

Oral Health Problems Among Flemish and Dutch Nursing Home Residents Assessed by Nondental Caregivers Using the Novel Oral Health Section for Inclusion in interRAI

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Decision Editor: Howard B. Degenholtz, PhD, FGSA

Abstract

Background and Objectives: Oral health of older adults in nursing homes is poor, which can negatively affect general health and well-being. Most oral health problems are preventable with good oral hygiene and regular dental check-ups. Caregivers can help improve residents' oral health through regular oral health assessments. The interRAI instrument used in Long-Term Care Facilities to evaluate older adults' health and well-being, has the potential to integrate oral care into general care planning. The recently optimized Oral Health Section for inclusion in the interRAI instruments (OHS-interRAI) enables nondental caregivers to identify residents requiring help with oral hygiene and/or a dental referral. This study reports the first data obtained using the OHS-interRAI, describing the oral health situation of older adults in Flemish and Dutch nursing homes.

Research Design and Methods: In this cross-sectional study, interRAI Long-Term Care Facilities data, including OHS-interRAI data, were collected from October 2020 to January 2023 and analyzed from 417 and 795 persons aged 65 years or older in Flemish and Dutch nursing homes, respectively.

Results: Most common oral health problems were poor oral hygiene and compromised teeth. Differences in oral health were found between Flemish and Dutch residents. Flemish residents had significantly more problems with chewing, dry mouth, oral and denture hygiene, and tongue condition than their Dutch counterparts. They also had a higher need for help with oral hygiene (19.4% vs 14.0%), and a dental referral (36.8% vs 20.9%). Older adults in Flemish nursing homes (20.3%) had significantly fewer dental check-ups than those in Dutch nursing homes (73.5%).

Discussion and Implications: The use of the OHS-interRAI by nondental caregivers identified at least one-third of the residents requiring help with oral hygiene and/or a dental referral. By means of trigger algorithms (Collaborative Action Points), the OHS-interRAI enables the integration of oral care into general care planning.

Keywords: Advance care planning, Care coordination, Continuum of Care, Long-term Care, Preventive medicine/care/services

Translational Significance: Oral health of older adults in nursing homes is poor. The OHS-interRAI is a section developed for use within holistic screening instruments evaluating persons' health and well-being (interRAI Suite), which enables caregivers to evaluate older adults' oral health and to identify individuals requiring assistance with oral hygiene and/or a dental referral. Such detection of oral health problems and treatment needs may contribute to actions improving oral health. A need for assistance in daily oral care and/or referral to a dentist was detected in over one-third of the residents. The OHS-interRAI facilitates integration of oral care into general care planning.

The aging population retains their natural dentition longer, resulting in more complex dental treatment needs (1,2). Several studies have reported poor oral health in older

adults (3–5). Their oral health often appears to deteriorate even more rapidly when they are admitted to nursing homes (4).

Received: December 22 2023; Editorial Decision Date: August 26 2024.

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The most commonly reported oral health problems among older individuals are dental caries, periodontitis, dry mouth, and mucosal lesions (6,7). Age-related conditions, including reduced ability to self-care, due to poor general health and polypharmacy, are important factors affecting oral health (1,6,8).

For instance, physical limitations such as reduced mobility and dexterity can affect older adults' ability to perform adequate oral hygiene (9). Cognitive impairment makes it difficult to understand the importance of oral hygiene and to follow a consistent hygiene routine (6,10). In addition, impaired vision and reduced sense of taste and smell can affect older adults' awareness of oral health problems, making adequate oral care more challenging (9,11). The fact that older adults often have more medical conditions requiring multiple medications can also increase the risk for oral health problems if proper oral care is not provided (1,12). Furthermore, lack of knowledge and awareness of the consequences of poor oral health and the social perception that deteriorating oral health is a natural part of aging may challenge maintaining good oral health (13).

Although oral health is often an overlooked aspect of general health and well-being, maintaining good oral health is important as oral diseases and poor oral hygiene can have a significant impact on general health and quality of life (4). Research has shown associations between periodontitis and systemic diseases such as cardiovascular diseases and diabetes (6). Caries and tooth loss, as a result of periodontitis, may also increase the risk of cognitive impairment or dementia (14,15). Malnutrition is associated with poor oral function (16). Furthermore, high levels of plaque on dentures increase the risk of aspiration pneumonia, especially if dentures are worn at night (6). In addition, poor oral health has been associated with dissatisfaction with dental appearance and psychosocial behavior, affecting an individual's self-esteem and quality of life (17).

