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Comparison of the oral health status of nursing home residents using the current and the newly developed interRAI oral health section (OHS-interRAI): a cross-sectional study

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Abstract

Background Regular dental l check-ups and good oral hygiene are challenging for nursing home residents, resulting in poor oral health. The interRAI instrument for Long-Term Care Facilities (LTCF) enables caregivers to evaluate residents' health, including oral health, and to integrate oral care into general care planning. Because the current oral heal1th section in the interRAI instruments does not accurately identify residents who need help with daily oral care or dental referral, the interRAI Oral Health Section (OHS-interRAI) was developed. The OHS-interRAI differs from the current section by including more items, response options and guidelines, photographs, instruction videos, and Collaborative Action Points to alert caregivers when oral care is needed.

This study describes and compares residents' oral health status assessed by caregivers using the current section and the OHS-interRAI.

Methods This cross-sectional study includes baseline data of adults aged 65 years or older in Flemish and Dutch nursing homes, collected by professional caregivers (e.g., nurses, nurse aids, therapists). Assessments with the current section dated from October 2016 to January 2023, and with the OHS-interRAI from October 2020 to January 2023.

Results InterRAI assessments of 12,476 residents from 158 nursing homes with the current section were compared with those of 1212 residents from 37 nursing homes with the OHS-interRAI.

The OHS-interRAI assessments showed more missing data. A higher proportion of oral health problems was detected with the OHS-interRAI compared to the current section for chewing function (13.7% vs. 6.8%), dry mouth (9.8% vs. 7.6%), teeth (22.1% vs. 16.6%),and gums (7.8% vs. 3.1%). There was no significant difference in the proportion of residents with discomfort or pain in the mouth.

Conclusions More missing OHS-interRAI data may be attributed to regulatory decisions on using the interRAI LTCF instrument. Caregivers identified more oral health problems with the OHS-interRAI, which may be due to its additional features, such as photographs and extensive instructions. The Collaborative Action Points included in the OHS-interRAI support continuity of care and enable integration of oral care into general care. Further research is needed

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to evaluate whether the OHS-interRAI accurately identifies residents who need help with daily oral hygiene or dental referral.

Keywords Advanced care planning, Assessment, Care coordination, Continuum of Care, Geriatric conditions, Intervention, Long-term care, Person-centered care, Preventive medicine/ care/ services, Successful aging, Oral health, Oral care

Background

Oral health, including oral hygiene, of older adults is generally poor. Most common oral health problems are tooth loss, dental caries, periodontal disease, dry mouth and mucosal lesions [1]. This is particularly true for those living in nursing homes, partly as a result of their reduced ability to self-care and more complex healthcare needs [2].

However, good oral hygiene and regular dental check-ups are important as poor oral health can negatively affect general health and well-being [3]. Several studies have reported a link between periodontal disease and an increased risk of diabetes and cardiovascular disease [4]. Poor oral hygiene has been associated with aspiration pneumonia, especially when dentures are worn at night [5]. In addition, tooth loss and poor oral function have been identified as risk factors for cognitive impairment and malnutrition [6, 7]. Furthermore, studies have shown that poor oral health, such as tooth loss, can affect a person's self-confidence which can lead to anxiety, depression and a reduced quality of life in general [4].

Although oral health problems are largely preventable and treatable, age-related conditions can present a challenge for older adults to maintain good oral health [2]. Persons with cognitive problems may have difficulty understanding the importance of good oral health and performing appropriate oral care. They often tend to forget how to brush their teeth [4, 8]. In addition, functional limitations such as reduced mobility and dexterity may affect their oral health habits and limit their access to dental care [9, 10]. Older adults may also be less aware of oral health problems due to sensory limitations such as reduced vision and loss of taste and smell [9, 10]. Furthermore, the high level of polypharmacy among older adults due to poorer general health may affect their salivary flow, leading to a dry mouth, which increases the risk of caries and mucosal lesions [4, 11, 12].

Caregivers are usually responsible for residents' daily care and can help prevent, early detect, and manage oral health problems [2]. However, they face several challenges in providing oral care, including insufficient knowledge and skills, lack of time, and low prioritization of oral care [13]. Organizational factors, such as the lack of necessary supplies and the absence of policies for oral care further contribute to their challenges [13]. Integrating oral health into general health assessments can help overcome some of these challenges and improve oral health outcomes for older adults [2, 14].

The interRAI Suite of instruments was developed for caregivers to identify care needs of vulnerable persons across different care settings and has been introduced in over 35 countries. These instruments collect standardized information on multiple domains, including function, cognition, mental health and social support, which can be easily and securely shared with other care providers to support decision-making at personal, clinical, managerial and policy levels. The integration of Collaborative Action Points (CAPs) (e.g., CAP Fall: risks of falls, CAP cognition: risk of cognitive decline) ensures that caregivers are alerted when health or other domains can be improved or when actions are needed to prevent health from deteriorating. This unique feature of the interRAI Suite supports continuity of care and facilitates care planning [15, 16]. The interRAI instruments used in Long-Term Care Facilities (LTCF) and Home Care (HC) include a section with oral health-related questions (items), providing the opportunity for regular oral health assessments by caregivers. The use of these instruments, which consider oral health as part of general health and well-being, can be a lever to integrate oral care into general care planning [16].

Several studies have examined the validity of the current oral health section (hereafter referred to as 'current section') within these instruments and found that the oral health section did not adequately identify oral care needs, indicating the need for further optimization [17–19]. Shortcomings included an incomplete list of items, no response option to indicate when an item does not apply, and no outcome derived from the oral health assessment to improve care [18]. In addition, a lack of clear instructions on how to assess oral health and a lack of awareness and training for caregivers were observed as reasons for not correctly identifying persons who need help with their daily oral hygiene or referral to a dentist [18, 19].

