

# Health status, care dependency and oral care utilization among older adults: a register-based study

Ina Tapager<sup>1</sup> | Caroline Louise Westergaard<sup>1</sup> | Esben Boeskov Øzhayat<sup>2</sup>

<sup>1</sup>VIVE - The Danish Center for Social Science Research, Copenhagen, Denmark

<sup>2</sup>Department of Odontology, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark

## Correspondence

Caroline Louise Westergaard, VIVE - The Danish Center for Social Science Research, Copenhagen, Denmark.  
Email: [calw@vive.dk](mailto:calw@vive.dk)

## Funding information

Sygeforsikringen "danmark"

**Background and objectives:** The aim of the study was to examine oral care utilisation among older Danes and to describe the extent to which oral care use is associated with the co-existence of challenges relating to general health and care dependency.

**Materials and methods:** The study used registry data covering the entire population of older adults ( $\geq 65$  years) in seven municipalities in Denmark ( $N=178\,787$  individuals). Oral care services utilisation was computed from administrative data on oral care contacts up to and including 2019, including both private oral care and a municipal oral care programme (MOCP). Various registry data sources were used to compute risk factors to describe oral care utilisation across indicators of general health and care dependency.

**Results:** Indicators for poorer health were associated with larger proportions of individuals enrolled in the MOCPs and larger proportions of non-users of any type of oral care. Higher degrees of care dependency were associated with larger proportions of individuals enrolled in MOCPs and individuals with no use of any oral care services, with the exception of nursing home residents, who comprised a lower proportion of non-users than individuals receiving at-home care. Municipal oral care mainly enrolled older adults who were nursing home residents (60% of nursing home residents were enrolled).

**Conclusion:** Our findings support existing evidence on the link between oral care utilisation and general health and frailty. While the municipal care programmes assisted in covering oral care for those with the highest level of care dependency, future preventive strategies for ensuring care continuity for older adults that are increasing in frailty may want to focus on the earlier stages of frailty and of general health deterioration.

## KEYWORDS

care dependency, frailty, general health, older people, oral healthcare use, polypharmacy

## 1 | INTRODUCTION

Oral health is associated with general health and wellbeing among ageing individuals,<sup>1-4</sup> who are generally advised to maintain regular

contact with professional oral care services to prevent and treat oral health problems.<sup>5,6</sup> However, studies have indicated that the oldest older adults visit the dentist less regularly than their younger peers, even though older age is associated with poorer oral health.<sup>4,7-9</sup>

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2024 The Authors. *Gerodontology* published by Gerodontology Association and John Wiley & Sons Ltd.

Accessing, accepting and using oral care services may be particularly challenging for individuals who have poor general health and in situations of care dependency,<sup>10–12</sup> likely leading to unmet oral health treatment needs.<sup>13</sup>

Previous research suggests that age-related transitions into worsened general health and the associated challenges with mobility, care dependency and poor oral health are demanding for the design and delivery of professional oral care services.<sup>13</sup> Barriers to oral care services may be experienced both by older adults living at home and in care facilities, and include challenges of availability of and access to relevant geriatric oral healthcare.<sup>12</sup> For instance, older adults living at home with complex care needs or characterised by frailty have been shown to often need assistance in seeking oral care.<sup>5</sup> The oral health of older adults has also been shown to be poor upon their admission to nursing homes, likely due to the older adults' gradually worsening abilities to maintain their own and professional care prior to entering institutionalised care dependency.<sup>14</sup>

In Denmark, adults are mainly served by private oral care clinics (POCCs).<sup>15</sup> Adults who cannot access and use the regular private clinics because of impaired physical or mental health are eligible for a public municipal oral care programme (MOCP).<sup>16</sup> The purpose of the MOCP is to ensure access to oral healthcare, thereby preventing and treating oral disease in those individuals who, for frailty-related reasons, cannot access oral care in the privately run setup.<sup>17</sup>

Danish reports have previously suggested that the uptake of the MOCP is low and does not live up to its goal of ensuring continued oral care.<sup>17,18</sup> These reports are now somewhat dated and do not examine data on the combined utilisation of the MOCP and POCC, nor do they examine whether the older adults with care needs and poorer health who were not enrolled on the MOCP received oral care at a POCC. Little is therefore known about the current utilisation of both the MOCP and POCC among older adults, nor about the personal characteristics associated with use and non-use of the MOCP and POCCs by older adults.

To address the needs of ageing populations, not only in Denmark but also in other countries, that are facing the challenges of declining health and growing care dependency, information on oral care utilisation and factors associated with use and non-use of oral care setups is needed. Knowing this would inform future policies on oral health care for older adults, the design of optimal oral care solutions, and initiatives to ensure continuity of care for older adults as they age and across the different modes of care provision. This study aimed to examine the patterns of oral care utilisation among older adults in Denmark in the POCCs and the MOCP, and to describe the extent to which oral care use is associated with general health and care dependency.

## 2 | MATERIALS AND METHODS

The study was register-based and applied descriptive statistics to examine oral care utilisation for different levels of care dependency and health indicators.

### 2.1 | Population

The population consisted of all individuals 65 years or older in seven municipalities of Denmark: Greve, Frederiksberg, Copenhagen, Varde, Svendborg, Randers and Aalborg. The study included all individuals who by the end of 2019 were alive, 65 years old or older and resided in one of the seven municipalities ( $N=178\,787$ , with  $N=40\,138$  aged 80 years or older). This is about one-sixth of the total Danish population older than 65. The seven municipalities are large (with Frederiksberg Copenhagen, Randers and Aalborg all being in the top ten) and medium-sized (Greve, Varde and Svendborg) based on population sizes. They represent all major geographical regions of Denmark and are diverse in their population characteristics.

