Louse Infestation of the Chiribaya Culture, Southern Peru: Variation in Prevalence by Age and Sex

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In order to improve the interpretive potential of archaeoparasitology, it is important to demonstrate that the epidemiology of ancient parasites is comparable to that of modern parasites. Once this is demonstrated, then we can be secure that the evidence of ancient parasitism truly reflects the pathoecology of parasitic disease. Presented here is an analysis of the paleoepidemiology of Pediculus humanus *infestation from 146 mummies from the Chiribaya culture 1000-1250 AD of Southern Peru. The study demonstrates the modern parasitological axiom that 10% of the population harbors 70% of the parasites holds true for ancient louse infestation. This is the first demonstration of the paleoepidemiology of prehistoric lice infestation.*

Key words: *Pediculus humanus* - pathoecology - paleoepidemiology - archaeoparasitology - Peru

In archaeoparasitology, as with any field of parasitology, interpretive strength is based on reliable analysis of large numbers of observations. For those of us dependent on archaeological excavations, the biggest challenge is obtaining large numbers of observations. Often times factors of preservation, field sampling conditions, and other aspects of archaeology reduce the number of observations to a handful of data points. This in turn limits the strength of interpretations about prehistoric infections, infestations and health.

Dr Jane Buikstra's Programa Contisuyo excavations in the Moquegua Valley of Southern Peru offered the opportunity to collect archaeoparasitology data from a large series of mummies. During dissection of the mummies, we noted the presence of louse nits and eggs in the hair and realized that a survey of the mummies for nits and eggs would provide an unparalleled source of intersite comparative data. We examined 146 mummified or partially mummified individuals from the sites of San Geronimo, Chiribaya Alta, Algodonal, and El Yaral.

MATERIALS AND METHODS

During the month of August, 1990, we collected data on louse parasitism for every individual that had been dissected to date and could be located in the Ilo Programa Contisuyo Laboratory from the sites of Chiriabya Alta, Algodonal, El Yaral and San Geronimo. One problem that we encountered was that many of the mummies had already been dissected and cleaned. Therefore, it was not possible to quantify all of the infestations. Of 164 individuals from all sites, we located 146 and examined them for lice nits/eggs. Not every specimen was acceptable for study. Some individuals had hair or scalp tissue that was too poorly preserved for analysis. These individuals were so noted in the field to prevent their inclusion in later comparative analysis (Table I). Because examination of hair did not require dissection, it was possible to analyze several mummies from El Yaral as they were unwrapped.

The technique improvised for this study was based on the examination of the hair bases at the scalp (referred to subsequently as scalp measurements) and hair shafts located several inches away from the scalp (referred to subsequently as hair measurements). The scalps were examined to identify areas of maximum nit density and minimum nit density. Maximum density usually was on the parietal area, and in the area above and behind the ears. A 2 x 2 cm square was cut into a cardboard strip. The cardboard strip was then placed on the identified areas and all nits/eggs within the 2 x 2 cm area were counted. Three observations were taken for each area of scalp minimum density and scalp maximum density (Table II). The hair was also examined for areas of minimum and maximum nit/egg density. An optimal distance of 5 inches from the scalp was preferred, but in some cases, observations were made 4-6 cm from the scalp when the hair was not well preserved at 10 cm. The cardboard strip was then placed on the identified areas and all nits/eggs within the 2 x 2 cm area were counted.

RESULTS

Of 146 individuals examined, not all were sufficiently preserved for analysis (Table I). In some cases, the scalp was poorly preserved but the hair was well preserved. More rarely, the hair was poorly preserved or absent, but the scalp was well preserved. A few individuals exhibited poor preservation of scalp and hair. The San Geronimo individuals especially exhibited poor preservation of the hair and scalp tissue. Consequently, this site had to be dropped from comparative study because of poor overall preservation.