A group of 12 experts with a professional background relevant to oral health of older adults discussed the content and requirements of an optimized oral health section. They agreed that, as an integral part of the interRAI instruments, the number of items should not exceed 10 and that the optimized oral health section should include

not only self-reported oral health items but also items requiring oral inspection [20]. This resulted in an optimized oral health section, the ohr-interRAI, that consists of nine items assessing *chewing function*, *discomfort and/or pain and dry mouth* by interview or observation during meals and the other six items (*hygiene of removable dentures*, *oral hygiene*, *teeth*, *gums*, *tongue*, *palate and inner surface of cheeks and lips*) by inspection of the mouth. It was also decided that the response options should differentiate between acceptable and unacceptable conditions, in addition to options to indicate that the item was not applicable or could not be assessed [20]. In order to help caregivers identify oral health problems, exemplary photographs of acceptable and unacceptable conditions were included for the items requiring oral inspection [20, 21]. General utilization guidelines, definitions and item-specific instructions were also added, together with instruction videos providing information on the oral health assessment. In addition, corresponding to the CAPs in the interRAI instruments, the ohr-interRAI included two CAPs on oral health, which are algorithms to help caregivers identify individuals who may need assistance with daily oral hygiene or referral to a dentist [20]. Guidelines for these CAPs were provided to help address the underlying oral health problems [22]. This optimized oral health section for inclusion in interRAI LTCF and HC, was identified by Rodrigues et al. [23] as the most appropriate instrument for evaluating older adults' oral health by non-dental caregivers, when comparing psychometric properties of several oral health assessment instruments.

Recently, the ohr-interRAI was further optimized and refined by a group of 53 international experts in oral health of older persons, resulting in the interRAI Oral Health Section (OHS-interRAI) [24]. This version differs from the ohr-interRAI through textual adjustments and additional clarifying information about the items, as well as better visualizations and labeling of relevant structures and abnormalities in the photographs [24].

As of June 2023, the use of the interRAI LTCF instrument to assess nursing home residents' health became mandatory in Flanders [25]. Although the OHS-interRAI is not yet officially implemented in the interRAI instruments, there is a Belgian software that offers nursing homes the opportunity to use this oral health section in the interRAI LTCF. In the Netherlands, there is no such legislation requiring the use of the interRAI instruments. However, there are nursing homes working with this Belgian software to assess residents' health with the interRAI LTCF, including their oral health with the current section or the OHS-interRAI.

This study describes and compares the oral health status of nursing home residents in Flanders and in the Netherlands, as assessed by their caregivers, using the current section and the OHS-interRAI.

Methods

Study design, aims, and inclusion criteria

This cross-sectional study includes interRAI LTCF pooled data from participants aged 65 years or older living in nursing homes in Flanders (Belgium) or in the Netherlands (Omring group, in North Holland) to evaluate oral health assessments with the current section and the OHS-interRAI. Caregivers from these nursing homes collected residents' interRAI data, including oral health data. Data from the interRAI LTCF instrument were collected from October 2016 to January 2023, including the current section, and from October 2020 to January 2023, including the OHS-interRAI.

Data collection

Oral health

Current oral health section in interRAI LTCF

The current section in the interRAI LTCF contains six items: *Difficulty with chewing*; *Dry mouth*; *Mouth or facial pain/discomfort*; *Denture/removable prosthesis use*; *Broken, fragmented, loose, or otherwise non-intact natural teeth (teeth);* and *Gum inflammation or bleeding adjacent to natural teeth or tooth fragments (gums)*. The presence of these oral health conditions is recorded dichotomously as 'yes' or 'no' by non-dental caregivers (e.g., nurses, nurse aids, therapists). They are instructed to collect the oral health information by interview, observation during meals, or inspection of the mouth. Each item has a short definition in the interRAI utilization guidelines. There is no particular attention on how to complete the oral health section during interRAI assessments' training sessions [18].

InterRAI oral health section (OHS-interRAI)

The OHS-interRAI consists of nine items to evaluate the oral health status of older adults in the last three days prior to the assessment: *Chewing function*; *Discomfort and/or pain in the mouth*; *Dry mouth*; *Hygiene of removable dentures*; *Oral hygiene*; *Teeth*; *Gums*; *Tongue*; and *Palate and inner surface of cheeks and lips*. Non-dental caregivers assess these items on a scale that distinguishes between acceptable and unacceptable oral health conditions. They can also indicate whether the item was not assessable due to the person's condition (e.g., if person resists) or not applicable (e.g., no teeth if edentulous) (Fig. 1). *Chewing function*, *Discomfort and/or pain in the mouth* and *Dry mouth* are assessed by interviewing or observing residents during meals. Assessment of the other six items requires inspection of the mouth.

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	Acceptable/ good	Unacceptable/ poor	Cannot be assessed	Not applicable
Oral hygiene	Acceptable/ good	Unacceptable/ poor	Cannot be assessed	Not applicable
Teeth	Acceptable/ good	Unacceptable/ poor	Cannot be assessed	Not applicable
Gums	Acceptable/ good	Unacceptable/ poor	Cannot be assessed	
Tongue	Acceptable/ good	Unacceptable/ poor	Cannot be assessed	
Palate and inner surface of cheeks and lips	Acceptable/ good	Unacceptable/ poor	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 acceptable/ good.
- Oral tissues are healthy.

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

Yellow - CAP oral hygiene

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

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

Red - CAP Referral to a dentist

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

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

Fig. 1 Items for the activation of CAP oral hygiene and CAP referral to a dentist

Photographs with labels and indications of relevant structures and abnormalities are available to assist caregivers in identifying oral health problems [20, 24]. In addition, general and specific utilization guidelines are available, as well as instruction videos with comprehensive information for each item [24].

