

Mapping the evidence for monitoring fluoride exposure in community prevention programmes for oral health using nail clippings and spot urine samples: a scoping review

Introduction

Dental caries, a preventable condition, remains an important global public health problem. The use of fluorides for population-based prevention of dental caries has been officially acknowledged by the World Health Organisation (WHO) since the late 1960s (Petersen and Ogawa, 2016). The goals of community-based public health programmes are generally to provide regular, low-level exposure to fluoride in the community through appropriate means such as fluoridated water, salt, milk and fluoride toothpaste.

Considering the narrow ‘dose-gap’ between the benefit of caries reduction and the risk of dental fluorosis, public health authorities should monitor total fluoride exposure of the population before and after introducing any fluoridation or supplementation programme for prevention of dental caries.

Direct assessment of total fluoride exposure in a population can be difficult and expensive. Identification of practical and accurate biomarkers for fluoride exposure has therefore gained considerable attention over the past several decades.

Daily urinary fluoride excretion has been suggested as a suitable biomarker for predicting fluoride intake for groups of people. In its recent publication, WHO has endorsed the use of daily (24h) urinary fluoride excretion for monitoring fluoride exposure in community prevention programmes for oral health. Due to practical difficulties in collecting 24h urine samples from children, spot urine samples and nail clippings have been used (Rugg-Gunn et al., 2011; Pessan and Buzalaf, 2011) as simpler alternatives. However, a clearer perspective is needed to better understand the association between fluoride intake and either biomarker (spot urine and nail clippings) and map situations including populations, settings and methods used in which they are strongly associated with intake.

Aim and objective

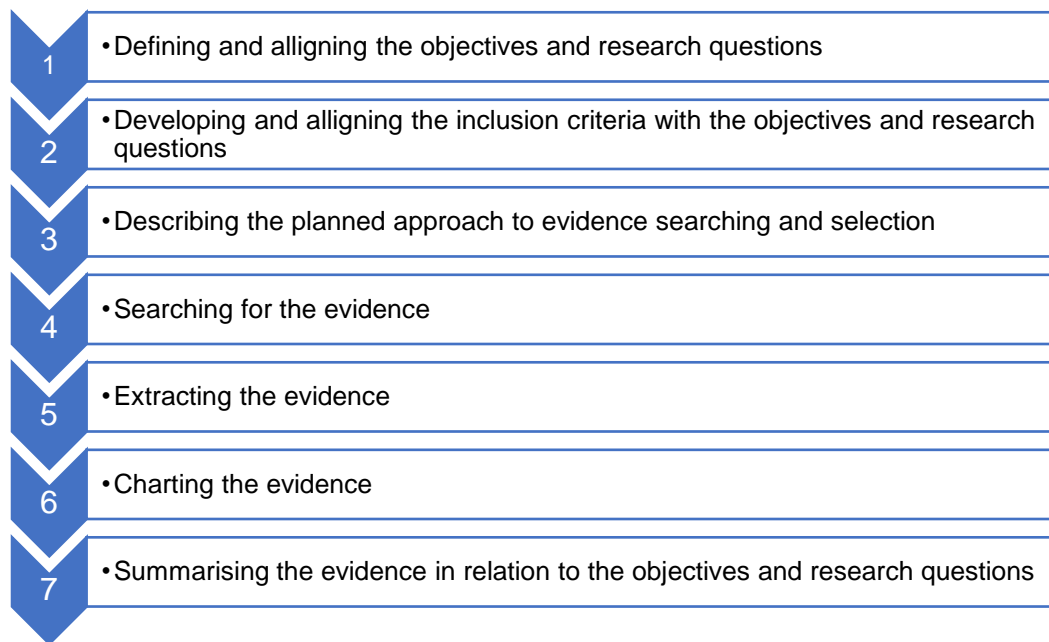
The aim of this scoping review is to map the current literature/evidence on the use of spot urine samples and nail clippings for monitoring fluoride exposure at a community level. The specific objective of this review is to identify the nature and extent of the available evidence on how these two biomarkers are used to measure fluoride intake according to the study population, setting, type of study design, methodology and analytical approach. The evidence will help to clarify the extent of research that is available and identify gaps in knowledge which will guide future research and inform practice.

Research question

What is the available evidence on measuring fluoride exposure and intake by spot urine and nail clippings and how does it vary according to study population, setting, type of study design, methodology and analytical approach?

Methods

This scoping review will be conducted and reported in accordance with the Joanna Briggs Institute Reviewers Manual (Aromataris and Munn, 2017). This will include the following stages:



Inclusion criteria

Types of participants

This scoping review will consider studies that assessed the use of spot urine and/or nail clippings to monitor fluoride intake/exposure among human participants. Human participants may include children and/or adults of any age, gender, or ethnicity.

Concept

This review will consider studies that have examined fluoride intake/exposure through the use of nail clippings and/or spot urine biomarkers, in terms of study population, setting, type of study design,

methodology, and analytical approach. Specifically, the following studies will be considered for inclusion: a) studies that have performed independent assessment of any of the aforementioned biomarkers, b) studies that have compared any of the biomarkers with a different type of biomarker, or c) studies that have compared the biomarkers with each other.

Context

Studies from any geographical location aimed at assessing fluoride intake/exposure using nail clippings and/or spot urine will be considered for inclusion. Studies may be carried out at any setting including nurseries, schools, preschools, kindergartens, childcare centres, hospitals, or community settings. Eligible studies with full-texts in a language different from the English language will only be included subject to availability of translators. No date restrictions will be applied to the search.