### 2.2 | Setting

Adult oral care in Denmark is mainly provided in POCCs and is financed on a fee-for-service basis by a mix of out-of-pocket payment and public subsidies for some services and with added subsidy eligibility for certain groups and individuals.<sup>15,19</sup> The MOCP, on the other hand, is provided by municipalities, and users pay a limited and fixed yearly out-of-pocket fee.<sup>16</sup> The MOCP is aimed at citizens with a certain level of care dependency.<sup>20</sup> The programme is organised differently across municipalities; some municipalities provide MOCP services in care facilities, others provide the services in municipally or privately run clinics, and some municipalities provide the MOCP services in the citizen's own home.<sup>17</sup> A person's eligibility for enrolment in the MOCP is individually assessed by their municipality of residence.<sup>21</sup>

### 2.3 | Oral care service use indicators

The Danish national administrative health services register (NHSR) contains information on all instances of publicly subsidised oral care services provided by POCCs.<sup>22</sup> Services eligible for subsidies include most basic services such as diagnostic examinations, prevention and a number of treatments. More advanced oral treatments, such as prosthodontics, are not subsidised and thus not centrally registered. Use of the MOCP is not centrally registered, but each municipality holds records of the citizens enrolled, which we gained access to for the seven municipalities.

Based on data on older Danes' use of oral care services up to and including 2019 in the combined municipal data on MOCP enrolment and the NHSR data on provision of publicly subsidised oral services by POCCs, we defined four categories of oral care service utilisation among older Danes in 2019:

1. Non-user: is neither registered as enrolled in the MOCP nor as having received services from a POCC in the 3-year period 2017–2019.

2. MOCP user: is registered as enrolled in the MOCP with entry before or in 2019. We do not have records of ongoing utilisation of services in the MOCP, but assume that once enrolled, a person remains an MOCP client.
3. Routine user of a POCC (routine user, POCC) with two or more check-up visits\* 2017–2019 and the latest within 2018–2019.
4. 'Occasional user' in private oral care clinics ('occasional user', POCC) with contact(s)/treatment(s) 2017–2019 but less than two diagnostic check-up visits.

The categories were mutually exclusive. Citizens may have contacts at a POCC while enrolled in the MOCP in 2017–2019. This could be because of the need for a procedure that the MOCP cannot offer. If citizens were recorded as enrolled in the MOCP with an entry date prior to or in 2019, they were categorised as MOCP users regardless of POCC use.

To explore the use of oral care at POCCs among citizens prior to their enrolment in the MOCP, we looked at individuals aged 65 or older enrolled in the MOCP in 2019 or 2020 in one of the seven municipalities. We looked at individuals enrolled in 2019 or 2020 to maximise the number of years we could track. Use of oral care at a POCC was defined as any type of service at a POCC in the 14 years prior to enrolment in the MOCP.

## 2.4 | Indicators of health-related challenges and care dependency

We used care dependency indicators and health indicators that could be identified through registries and were applicable to future policy and intervention work. Consequently, the indicators were based on characteristics and information available to municipal health care and social workers or on characteristics that made groups easy to define and for whom interventions could be designed.

### 2.4.1 | Care dependency

Care dependency was assessed using a combination of data sources on assessments for in-home care needs (data compiled from municipal data by Statistics Denmark) and data on residence at a nursing home (database compiled by the Danish Health Data Authority). Based on these data, for the period 2017–2019, we created four hierarchical and mutually exclusive categories of care levels: (1) Neither receiving in-home care nor residing in nursing home, (2) registered as eligible for practical assistance only, (3) registered as eligible for personal care assistance (and possibly also practical assistance) and (4) resident in a nursing home.

\*NHSR codes for examination/diagnostic check-ups within dental care specialties 49–50: 1111, 1112, 1113, 1114, 1115, 1140, 1141.

## 2.4.2 | General health risk indicators

To assess the general comorbidity burden in our population, we used the Charlson Comorbidity Index (CCI) for somatic diseases using ICD-10 diagnostic codes for hospital contacts.<sup>23</sup> We looked at hospital contacts for 2015–2019, supplemented with registered chronic diseases in the CCI diagnostic categories from the Danish Register of Chronic Diseases (RUKS).<sup>24</sup>

We also computed an indicator of polypharmacy. Polypharmacy is known to be a specific risk factor for oral health among older adults<sup>13</sup> as well as an indicator of vulnerability in terms of complex health status.<sup>25</sup> There is no consensus on the specific definition of polypharmacy.<sup>26</sup> For this study we defined polypharmacy as the dispensing of six or more different ATC-level- medicines to an individual within 6 months and further required this criterion to be fulfilled for at least half the studied period (i.e. for three 6-month periods during 2017–2019).<sup>27</sup> Data on dispensed medicines from the Danish National Prescription Registry (DNPR)<sup>28</sup> were used during the study period 2017–2019.