The OHS-interRAI includes two CAPs to alert caregivers when older adults need oral care. The CAP *oral hygiene* is activated when residents need help with daily oral hygiene and the CAP *referral to a dentist* when residents need a referral to a dentist. The items responsible for activation of these CAPs are shown in Fig. 1. Accompanying guidelines enable caregivers to help resolve the underlying oral health problems [20, 24].

Data analyses

Descriptive analyses were used to describe characteristics of the participating nursing homes and residents in Flanders and in the Netherlands, assessed with the current section and the OHS-interRAI.

Outcome scales with validated cut-off values included in the interRAI instruments provide information on a person's clinical status. The Activities of Daily Living (ADL) scale, ranging from 0 to 6, has a cut-off ≥ 3. This implies an extensive degree of dependence on personal care (e.g., personal hygiene, toilet use) if the score is above or equal to 3 [26]. Other outcome scales (range, $\geq$ cut-off value) analyzed in this study were the Cognitive Performance Scale (CPS) (0–6, ≥ 3), Pain (0–4, ≥ 2), Depression Rating Scale (DRS) (0–14, ≥ 3) and Changes in Health, End-stage disease and Symptoms and Signs (CHESS) (0–5, ≥ 3) [16, 27]. Categorical variables were expressed as percentages relative to the total, while continuous variables were presented as means with standard deviations (SDs).

The missing oral health data in the interRAI assessments were analyzed and compared between the two oral health sections. To compare the results of similar items between the oral health sections, only the acceptable/unacceptable response options were considered for the OHS-interRAI. This is because the response options indicating that the item could not be assessed or was not applicable are not available in the current section and do not provide a result regarding oral health. Furthermore, the percentages of the activated CAPs included in the OHS-interRAI were calculated. A CAP *referral to a dentist* for the current section was calculated similar to that in the OHS-interRAI based on the items *Difficulty with chewing*, *Mouth or facial pain/discomfort*, *Teeth* and *Gums*. The CAP *referral to a dentist* included in the OHS-interRAI was also recalculated taking into account only *Chewing function*, *Discomfort and/or pain in the mouth*, *Teeth* and *Gums.* This made it possible to compare the number of residents in need of a dental visit between the oral health sections. It was not possible to calculate a similar CAP *oral hygiene* for the current section because it does not include items relating to oral hygiene or hygiene of removable dentures.

The chi-square test was used to examine differences in the proportions of missing oral health data and prevalence rates of oral health problems between both oral health sections. A p-value < 0.05 was considered statistically significant. Analyses were performed in IBM SPSS

Statistics, version 28.0.1.1 and SAS Enterprise Guide, version 8.1.

Results

Baseline characteristics: Table 1

A total of 12,777 and 1298 residents were assessed for the first time by caregivers using the interRAI LTCF including the current section and the interRAI LTCF including the OHS-interRAI, respectively. However, they did not complete the oral health sections for all these residents. Table 1 shows that significantly more complete oral health data were available for older adults assessed with the current section than with the OHS-interRAI. The interRAI assessments with completely missing oral health data were excluded from further analyses, resulting in interRAI data including the current section of 12,476 residents from 158 nursing homes and interRAI data including the OHS-interRAI of 1212 residents from 37 nursing homes.

The mean age of the residents assessed with the current section and the OHS-interRAI was 83.7 (±7.4) and 82.2 (±7.4) years, respectively. The majority of participating residents were female (>65.0%). Significantly more nursing home residents assessed with the current section were dependent for activities of daily living (64.6%) than their counterparts assessed with the OHS-interRAI (55.6%). They were also more dependent on others for their personal hygiene (75.4% vs. 69.1%). Cognitive problems were less common in older adults assessed with the current Sect. (54.2%) than with the OHS-interRAI (60.4%). Residents assessed with the current section had significantly fewer dental check-ups in the last year (32.7%) than those assessed with the OHS-interRAI (55.3%). Tables 2 and 3 provide more details on the participating nursing homes and residents.

Oral health

Tables 4 and 5 present Flemish and Dutch nursing home residents' oral health status assessed by caregivers using the current section and the OHS-interRAI, respectively.

Current oral health section in interRAI LTCF: Table 4

The most common oral health problem among nursing home residents in Flanders and in the Netherlands was the presence of compromised teeth (16.6%), followed by dry mouth (7.6%). Chewing problems and mouth or facial pain were reported by 6.8% and 5.8% of the older adults, respectively. Caregivers registered the presence of dentures in 67.0% of the residents. Gum problems were reported by 3.1%.

Table 1 Completeness of the current section and the OHS-interRAI in Flanders and in the Netherlands

	Total			Flanders			The Netherlands		
	Current section = 12777	OHS-interRAI = 1298		Current section = 9526	OHS-interRAI = 476		Current section = 3251	OHS-interRAI = 822	
	%	%	*p*-value	%	%	*p*-value	%	%	*p*-value
Complete	96.4	89.1	<0.001***	96.7	83.6	<0.001***	95.4	92.2	<0.001***
Incomplete	1.3	4.3	<0.001***	0.9	4.0	<0.001***	2.4	4.5	<0.001***
Missing	2.4	6.6	<0.001***	2.4	12.4	<0.001***	2.2	3.3	0.066

***$p < 0.001$

Table 2 Characteristics of nursing homes using the interRAI instrument including the current section and the OHS-interRAI

	Current section			OHS-interRAI		
	Total	Flanders	The Netherlands	Total	Flanders	The Netherlands
Number of nursing homes	158	117	41	37	11	26
Size of the nursing homes						
50–99 residents	82	55	27	5	3	2
100–199 residents	55	53	2	32	8	24
≥200 residents	6	6				
Missing	15	3	12			
Number of interRAI assessors	1535	953	582	203	47	156

