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Prevalence of Head Lice (*Pediculus humanus capitis*) Infestation among Pupils in Elementary Schools in Makkah, Saudi Arabia

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ABSTRACT

***Background**: Head lice infestation (Pediculosis capitus) is a common public health problem worldwide. It is a contagious condition caused by the human louse Pediculus humanus capitis, an obligate ectoparasite.* ***Objective**: To explore the prevalence of pediculosis among the pupils in the elementary schools in Makkah, and to study the risk factors that increase the lice infestation.* ***Methods:** A cross-sectional study was conducted in random school girls and boys in different areas in Makkah city. Questionnaire for collecting data with different clinical methods for inspection was done.* ***Results:** A total of 705 pupils aged between 6-15 years from 21 different schools participated. About 486 girls and 219 boys participated in the current study. The overall prevalence was 31.2% girls were significantly infested than boys 42.8%, 5.5% respectively ($p<0.0001$). Age group of 8-11 years in both boys and girls had a significant relationship with lice infestation ($p<0.02$). Both boys and girls who reside in the middle area were more suspected of lice ($p<0.003$). High significant was found in Arab race than others ($p<0.0001$). Pupil whose father has worked was more suspected of lice infestation ($p<0.0001$), however pupil whose mother is housewife was more suspected of lice infestation ($p<0.008$). Shared head scarf with others girls had significant different to increase the infestation ($p<0.05$). The result showed the relationship between smooth hair and lice infestation ($p<0.0001$).* ***Conclusion:** The results obtained in the current study showed the spread of lice in the elementary schools in Makkah and the importance to prepare the comprehensive program for health education besides preparing a strategic plan for control, management, and eradication.*

Keywords: Epidemiology, Head lice, *Pediculosis capitis*, Infestation

INTRODUCTION

Head lice infestation (*Pediculosis capitus*) is a common public health problem worldwide [1]. It is a contagious condition caused by the human louse *Pediculus humanus capitis*, an obligate ectoparasite. These blood-sucking insects can cause many physiological, psychological, and social complications [2,3]. They can spread rapidly in closed environments; schools, predominantly. The main route of transmission is direct head-to-head contact; however, the indirect spread can occur through shared items, such as combs, scarfs, and hats [4-6]. Although louse infestation in some children is asymptomatic, the most common symptom is pruritus, which may occur due to sensitization to both fecal antigens and louse salivary and maybe lead to excoriations and secondary infection with bacteria [7].

Many factors impact the risk of *Pediculosis capitis*. Socio-demographic, behavioral and environmental factors, as

well as reduced personal hygiene, have a significant influence on head lice prevalence. Nonetheless, infestations can occur regardless of socio-economic status [8,9]. School-age children (5-13 years) are at higher risk of being infested [2,10]. Hair characteristics, including hair length and color, were found to be independent risk factors [7]. *Pediculosis capitis* is also associated with the parents' levels of education and their attitude to health standards [11].

Global prevalence data are not directly comparable due to considerable variations even within the same country [7,12,13]. Worldwide prevalence showed a wide range of head lice infestation rates (up to 80%). Higher frequencies were reported in females [12,14]. *Pediculosis capitis* annually affects about 6-12 million individuals in the United States alone [15].

Few studies were reported in Saudi Arabia [16]. In a survey done in Jeddah, 9.7% out of 2928 elementary school girls had head lice infestation [17]. Whereas in Abha, the infestation rate among school boys was 9.6% [18]. Another study in Al-Khobar city demonstrated a lower prevalence of 5.2% in elementary female school children [19].

To control head lice, strategic planning should be improved and the rate of infestation should decrease. It is essential to obtain epidemiological data from different regions. The current study aims to estimate the prevalence of head lice infestation and assess the factors affecting it among elementary school children in Makkah, Saudi Arabia.

PATIENTS AND METHODS

The current study is a school-based analytical cross-sectional study done in the period between February 2016 and March 2017. The bioethical committee approved the study in the Faculty of Public Health and Health Informatics, Umm AL Qura University and acceptance also was obtained from the educational affairs office in Makkah. A letter of acceptance was sent to all government schools from educational affairs.

