


# Oral health and dental care of older persons—A systematic map of systematic reviews

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**Objectives:** To examine the current knowledge on oral health status and dental care of older persons through a systematic mapping of systematic reviews of low or moderate risk of bias.

**Background:** Geriatric dentistry covers all aspects of oral health and oral care of older persons. Oral health is part of general health and contributes to a person's physical, psychological and social wellbeing.

**Methods:** A literature search was performed in three different databases (PubMed, The Cochrane Library and Cinahl) within 12 domains: Dental caries, periodontitis, Orofacial pain and temporomandibular joint (TMJ) pain, mucosal lesions, oral motor function, dry mouth, halitosis, interaction between oral status and other medical conditions, ability to interrelate and communicate, quality of life, ethics and organisation of dental care for older persons. Systematic reviews were identified and scrutinised, highlighting scientific knowledge and knowledge gaps.

**Results:** We included 32 systematic reviews of which 14 were judged to be of low/moderate risk of bias. Most of the domains lack systematic reviews with low or moderate risk of bias. In two of the domains evidence was identified; in institutionalised

people aged 65 or older, effective oral hygiene can prevent pneumonia. Furthermore, there is an evidence of a relationship between malnutrition (protein energy-related malnutrition, PEM) and poor appetite and edentulousness.

**Conclusions:** There is an urgent need for further research and evidence-based knowledge within most domains in geriatric dentistry and in other fields related to oral health and dental care for older persons striving for multi-disciplinary research programmes.

#### KEYWORDS

geriatric dentistry, knowledge gaps, older persons, oral health, person-centred care, systematic reviews gerodontology

## 1 | INTRODUCTION

Geriatric dentistry covers all aspects of oral health and oral care of older persons. Oral health is part of general health and contributes to a person's physical, psychological and social wellbeing. It is based on adequate oral function and absence of disease.<sup>1</sup>

Demographic changes have resulted in an increasing number of older people in the population. The population forecast by Statistics Sweden shows a marked increase in the proportion of older persons in the population. From 2015 to 2030, it is predicted that the proportion of the population aged 75 years or older will increase by more than 50%. Epidemiological data show that many older persons retain their natural dentitions, with a high number of remaining teeth.<sup>2</sup> Moreover, advanced prosthodontic reconstructions, such as osseointegrated implants, have become more common and removable appliances are decreasing.<sup>3</sup>

Having natural teeth or fixed reconstructions in old age implies improved health and increased quality of life, but it also entails an increased risk of oral diseases, thus the need for high-quality oral care increases. This includes a high level of daily oral hygiene, regardless of whether this is undertaken independently by the older person him/herself, or with assistance.

With increasing age, the risk of diseases and disabilities rises. There is a mutual and complex relationship between oral and general health. Systemic diseases can increase the risk of oral disease and vice versa. While it is generally acknowledged that compromised ability to chew and swallow has a negative effect on nutritional status and contributes to impaired quality of life, cognitive impairment and frailty, more research is warranted to demonstrate correlations and causes.<sup>4</sup> Further complications may be due to the high use of drugs causing xerostomia. Older adults are high users of medications. It is estimated that 40% of community-dwelling and 75% of institutionalised older adults take 5 or more medications, with approximately 10% of older adults taking 10 or more.<sup>5</sup>

Both national authorities and dental care providers have acknowledged the challenge and complexity of ensuring good oral health for the older population. There is a need for more knowledge about the oral health of older persons, not only among dental

care providers but also among other healthcare professionals. In later life, many people require assistance with activities of daily living and mouth care will be provided by nursing professionals.<sup>6</sup> However, oral health and mouth care are not always included in undergraduate training programmes for healthcare professionals or nursing assistants and healthcare aides.<sup>4,7</sup> Moreover, with increasing age and debility, a considerable number of older people lose contact with their dental service providers; thus, there is also a need to organise geriatric dentistry and clarify its place in the chain of care.<sup>8</sup>

The present study, in the form of a systematic evaluation of systematic literature reviews on the subject, was undertaken in order to examine and describe the extent, range and nature of research activities. Furthermore, we also aimed to determine the value of undertaking full systematic reviews on domains of importance for oral health and dental care for older persons and to identify gaps in the existing body of literature.

## 2 | MATERIAL AND METHODS

To identify domains of importance for oral health and dental care for older persons, areas were recognised by the authors and discussed until agreement was reached. Thereafter, specialists and stakeholders from the Nordic countries in dental care of frail older persons were asked to evaluate the proposed domains and, if necessary, suggest changes. As a consensus of the process, the following 12 domains were identified as covering the most important issues: dental caries, periodontitis, orofacial pain and temporomandibular joint (TMJ) pain, mucosal lesions, oral motor function (speech, chewing and swallowing capacity, para- and lip function), dry mouth, halitosis, interaction between oral status and other medical conditions, ability to communicate and participate, quality of life, ethics and organisation of dental care for older persons.

The protocol for this mapping was registered (CRD42016038551) in the International Prospective Register of Systematic Reviews (PROSPERO) which is an open database for registering protocols for systematic reviews. The database is administered by the Center

of Reviews and Dissemination, University of York (<http://www.crd.york.ac.uk/prospero/>).

