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Risk Factors and Effects of Infestation with Pediculosis Capitis and Scabies among Primary School Students in Cairo, Egypt

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ABSTRACT

Background: Pediculosis capitis (PC) and scabies are an important public health problem in childhood. They have a worldwide distribution. Also, they have many effects on the infested students. **Objectives**: To define the prevalence of PC and scabies, to find out the socio-demographic, environment, and health care behavior risk factors, and to determine the effects on the studied students in Cairo, Egypt. **Subjects and Methods**: A cross-section, analytical study design was chosen to conduct this work. Three primary schools were the field of this study. Total number of the students was 1987. The students were clinically examined; for each infested case with PC and/ or scabies a control student was chosen. **Results**: Prevalence of PC and scabies was 10.2% and 3.4%, respectively. These infestations were more common significantly among students in the public school. Significant social risk factors of infested students were the low level of head of the family education, occupation, and social status. Also, significant personal hygiene risk factors were poor hair, body, and environment hygiene. While significant health care behavior risk factors were student never received skin examination, no early consultation for skin diseases, and no compliance with therapy. Also; female gender, the last birth order child, had previous infestation with PC, had sibling(s) with PC, and had parents with history of infestation with PC were significant risk factors. On the other hand; male gender, the last birth order child, had previous infestation with scabies, had sibling(s) with scabies, and had parents with history of infestation with scabies were significant risk factors. Further, the PC cases with crowding index >1, had no sun access, had shared water supply and bathing facilities, co-sleeping, had no short cut hair, and sharing hair brushes were significant risk factors. On the other hand, the scabitcs with crowding index >1, had no sun access, had shared water supply and bathing facilities, and co-sleeping were significant risk factors. Lastly, presences of psychiatric, sleep, and peers' relations disturbances were significantly more common among the infested students. **Conclusions**: Many risk factors of PC and scabies can be manipulated, so these infestations can be prevented, so many health hazards on the students could be prevented. **Recommendations**: Improving students' hygiene, health education, and regular dermatological screening and treatment of students are important essentiality. Also, dermatological health component should be integrated in school health program. Lastly, further studies in different rural and urban areas in Egypt are recommended.

Key words: Pediculosis capitis, scabies, prevalence, risk factors, primary schools.

INTRODUCTION

School children are considered one of the most important sectors of population. They are a vulnerable group and great attention should be paid for them. [(1)] Also, school environment makes children vulnerable to cross transmission of communicable dermatological diseases, which can then be passed on to their family members. [(2)] So, coordinated school health programs in conjunction with community efforts can prevent many health problems among students and help them to establish lifelong safety skills. [(3, 4)]

Dermatological disorders are among the most frequently diagnosed conditions in school children all over the world, in developing and developed countries. [(5, 6, 7)] Skin diseases are associated with environmental factors and public health approach is particularly important. [(7)] Further, infestations with ecto-parasitoses are usually considered to be vexing disorders. These disorders do not attract much clinical attention, but they can cause significant morbidity. [(8)]

Pediculosis capitis (PC) and scabies are ubiquitous, contagious, and debilitating parasitic dermatoses. They have been known since antiquity and are distributed all over the world. [(9, 10)] Depending on the socioeconomic

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setting, these infestations may affect a large proportion of a population. Ectoparasitic infestations can be sporadic, endemic, or epidemic. [8]

Infestation of humans by the parasite *Pediculosis humanus capitis* had been recognized for hundreds of years. [11] Man is the only natural host for this parasite; so, PC infestation remains a major personal and public health problem, which appears to be on the rise. [12] PC has a worldwide distribution, with a variable rate of up to 80.0%. [13] Since the middle of the 1960s [9] and during 1970s prevalence of head lice has increased in many countries. [13] PC affected all ages, but school-age children, within the age range of 3-11 years, are the most affected age group. [14, 9] Prevalence of PC among school children varied in different parts of the world; 3.0% in Poland, [15] 8.0% in Iran, [16] 33.7% in Australia, [11] and 81.4% in Argentina. [17] Also, in Egypt, PC is a public health problem, school children are the most important group of population at risk. [18] Prevalence of PC among school children, in Egypt, varied from 15.98 % of school children in Sohag [19] to 48.2% among primary school children in Beni Suef. [20] Many factors such as poor hygiene, socioeconomic status, lack of medical treatment and resistance to the treatment leads to increase the prevalence of head lice. [21, 22]

Scabies is a common encountered dermatological infestation caused by the itch mite, *Sarcoptes scabiei var homonis*, an obligate human parasite that burrows tunnels downward into the epidermis. The organism was identified with the disease over 300 years ago, [12] but scabies has been known for over 2,500 years. [9] Scabies continues to be an important parasitic disease that persists throughout the world despite the availability of various acaricides used for its control. Worldwide, an estimated 300 million people are reported to be infested with scabies, which spreads through human contact. [23] Scabies itself is not a fatal or life-threatening condition, but it can be severe and persistent. [24]
Scabies affects a high proportion of population in many developing [25] and developed [5] countries. The prevalence of scabies varies widely from one country to another. [26] In developing countries the prevalence of the disease is 5.8%-8.3% among rural populations. [14, 27] The situation is worsening in underdeveloped countries in Africa, where prevalence reaches up to 31.0%. [28]

Scabies occurrence is higher among young male children. [29] It affects 2.2% of school children in Turkey. [7] It is considered a serious public health problem in Egypt. [30] In one study it is reported that scabies found among 5.8% of the primary school children in Beni Suef Governorate, Egypt. [20]

Although, PC and scabies are common parasitic skin diseases, especially in resource-poor communities, but data on epidemiology and morbidity are scanty. [31] So, we decided to conduct this study to define some epidemiological characteristics of students infested with these disorders in primary schools in Egypt.

STUDY OBJECTIVES

A- Ultimate objective:

Improving quality of health and quality of life of the school children in Egypt.

