

Worldwide, there have been several studies on the prevalence of cutaneous warts among school children, showing a prevalence varying from 2.4% to 33% [6,7]. Several studies have revealed risk factors for the children and adolescents who contract warts that include low social class, practicing gymnastics and sports, taking part in work, a large family size, and keeping household animals [6-9].

There have been a few published studies on skin diseases from Saudi Arabia that have focused on this subject [10-12]. In particular, there is little information about the epidemiology of warts among primary school children in Madinah. The aims of this study were to determine the prevalence of warts among primary school children in Madinah and Jeddah, Saudi Arabia, and to investigate the possible risk factors associated with their development.

Research questions posed in this study

Research questions that will be answered in this study include the following:

What is the point-prevalence of verruca vulgaris among selected primary school children in the cities of Madinah and Jeddah, Saudi Arabia?

What are the characteristics of the children that are associated with the presence of verruca vulgaris?

What risk factors associated with the development of verruca vulgaris are present among the children?

Method and Study Plan

Study setting and study population

This school-based, cross-sectional study was conducted among 6th grade primary school children enrolled in the academic year 2016/2017 in the cities of Jeddah and Madinah.

Sampling technique and size

A multistage, stratified random sampling method was used, in which primary schools in Madinah and Jeddah were defined in strata according to their status (public or private) and students' sex (male or female). Ten primary schools were randomly chosen in Madinah (four boys' and four girls' public schools, and one boys' and one girls' private schools), and five girls' schools were chosen in Jeddah (four public and one private). Within each selected school, all students in the 6th grade were eligible and were invited to participate in the study.

Data collection

Based on a review of the literature, a questionnaire was prepared for data collection. The questions covered three areas: (i) Sociodemographic data: age, sex, and residence, parents' education and occupation, monthly family income and family size; (ii) lifestyle features: swimming, sports practice, working after school, smoking, and body mass index; and (iii) environmental features: the presence of household animals (farm, pet, and domestic animals).

The children were questioned by the researchers in the presence of a teacher. After completing the questionnaire, each child's hands, feet, head, and neck were examined for warts, recording the number, site, size, and type on the same sheet.

Diagnostic definition of verruca vulgaris

Warts were diagnosed clinically as the presence of a sessile, firm, variable sized papule, with a rough papillary surface and colored or darker skin [13,14]. The examination was conducted at the school clinic in the presence of a teacher and/or the school doctor.

Statistical analysis

All data analyses were performed using the Statistical Analysis System (SAS) software [15]. The prevalence of warts in the study population was calculated and descriptive statistics were performed, comparing characteristics between the children who had warts and those who did not, using the chi-square test for categorical variables and the t-test for continuous variables. The level of statistical significance was defined as $P \leq 0.05$. Logistic regression analysis was used to evaluate odds ratios (OR) and their 95% confidence intervals (95% CI) for the risk factors associated with the presence of warts.

Ethical Consideration

Participation in the study was voluntary, and school officials were clearly informed about the aim and scope of the study. At the time of data collection, the researcher read out the consent form to obtain written consent of the participants' teacher who acted in loco parents. Privacy and confidentiality were ensured for all collected data that was used only for research purposes. Children who required treatment were referred to the nearest health care facility in cooperation with the school doctor.

Results

Warts were found in 66 of the 730 children studied, which was a prevalence of 9.04% (95% CI=6.96%-11.12%). About 65% of the children with warts were boys (43/66). Table 1 presents the sociodemographic characteristics of the participating children. The mean age was 11.2 ± 1.5 years, and 40.8% of the children were boys. Nearly two-thirds (64%) of the children were found to have acute disease. The majority of the children (81.4%) attended public schools, with more than half from Madinah. More than 85% reported a monthly family income over 5,000 SAR. More than half (61.1%) of the children's fathers had received university or higher education.

Characteristics	No. (%), N=730
Sex	
Male	298 (40.8)
Female	432 (59.2)
Age in years, mean \pm SD (range)	11.2 \pm 1.5 (10.5-14.0)
Type of school	
Public	594 (81.4)
Private	136 (18.6)
City of residence	
Madinah	425 (58.2)
Jeddah	305 (41.8)
Monthly family income, SAR	

<5,000	89 (12.2)
5,000-10,000	230 (31.3)
≥ 10,000	411 (56.3)
Family size	
≤ 5	278 (38.1)
>5	452 (61.9)
Father's education	
Illiterate	29 (4.0)
Less than university	255 (39.9)
University and higher	446 (61.1)
Father's occupation	
Unskilled work	233 (31.9)
Skilled work	252 (34.5)
Professional	245 (33.6)
Mother's education	
Illiterate	119 (16.3)
Less than university	344 (47.1)
University and higher	267 (36.6)
Mother's occupation	
Housewife	486 (66.6)
Skilled or unskilled work	88 (12.1)
Professional	156 (21.3)

Table 1: Demographic characteristics of the participating children (Data are presented as mean ± SD or n (%)).