## 2.1 | Inclusion criteria

- Systematic reviews published in peer-reviewed journals addressing questions on any of the selected domains. Intervention, control and outcome parameters in accordance with the question
- Population: Frail older persons, defined as  $\geq 65$  years, dependent on others for activities of daily living, for example; home care service, residential care homes or geriatric care. Participants  $< 65$  years diagnosed with dementia were also included.
- Interventions: Diagnostic testing, prediction, prevention, treatment
- Control: Reference test, control (comparator)
- Outcomes: Accuracy, validity, effect of intervention

## 2.2 | Exclusion criteria

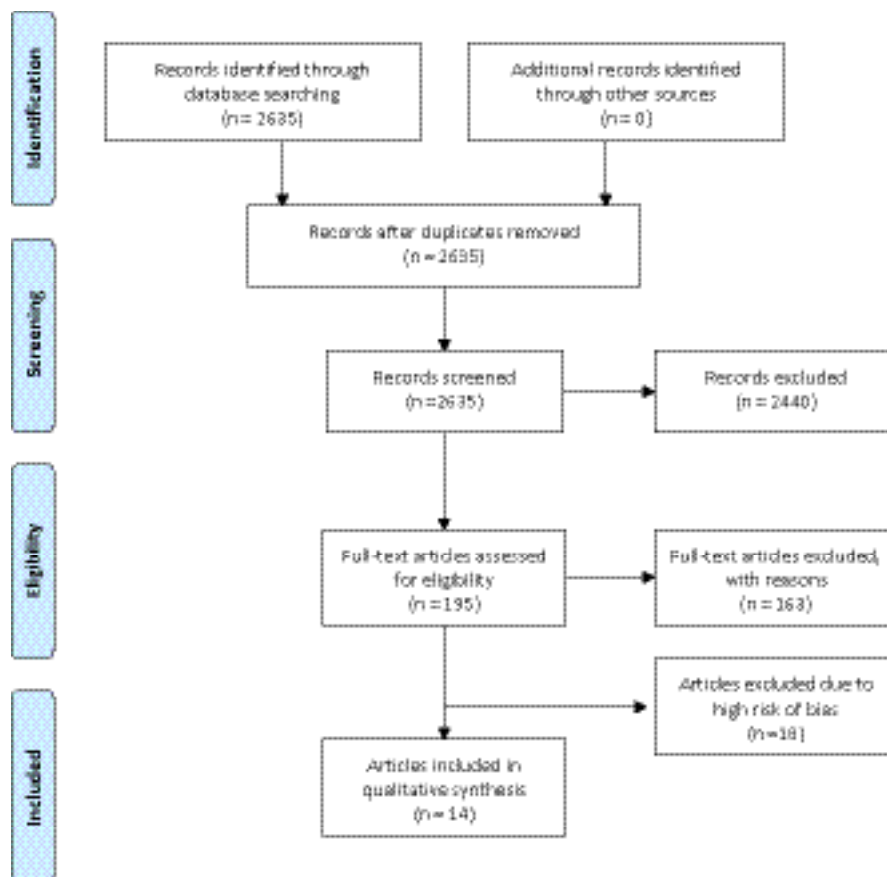
- Prosthetic treatment
- Systematic reviews not written in English or Scandinavian languages
- Grey literature

## 2.3 | Literature search

The latest literature search was conducted in March 2018 and covered three databases: PubMed, The Cochrane Library and Cinahl (Table S1). The number of abstracts retrieved and articles included and excluded at each stage of the search process are presented in a flow chart (Figure 1). Abstracts meeting the inclusion criteria were scrutinised independently by two review authors. If at least one reviewer deemed an abstract to be potentially relevant, it was included and the article was ordered in full text. To assure a rich outcome of the literature search, the strategy was to include prosthetic rehabilitation as search term, although the domain was not included in the analysis. Systematic reviews often cover several clinical strategies; hence, it was considered necessary to scan the prosthetic literature in order to find “hidden” information, relevant for the scope of this systematic map.

## 2.4 | Data extraction and quality assessment

Data extraction and assessment of the relevance and quality of the included reviews were undertaken independently by two review authors. Any differences were solved by consensus; a third review author was consulted if necessary. In the case of reviews in which one of the review authors was involved, the quality was assessed by two independent reviewers. The quality (in terms of risk of bias) of all full text reviews was assessed using AMSTAR (a measurement



**FIGURE 1** Flow diagram of the search strategy: number of abstracts retrieved, and included and excluded articles

tool to assess the methodological quality of systematic reviews).<sup>9</sup> Items 1-3 and 5-8 were selected as being most important. The wording of question 7 was found to be somewhat unclear and was rephrased to "Was the overall scientific quality of each included study assessed and documented?" Thus, a yes-answer required an assessment of the overall risk of bias in each included study. The pre-specified criteria for low, moderate and high risk of bias are presented in Table 1. A conservative approach was used; if a feature was not reported, it was assumed to be absent. If the answer to a particular question was unclear, it was discussed and consensus was reached as to whether the review should be classified as at moderate or high risk of bias. As a rule, the quality of individual studies in the reviews was not checked. An exception was made when there was inconsistency or uncertainty about the results or conclusions of a review. In these cases, spot checks of individual articles were made. If more than one systematic review on the same subject was found, only the one with the best quality and the most recent date was included.<sup>10</sup>

