MESOLITHIC HEALTH AND SUBSISTENCE AT LANGHNAJ AND MAHADAHA, INDIA

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ABSTRACT

The late Mesolithic period in India saw the emergence of agriculture in the Harappan civilization. From here agriculture spread east and south replacing hunting and gathering. Health throughout the world changed as agriculture was adopted, which can be seen in human skeletal remains. Langhnaj and Mahadaha are two of these late Mesolithic hunting and gathering sites. Langhnaj is located in western India within the area the Harappan civilization controlled and had access to domesticated food. Mahadaha is located in eastern India in an area with no evidence of agriculture. From the human remains, more specifically the attributes of the dentition, this study will try to determine whether there was a difference in health between these sites.

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INTRODUCTION

Throughout the world the development of agriculture has been a turning point for cultures. For most, it was favored over hunting and gathering because it allowed settlements to increase in size, since there was less need to travel to acquire a food supply to survive. The disadvantage of this shift to agriculture, however, is that the health of populations declined with a reliance of agriculture.

In India, agriculture did not spread to all populations in a region at the same time. Toward the end of the Mesolithic, generally defined as the period of time after the Ice Age, up to the Neolithic, a period of time after the emergence of agriculture, groups in the south and east continued to practice hunting and gathering, while groups in the west were the first to begin using agriculture.

The purpose of this study is to compare dental attributes from the human remains found at the Mesolithic sites of Langhnaj and Mahadaha. There is evidence at the site of Langhnaj that there was extensive interaction between the people of this site with a large agricultural population, while there is no evidence of the people at the site of Mahadaha having interaction with agriculturalists. It remains to be seen if interaction with agricultural populations had an impact on the health of hunter/gatherers at these sites.

MESOLITHIC INDIA

The Mesolithic period in India dates from about 10,000 to 4,000 B.C. Dates are assigned to differentiate the Mesolithic from the later Neolithic though there were still many Mesolithic practices that continued into the Neolithic. The beginning of the Mesolithic showed an expansion of population to areas previously covered by glaciers. The change in climate made new areas habitable but also led to many other climatic changes, most notably monsoons which affected all areas of India except for central India, where Mahadaha is located.

In the Mesolithic there tended to be certain areas that were favored for settlements, which was not a trend in the earlier Paleolithic. Some of these areas included rock shelters, fossilized sand dunes, which is where Langhnaj is located, and oxbow lakes, where Mahadaha is located. These settlements were not usually sedentary, only the rock shelters show evidence of year long human habitation.

The sites of Langhnaj and Mahadaha date from the Mesolithic into the early Neolithic but are still considered Mesolithic sites. This is mainly based on types of technology created by these people, including microlithic tools, otherwise known as small stone tools. These small tools were usually attached to the ends of wooden or bone shafts to more efficiently kill animals for food. They were also commonly used to modify other materials such as wood, shell, leather and bone. These tools were made from local materials though occasionally there were foreign types of rock suggesting there was contact with other areas. Most sites have some foreign material so it seems people commonly traveled long distances to interact with each other.

Evidence of types of technology used besides microliths can be hard to find in some areas of India. In order to fill in the gaps from what is not found archaeologically there is much interest in studying the hunter/forager groups that still exist in India as well as the many rock shelters in the Ganges River Valley that contain art from this time. The art in these caves does not just date to the Mesolithic but also the Paleolithic and into historic times. The images that are known to date to the Mesolithic show evidence of high levels of technology. They made crafts to maneuver in lakes and rivers, containers to collect and move food and other materials, animal traps, and twine and poles to construct and support their shelters (Kennedy 1992).

The end of the Mesolithic varied throughout India. Transition into the Neolithic usually meant adopting agriculture among other things. In India agriculture spread from the western city of Harappa where they grew domesticated rice, wheat and barley, then to the east and then south (Hutchinson 1976).

Mahadaha

The site of Mahadaha is located in the Ganges Plain of eastern India in the state of Uttar Pradesh (Figure 1). Mahadaha was one of three extremely well preserved seasonal sites, including Sarai Nahar Rai and Damdama, situated around an ancient oxbow lake. The earliest radio carbon date for the site of Mahadaha dates it to around 2010 B. C. This time period is when many areas in India were beginning to adopt agriculture. However the site's location was unfavorable for growing crops. The flooding of the Ganges deposited minerals and salt into the soil and as the water receded would form a thick crust on the surface, called *reh*, which decreased the favorability of the land. This may be one factor in why agriculture was not practiced in Mahadaha (Kennedy 1992).