### 2.4.3 | Specific health conditions

We computed an indicator for dementia, as dementia-related cognitive decline is known to cause challenges with oral healthcare utilisation.<sup>29</sup> We also computed an indicator for anxiety/depression, as similar challenges with oral health are also associated with psychological health among older citizens.<sup>30,31</sup> The dementia indicator was based on registered cases of dementia in RUKS, where dementia is estimated based on algorithmic criteria regarding dispensed medicine and hospital diagnostic codes.<sup>32</sup> All individuals who appeared with a dementia diagnosis in RUKS up until and including 2019 were assigned as having dementia. Anxiety/depression-related diagnoses and treatments were approximated from dispensed medicine and hospital diagnostic codes according to the criteria previously defined by Nexø et al.,<sup>33</sup> including for instance dispensation of antidepressants. We only looked at recent activity (2017–2019) and did not require chronic use (repeated dispensing).

## 2.5 | Statistical methods

We described oral care utilisation in the population in terms of simple frequencies and by comparing distributions of the computed risk factor indicators, described above, across categories of use. We used a chi-squared test for independence to assess whether distributions of oral care utilisation are likely to be statistically independent of the risk factor in question. Analyses were carried out in SAS 9.4.

## 2.6 | Ethics

This project is based on Danish registry data, with access, use and permissions regulated under Danish Data Protection Law and

the European General Data Protection Regulation (GDPR). The project is registered in the record of research projects containing personal data at VIVE (the Danish Center for Social Science Research). De-identified (pseudonymised) data were accessed and analysed via a secured research environment regulated and administrated by Statistics Denmark from which only strictly anonymised results can be used. This type of registry data project does not require individual consent or specific ethical review under Danish law.

### 3 | RESULTS

**Table 1** presents the study participant characteristics. As expected, there were higher proportions of comorbidity, polypharmacy, anxiety/depression and dementia among individuals  $\geq 80$  years old than those 65–79 years old. Most notably, only 10% of the 65- to 79-year olds were care dependent, whereas almost half (47%) of individuals  $\geq 80$  years old were care dependent.

As expected, there was a notable difference in the use of oral care between the two age groups. There were larger proportions of individuals who were non-users and enrolled in the MOCP among

individuals  $\geq 80$  years old than was the case for the 65- to 70-year olds. Correspondingly, the 65- to 70-year olds comprised a larger proportion of routine users.

**Table 2** presents oral care utilisation for groups with different levels of care dependency. Individuals with higher levels of care dependency were more often non-users or enrolled in the MOCP; no individuals with no formal care assistance were enrolled in the MOCP, whereas 60% of nursing home residents were enrolled in the MOCP. In fact, 82% of MCDP users resided in nursing homes (data not shown). However, a smaller proportion of nursing home residents were non-users of dental services (23%) than individuals who received personal care assistance (37%). The chi-squared tests showed a statistically significant difference (at a 5% significance level) in use of oral care between all the groups of care dependency.

**Figure 1** shows that a larger proportion of women aged 65–79 were routine users of POCC than men aged 65–79. By contrast, among participants aged  $\geq 80$  years, more men than women used oral health services routinely, and more women than men aged  $\geq 80$  were enrolled in the MOCP. In general, older age and poorer general health were associated with smaller proportions of routine users (POCC) and larger proportions of non-users of dental services. There were larger proportions of non-users of dental

	Age 65–79		Age $\geq 80$		Total	
	N	%	N	%	N	%
Female	73 530	53	24 994	62	98 524	55
CCI=0	75 765	55	16 026	40	91 791	51
CCI=1–2	47 459	34	17 391	43	64 850	36
CCI=3+	15 425	11	6 721	17	22 146	12
Polypharmacy	43 966	32	21 841	54	65 807	37
Anxiety/depression	18 746	14	8 211	20	26 957	15
Dementia	2 592	2	3 720	9	6 312	4
No public formal care assistance	124 280	90	21 077	53	145 357	81
Homecare: practical assistance	5 272	4	5 480	14	10 752	6
Homecare: personal care assistance	6 810	5	8 526	21	15 336	9
Nursing home residence	2 287	2	5 055	13	7 342	4
Routine user (POCC)	93 300	67	20 401	51	113 701	64
Occasional user (POCC)	18 672	14	5 311	13	23 983	13
MOCP	1 988	1	3 412	9	5 400	3
Non-user	24 689	18	11 014	27	35 703	20
N	138 649		40 138		178 787	

**TABLE 1** Characteristics of adults  $\geq 65$  years by age group based on data from 2017 to 2019.

Note: 'No public formal care assistance', 'Home care: practical assistance' and 'Home care: personal care assistance' are based on data from 2019, Nursing home residence is based data from 2017 to 2019. The groups of level of care dependence are hierarchical groups of mutually exclusive subsets. Categories of oral care and care dependency are based on activity in the 3 years leading up to and including 2019 (2017–2019).

Abbreviations: CCI, Charlson Comorbidity Index; MOCP, municipal oral care clinics; POCC, private oral care clinics.