### 2.5 | Handling of data

Reviews assessed as having a low or moderate risk of bias were used to summarise results and formulate existing knowledge and knowledge gaps for each domain. In accordance with the working process described by Whitlock,<sup>10</sup> no synthesis was made of any effect size of different interventions. To achieve a uniform summary appraisal of the quality of evidence of the effects investigated, the various

expressions used in the separate systematic reviews were transformed to the terms used by the GRADE system.<sup>11</sup>

## 3 | RESULTS

The literature search identified 2635 abstracts. We included 32 reviews of which 14 were judged to low/moderate risk of bias. The number of reviews with low/moderate and high risk of bias according to the 12 domains is presented in Table 2. The main characteristics of reviews with low/moderate risk of bias are described in Table 3 and the 18 reviews<sup>12-28</sup> with high risk of bias are reported in Table S2. Table S3 presents the 163 excluded reviews and the main reason for exclusion. The existing evidence-based knowledge for interventions related to oral health and dental care of older persons is listed in Table 4 and in Table 5 the knowledge gaps identified in the report are listed according to the 12 domains. The main results are presented below for each domain.

### 3.1 | Domains—\*Dental caries, \*Periodontitis,\* Orofacial pain and Temporomandibular Joint (TMJ) pain, \*Mucosal lesions, \*Oral motor function, \*Dry mouth and \*Halitosis

For all of these seven domains, the search strategy was performed considering the following perspectives: Diagnostics, Prevention, Risk assessment and Non-operative and operative treatment. Within the

**TABLE 1** Pre-specified criteria for assessing low, moderate and high risk of bias

Risk of bias	Criteria <sup>a</sup>
Low	A yes-answer to: Predetermined research question and inclusion criteria established (AMSTAR Question 1) At least two independent data extractors and consensus procedure reported (AMSTAR Question 2) At least the database MEDLINE/PubMed used. Search strategy reported so that it can be repeated (AMSTAR Question 3) A list of included and excluded studies reported <sup>b</sup> (AMSTAR Question 5) Relevant characteristics of included studies reported (AMSTAR Question 6) Assessment of the overall scientific quality of each included study provided (AMSTAR Question 7) The scientific quality of included studies used appropriately in formulating conclusions (AMSTAR Question 8) The rationale for combining/not combining results reported. Methods for pooling results reported (AMSTAR Question 9) Likely publication bias reported. This item can be omitted if publication bias was unlikely but not reported (AMSTAR Question 10) Any conflict of interest reported. This item can be omitted if conflicts of interest were unlikely (AMSTAR Question 11)
Moderate	A yes-answer to AMSTAR Questions 1, 2 and 5-8.
High	A no-answer to any of the question listed under moderate risk of bias.

<sup>a</sup>Modified list of questions based on A measurement tool for the assessment of multiple systematic reviews (AMSTAR).

<sup>b</sup>List of included studies is mandatory; list of excluded studies not necessarily required.

**TABLE 2** Number and distribution of included systematic reviews

Domain	Number of included systematic reviews	Number with low/moderate risk of bias	Number with high risk of bias
Caries risk assessment and caries detection	1		1
Periodontitis	2	0	2
Orofacial pain and temporomandibular joint (TMJ) pain	0		
Mucosal lesions	1	0	1
Oral motor function (speech, chewing and swallowing capacity, para- and lip function)	5	0	5
Dry mouth	0		
Halitosis	0		
Interaction between oral status and other medical conditions	10	3	7
Ability to interrelate and communicate	0		
Quality of life	0		
Ethics	0		
Organisation of dental care for older persons	13	11	2
Total number of included systematic reviews	32	14	18

domains Dental caries, Periodontitis, Oral motor function (including speech, chewing and swallowing capacity, para- and lipfunction) and Mucosal lesions, nine systematic reviews were found, of which all were assessed having a high risk of bias. Thus, no systematic reviews with low or moderate risk of bias were included in any of these domains (Table 2).

### 3.2 | Domain—\*Interaction between oral status and other medical conditions

The domain included the subdomains Infections (stress due to untreated condition), Non-specific pain and Nutritional status. Totally 10 systematic reviews were identified within the domain of which 3 were assessed with low or moderate risk of bias. One of the included reviews describes the prevalence of infections due to untreated oral conditions<sup>29</sup> and two concerned nutritional problems.<sup>30,31</sup> No systematic reviews of low or moderate risk of bias describing non-specific pain could be identified, while four systematic reviews judged to be of high risk of bias, and therefore excluded, described a general association between oral status and general status (Table 2).