B- Immediate objectives:

1- To define the prevalence of PC and scabies among the studied primary school students in Cairo, Egypt.
2- To define the sociodemographic, environmental and health care behavior characteristics of the school students infested with these diseases.
3- To determine the effects of these infestations on the studied school students.

SUBJECTS AND METHODS

A- Technical Design

I- Research Questions: What are the prevalence PC and scabies among school children in Cairo**,** Egypt? Is there socio-demographic, environmental or health care behavior characteristics of the affected students with these diseases?

II- Research Design: A cross-section, analytical study design was chosen to investigate the current research problem.

III- Research Setting: This study was conducted in Al-Marg region, east district of Cairo**,** Egypt. This region is a densely populated area, contains mainly low and middle social classes and it is a resource-poor community. Three primary schools (one public, one experimental, and one private) were chosen randomly in this region.

VI- Research Sample: In each school all students were recruited and clinically examined after agreement of their responsible parent. The total number of students was 2630. The total number of students (after exclusion of refused parents, non-cooperative students, absentees or incomplete data) was 1987; 681 in the public school, 723 in the experimental school, and 583 in the private school. The students aged 4-13 years. For each infested case a control one was chosen from the students' class list, the name after name of the case.

VI- Research Tools and Methods:

1- Diagnosis of PC and scabies: All students had undergone dermatological examination to detect those with the diseases. The student's hair was carefully and closely examined by a hand lens for presence of viable nits, nymphs or adult lice in the hair (the criteria for diagnosis of PC infestation). Scabies was, also, diagnosed clinically. The definitive diagnosis was made by microscopic identification of the mites or eggs from skin scrapings. All the students with PC and scabies were managed freely and referred to the school health insurance physician for follow up.

2- Interview questionnaire: It was used to collect data relevant to topic of the study. The cases and controls were interviewed, in case of too young and/or non-cooperative student one of his/her parents was interviewed.

B- Operational Design

I- Pilot Study: It was done on 100 students to test the feasibility of the study at the study sites and to measure the time and resources needed for the field work.

II- Ethical Consideration: A verbal agreement from all the students' parents/care givers to participate in the research was taken after full explanation of the aims of the research. The participants' parents were assured that the researcher's will investigate and treat all positive cases and the parents will be informed.

III- Practical Phase: This phase took about 4 months. The students were examined and the data were collected through field visits.

IV- Statistical Design: Statistical analysis of data was performed; it included coding, data entering, and sorting by Microsoft office 2010 and statistical analysis program IBM, statistical package for social studies (SPSS) version 20 (SPSS Inc.; Chicago, USA). Chi-square (χ^2) and Fisher exact (FE) were used as tests of significance. The significance level for χ^2 and FE were accepted if the P-value <0.05. Also, odds ratio (OR) was used to define the risk, the confidence interval (CI) or exact confidence limits (ECL) were used to determine the significance of the OR.

RESULTS

The overall percent of PC and scabies among the studied school students **(table 1)** was 10.2% and 3.4%, respectively. The total number of diseases was 270 (13.6%) while the total number of students with diseases was 247 (12.4%). This conflict because there were 46 students infested simultaneously with PC and scabies.

In the present study **(table 2)**, we showed that PC was present among 13.4%, 10.2%, and 6.5% of the public, experimental, and private school students respectively with a statistically significant difference, P=0.00003. Also; 5.4%, 3.2%, and 1.2% of the public, experimental, and private school students respectively had scabies with a statistically significant difference, P=0.00001. Further; 5.0%, 1.1%, and 0.7% of the public, experimental, and private school students respectively had PC and scabies simultaneously with a statistically significant difference, P=0.000.

As respect social characteristics of head the student's family **(table 3)**, we cleared that low educational level, low occupational level, and low social level were statistically significant risk factors for families of students with PC and scabies, OR=1.84, 95% CI: 1.26-2.67; OR= 2.35, 95% CI: 1.61-3.43; and OR=2.13, 95% CI: 1.46-3.1; respectively. On the other hand, middle educational level, middle and high occupational levels, and middle & high social levels were significant social protective factors for these families, OR=0.68, 95% CI: 0.47-1.0; OR=0.62, 95% CI: 0.42-0.91; OR=0.46, 95% CI: 0.27-0.78; OR=0.64, 95% CI: 0.44-0.95; and OR=0.53, 95% CI: 0.32-0.89; respectively.

Regarding personal hygiene and health care behavior characteristics' of the studied school students **(table 4)**; poor hair and body hygiene, poor environmental hygiene, never received dermatological examination, no early

consultation for skin diseases, and in-compliance with therapy were personal hygiene and health care behavior statistically significant risk factors for students with PC and scabies, OR=2.13, 95% CI: 1.46-3.11; OR=3.5, 95% CI: 2.38-5.17; OR=8.77, 95% CI: 5.71-13.5; OR=3.31, 95% CI: 2.23-4.91; and OR=4.37, 95% CI: 2.94-6.49; respectively. On the other hand, fair hair and body hygiene, fair environmental hygiene, never received dermatological examination, no early consultation for skin diseases, and no compliance with therapy were personal hygiene and health care behavior statistically significant protective factors for these students, OR=0.54, 95% CI: 0.36-0.79; OR=0.33, 95% CI: 0.22-0.49; OR=0.11, 95% CI: 0.07-0.18; OR=0.3, 95% CI: 0.2-0.45; and OR=0.23, 95% CI: 0.15-0.34; respectively.

In respect to personal and familial characteristics of students with PC **(table 5)**; prevalence of PC was increased with increasing age, but there was no age group represented a statistically significant risk or protective factor, while the oldest age group was non-statistically significant factor. On the other hand, female gender was found to be statistically significant risk factor (OR=5.74, 95% CI: 3.46-9.58), while the male gender was statistically significant protective factor (OR=0.17, 95% CI: 0.1-0.29).