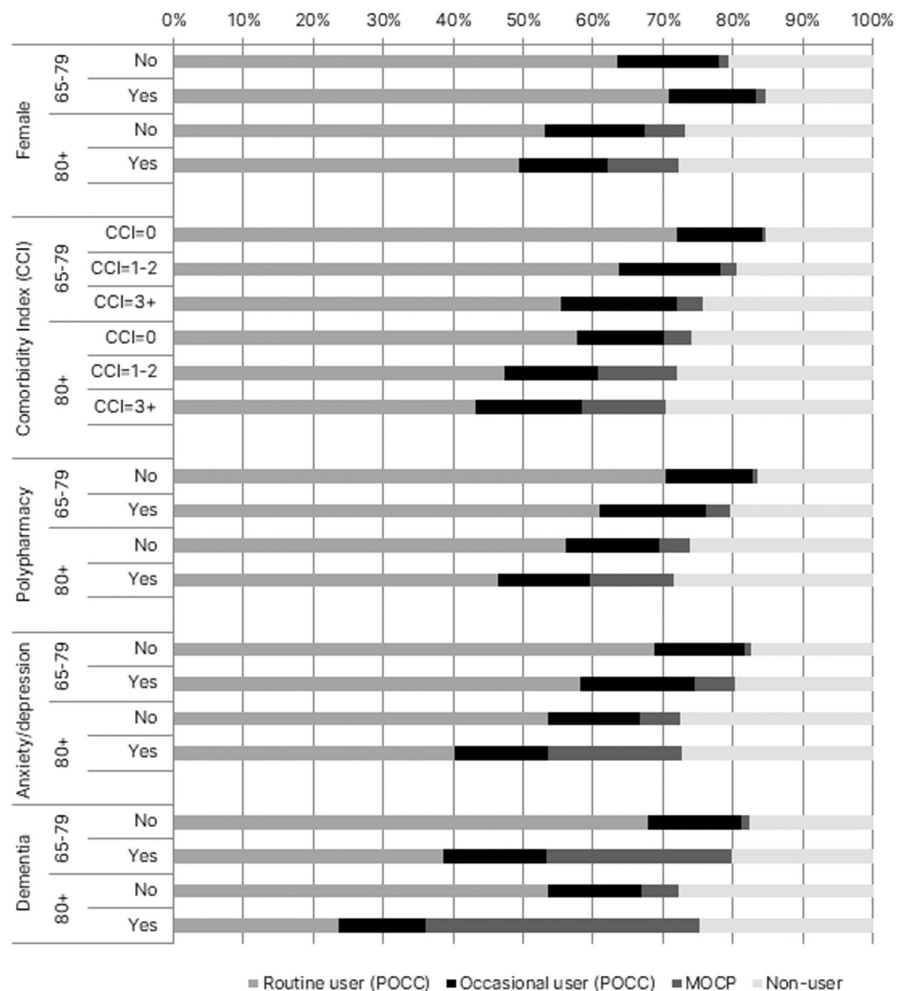
**TABLE 2** Oral care utilisation across categories of care dependency among adults  $\geq 65$  years old based on data from 2017 to 2019.

	Routine user (POCC)		Some-use (POCC)		MOCP		Non-user	
	N	%	N	%	N	%	N	%
No public formal care assistance	101 131	70	18 869	13	209	0	25 148	17
Homecare: practical assistance	5795	54	1764	16	42	0	3151	29
Homecare: personal care assistance	6068	40	2781	18	747	5	5740	37
Nursing home residence	707	10	569	8	4402	60	1664	23
N	113 701		23 983		5400		35 703	

Note: 'No public formal care assistance', 'Home care: practical assistance' and 'Home care: personal care assistance' are based on data from 2019, Nursing home residence is based data from 2017 to 2019. The groups of level of care dependence are hierarchical groups of mutually exclusive subsets. Categories of oral care and care dependency are based on activity in the 3 years leading up to and including 2019 (2017–2019).

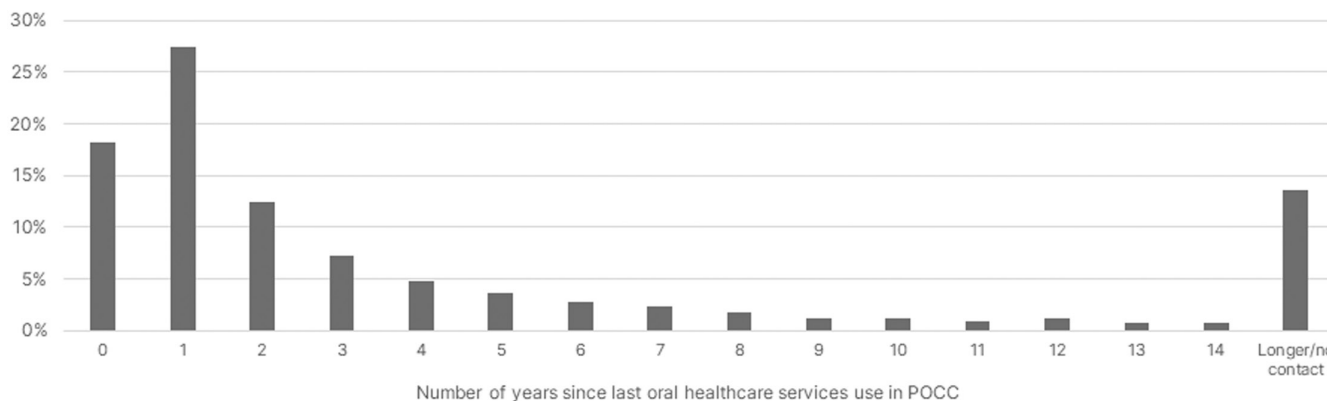
Abbreviations: CCI, Charlson Comorbidity Index; MOCP, municipal oral care clinics; POCC, private oral care clinics.