Generally, individuals who had lice nits/eggs on the scalp had louse nits/eggs on the hair. From all 4 sites, 75 mummies had both scalp and hair present. Twenty (27%) individuals had nits/eggs on the hair immediately adja-

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TABLE I

Provenience and condition of individuals examined for louse infestation. Asterisks indicate individuals whose scalp or hair was too poorly preserved for study. Chiribaya Culture mummies, Peru

Provenience	Nits/eggs Present?	Condition
Algodonal		
T-330-1	Yes	Scalp and hair present
T-342	Yes	Scalp and hair present
T-338	Yes	Scalp and hair present
T-388-2-1	No	Scalp and hair present
T-521-16-2	Yes	Scalp and hair present
T-369-1-1	No	Scalp and hair present
T-526-1-1	Yes	Scalp and hair present
San Geronimo		
92-4032	No*	Scalp and hair fragments
30-2020	No*	Single braid, no scalp
30-2363	No*	Some hair present, no scalp
30-2365	No*	Some hair present, no scalp
8- 459	Yes*	Some hair present, no scalp
24- 862	No*	Some hair present, no scalp
84-3575	No*	Some hair present, no scalp
84-2067	No*	Small hair fragments, no scalp
84-1585	No*	Small hair fragments, no scalp
84- 128	No*	Small hair fragments, no scalp
84-1391	No*	One small braid, no scalp
El Yaral		
142-10218	No	Scalp and hair present
238-10563	No	Scalp and hair present
131-10166	No	Scalp and hair present
107-10033	No	Scalp and hair present
206-10296	No	Scalp and hair present
134-10178	No	Scalp and hair present
109-10047	No*	Small hair fragments only
231-10461	No	Scalp and hair present
203F-10592	No	Scalp and hair present
101F-10024	Yes	Scalp and hair present
116-10088	Yes	Scalp and hair present
247-10594	No	Scalp and hair present
137-10200	No	Hair present, no scalp
236-10560	No	Scalp and hair present
101F-10024	Yes	Scalp and hair present
234-10485	No	Scalp and hair present
233-10480	No	Scalp and hair present
246-10593	Yes	Scalp and hair present
243-10566	No	Scalp and hair present
229-10427	No	Scalp and hair present
225-10441	No	Scalp and hair present
216-10360	No	Scalp and hair present
219-10369	No	Scalp and hair present
Chiribaya Alta		
217-2247	No*	Scalp fragments only
325-3763	Yes	Hair present, no scalp
516-1926	Yes	Scalp and hair present
322-3495	-*	Not located for study
802-1371	-*	Scalp and hair matted, uncountable
322-3495	No	No hair, scalp fragment present
711-1604	No	Scalp and hair present
211-11	Yes	Scalp and hair present
11-222	Yes	Scalp and hair present
755-3251	No	Scalp and hair present
416-3398	No	Scalp and hair present
907-2169	No	Scalp and hair present
324-3751	-*	No hair, no scalp
320-3792	No*	Small hair fragments, no scalp
728-2743	-*	No hair, no scalp
610-2291	-*	No hair, no scalp
318-3477	Yes	Scalp and hair present
609-2079	No	Scalp and hair present
746-2970	No	Scalp and hair present
437-3947	Yes	Hair present, no scalp
439-3955	Yes	Scalp present, no hair
328-3757	-*	Not located for study
241-3545	-*	Not located for study
328-3759	No	Hair present, no scalp
302-1012	No	Scalp and hair present
16-286	-*	No hair, no scalp
327-3756	-*	No hair, no scalp
401-1206	-*	No hair, no scalp
901-2059	Yes	Scalp and hair present
304-1068	Yes	Scalp and hair present
428-2642	Yes	Scalp and hair present
313-1155	No	Scalp and hair present
313-1252	No	Scalp and hair present
326-3754	Yes	Scalp and hair present
313-1252	No	Scalp and hair present
714-1766	Yes	Scalp and hair present
307-1128	No	Hair present, no scalp
326-3754	Yes	Scalp and hair present
305-1079,10	Yes	Hair present, no scalp
305-1079,06	No	Hair present, no scalp
321-1174-A	No	Hair present, no scalp
321-1174-B	No	Scalp and hair present
429-3911	No	Scalp and hair present
502-1671	No	Hair present, no scalp
402-1219	No	Hair present, no scalp
415-3364	No	Scalp and hair present
615-1369	No	Scalp and hair present
436-3941	No	Hair present, no scalp
718-2016	No	Hair present, no scalp
758-3274	No	Hair present, no scalp
702-1443	No	Hair present, no scalp
740-2705	No	Scalp and hair present
704-1487	No	Hair present, no scalp
229-2314	Yes	Scalp and hair present
10-147	Yes	Scalp and hair present
1-60	No	Hair present, no scalp
512-1866	-*	Not located for study
608-2026	-*	No hair, no scalp
101-2051	-*	No hair, no scalp
317-1173	Yes	Scalp and hair, hair cut
38-251	-*	No hair, no scalp
21-222	No	Scalp and hair
907-2169	-*	Not located for study
322-3495	-*	Not located for study
331-3854	-*	Not located for study
329-3765	-*	Not located for study
211-2225	-*	Not located for study
303-1028	-*	not located for study
7-151	-*	not located for study
240-2815	-*	Not located for study
755-3251	-*	Not located for study