Figure 1: Map of India (modified from mapsof.net 2012)

The faunal remains recovered at this site include hippopotamus, antelope, deer, pig, goat, turtle, fish and birds. The larger animals were brought back to the site in pieces so not all bones are recovered from excavations. Several areas around the ancient lake seem to have been used as butcher sites. Though many floral samples remain unidentified in Sharma, et al. (1980)'s publication, the identified remains include grassland species and indigenous varieties of wild rice.

Mahadaha is associated with a microlithic culture that traveled to this site and other rock shelter sites in the Vindhays, which is south of the Ganges. The main type of tool made was blunted back blades. The material used for this and other tools is from the Vindhays. It seems that while people were living at Mahadaha they used these tools for as long as possible before discarding them. There is a large assemblage of very small pieces of stone at Mahadaha while at Vindhays there are larger pieces found.

Excavations of the site have uncovered 32 human skeletons. Most were in a supine position with arms at their sides and oriented east-west or west-east. The graves were filled with hearth residue, pieces of charred animal bone or clay mixed with the soil. There are some burial goods such as a bone arrowhead, bone rings, rubbed ochre pieces and animal bones (Kennedy 1992).

Langhnaj

The site of Langhnaj is located in western India in the state of Gujarat (Figure 1). The site rests on a fossilized sand dune which is a common feature in this part of the subcontinent (Allchin 1971). The surrounding landscape is a flat alluvial plain dotted with groups fossilized sand dunes. During the monsoon season the area between the dunes filled with water creating temporary lakes which went dry by May or June (Sankalia 1965). No archaeological evidence at Langhnaj of plant remains has been found due to the calcareous nature of the soil, although this has allowed for many faunal remains to be preserved. The vegetation present today gives a picture to what the vegetation most likely was over 4,000 years ago. Today there is only shrub vegetation, mainly babul, cactus, bor, a type of berry, and many varieties of wild flowers (Ehrhardt 1965).

There are many animals represented in the faunal remains of Langhnaj. Cattle, ox, and goat are among the remains although the exact species cannot be determined and these were found in the site's later occupation (Ehrhardt 1965). Other remains are of deer, wild boar, squirrel, rat, tortoise, fish and rhinoceros (Sankalia, 1949). All the bones, with the exception of the scapula and some vertebrae were smashed or cut lengthwise, presumably to extract the marrow. One bone shows evidence of charring but whether this was deliberate or not is hard to

say, though no evidence of the use of fire in other instances was found in the archaeological record (Sankalia 1965).

Carbon dating done on faunal remains from the earliest occupation dates the site to around 1875 B.C. though there is evidence of contamination in the samples, so it is likely the site dates to an earlier time. Comparisons to similar sites of the region suggest the site may have dated as far back as 7000 B.C. Langhnaj was most likely occupied into the second millennium B.C. during which time the nearby Harappan civilization was at its peak (Allchin 1971). Using the timelines from similar sites around the area of Langhnaj, habitation of the site has been divided into two main time periods. The first ends around 2500 B. C. and the later occupation began around 2000 B.C (Sankalia 1965).

The first occupation is associated with a microlithic culture. Crude flakes account for eighty-six percent of the 1,300 microliths recovered (Sankalia 1965: 32). Some of the other tools found were cores, parallel sided flakes, scrapers, points and blunted back blades. They also made what is described as "ill-baked" pottery which was occasionally decorated. This pottery is roughly made and not much is found in this early period. Some small pieces of pottery are found in the earliest stratigraphy of the site but this may not be evidence of early pottery manufacture since the porous nature of the soil and the abundance of burrowing animals can disrupt the chronology.