**FIGURE 1** Oral care utilisation 2017–2019 compared across groups characterised by various types of health-related challenges, stratified by age group. Light grey: Routine user (POCC). Black: Occasional user (POCC). Dark grey: MOCP. Beige: Non-user. Note:  $N = 178\,787$  aged  $\geq 65$  years by end of 2019. All of the age-stratified cross-tabular distributions of oral care utilisation on risk factors are statistically significantly different ( $p < .001$  for chi-square tests). CCI, Charlson Comorbidity Index. Polypharmacy =  $>6$  drug types/6 months for at least three 6-month periods during 2017–2019. Anxiety/depression and dementia indicators are based on hospital diagnoses and dispensed medicines (see Section 2: Methods).



services for those aged 80 years or older than for 65- to 79-year olds with the same levels of health. Poorer health was associated with higher proportions of non-users within the same age

groups with the exception of depression/anxiety and dementia among  $\geq 80$ -year olds. The proportion of non-users was the same among  $\geq 80$ -year olds with and without depression/anxiety. The



**FIGURE 2** Oral care contacts in regular care prior to municipal oral care enrolment in 2019–2020. Number of years since last oral healthcare services use in POCC. Note:  $N=2894$  persons ( $\geq 65$ ) enrolled in the MOCP in the seven municipalities in 2019–2020.

proportion of non-users among  $\geq 80$ -year olds was smaller for individuals with dementia than for individuals without dementia. The chi-squared tests showed a statistically significant difference (at a 5% significance level) in the use of oral care services between all the health indicators.

More than half of the individuals enrolled in the MOCP had their last contact with a POCC within 2 years prior to enrolment (Figure 2). Further, of the individuals enrolled in the MOCP, 14% had no contact with a POCC within the 14 years' data included in the study.

## 4 | DISCUSSION

This study examined the associations between oral care utilisation and different health indicators and levels of care dependency across two types of care delivery for older adults. Oral care utilisation appeared strongly associated with care dependency; the proportion of non-users of dental care services were larger in groups characterised by higher levels of care dependency. However, in our highest category of care-dependency (i.e. nursing home residents), the proportion of non-users was smaller than the proportion of non-users among the group of older adults receiving personal assistance at home. There was also a clear association between poor health and health service use, with generally larger proportions of non-users of dental care among those in poorer health. While the MOCP seemed to succeed in reaching many of the most frail (nursing home residents), a larger proportion of older adults receiving in-home care were non-users of oral health services.

### 4.1 | Strengths and limitations

The strength of this study is the data it utilises; we used data for the entire population of  $\geq 65$ -year olds in seven municipalities of Denmark and combined these data with national administrative data on regular POCC utilisation as well as on enrolment in MOCPs. This provided a comprehensive description of oral care utilisation among older adults in Denmark. Additionally, we used information

on eligibility for in-home care as well as on nursing home residency, which provided nuanced information on care dependency covering both community-dwelling individuals and nursing home residents, whereas many previous studies concentrate on one or the other. The study thus contributes a comprehensive survey of oral care utilisation across different types of oral health services provision and across several health-related and frailty-related risk factors associated with reduced oral care contact. Further, the sample of municipalities included both large and small cities and covered diverse geographical areas of Denmark. As such, it provides greater insights into the older population in Denmark than single-site studies. Nevertheless, we cannot establish transferability of findings to settings with different social and health system characteristics.

That we did not have information on oral care needs with regard to factors such as oral problems, dentition status and use of prostheses is a limitation of this study. Previous research has shown that individuals without any natural teeth remaining are less likely to seek oral care.<sup>34,35</sup> However, the number of edentulous older adults in Denmark has been drastically reduced over recent decades, to around 18% among  $>75$ -year olds why the lack of this information has less of an impact.<sup>36</sup>

A further limitation is the lack of data on people's preferences for oral care service use. Hence, we cannot tell to what extent non-use of oral care services is a consequence of a lack of perceived need for dental care or failure in the health system to accommodate the needs of older adults that is, whether non-use of services is driven by preference or circumstance. We note, however, that current guidelines generally recommend regular check-ups at 12- to 24-month intervals. Furthermore, a status report from 2017 showed that 94% of older adults ( $>66$  years) who visited regular oral care clinics were registered in the care categories that imply recommendations for more frequent contacts for professional oral care,<sup>6,37</sup> p. 36. We did not have data on the services provided and the interval with which they were given in the context of the MOCP. Thus, we cannot ascertain whether the care provided by the MOCP can be considered sufficient to meet the needs of the individuals enrolled in the MOCP. Altogether, there is a need for further exploration and research into the more detailed patterns of use of oral care services



and the personal drivers and barriers for use of oral care services related to ageing and the accompanying health and care challenges.

This study did not aim to determine the causal drivers for oral care utilisation. Adding to the challenge of age-related frailty transitions, previous research shows that the oral care utilisation is also related to socioeconomic resources, including income.<sup>38–40</sup> Since socioeconomic resources are related to both general health, oral health and health-care utilisation,<sup>40–42</sup> it is not a trivial task to determine the pathways of these interlinked relationships, particularly for older adults with health risks and behaviours accumulated over a lifetime.<sup>40,43</sup>

## 4.2 | Current literature

The findings of the study are in accordance with previous findings of low oral care utilisation among older adults<sup>7,9,34</sup> and that general health challenges are associated with low use of oral care services.<sup>44,45</sup> While this study does not reveal the mechanisms behind these patterns of use of oral care services, such mechanisms may include a mix of changes in unobserved general health deterioration as well as underlying oral health and oral health habits that may be cohort specific.<sup>34</sup> Other possible reasons include low prioritisation of oral health among all health burdens,<sup>46</sup> along with issues associated with access and availability of appropriate geriatric oral care options.<sup>5,12,13</sup>