Good oral hygiene and routine dental check-ups are essential for preventing, identifying, and addressing oral health problems in older adults (6). Caregivers are usually in charge of care-dependent older adults' daily care, making them important intermediaries who can contribute to the prevention, early detection, and timely referral of oral health problems through regular oral health assessments (4,18).

Several oral health assessment instruments for nondental caregivers exist, such as the Resident Oral Assessment Guide (ROAG), the Oral Health Assessment Tool (OHAT), the Oral Health Screening Tool for Nursing Personnel, and the oral health-related section for use in the interRAI suite of instruments (ohr-interRAI) (19,20).

The interRAI Suite of instruments is a set of comprehensive assessment instruments to evaluate health and well-being of care-dependent persons in different healthcare settings, introduced in more than 35 countries. The instruments can be completed by various types of caregivers, such as nurses, care aids, physicians, occupational therapists, and physiotherapists. In some countries, several caregivers collaborate to complete the instrument for one care-dependent person. The collection of high-quality health and well-being data, based on a multidimensional set of items, enables caregivers to identify care needs and facilitate care planning. The interRAI instruments for use in Long-Term Care Facilities (LTCF) and Home Care (HC) include oral health as part of general health (<https://interrai.org/>) (21). However, research has shown that

the current oral health section of the interRAI LTCF and HC is incomplete and has limited validity (22,23). Therefore, an optimized oral health section was developed, the ohr-interRAI (24), which was recommended by Rodrigues et al. (20) as the most suitable instrument for oral health evaluation of institutionalized older adults by nondental caregivers.

Recently, the ohr-interRAI was further validated and refined by 53 international experts from 34 countries in oral health for older adults, resulting in the Oral Health Section for inclusion in the interRAI Suite (OHS-interRAI) (25). The latter evaluates the oral health of older adults according to nine items (oral health indicators) on a scale differentiating between acceptable and unacceptable conditions. The assessor also has the option of indicating that the item is not applicable (eg, assessment of teeth in a person who no longer has teeth) or that it cannot be assessed (eg, person resists; Figure 1). Caregivers assess *Chewing function*, *Discomfort and/or Pain*, and *Dry mouth* by interviewing and/or observing residents during meals and during their daily routine. In order to evaluate *Hygiene of removable dentures*, *Oral hygiene*, *Teeth*, *Gums*, *Tongue*, and *Palate and inner surface of cheeks and lips*, a visual inspection of the mouth is required. For these items, photographs, with labels and indications of relevant structures and abnormalities, are provided to help caregivers identify oral health problems (24,25).

In addition, the OHS-interRAI includes two Collaborative Action Points (CAPs). These are trigger algorithms that are automatically calculated after the assessment is completed. The CAP *oral hygiene* alerts caregivers when help with daily oral hygiene is needed (eg, motivating the resident, providing knowledge and skills, supporting oral care) and the CAP *referral to a dentist* when a referral to a dentist is recommended (24,25). Guidelines accompanying these CAPs suggest concrete actions to help resolve the underlying oral health problems (26). Furthermore, general and specific utilization guidelines, as well as instruction videos are available to facilitate the assessment process and improve the quality of the assessment (24,25).

The OHS-interRAI is currently not officially included in the interRAI Suite. However, there is a Belgian software (27) offering caregivers the opportunity to use the OHS-interRAI included in the interRAI LTCF to evaluate and monitor the oral health status of older adults in Flemish and Dutch nursing homes. This study aims to describe the oral health problems in this population and is the first study to report data obtained using the OHS-interRAI in regular clinical use.

Research Design and Methods

Study Design and Inclusion Criteria

This is a retrospective cross-sectional study using interRAI LTCF data, including the OHS-interRAI, to evaluate the prevalence of oral health problems among care-dependent older adults. All participants were at least 65 years old and were living in nursing homes in Flanders or in the Netherlands. Only residents in nursing homes using the Belgian software Pyxicare (27), allowing the use of the OHS-interRAI in the interRAI LTCF instrument, were able to participate in the study.

Ethical Approval

Approval for this multicenter study was obtained from the Belgian Privacy Commission and Ethics Committee Research

Items	Response options			
	1	2	3	4
Chewing function	No chewing problems	Chewing problems	Cannot be assessed	Not applicable
Discomfort and/ or pain in the mouth	No discomfort and/or pain	Discomfort and/ or pain	Cannot be assessed	
Dry mouth	No dry mouth	Dry mouth combined with poor oral hygiene ⁺	Cannot be assessed	
Hygiene of removable dentures	Good/ acceptable	Poor/ unacceptable	Cannot be assessed	Not applicable
Oral hygiene	Good/ acceptable	Poor/ unacceptable	Cannot be assessed	Not applicable
Teeth	Good/ acceptable	Poor/ unacceptable	Cannot be assessed	Not applicable
Gums	Good/ acceptable	Poor/ unacceptable	Cannot be assessed	
Tongue	Good/ acceptable	Poor/ unacceptable	Cannot be assessed	
Palate and inner surface of cheeks and lips	Good/ acceptable	Poor/ unacceptable	Cannot be assessed	

+ In case of a dry mouth, the CAP referral to a dentist will only be triggered when oral hygiene is also poor.