Table 2 presents the characteristics of warts in a comparison between the boys and girls. A significantly higher proportion of de novo warts was observed among the boys (P=0.02), and their warts tended to be more numerous, smaller in size and of longer duration, although these differences were not statistically significant.

Wart characteristics	Boys (n=43)	Girls (n=23)	P value
Warts			
De novo	31 (72.0)	10 (43.0)	
Recurrent	12 (28.0)	13 (57.0)	0.02 [†]
Type of wart			
Common	19 (44.2)	13 (56.5)	
Plane	17 (39.5)	4 (17.4)	
Filiform	7 (16.3)	6 (26.1)	0.19
Number (mean ± SD)	4.4 ± 1.4	2.4 ± 1.3	0.8
Size in mm (mean ± SD)	3.8 ± 1.2	4.5 ± 2.3	0.54

Duration of the warts, months (mean ± SD)	9.2 ± 8.2	7.3 ± 4.7	0.45
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Table 2: Characteristics of the warts compared between the boys and girls (n=66) ([†] statistically significant).

Table 3 shows sociodemographic data with respect to the presence or absence of warts. The prevalence of warts was significantly higher among boys (14.9%), among those attending public schools (9.8%), and among those living in Madinah (13.9%), with the highest prevalence (24.1%) observed among those children who reported having illiterate fathers. Although statistically insignificant, the prevalence of warts was also high in those with large families (10.2%), university-educated mothers (10.5%), and mothers in professional work (10.3%).

Sociodemographic characteristics	Warts (n=66)	No warts (n=664)	P value
Sex			
Male	43 (14.9)	255 (85.1)	
Female	23 (5.3)	409 (94.7)	<0.0001*
Age in years, mean ± SD	11.3 ± 1.4	11.0 ± 1.5	0.35
Type of school			
Public	58 (9.8)	536 (91.2)	
Private	8 (5.9)	128 (94.1)	0.15
City of residence			
Madinah	59 (13.9)	366 (86.1)	
Jeddah	7 (2.3)	298 (97.7)	<0.0001*
Monthly family income, SAR			
<5,000	12 (13.5)	77 (86.5)	
5,000-10,000	22 (9.6)	208 (90.4)	
≥ 10,000	32 (7.8)	379 (92.2)	0.22
Family size			
≤ 5	20 (7.2)	258 (92.8)	
>5	46 (10.2)	406 (89.8)	0.17
Father's education			
Illiterate	7 (24.1)	22 (75.9)	
Less than university	25 (9.8)	230 (91.2)	
University and higher	34 (7.6)	412 (92.4)	0.01*
Father's occupation			
Unskilled work	21 (9.0)	212 (91.0)	
Skilled work	24 (9.5)	228 (90.5)	
Professional	21 (8.6)	224 (91.4)	0.93
Mother's education			

Illiterate	19 (10.0)	100 (90.0)	
Less than university	19 (5.5)	325 (94.5)	
University and higher	28 (10.5)	239 (89.5)	0.001*
Mother's occupation			
Housewife	45 (9.3)	441 (90.7)	
Skilled and unskilled work	5 (5.7)	83 (94.3)	
Professional	16 (10.3)	140 (89.7)	0.46

Table 3: Sociodemographic characteristics of the participating children (n=730) (*Statistically significant. Data are presented as number (percentage)).

Table 4 presents the distribution of warts according to lifestyle and environmental factors. A higher prevalence of warts was found in children who smoked (P<0.0001), played sports more than three times a week (P<0.001), or kept pets or farm animals (P<0.0001, P<0.01). Prevalence was also high among children who swam in public pools more than three times a week, had a pet bird, received medications, or worked after school.

Lifestyle and environmental factors	Warts (n=66)	Without warts (n=664)	P value
Smoking			
Yes	4 (6.1)	3 (0.4)	
No	66 (93.9)	661 (99.6)	<0.0001*
Sports activity/week			
None	17 (5.8)	275 (94.2)	
1-3	21 (8.1)	237 (91.9)	
>3	28 (15.6)	151 (84.4)	0.001*
Swimming in pool/week			
None	24 (9.6)	396 (90.4)	
1-3	20 (7.5)	244 (92.5)	
>3	4 (14.3)	24 (85.7)	0.4
Presence of farm animals			
No	43 (7.7)	555 (92.3)	
Yes	23 (17.4)	109 (82.6)	0.0001*
Presence of birds			
No	53 (8.5)	574 (94.5)	
Yes	13 (12.6)	90 (87.4)	0.05
Presence of pets			
No	51 (7.9)	594 (92.1)	
Yes	15 (17.9)	69 (82.1)	0.01*
History of working after school			

No	64 (8.9)	649 (91.1)	
Yes	2 (11.8)	15 (88.20)	0.69
History of receiving medication			
No	62 (8.8)	636 (91.2)	
Yes	4 (12.5)	28 (78.5)	0.48

Table 4: Comparison of lifestyle and environmental factors between the children with and those without warts (*Statistically significant. Data are presented as number (percentage)).