The difference in the second occupation seems only to be the types of technology used and not much difference in subsistence. They continued to make and use microliths but other tools are also found. A copper hunting knife, two small ground stone axes and a ring-stone are examples of the tools found in this second time period. The function of ring-stones is unknown but they are only found in the Western areas of India. All of these examples of tools were not

produced at Langhnaj and had to be traded for. The pottery also changed and typically was decorated with a burnished black interior and a red slipped exterior. The pieces uncovered are very small and only a few rim or base pieces have been found so not much is known about the function of this pottery. This type of pottery is common throughout the region. The pottery and tools found at Langhnaj are evidence of interaction and trade between these groups.

No evidence has been found for houses from either time period. Natural shrub seems to be the only shelter used. There is no evidence of wattle-and-daub houses and there was most likely not enough vegetation to build a semi permanent shelter large enough to live in, though there is still the possibility that they built the latter since no floral remains have been preserved (Sankalia 1965).

Some archaeologists have suggested that the evidence at Langhnaj points to the people there having been nomadic pastoralists rather than hunter/gatherers (Kennedy 1992). Whether they were hunter/gatherers or not it is likely they traded for food with agricultural settlements nearby. They did trade for other materials and during the second occupation of Langhnaj, two major cities in the north developed, Mohenjo Daro and Harappa (Kenoyer 1997). They had large areas of influence and either directly or indirectly Langhnaj peoples probably consumed their food.

There were thirteen human skeletons excavated from the site. Most were buried in a flexed position oriented east-west. All the remains show heavy fracturing possibly caused by the weight of the ground over time or evidence of deliberate fracturing. Four of the thirteen remains have deliberate fractures caused before death and were probably the cause of death. One has a large cut on his forehead, the other three have fracturing on their head or face or both. Not all the fractures are attributed to a blow to the head, they may have happened after burial from the

pressure of the soil. Other skeletons have similar breaks in their skull. One idea for this is that there may have been some kind of ritual to break the skull with a rock or some other heavy object to release the soul. One skeleton was found with a large rock buried with him, however it is not necessarily proof for this theory (Ehrhardt 1965).

METHODOLOGY

By taking samples from known hunter/gatherers and known agriculturalists, researchers have been able to compare patterns of wear and dental diseases associated with certain types of subsistence. For example pre-agricultural populations generally have low frequencies of dental caries and linear enamel hypoplasia and high frequencies of alveolar resorption and heavy tooth wear (Lukacs 1993:755). To be able to determine the health of the individuals at Langhnaj and Mahadaha I will be focusing on certain dental indicators which I obtained from pictures and descriptions of each skeleton at both sites (Kennedy 1992 and Ehrhdart 1965).

One of the categories of dental diseases is dental caries, also known as cavities. Caries are usually caused by an increase in carbohydrates, including cereal grains, milk and fruit. I will count the total number of teeth still in the skull from each site and the number of those teeth that have caries. I will only use information from descriptions provided in the two site reports for this category. I can then come up with a percentage that can be easily compared. I expect Langhnaj to have the higher percentage of caries since it had more archaeological evidence of contact with agricultural populations.

The next category I will look at is alveolar resorption. Alveolar resorption is most commonly caused by deficiencies in diet although other diseases can sometimes cause it. Plaque and tartar build up and first make the gum line recede then the bone starts to disintegrate causing teeth to fall out if the alveolar, the part of the bone that holds the teeth, recedes far enough. If teeth are still attached the roots of the teeth can be seen in the skeletons which is a less severe

form of resorption. For this I will count the total number of skulls with teeth attached that can be studied in each site and then count the number of those that show disintegration of the alveolar. In most photographs from the sites evidence of resorption is visible although I also used the descriptions to verify what was seen in those photos. I would expect to see more evidence of the disease in Mahadaha (Lukacs 1993).

I will also look at tooth wear. Heavier tooth wear is typically seen in hunter/gatherers because the food is usually more abrasive and teeth more often used as tools. Domesticated plants also need some degree of processing before consumption which ends up making them easier to break down which results in less wear. For this category I will divide up the remains into age groups. This way the wear patterns due to age will not affect the results. Each age can be compared to see if one site has heavier wear than the other. Degree of wear will be determined by the information provided by the dental examinations in the site reports (Kennedy 1992 and Ehrhdart 1965). If there is a significant difference in this category I expect less wear on the remains at Langhnaj.