Green

- Daily oral hygiene and hygiene of removable dentures are good/ acceptable.
- Oral tissues are healthy.

⇒ No CAPs are triggered. The ongoing care is to be continued.

Yellow

- Daily oral hygiene and/ or hygiene of removable dentures are/ is poor/ unacceptable.

⇒ CAP *oral hygiene* is triggered. Daily oral hygiene care will be improved following the guidelines.

Red

- One or more aspects of oral health are poor/ unacceptable.

⇒ CAP *referral to a dentist* is triggered. The client will be referred to a dentist for professional oral health care.

Figure 1. Activation of the collaborative action points (CAPs). interRAI = xxx.

UZ/KU Leuven (B3222021000448). All participants in Flanders and the Netherlands gave their informed consent.

Data Collection

The oral health of the nursing home residents was assessed by caregivers using the OHS-interRAI, included in the interRAI LTCF instrument. Figure 1 gives an overview of the items and response options of the OHS-interRAI and illustrates the items responsible for activating the CAP *oral hygiene* in yellow and the CAP *referral to a dentist* in red. All data were collected from October 2020 to January 2023.

The interRAI LTCF instrument provided comprehensive information in a standardized manner about different areas of personal functioning (eg, physical, cognitive, psychological, and social) and various aspects of health and well-being, including information on whether a resident had a dental check-up in the last year.

Data Analyses

Statistical analyses were performed using IBM SPSS Statistics, version 28.0.1.1, and SAS Enterprise Guide, version 8.1. The same analyses were conducted for interRAI data from Flanders and the Netherlands.

All residents’ first assessments (after the start of the data collection) with the interRAI LTCF instrument including the OHS-interRAI were analyzed in this study. Missing values in oral health data were analyzed to determine whether differences in health outcomes between residents with and without a completed OHS-interRAI were random.

Descriptive statistics illustrate characteristics of the nursing homes, interRAI data of residents, and their oral health status (oral health items of the OHS-interRAI and activation of CAPs). The outcome scales included in the interRAI instrument with validated cutoff values (eg, Activities of Daily Living (ADL): range 0–6, cutoff ≥ 3) represent a person’s clinical status (21). Categorical variables were expressed using absolute and relative frequencies according to available data

per item. Mean and standard deviation were used to describe the frequency and distribution of continuous variables.

The oral health items of the OHS-interRAI were considered binary, indicating firstly whether the items were assessed or not; and then whether the oral health situation for each item was acceptable or unacceptable. The response options “cannot be assessed” and “not applicable” could be used in case the assessment could not be performed (eg, because of resistance of the person) or if the item did not apply (eg, condition of the teeth for edentulous persons). The chi-square test was used to evaluate whether the oral health status of residents differed between Flanders and the Netherlands. A *p* value <.05 was considered statistically significant.

Results

Baseline Characteristics

InterRAI data were collected from 476 residents in Flanders and 822 in the Netherlands. Analyses were performed to assess whether missing oral health data were related to certain aspects of health and well-being of the persons involved. As the analyses did not reveal such a correlation, missing oral health data of these residents were assumed to be random. After exclusion of interRAI assessments with completely missing oral health data, a total of 417 residents from 11 Flemish nursing homes and 795 residents from 26 Dutch nursing homes were included in the study. Most nursing homes had a capacity of 100–199 residents (Flanders: 8/11, the Netherlands: 24/26). The assessments were completed by 47 and 156 different nondental caregivers in Flanders and the Netherlands, respectively.

The average age of the residents was 83.4 (±6.9) years in Flanders and 81.5 (±7.6) years in the Netherlands. The majority of residents, in both countries, were female, 67.4% and 64.3% respectively. In Flanders, more older adults (71.9%) were dependent on ADL than in the Netherlands (47.1%). The same pattern was seen for physical dependency on others

for personal hygiene, which was 83.4% in Flanders and 61.3% in the Netherlands. Pain was reported less frequently in Flemish residents (6.3%) than in Dutch residents (18.4%) and Flemish residents (30.6%) had fewer depressive symptoms according to the Depression Rating Scale than their Dutch counterparts (41.6%).