#### 3.2.1 | Infection—stress due to untreated conditions

One systematic review studied the effect of oral hygiene on pneumonia and respiratory infection in people aged 65 years or older, in hospitals or nursing homes.<sup>29</sup> The review was based on 15 studies—5 RCT studies, 3 case-control studies, 5 cross-sectional studies, 1 retrospective longitudinal study and 1 systematic review. In all, these studies included 3545 subjects. All RCT studies and most of the non-RCT studies showed that oral hygiene had a positive preventive effect on the prevalence of pneumonia. Absolute risk reduction was

6.6%–11.7% and “numbers needed to treat” (NNT) were 8.6–15.3 individuals.

No systematic review describing how untreated periodontal disease and apical periodontitis affect the health of older persons could be identified.

#### 3.2.2 | Nutritional status

Two systematic reviews with moderate risk of bias focused on malnutrition and possible associations with oral status in older persons. In a systematic review by van der Pols-Vijlbrief et al,<sup>30</sup> determinants for protein energy malnutrition (PEM) were studied in older persons living at home. This systematic review included 28 studies. Thirty-seven of the 122 potential determinants of PEM could be included in a “best evidence synthesis.” There was strong evidence to support a relationship between PEM and poor appetite, and moderate evidence for a relationship between PEM and edentulousness, the absence of diabetes, hospital admissions and self-reported poor health. Strong evidence for a lack of correlation with PEM was noted for anxiety, chewing difficulties, having few friends, living alone, loneliness, the death of close relatives, multi-morbidity, cardiovascular disease, stroke and use of anti-inflammatory drugs. The authors concluded that PEM is a multifactorial problem and that for many determinants, evidence is lacking or insufficient. Instead of treating PEM with nutritional supplements and dietary advice only, preventive strategies should target modifiable determinants such as loss of appetite and edentulousness.

The second systematic review by van Lancker et al<sup>31</sup> studied the link between malnutrition and oral status in older residents of long-term care facilities. Sixteen studies met the inclusion criteria. Nine studies reported an association between oral status and malnutrition, four reported a correlation between chewing ability and malnutrition and five

**TABLE 3** Brief summary of systematic reviews with low or moderate risk of bias

Reference	Aim	Age	No of studies	No of participants	Main findings	Level of evidence according to authors	Risk for Bias according to review authors
Sjögren et al <sup>17</sup> Sweden	Summarise existing studies on how oral hygiene effects pneumonia and respiratory infections	≥65 y	Total 15 studies: 5 RCT <sup>a</sup> 3 prospective cohorts 5 cross-sectional 1 retrospective cohort 1 SR <sup>b</sup>	3545	Oral care reduces the risk of pneumonia and respiratory infections (absolute risk reduction AAR: 6.6%-11.7%; "numbers needed to treat" <sup>c</sup> NNT: 8.6-15.3)	Low	Moderate
Van Lancker et al <sup>19</sup> The Netherlands	To determine whether there is an association between oral health and malnutrition in institutionalised older people	≥80 y	Total 16 Cross-sectional studies	40-3088	Tentative evidence suggests an independent association between oral health and malnutrition in institutionalised older people. Due to methodological limitations, the results should be interpreted with caution. Further studies are needed to establish a causal link between oral health and malnutrition	Not specified	Moderate
van der Pols-Vijlbrief et al <sup>18</sup> The Netherlands	To provide an evidence-based overview of potential determinants of protein energy malnutrition (PEM) in older persons living at home	≥65 y	Total 28 studies: 10 longitudinal 18 cross-sectional	49-12 883	Strong evidence was found for an association between PEM and poor appetite. Moderate evidence to support an association between PEM and hospitalisation, poor self-reported health, absence of diabetes and edentulousness.	Not specified	Moderate
Brady et al <sup>30</sup> Great Britain	To compare the effects of oral care interventions with standard care for ensuring oral hygiene of stroke patients	All ages	3 studies: 2 RCT 1 cluster RCT (randomised cluster)	615 patients	An improvement of the nursing staff's knowledge and attitudes, patient's denture hygiene and the incidence of pneumonia was reported, but not the level of hygiene for natural teeth.	1-2	Moderate
de Lugt-Lustig et al <sup>29</sup> The Netherlands	To conduct a systematic review of the literature on the effect of training programmes in oral health to staff in nursing homes on knowledge of and attitudes towards oral health as well as practical skills in carrying out oral hygiene on patients	≥65 y (patients)	6 studies: 2 RCT 2 cross-sectional 1 quasi-experimental 1 longitudinal experimental	464 patients 470 staff	Some evidence that training programmes in oral health for staff in nursing homes can provide better knowledge and improve attitudes, but no improvement in practical skills of carrying out oral care could be identified	1-2	Moderate

(Continues)

TABLE 3 (Continued)