Further, the last birth order child was a statistically significant risk factor (OR=3.08, 95% CI: 1.97-4.83), while the first birth order child was a statistically significant protective factor (OR=0.37, 95% CI: 0.24-0.59). Moreover, previous infestation with PC, sibling(s) with PC, and parental history of infestation with PC were statistically significant risk factors for PC (OR=6.33, 95% CI: 4.1-9.77; OR=9.79, 95% CI: 6.17-15.6; and OR= 3.0, 95% CI: 1.48-6.13; respectively. Further, no previous infestation with PC, no sibling(s) with PC, and no parental history of infestation with PC were statistically significant protective factors for PC (OR=0.16, 95% CI: 0.1-0.24; OR=0.1, 95% CI: 0.06-0.16; and OR=0.33, 95% CI: 0.16-0.67; respectively. At the same time, prevalence of scabies was increased with increasing age, but there was no age group represented a statistically significant risk or protective factor. While, male gender was found to be statistically significant risk factor (OR=2.12, 95% CI: 1.17-3.86), while the female gender was statistically significant protective factor (OR=0.47, 95% CI: 0.26-0.85). Also, the last birth order child was statistically significant risk factor (OR=3.54, 95% CI: 1.91-6.58), while the first birth order child was statistically significant protective factor (OR=0.37, 95% CI: 0.18-0.74). Further, previous infestation with scabies, sibling(s) with scabies, and parental history of infestation with scabies were statistically significant risk factors for scabies (OR=41.04, 95% CI: 17.57-98.16; OR=32.9, 95% CI: 14.47-76.31; and OR=4.21, 95% CI: 1.6-11.1; respectively. While, no previous infestation with scabies, no sibling(s) with scabies, and no parental history of infestation with scabies were statistically significant protective factors for scabies (OR=0.02, 95% CI: 0.01-0.06; OR=0.03, 95% CI: 0.01-0.07; and OR=0.24, 95% CI: 0.09-0.62; respectively.

As regard distribution of cases with PC **(table 6)**; crowding index >1 was found to be a statistically significant risk factor (OR=4.68, 95% CI: 3.07-7.14), while the crowding index =1 and <1 were statistically significant protective factors (OR=0.56, 95% CI: 0.37-0.85 and OR=0.24, 95% CI: 0.14-0.41, respectively). Also, no sun access inside the house was statistically significant risk factor (OR=5.88, 95% CI: 3.44-10.13). Further, shared water supply and bathing facilities were statistically significant protective factor (OR= 4.34, 95% CI: 2.85-6.63). Also, co-sleeping was statistically significant risk factor (OR= 1.99, 95% CI: 1.27-3.12). Also, not short cut hair and sharing hair brushes/combs were statistically significant risk factors (OR=4.2, 95% CI: 2.76-6.4 and OR=5.06, 95% CI: 2.92-8.81, respectively).

As respect scabies; crowding index >1 was found to be statistically a significant risk factor (OR=7.78, 95% CI: 4.06-15.04), while the crowding index =1 and <1 were statistically significant protective factors (OR=0.37, 95% CI: 0.18-0.75 and OR=0.15, 95% ECL: 0.05-0.39, respectively). Also, no sun access inside the house was statistically significant risk factor (OR=7.27, 95% ECL: 2.98-21.27). Further, shared water supply and bathing facilities were statistically significant risk factor (OR=11.6, 95% CI: 5.07-27.54). Moreover, co-sleeping was statistically significant risk factor (OR=2.72, 95% CI: 1.3-5.82). Also, sharing and non sharing towels/undergarments were non-statistically

significant risk and protective factors (OR= 1.86, 95% CI: 0.96-3.62).

Regarding distribution of cases with PC and scabies according to effects of these infestations **(table 7)**; we observed that psychiatric disturbances were higher (32.5%) among PC cases compared to the controls (11.7%) with a statistically significant difference (P=0.000). In details, we reported that irritability, anxiety, and depression were higher among PC cases compared to the controls; 13.3% &5.7%, 10.3% &4.4%, and 8.9% &1.6%, respectively with statistically significant differences (P=0.005, 0.01, and 0.0003, respectively). Further, sleep disturbance was present in 64.5% of PC cases compared to 10.5% in the controls with a statistically significant difference (P=0.000). Furthermore, relation with peers was isolation in 62.1% of PC cases compared to 22.3% in the controls with a statistically significant difference (P=0.000). Also, secondary bacterial infections in the scalp was found among 35.5% and 2.4% of the cases and the controls, respectively (p=0.000). Lastly, results of the first term exam were <50.0%, 50.0%-85.0, and >85.0% in 12.8% &5.7%, 42.4% &40.1%, and 44.8% &54.2%, in PC cases and the controls, respectively (P=0.008, 0.62, and 0.04, respectively). At the same time, we showed that psychiatric disturbances were higher (43.3%) among scabietic cases compared to the controls (11.7%) with a statistically significant difference (P=0.000). In details; irritability, anxiety, and depression were higher among scabietic cases compared to the controls; 19.4% &5.7%, 16.4% & 4.4%, and 7.5% &1.6%, respectively with statistically significant differences (P=0.0003, 0.001, and 0.02, respectively). Further, sleep disturbance was present in 80.6% of scabietic cases compared to 10.5% in the controls with a statistically significant difference (P=0.000). Furthermore, relation with peers was the isolation in 88.1% of scabietic cases compared to 22.3% in the controls with a statistically significant difference (P=0.000). Also, secondary bacterial infections in the scalp was found among 35.5% and 2.4% of the cases and the controls, respectively (p=0.000). Lastly, results of the first term exam were <50.0%, 50.0%-85.0, and >85.0% in 13.4% &5.7%, 46.3% &40.1%, and 40.3% &54.2% in the cases and controls, respectively (P=0.03, 0.36, and 0.04, respectively).

DISCUSSION

Prevalence of PC and scabies differ in different communities and populations according to many factors, which include social and environmental characters of the community and population, health habits of the community, personnel hygiene, and technical methods used in diagnosis of these diseases.