Provenience	Nits/eggs Present?	Condition
1-35	-*	Not located for study
763-3468	-*	Not located for study
416-3398	-*	Not located for study
308-1130	No	Hair present, no scalp
804-1383	No	Scalp and hair present
14-175	Yes	Scalp and hair present
21-246	Yes	Scalp and hair present
850-1391	Yes	Scalp and hair present
1-120	No	Scalp and hair present
30-316	No	Scalp and hair present
3-93	Yes	Scalp and hair present
17-319	Yes	Scalp and hair present
809-1405	Yes	Scalp and hair present
705-1502	Yes	Scalp and hair present
707-1563	-*	No scalp, no hair
407-1304	Yes	Scalp and hair present
411-1354	No	Scalp and hair present
706-1546	No	Scalp and hair present
301-1000	No	Scalp and hair present
309-1132	No	Scalp and hair present
504-1700	Yes	Scalp and hair present
1-1213	No	Scalp and hair present
717-1771	-*	No scalp, no hair
702-1443	No	Scalp and hair present
806-1396	Yes	Scalp and hair present
714-1766	No	Hair present, no scalp
712-1644	No	Hair present, no scalp
704-1487	No	Hair present, no scalp
803-1380	-*	Not located for study
510-1850	-*	Not located for study
412-1364/1365	No	Hair present, no scalp

cent to the scalp and on the hair away from the scalp, 4 (5%) had nits/eggs on the hair only, and 9 (12%) had nits/eggs on the scalp hairs only. In general, there was a tendency for maximum density of nits/eggs to decrease from the scalp to the hair away from the scalp. Twenty (27%) individuals had fewer nits/eggs on the hair in comparison to the scalp, and 11 (17%) showed more nits/eggs on the hair than on the scalp.

Only seven individuals from Algodonal were available for field analysis. Of these, 5 (71%) were infested with lice. From El Yaral, 22 individuals were available and were sufficiently preserved for analysis. Of these, 4 (18%) were infested. From Chiribaya Alta, 69 individuals could be studied of which 25 (36%) were infested. Statistical significance in prevalence beyond the 0.05 level is present in El Yaral-Algodonal and Alta-Algodonal comparison ($\chi^2 = 9.742$, $0.005 > P > 0.001$ and $\chi^2 = 4.933$, $0.05 > P > 0.025$ respectively). Significance at the near 0.05 level is evident in the El Yaral-Chiribaya Alta comparison ($\chi^2 = 3.403$, $0.10 > P > 0.05$). Therefore, louse prevalence is significantly variable between sites (Table III). Sex is a variable that can affect parasite prevalence (Table III). The sites were pooled for this comparison. Of 21 women, 8 (38%) were infested. Of 18 men, 10 (56%) were infested. This difference is not statistically different at the 0.05 probability level ($\chi^2 = 1.995$, $0.25 > P > 0.10$). There was variation between adults and children. Of 49 subadults from Chiribaya Alta and El Yaral, 12 (24%) show infestation. Of 43 adults, 19 (44%) show infestation. The difference is statistically significant beyond the 0.05 confidence interval ($\chi^2 = 4.907$, $0.05 > P > 0.025$).

