Investigation of the Effects of Diet, Sex, and Age on Dental Health Among Ancient Asian Samples from China and Mongolia

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Introduction

The transition from hunting and gathering to agriculture and its effect on human beings has been widely investigated\(^1\). Based on these studies, it has been shown that different modes of subsistence result in different effects on the skeletal remains\(^2\). As populations increased their consumption of carbohydrates, their oral disease rates, in the form of carious lesions, antemortem tooth loss (AMTL), and abscesses among others, increased\(^3\). It has also been noted that females experienced greater frequencies of oral pathology than males, and this has been attributed to behavioral differences\(^4\) and physiological aspects\(^5\). Increased frequency of oral pathology with age has also been established, with the exception of carious lesions, which can decrease in frequency when left untreated and result in other forms of oral pathology, such as AMTL\(^6\). Focus has centered on agricultural and hunting and gathering populations but oral disease rates and the effect of sex and age among pastoral and agropastoral populations has been relatively neglected. This study addresses this gap by exploring dental health among ancient Asian samples with different modes of subsistence to examine the effect of diet, sex, and age.

Materials and Methods

This study examines samples from multiple sites that represent three different modes of subsistence. (Table 1, Figures 1-2)

1. Agricultural sample from Henan, China -Chenjiagou site: 475-221 BC
2. Agropastoral sample from the Manchuria region of China -Lamadong site, AD 337-410
3. Pastoral samples from Mongolia -Various sites from the Mongol Empire AD 13\(^{th}\)-14\(^{th}\) c. and Xiongnu Period 3\(^{rd}\) c.-AD 2\(^{nd}\) c.

Oral disease in the forms of carious lesions, AMTL, and abscesses were examined. Carious lesions form when the enamel is eroded by acid, a by-product of carbohydrate fermentation\(^7\). AMTL is defined as alveolar bone resorption after the loss of a tooth,\(^8\) and abscesses are defined as the presence of cloacae and inflammatory bone reaction\(^9\). Observations of oral pathology were made on site (primarily by Eng, also Myagmar for Mongol period) and later cross- checked with pictures and field notes (by Gomez). Significance, at the p=0.05 level, was tested using independent t-tests.

Table 1: Population Numbers

<table>
<thead>
<tr>
<th>Population</th>
<th>Chenjiagou Site</th>
<th>Lamadong Site</th>
<th>Mongolia 1 (Eng)</th>
<th>Mongolia 2 (Myagmar)</th>
<th>Xiongnu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Subsistence</td>
<td>Agriculture</td>
<td>Agropastoral</td>
<td>Pastoral</td>
<td>Pastoral</td>
<td>Pastoral</td>
</tr>
<tr>
<td>Females (N=142)</td>
<td>26</td>
<td>56</td>
<td>21</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>Males (N=163)</td>
<td>33</td>
<td>55</td>
<td>14</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Female (YA) 20-35</td>
<td>5</td>
<td>20</td>
<td>9</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Female (MA) 35-50</td>
<td>15</td>
<td>25</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Female (OA) 50+</td>
<td>6</td>
<td>11</td>
<td>6</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Male (YA) 20-35</td>
<td>10</td>
<td>20</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Male (MA) 35-50</td>
<td>18</td>
<td>25</td>
<td>7</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Male (OA) 50+</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Total (N=305)</td>
<td>59</td>
<td>111</td>
<td>35</td>
<td>45</td>
<td>55</td>
</tr>
</tbody>
</table>

The Effect of Diet

The sample with the worse overall dental health was the agropastoral sample, especially in carious lesions (Figures 3-4). They significantly suffered from more carious lesions than either the pastoral sample (p=0.001) or the agricultural sample (p=0.006). It was expected that the agricultural sample would have the highest rates of dental disease due to their diet rich in carbohydrates but this was not the case and they had relatively low rates of all forms of oral pathology. Additionally, the pastoral sample has significantly higher rates of AMTL (p=0.017 vs agricultural, see Figure 5). While all samples suffered from oral disease, the agropastoral sample had the worse overall dental health.

The Effect of Sex

Both males and females in all of the samples experienced high rates of oral disease; neither sex experience significantly worse dental health than the other (Figure 5). Combined pathology rates from all subsistence patterns for males and females showed no significant difference between the sexes for any form of oral pathology (p=0.375 (AMTL), 0.731 (carious lesions), and 0.426 (abscesses)). When comparing males and females within each mode of subsistence, slight significance was found for males over females in abscesses in the pastoral sample (p=0.140), and for females over males in AMTL in the agricultural (p=0.149) and agropastoral (p=0.178) samples. No results are significant.

The Effect of Age

As age increases there are higher rates of oral pathology (Figure 7). Both males and females had the expected significantly higher rates of AMTL and abscesses as the chronological age of the samples increased, but this was not the case for carious lesions (Figure 6).

Conclusions

Several general conclusions can be drawn from this examination of oral pathology among three different modes of subsistence:

1. The Effect of Diet: The agropastoral sample had the highest overall rates of dental disease among these three modes of subsistence especially in the rates of carious lesions. This could be the result of diet/cultural differences and high consumption rates of cariogenic foods. The pastoralists had significantly higher rates of AMTL which could be the result of high numbers of OA (44\%) of sample compared to 15\% in the agricultural sample and 18\% in the agropastoral sample or cultural factors, such as trade that allowed them to supplement their diet with carbohydrates. The agricultural sample had lower rates of oral pathology and this could be the result of low sample size.

2. The Effect of Sex: Both males and females experienced high rates of oral pathology and there was no significant difference. This is surprising considering that sexual division of labor has been seen in both agricultural\(^1\) and pastoral\(^6\) samples, and these behavioral differences have been linked to different rates of oral pathology. Physiological aspects could also result in females having worse dental health than males\(^3\). However, this trend is not significantly seen in these samples. This could be the result of having more old adults, males than females (48 M vs 35 F) or the various cultural factors that influence diet in these samples.

3. The Effect of Age: As individuals aged, their dental health decreased significantly in the forms of AMTL and abscesses but not carious lesions. This correlates with known information about how untreated carious lesions can lead to AMTL and abscesses.

Suggestions for future work: Increase sample sizes to be proportional in age and sex categories; examine location of carious lesions; include periodontal disease and root exposure; add other reference samples.

References


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