A simple random sampling technique was used to recruit primary school children between 6 and 13 years of age (grades 1 to 6). Randomly 21 schools were selected (7 male schools and 14 female schools) from different geographic and socio-economic regions in Makkah. Approximately, 4000 consent forms were distributed to the children's parents to obtain approval. Only children whose parents signed the consent letter with agreeing were included in the current study, the response rate was (17.6%). In some schools, all the parents refused, and therefore these schools were not included in this study. Accordingly, 705 children examined in specific rooms in their schools. The whole process was done using the naked eye along with disposable fine-toothed comb (Lice comb), a hand lens and an LED penlight. Electronic lice combs were used to collect the lice from hair in the machine bag. Collected insects were transferred to 2 types of a tube; one is plane tube and the other tube contains 75% alcohol. Hair with nits was cut using the scissors and was put in plane tubes and was then incubated at 37°C.

The pupils' hair and scalps were examined for both lice and nits. A child was considered infested based on finding at least one of the developing stages of the parasite.

Obtained results recorded in a detailed questionnaire that contained the following data: age, gender, place of residence, parents' occupation, traveling status, sharing personal items in contact with hair (combs and scarfs), previous lice infestations and individual's hair characteristics (color, length, and nature).

Data were analyzed using the SPSS software version 23. Chi-square test was used to compare categorical variables. For all statistical analysis, a significance level of $p<0.05$ was adopted.

RESULTS

The study was done in 21elemantary schools in Makkah city. About 14 schools for girls and 7 schools for boys. All schools for girls infested and pediculosis was observed and recorded ($p=0.027$) while 5 out of 7 schools for boys were infested (71.4%) ($p<0.05$) (Tables 1 and 2).

Table 1 Prevalence of pediculosis in different girl schools

School	No. of girls examined	No. of girls with Lice	Prevalence (%)	p-value

1	15	6	40.00%	0.027
2	35	8	22.90%	
3	25	7	28.00%	
4	51	33	64.70%	
5	30	16	53.30%	
6	62	24	38.70%	
7	11	6	54.50%	
8	31	13	41.90%	
9	20	8	40.00%	
10	36	14	38.90%	
11	67	27	40.30%	
12	37	21	56.80%	
13	38	14	36.80%	
14	28	11	39.30%	

Table 2 Prevalence of pediculosis in different boy schools

School	No. of boys examined	No. of boys with Lice	Prevalence (%)	p-value
1	49	1	2.0%	0.348
2	15	0	0.0%	
3	31	2	6.5%	
4	41	5	12.2%	
5	37	2	5.4%	
6	29	2	6.9%	
7	17	0	0.0%	

The prevalence of pediculosis in general in elementary schools in Makkah was 31.2%. The infestation rate in boys and girls from the total were 1.7% and 29.5% respectively (Table 3). There was a highly significant association between gender and infestation with lice in the current study ($p<0.0001$).

Table 3 The prevalence of lice infestation among different genders

Gender	No. of Children Inspected	No. of Children with Lice	Infestation Rate (%)	χ^2	p-value
Boys	219	12	5.5%	97.94	0.0001
Girls	486	208	42.8%		
Total	705	220	31.2%		

Age played a role in the infestation with lice, 9 years girls were more suspected of infestation with lice while 7 years boys were more suspected (Figure 1). Age group of 8-11 years in both boys and girls had a significant relationship with lice infestation ($p<0.02$) (Table 4).

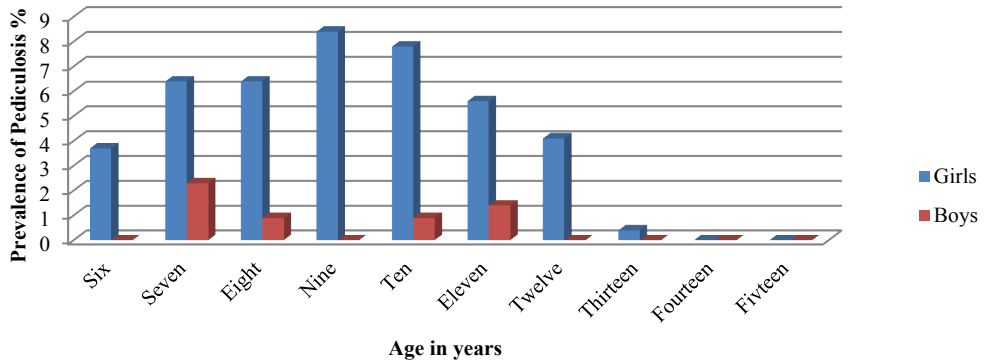

Figure 1 Prevalence of pediculosis in different ages in both girls and boys

Association between the level of education and lice infestation wasn't observed in this study ($p>0.05$) (Table 4). The relationship between the residential area of pupils and lice infestation was observed, therefore, both boys and girls