Table 3 Characteristics of residents, assessed using the interRAI instrument including the current section and the OHS-interRAI

	Total					Flanders					The Netherlands				
	current section		OHS-interRAI			Current section		OHS-interRAI			Current section		OHS-interRAI		*p*-value
	n/N	M (± SD) or %	n/N	M (± SD) or %	*p*-value	n/N	M (± SD) or %	n/N	M (± SD) or %	*p*-value	n/N	M (± SD) or %	n/N	M (± SD) or %	
Age	12,476/12,476	83.7 (± 7.4)	1212/1212	82.2 (± 7.4)	< 0.001***	9296/9296	84.1 (± 7.4)	417/417	83.4 (± 6.9)	0.066	3180/3180	82.6 (± 7.4)	795/795	81.5 (± 7.6)	< 0.001***
Gender					0.002**					0.112					0.474
Female	8687/12,476	69.6	792/1212	65.3		6600/9296	71.0	281/417	67.4		2087/3180	65.6	511/795	64.3	
Male	3789/12,476	30.4	420/1212	34.7		2696/9296	29.0	136/417	32.6		1093/3180	34.4	284/795	35.7	
Daily smoker	626/12,362	5.1	93/1207	7.7	< 0.001***	368/9222	4.0	24/413	5.8	0.067	258/3140	8.2	69/794	8.7	0.666
Scales															
Activities of Daily Living (ADL (0–6) ≥ 3)	7977/12,342	64.6	673/1210	55.6	< 0.001***	6526/9216	70.8	299/416	71.9	0.641	1451/3126	46.4	374/794	47.1	0.729
Cognitive Performance Scale (CPS (0–6) ≥ 3)	6647/12,268	54.2	727/1203	60.4	< 0.001***	4843/9141	53.0	243/410	59.3	0.013*	1804/3127	57.7	484/793	61.0	0.088
Pain ((0–4) ≥ 2)	1854/12,306	15.1	172/1207	14.3	0.449	1249/9211	13.6	26/414	6.3	< 0.001***	605/3095	19.5	146/793	18.4	0.469
Depression Rating Scale (DRS (0–14) ≥ 3)	4348/12,376	35.1	457/1207	37.9	0.058	3212/9234	34.8	126/412	30.6	0.079	1136/3142	36.2	331/795	41.6	0.004**
Changes in Health, End-stage disease and Symptoms and Signs (CHESS, (0–5) ≥ 3)	787/11,771	6.7	64/1193	5.4	0.079	606/8893	6.8	17/407	4.2	0.037*	181/2878	6.3	47/786	6.0	0.750
Diseases															
Depression	1751/12,284	14.3	165/1209	13.6	0.564	1356/9166	14.8	74/417	17.7	0.098	395/3118	12.7	91/792	11.5	0.369
Dementia	3515/12,262	28.7	360/1207	29.8	0.396	2652/9140	29.0	132/416	31.7	0.233	863/3122	27.6	228/791	28.8	0.508
Heart failure (CHF)	2797/12,249	22.8	276/1208	22.9	0.992	1972/9141	21.6	89/417	21.3	0.911	825/3108	26.5	187/791	23.6	0.096
Pneumonia	206/12,311	1.7	19/1208	1.6	0.795	130/9178	1.4	7/416	1.7	0.654	76/3133	2.4	12/792	1.5	0.122
Diabetes mellitus	2398/12,313	19.5	256/1208	21.2	0.152	1739/9184	18.9	73/416	17.5	0.479	659/3129	21.1	183/792	23.1	0.211
Poor self-reported health	1080/10,591	10.2	95/1207	7.9	0.193	825/7743	10.7	32/413	7.7	0.466	255/2848	9.0	63/794	7.9	0.840
Resistance to care	2287/12,410	18.4	232/1206	19.2	0.490	1729/9247	18.7	75/412	18.2	0.801	558/3163	17.6	157/794	19.8	0.163

Table 3 (continued)

	Total					Flanders					The Netherlands				
	current section		OHS-interRAI			Current section		OHS-interRAI			Current section		OHS-interRAI		*p*-value
	n/N	M (± SD) or %	n/N	M (± SD) or %	*p*-value	n/N	M (± SD) or %	n/N	M (± SD) or %	*p*-value	n/N	M (± SD) or %	n/N	M (± SD) or %	
Conflict with or criticism towards caregivers	2266/12,385	18.3	209/1206	17.3	0.407	1745/9224	18.9	82/412	19.9	0.618	521/3161	16.5	127/794	16.0	0.740
Continued frustration with the resident	1715/12,384	13.8	120/1206	10.0	<0.001***	1343/9223	14.6	51/412	12.4	0.218	372/3161	11.8	69/794	8.7	0.014*
Limited assistance to full physical dependence on others for personal hygiene	9334/12,381	75.4	834/1209	69.1	<0.001***	7351/9219	79.7	347/416	83.4	0.067	1983/3162	62.7	487/793	61.3	0.525
Strong and supportive relationship with family	10,345/12,373	83.6	1058/1205	87.8	<0.001***	7500/9221	81.3	352/411	85.6	0.028*	2845/3152	90.3	706/794	88.9	0.260
Dental check-up in the last year	3977/12,163	32.7	667/1206	55.3	<0.001***	2243/9062	24.8	84/413	20.3	0.042*	1734/3101	55.9	583/793	73.5	<0.001***

n/N: Specific outcome per item/total available data per item

M (± SD): Mean (± Standard Deviation)

