



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 humans has been widely investigated¹. Based on these studies, it has been shown that different modes of subsistence result in different effects on the skeletal remains². 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, increased¹. It has also been noted that females experienced greater frequencies of oral pathology than males, and this has been attributed to behavioral differences¹ and physiological aspects³. 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 AMTL⁴. 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 13th-14th c and Xiongnu Period 3rd c. BC–AD 2nd c.



Figure 1: Map showing the agricultural and agropastoral sites in China.



Figure 2: Map showing the various pastoral sites from Mongolia.

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,⁵ AMTL is defined as alveolar bone resorption after the loss of a tooth,⁵ and abscesses are defined as the presence of cloacae and inflammatory bone reaction⁵. 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

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

The Effect of Diet

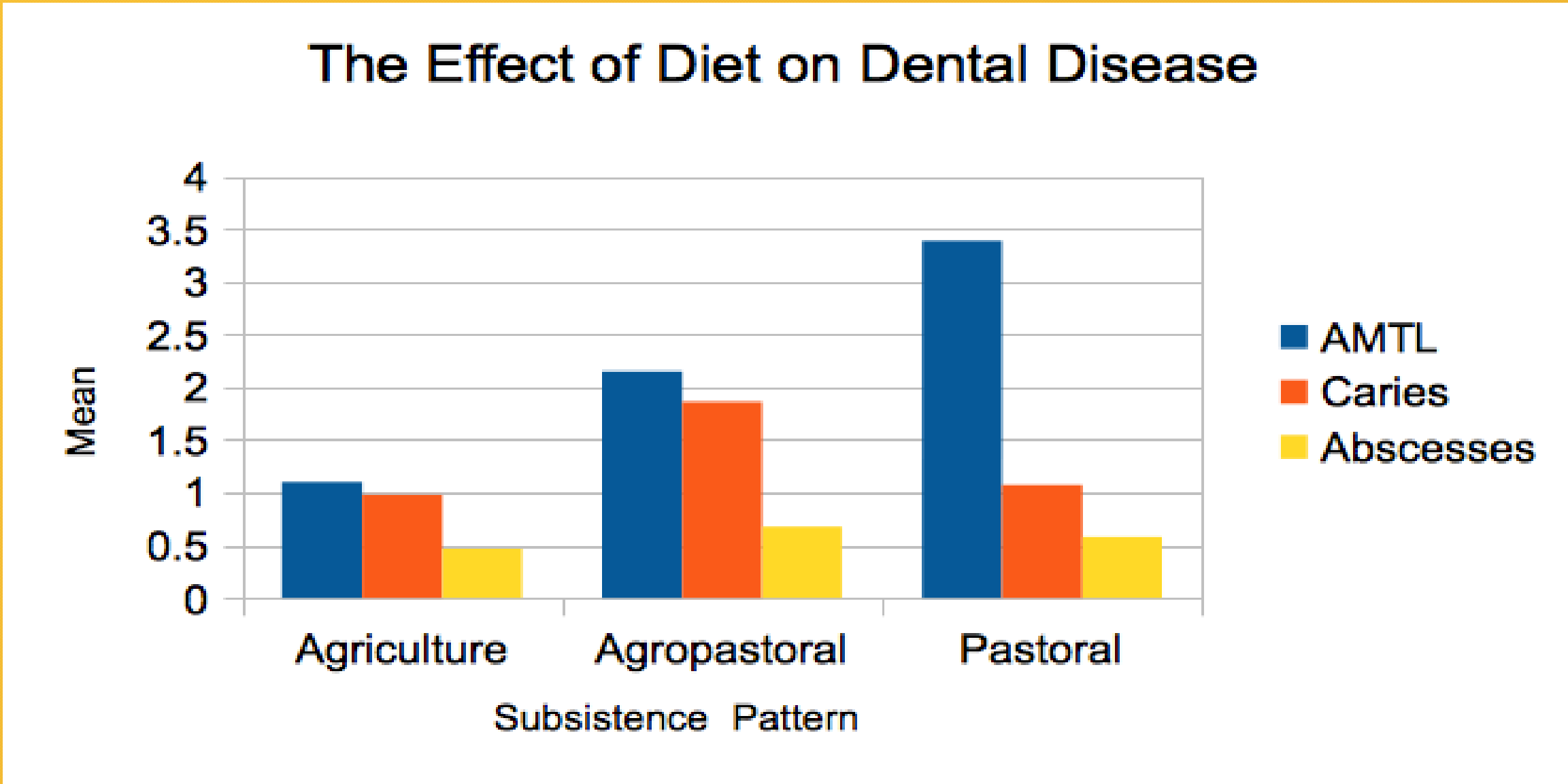


Figure 3: Mean rates of dental disease (AMTL, carious lesions, and abscesses) among three different modes of subsistence from Ancient Mongolia and China.