Reference	Aim	Age	No of studies	No of participants	Main findings	Level of evidence according to authors	Risk for Bias according to review authors
Low et al <sup>32</sup> Australia	To conduct a systematic review of interventions aimed to change behaviors of nursing staff and thereby improve the care for older persons in nursing homes	Not shown	63 studies, 3 are related to oral health: 1 RCT 1 cluster RCT 1 single-blind RCT	Data not presented	No single intervention, combination or number of components increased the likelihood of a positive outcome. Interventions in specific areas such as oral care more often gave positive results than the more general, such as care philosophy, as well as studies in which intervention theories were used. It was often not clear how and whether the intervention and the assessments of the outcome were linked. It is possible to change the nursing staff's routines, but it is complex. Several studies described the obstacles of nursing staff (personnel changes of clothes, high pressure treatment, attitudes) or organisation (finance, resources, logistics). One must consider how each constituent component of barriers and facilitating factors can influence the outcome of an intervention	2-3	Moderate
Wang et al <sup>31</sup> Taiwan	To evaluate the effects of training in oral health to health professionals on oral health status in older persons	≥65 y (pat)	5 studies: 1 RCT 4 pre-post	602 patients	Limited evidence exists that training in oral health for health professionals leads to improved oral health in older persons	1-2	Moderate
Weening-Verbee et al <sup>33</sup> Netherlands	To evaluate strategies to implement interventions intended to improve the oral health of institutionalised older persons through behavioral change techniques, to determine strategy content at determinant level and its effectiveness	Not shown	20 studies	Approx. 2500 patients Approx. 5400 staff	Knowledge, self-efficacy and facilitation of desirable behaviour are frequently used strategies. No single approach can be recommended over another but choice of appropriate strategy should be based on the setting and target group. One should also try to train the memory, give feedback and mobilise social norms	Not specified	Moderate

(Continues)

TABLE 3 (Continued)

Reference	Aim	Age	No of studies	No of participants	Main findings	Level of evidence according to authors	Risk for Bias according to review authors
Hoben et al <sup>24</sup> Canada	Evaluate the effectiveness of strategies that nursing home providers can apply to either prevent/overcome residents' responsive behaviors to oral care, or enable/motivate residents to perform their own oral care	Not given Nursing home residents Formal, paid care providers	Total 7 papers, representing 4 studies 3 group pre-test, post-test 1 cross-sectional	122 residents	Potentially promising strategies were able to identify but the methodological quality of the studies was low	Low	Moderate
Hoben et al <sup>23</sup> Canada	Identify and synthesise the evidence on barriers and facilitators care aides perceive in providing oral care to nursing home residents	Not given Nursing home residents	Total 45 papers, representing 41 studies	Ca 4500 care providers	Strategies to prevent or manage residents' responsive behaviors and to improve care aides' oral care knowledge are especially needed	Low	Moderate
Rozas et al <sup>22</sup> USA	Systematically review interventions effective at improving dental health in patients with cognitive impairment and describe remaining research gaps	Formal, paid care providers	Total 9 studies 1 RCT	343 residents 87 staff members	Patients with dementia should have an oral examination on diagnosis or admission to a nursing home, biannually dental screening or more often if needed and dental treatment as soon a problem is detected. The multidisciplinary care team should include a dental healthcare provider	Low	Moderate
Siegel et al <sup>21</sup> Australia	Systematically review the content and effectiveness of interventions and implementation strategies used to improve or maintain the oral health of people with dementia or cognitive impairment	≥65 y	18 studies 8 pre-post 4 RCT 3 cluster RCT 1 quasi RCT 1 controlled cross-over 1 controlled pre-post	3199	It is not possible to make recommendations about the benefit of specific interventions for people with dementia or cognitive impairment based on the available evidence	Low	Moderate

(Continues)



TABLE 3 (Continued)

Reference	Aim	Age	No of studies	No of participants	Main findings	Level of evidence according to authors	Risk for Bias according to review authors
Sjögren et al <sup>17</sup> Sweden	Compare the effect of intensified oral care interventions given by dental or nursing personnel on mortality from healthcare-associated pneumonia (HAP) in elderly adults in hospitals or nursing homes with usual oral care	≥60 y	5 RCT studies	3844	Oral care interventions given by dental personnel may reduce mortality from HAP, whereas interventions by nursing personnel probably result in little or no difference from usual care	Low	Moderate
Albrecht et al <sup>25</sup> Tyskland	To assess the effects of oral health educational interventions for nursing home staff or residents or both, to maintain or improve the oral health of nursing home residents	The mean resident age ranged from 78 to 86 y across studies	9 RCT studies	3253 nursing home residents	Insufficient evidence to draw robust conclusions about the effects of oral health educational interventions for nursing home staff and residents. No evidence of meaningful effects of educational interventions on any measure of residents' oral health; however, the quality of the available evidence is low. More adequately powered and high-quality studies using relevant outcome measures are needed	Low	Moderate

<sup>a</sup>Randomised control trial.<sup>b</sup>Systematic review.