*$p < 0.050$

**$p < 0.010$

***$p < 0.001$

Table 4 Oral health status of nursing home residents using the current section

	Total = 12,476			Flanders = 9296			The Netherlands = 3180			*p*-value
	No	Yes		No	Yes		No	Yes		
	%	%	*N*	%	%	*N*	%	%	*N*	
Difficulty with chewing	93.2	6.8	12,443	93.5	6.5	9281	92.2	7.8	3162	0.012*
Dry mouth	92.4	7.6	12,449	93.1	6.9	9282	90.0	10.0	1367	< 0.001***
Mouth or facial pain/discomfort	94.2	5.8	12,417	95.0	5.0	9274	92.0	8.0	3143	< 0.001***
Denture/removable prosthesis use	33.0	67.0	12,413	36.8	63.2	9252	21.9	78.1	3161	< 0.001***
Broken, fragmented, loose, or otherwise non-intact natural teeth	83.4	16.6	12,400	81.3	18.7	9243	89.5	10.5	3157	< 0.001***
Gum inflammation or bleeding adjacent to natural teeth or tooth fragments	96.9	3.1	12,407	97.2	2.8	9269	95.8	4.2	3138	< 0.001***
CAP referral to a dentist	75.6	24.4	12,219	74.7	25.3	9149	78.3	21.8	3070	< 0.001***

N: Total available data per item

*$p < 0.050$

***$p < 0.001$

The current section does not include CAPs to identify oral care needs. However, calculation of a CAP *referral to a dentist* based on similar items included in the OHS-interRAI resulted in 24.4% of the residents needing a dental visit according to their caregivers.

A comparison between Flemish and Dutch residents showed that caregivers reported significantly fewer problems with chewing ($p = 0.012$), dry mouth ($p < 0.001$), pain ($p < 0.001$) and gums ($p < 0.001$) in Flemish than in Dutch residents. There were also fewer older adults wearing dentures ($p < 0.001$). On the other hand, residents in Flemish nursing homes had significantly more broken, fragmented, loose, or otherwise non-intact natural teeth than their Dutch counterparts ($p < 0.001$). The CAP *referral to a dentist* was significantly more activated for residents in Flanders than in the Netherlands ($p < 0.001$).

OHS-interRAI: Table 5

Compromised teeth (22.1%) and poor oral hygiene (19.1%) were the most common oral health problems identified by caregivers using the OHS-interRAI. Chewing problems and the feeling of a dry mouth were reported by 13.7% and 9.8% of the residents, respectively. The use of dentures was registered in 74.7% of the residents, of which denture hygiene could not be assessed in 30.7% (e.g., if person resists). Poor denture hygiene was found in 9.2%. In addition, 4.4% of the older adults had discomfort and/or pain in the mouth. Unacceptable conditions of the tongue and palate and inner surface of cheeks and lips were found in 3.7% of the residents.

With regard to the activation of the CAPs, 15.9% of the residents needed help with daily oral care (CAP *oral hygiene*) and 26.4% needed a referral to a dentist (CAP *referral to a dentist*).

When comparing the oral health status of the nursing home residents in both countries, Flemish residents had significantly more problems with chewing ($p < 0.001$), dry mouth ($p = 0.010$), denture hygiene ($p = 0.014$), oral hygiene ($p = 0.005$) and tongue condition ($p < 0.001$). There was no significant difference between Flanders and the Netherlands for the other items. Both CAPs on oral health were significantly more activated in Flemish than in Dutch nursing home residents.

Comparison of oral health items between the current section and the OHS-interRAI

Items in the current section and the OHS-interRAI, measuring similar oral health structures, were compared to gain insight into possible differences in the oral health status of nursing home residents assessed with the instruments.

The current section includes an item indicating the use of dentures, whereas the OHS-interRAI does not explicitly assess the use of dentures. However, when assessing hygiene of removable dentures, there is the response option to indicate that this item does not apply, which implies that this person does not have dentures. A comparison between the oral health sections showed that dentures were significantly less common among Flemish and Dutch nursing home residents assessed with the current section than among those assessed with the OHS-interRAI (67.0% vs.

Table 5 Acceptable/unacceptable oral health conditions of nursing home residents and CAP outcomes using the OHS-interRAI

	Total = 1212			**Flanders = 417**			**The Netherlands = 795**			
	Acceptable/ good	**Unacceptable/ poor**		**Acceptable/ good**	**Unacceptable/ poor**		**Acceptable/ good**	**Unacceptable/ poor**		
	%	**%**	***N***	**%**	**%**	***N***	**%**	**%**	***N***	***p*-value**
Chewing function	86.3	13.7	1160	81.4	18.6	392	88.8	11.2	768	< 0.001***
Discomfort and/or pain in the mouth	95.6	4.4	1132	94.5	5.5	383	96.1	3.9	749	0.212
Dry mouth	90.2	9.8	1133	87.0	13.0	385	91.8	8.2	748	0.010*
Hygiene of removable dentures	90.8	9.2	760	87.0	13.0	238	92.5	7.5	522	0.014*
Oral hygiene	80.9	19.1	786	75.5	24.5	274	83.8	16.2	512	0.005**
Teeth	77.9	22.1	588	74.2	25.8	240	80.5	19.5	348	0.071
Gums	92.2	7.8	999	92.1	7.9	343	92.2	7.8	656	0.957
Tongue	96.3	3.7	1050	92.6	7.4	352	98.1	1.9	698	< 0.001***
Palate and inner surface of cheeks and lips	96.3	3.7	973	97.4	2.6	346	95.7	4.3	627	0.177
CAP oral hygiene	84.1	15.9	1190	80.6	19.4	407	86.0	14.0	783	0.016**
CAP referral to a dentist	73.6	26.4	1156	63.2	36.8	399	79.1	20.9	757	< 0.001***

N: total available data per item

*$p < 0.050$

**$p < 0.010$

***$p < 0.001$

74.7%, $p < 0.001$). Table 6 presents the results for other comparable items in the instruments.