Figure 4: Sample with carious lesion from the mature adult individual M14 (BLII) from the Lamadong site (agropastoral sample).

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=0.000) 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 3). While all samples suffered from oral disease, the agropastoral sample had the worse overall dental health.

The Effect of Sex

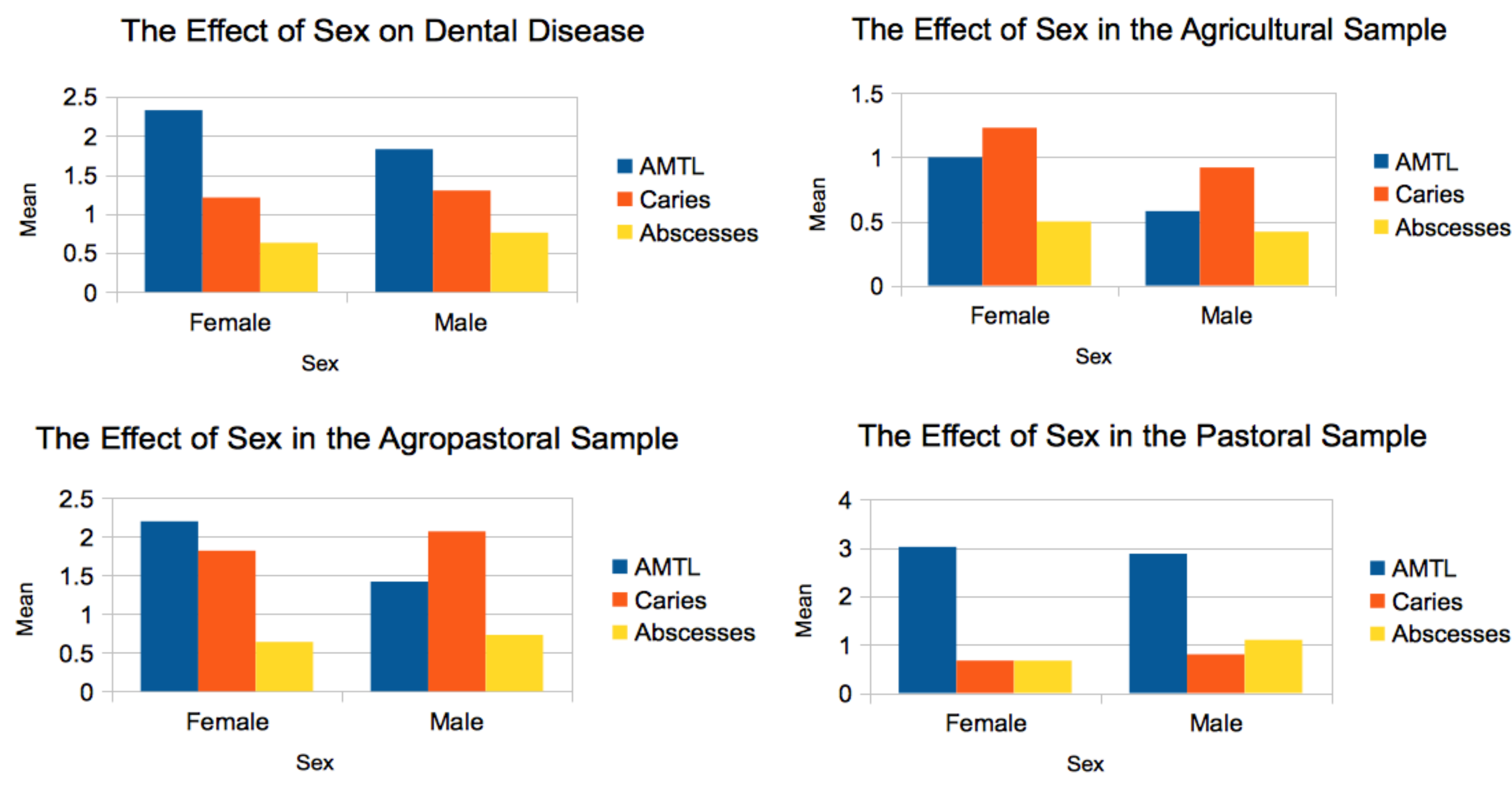


Figure 5: Mean rates of dental disease between the sexes among the different modes of subsistence and overall.



Figure 6: Sample with AMTL from the mature adult M213 (BLII) from the Lamadong site (agropastoral sample).