The scalp maximum nit/egg densities (column 1 in Table II) are insightful with regard to parasitism at or around the time of death for the individuals under study. We believe that this provides a better idea of how many active louse infestations occurred in the population as opposed to measurements from the hair shafts which infestations represent several months before death. An examination of the distribution of infection (Fig. 1) shows that the louse nits/eggs are not evenly distributed in the human host population. Most individuals were not infected or had small numbers of eggs/cm^2 of scalp. Only a few individuals were heavily infected. For all of the sites, 194 nits/eggs were observed. Of these, 118 (61%) were observed on 5 (6%) of the mummies. For the site with the largest sample size, Chiribaya Alta, 95 nits/eggs were observed. Of these, 70 (74%) were found on 5 (4%) of the mummies.

The mean maximum louse density also varied per site. The highest mean maximum density of 8.9 nits/eggs/cm^2 was found for Algodonal. The mean maximum density for Chiribaya Alta and El Yaral were 1.7 and 1.73 nits/eggs/cm^2 respectively. The value for all sites was 2.28 nits/eggs/cm^2. The mean maximum nit/egg density varied between children, men and women. Children had a mean maximum value of 0.8 nits/eggs/cm^2 as opposed to 2.6 for women and 3.5 for men.

The highest concentrations occurred among adults. Among the adults, infestation was limited to 31 (34%) of 92 people in the sample. Of those people infested, most have a mean maximum scalp value of 1 nit/cm^2 or less. We consider a mean maximum density of 5 nits/eggs/cm^2 or more to represent heavy infestations. Only 8 individuals had heavy infestations which ranged from mean maximum scalp value of 5 nits/eggs/cm^2 to 22 nits/eggs/cm^2. Of the total number of nits/eggs counted in the study, 69% were found on these eight individuals who make up only 9% of the 92 individuals studied.

DISCUSSION

In modern parasitology, it is axiomatic that 10% of the hosts will harbor 70% of the parasites. These numbers are approximated in the data for El Yaral and Chiribaya Alta. For El Yaral, 84% of the parasites found in the 2 (10%) of the most heavily infested mummies. For Chiribaya Alta, 74% of the parasites were observed on 5 (9%) of the most heavily infested mummies (Figs 1, 2). Statistically, these are the most important points that come from this analysis. This demonstrates that it is possible to retrieve paleoepidemiological data from archaeoparasitology studies that approximate the modern world. This is an essential basis for going on to more fine-tuned paleoepidemiological interpretations.

Several basic points can be distilled from Table III. First of all, there is significant variation between the sites in the percentage of mummies infested (Fig. 3). This indicates that the pathoecology of the sites was variable.

TABLE II

Louse nit counts from specified individuals. Three observations were taken for four categories, scalp maximum density, scalp minimum density, hair maximum density, and hair minimum density. Observations are presented in terms of number of nits/eggs present per 2 x 2 cm areas. Chiribaya Culture mummies, Peru