Residents assessed using the current section had significantly less problems with chewing, dry mouth, teeth, and gums than those assessed using the OHS-interRAI. In particular, caregivers using the OHS-interRAI identified more than twice as many older adults with chewing problems (6.8% vs. 13.7%) and gum diseases (3.1% vs. 7.8%). There was no significant difference between the current section and the OHS-interRAI in the proportion of residents with discomfort or pain in the mouth.

The CAP *referral to a dentist* included in the OHS-interRAI was recalculated because it contains more items responsible for activation than the same CAP created for the current section. The results showed that there was no significant difference between older adults in need of a dental visit between the oral health sections. However, when Flanders and the Netherlands were considered separately, a significant difference was found in Flanders, indicating that fewer residents assessed with the current section needed a referral to a dentist than those assessed with the OHS-interRAI (25.3% vs. 34.4%, $p < 0.001$).

Table 7 provides an overview of missing values for the comparable items in the oral health sections and the results for the additional response options in the OHS-interRAI when items could not be assessed. There were significantly fewer missing data for chewing problems and the condition of teeth and gums with the current section than with the OHS-interRAI.

Discussion

This study described and compared the oral health status of nursing home residents assessed by caregivers using the current section in the interRAI LTCF and the OHS-interRAI. Differences between the oral health sections may affect the detection of oral health problems.

The OHS-interRAI differs from the current section by adding (*Oral and Denture hygiene*, *Tongue*, *Palate and inner surface of cheeks and lips*) and deleting (*Prothesis use*) some items, visual inspection of the mouth rather than self-reported questions to assess hygiene and oral structures. In addition, the OHS-interRAI provides response options when items cannot be assessed, photographs, CAPs and detailed instructions for completing the section and for actions after activation of the CAPs [18, 20].

This study showed that there were fewer incomplete and completely missing oral health assessments with the current section than with the OHS-interRAI in Flanders. This may be because data with the current section were collected as part of a pilot study to implement the interRAI LTCF in nursing homes, which was proposed by the Flemish government in the Residential Care Decree as a care planning instrument to improve quality of care [25]. The pilot study was conducted in Flanders from 2020 to 2022 and had the aim of obtaining 3500 fully completed interRAI LTCF assessments to study the resource utilization of this population [28]. The use of the OHS-interRAI is possible within a Belgian software, but is not yet formally included in interRAI LTCF, which may make

Table 6 Unacceptable conditions for comparable items in the current section and the OHS-interRAI

	Total			Flanders			The Netherlands		
	Current section	OHS-interRAI		Current section	OHS-interRAI		Current section	OHS-interRAI	
	%	%	*p*-value	%	%	*p*-value	%	%	*p*-value
Chewing problems	6.8	13.7	< 0.001***	6.5	18.6	< 0.001***	7.8	11.2	0.003**
Discomfort and/or pain	5.8	4.4	0.057	5.0	5.5	0.695	8.0	3.9	< 0.001***
Dry mouth	7.6	9.8	0.010*	6.9	13.0	< 0.001***	10.0	8.2	0.129
Teeth	16.6	22.1	< 0.001***	18.7	25.8	0.005**	10.5	19.5	< 0.001***
Gums	3.1	7.8	< 0.001***	2.8	7.9	< 0.001***	4.2	7.8	< 0.001***
CAP referral to a dentist	24.4	24.6	0.897	25.3	34.4	< 0.001***	21.8	19.4	0.153

*$p < 0.050$

**$p < 0.010$

***$p < 0.001$

Table 7 Missing values for items in both oral health sections and the OHS-interRAI's extended response options

	Total					Flanders					The Netherlands				
	Current section	OHS-interRAI				Current section	OHS-interRAI				Current section	OHS-interRAI			
	Missing %	Missing %	*p*-value	Cannot be assessed %	Not applicable %	Missing %	Missing %	*p*-value	Cannot be assessed %	Not applicable %	Missing %	Missing %	*p*-value	Cannot be assessed %	Not applicable %
Chewing problems	0.3	1.6	< 0.001***	1.6	1.2	0.2	1.0	< 0.001***	3.1	1.9	0.6	1.9	< 0.001***	0.8	0.8
Discomfort or pain	0.5	0.4	0.769	6.2		0.2	0.5	0.328	7.7		1.2	0.4	0.047*	5.4	
Dry mouth	0.2	0.4	0.177	6.1		0.2	0.5	0.105	7.2		0.4	0.4	0.900	5.6	
Teeth	0.6	1.5	< 0.001***	10.4	40.4	0.6	1.4	0.026*	11.7	29.9	0.7	1.5	0.034*	9.7	45.8
Gums	0.6	2.1	< 0.001***	15.8		0.3	2.9	< 0.001***	15.3		1.3	1.8	0.346	16.0	

*$p < 0.050$

***$p < 0.001$

completion less binding. In the Netherlands, there was no difference in the number of completely missing oral health assessments between the instruments. A possible explanation is that there is no such legislation regarding the use of a health assessment instrument.

Other aspects may also explain the difference in missing data between the oral health sections. Completion of the OHS-interRAI requires an inspection of the mouth, which may be challenging for caregivers, as research has shown that caregivers often find this inappropriate and consider the mouth to be an intimate area of the body [18]. In addition, caregivers consider oral health and oral hygiene to be uncommon and sensitive topics of discussion [18]. As it is likely that Flemish and Dutch caregivers experience similar barriers when performing oral health assessments, further research on how assessments are completed would be interesting [18, 29–31].