Table 5 presents the results of the logistic regression analysis for sociodemographic factors potentially associated with the presence of warts. Male sex and residence in Madinah appeared to have significant roles in the risk of contracting warts, with adjusted ORs of 2.40 (95% CI=1.35-4.20) and 6.80 (95% CI=2.0-18.0) respectively. The risk of warts was also higher among children in public schools and those from large families, although this was not statistically significant. The risk was significantly reduced (by about 60%) for children with highly educated fathers (OR=0.40; 95% CI=0.10-0.99).

Sociodemographic Factors*	Warts (n=66)	Without warts (n=664)	OR	95% CI
Sex				
Male	43	255	2.4	1.35-4.20**
Female	23	409	1	Ref.
Age	66	664	1.12	0.93-4.19
Type of school				
Public	58	536	1.95	0.80-3.98
Private	8	128	1	Ref.
City of residence				
Madinah	59	7	6.8	2.0-18.0*
Jeddah	366	298	1	Ref.
Monthly family income, SAR				
<5,000	12	77	1	Ref.
5,000-10,000	22	208	0.77	0.35-1.78
≥ 10,000	32	379	0.75	0.30-1.97
Family size				
≤ 5	20	258	1	Ref.
>5	46	406	1.5	0.80-2.40
Father's education				
Illiterate	7	22	1	Ref.
Less than university	25	230	0.5	0.23-0.92*
University and higher	34	412	0.4	0.10-0.99*

Father's occupation				
Unskilled work	21	212	1	Ref.
Skilled work	24	228	1.1	0.80-2.30
Professional	21	224	0.9	0.78-2.56
Mother's education				
Illiterate	19	100	1	Ref.
Less than university	19	325	0.5	0.23-1.07
University and higher	28	239	1.01	0.42-2.66
Mother's occupation				
Housewife	45	441	1	Ref.
Skilled or unskilled work	5	83	0.65	0.35-1.77
Professional	16	140	0.85	0.40-1.96

Table 5: Logistic regression analysis of the association between sociodemographic factors and the presence of warts (*Each variable is adjusted by other variables in the table, **Statistically significant, OR: Odds Ratio; CI: Confidence Interval; Ref: Reference Value for the Odds Ratio).

Table 6 shows that the results of the logistic regression analysis for lifestyle and environmental factors were potentially associated with the presence of warts.

Lifestyle and Environmental Factors	Warts (n=66)	No warts (n=664)	OR	95% CI
Smoking				
Yes	4	3	10.2	2.10-51.6**
No	66	661	1	Ref.
Sports activity/week				
None	17	275	1	Ref.
1-3	21	237	1.3	0.65-2.56
>3	28	151	2.5	1.25-4.94**
Swimming in pool/week				
None	24	396	1	Ref.
1-3	20	244	0.7	0.37-1.21
>3	4	24	0.75	0.22-2.58
Presence of farm animals				
No	43	555	1	Ref.
Yes	23	109	1.9	1.02-3.50**

Presence of birds				
No	53	574	1	Ref.
Yes	13	90	0.97	0.45-1.65
Presence of pets				
No	51	594	1	Ref.
Yes	15	69	2.1	1.01-4.05**
History of work after school				
No	64	649	1	Ref.
Yes	2	15	1.5	0.50-6.10
History of receiving medications				
No	62	636	1	Ref.
Yes	4	28	1.45	0.35-3.89

Table 6: Logistic regression analysis of the association between lifestyle and environmental factors and the presence of warts (*Significant; OR: Odds Ratio; CI: Confidence Interval; Ref: Reference Value for the Odds Ratio).

The risk of warts was significantly increased by smoking (OR=10.2; 95% CI=2.10-51.6), playing sports more than three times a week (OR=2.5; 95% CI=1.25-4.94), the presence of farm animals at home (OR=1.90; 95% CI=1.02-3.50), and having pets (OR=2.10; 95% CI=1.01-4.05). There was also a higher risk for children who reported working after school, and for those who were receiving medication. Conversely, the risk was lower among those who swam in public pools. The presence of birds at home did not appear to be a risk factor.

Discussion

This study included a cohort of 730 primary school children and found the prevalence of cutaneous warts among them to be 9.04%. Further analysis showed a significantly higher prevalence of warts in boys as compared to girls (14.9% vs. 5.3%), among children from Madinah as compared to those from Jeddah (13.9% vs. 2.3%), among those with a lower family income (13.9%), and in children with illiterate fathers (24.1%).