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 females and males 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

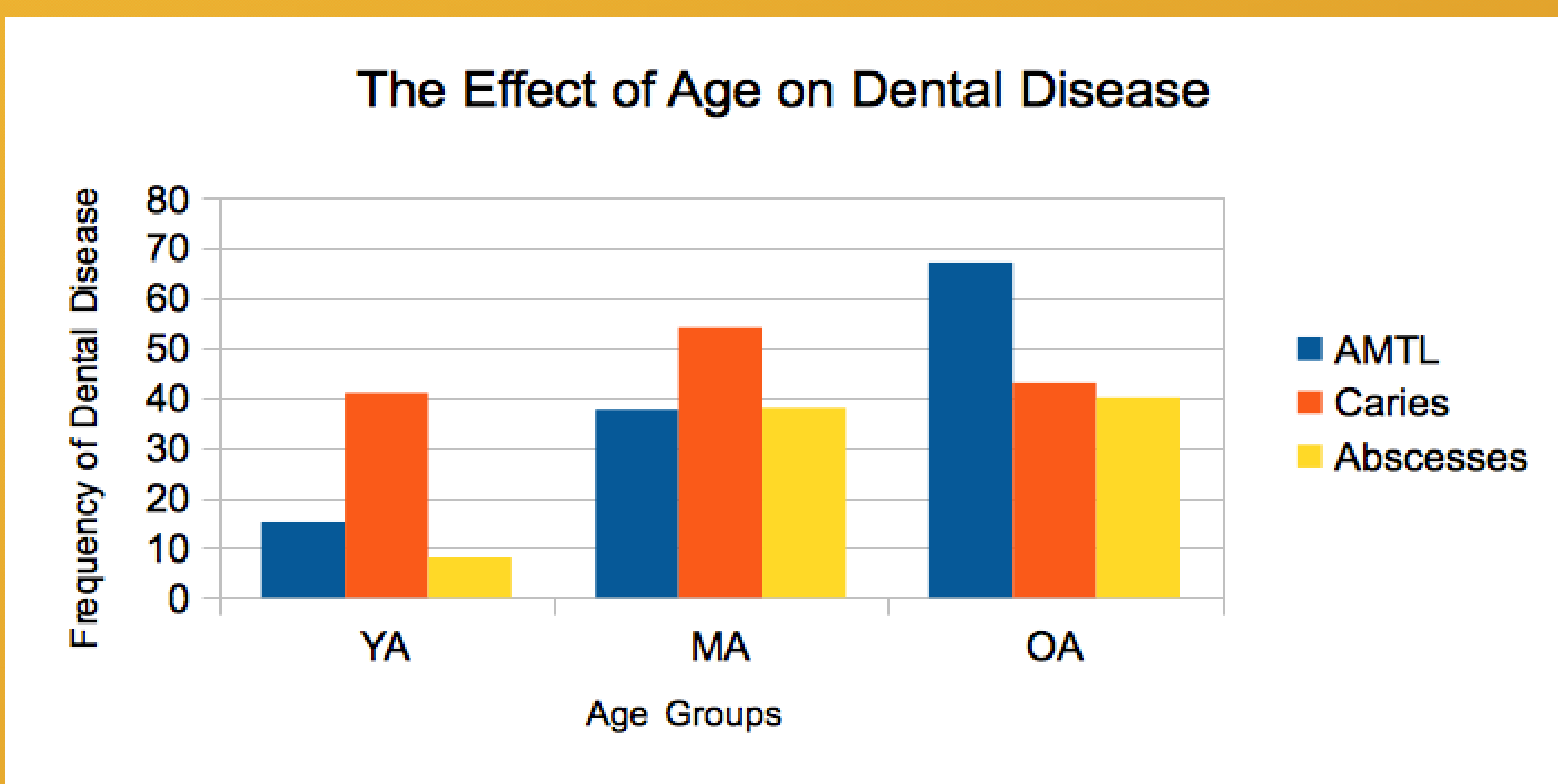


Figure 7: The combined frequencies of dental disease based on age among the three modes of subsistence.

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 8).



Figure 8: Sample with an abscess lesion from the mature adult individual M58 (BLII) from the Lamadong site (agropastoral sample).

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 agricultural¹ and pastoral^{6,7} 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 males³. However, this trend is not significantly seen in these samples. This could be the result of having more old adult 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.

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Acknowledgements

The first author thanks her co-authors for access to their data. We also thank: the Research Center for Frontier Archaeology at Jilin University, Henan Provincial Institute of Cultural Relics and Archaeology and the Department of Archaeology and Anthropology at the National University of Mongolia for access to their osteological collections and reports of the sites; Andrew Baker for assistance in sorting the remains in Mongolia; and Jason Glatz for the maps. Funding was provided by the ISBER at US Santa Barbara to Dr. Philip Walker for the research visit to Henan with Dr. Eng and an AAPA Professional Developmental Grant and Faculty Research and Creative Activities Award to Dr. Eng.