Provenience	Scalp Max	Scalp Min	Hair Max	Hair Min	Sex
Algodonal					
T-330-1	10/12/4	0/0/0	0/0/0	0/0/0	?
T-342	1/1/1	0/0/0	1/1/1	0/0/0	?
T-338	50/25/58	4/10/9	8/10/12	3/3/1	?
T-388-2-1	0/0/0	0/0/0	0/0/0	0/0/0	?
T-521-16-2	3/2/1	0/0/0	3/4/5	0/0/0	?
T-369-1-1	0/0/0	0/0/0	0/0/0	0/0/0	?
T-526-1-1	6/11/1	0/0/0	1/2/3	0/0/0	?
El Yaral					
142-10218	0/0/0	0/0/0	0/0/0	0/0/0	S
238-10563	0/0/0	0/0/0	0/0/0	0/0/0	S
131-10166	0/0/0	0/0/0	0/0/0	0/0/0	E
107-10033	0/0/0	0/0/0	0/0/0	0/0/0	G
206-10296	0/0/0	0/0/0	0/0/0	0/0/0	S
134-10178	0/0/0	0/0/0	0/0/0	0/0/0	S
231-10461	0/0/0	0/0/0	0/0/0	0/0/0	S
203F-10592	0/0/0	0/0/0	0/0/0	0/0/0	S
101F-10024	14/12/0	0/0/0	1/0/0	0/0/0	S
101F-10024	1/6/7	0/0/0	0/0/0	0/0/0	S
116-10088	24/29/14	0/0/0	9/1/1	0/0/0	G
247-10594	0/0/0	0/0/0	0/0/0	0/0/0	S
137-10200	0/0/0	0/0/0	0/0/0	0/0/0	S
236-10560	0/0/0	0/0/0	0/0/0	0/0/0	S
234-10485	0/0/0	0/0/0	0/0/0	0/0/0	E
233-10480	0/0/0	0/0/0	0/0/0	0/0/0	?
246-10593	2/0	0/0/0	0/0/0	0/0/0	G
243-10566	0/0/0	0/0/0	0/0/0	0/0/0	S
229-10427	0/0/0	0/0/0	0/0/0	0/0/0	G
225-10441	0/0/0	0/0/0	0/0/0	0/0/0	G
216-10360	0/0/0	0/0/0	0/0/0	0/0/0	S
219-10369	0/0/0	0/0/0	0/0/0	0/0/0	S
Chiribaya Alta					
325-3763	——	——	3/1/1	0/0/0	E
516-1926	2/3	0/0/0	2/2/4	0/0/1	S
711-1604	0/0/0	0/0/0	0/0/0	0/0/0	S
211-2225	10/17/13	1/0/0	4/5/1	0/0/0	E
21-222	1/1/1	0/0/1	0/0/1	0/0/1	S
755-3251	0/0/0	0/0/0	0/0/0	0/0/0	S
416-3398	0/0/0	0/0/0	0/0/0	0/0/0	?
907-2169	0/0/0	0/0/0	0/0/0	0/0/0	E
318-3477	0/0/0	0/0/0	1/2/3	0/0/0	G
609-2079	0/0/0	0/0/0	0/0/0	0/0/0	G
746-2975	0/0/0	0/0/0	0/0/0	0/0/0	E
437-3947	——	——	3/2/1	0/0/0	G
439-3955	6/0/0	0/0/0	0/0/0	0/0/0	S
328-3759	——	——	0/0/0	0/0/0	S
302-1012	0/0/0	0/0/0	0/0/0	0/0/0	E
901-2059	9/3/3	0/0/0	22/6/4	0/0/0	E
304-1068	1/0/0	0/0/0	1/0/0	0/0/0	G
428-2642	1/0/0	0/0/0	0/0/0	0/0/0	S
313-1155	0/0/0	0/0/0	0/0/0	0/0/0	S
313-1252	0/0/0	0/0/0	0/0/0	0/0/0	S
326-3754	2/7/3	1/1/1	0/0/0	0/0/0	S
313-1252	0/0/0	0/0/0	0/0/0	0/0/0	S
714-1766	0/0/0	0/0/0	0/0/0	0/0/0	S
307-1128	——	——	0/0/0	0/0/0	S
326-3754	10/6/7	3/5/3	0/0/0	0/0/0	S
305-1079,10	——	——	1/1/1	0/0/0	E
305-1079,06	——	——	0/0/0	0/0/0	S