**TABLE 4** Existing evidence-based knowledge for interventions related to oral health and dental care of older persons

Domain	Statement	Quality of evidence according to review authors
Interaction between oral status and other medical conditions	Positive preventive effect of oral hygiene on the prevalence of pneumonia	Moderate
	Protein energy malnutrition (PEM) is associated with poor appetite	Strong
	Protein energy malnutrition (PEM) is associated with edentulousness, the absence of diabetes, hospitalisation and poor self-reported health	Moderate
	Protein energy malnutrition (PEM) is <u>not</u> associated with anxiety, chewing difficulties, few friends, living alone, feeling of loneliness, death of close relatives, multi-morbidity, cardiovascular disease, stroke and use of anti-inflammatory drugs	Strong
	Possible association between oral health and malnutrition	Moderate
Organisation of dental care for older persons	No particular intervention increased the possibility of a positive outcome	Moderate

studies reported associations between malnutrition and dental status, the number of oral problems, candidiasis and tongue afflictions as well as low saliva flow. The methodology of the included studies was assessed as of medium quality. The authors concluded that there is some tentative evidence of an independent association between oral health and malnutrition but that the results should be interpreted with caution because there is no “gold standard” for malnutrition and oral health.

**3.3 | Domain—\*Ability to communicate and participate**

This domain contained five subdomains; Dental fear, Cognitive ability, Ability to communicate, Sedation, including anaesthesia and Therapy planning and care objectives based on the patient’s condition—improve, preserve, delay and alleviate. No systematic reviews were found within this domain.

**3.4 | Domain—\*Quality of life**

Quality of life consisted of five subdomains; Aesthetics, Social ability, Function, Pain and Patient preferences and experiences. No systematic reviews were found within this domain.

**3.5 | Domain—\*Ethics**

Ethical aspects consisted of four subdomains; Prioritisation, Socio-economy, Autonomy, integrity, restraint and Cultural differences. No systematic reviews could be identified within the domain.

**3.6 | Domain—\*Organisation**

This domain comprised seven subdomains; Dental attendance, Daily oral care, Knowledge, competence and attitudes, Implementation, Financial subsidies, Access to dental care and Care planning. Totally 13 systematic reviews were identified of which 11 with low or moderate risk of bias were included, 4 in *Knowledge, competence and attitudes* and 7 in *Implementation*.

**3.6.1 | Knowledge, competence and attitudes**

The dental hygienist provides oral health education to nursing staff and thus has major responsibility for the oral health of the older person. A review by de Lugt-Lustig,<sup>32</sup> with six included studies, provided some evidence that oral health education programmes for nursing staff result in better knowledge and attitudes but do not improve their skills in delivery of oral hygiene for their patients. A Cochrane review by Brady<sup>33</sup> on stroke patients, with three included studies, showed positive effects on the nursing staff’s knowledge and attitudes, the patients’ dental hygiene and the incidence of pneumonia, but not on the oral hygiene status of natural teeth. According to a review by Sjögren et al.,<sup>34</sup> to reduce pneumonia the oral interventions ought to be given by dental personnel. A review by Wang<sup>35</sup> with five included studies presented certain evidence that oral health education for nursing staff improved older person’s oral health.

**3.6.2 | Implementation**

It is difficult to change behaviours.<sup>32,33</sup> Low<sup>36</sup> published a review of interventions intended to change the behaviour of the nursing staff. Sixty-three included studies were stratified into the following areas: oral health (n = 3), hygiene and infection control (n = 3), nutrition (n = 2), hospital acquired pneumonia (n = 2), depression (n = 2) treatment recommendations (n = 7), force (n = 3), behavioural and psychological symptoms of dementia (n = 6), fall prevention (n = 11), quality improvement (n = 9), care philosophy (n = 10) and others (n = 5). No particular intervention increased the possibility of a positive outcome. To change the routines of nursing staff is a complex task, with many obstacles, such as staff turnover, high work load, attitudes, economy, resources and logistics. A review by Weening-Verbree<sup>37</sup> gave no recommendations for strategy implementation. Knowledge, self-efficacy and factors enabling desirable behaviour are often addressed, but the authors point out that memory training, clinical feedback and social norms ought to be studied. Focusing on people with

**TABLE 5** Knowledge gaps identified in the report

Domain	Knowledge gaps
Caries risk assessment and caries detection	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Periodontitis	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Orofacial pain and temporomandibular joint (TMJ) pain	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Mucosal lesions	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Oral motor function (speech, chewing and swallowing capacity, para- and lip function)	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Dry mouth	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Halitosis	Diagnostics, Prevention, Risk assessment, Non-operative and operative treatment
Interaction between oral status and other medical conditions	Infection, stress due to untreated condition, (Diagnostics, Risk assessment), Non-specific pain (Diagnostics, Prevention, Risk assessment), Nutritional status (Diagnostics, Prevention, Risk assessment)
Ability to interrelate and communicate	Dental fear (Diagnostics, Prevention, Risk assessment, Treatment), Cognitive ability (Diagnostics, Prevention, Risk assessment, Approaches and actions), Ability to communicate (Diagnostics, Prevention, Risk assessment, Approaches and actions), Sedation, including anaesthesia (Prevention, Risk assessment, Approaches and actions), Therapy planning and care objectives based on the patient's situation – improve, preserve, delay and alleviate
Quality of life	Aesthetics, Social ability, Function, Pain, Patient preferences and experiences
Ethics	Prioritisation, Socio-economy, Autonomy (integrity, restraint), Cultural differences
Organisation of dental care for older persons	Dental attendance (Organization of dental care, Organization of municipal activities, Social support and regulations), Daily oral care (Oral self-care, Support for daily oral care, Aids for oral care), Knowledge, competence and attitudes (Dental staff, Nursing staff, Education outcomes), Implementation, Financial subsidies, Access to dental care (Outreach programs, Domiciliary dental care, Clinics adapted to admit patients with functional impairments), Care planning (Care levels, referral possibilities, Information, communication between caregivers, Multidisciplinary team)