Table 1 provides more details about the participating residents.

Oral Health

The OHS-interRAI was used by nondental caregivers to assess the oral healthcare needs of nursing home residents. Table 2 presents the results of the nine oral health items, and Table 3 provides information on the activation of the CAPs for the residents in both countries.

Flanders, Belgium

About 19.0% of the residents experienced chewing problems. Discomfort and/or pain in the mouth and a feeling of a dry mouth were reported by 5.5% and 13.0% of the Flemish residents, respectively. Teeth were not assessed in 41.6% of the residents, of whom 71.9% were edentulous. Caregivers observed the condition of the teeth in 58.4% of the residents,

and 25.8% of them had compromised teeth. Oral hygiene was assessed in 67.2% of the older adults and found to be poor in 24.5% of them. Hygiene of removable dentures was assessed in 58.0% of the residents, indicating that the others did not have removable dentures or were, for example, resistant to care. Of those where removable dentures were assessed, 13.0% exhibited poor denture hygiene. The prevalence of residents with gum and tongue problems was 7.9% and 7.4%, respectively. The condition of the palate and inner surface of cheeks and lips was generally considered to be poor and unacceptable by the caregivers in 2.6% of the residents.

The CAP oral hygiene was triggered in 19.4% of the residents, indicating a need for oral hygiene improvement, which implies a need for assistance with daily oral hygiene. In addition, the CAP referral to a dentist was triggered in about 37.0% of the residents, mostly because of compromised teeth and chewing problems. In Flanders, 20.3% of the residents had a dental check-up in the last year. Of these residents, the CAP oral hygiene was triggered in 30.5% and the CAP referral to a dentist in 45.7%. However, the CAP referral to a dentist was not significantly more triggered for older adults who went to the dentist in the last year ($p = .074$).

Table 1. Characteristics of the Participating Residents

Variable	Total		Flanders		The Netherlands		p Value
	n/N	M (\pm SD) or %	n/N	M (\pm SD) or %	n/N	M (\pm SD) or %	
Age	1 212/1 212	82.2 (\pm 7.4)	417/417	83.4 (\pm 6.9)	795/795	81.5 (\pm 7.6)	<.001
Gender							.280
Female	792/1 212	65.3	281/417	67.4	511/795	64.3	
Male	420/1 212	34.7	136/417	32.6	284/795	35.7	
Daily smoker	93/1 207	7.7	24/413	5.8	69/794	8.7	.075
Scales							
Activities of Daily Living (ADL; [0–6] \geq 3)	673/1 210	55.6	299/416	71.9	374/794	47.1	<.001
Cognitive Performance Scale (CPS; [0–6] \geq 3)	727/1 203	60.4	243/410	59.3	484/793	61.0	.553
Pain ([0–4] \geq 2)	172/1 207	14.3	26/414	6.3	146/793	18.4	<.001
Depression Rating Scale (DRS; ([0–14] \geq 3)	457/1 207	37.9	126/412	30.6	331/795	41.6	<.001
Changes in Health, End-stage disease and Symptoms and Signs (CHESS; [0–5] \geq 3)	64/1 193	5.4	17/407	4.2	47/786	6.0	.190
Diseases							
Depression	165/1 209	13.6	74/417	17.7	91/792	11.5	.003
Dementia	360/1 207	29.8	132/416	31.7	228/791	28.8	.294
Heart failure (CHF)	276/1 208	22.9	89/417	21.3	187/791	23.6	.366
Pneumonia	19/1 208	1.6	7/416	1.7	12/792	1.5	.824
Diabetes mellitus	256/1 208	21.2	73/416	17.5	183/792	23.1	.025
Poor self-reported health	95/1 207	7.9	32/413	7.7	63/794	7.9	.909
Resistance to care	232/1 206	19.2	75/412	18.2	157/794	19.8	.512
Conflict with or criticism toward caregivers	209/1 206	17.3	82/412	19.9	127/794	16.0	.089
Continued frustration with the resident	120/1 206	10.0	51/412	12.4	69/794	8.7	.042
Limited to full physical dependence on others for personal hygiene	834/1 209	69.1	347/416	83.4	487/793	61.3	<.001
Strong and supportive relationship with family	1 058/1 205	87.8	352/411	85.6	706/794	88.9	.100

Notes: n/N: specific outcome per item (n)/total available data per item (N). CHF = Congestive Heart Failure; SD = Standard Deviation.