I will not be looking at linear enamel hypoplasia since it will be difficult to consistently determine wear on the enamel with only access to photographs and descriptions.

RESULTS

I expect to see Langhnaj showing similarities agricultural groups since there is evidence of trade with the kingdom of Harappa. Although if Langhnaj did not have an agricultural diet from the influence of Harappa, there should be a similarity to Mahadaha.

In order to give more understanding to this section, tables of each individual from both sites are shown in Table 1 and Table 2. These tables show the age and sex of the remains and also include the specific indicators that will be used to determine the dental health. The column for number of teeth is including teeth where the crown may have fallen off at some point after burial but there is still evidence of the root in the alveolar. Fragments of the maxilla or mandible with attached teeth are also included in the chart so those with few teeth may just be the result of a fragment rather than extreme tooth loss.

Table 1: Remains at Langhnaj (Ehrhardt 1965)

Skeleton Number	Sex	Age	Number of Teeth	Tooth Wear	Alveolar Resorption	Dental Caries
1	Male	40-50	23	Severe		
2	Male	30-40	24	Severe		X
3	Male	30-40	13	Severe		
4	Female	20	28	Minimal		
5	Male	40-50	16	Severe		
6		Adult				
7	Male	30-40				
8						
9		5-6				
10		Adult	2	Severe		
11	Male	Adult	3	Severe		
12	Female	Elderly	4	Severe	X	
13		9-10				

Table 2: Remains at Mahadaha (Kennedy 1992)

Skeletal Number	Sex	Age	Number of Teeth	Tooth Wear	Alveolar Resorption	Dental Caries
1	Male	18-21	5	Minimal		
2	Male	18-21	14	Minimal		X
3	Male	24-28	32	Moderate		
4	Male	Adult				
5	Male	Adult				
6	Male	19-22				
7						
8	Male	Adult				
9	Male	19-22	7	Minimal		
10	Male	18-20				
11	Male	18-20	32	Minimal		X
12	Male	22-26	21	Minimal	X	
13	Male	Adult				
14	Female	28-32				
15	Male	20-25	22	Minimal	X	
16						
17						
18	Female	Adult				
19	Female	50-60	3	Severe	X	
20		4-5				
21	Female	52-60	14	Severe	X	X
22		Adult				
23	Male	30-40	20	Severe	X	
24	Male	21-23	16	Minimal	X	
25	Female	Adult	10	Moderate	X	
26	Male	19-21	30	Minimal	X	
27	Female	Adult	8	Minimal	X	
28		2-3				
29	Male	Adult				
30	Female	30-40	24	Moderate		
31						
32						

Alveolar resorption and dental caries were identified for each skeleton in the analysis by Kennedy, et al. (1992). The data available for dental caries may be skewed since there is the possibility of those teeth being removed at some point during a person's lifetime. Therefore the only data that is included is evidence of caries in the teeth of the skeletons and may not be truly representative of caries these people may have had in their life. Since this category has been used in a similar way on other skeletal remains it will still be included in this analysis. Alveolar resorption has varying degrees of severity. I have not decided to differentiate these so those individuals with slight resorption are marked with an "x".

Skeleton number 8 on the Langhnaj table is left blank because there was not enough skeletal material to estimate age or sex and no dental remain were found with that individual. On the table for Mahadaha the skeleton numbers 7, 16, 17, 31 and 32 are blank for the same reason. I have included them on the table just to mention them since they did have burials if not much of their remains was uncovered. There are also skeletons from both sites that have been given a sex and age but there were no dental remains found with them either from being lost or from the remains being of a young child where there would not be permanent teeth to analyze.

The first category examined was dental caries. At the site of Langhnaj there are a total of 113 teeth, with 9 caries. At the site of Mahadaha there are 258 total teeth, with 3 dental caries. From this data Langhnaj shows a very high percentage of caries compared to Mahadaha, which would follow what I had expected. However if only the number of individuals with caries are counted rather than the caries themselves there is 1 individual out of 8 at Langhnaj and 3 individuals out of 15 at Mahadaha which is more accurate but not what was expected, as it shows a slightly higher percentage at the site without agriculture (Figure 2).