Oral care contacts in regular private oral care setups were much less common among persons with dementia. This is in accordance with the literature on low oral care utilisation with dementia onset.<sup>29,47</sup> We also found a large proportion of people with dementia enrolled in the MCDP. This is likely due to a higher level of care dependency and higher likelihood of nursing home residency for persons with dementia. We also saw a higher proportion of MOCP users among older adults who had received depression/anxiety treatment. This may also be a result of the treatment characteristics of the nursing home population mainly served by the MCDP; for instance, use of antidepressants has been shown to be high and increasing following nursing home admission.<sup>48</sup> Finally, we found that a larger proportion of women than men aged  $\geq 80$  years were enrolled in the MDCP, most likely owing to a higher proportion of women than men residing in nursing homes in Denmark.<sup>49</sup>

## 4.3 | Implications for research and practice

We found that the proportion defined as non-users of any type of oral care services was significantly smaller for nursing home residents than persons receiving in-home care. At the same time, the proportion of older adults enrolled in the MOCP was significantly larger for nursing home residents than older adults living at home. To some extent this is to be expected, as MCDP eligibility is defined according to physical and mental impairments and (in turn) their ability (or not) to access regular private clinics.<sup>18</sup> Nevertheless, a considerable proportion of older adults dependent on care at home were

non-users of any type of oral care services. This indicates that there is a large proportion of older adults who are dependent on home care who are not being seen in the existing oral care system; that is, either by the POCs or the MOCP. Since we did not have data on the state of their oral health, we could not determine whether this group of non-users are not being provided with the professional oral care they need. However, if meeting the recommendations of receiving oral care every 12–24 months<sup>6</sup> is taken as an indicator of sufficient use of oral care, there are strong indications that a large proportion of older adults who are dependent on home care are not receiving the oral care they need. Future studies should examine this further. The non-users with home care needs are an easy group to identify, since they are in regular contact with municipal healthcare and social workers. This, together with the large proportion of non-users in this health indicator group, suggests they could be a relevant target group for possible health policy interventions.

Previous literature has suggested that health policy interventions for older adults should focus more on the oral health and oral care of older adults from the beginning of care dependency when people in the intervention target group still live in their own homes.<sup>14</sup> It has also been recommended to better integrate oral health care of older adults with general health management because of the interlinked relationship of decreasing oral health and general health<sup>13</sup> and because the accessibility and visibility of relevant oral care options and care pathways for older adults need to be ensured.<sup>8</sup> Another suggestion in the literature includes improving options for delivering professional oral care in the homes of community-dwelling older adults as well as exploring telecare options and improving accessibility in clinics.<sup>13</sup> Furthermore, such recommendations need to be considered on the background of current and developing characteristics of the older population. Older adults are increasing in number, and in proportion relative to the general population.<sup>50</sup> At the same time, we see an increasing proportion of older adults with more remaining teeth,<sup>36</sup> and there seems likely to be a trend towards older adults remaining resident in their own homes for as long as possible.<sup>13</sup> It would therefore appear relevant to pursue integrated and flexible oral care solutions that are adapted to the needs of older adults, their circumstances and their level of care dependency.

## 5 | CONCLUSION

Our findings support existing evidence on the link between oral care utilisation and general health and frailty. While the municipal care programmes assisted in covering oral care for those with the highest level of care dependency, future preventive strategies for ensuring care continuity for older adults who are increasing in frailty should also consider the earlier stages of frailty and of general health deterioration.

### AUTHOR CONTRIBUTIONS

IT: Methodology, formal analysis, writing – original draft, CLW: writing – review and editing, methodology, formal analysis, EBØ:

Conceptualisation, methodology, writing – review and editing, supervision, funding acquisition. All authors have read and approved the final submitted version of the article.

## ACKNOWLEDGEMENTS

This article stems from research carried out as part of the research project ‘Lifelong oral health’ and builds on a previously published Danish report.<sup>51</sup> This research was funded by Sygeforsikringen ‘danmark’. We would like to thank the rest of the research group, collaborators and advisory board for their helpful comments on the analyses.

## DATA AVAILABILITY STATEMENT

The data for this study were used under licence and are not possible to share due to third party restrictions.