who reside in the middle area were more suspected to have lice (p<0.003) (Table 4). High significance was found in Arab race than others (p<0.0001) (Table 4). Pupil whose father has worked was more suspected to lice infestation (p<0.0001) (Table 4), however, a pupil whose mother was a housewife was more suspected to lice infestation (p<0.008) (Table 4).

Table 4 Socio-demographic characteristic of students participated in the study and association to infestation

Variable	Infested group		Non-infested group		χ^2	p-value
	No.	%	No.	%		
Gender						
Boys	12	5.5%*	207	94.5%*	97.941	0.0001¥
		1.7%†		29.4%		
Girls	208	42.8%*	278	57.2%*		
		29.5%†		39.4%†		
Age Group (Years)						
6-8	86	28.7%*	214	71.3%*	7.63	0.022¥
		12.2%†		30.4%†		
8-11	112	36.2%*	197	63.8%*		
		15.9%†		27.9%†		
11-15	22	22.9%*	74	77.1%*		
		3.1%†		10.5%†		
Educational Level						
1st Class	48	32.0%*	102	68.0%*	6.795	0.236
		6.8%†		14.5%†		
2nd Class	41	28.5%*	103	71.5%*		
		5.8%†		14.6%†		
3rd Class	43	38.1%*	70	61.9%*		
		6.1%†		9.9%†		
4th Class	38	32.5%*	79	67.5%*		
		5.4%†		11.2%†		
5th Class	31	33. %*	63	67.8%		
		4.4%†		8.9%†		
6th Class	19	21.8%*	68	78.2%*		
		2.0%†		9.6%†		
Resident (Makkah)						
North	24	20.3%*	94	79.7%*	16.129	0.003¥
		3.4%†		13.3%†		
East	33	24.6%*	101	75.4%*		
		4.7%†		14.3%†		
Middle	106	37.3%*	178	62.7%*		
		15.0%†		25.2%†		
West	25	29.4%*	60	70.6%*		
		3.5%†		8.5%†		
South	32	38.1%*	52	61.9%*		
		4.5%†		7.4%†		
Ethnicity						
Arab	144	25.9%*	413	74.1%*	40.004	0.0001¥
		20.5%†		58.9%†		
Asian	66	54.5%*	55	45.5%*		
		9.4%†		7.8%†		
African	7	35.0%*	13	65.0%*		
		1.0% †		1.9%†		
Others	2	66.7%*	1	33.3%*		
		0.3% †		0.1%†		
Father Work						

Yes	151	27.0%*	408	73.0%*	23.544	0.0001¥
		21.5%†		58.0%†		
No	43	45.3%*	52	54.7%*		
		6.1%†		7.4%†		
I don't know	25	52.1%*	23	47.9%*		
		3.6%†		3.3%†		
Dead	0	0.0%*	1	100%*		
		0.0%†		0.1%†		
Mother Work						
Yes	31	24.2%*	97	75.8%*	11.908	0.008¥
		4.4%†		13.8%†		
No	173	31.6%*	374	68.4%*		
		24.6%†		53.3%†		
I don't know	15	57.7%*	11	42.3%*		
		2.1%†		1.6%†		
Dead	0	0.0%*	1	100%*		
		0.0%†		0.1%†		
*% within cases; †% of total; ¥ significant different						

Regarding the risk factors associated with lice infestation in girls, some of these factors were not significant as in travel abroad or shared the head comb with others ($p>0.05$) (Table 5). Some were significant as in shared head scarf with others girls ($p<0.05$) (Table 5). Moreover, some of the others factors were highly significant such as the previous infestation particularly in the duration of 6 months ($p<0.0001$). Girls who were infested during the last 6 months were more suspected of new infestation with lice. Also, girls who used a combination of shampoo with lice comb were found more infested than even girls who did not use any treatment ($p<0.0001$) (Table 5).