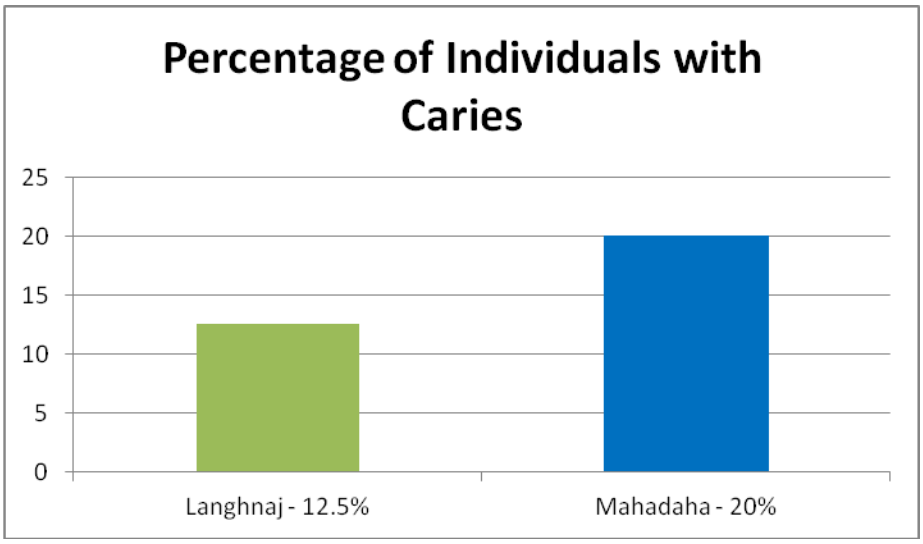

Figure 2: Graph of Percentage of Indivduals with Dental Caries

The next category that will be examined is alveolar resorption. At Langhnaj there are 8 skeletons, 1 with evidence of resorption. At Mahadaha there are 9 of the 15 remains with evidence of some degree of resorption. This follows what was expected and shows a much more dramatic difference between the sites (Figure 3).

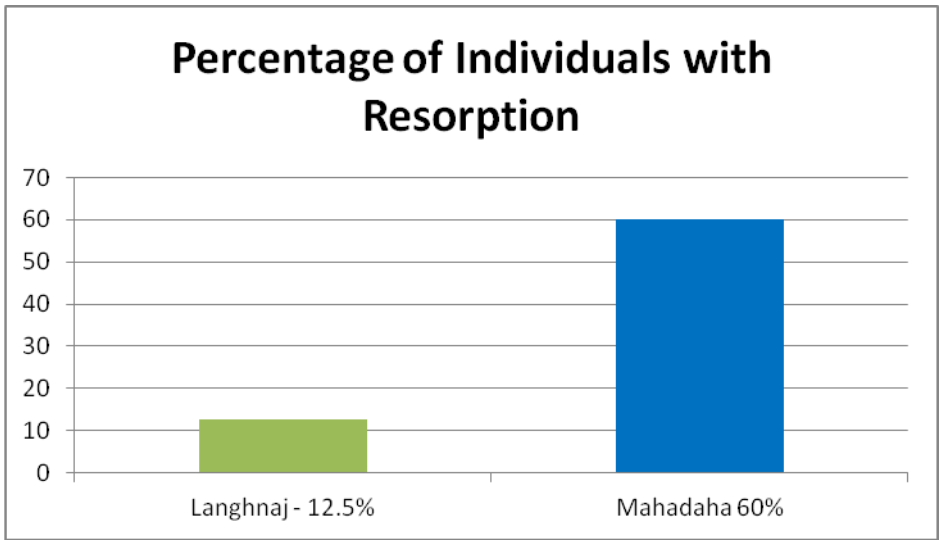

Figure 3: Graph of the Percentage of Individuals with Alveolar Resorption

The final category to analyse is tooth wear. For this category I divided the remains into 5 groups based on age. These are 18-22, 23-29, 30-39, 40-49, and over 50. The skeletons with no age will be divided accordingly: adult will be counted in the 30-39 group and elderly will be in the over 50 group. Women and men are grouped together. The sites are compared based on these groups to see if there is a difference in wear, using percentages. Figure 4 does not have data from all age groups so unfortunately these groups do not give the best idea of wear. From this data it seems that there is less wear in Mahadaha which would have been expected to have more (Figure 4).