PC and scabies are common among primary school children. [20] PC, also known as head lice infestation, is an important public health concern, which affects millions of children around the world. [10, 32]

The peak incidence is between 5 and 13 years of age. [10, 32] So, prevalence of PC probably keeps high among primary school children. This occurs probably because as children inter the school, they will be in contact with large numbers of children coming from families with different socioeconomic and cultural levels. Also, the child has no knowledge about the possibilities of transmission of head lice, especially if his/her parents were illiterates. As the children grow up their knowledge will improve and subsequently decreases the rate of infestation. [33] While, prevalence of scabies probably keeps low due to increasing pruritus and clinical lesions it causes to the infested individual; this is not the case of PC, because in general, the lesions are secondary. [34]

In the present study we cleared that prevalence of PC among the studied school students was 10.2%. This figure is similar to that of **İnanir *et al.*** [7]; they illustrated prevalence of infestation 9.4% among primary school children in Turkey.

On one hand, our figure is less than that of 15.0% among school children in Torino, France [35], 55.0% among Ethiopian immigrants in Israel [36], 40.0% in Taiwan [37], 25.4% among school children in Chile, [14] 81.4% and 61.4% among school children in Argentina [17, 38], 33.7% in Australia, [11] 35.5% in Malaysia [39], 28.3% in the U.K [40], 43.4% in a slum area in Brazil [31], 21.2% in Iraq [33], 14.1% in Palestine [41], and 16.8% in the Gaza, Palestine. [42] Epidemiologic studies that have been conducted in Turkey showed prevalence of PC have been reported to be 18.6% in Adana,

16.1% and 20.7% in Izmir, 7.3% in Sivas, and 1.8% in Ankara. [43] The highest figure of **Heukelbach *et al.*** [31] could be explained, the study is a community based study in a slum area in Brazil.

In Egypt, our figure is less than that of **Nada et al.** [19], **Morsy *et al.*** [44], **El-Shafie & El-Shazly** [45], and **El-Rifaie *et al.*** [20]; they showed prevalence's of 15.98% among school children in Sohag, 21.86% in Cairo, 32.2% in Minofiya, and 48.2% among the primary school children in Beni Suef, respectively. The highest figure of **El-Rifaie *et al.*** [20] could be explained, the study sample contains rural school students with high prevalence (51.6%) of PC compared to urban school students (40.4%), low personal hygiene, big family size, and low socioeconomic standard.

On the other hand, our figure (10.2%) is higher than the following; 0.8% and 5.1% among preschool nursery [46] and school [47] children in Turkey, 1.8% among school children in Iran, [10] 3.0% among school children in Poland, [15] 3.7% among primary school children in Nigeria [48], 5.2% in Saudi Arabia [49], 5.5% in Egypt [50], 6.5% among primary school children in Ethiopia [6], and 6.8% among primary school children in Sierra Leone. [51]

At the same time, the overall prevalence of scabies among our studied school students was 3.4%. This figure is higher than that of **Kristensen** [26], **Morsy *et al.*** [30], **Sagua *et al.*** [14], **Downs *et al.*** [25], **Hegazy *et al.*** [52], **Speare & Buettner** [11], and **İnanir *et al.*** [7]. The prevalence of infestation with scabies was found to be 1.06% among school children in Ethiopia, [6] 1.8% among school children in Chile, [14] 2.37% among school children in Argentina [53], 2.6% among students in Egypt [52], and 2.2% among primary school children in Turkey. [7] On one hand, **Onlen *et al.*** [54], and **Ciftci *et al.*** [46] noticed prevalence of scabies was 0.48% and 0.4%, respectively among school and preschool nursery children in Turkey. On the other hand, our figure is less than that of **El-Rifaie *et al.*** [20]; they illustrated prevalence of infestation 5.8% among primary school children in Beni Suef Governorate, Egypt. Also, a study conducted among primary school children in Turkey reported the prevalence of scabies was 9.9%.[55] Further, our figure (3.4%) is less than that of **Heukelbach *et al.*** [31]; they reported prevalence of infestation of scabies was 8·8% of the population in a slum area in Brazil. Lastly, most of general practitioners and dermatologists rarely or never reported scabies to the health authorities. As a result, the true incidence of scabies in many countries is not known. [46]

Further, we cleared that co-infestation of PC and scabies was found among 2.3% of the students. **Heukelbach *et al.*** [31] showed that age ≤ 15 years, being of female sex and living in the urban slum were independent factors contributing to the simultaneous co-infestation with PC and scabies.

We showed that PC, scabies, and mixed infestation are more common in the public school compared with experimental and private schools with a statistically significant difference. Public school is almost free of charge and experimental school is of minimal charge, while private school is completely paid i.e. with high charge. So, these results mean that there is a relation between economic level of the students and occurrence of PC and scabies. Further, **Karim *et al.*** [56] noticed that scabies severity and re-infestation were related to household income ($P<0.001$ for both). On the other hand, **Ciftci *et al.*** [46] observed that family income was not found to be significantly differs between infested and non infested cases, however infested children belonging to families with low income were majority, 42.9%. Also, we assume that another cause of the low prevalence of infestation in private school is the low number of students in the class.

Social status and living standard of human being significantly affected the prevalence of PC. [16, 22, 57, 58, 59, 60]

In this study, we cleared that low educational level of head of the family, low occupational level, and low social level were significant risk factors for families of students with PC and scabies.