dementia, both Siegel et al<sup>38</sup> and Rozas et al<sup>39</sup> pointed out a lack of knowledge regarding effective methods to improve oral health, so no recommendations could be made concerning specific interventions. Two systematic reviews by Hoben et al<sup>40,41</sup> and a review by Albrecht et al<sup>42</sup> stressed the low quality of the available evidence and the need of rigorous studies using relevant outcome measures.

## 4 | DISCUSSION

This study investigated, through a systematic mapping of systematic reviews, the knowledge of dental care of older persons. Systematic reviews with low/moderate risk of bias showed that effective oral hygiene can prevent pneumonia<sup>29</sup> and nutritional factors relate to oral health.<sup>30,31</sup> Further the systematic reviews concluded that training programmes can increase knowledge among care professionals and influence their attitudes on oral health<sup>32,33,35</sup> but no specific interventions aimed for changing the behaviour of nursing staff had positive outcomes.<sup>36-39</sup> Although knowledge was found in several areas, knowledge gaps were identified within majority of the investigated domains.

This survey is based on systematic reviews with low or moderate risk of bias according to the quality assessment using AMSTAR.

Due to this assessment, 18 identified systematic reviews pertaining to three domains were excluded. However, systematic reviews with high risk of bias can include original studies of high quality. Thus, there is an option to conduct systematic reviews within these three domains with a rigour methodology and thereby increase the knowledge in these domains.

Extrapolation of international research to local conditions must be made with caution. Besides changes in validity over time, differences in demographics, living standards, social structure and cultural differences may also play a role. The prevalence of oral diseases varies in different parts of the world. When the prevalence of disease is high in a population, the effect of intervention tends to be more pronounced. Moreover, if preventive care, including self-care, is poorly developed, the effect of an intervention is more pronounced. There may also be differences in the diagnostics, treatment options and interpretation of treatment results between international studies and those conducted in geographic proximity.

Dental caries and periodontitis are the two major oral diseases.<sup>43,44</sup> WHO reports that almost 100% of the adult population has experienced dental caries and 15%-20% have severe periodontal disease. Older people who have retained their natural dentitions are at increased risk of caries. Risk factors for developing caries are

well-defined.<sup>43</sup> Several of the risk factors, such as xerostomia, decreased oral motor function and decreased ability to manage daily oral hygiene independently, are more common among older persons. Furthermore, the risk is increased for periodontitis, a condition affecting the supporting structures of the teeth due to systemic risk factors, even though periodontal disease most often emerges earlier in life.<sup>44</sup> While these diseases are common among older persons, there is a lack of knowledge concerning effective treatments.<sup>45</sup>

Older persons often suffer from dental diseases and lesions of the oral mucosa which could have been avoided by appropriate daily oral hygiene. With increasing age the oral health risk factors and the importance of daily oral care increases, while the ability to manage the oral hygiene often decreases.<sup>46</sup> At the same time, the need for different oral health care support products increases. Three systematic reviews with low/moderate risk of bias described that oral health programmes could influence the knowledge and attitudes of oral health among nursing staff but the higher level of knowledge did not improve the oral hygiene status of the older persons.<sup>32,33,35</sup>

Problems encountered in dental care are often complex and it is often necessary to adapt treatment to the patient's general condition and personal situation. This is especially true for frail elderly people whose functions, such as physical ability and cognition, are weakened.<sup>45,47</sup> Dental treatment for someone with impaired cognitive function may be perceived as violation and invasion of personal integrity.<sup>48</sup> Therapy planning and treatment goals must be determined by taking into account the individual's capacity. Realistic goals of what can be achieved needs to be established, i.e. should the patient's oral health and functions be improved, preserved, delayed or alleviated? A complicating factor is that in recent years, tooth loss has increasingly been treated with implant-based prosthetics and the incidence of peri-implantitis has also increased. For frail elderly, this may lead to the need for advanced dental care, which can be impossible for them to cope with. In addition, with increasing age and sickness,<sup>49</sup> medical contacts and daily community support increase, while dental contacts decrease.<sup>50</sup> Among people who fail to seek regular dental care, fear is one of the most common reasons. As they age, people with dental fear tend to have lost more teeth and have greater dental needs than those who attend dental care regularly.<sup>51</sup>

An ethical dilemma may arise when the older person with cognitive impairment refuses to accept oral hygiene procedures as part of routine daily care. Nursing staff may perceive a conflict between respect for the patient's autonomy and providing good and safe care. There is a risk that health and medical professionals and staff in home care do not give adequate priority to oral health and mouth care, due to, e.g., lack of time or lack of knowledge.<sup>52</sup>