Provenience	Scalp Max	Scalp Min	Hair Max	Hair Min	Sex
321-1174-A3494	0/0/0	0/0/0	0/0/0	0/0/0	E
321-1174-B3494	0/0/0	0/0/0	0/0/0	0/0/0	E
429-3911	0/0/0	0/0/0	0/0/0	0/0/0	S
502-1671	——	——	0/0/0	0/0/0	G
402-1219	——	——	0/0/0	0/0/0	E
415-3364	0/0/0	0/0/0	0/0/0	0/0/0	G
615-1369	0/0/0	0/0/0	0/0/0	0/0/0	S
436-3941	0/0/0	0/0/0	0/0/0	0/0/0	S
718-2016	0/0/0	0/0/0	0/0/0	0/0/0	S
758-3274	0/0/0	0/0/0	0/0/0	0/0/0	S
702-1443	0/0/0	0/0/0	0/0/0	0/0/0	S
740-2705	0/0/0	0/0/0	0/0/0	0/0/0	G
704-1487	0/0/0	0/0/0	0/0/0	0/0/0	S
229-2314	3/5/1	0/0/0	0/0/0	0/0/0	S
10-147	34/12/16	1/1/1	1/2/1	0/0/0	E
1-60	——	——	0/0/0	0/0/0	E
317-1173	14/26/15	9/13/2	——	——	G
11-222	0/0/0	0/0/0	0/0/0	0/0/0	S
308-1130	——	——	0/0/0	0/0/0	E
804-1383	0/0/0	0/0/0	0/0/0	0/0/0	S
14-175	1/1/1	0/0/0	4/3/1	0/0/0	G
21-246	0/0/1	0/0/0	5/5/3	0/0/0	S
850-1391	1/0/1	0/0/0	3/4/3	0/0/0	E
1-120	0/0/0	0/0/0	0/0/0	0/0/0	S
30-316	0/0/0	0/0/0	0/0/0	0/0/0	E
3-93	1/1/1	0/0/0	0/0/0	0/0/0	E
17-319	0/0/0	0/0/0	1/1/1	0/0/0	G
809-1405	2/2/1	0/0/1	1/0/0	0/0/0	S
705-1502	1/3/1	0/0/0	1/1/1	0/0/0	E
407-1304	8/17/4	2/5/2	3/0/3	0/0/0	G
411-1354	0/0/0	0/0/0	0/0/0	0/0/0	E
706-1546	0/0/0	0/0/0	0/0/0	0/0/0	S
301-1000	0/0/0	0/0/0	0/0/0	0/0/0	E
309-1132	0/0/0	0/0/0	0/0/0	0/0/0	S
504-1700	0/0/0	0/0/0	3/1/0	0/0/0	G
1-1213	0/0/0	0/0/0	0/1/0	0/0/0	S
702-1443	0/0/0	0/0/0	0/0/0	0/0/0	S
806-1396	1/0/1	0/0/0	3/2/1	0/0/0	S
714-1766	0/0/0	0/0/0	0/0/0	0/0/0	S
712-1644	——	——	0/0/0	0/0/0	S
704-1487	——	——	0/0/0	0/0/0	S
412-1364/1365	——	——	0/0/0	0/0/0	G

S: subadult; E: adult female; G: adult male

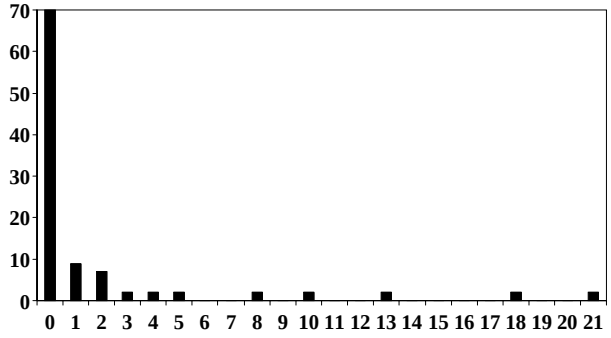

Fig. 1: the distribution of mummies by infection category for Chiribaya Alta. The X-axis is the mean maximum egg/nit counts from the scalp. The Y-axis shows the percentage of mummies that occur in each category. As can be seen, the largest percentage of mummies had no lice nits or eggs.

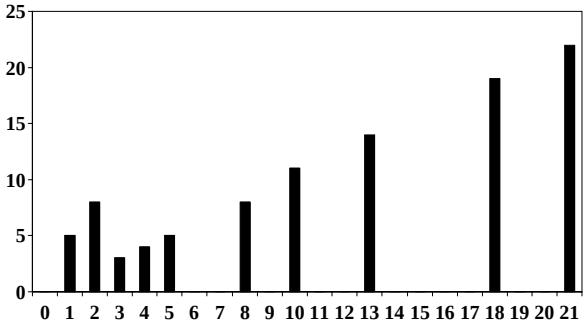

Fig. 2: the percentage of louse observations by infection category for Chiribaya Alta. The X-axis is the mean maximum egg/nit counts from the scalp. The Y-axis shows the percentage of louse egg/nit observations made for each category. As can be seen, the largest percentage of louse observations came from the few mummies that were heavily infected.