Table 2. Prevalence of Oral Health Problems in Flanders and in the Netherlands.

Oral Health Items and Assessment Status	Total		Flanders		The Netherlands		p Value
	n	%	n	%	n	%	
Chewing function	1 193		413		780		<.001
Assessed	1 160	97.2	392	94.9	768	98.5	
Good/acceptable	1 001	86.3	319	81.4	682	88.8	
Poor/unacceptable	159	13.7	73	18.6	86	11.2	
Not assessed	33	2.8	21	5.1	12	1.5	
Cannot be assessed	19	57.6	13	61.9	6	50.0	
Not applicable	14	42.4	8	38.1	6	50.0	
Missing oral health data	19/1 212		4/417		15/795		
Discomfort and/or pain	1 207		415		792		.212
Assessed	1 132	93.8	383	92.3	749	94.6	
No	1 082	95.6	362	94.5	720	96.1	
Yes	50	4.4	21	5.5	29	3.9	
Not assessed	75	6.2	32	7.7	43	5.4	
Cannot be assessed	75	100.0	32	100.0	43	100.0	
Missing oral health data	5/1212		2/417		3/795		
Dry mouth	1 207		415		792		.010
Assessed	1 133	93.9	385	92.8	748	94.4	
No	1 022	90.2	335	87.0	687	91.8	
Yes	111	9.8	50	13.0	61	8.2	
Not assessed	74	6.1	30	7.2	44	5.6	
Cannot be assessed	74	100.0	30	100.0	44	100.00	
Missing oral health data	5/1 212		2/417		3/795		
Hygiene of removable dentures	1 197		410		787		.014
Assessed	760	63.5	238	58.0	522	66.3	
Good/acceptable	690	90.8	207	87.0	483	92.5	
Poor/unacceptable	70	9.2	31	13.0	39	7.5	
Not assessed	437	36.5	172	42.0	265	33.7	
Cannot be assessed	134	30.7	46	26.7	88	33.2	
Not applicable	303	69.3	126	73.3	177	66.8	
Missing oral health data	15/1 212		7/417		8/795		
Oral hygiene	1 192		408		784		.005
Assessed	786	65.9	274	67.2	512	65.3	
Good/acceptable	636	80.9	207	75.5	429	83.8	
Poor/unacceptable	150	19.1	67	24.5	83	16.2	
Not assessed	406	34.1	134	32.8	272	34.7	
Cannot be assessed	154	37.9	52	38.8	102	37.5	
Not applicable	252	62.1	82	61.2	170	62.5	
Missing oral health data	20/1 212		9/417		11/795		
Teeth	1 194		411		783		.071
Assessed	588	49.2	240	58.4	348	44.4	
Good/acceptable	458	77.9	178	74.2	280	80.5	
Poor/unacceptable	130	22.1	62	25.8	68	19.5	
Not assessed	606	50.8	171	41.6	435	55.6	
Cannot be assessed	124	20.5	48	28.1	76	17.5	
Not applicable	482	79.5	123	71.9	359	82.5	
Missing oral health data	18/1 212		6/417		12/795		
Gums	1 186		405		781		.957
Assessed	999	84.2	343	84.7	656	84.0	
Good/acceptable	921	92.2	316	92.1	605	92.2	
Poor/unacceptable	78	7.8	27	7.9	51	7.8	
Not assessed	187	15.8	62	15.3	125	16.0	
Cannot be assessed	187	100.0	62	100.0	125	100.0	

Table 2. Continued

Oral Health Items and Assessment Status	Total		Flanders		The Netherlands		<i>p</i> Value
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Missing oral health data	26/1 212		12/417		14/795		
<i>Tongue</i>	1 197		409		788		<.001
Assessed	1 050	87.7	352	86.1	698	88.6	
Good/acceptable	1 011	96.3	326	92.6	685	98.1	
Poor/unacceptable	39	3.7	26	7.4	13	1.9	
Not assessed	147	12.3	57	13.9	90	11.4	
Cannot be assessed	147	100.0	57	100.0	90	100.0	
Missing oral health data	15/1 212		8/417		7/795		
Palate and inner surface of cheeks and lips	1 191		409		782		.177
Assessed	973	81.7	346	84.6	627	80.2	
Good/acceptable	937	96.3	337	97.4	600	95.7	
Poor/unacceptable	36	3.7	9	2.6	27	4.3	
Not assessed	218	18.3	63	15.4	155	19.8	
Cannot be assessed	218	100.0	63	100.0	155	100.0	
Missing oral health data	21/1 212		8/417		13/795		

Notes: For missing oral health data, missing data per item/total of participating residents (*n/N*) are reported.