PC and scabies are diseases, which are strongly influenced by socioeconomic factors. [14, 20] Our result regarding increase prevalence of PC and scabies among school students belonging to families with low educational status was in agreement with **İnanir *et al.*** [7],

Ciftci *et al.* [46], and **Salih** [33]; they showed that PC and scabies were more common among children of illiterate parents have no or little knowledge about health care [33]; educated parents have more information about head lice. [59, 60, 61] Prevalence of PC infestation was correlated with level of education (p=0.04), father's job (p=0.01), father's education (p=0.003), and mother's education (p=0.001). [16] Also, prevalence of PC was greater among students whose parents' education level was low; **Motovali-Emami *et al.*** [10] noticed that pupils who reported as having been infested with head lice in the previous 6 months; their mother's education level was a significant risk factor. Further, we noticed increase prevalence of PC and scabies among school students belonging to families with low occupational level. Infestation was found to be more frequent among children whose mothers were housewives than children with mothers of other occupations (P <0.05). [46] This could be explained; housewives might be having low educational level, so they cannot find official jobs outside their homes.

Scabies is prevalent in all socioeconomic groups and communities throughout the world. In some developed cities the prevalence rates vary between 6.0% and 27.0%. [36] While, **De Doucet *et al.*** [53] showed that scabies was more significantly more prevalent among poor and fair socioeconomic status.

Low socioeconomic status significantly increases the rate of PC infestation. [7, 22, 33, 42, 58, 59, 60] Our result regarding increase prevalence of PC and scabies among school students belonging to families with low socioeconomic status were in accordance with **Hegazy *et al.*** [52], they observed that scabies was more common among families with low socioeconomic status in Egypt. Also, in Egypt, **El-Rifaie *et al.*** [20] illustrated that PC and scabies were found more common among school students from families with low social class. Further, **El-Shafie & El-Shazly** [45] and **Nada *et al.*** [19], in Egypt, cleared that low socioeconomic status significantly increased the rate of PC infestation.

We reported that poor hair and body hygiene (56.3%) and poor environmental hygiene (65.2%) were found to be statistically significant risk factors for students with PC and scabies. Islam encourages importance of health and individual hygiene. So, this should lower prevalence rates of PC and scabies infestations in Islamic countries like Egypt. A negative relation was found between the frequency of hair washing and head lice infestation in Egypt. [20, 50, 19] Also, **Alzain** [42] found that PC infestation rate was greater among children who did not have separate facilities for bathing in their houses.

On the other hand, there was a negative correlation between frequency of hair washing and head louse infestation; students who wash hair ≥3 per week had the least PC infestation compared with the children who wash hairs 1 or 2 time per week. [16] In addition, prevalence of PC infestation was associated with the frequency of using shampoo. Also, **Salih** [33] and **Al-Shawa** [22] showed that poor hair hygiene leads to increase the prevalence of PC. **Karim *et al.*** [56] noticed that 74.0% of scabietic children were living in poorly ventilated buildings. Further, they showed that sanitation was also poor; 39.0% of them bathed infrequently. Also, they reported that scabies severity and re-infection were associated with infrequent washing of clothes (P<0.001) and bed linen (P<0.001), and infrequent bathing (P<0.001) with soap (P<0.001). On the other hand, **Ciftci *et al.*** [46] showed that frequency of hair washing was not found to be significantly differ between infested and non infested subjects, however infested children who infrequently hair washers (once/week) were the commonest compared to children who frequently hair washers (twice/week).

In the current study, we showed that never receiving skin examinations, no early consultation for skin diseases, and incompliance with therapy were found to be statistically significant risk factors among cases. Screening and treatment for PC among children should be done continuously in order to reduce infestation rates. [62] Also, **Alzain** [42] showed that prevalence of PC infestation was associated with the frequency of hair examination (P < 0.05). **Al-Shawa** [22] showed that lack of medical treatment and resistance to the treatment lead to increase the prevalence of head lice.

We cleared that prevalence of PC increased with increasing age among primary school children but no age group found to be a statistically significant risk factor. The peak incidence of PC is from 5 to 13 years of age. [10]

Our result is consistent with **El-Rifaie *et al.*** [20] and **Nada *et al.*** [19]; they did not find any significant influence of age on the incidence of infestation. While, results of many other studies as **Combescot** [35], **Gbakima & Lebbie** [51], **Chouela *et al.*** [17], **Shakkoury & Abu-Wandy** [2], **Amr & Nusier** [63], **Heukelbach *et al.*** [31], and **Nada *et al.*** [19] have been reported significant increase of PC among older primary school students compared to the younger ones. On the other hand; **Sagua *et al.*** [14], **Menan *et al.*** [64], **Morsy *et al.*** [44], **Salih** [33], and **Alzain** [42] reported significant higher prevalence of PC among younger school students aged 6-9 years as compared to the older students who aged 10-13 years.

The low infestation rate in children 10 years of age and older observed in these studies may indicate better personal hygiene practices, including regular combing and washing of the hair, are probably the main reason for the low head lice infestation rate in this group in comparison to the younger groups, made up of students who may need help from their parents in combing and washing their hair. Also, there are relation between PC infestation and age (p=0.04); children 8-9 years had the most head infestation (41.7%) and children ≥12 years had the lowest infestation (3.3%). [16]

Also, we cleared that female and male genders were found to be statistically significant risk and protective factors, respectively for PC. This result is accepted and expected as females almost had long hair that necessitates great and difficult careful, while boys usually had short hair that facilitates care. Also, our result is in agreement with results of many studies; **Ebomoyi** [48], **Sagua *et al.*** [14], **Speare & Buettner** [11], **Amr & Nusier** [63], **İnanir *et al.*** [7], **Heukelbach *et al.*** [31], **Nada *et al.*** [19], and **Alzain** [42]. Further, our result is in agreement with **El-Rifaie *et al.*** [20] in Egypt; they found that prevalence of PC was 86.9% and 13.1% among female and male school students, respectively with statistically significant difference, P<0.001. In Iraq, **Salih** [33] showed 72.2% prevalence of PC infestation among girls compared to 27.8% among boys. Further, **Motovali-Emami *et al.*** [10] observed that prevalence of PC infestation was significantly higher in girls (2.9%) than in boys (0.6%) (P=0.000). On the other hand, **Ciftci *et al.*** [46] found no significant gender differences in infested cases with PC and scabies; 42.9% of the infested cases were boys and 57.1% were girls.