Table 5 Risk factors associated with pediculosis in girl schools

Factors	**Infested group**		**Non-infested group**		χ^2	**p-value**
	No.	**%**	**No.**	**%**		
Travel outside home						
Yes	52	38.5%*	83	61.5%*	1.252	0.155
		10.7%†		17.1%†		
No	154	44.1%*	195	55.9%*		
		31.8%†		40.3%†		
Shared the comb with others						
Yes	144	44.6%*	179	55.4%*	1.429	0.136
		29.7%†		36.9%†		
No	63	38.9%*	99	61.1%*		
		13.0%†		20.4%†		
Shared the headscarf with others						
Yes	80	48.5%*	85	51.5%*	3.444	0.039¥
		16.5%†		17.5%†		
No	127	39.7%*	193	60.3%*		
		26.2%†		39.8%†		
Previous infestation						
Yes	165	51.4%*	156	48.6%*	28.102	0.0001¥
		34.0%†		32.2%†		
No	43	26.2%*	121	73.8%*		
		08.9%†		24.9%†		
Time of the Previous infestation						

Before 6months	55	67.1%*	27	32.9%*	45.372	0.0001¥
		11.3%†		05.6%†		
Before 1 Year	39	46.4%*	45	53.6%*		
		08.0%†		09.3%†		
Before 2 Years	33	54.1%*	28	45.9%*		
		06.8%†		05.8%†		
More than 2 years	3	25.0%*	9	75.0%*		
		0.6%†		1.9%†		
Before 3 years	22	48.9%*	23	51.1%*		
		4.5%†		4.7%†		
Not applicable	51	26.8%*	139	73.2%*		
		10.5%†		28.6%†		
I don't Know	5	41.7%*	7	58.3%*		
		1.0%†		1.40%		
Previous treatment						
No treatment	34	85.0%*	6	15.0%*	56.455	0.0001¥
		7.0 %†		1.2%†		
Lice comb	24	43.6%*	31	56.4%*		
		4.9%†		6.4%†		
Shampoo	23	48.9%*	24	51.1%*		
		4.7%†		4.9%†		
Spraying	9	39.1%*	14	60.9%*		
		1.9%†		2.9%†		
Oil	8	66.7%*	4	33.3%*		
		1.6%†		0.8%†		
Shampoo and spraying	4	33.3%*	8	66.7%*		
		0.8%†		1.6%†		
Shampoo and cream	0	0.0%*	2	100%*		
		0.0%†		0.4%†		
Shampoo and lice comb	50	49.0%*	52	51.0%*		
		10.3%†		10.7%†		
Shampoo and oil	8	57.1%*	6	42.9%*		
		1.6%†		1.2%†		
Vinegar and lice comb	0	0.0%*	1	100%*		
		0.0%†		0.2%†		
Not applicable	48	27.0%*	130	73.0%*		
		9.9%†		26.70%		

*% within cases, †% of total, ¥significant different

In the other side, most risk factors which were studied regarding lice infestation in boys were not significant such as travel abroad, shared head comb with others, shared head cap, previous infestation or the duration of the prior infestation ($p<0.05$), (Table 6). The only significant difference was found during the last treatment ($p<0.05$) (Table 6).

Table 6 Risk factors associated with pediculosis in boy schools

Factors	Infested group		Non-infested group		χ^2	p-value
	No.	%	No.	%		
Travel outside home						
Yes	2	3.0%*	65	97.0%*	1.16	0.231
		0.9%†		29.7%†		
No	10	6.6%*	102	93.4%*		
		4.6%†		64.8%†		
Shared the comb with others						