Table 3. Prevalence of Activated Collaborative Action Points (CAPs) and Dental Check-Ups in Flanders and in the Netherlands

Variable	Total		Flanders		The Netherlands		<i>p</i> Value
	<i>n/N</i>	%	<i>n/N</i>	%	<i>n/N</i>	%	
CAPs							
Oral hygiene	189/1 190	15.9	79/407	19.4	110/783	14.0	.016
Referral to a dentist	305/1 156	26.4	147/399	36.8	158/757	20.9	<.001
Dental check-up in the last year	667/1 206	55.3	84/413	20.3	583/793	73.5	<.001
CAP oral hygiene	114/655	17.4	25/82	30.5	89/573	15.5	<.001
CAP referral to a dentist	165/630	26.2	37/81	45.7	128/549	23.3	<.001

Notes: *n/N*: specific outcome per item (*n*)/total available data per item (*N*). CAP = Collaborative Action Point.

The Netherlands

Chewing problems were reported in 11.2% of the Dutch nursing home residents. The proportion of residents suffering from dry mouth (8.2%) was higher than those having discomfort and/or pain in the mouth (3.9%). Hygiene of removable dentures was assessed in 66.3% of the residents and was unacceptable in 7.5% of them. The condition of the teeth was not assessed in 55.6% of the residents, mainly because caregivers reported that this item did not apply (82.5%) to these residents, due to edentulism. Of those with assessable teeth (44.4%), an unacceptable condition was observed in 19.5%. Poor oral hygiene and gum problems were observed in 16.2% and 7.8% of the residents, respectively. The least common identified oral health problems were problems with the tongue (1.9%) and palate and inner surface of cheeks and lips (4.3%).

The CAP *oral hygiene* and the CAP *referral to a dentist* were triggered in 14.0% and 20.9% of the residents, respectively. The majority of the residents had a dental check-up in the last year (73.5%). Of these residents, 15.5% needed help with daily oral hygiene, and a dental check-up was recommended for 23.3%. A significant difference was found between the

activation of the CAP *referral to a dentist* and those having a dental check-up in the last year ($p = .007$).

Comparison of Flanders, Belgium, and The Netherlands

The oral health situation of residents was generally considered to be better and more acceptable in the Netherlands compared to Flanders. The prevalence of problems was significantly higher in Flanders regarding chewing function ($p < .001$), dry mouth ($p = .010$), hygiene of removable dentures ($p = .014$), oral hygiene ($p = .005$), and tongue condition ($p < .001$) than in the Netherlands. Notably, Flemish residents (7.4%) were reported to have almost four times more frequently unacceptable conditions of the tongue than Dutch residents (1.9%).

On the other hand, problems identified with teeth ($p = .071$), gums ($p = .957$), and palate and inner surface of cheeks and lips ($p = .177$) were not statistically different between Flemish and Dutch residents. Caregivers also reported comparable results concerning discomfort and pain in the mouth ($p = .212$). Additionally, the CAP *oral hygiene* and the CAP *referral to a dentist* were significantly more often triggered for the Flemish residents ($p < .001$). This aligns with the fact that

significantly fewer Flemish residents had a dental check-up in the last year compared to their Dutch counterparts (20.3% vs 73.5%, $p < .001$).

Discussion and Implications

This study describes the oral health problems among care-dependent older adults in Flemish and Dutch nursing homes, as assessed by nondental caregivers using the OHS-interRAI. The OHS-interRAI was developed for inclusion in the interRAI instruments to assess the oral health situation and to identify persons who need assistance with daily oral care or referral to a dentist (24,25).

The first three items of the OHS-interRAI, *dry mouth, discomfort or pain*, and *chewing function*, are assessed through interviews with residents and/or observing their behavior during meals. Reduced saliva production increases the risk of oral diseases such as mucosal inflammation and dental caries and negatively affects physical, emotional, and social functioning (eg, an increased likelihood of oral pain and difficulty eating and communicating) (28,29). This study noted xerostomia (the feeling of a dry mouth) in 9.8% of the participants, although prevalence rates in institutionalized older adults generally range from 20.0% to 72.0% (12). Reported prevalence rates of objective oral dryness or hyposalivation ranged from 13.0% to 75.0% (30).

Orofacial pain is often overlooked in older adults (31). In this study, 4.4% of the residents reported discomfort or pain in the last 3 days. This is consistent with the prevalence of self-reported orofacial pain in older adults by Delwel et al. (32), ranging from 0.0% to 9.6%. However, the same study revealed a higher percentage of orofacial pain (25.7%) in these individuals using objective measures (32). Given the association between oral pain and psychological and physical distress, as well as social disability, oral health interventions to prevent or alleviate this type of pain are necessary (33).