The ethical principles of "doing good" and "justice"<sup>[53,57]</sup> support the premise that through research it should be possible to reduce knowledge gaps with respect to more vulnerable groups in society.<sup>[54,58]</sup> If scientifically based evidence is unavailable for frail older people, there is a risk that this group will receive poorer quality of care.<sup>55</sup> It is therefore important that attention is drawn to the lack of such research.<sup>56</sup>

It is important to recognise and treat oral symptoms before dietary changes are introduced. Moreover, the effects of dietary supplements and special food regimens on oral health need to be considered.<sup>57</sup> In the present study, one systematic review was identified describing the opinions of older persons regarding eating conditions, but was excluded due to high risk of bias. The older persons requested tailored advice about nutrition and support from their caregivers to avoid negative experiences and embarrassment at mealtimes.<sup>21</sup> Dry mouth, which is a common condition among older persons as a side effect of medications<sup>58</sup> and oral motor function, affects speech, chewing and swallowing, which can in turn influence their nutritional status.<sup>59</sup> The ageing patient often has a complex and difficult medical history of pain conditions which leads to a frequent use of medication.<sup>60</sup> Dental care providers must collaborate with other healthcare professionals and the older person to create prerequisites for good oral health/oral care.<sup>47</sup>

Many different personnel categories, with different educational backgrounds and experience, are involved in the life of an older person. It is therefore important to collaborate and respect one another's professional knowledge.<sup>61</sup> Person-centred care often leads to improvements, even if actions and effect outcomes vary, for example wellness and quality of life, physical function and re-hospitalisation.<sup>62</sup> Gerodontology is a new and comprehensive area of dentistry which includes a range of persons from healthy, older persons to those with multiple diseases and dependency in daily life. It also includes a period of life with declining health and functional abilities, referred to as frail. While research about implementation of new evidence in health and medical care has increased, there is inadequate information about effective models in the field of oral and dental health of older persons. A new challenge in dentistry would be the development of person-centred care for older persons, in collaboration with nursing personnel providing daily support through home care and in nursing homes. Although patient autonomy is acknowledged, the knowledge is limited on perspectives of the frail older persons regarding oral and nursing care. Thus, further studies are needed regarding perceptions on health, care related to oral health and older persons' wishes and priorities.

#### 4.1 | Health economic aspects

This project included a literature search of health economic evaluation studies, conducted as for the literature search of clinical effects, with the addition of health economic terms. None of the studies fulfilled the inclusion criteria of this project; hence, no conclusions about cost-effectiveness can be made, based on published articles.

However, some observations could nevertheless be made about cost-effectiveness, with reference to the clinical results. We found limited evidence of the effects of training in oral health for nursing staff, thus an estimation of its cost-effectiveness is relevant. Estimations by Cleves et al<sup>63</sup> have shown that training does not need to lead to significant costs if administered effectively, but duplicate moments should be avoided. Thus, it seems likely that such training is cost-effective. Furthermore, we found an association between the

lack of oral hygiene and pneumonia, implying that effective methods to improve oral hygiene would probably have far-reaching positive consequences, both for the health of the older person and for the overall costs. However, no calculations for this could be found.

A few other health economic studies should also be noted. Lundqvist et al<sup>64</sup> reported that domiciliary dental care for older persons living in nursing home in Sweden has a lower societal cost in general and is cost-effective, compared with care at fixed clinics. However, the study uses many assumptions (not based on evidence). Mariño et al<sup>65</sup> conducted a cost minimisation analysis of a tailored oral health intervention for immigrant older persons in Australia. They showed that the study programme is expected to save considerable resources compared with providing information to each person individually.

## 4.2 | Considerations for research and practice

The oral health and dental care of older persons is a young discipline. Many aspects are unexplored or have not been well studied, including the two major oral diseases dental caries and periodontitis, as shown in this review. The increasing number of older persons who have retained their natural dentitions presents a new challenge for preventive and restorative dental care. In the absence of evidence of effective methods, caution must be taken when extrapolating knowledge from younger age groups and healthy older patients. This may not be appropriate in care of frail older patients since they can be hampered by impaired functions, like muscle strength and ability as well as cognitive impairment, among other things.

Transferring knowledge on oral health of older people to those providing daily care for older people in need of support is also a challenge. All professionals involved in care of the older person should have basic knowledge of oral health and how poor oral health can seriously affect the individual's general health condition. Future research should preferably be carried out in collaboration between different professionals and disciplines in medicine and care sciences.

Other challenges are the increasing number of older persons with cognitive disabilities who are dependent on their caregiver's actions. It is important to address these challenges in order to reduce gaps in knowledge. Moreover, the oral health and dental care of older persons should be established as a subject within the dental education curriculum, which is not the case today.

## 5 | CONCLUSIONS

There is an urgent need for further research and evidence-based knowledge within most domains in geriatric dentistry and in other fields related to oral health and dental care for older persons striving for multi-disciplinary research programmes.

## CONFLICTS OF INTEREST

The authors have declared that no competing interests exist.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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