## REFERENCES

- Kandelman D, Petersen PE, Ueda H. Oral health, general health, and quality of life in older people. *Spec Care Dentist*. 2008;28(6):224-236. doi:10.1111/j.1754-4505.2008.00045.x
- Lindmark U, Ernsth Bravell M, Johansson L, Finkel D. Oral health is essential for quality of life in older adults: a Swedish National Quality Register Study. *Gerodontology*. 2021;38(2):191-198. doi:10.1111/ger.12514
- Dörfer C, Benz C, Aida J, Campard G. The relationship of oral health with general health and NCDs: a brief review. *Int Dent J*. 2017;67:14-18. doi:10.1111/idj.12360
- Gil-Montoya JA, de Mello ALF, Barrios R, Gonzalez-Moles MA, Bravo M. Oral health in the elderly patient and its impact on general well-being: a nonsystematic review. *Clin Interv Aging*. 2015;10:461-467. doi:10.2147/CIA.S54630
- Bakker MH, Vissink A, Spoorenberg SLW, Wynia K, Visser A. Self-reported oral health problems and the ability to organize dental care of community-dwelling elderly aged ≥75 years. *BMC Oral Health*. 2020;20(1):1-9. doi:10.1186/s12903-020-01175-7/TABLES/3
- Sundhedsstyrelsen [Danish Health Authority]. *Nationale Kliniske Retningslinjer for Fastlæggelse Af Intervaller Mellem Diagnostiske Undersøgelser i Tandplejen [National Clinical Guidelines for Intervals between Diagnostic Dental Care Examinations]*; 2016.
- Grönbeck-Linden I, Hägglin C, Petersson A, Linander PO, Gahnberg L. Discontinued dental attendance among elderly people in Sweden. *J Int Soc Prev Community Dent*. 2016;6(3):224-229.
- Borreani E, Wright D, Scambler S, Gallagher JE. Minimising barriers to dental care in older people. *BMC Oral Health*. 2008;8(1):1-15. doi:10.1186/1472-6831-8-7
- Nitschke I, Stillhart A, Kunze J. Utilization of dental services in old age. *Swiss Dent J*. 2015;125(4):433-447. <http://www.ncbi.nlm.nih.gov/pubmed/26169279>
- Niessen D, Witter DJ, Bronkhorst EM, Creugers NHJ. Oral health care behavior and frailty-related factors in a care-dependent older population. *J Dent*. 2017;61:39-47. doi:10.1016/j.jdent.2017.04.002
- Sicsic J, Rapp T. Frailty transitions and health care use in Europe. *Health Serv Res*. 2019;54(6):1305-1315.
- El-Yousfi S, Jones K, White S, Marshman Z. A rapid review of barriers to oral healthcare for vulnerable people. *Br Dent J*. 2019;227(2):143-151.
- van der Putten GJ, de Baat C, De Visschere L, Schols J. Poor oral health, a potential new geriatric syndrome. *Gerodontology*. 2014;31:17-24. doi:10.1111/ger.12086
- Hoeksema AR, Peters LL, Raghoobar GM, Meijer HJA, Vissink A, Visser A. Oral health status and need for oral care of care-dependent indwelling elderly: from admission to death. *Clin Oral Investig*. 2017;21(7):2189-2196. doi:10.1007/S00784-016-2011-0/TABLES/4
- Gabel F, Kalmus O, Rosing K, Trescher AL, Listl S. Implementation of altered provider incentives for a more individual-risk-based assignment of dental recall intervals: evidence from a health systems reform in Denmark. *Health Econ*. 2020;29(4):475-488. doi:10.1002/hec.3997
- Tandlægeforeningen. Tilskud til tandpleje: Voksne. Tandlægeforeningen. Accessed September 1, 2022. <https://www.tandlaegeforeningen.dk/til-patienter/priser-og-tilskudsmuligheder/tilskud-til-tandpleje/voksne/>
- Christensen LB, Hede B, Petersen PE. Omsorgstandplejen i Danmark. *Tandlægenes Nnye Tidsskr*. 2005;8(20):8-15.
- Ministeriet for Sundhed Og Forebyggelse Rapport Om Serviceeftersyn Af Sundhedslovens Krav Til Indholdet Af Omsorgstandplejen. Ministeriet for Sundhed og Forebyggelse 2014.
- Bilde L, Halling CB, Kiil A. *Hvad Ved vi Om Brugerbetaling Og Efterspørgsel Efter Voksentandpleje? Del II*. International Sammenligning Af Erfaringer Med Brugerbetaling i Voksentandplejen; 2018. Accessed May 19, 2022. <https://www.vive.dk/media/pure/8166/1905669>
- Sundhedsstyrelsen. Omsorgstandpleje. 2023. Accessed February 1, 2023. <https://www.sst.dk/da/viden/sundhedsvaesen/det-primære-sundhedsvaesen/tandsundhed/omsorgstandpleje>
- Sundhedsstyrelsen. Modernisering Af Omsorgstandplejen: Anbefalinger for En Styrket Forebyggelse, Behandling, Visitation Og Organisering. Sundhedsstyrelsen; 2016.
- Sahl Andersen J, De Fine ON, Krasnik A. The Danish national health service register. *Scand J Public Health*. 2011;39(7):34-37. doi:10.1177/1403494810394718
- Thygesen SK, Christiansen CF, Christensen S, Lash TL, Sørensen HT. The predictive value of ICD-10 diagnostic coding used to assess Charlson comorbidity index conditions in the population-based Danish National Registry of patients. *BMC Med Res Methodol*. 2011;11:83. doi:10.1186/1471-2288-11-83
- Sundhedsdatastyrelsen. Danskernes brug af sundhedsvaesenet. 2016 (November).
- Liu B, Dion MR, Jurassic MM, Gibson G, Jones JA. Xerostomia and salivary hypofunction in vulnerable elders: prevalence and etiology. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2012;114(1):52-60.
- Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. *BMC Geriatr*. 2017;17(1):1-10. doi:10.1186/s12877-017-0621-2/TABLES/1
- Kornholt J, Christensen MB. Prevalence of polypharmacy in Denmark. *Dan Med J*. 2020;67(6):1-5.
- Wallach Kildemoes H, Toft Sørensen H, Hallas J. The Danish national prescription registry. *Scand J Public Health*. 2011;39(7):38-41. doi:10.1177/1403494810394717
- Fereshtehnejad SM, Garcia-Ptacek S, Religa D, et al. Dental care utilization in patients with different types of dementia: a longitudinal nationwide study of 58,037 individuals. *Alzheimers Dement*. 2018;14(1):10-19. doi:10.1016/j.jalz.2017.05.004
- Kunrath I, Silva AER. Oral health and depressive symptoms among older adults: longitudinal study. *Aging Ment Health*. 2021;25(12):2265-2271. doi:10.1080/13607863.2020.1855104
- Coleman P. Improving oral health care for the frail elderly: a review of widespread problems and best practices (CE). *Geriatr Nurs (Minneap)*. 2002;23(4):189-198. doi:10.1067/mgn.2002.126964
- Sundhedsdatastyrelsen. Algoritmer for Udvalgte Kroniske Sygdomme Og Svaere Psykiske Lidelser. 2018. Accessed February 1, 2023. <http://esundhed.dk/sundhedsregistre/uks/Documents/2018-01-18 Algoritmer for RUKS.PDF>