Assessing chewing function is important as it can affect food choices, eating habits, and oral health-related quality of life in general (34). In addition, chewing difficulties may negatively affect general health, including cognitive function and mental health (16,35). This study reported chewing difficulties in 13.7% of the residents, which is lower than in other research using self-reported screenings (35.0%) (36). Objective measures of chewing function using color-changing gum showed relatively poor chewing function in 39.0% of older individuals (37).

As *dry mouth, discomfort or pain*, and *chewing function* were assessed through self-report, the results of this study may be affected by self-report bias. The OHS-interRAI guidelines suggest relying on input from other caregivers or family members, or observations during meals when residents are unable to communicate, which could lead to misinterpretation. Therefore, objective assessments of these items might have yielded different results. To assess the other six items of the OHS-interRAI, *hygiene of removable dentures, oral hygiene, teeth, gums, tongue*, and *palate and inner surface of cheeks and lips*, an observation in the mouth was required.

Poor oral and denture hygiene was identified in 19.1% and 9.2%, respectively, of the participants for whom it was applicable. Caregivers assessed this based on plaque covering more or less than one-third of a tooth or denture surface. This assessment method appears to be a crude and underestimating measure as assessments by oral health professionals

observed a higher prevalence of poor oral (27.0%) and denture (36.7%) hygiene of nursing home residents (38,39). Considering that the absence of oral biofilm through oral hygiene is a prerequisite for the prevention of caries and oral infections (40,41), efforts should be made to improve the detection of suboptimal oral hygiene conditions.

Similarly, the prevalence of gum disease (7.8%), indicated by inflammation of the gums, appears low compared to the WHO-reported global prevalence of periodontitis of 48.7% (42). The difference between observed (3.7%) and reported (64.0%) (43) unacceptable oral mucosal conditions is even higher, although their detection is important given that mucosal tissues are susceptible to the development of oral cancer (44). However, the prevalence of edentulism (40.4%) was more in line with reported data from nursing home residents (20.4%–62.0%) (40). Finally, compared to Chan et al.'s systematic review (45), 21.0%–59.0% of institutionalized older adults in Europe had dental caries and 8.0%–54.0% had root caries. Timely referral to a dentist is, however, important as severe caries can lead to tooth loss, which can negatively affect a person's esthetics, function, self-esteem, and overall quality of life (45).

In summary, caregivers identified lower prevalence rates of oral health problems for the six items requiring an oral examination than oral health professionals. This indicates underestimation of oral health problems by nondental caregivers, most likely due to their limited oral health care education and experience (46) as well as to the crude screening tool and their reluctance to inspect the mouth (46,47).

The underestimation of oral health problems by caregivers compared to dentists using the ohr-interRAI was also reflected in the sensitivity and specificity analysis by Krausch-Hofmann et al. (24). Regarding the CAPs, they found low sensitivity (44.8%) but high specificity (86.7%) for the CAP *oral hygiene*, which implies that caregivers often missed identifying residents in need of improved daily oral care but were effective in recognizing those not requiring assistance. In contrast, the CAP *referral to a dentist* showed high sensitivity (92.0%) but lower specificity (54.5%), indicating accurate identification of residents in need of referral but less in recognizing those without such need. Lack of training and experience was suggested as the main difficulty in accurately detecting oral care needs and further training was recommended (24). Nevertheless, screening by caregivers remains important because it allows the identification of problems that would otherwise go unnoticed, although unfortunately not always. This argues for further optimization of the sensitivity of the OHS-interRAI.

Comparing the OHS-interRAI with other assessment instruments, such as the OHAT, ROAG, and oral health section in the MDS 3.0, provides valuable insights into its features. The OHAT consists of the evaluation of the *Lips, Tongue, Gums and oral tissues, Saliva, Natural teeth, Dentures, Oral cleanliness*, and *Dental pain* on a three-point scale (0: *healthy*, 1: *changes in the situation*, 2: *unhealthy*), recommending a dental visit for a score of one or higher. The ohr-interRAI, predecessor of OHS-interRAI, was preferred over the OHAT due to its higher-quality evidence of sufficient content validity (20).

The ROAG evaluates oral health using nine items; *Voice, Lips, Mucous Membranes, Tongue, Gums, Teeth, Dentures, Saliva*, and *Swallowing* on a three-point scale (0: *healthy*, 1: *moderate problem*, 2: *severe problem*). Similar to the OHS-interRAI, it recommends a consultation with a physician/

dentist or oral care support when oral health problems are identified (48). Research suggests using clinical photographs, as included in the OHS-interRAI, to enhance assessments with the ROAG (48).

