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Review article

Does tooth loss affect dietary intake and nutritional status? A systematic review of longitudinal studies

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ABSTRACT

Introduction/objective: A systematic review was conducted to explore whether tooth loss affects dietary intake and nutritional status among adults.

Data: Longitudinal studies of population-based or clinical samples of adults exploring the effect of tooth loss on food/dietary/nutrient intake and/or nutritional status were included for consideration. The risk of bias was assessed using the Newcastle-Ottawa Scale for cohort studies.

Sources: A search strategy was designed to find published studies on MEDLINE, EMBASE and LILACS up to March 2017.

Study selection: Eight longitudinal studies in 4 countries (United States, Japan, Australia and Brazil) were included. Five of the six studies investigating the association between tooth loss and dietary intake showed significant results. The only consistent association, as reported in 2 studies, was for greater (self-reported) tooth loss and smaller reductions in dietary cholesterol. Three of the 4 studies investigating the association between tooth loss and nutritional status showed significant results. However, most results were contradicting. The quality of the evidence was weak.

Conclusion: There is at present no strong evidence on the effect of tooth loss on diet and nutrition, with inconsistent results among the few studies identified. Additional high-quality longitudinal studies should address the limitations of previous studies identified in this review.

1. Introduction

Diet is an important component of leading a healthy life as it has a role in the aetiology, and thus prevention, of many chronic conditions such as obesity, cardiovascular disease, diabetes and cancer among other chronic conditions [1,2]. Tooth loss and nutritional intake are intricately connected [3]. The oral cavity is not only the entryway for nutrient intake but the primary function of teeth is mastication [4]. Tooth loss reduces masticatory function and chewing ability, which in turn can limit food choices and variety in the diet [5–7]. For these reasons, dietary intake has been regarded as an intermediate in the pathway between tooth retention and a number of diet-related chronic diseases [8–10].

Given these claims, it is not surprising to find a few reviews on the interrelationship between tooth loss, diet and nutritional status [11–14]. However, they are not without limitations. Earlier reviews did not follow a systematic procedure for the identification and synthesis of studies [11–14]. Later reviews have been more systematic in their approach to review the available literature but have had a limited scope looking at older adults [11], free-living older adults [12,14] or papers published very recently [14]; missed some important longitudinal studies [12]; included evidence from cross-sectional studies [11–14]; or did not assess the quality of the included studies [11]. The latter point is important since confounding by participants' socioeconomic status and health status needs to be addressed in observational studies [11–14]. Without addressing these limitations, robust conclusions on the association between tooth loss and nutrition cannot be reached. The aim of this study was to systematically review longitudinal evidence on whether tooth loss affects dietary intake and nutritional status among adults. Although a poor diet, especially one low in calcium [15] and fibre [16], may be a risk factor for tooth loss, we are interested in how tooth loss may influence dietary intake, and subsequently, nutritional status, given the increasing interest in tooth loss as a risk factor for various chronic diseases and mortality.

Abbreviations: ADL, activities of daily living; BMI, body mass index; DVS, dietary variety score; FFQ, food frequency questionnaire; FTU, functional tooth unit(s); MNA, mini nutritional assessment; NOS, Newcastle-Ottawa Quality Assessment Scale; REE, resting energy expenditure; USA, United States of America; WC, waist circumference

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2. Methods

This systematic review followed the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) recommendations [17,18]. The review protocol was registered in PROSPERO (Registration number CRD42017065361).

2.1. Criteria for considering studies for this review

Broad criteria were predefined to select articles for inclusion, following the PICO format. Only longitudinal/panel studies were included as they provide the strongest observational evidence. Case-control, cross-sectional, case report/series and expert opinions were excluded. Participants were adults aged 18 years or above, irrespective of recruitment setting (community-dwelling, nursing/care homes, hospitals) and health status (generally healthy or with one or more morbidities). The exposure was tooth loss measured at least once during the duration of the study (baseline assessment) through self-reports or clinical examination. The outcome measures were dietary/food/nutrient intake (measured as total energy intake or specific nutrient intake from questionnaires, recalls, blood samples, etc.) and nutritional status (measured as weight loss, body mass index, anthropometric measurements, etc.).

2.2. Study selection and data extraction

Three electronic databases (MEDLINE via PubMed, EMBASE via Ovid and LILACS via BIREME) were searched for published literature up to March 2017 using a combination of Medical Subject Headings (MeSH) terms and text words around three main topics: the exposure (tooth loss) and the outcomes (nutrient intake or nutritional status). These were combined with methodological filters for longitudinal studies specific for each database. Search terms were chosen based on the team expertise and previous related reviews. No language restrictions were applied. Search strategies are shown in Supplemental file 1.

