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Tooth loss and its association with dietary intake and diet quality in American adults

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ABSTRACT

Objectives: To investigate associations between the number of natural teeth and energy intake, nutrient intake, and diet quality in adults.
Methods: Eligible adults who participated in the National Health and Nutrition Examination Survey during 2005–2008 were included in the present study ($n = 9140$). Participants were classified into three groups depending on the total number of natural teeth (excluding third molars): full dentition (28 teeth), moderate dentition (21–27 teeth), and poor dentition (20 teeth or less). Dietary intake and diet quality were estimated from the first 24-h dietary recall data.
Results: Participants in the poor dentition group had significantly lower energy intake than those with moderate dentition ($P < 0.05$), however, both groups did not significantly differ from those who had full dentition. Adjusting for sociodemographic characteristics, physical activity, smoking status, and energy intake, the intake of protein as well as most vitamins and minerals were positively associated with the total number of natural teeth ($P < 0.05$); an inverse association was observed for carbohydrate intake ($P < 0.001$). Diet quality, as measured by the Healthy Eating Index 2005, was inversely associated with tooth loss ($P < 0.001$).
Conclusions: Tooth loss in adults is associated with lower diet quality and reduced intake of most nutrients; this may partly explain for the higher risk of chronic diseases in this population.
Clinical significance: People with missing teeth are recommended to monitor their dietary intake to avoid nutrient deficiency and to improve their diet quality for better health.

1. Introduction

Tooth loss in adults is a common condition resulting from ageing, poor oral care, or injury. Recent data reported that American adults aged 20–64 years have an average of 25 teeth; for adults over 65 years old, the number is 19.[1] Several studies have shown that tooth loss in adults is associated with an increased risk of chronic diseases such as obesity,[2–7] cardiovascular diseases,[8,9] diabetes,[9–13] and certain types of cancer.[14,15] Similar results have been reported by studies that examined the associations exclusively in older adults.[16–23]

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The relationship between tooth loss and chronic diseases may partly be explained by changes in dietary intake, as a balanced diet contributes to reduced risk of chronic diseases.[24] For people with missing teeth, their chewing ability is reduced as the number of natural teeth decreases.[25,26] As a result, there may be changes in their dietary choices such as a reduction in the intake of harder foods including certain fruits and vegetables, leading to reduced intake of certain nutrients.[26–43]

Among studies that have evaluated the impact of tooth loss on dietary intake,[26–43] the majority have only focused on older adults.[26–37] This is likely due to the fact that older adults are at a higher risk of tooth loss than young adults;[44] nonetheless, studies that included young and middle-aged adults are needed to support many studies that have shown significant associations between tooth loss and chronic diseases in the general adult population.[2–15] A limited number of studies did include young or middle-aged adults in their study sample; however, they were usually conducted in a defined population such as veterans,[38] dentists,[39] health professionals[40] or nurses.[41] Two studies have sampled participants from the general population; nevertheless, the investigation was limited to intake of certain foods such as carrots, tossed salads, and dietary fibre,[42,43] rather than a comprehensive examination of dietary and nutrient intake. In addition, none of these studies examined diet quality in relation to tooth loss.[38–43] Therefore, studies to investigate associations between tooth loss and overall dietary intake and diet quality in the general adult population are needed to fill these gaps.

Using data from the National Health and Nutrition Examination Survey (NHANES), the present study evaluated the associations between the total number of natural teeth and diet in a nationally representative adult population. Energy intake, nutrient intake, and diet quality were examined. It was hypothesized that tooth loss in adults was associated with lower diet quality and reduced energy and nutrient intake.

2. Materials and methods

2.1. Data source and study population

The NHANES was conducted by the National Centre for Health Statistics and involved interview, physical examination, 24-h dietary recalls, and laboratory tests of sampled participants.[45] The NHANES dietary interview component was What We Eat in America, to assess the types and amount of foods and beverages consumed during the 24-h period reported by participants.[45] In 2005–2008, the NHANES oral health examination included a tooth count for participants who were at least 5 years old by trained health technologists. The methodology, quality controls, and de-identified data sets of the NHANES are publicly available.[45] The NHANES were conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures were approved by National Centre for Health Statistics Research Ethics Review Board. Written informed consent was obtained from all participants.

The present study combined data from the NHANES 2005–2006 and the NHANES 2007–2008. Adults aged 19 years or older, who completed the oral health examination were initially included (n = 9869). Among them, 14 participants had at least one tooth not assessed, 433 were pregnant or lactating women, 291 had an unreliable dietary recall as determined by NHANES staff. Participants who were in at least one of the above categories were excluded (n = 729), giving a final sample size of 9140 participants in the present study.

2.2. Exposure and outcome variables

For each tooth assessed, a status was recorded in the NHANES oral health examination dataset (primary tooth present, permanent tooth present, tooth not present, or permanent dental root fragment present). Based on this information, a binary variable was created in the present study for each tooth to indicate if the natural tooth was present, with a value of ''1'' if primary or permanent tooth present, and ''0'' if tooth not present or permanent dental root fragment present. The total number of natural teeth, excluding third molars, was then calculated. Participants were then categorized into three groups: full dentition (28 teeth), moderate dentition (21–27 teeth), and poor dentition (20 teeth or less). Participants with 20 teeth or less were considered as having poor dentition because people with at least 21 teeth are able to chew most foods without difficulty.[46] The same number was used in previous dental studies.[29,30,43]

Data from the first 24-h dietary recall was used to estimate energy intake, nutrient intake and diet quality. The NHANES processed 24-h dietary recall data using the United States Department of Agriculture's Food and Nutrient Database for Dietary Studies, to calculate energy and nutrients from each reported food item. Diet quality was measured using the Healthy Eating Index 2005 (HEI-2005).[47,48] The HEI-2005 contains 12 food groups that can be used to evaluate the overall diet quality; it has 9 adequacy components and 3 moderation components; reported food items under each component were standardized to percent of 4189 kJ (1000 kcal), then compared to Dietary Guidelines for Americans 2005; a higher score indicates better compliance with dietary guidelines, i.e., higher intake of foods from the adequacy components and lower intake of foods from moderation components.[47,48] The HEI-2005 total and component scores were calculated using SAS programmes developed by the Centre for Nutrition Policy and Promotion at the United States Department of Agriculture.[49]

2.3. Covariates

The covariates included in the analysis were age, gender, race/ethnicity, ratio of family income to poverty, physical activity, smoking status, and energy intake.[30,50–52] For race/ethnicity, participants were recoded to one of the four groups: hispanic, non-hispanic white, non-hispanic black, and other.[53] For ratio of family income to poverty, it was recoded to a three-level categorical variable.[54] Because previous studies found physical activity[55] and smoking[56–58] were associated with tooth loss, they were included as covariates in the present study. Physical activity was coded using responses from questions ''does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate'' and ''do you do any