Study types

This review will include all original primary research (quantitative and qualitative) studies, including, but not limited to randomised controlled studies, quasi-experimental studies, surveys, retrospective and prospective cohort studies, case studies, phenomenological studies, and expert opinions.

Exclusion criteria

The following exclusion criteria will be applied to the title and abstract as well as the full-text review stage.

- Irrelevant problem/focus: studies that do not examine fluoride intake/exposure.
- Irrelevant biomarker: studies that have measured exposure to fluorides through biomarkers other than nail clippings and/or spot urine.
- Irrelevant participants: studies that have examined fluoride exposure using biomarkers from animal species.
- Irrelevant type of study: review reports, expert opinions and statements on fluoride exposure will be excluded.
- Irrelevant data output: studies that do not report on the methodologies used for monitoring fluoride exposure, such as the population, setting, type of study design, method, and analytical approach.
- Language: studies reported in a language other than English will be excluded if there are no available translators.

Search strategy

The search strategy will aim to find both published and unpublished studies. Search terms will include a combination of key concepts in the research question. This will include fluoride exposure, fluoride intake, fluoride biomarkers, spot urine, and nail clippings. The Boolean operators, ‘AND’, and ‘OR’ will be used as follows:

(fluoride intake OR fluoride ingestion OR fluoride dose OR fluoride exposure OR fluoride content OR fluorida* OR fluoride biomarker*) **OR** (groundwater OR consumption OR dose* OR intake OR ingest* OR expos* OR fluorid* content OR fluoridat* OR water OR drinking water OR exp mineral water* OR exp water supply) **OR** (diet* OR supplement* OR dentifrice* OR tablet OR salt OR milk OR dental product* OR fluoride varnish* OR mouth rinse* OR infant milk formula OR food* OR beverage OR fluorid* water* OR drink*) **AND** (spot urin* fluoride concentration* OR spot urin* fluoride excretion OR spot urin* fluoride level* OR spot urin* fluoride retention OR renal fluoride excretion OR spot urin* fluoride OR spot urin* fluoride monitor* OR spot urin* fluoride content OR fluoride balance*) **OR** (nail* OR nail clipping*) **AND** (human* populati* OR adult* OR child* OR wom#n OR female OR adult wom#n OR m#n OR male* OR infant* OR newborn oR neonate OR bab* OR toddler* OR preschooler* OR early childhood)

The table below presents a list of the databases, grey literature, and search engines that will be searched. In addition, the reference lists of all included papers will be searched for additional studies.

Databases	Grey literature	Search engines
MEDLINE	OpenGrey	Google
CINAHL	NICE Evidence Search	Google Scholar
Web of science	The Grey Literature Report	
Scopus	Bielefeld Academic Search Engine (BASE)	
ScienceDirect		

<p>Sage Journals Online</p> <p>Campbell Collaboration</p> <p>Cochrane collaboration</p> <p>Embase</p>	<p>Australian Bureau of Statistics (ABS)</p> <p><i>Note:</i> to include the list of countries and websites that will be provided by the Borrow foundation.</p>	
<p>For the database searches, a master search strategy will be developed for one of the databases (e.g. MEDLINE). This will then be modified for the other databases.</p>		

Management of references

Firstly, the full set of search results will be imported directly into an Endnote Library. Where this is not possible, search results will be entered manually into the Endnote Library. An Endnote library will make it easier to identify duplicates and to manage references. The search results will then be exported from Endnote into Covidence (a web-based software platform that streamlines the production of systematic/scoping reviews) for screening of the search results.

Selection of studies

A two-stage screening process will be used to evaluate search results for relevant studies. The first level of screening will be done by two independent reviewers and will involve screening of only titles and abstracts. Subsequently, the full texts of potentially relevant studies will be examined independently by two reviewers. Discrepancies amongst reviewers will be resolved through discussions. If disagreements persist, a third reviewer will be consulted.

Data charting

A standardised data extraction tool will be developed to aid in extracting relevant information from included studies. The data extraction tool will be designed to collect the following information: author(s), year, title, aim of study, study design, country, setting, number of participants, age, gender, exposure/intake data, methods of data collection, analytical procedures, and outcome(s).

The developed data extraction tool will be tested using 10% of the included articles, prior to commencing the actual data extraction. Data extraction will be undertaken by one reviewer and verified by another.

Data synthesis

The extracted data will be recorded into Excel before importing them to SPSS for descriptive data analysis. Studies will be reported according to their characteristics, including year of publication, country, setting, population, and study design.

The synthesis of outcome measures will include main source of fluoride exposure (e.g. water, salt, etc), fluoride intake, fluoride concentration of urine, and/or nail clippings, analytical methods for assessment of fluoride concentrations, validity of data collection, analytical methods, and relationship between intake and fluoride concentration of spot urine and/or nail clippings.

Data will be described in summary tables alongside a more in-depth narrative synthesis.

References

Aromataris, E., Munn, Z. (Eds.) (2017). Joanna Briggs Institute reviewer's manual. Retrieved from <https://reviewersmanual.joannabriggs.org/>

Petersen P.E., Ogawa H. (2016) Prevention of dental caries through the use of fluoride—the WHO approach. *Community Dent Health*, 33(2), pp. 66–8.

Rugg-Gunn, A.J., Villa, A.E., Buzalaf, M.R.A. (2011) 'Contemporary biological markers of exposure to fluoride', *Monogr Oral Sci*, 22, pp. 37-51.

Pessan, J.P., Buzalaf, M.R.A. (2011) 'Historical and recent biological markers of exposure to fluoride', *Monogr Oral Sci*, 22, pp. 52-65.