In the current study, we observed that the last birth order child was found to be a significant risk factor for PC. This result is accepted and expected as the last birth order child might have been paid little attention and care by parents. Also, this might be because the last birth order child might be members of large families and so parents may pay less attention to hair care. [65] At the same time, previous infestations with PC, sibling(s) with PC, and parental history of infestation with PC were found to be significant risk factors for PC. Again, these results are accepted and expected as PC is an infectious disease that has the ability to spread by close contact governing by overcrowding and low hair hygiene. Also, children might be infested through contact with their diseased parents. **Al-Shawa**[22] cleared that PC transmit from person to person directly during children's play. Also, PC and scabies are diseases that carry a high social stigma, so such patients hesitate to seek medical treatment or tell others that he/she infested with one of them, otherwise percent of parents who infested with one or both of them might be higher. Our results are consistent with **Motovali-Emami *et al.*** [10]; they reported that 58.8% of the infested children with PC were reported as having been infested with head lice in the previous 6 months.

As regard infestation with scabies; prevalence of scabies increased with increasing age among school children but no age group found to be a statistically significant risk factor. This result is in agreement with **El-Rifaie *et al.*** [20] in Egypt. Also, we noticed that male and female genders were found to be statistically significant risk and protective factors, respectively for PC. Again, this result is in agreement with **El-Rifaie *et al.*** [20]; they found that scabies was more common among male (58.3%) than female (41.7%) students, but with non-statistically significant difference. Also, **Amro and Hamarsheh** [29] showed that scabies was more common among males than females with non-statistically significant difference. On the other hand, **Morsy *et al.*** [30] found 1:1.5 male to female ratio. Further, there is an inconsistency as regard the role of gender in

scabies prevalence. [53, 29] Therefore, global meta-analysis is recommended to better understand role of gender in occurrence of scabies prevalence worldwide. [29]

Further, we reported that the last birth order child was found to be a significant risk factor for scabies. Also, previous infestation with scabies, sibling(s) with scabies, and parental history of infestation with scabies were found to be significant risk factors for scabies. Again, these results are accepted and expected as scabies is an infectious disease that has the ability to spread by close contact governing by overcrowding and low body hygiene. Also, **Karim *et al.*** [56] observed that about 71.0% of the scabitic children had been re-infected.
In this study, we cleared that crowding index >1 was found to be a significant risk factor for PC.

Environmental conditions and poor hygiene lead to increase the prevalence of PC. [22] Also, **Nada *et al.*** [19] and **Salih** [33] showed that large family size was associated with increase prevalence of PC. Also, **Alzain** [42] reported that infestation with PC in children who were living in large families was greater than among those living in smaller families. This may be because children with overcrowding index families have a higher risk of being infested by their siblings. [15, 65] Also, no sun access was found to be a significant risk factor for PC. Further, shared water supply and bathing facilities were found to be a significant risk factor for PC. At the same time, co-sleeping was found to be a significant risk factor for PC. Co-sleeping, a habit, which had a close relation to the family size, was found to have great influence on the PC infestation; co-sleepers are liable of infestation more than three and half times than single sleepers. [19] So, physical contacts, especially head to head contact are the most important factors in transmission of head lice infestation. [59]

In the present study, we showed that not short cut hair and sharing hair brushes were found to be significant risk factors for PC. PC transmits from person to person directly and through contact with objects carrying lice such as brushes, combs, clothing, and towels. [22] Also, a relation was found between PC infestation and sharing items such as combs between children in the same family or beers. [16, 42]

Further, prevalence of PC increases with sharing of bed and taking bath in a common place are dissemination factors of head louse infestation among children. [16] PC infestation often is found in long haired female than male with short hair. [33] However, when male's hairstyle resembled to female hairstyle; infestation with PC was slightly predominant among males, 55.4%. [17] In details, students with short hair had a lower infestation rate (4.4%) compared to those with longer hair (15.4%).[42] Also, medium length hair (5-15 cm) pupils were found to be more susceptible to be infested nearly two and half times as much as those of short hair (<5cm). [19]

Regarding distribution of cases with scabies according to environmental conditions; crowding index >1 was found to be a significant risk factor for PC. **Hegazy *et al.*** [52] and **El-Rifaie *et al.*** [20] showed that scabies was prevalent among children of large family and higher crowding index. Also, no sun access was found to be a significant risk factor for PC. Further, shared water supply and bathing facilities were found to be significant risk factors for PC. At the same time, co-sleeping was found to be a significant risk factor for PC. Scabies severity and re-infection were associated with overcrowded sleeping arrangements (P<0.001). [56]

Lastly, we noticed that sharing towels and/or undergarments was found to be a significant risk factor for PC. Also, **Karim *et al.*** [56] observed that 21.0% shared towels, 8.0% shared undergarments, 30.0% shared bed linen, and 81.0% kept their used clothes on a communal line or shelf.

In the current study we cleared that PC and scabies had drawback effects on many aspects of the health such as psychiatric, sleep, and peers' relation disturbances. Scabies itself is not a fatal or life-threatening condition, but it can be severe and persistent, leading to debilitation and discomfort, depression, and secondary skin infections. Post-infective complications such as acute post-streptococcal glomerulo-nephritis are common. [24] Also, our findings as regard PC were similar, but with milder hazards on the same health aspects, to

that of scabies. PC causes scalp pruritus; this symptom is in response to sensitization to both saliva of the louse and fecal antigens may be so intense that lead to excoriations, secondary bacterial infection [(66)], disturbances, sleep loss, and scratching. Although, PC infestation is found on the head, it hybridizes easily with other strains such as pediculosis corporis, which is found on the body. [(25, 67)]

CONCLUSIONS AND RECOMMENDATIONS

We can conclude that PC and scabies were prevalent among primary school students and they were more common in the public schools. The study findings have potentially dangerous implications for public health. Many causes of these diseases can be manipulated and prevented. Immediate attention should be given to developing a sustainable long-term intervention program to combat PC and scabies, and to save thousands of children from impending complications. Improving students' and environment's hygiene, health education, and regular dermatological screening and treatment of students are important essentiality. We should encourage Islamic rules regarding importance of health and individual hygiene that would reduce prevalence of PC and scabies in our Islamic country. Also, improvement of socioeconomic conditions is needed to reduce the prevalence of these diseases to reduce costs related to their treatment and effects. Dermatological health component of school health services should be integrated in school health program. Further, teacher and school nurse must have role in PC and scabies prevention and control. Lastly, more studies on students in different rural and urban areas in Egypt are recommended.