33. Nexø MA, Carlsen K, Pedersen J, et al. Long-term sickness absence of 32 chronic conditions: a Danish register-based longitudinal study with up to 17 years of follow-up. *BMJ Open*. 2018;8:20874. doi:[10.1136/bmjopen-2017-020874](https://doi.org/10.1136/bmjopen-2017-020874)
34. Kiyak HA, Reichmuth M. Barriers to and enablers of older adults' use of dental services. *J Dent Educ*. 2005;69(9):975-986.
35. Holm-Pedersen P, Vigild M, Nitschke I, Berkey DB. Dental care for aging populations in Denmark, Sweden, Norway, United Kingdom, and Germany. *J Dent Educ*. 2005;69(9):987-997.
36. Petersen PE, Davidsen M, Rosendahl Jensen H, Ekholm O, Illemann CA. Trends in dentate status and preventive dental visits of the adult population in Denmark over 30 years (1987-2017). *Eur J Oral Sci*. 2021;129(5):1-12.
37. Sundhedsstyrelsen. *Evaluering Af National Klinisk Retningslinje for Fastlæggelse Af Intervaller Mellem Diagnostiske Undersøgelser i Tandplejen*. Sundhedsstyrelsen; 2017.
38. Shen J, Listl S. Investigating social inequalities in older adults' dentition and the role of dental service use in 14 European countries. *Eur J Health Econ*. 2018;19:45-57.
39. Listl S. Income-related inequalities in dental service utilization by Europeans aged 50+. *J Dent Res*. 2011;90(6):717-723.
40. Tsakos G. Inequalities in oral health of the elderly: rising to the public health challenge? *J Dent Res*. 2011;90(6):689-690.
41. Knorst JK, Sfreddo CS, de Meira FG, Zanatta FB, Vettore MV, Ardenghi TM. Socioeconomic status and oral health-related quality of life: a systematic review and meta-analysis. *Community Dent Oral Epidemiol*. 2021;49(2):95-102. doi:[10.1111/cdoe.12616](https://doi.org/10.1111/cdoe.12616)
42. Diderichsen F, Andersen I, Manuel C, et al. Health inequality - determinants and policies. *Scand J Public Health*. 2012;40(Suppl 8):12-105. doi:[10.1177/1403494812457734](https://doi.org/10.1177/1403494812457734)
43. Tsakos G, Watt RG, Guarnizo-Herreño CC. Reflections on oral health inequalities: theories, pathways and next steps for research priorities. *Community Dent Oral Epidemiol*. 2023;51:17-27. doi:[10.1111/cdoe.12830](https://doi.org/10.1111/cdoe.12830)
44. Dolan TA, Peek CW, Stuck AE, Beck JC. Functional health and dental service use among older adults. *J Gerontol A Biol Sci Med Sci*. 1998;53(6):413-418.
45. Reda SM, Krois J, Reda SF, Thomson WM, Schwendicke F. The impact of demographic, health-related and social factors on dental services utilization: systematic review and meta-analysis. *J Dent*. 2018;75(February):1-6. doi:[10.1016/j.jdent.2018.04.010](https://doi.org/10.1016/j.jdent.2018.04.010)
46. Kuthy RA, Strayer MS, Caswell RJ. Determinants of dental user groups among an elderly, low-income population. *Health Serv Res*. 1996;30(6):809-825.
47. Lee KH, Wu B, Plassman BL. Dental care utilization among older adults with cognitive impairment in the USA. *Geriatr Gerontol Int*. 2015;15(3):255-260. doi:[10.1111/ggi.12264](https://doi.org/10.1111/ggi.12264)
48. Lundby C, Jensen J, Larsen SP, Hoffmann H, Pottsgård A, Reilev M. Use of medication among nursing home residents: a danish drug utilisation study. *Age Ageing*. 2020;49(5):814-820. doi:[10.1093/ageing/afaa029](https://doi.org/10.1093/ageing/afaa029)
49. Statistik D. Flest kvinder bor på plejehjem eller i plejebolig. Nyt fra Danmarks Statistik. 2020. Accessed January 4, 2024. <https://www.dst.dk/da/Statistik/nyheder-analyser-publ/nyt/NytHtml?cid=30746>
50. Danmarks Statistik. Befolkningsfremskrivning 2022 - tabel FRKM122. 2023. Statistikbanken. Accessed January 20, 2023. <https://www.statistikbanken.dk/statbank5a/default.asp?w=1920>
51. Tapager I, Westergaard CL. Tandplejebrug blandt ældre i Danmark. En registerbaseret undersøgelse af ældres brug af tandpleje med fokus på skrøbelighed og brug af omsorgstændpleje. 2023. [Report in Danish]. VIVE. The Danish Center for Social Science Research.

**How to cite this article:** Tapager I, Westergaard CL, Øzhayat EB. Health status, care dependency and oral care utilization among older adults: a register-based study. *Gerodontology*. 2024;00:1-9. doi:[10.1111/ger.12748](https://doi.org/10.1111/ger.12748)