4. Pincus G, White P (1934) On the inheritance of diabetes mellitus. II. Further analysis of family histories. *Am J Med Sci* 188:159–169.
5. Kobberling J, Tillil H (1982) Empirical risk figures for first degree relatives of non-insulin-dependent diabetics. In *The Genetics of Diabetes Mellitus*. Kobberling J, Tattersall R, Eds. Academic Press, New York, 201–209.
6. Kahn CR, Vicent D, Doria A (1996) Genetics of non-insulin dependent (type II) diabetes mellitus. *Annu Rev Med* 47:509–531.
7. Rich SS (1990) Mapping genes in diabetes: a genetic epidemiologic perspective. *Diabetes* 39:1315–1319.
8. Raffel LJ, Goodarzi MO, Rotter JI (2007) Diabetes mellitus. In *Principles and Practice of Medical Genetics* Rimoin DL, Connor JM, Pyeritz RE, Korf B, Eds London, Churchill Livingstone, 1980–2022.
9. Rich, S. S., Norris, J. M., & Rotter, J. I. (2008). Genes Associated with Risk of Type 2 Diabetes Identified by a Candidate-Wide Association Scan: As a Trickle Becomes a Flood. *Diabetes*, 57(11), 2915–2917. <http://doi.org/10.2337/db08-0941>.
10. Hensen J, Buchfelder M (2001). The posterior pituitary and its disease; in Pinchera A, et al (eds): *Endocrinology and Metabolism*. New York, McGraw-Hill, 99–115.
11. Fujiwara TM, Bichet DG (2005). Molecular biology of hereditary diabetes insipidus. *J Am Soc Nephrol*, 1 6: 2 836–2846.
12. Ramachandran, A. (2014). Know the signs and symptoms of diabetes. *The Indian Journal of Medical Research*, 140(5), 579.
13. Frankish N, de Sousa Menezes F, Mills C, Sheridan H. (2010) Enhancement of insulin release from the beta-cell line INS-1 by an ethanolic extract of *Bauhinia variegata* and its major constituent roseoside. *Planta Med*, 76(10): 995-997.
14. Chauhan A, Sharma PK, Srivastava P, Kumar N, Duehe R. (2010) Plants having potential antidiabetic activity: a review. *Der Pharm Lett*, 2(3): 369-387.
15. Qa'dan F, Verspohl EJ, Nahrstedt A, Petereit F, Matalka KZ. (2009). Cinchonain Ib isolated from *Eriobotrya japonica* induces insulin-secretion in vitro and in vivo. *J Ethnopharmacol*, 124(2): 224-227.
16. Bnouham M, Ziyat A, Mekhfi H, Tahri A, Legssyer A. (2006). Medicinal plants with the potential antidiabetic activity—a review of ten years of herbal medicine research (1990-2000). *Int J Diabetes Metab*, 14: 1-25
17. KONDO, Y., F. YAKANO, H. HOJO (1993): Inhibitory effect of bisbenzylisoquinoline alkaloids on nitric oxide production in activated macrophages. *Biochem. Pharmacol.* 46, 1337-1392.
18. Amish J. Patel, *Pharmacognostical*, (2016). *Phytochemical and Pharmacological investigation of Echinops echinatus (Roxb.) Ph. D Synopsis*, 2-14
19. Berman, H. M. (2008). The Protein Data Bank: a historical perspective. *Acta Crystallographica Section A Foundations of Crystallography*, 64(1), 88–95. <http://doi.org/10.1107/S0108767307035623>
20. Wang, Y., Xiao, J., Suzek, T. O., Zhang, J., Wang, J., & Bryant, S. H. (2009). PubChem: a public information system for analyzing bioactivities of small molecules. *Nucleic Acids Research*, 37(Web Server), W623–W633. <http://doi.org/10.1093/nar/gkp456>
21. Drwal, M. N., Banerjee, P., Dunkel, M., Wettig, M. R., & Preissner, R. (2014). ProTox: a web server for the in silico prediction of rodent oral toxicity. *Nucleic Acids Research*, 42(W1), W53–W58. <http://doi.org/10.1093/nar/gku401>
22. Schneidman-Duhovny, D., Inbar, Y., Nussinov, R., & Wolfson, H. J. (2005). PatchDock and SymmDock: servers for rigid and symmetric docking. *Nucleic Acids Research*, 33(Web Server), W363–W367. <http://doi.org/10.1093/nar/gki481>

23. Valerio, L.G. (2009) In silico toxicology for the pharmaceutical sciences. *Toxicol. Appl. Pharmacol.*, 241, 356–370.
24. Thai, K.-M., Ngo, T.-D., Tran, T.-D. and Le, M.-T. (2013) Pharmacophore modeling for anti-targets. *Curr. Top. Med. Chem.*, 13, 1002–1014.
25. Aravanan G, Pari L (2008). Hypoglycaemic and antihyperglycaemic effect of *Syzygium cumini* bark in streptozotocin-induced diabetic rats. *J Pharmacol Toxicol* 3: 1-10.
26. McConkey BJ, Sobolev V, Edelman M. (2002). The performance of current methods in ligand-protein docking. *Current Science*. 83:845–855.
27. Meng, X.-Y., Zhang, H.-X., Mezei, M., & Cui, M. (2011). Molecular docking: a powerful approach for structure-based drug discovery. *Current Computer-Aided Drug Design*, 7(2), 146–157.
28. Wadkar KA, Magdum CS, Patil SS, Naikwade NS. (2008). Antidiabetic potential and Indian medicinal plants. *J Herbal Med Toxicol* 2: 45-50.
29. Arumugam, G., Manjula, P., & Paari, N. (2013). A review: Antidiabetic medicinal plants used for diabetes mellitus. *Journal of Acute Disease*, 2(3), 196–200. [http://doi.org/10.1016/S2221-6189\(13\)60126-2](http://doi.org/10.1016/S2221-6189(13)60126-2)
30. Malviya, N., Jain, S., & Malviya, S. A. P. N. A. (2010). Antidiabetic potential of medicinal plants. *Acta Pol Pharm*, 67(2), 113-118.
31. S. Akheli, Deepa, S., & Alwar, M. C. (2007). Acute Toxicity Studies and Determination of median Lethal Dose, 93(7)