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Table (1): Frequency distribution of pediculosis capitis and scabies among the studied students

Types of skin infestations	No. (n=1987)	Percent
Pediculosis capitis	203	10.2
Scabies	67	3.4
Pediculosis capitis & scabies	46	2.3
Total number of infested students	270	13.6
Total number of students with infestaions	247	12.4

Table (2): Frequency distribution of cases with pediculosis capitis and scabies among students in public, experimental, and private schools

Types of skin infestations	School type						χ^2	P-value
	Public (n=681)		Experimental (n=723)		Private (n=583)			
	No.	%	No.	%	No.	%		
Pediculosis capitis	91	13.4	74	10.2	38	6.5	16.04	0.00003
Scabies	37	5.4	23	3.2	7	1.2	17.39	0.00001
Pediculosis capitis & scabies	34	5.0	8	1.1	4	0.7	33.10	0.000
Total number of infested students	128	18.8	97	13.4	45	7.7	32.85	0.000
Total number of students with infestations	111	16.3	93	12.9	43	7.4	23.17	0.000

Table (3): Distribution of cases with pediculosis capitis (PC) and scabies, and control group of students according to head of their families' social characteristics

Social characteristics	PC/scabies (n=247)		Controls (n=247)		OR (95% CI)
	No.	%	No.	%	
Head of the family educational level:					
Low (illiterate & read/write)	131	53.0	94	38.1	1.84 (1.26-2.67)#
Middle (up to preparatory)	82	33.2	104	42.1	0.68 (0.47-1.00)#[1]
High (secondary & university)	34	13.8	49	19.8	0.65 (0.39-1.07)
Head of the family occupational level:					
Low (unskilled)	148	59.9	96	38.9	2.35 (1.61-3.43)#
Middle (semi-skilled)	72	29.2	99	40.1	0.62 (0.42-0.91)#[1]
High (skilled labor & professional)	27	10.9	52	21.0	0.46 (0.27-0.78)#[1]
Social level:					
Low	141	57.1	95	38.5	2.13 (1.46-3.1)#
Middle	76	30.8	101	40.9	0.64 (0.44-0.95)#[1]
High	30	12.1	51	20.6	0.53 (0.32-0.89)#[1]

#= Significant risk factor #[1] = Significant protective factor

Table (4): Distribution of cases with pediculosis capitis (PC) and scabies, and control group of students according to personal hygiene and health care behavior characteristics

Personal hygiene and health care behavior characteristics	PC/scabies (n=247)		Controls (n=247)		OR (95% CI)
	No.	%	No.	%	
Hair and body hygiene:					
Poor	139	56.3	93	37.7	2.13 (1.46-3.11)#
Fair	72	29.1	107	43.3	0.54 (0.36-0.79) #[1]
Good	36	14.6	47	19.0	0.73 (0.44-1.2)
Environmental hygiene:					
Poor	161	65.2	86	34.8	3.5 (2.38-5.17)#
Fair	58	23.5	119	48.2	0.33 (0.22-0.49)#[1]
Good	28	11.3	42	17.0	0.62 (0.36-1.08)
Student never received dermatological examination:					
Yes	173	70.0	52	21.0	8.77 (5.71-13.5)#
No	74	30.0	195	79.0	0.11 (0.07-0.18)#[1]
Early consultation for dermatological diseases:					
No	181	73.3	112	46.3	3.31 (2.23-4.91)#
Yes	66	26.7	135	54.7	0.3 (0.2-0.45)#[1]
Compliance with therapy:					
No	163	66.0	76	30.8	4.37 (2.94-6.49)#
Yes	84	34.0	171	69.2	0.23 (0.15-0.34)#[1]

#= Significant risk factor #[1] = Significant protective factor

Table (5): Distribution of cases with pediculosis capitis (PC) and scabies, and control group of students according to personal and familial characteristics

Personal and familial characteristics	Cases		Controls (n=247)		OR (95% CI) OR (95% ECL)*
	No.	%	No.	%	
Pediculosis capitis (n=203)					
Age (years):					
4-5	12	5.9	14	5.7	1.05 (0.44-2.47)
6-9	93	45.8	104	42.1	1.16 (0.79-1.72)
≥ 10	98	48.3	129	52.2	0.85 (0.58-1.26)
Gender:					
Female	177	87.2	134	54.3	5.74 (3.46-9.58)#
Male	26	12.8	113	45.7	0.17 (0.1-0.29)#[1]
Birth order:					
First	40	19.7	98	39.7	0.37 (0.24-0.59)#[1]
In the middle	79	38.9	103	41.7	0.89 (0.60-1.32)
Last	84	41.4	46	18.6	3.08 (1.97-4.83)#
Previous infestation with PC:					
Yes	136	67.0	60	24.3	6.33 (4.1-9.77)#
No	67	33.0	187	75.7	0.16 (0.1-0.24)#[1]
Sibling(s) with PC:					
Yes	162	79.8	71	28.7	9.79 (6.17-15.6)#
No	41	20.2	176	71.3	0.1 (0.06-0.16)#[1]
Parental history of PC:					
Yes	31	15.3	14	5.7	3.0 (1.48-6.13)#
No	172	84.7	233	94.3	0.33 (0.16-0.67)#[1]
Scabies (n=67)					
Age (years):					
4-5	1	1.5	14	5.7	0.25 (0.01-1.72)*
6-9	31	46.3	104	42.1	1.18 (0.66-2.11)
≥ 10	35	52.2	129	52.2	1.0 (0.56-1.78)
Gender:					
Female	24	35.8	134	54.3	0.47 (0.26-0.85)#[1]
Male	43	64.2	113	45.7	2.12 (1.17-3.86)#
Birth order:					
First	13	19.4	98	39.7	0.37 (0.18-0.74)#[1]
In the middle	24	35.8	103	41.7	0.78 (0.43-1.41)
Last	30	44.8	46	18.6	3.54 (1.91-6.58)#
Previous infestation with scabies:					
Yes	44	65.7	11	4.5	41.04 (17.57-98.16)#
No	23	34.3	236	95.5	0.02 (0.01-0.06)#[1]
Sibling(s) with scabies:					
Yes	42	62.7	12	4.9	32.9 (14.47-76.31)#
No	25	37.3	235	95.1	0.03 (0.01-0.07)#[1]
Parental history of scabies:					
Yes	11	16.4	11	4.5	4.21 (1.60-11.10)#
No	56	83.6	236	95.5	0.24 (0.09-0.62)#[1]