The prevalence of warts in this study was relatively high as compared to reports of studies conducted in Al Hassa rural area, Saudi Arabia [12], and in Cairo, Egypt [16]. The prevalence rates in these two studies were 4.5% and 7.5%, respectively. However, unlike our study, they included children from all grades of primary school, and the prevalence they estimated included only common warts of the hands and feet. In the present study, we recorded all types of warts (common, flat, and filiform), de novo and recurrent, and from many parts of the body.

The low prevalence rate of warts observed in the previous studies and in certain categories of our study (such as those with highly educated fathers, residents of Jeddah city, girls, and those attending private schools) may be attributed to the availability and accessibility

of medical care. The availability of adequate medical care at school may help in early diagnosis and prompt treatment for the children affected, which in turn would shorten the disease duration and reduce the prevalence [17,18]. In our study the prevalence and mean duration of warts were lower among the girls than the boys. The boys' warts also tended to be smaller and more numerous.

The statistical analysis revealed significant positive associations between warts and the male sex and being residents of Madinah, with non-significant associations with having a large family and attending public schools. Conversely, having a father educated to university or higher level was found to significantly reduce the risk of wart development. A cross-sectional study conducted in Taiwan that included 3,273 children aged 6-11 reported that having a father with a manual occupation was associated with an increased risk for cutaneous warts [19]. Health awareness and good hygiene standards within the family are known to be affected by an individual's education and occupation; the educated parent will seek medical help if his or her child has a wart [20,21]. This attitude, however, is unlikely to reduce the incidence of warts, although it may reduce the prevalence through early diagnosis and treatment [18]. Coming from a large family was associated with an increased risk of contracting warts, although this was not statistically significant. Similar findings have been reported by other studies [19], as well as an increased risk for children living in lower social classes [19,22]. In large families and in families of low social class, overcrowding and poor personal hygiene, as well as sharing clothing, may play a role in the transmission of such infectious skin diseases [19].

Out of the studied family and environmental factors, the risk of warts significantly increased with smoking, taking part in sporting activities more than three times a week, and the presence of farm or domestic animals at home. These findings confirm the role of environmental factors as reported by previous studies, with the presence of household animals contributing to poor standards of hygiene and thus favouring the spread of contagious skin diseases [19,23].

Although not statistically significant, the risk of warts in this study was higher among children who reported working after school or swimming in public pools. The risk of warts was increased with taking part in work with an adjusted odds ratio of 1.5. Working during childhood is correlated with the socioeconomic status of the family, which in turn affects the incidence and prevalence of warts [19,24]. In our study, the prevalence of warts among children of families with lower income was 13.9%, as compared to only 7.8% in the higher income category. The risk of warts was lower in children who reported swimming in public pools, with the risk reduced by 30% and 25% among these children, although this was not statistically significant. A large cross-sectional study involving 1,465 primary school children from four Dutch primary schools aged 4-12 years found no effect of visiting swimming pools on the risk of warts. The authors concluded that public showers or swimming pool visits were not related to the presence of warts [22]. In contrast with these findings, a recent study conducted in El-Dakahlia rural area, Egypt [25], reported a significant risk of developing warts to be associated with swimming in channels of the Nile River, with an adjusted OR of 5.6 (95% CI=2.9-10.6). This difference may be due to the children in our study swimming in more sanitary club pools that follow healthy and hygienic standards, which is completely different from swimming in small water channels with stagnant water that favours the spread of skin diseases.

The present study had a number of strengths, including its design as a school-based study. To the best of our knowledge, this study is the first to determine the prevalence of warts among primary school children and to examine the associated risks in the cities of Madinah and Jeddah. All of the participating children were Saudi nationals and there was no diversity (racial, cultural, or ethnic) in the sample. Finally, the present study took into account all types of warts (*de novo vs. recurrent, and common, filiform, and flat*) from many parts of the body, and this may explain the relatively high prevalence of warts observed.

This study had the limitation that, due to its cross-sectional nature, the causal influences of the risk factors could not be determined. However, the consistent strength and significance of the results obtained in this and other similar studies support the role of these factors in the development of warts among primary school children, also our sample size is one of the limitations.

In summary, the results of this study revealed a high prevalence of warts among primary school children in Madinah and Jeddah. The risk factors for the development of warts included male sex, attending public schools, a large family size, smoking, working, participating in sports, and the presence of domestic and farm animals at home. Having a father, who had been educated up to university or a higher level however, appeared to reduce the risk. Addressing the results of this study to the Saudi Ministry of Education and Ministry of Health may help in the development of effective health messages about methods for preventing skin diseases in general and in understanding the value of seeking medical care when needed.

Competing Interest

The authors declare that there are no competing interests regarding the publication of this manuscript.

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