The oral health section in the MDS 2.0 was optimized because of its limited ability to identify prevalent and important oral health conditions, resulting in an optimized version in the MDS 3.0, the assessment instrument required for Medicare or Medicaid reimbursement (22,49,50). The optimized oral health section in the MDS 3.0 includes six items (*Broken or loosely fitting full or partial denture, No natural teeth or tooth fragment(s), Abnormal mouth tissue, Obvious or likely cavity or broken natural teeth, Inflamed or bleeding gums or loose natural teeth, and Mouth or facial pain, discomfort or difficulty with chewing*) to assess the oral/dental status. Caregivers have to check all items that applied in the last 5 days, in addition to the options that none of the items were present or an examination was not possible (49). It also has an alarm signal (Dental Care CAT) for dental problems (50).

In summary, the OHS-interRAI includes photographs and more clarifying information than the other assessment instruments mentioned. Compared to the OHAT and oral health section in the MDS 3.0, the OHS-interRAI has a second trigger algorithm for identifying help with daily oral care. Caregivers using the ROAG or OHAT could not indicate when an item was not assessable or applicable due to a person's condition, which could lead to inaccurate or meaningless results. In contrast to the oral health section in the MDS 3.0, the OHS-interRAI has the ability to indicate the non-assessable options per item. Although the removal of plaque and tartar is essential to maintaining good oral health, the ROAG and MDS 3.0' oral health section do not include an item to assess oral hygiene (4).

Some limitations should be acknowledged in this study. Only nursing homes using the Belgian software (27) in which the OHS-interRAI is integrated, were included in the study. Furthermore, the participating Dutch nursing homes belonged to the only umbrella group of nursing homes (Omring group) using the interRAI including the OHS-interRAI, because their management was motivated to use the OHS-interRAI as part of their oral health policy. This may imply an overrepresentation of motivated and cooperative nursing homes. However, it may not fully explain the differences in results between Flanders and the Netherlands. A more prominent reason could be that all Dutch residents are entitled to a dental visit, covered by a reimbursement rule regulated in the law of long-term care (51).

In addition, the oral health assessments in this study were performed for the first time using the OHS-interRAI and by several different caregivers, whose training or education was unknown. This may have led to some variation in the way the assessments were carried out.

Further research is needed to assess the concurrent validity of the OHS-interRAI. In addition, analyzing longitudinal oral health data will reveal whether the integration of the OHS-interRAI in daily care has an impact on the oral health situation of residents. It is also interesting to explore the interactions between oral and general health using the OHS-interRAI included in the interRAI LTCE, as research has shown that some populations are more at risk of developing oral health problems (7). Furthermore, improving oral health of older adults requires efforts at

different levels within nursing homes (3). Therefore, further research evaluating the impact and the use of the OHS-interRAI at the organization, caregiver, and resident levels would be useful.

In conclusion, this study shows that improved and regular assessment of oral health as part of daily care in nursing homes is possible, and sheds light on the oral health situation of Flemish and Dutch nursing home residents assessed by nondental caregivers using the OHS-interRAI. An underestimation of oral health problems was found when compared to evidence of assessments by oral health professionals, which highlights the need for better training and creating more awareness among caregivers. Nevertheless, the OHS-interRAI has several assets, including exemplary photographs, comprehensive response options, and CAPs, which differentiate it from other oral health assessment instruments. Further research on the OHS-interRAI is needed to ensure accurate identification of those who need help with daily oral care and referral to a dentist, which in turn can contribute to improved oral health of older adults. This is particularly important as poor oral health can negatively affect general health and quality of life.

Funding

This work was supported by KU Leuven [C24M-20-063] and Research Foundation Flanders [TBM T003220N].

Conflict of Interest

None.

Data Availability

The data generated and/or analyzed in this study are not publicly available due to data privacy. Information on the official procedure for requesting the data can be obtained by contacting the corresponding author. The study reported in this manuscript was not preregistered.

Acknowledgments

In this manuscript, AI writing assistance from DeepL Write and Grammarly was used to verify the English language and writing style. The authors would like to express their gratitude to the participating Flemish and Dutch nursing homes. In addition, they would like to thank the residents and nondental caregivers for their time and valuable contribution to this study. Furthermore, many thanks to Marijke Boorsma en Sandra Hartog for the communication with the Omring group in the Netherlands.

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