Yes	7	4.4%*	151	95.6%*	1.498	0.184
		3.3%†		70.2%†		
No	5	8.8%*	52	91.2%*		
		2.3%†		24.2%†		
Shared the head cover with others						
Yes	7	6.0%*	109	94.0%*	0.147	0.468
		3.2%†		49.8%†		
No	5	4.9%*	98	95.1%*		
		2.3%†		44.7%†		
Previous infestation						
Yes	9	8.5%*	97	91.5%*	3.596	0.054
		4.1%†		44.3%†		
No	3	2.7%*	110	97.3%*		
		01.4%†		50.2%†		
Time of the previous infestation						
Before 6months	5	13.9%*	31	86.1%*	8.7	0.122
		2.3%†		14.2%†		
Before 1 Year	3	5.6%*	51	94.4%*		
		01.4%†		23.3%†		
Before 2 Years	1	16.7%*	5	83.3%*		
		00.5%†		02.3%†		
More than 2 years	0	0.0%*	4	100%*		
		0.0%†		1.8%†		
Before 3 years	0	0.0%*	7	100%*		
		0.0%†		3.2%†		
Not applicable	3	2.7%*	109	97.3%*		
		1.4%†		49.8%†		
Previous treatment						
No treatment	0	00.0%*	8	100%*	17.57	0.025¥
		0.0 %†		3.7%†		
Lice comb	2	33.3%*	4	66.7%*		
		0.9%†		1.8%†		
Shampoo	2	4.1%*	47	95.9%*		
		0.9%†		21.5%†		
Spraying	0	0.0%*	6	100%*		
		0.0%†		2.7%†		
Shampoo and spraying	1	25.0%*	3	75.0%*		
		0.5%†		1.4%†		
Shampoo and oil	0	0.0%*	1	100%*		
		0.0%†		0.5%†		
Vinegar and lice comb	2	11.1%*	16	88.9%*		
		0.9%†		7.3%†		
Hair Shaving	2	13.3%*	13	86.7%*		
		0.9%†		5.9%†		
Not applicable	3	2.7%*	109	97.3%*		
		1.4%†		49.8%†		

*%within cases, †% of Total, and ¥Significant different

The relationship between lice infestation and girls' hair was included in this study. Risk factors such as sickness of the hair, length of the hair, the abundance of the hair, and the color of the hair have never had any relationship with lice infestation ($p>0.05$) (Table 7). The factor which was highly significant with lice infestation was the type of the hair. The result showed a relationship between smooth hair and lice infestation ($p<0.0001$) (Table 7).

Table 7 Risk factors associated with infestation and girls' hair

Factors	Infested girls		Non-infested girls		X^2	p-value
	No.	%	No.	%		
The sickness of the hair						
Thick	54	39.1%*	84	60.9%*	1.398	0.497
		13.2%†		20.6%†		
Moderate	52	43.3%*	68	56.7%*		
		12.7%†		16.7%†		
Thin	69	46.0%*	81	54.0%*		
		16.9%†		19.9%†		
Length of the hair						
Short than 10 cm	36	43.4%*	47	56.6%*	0.04	0.98
		9.6%†		12.5%†		
Between 10 1nd 20 cm	55	42.0%*	76	58.0%*		
		14.6%†		20.2%†		
Long than 20 cm	69	42.6%*	93	57.4%*		
		18.4%†		24.7%†		
The abundance of the hair						
Copious	42	38.2%*	68	61.8%*	2.901	0.234
		10.3%†		16.6%†		
Moderate	101	47.0%*	114	53.0%*		
		24.7%†		27.9%†		
Light	33	39.3%*	51	60.7%*		
		8.1%		12.5%		
Type of hair						
Smooth	161	48.5%*	171	51.5%*	22.797	0.0001¥
		39.4%†		41.8%†		
Hard	8	15.1%*	45	84.9%*		
		2.0%†		11.0%†		
Curly	7	29.2%*	17	70.8%*		
		1.7%†		4.2%†		
Colour of the hair						
Black	92	40.2%*	137	59.8%*	7.24	0.065
		22.4%†		33.4%†		
Bland	5	23.8%*	16	76.2%*		
		1.2%†		3.9%†		
Brown	76	49.7%*	77	50.3%*		
		18.5%†		18.8%†		
Others	4	57.1%*	3	42.9%*		
		1.0%†		0.7%†		

*%within cases, †% of Total, ¥Significant different

The results also showed that most of the pupils know well about the lice and were familiar with it, and saw it by naked eye which was found significant with lice infestation (Table 8).