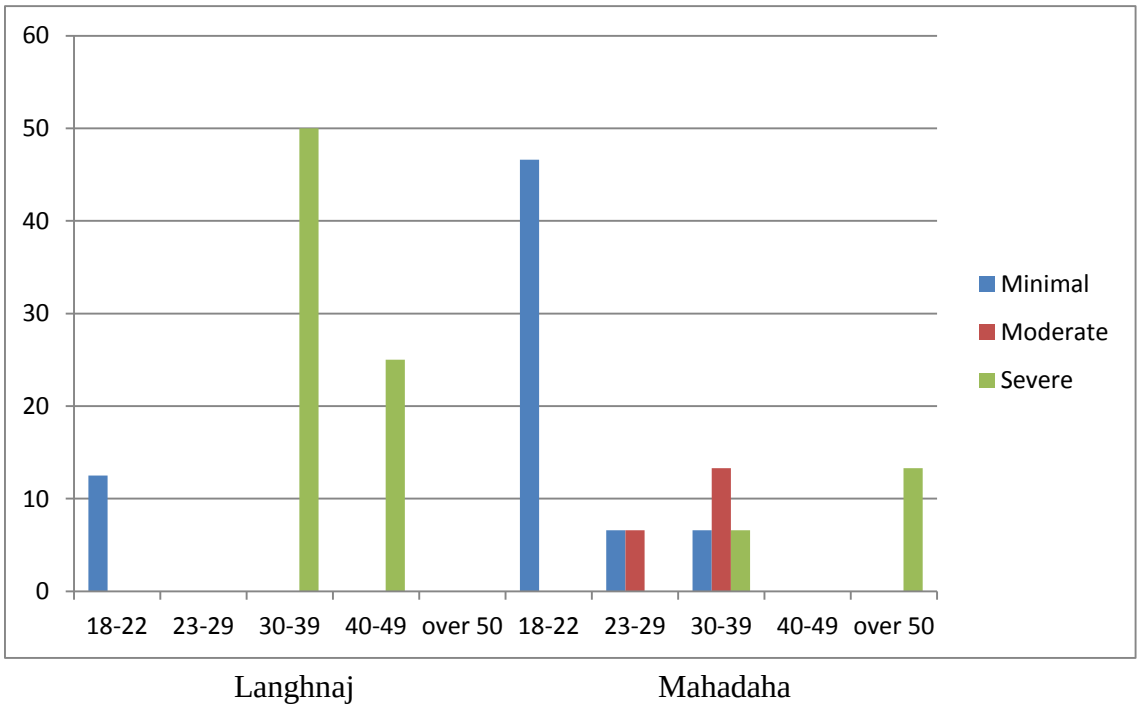

Figure 4: Graph of Tooth Wear Severity Percentage by Age and Site

These analyses do not show a strong difference between the health of the two groups in terms of tooth wear severity. Since the data from Langhnaj did not include teeth with moderate tooth wear I do not know whether that was because there was no evidence of moderate wear or

the way the wear was measured was different and did not include moderate wear. Whichever the reason for this the data can still be used by just omitting the moderate wear in Mahadaha.

CONCLUSION

From the results there is not a difference in health shown in dental attributes that would be expected if Langhnaj was practicing agriculture or had regular trade and interaction with an agricultural society. Langhnaj, when compared to Mahadaha in this study, has more dental health characteristics seen in hunter/gatherer societies, which are a lower incidence of dental caries and more heavy tooth wear, although Mahadaha has a higher percentage of alveolar resorption.

The purpose of this research was to primarily see how Mahadaha and Langhnaj compared in regard to health with similar subsistence practices. If there was a difference it would have caused more questions to be asked about how much consumption of agricultural foods over how long a period of time would lead to signs of changes in health. These questions can still be looked into though the research here does not necessarily lead to it.

Sites and remains dated from the late Mesolithic seem to be common throughout India. Skeletal remains from the middle Neolithic period are more difficult find than those from the Mesolithic. In the west, where Harappa is located, there are many sites to choose from but the south and east have few excavated sites. Future research on this topic would contribute much to better understand the transition to agriculture from hunting and gathering, especially in the eastern and southern regions.

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