All references retrieved were managed in bibliographic software EndNote X7 (Clarivate Analytics, New York, United States). Duplicated articles were excluded at this stage. Two reviewers (PG and EB) independently and in duplicate screened the titles and abstracts of all identified publications against the eligibility criteria for inclusion. The full-text of publications were sought if at least one of the reviewers considered the study as potentially meeting the inclusion criteria. The final decision about whether a study met the inclusion criteria was made based on the full-text and after discussion between reviewers. The grey literature was searched by looking for relevant material in OpenGrey repository, Google Scholar and searching the internet using the pre-set text words as well as searching all relevant reference lists of identified articles and related reviews.

A master file was created in excel listing all studies retrieved and including their title, authors, journal, publication year and reason for exclusion (Supplemental file 2). For eligible studies, the two reviewers additionally extracted information on study design, participants' characteristics (sample size, age range and country), length of follow-up, attrition rate, exposure variables, outcome measurements, covariates/confounders, data analysis and main findings. Disagreements were resolved through discussion.

2.3. Risk of bias assessment

Included studies were assessed for risk of bias using the Newcastle-Ottawa Quality Assessment Scale (NOS) [19]. The NOS evaluates three domains: selection (4 items), comparability (1 item) and outcome (3 items). A study could be given one star for each item under selection and outcome and two stars under comparability. For selection, a star was given when the exposed cohort was truly or somewhat representative of exposed adults in the community, when the non-exposed cohort was drawn from the same community as the exposed cohort, when the exposure (tooth loss) was ascertained through clinical examinations, and when the outcome of interest was measured both at baseline and follow-up. For comparability, a star was given when the study controlled for socio-demographic characteristics (sex, age and any socioeconomic position indicator) during the design or analysis, and it was given two stars when it additionally controlled for participants' health status (chronic conditions, comorbidities, activities of daily living and the like). For outcome, one star was given when the assessment of outcome was independent/blinded or through record linkage, when the follow-up period was long enough for changes in outcomes to occur, and when all participants were accounted for during follow-up or those lost to follow-up were unlikely to introduce bias (< 20% attrition rate and description provided of those lost). A good quality scored required 3–4 stars in selection domain AND 1–2 stars in comparability domain AND 2–3 stars in outcome domain; a fair quality study required 2 stars in selection domain AND 1–2 stars in comparability domain AND 2–3 stars in outcome domain; and a poor quality study 0–1 stars in selection domain OR 0 stars in comparability domain OR 0–1 stars in outcome domain [19].

2.4. Data synthesis

A meta-analysis of the findings (i.e. forest and funnel plots) was not feasible given the high level of heterogeneity found across studies. Instead, we opted for a narrative synthesis of the results [20]. To that end, we created tables summarising the key methodological characteristics of all included studies and the methodological quality assessment of the studies based on NOS.

3. Results

A flow chart of the screening and selection of studies is shown in Fig. 1. Of the 2232 unique citations retrieved, 2133 articles were excluded after screening titles and abstracts as clearly irrelevant. The full text of 99 articles was retrieved to check eligibility and 89 articles were subsequently removed as not meeting the inclusion criteria. The major cause for exclusion was using a cross-sectional design (n = 43). Therefore, a total of 10 reports in 8 cohorts were included in this systematic review.

Table 1 summarises the characteristics of the included studies. Two Japanese studies [21,22] and two Unites States (US) studies [3,23] used data from the same cohorts, the Niigata Study and the Health Professionals' Follow-up Study, respectively. They were considered as different analyses of their respective cohorts. Thus, we summarised findings based on 8 original studies; 4 in the US, 2 in Japan, 1 in Australia

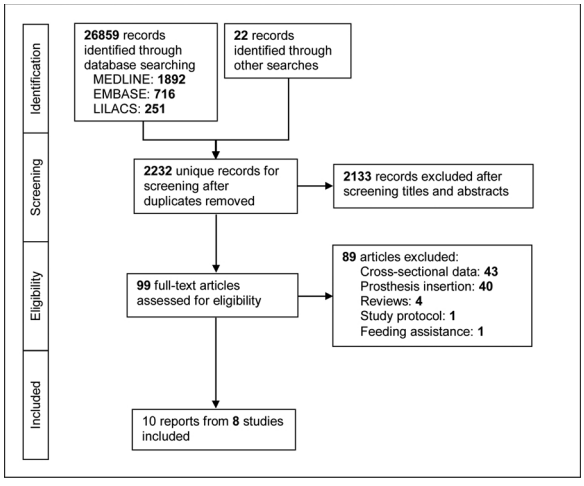

Fig. 1. Flowchart of the selection of studies for the review.