In addition, the lack of response options to indicate when an item cannot be assessed or is not applicable raised the expectation that the number of missing data for the items in the current section would be higher than in the OHS-interRAI, but this study showed the opposite. Therefore, it is unclear what caregivers are reporting with the current section in these circumstances. For example, they are asked to indicate yes or no to the question of whether the resident has '*Broken, fragmented, loose, or otherwise non-intact natural teeth*' and the guidelines do not specify which option to indicate when natural teeth are no longer present. Analysis of the number of missing data indicated that this question was not assessed in only 0.6% of the residents. A comparison with the assessment of teeth with the OHS-interRAI showed both more missing data (1.5%) and an inability to assess in 10.4% of the residents. In addition, the assessment of the condition of the teeth was not applicable in 40.4%. This suggests that the possibility of indicating a wrong answer with the current section is real, coupled with uncertainty about what caregivers report when a person has no natural teeth. Further research may shed light on this issue.

The assessments of *Chewing problems*, *Mouth discomfort and/or pain*, *Dry mouth*, *Teeth and Gums* can be compared between the current section and the OHS-interRAI.

This study showed that residents assessed using the current section had significantly less chewing problems (6.8% vs. 13.7%) and less dry mouth (7.6% vs. 9.8%) than those assessed using the OHS-interRAI. This may be because caregivers using the OHS-interRAI have access to instruction videos and can ask follow-up questions for these self-reported items, as indicated in the accompanying guidelines. For example, they are asked to register whether residents can eat all foods even if some have to be peeled or cut, only certain foods due to chewing difficulties, or blended food due to swallowing difficulties. The sensation of a dry mouth should be registered regardless of the situation or the moment it occurs, with special attention to older adults taking various types of medications. Such guidelines and instruction videos are not available for the current section. Although the reported prevalence of chewing problems and dry mouth were higher with the OHS-interRAI, they are still much lower than those found in systematic reviews, reporting chewing problems and dry mouth in 35.0% [32] and 9.1–45.0% [33] of older adults, respectively.

There was no significant difference for the prevalence of discomfort and/or pain in the mouth between the instruments to assess residents' oral health in Flanders and the Netherlands (5.8% vs. 4.4%). The prevalence rates were consistent with research by Delwel et al. [34], reporting orofacial pain in 0.0-9.6% of older adults. However, there were significant more residents in the Netherlands having discomfort or pain in the mouth assessed with the current section than those assessed with the OHS-interRAI (8.0% vs. 3.9%). Analyses of interRAI data showed that Dutch older adults assessed with the current section also had significantly fewer dental check-ups in the last year than those assessed with the OHS-interRAI. Further research may reveal whether there is an association between these two factors, and consequently whether residents who were assessed with the current section had more pain as a result of these fewer dental visits, or simply had more oral health problems.

Gum problems in residents were half as many reported by caregivers using the current section as using the OHS-interRAI (3.1% vs. 7.8%). Caregivers using the current section also observed significantly fewer compromised teeth in residents than caregivers using the OHS-interRAI (16.6% vs. 22.1%). In the study by Krausch-Hofmann et al. [18], caregivers reported difficulty assessing teeth and gums with the current section and according to oral health experts, these assessments were not feasible for caregivers not specifically trained for current section' assessments. The difference in prevalence rates between the instruments could be explained by the fact that caregivers using the OHS-interRAI are instructed to assess these items' conditions by inspecting the mouth. Specific guidelines are provided on how caregivers should assess these items and photographs of acceptable and unacceptable conditions are available to help them identify oral health problems. In addition, these guidelines specify that the assessment of gum problems includes the inspection of the jaw area for persons without teeth or denture retainers. This differs from the current section, which only evaluates the assessment of the area around natural teeth and tooth fragments. This study found quite similar results when using the OHS-interRAI to those

identified by nursing staff using the Revised Oral Assessment Guide (ROAG), with gum and tooth problems in 8.5% and 26.9% of the residents, respectively [35].

The item on the presence of removable dentures only appears in the current section. However, the response option 'not applicable' of the item in the OHS-interRAI assessing denture hygiene provides an indication that dentures are not present. When comparing the results, dentures were significantly less registered in residents assessed with the current section than in those assessed with the OHS-interRAI (67.0% vs. 74.7%). These percentages are consistent with previous research, in which 65.2% of 62,798 older adults in long-term care facilities in New-Zealand wore dentures [36]. As the presence or absence of dentures provides little information about the need for oral care, this information is of limited relevance. It is more important to assess oral hygiene because it is the major cause of oral decline due to plaque-related periodontal disease, dental caries and its association with systemic diseases such as aspiration pneumonia [37]. Therefore, the OHS-interRAI included items on oral (concerning natural teeth) and denture hygiene [18]. This study found poor oral and denture hygiene in 19.1% and 9.2% of the nursing home residents, respectively. Compared to assessments by caregivers using the Oral Health Assessment Tool (OHAT), unhealthy oral cleanliness (including denture hygiene) was found in 11.8% of older adults [38].

Items on the condition of the tongue and palate and inner surface of cheeks and lips are only included in the OHS-interRAI and were both found to be unacceptable in 3.7% of the residents. Compared to other research, Bellander et al. [35] found a poor condition of the tongue in 6.4%, the mucosal membranes in 6.2% and the lips in 6.0% of residents assessed with the ROAG. It is important to assess these mucosal tissues because they are more susceptible to the development of oral cancer, which is more commonly diagnosed in older adults. Early detection of suspicious mucosal lesions by caregivers is critical to avoid compromising general health and quality of life [39].