Second, males are more commonly infested than females at all sites. At Chiribaya Alta, adult females are more commonly infested than children. At El Yaral, children are more often infested than women.

Lice are easily transmitted from person to person and crowding results in higher prevalence. Therefore, *Pediculus humanus* tells us something of the nature of the life conditions between the two villages of Chiribaya Alta and El Yaral. The prevalence per site for *P. humanus* is plotted in Fig. 3. The prevalence is markedly different between Yaral and Chiribaya Alta. This indicates that the inhabitants of Chiribaya Alta were more crowded and therefore at greater risk of exposure and reexposure than those of El Yaral.

The Chiribaya were certainly host to head lice. The lice must have been a source of considerable discomfort. *P. humanus* is a species of anopluran lice, commonly called sucking lice. The common name refers to their mode of feeding which is by ingesting blood. Their mode of obtaining a blood meal is termed solenophagia. Solenophagic arthropods push their mouth parts directly into blood vessels to obtain blood. The mouth parts are modified into piercing stylets which work in a way analogous to a hypodermic needle. The bites of the louse cause a localized, pruritic response which in turn elicits scratching. The scratching can lead to dermatitis. Secondary infestation could also be a problem. After years of exposure, the scalp becomes thickened and discolored. This condition is commonly known as vagabond's disease. Further examination of Chiribaya crania may show that many individuals suffered from dermatitis.

Individual 802-1371 may reflect the extreme development of pediculosis: plica polonica. In the case of plica polonica, the hair becomes matted with exudate and fungus grows in the mass. Individual 802-1371 exhibited hair that was matted in scab-like material and perhaps was badly effected by lice.

Unfortunately, the hair was so matted on this individual that it was impossible to examine the scalp for the proliferation of lice that accompany plica polonica without destroying the integrity of the specimen.

Men had a higher infestation prevalence than women. This is because men more commonly had elaborate hair styles that covered the scalp in braids (Fig. 4). Shielded by these hair styles, the lice might find more hospitable hosts on men. The men's braided hair was remarkably clean. It is likely that Chiribaya men had more lice for the same reasons as modern girls who are more commonly infested because long, clean hair promotes louse infestation.

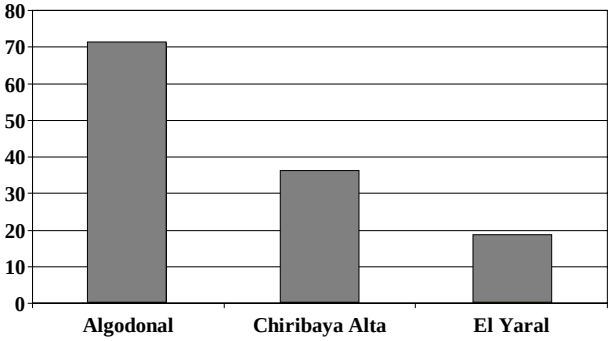

Fig. 3: the percentage of mummies infected from the three main sites, Chiribaya Culture, Peru. As can be seen by this gross comparison, the prevalence of infection varied markedly between the sites.

Considering the annoyance lice must have caused to Chiribayans, they must have had some technological and hygienic tools to minimize louse proliferation. It is possible that the lice were controlled by mutual grooming

Fig. 4: braided hair styles typical of Chiribaya men, Chiribaya Culture, Peru. Women and children had simple, straight, unbraided hair.