Table 8 Previous knowledge and seeing of lice

Clinical Feature	Age group	Knowing Lice		Seeing Lice		p-value
		Yes	No	Yes	No	
Infested	6-8	79 (35.9%)	7 (3.2%)	66 (30.0%)	20 (9.1%)	0.038*
	8-11	109 (49.5%)	3 (1.4%)	100 (45.5%)	12 (5.5%)	0.018†
	11-15	22 (10.0%)	0 (0.0%)	20 (9.1%)	2 (0.9%)	

Non-infested	6-8	167 (34.5%)	46 (9.5%)	122 (25.2%)	92 (19.0%)	0.0001*
	8-11	181 (37.4%)	16 (3.3%)	155 (32.0%)	42 (8.7%)	0.0001†
	11-15	70 (14.5%)	4 (0.8%)	58 (12.0%)	16 (3.3%)	
*Associated with knowing, †associated with seeing						

DISCUSSION

The spread of the pediculosis in elementary schools in Makkah city was the main aim of the current study. The surprising outcome of this investigation was the random girl schools infested with lice. This finding indicated that lice were universal public health in the elementary girl school in Makkah. Similar results were found in primary schools in Buenos Aires in Argentina [1].

The overall prevalence of active pediculosis obtained in the current study was 31.2%. This finding showed a high prevalence of pediculosis in Saudi Arabia and entirely different from a study done in the same target group in Jeddah which was 9.7%, Abha 9.6%, and Al-Khobar 5.2% [17-19]. The result showed the importance of pediculosis in Makkah city particularly in the girl schools which need program and strategy plan for control so that the performance of pupils is not affected. The strategy program should involve the family of pupils, the decision makers, as well as school health.

Gender showed the highly significant difference and, the proportion was 17:1 between female and male respectively. A similar result was obtained in the study done in primary school children in Turkey and Palestine [20,21]. The result may be due to different attitude and behaviors.

In general age groups between 8-11 years were more suspected to acquire the lice infestation and this may be due to pupils that take care of themselves instead of care by their mothers. While girls under 9 years were more suspected, this may be due to good and an entire relationship between girls at this age. For boys, 7 years were a more suspected age for infestation by lice may be due to direct contact during playing together. Similar results were obtained in Turkey, Greece, and Jordan [21-23].

The results demonstrated that pupils who reside in the middle of the city were more susceptible to gain infestation with lice. The results may be referred to the overcrowding and usually, in the old town, the relationship between people was stronger than in a new town. Therefore, the contact was more closed; similar results were found in some other study associated with the problem of lice as an urban problem [24-27].

In the current study, the lice as a health problem associated with Arab race and with high significance were identified in this race. This finding might be due to the wrong belief that infestation with lice may enhance the growth of hair which spread in the community. The result obtained in this study has refuted this theory and we didn't find any relationship between infestations by lice and enhancement of the growth of hair.

High significance was found between working of father and infestation with lice, this result may be due to the busy schedule of father and as they didn't take care of their children particularly in girls and the effect matched with result obtained in Jeddah in the same target group and differ from study showed that unemployed father increased the infestation of lice [26,28]. In another hand, the significance was identified between infestations with lice and unemployed mother; the results showed how often women have plenty of work during the day and night particularly in teaching their children. The result was same as the result obtained in Jeddah but contrasted with a result which found significance between infested children and working mother [26,28].

In girls, sharing a scarf with others was found significant to acquire infestation with lice, these results were matching with others studies that found sharing of comb and towels were significant [1,28-30]. In the current study, using shampoo and lice comb at the same time to eradicate lice may increase the infestation with lice. This finding may be due to wrong use or inaccurate usage.

This study confirmed that there was no relationship between infestations with lice changes the length of hair or color or the sickness of hair or abundance of hair as some people believed in the study area. That means infestation with lice have no benefits to human hair at all and the relationship which was found in the current study between lice infestation and smooth hair was because most of the people here have smooth hair.

The impact of the study confirmed the widespread of lice infestation in the pupils in Makkah particularly girls. The study also refuted the relationship between infestation with lice enhance the illustration of the hair, particularly in girls as some women believed.

CONCLUSION

To eradicate lice from elementary schools, we should prepare the comprehensive program for health education besides preparing the strategic plan for control, management, and eradication. The program should include all the community and all people should have a role or contribution to the program.

DECLARATIONS

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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