An asset of the OHS-interRAI is that the CAPs enable the integration of oral care into general care planning and that the use of this section may increase caregivers' awareness of oral health problems among residents. Although CAPs are not available for the current section, an adverse outcome of an item can be interpreted as a care need, and therefore a comparable CAP *referral to a dentist* as included in the OHS-interRAI was created. Recalculating the existing CAP in the OHS-interRAI, made it possible to compare the number of residents in need of a dental visit between the oral health sections. The results showed a lower need for referral to a dentist among residents assessed with the current section than with the OHS-interRAI in Flanders (25.3% vs. 34.4%). This may be attributed to the current section not detecting oral health problems as accurately, fewer problems reported by caregivers, or simply because the residents being assessed using the current section had fewer oral health problems. The difference between the oral health sections was not found for the residents in the Netherlands. The fact that significantly more older adults reported discomfort or pain in the mouth with the current section than with the OHS-interRAI in the Netherlands (8.0% vs. 3.9%) could be a reason for the difference in the activated CAP between the countries.

This study is part of research optimizing oral health assessments of older adults by non-dental caregivers to identify care needs in time and integrate them into general care. There are several instruments available for this purpose, but the focus was on the section within the interRAI Suite as this holistic instrument is an important lever for integrating oral into general care. In addition, the ohr-interRAI has already been discussed in a systematic review by Rodrigues et al. [23], that compared its psychometric properties with several other commonly used oral health assessment instruments (OHAT, DHI, OAS, ohr-MDS, BOHSE, OHS TNP) and proposed it as the most appropriate for assessing oral health of older adults by non-dental caregivers until further evidence of the instruments' measurement properties is provided. As the OHS-interRAI is a refinement of the ohr-interRAI, it is worth investigating its potential further.

Some limitations of this study need to be acknowledged. It is important to note that the comparison of the items between the oral health sections must be done with some caution because these items do not cover the same content identically (e.g., assessment of gum problems: area around natural teeth and tooth fragments (current section) vs. area around teeth or denture retainers or jaw area (OHS-interRAI)) or have different wording.

In addition, the oral health problems evaluated with the current section and the OHS-interRAI can only be compared at population level, because this study did not include information on residents' oral health as measured by both the current section and the OHS-interRAI. Therefore, no conclusions can be drawn about differences between the oral health sections at resident level.

Furthermore, this study included all first assessments with the interRAI LTCF instruments for which it is not known what training or education the caregivers received. This means that there may be some variation in how the assessments were performed, which could potentially have affected the results. The extent to which

caregivers relied on the available guidelines and tools (e.g., instruction videos for the OHS-interRAI) is also unknown.

All nursing homes participating in this study used the only software currently available that provides the OHS-interRAI integrated into the interRAI Suite to nursing homes to collect residents' interRAI LTCF data. In addition, the participating nursing homes in the Netherlands requested to use the interRAI instrument to assess their residents' health and are among the few that use these instruments in their country. Furthermore, the nursing homes in the Netherlands that used the interRAI LTCF, including the OHS-interRAI, are part of the same umbrella group (Omring group). It is therefore possible that these homes were particularly motivated to work on improving residents' oral care and oral health. Therefore, it is not possible to generalize the results to the entire population of nursing home residents.

In addition to qualitative research on the assessment process and actions after activation of the CAPs included in the OHS-interRAI (e.g., application of the accompanying guidelines in the care plan), it is interesting to evaluate the concurrent validity of the oral health sections. Previous research has shown an underestimation of oral health problems among residents by caregivers compared to assessments by dental professionals. Reasons for this may include lack of knowledge and experience [17, 20]. As a result, an e-learning with comprehensive information, including practical examples and attention to residents with cognitive difficulties, was recently developed to help caregivers identify oral health problems with the OHS-interRAI [24].

The collection of longitudinal oral health data can provide information to evaluate the impact of the oral health assessments on residents' oral care and oral health. Analysis of interRAI data also provides an opportunity to explore interactions between oral and general health and to identify characteristics of individuals at greater risk of having or developing oral health problems.

Conclusions

Regular oral health assessments can help improve the poor oral health status of nursing home residents. The OHS-interRAI, an optimized oral health section for inclusion in the holistic interRAI instrument to evaluate health and well-being, enable the integration of oral care into general care planning. This study shed light on the oral health status of nursing home residents assessed by non-dental caregivers using the current section and the OHS-interRAI. When comparing the results between the oral health sections for items measuring similar oral structures, caregivers using the OHS-interRAI identified more dry mouth, compromised teeth and problems with chewing and gums in residents than those using the current section, which are results more consistent with prevalence rates found in previous research. This may be due to the additional features of the OHS-interRAI over the current section such as comprehensive response options, CAPs, extensive guidelines, exemplary photographs and instruction videos to help identify oral health problems. However, further research is needed to ensure that the OHS-interRAI accurately identifies older adults who need help with daily oral hygiene or referral to a dentist in order to contribute to improved oral health in older adults.

Abbreviations

LTCF	Long-term care facilities
OHS-interRAI	InterRAI oral health section
CAP	Collaborative action point
HC	Home care
ADL	Activities of daily living
CPS	Cognitive performance scale
DRS	Depression rating scale
CHESS	Changes in health, end-stage disease and symptoms and signs
SD	Standard deviation
ROAG	Revised oral assessment guide
OHAT	Oral health assessment tool

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Authors' contributions

ES contributed to conception and design, data acquisition, analysis and interpretation, drafted and revised the manuscript. JDAM and JD contributed to conception and design, data interpretation, substantively revised the manuscript. PAIV, HPJVH, JDL, AD and DD contributed to conception and design, substantively revised the manuscript. All authors approved the submitted version and agreed to be personally accountable for all aspects of the manuscript.

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Data availability

The data sets generated and/or analyzed in the current 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.

Declarations

Ethics approval and consent to participate

Approval for this multi-center study was obtained by the Belgian Privacy Commission and the Ethics Committee Research UZ/KU Leuven (No.: S65354 - B3222021000448). All participants signed an informed consent and agreed to the use of their interRAI data for research purposes.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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