TABLE III

Prevalence of infestation between main study sites. Chiribaya Culture mummies, Peru

Prevalence in %	Algodonal	El Yaral	Chiribaya Alta	All sites
All mummies	71%	18%	36%	35%
Male mummies	n.a.	60%	62%	56%
Female mummies	n.a.	0%	42%	38%
Child mummies	n.a.	14%	29%	24%

accompanied by eating the lice, as is common among many tribal peoples. Artifactual evidence bears on the question. We noticed comb-like tools buried with some individuals (Fig. 5). These may have been used for weaving. However, the presence of these artifacts shows that the Chiribaya had the technology to make combs. A few individuals had a decreased density of scalp nits/eggs in comparison to hair measurements. This suggests that louse infestation could be controlled and decreased by hygienic measures. Individuals 901-2059, 14-175, 21-46, 850-1391, and 4-1700 show decreasing louse density from the hair to the scalp. This indicates that these individuals were reducing their louse infestations. When louse infestation became extreme, a technique of last resort must have been cutting off the hair. One male, 317-1173, had an amazing density of louse nits/eggs. He did not exhibit the highest maximum density of lice, but he did exhibit a relatively high minimum density. Every square centimeter of scalp had louse nits or eggs. The range of maximum density was 7-13 nits/eggs/cm^2 with a mean of 9/cm^2. The range of minimum densities was 1-6.5 nits/eggs/cm^2 with a mean of 4/cm^2. This individual must have been suffering severely from louse infection and his hair was shorn off between 1 and 2 inches from the scalp. This individual also suffered from an infestation of the mucocutaneous tissue of the nose and mouth, probably as a result of leishmaniasis. The facial disfigurement of this individual was profound and probably inspired avoidance by other members of the village. Such avoidance and fear is common in areas with endemic leprosy which produces similar soft tissue lesions. In the case of individual 317-1173, it appears that the lice proliferated in a weakened individual who may not have been able to gain hygienic aid from anyone else beyond a hair cut. Several individuals show pronounced densities of lice at the scalp with lower densities in the hair. This may indicate a similar proliferation of lice in sick and dying individuals (407-1304, 10-147, and 211-2225). Therefore, declining individual health status may have allowed lice to proliferate when individual care could not be easily rendered.

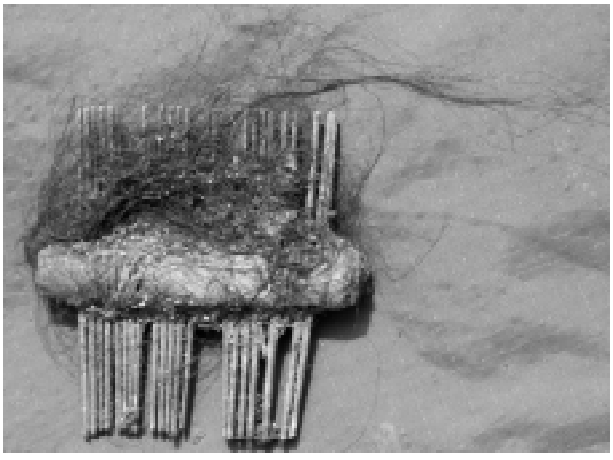

Fig. 5: comb-like tool found in a tomb, Chiribaya Culture, Peru.

The fact that children were least often infested is interesting. In modern societies, children are most often infested (Mellanby 1942, Ibarra 1989, Mumcuoglu et al. 1990, Ibarra & Hall 1996, Ibarra et al. 2000). Children from large families are more likely to be infested than children from small families. Child cares, schools, and preschools in the modern world promote social interaction between children and louse infestation. The low prevalence of infestation among Chiribaya children suggest that children were not associated in the same social settings as modern children. The contrast between Chiribaya louse prevalence between the Chiribaya children and modern children highlights the importance of schools and other child-centered social activities in promoting infestation.

Of all the areas of archaeoparasitology, we believe that the study of lice has the greatest potential for providing real epidemiological data regarding past populations. When large numbers of mummies are examined, it is relatively effortless to collect sufficient observations for interpretation. In this study, only San Geronimo had such poor preservation that it could not be used. The poor preservation of mummies from the site of San Geronimo is due to it beach location and association with moisture. Of the remaining three sites, Chiribaya Alta and El Yaral provide the best insights into louse paleoepidemiology due to the relatively large numbers of mummies for which age and sex was determined. The analysis of these mummies shows how aspects of hairstyle and other behavior effected louse distribution among the Chiribaya.

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