#= Significant risk factor #[1] = Significant protective factor

Table (6): Distribution of cases with pediculosis capitis and scabies, and control group of students according to environmental conditions

Environmental conditions	Cases		Controls (n=247)		OR (95% CI) OR (95% ECL)*
	No.	%	No.	%	
Pediculosis capitis (n=203)					
Crowding index:					
> 1	126	62.1	64	25.9	4.68 (3.07-7.14)#
=1	54	26.6	97	39.3	0.56 (0.37-0.85)#[1]
< 1	23	11.3	86	34.8	0.24 (0.14-0.41)#[1]
Sun access inside the house:					
No	181	89.2	144	58.3	5.88 (3.44-10.13)#
Yes	22	10.8	103	41.7	0.17 (0.10-0.29)#[1]
Water supply/bathing facilities:					
Shared	149	73.4	96	38.9	4.34 (2.85-6.63)#
Private	54	26.6	151	61.1	0.23 (0.15-0.35)#[1]
Co-sleeping:					
Yes	160	78.8	161	65.2	1.99 (1.27-3.12)#
No	43	21.2	86	34.8	0.50 (0.32-0.79)#[1]
Short cut hair:					
No	147	72.4	95	38.5	4.2 (2.76-6.4)#
Yes	56	27.6	152	61.5	0.24 (0.16-0.36)#[1]
Sharing hair brushes/combs:					
Yes	182	89.7	156	63.2	5.06 (2.92-8.81)#
No	21	10.3	91	36.8	0.20 (0.11-0.34)#[1]
Scabies (n=67)					
Crowding index:					
> 1	49	73.1	64	25.9	7.78 (4.06-15.04)#
=1	13	19.4	97	39.3	0.37 (0.18-0.75)#[1]
< 1	5	7.5	86	34.8	0.15 (0.05-0.39)*#[1]
Sun access inside house:					
No	61	91.0	144	58.3	7.27 (2.98-21.27)*#
Yes	6	9.0	103	41.7	0.14 (0.05-0.34)*#[1]
Water supply/bathing facilities:					
Shared	59	88.1	96	38.9	11.6 (5.07-27.54)#
Private	8	11.9	151	61.1	0.09 (0.04-0.2)#[1]
Co-sleeping:					
Yes	56	83.6	161	65.2	2.72 (1.3-5.82)#
No	11	16.4	86	34.8	0.37 (0.17-0.77)#[1]
Sharing towels/undergarments:					
Yes	51	76.1	156	63.2	1.86 (0.96-3.62)
No	16	23.9	91	36.8	0.54 (0.28-1.04)

#= Significant risk factor #[1] = Significant protective factor

Table (7): Distribution of cases with pediculosis capitis & scabies and control group of students according to effects of the infestations

Effects of the infestations	Cases		Controls (n=247)		χ^2 FE*	P-Value
	No.	%	No.	%		
Pediculosis capitis (n=203)						
Psychiatric disturbances:						
Present:	66	32.5	29	11.7	28.87	0.000
Irritability	27	13.3	14	5.7	7.84	0.005
Anxiety	21	10.3	11	4.4	5.85	0.015
Depression	18	8.9	4	1.6	12.59	0.0003
Sleep disturbances:						
Present	131	64.5	26	10.5		
Absent	72	35.5	221	89.5	143.06	0.000
Relation with peers:						
Isolated	126	62.1	55	22.3		
Engaged	77	37.9	192	77.7	73.41	0.000
Secondary bacterial infections:						
Yes	72	35.5	6	2.4	84.88	0.000
Results of the 1st term exam:						
< 50%	26	12.8	14	5.7	7.01	0.008
50-85%	86	42.4	99	40.1	0.24	0.62
> 85%	91	44.8	134	54.2	3.96	0.04
Scabies (n=67)						
Psychiatric disturbance:						
Present:	29	43.3	29	11.7	34.82	0.000
Irritability	13	19.4	14	5.7	12.65	0.0003
Anxiety	11	16.4	11	4.4	FE	0.001
Depression	5	7.5	4	1.6	FE	0.02
Sleep disturbance:						
Present	54	80.6	26	10.5		
Absent	13	19.4	221	89.5	136.29	0.000
Relation with peers:						
Isolated	59	88.1	55	22.3		
Engaged	8	11.9	192	77.7	98.66	0.000
Secondary bacterial infections:						
Yes	32	47.8	6	2.4	101.82	0.000
Results of the 1st term exam:						
< 50%	9	13.4	14	5.7	4.68	0.03
50-85%	31	46.3	99	40.1	0.83	0.36
> 85%	27	40.3	134	54.2	4.11	0.04

*FE= Fisher exact test