Received: 19 February 2019 | Revised: 9 August 2019 | Accepted: 29 August 2019

DOI: 10.1111/ger.12437

ORIGINAL ARTICLE

Gerodontology WILEY

Development of an instrument to assess oral hygiene ability in older adults: The oral hygiene ability instrument

Ingela Grönbeck Lindén[1,2] | Pia Andersson[3] | Synneve Dahlin-Ivanoff[4] | Lars Gahnberg[5] | Catharina Hägglin[1,2]

[1]Department of Gerodontology, Public Dental Service, Region Västra Götaland, Sweden

[2]Department of Behavioral and Community Dentistry, Institute of Odontology, Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden

[3]Department of Oral Health, Faculty of Health Sciences, Kristianstad University, Kristianstad, Sweden

[4]Department of Health and Rehabilitation, Institute of Neuroscience and Physiology, Sahlgrenska Academy at the University of Gothenburg, Gothenburg, Sweden

[5]Department of Dental Medicine, Karolinska Institutet, Stockholm, Sweden

Correspondence
Ingela Grönbeck-Lindén, Department of Gerodontology, Public Dental Service, Region Västra Götaland, Sweden.
Email: ingela.gronbeck-linden@vgregion.se

Funding information
Dementia Fund for Research, Stockholm, Sweden; The Swedish Order of Freemasons, Grand Lodge of Sweden; Göteborgs Tandläkare-Sällskap

Abstract

Objectives: To describe the development process of an instrument to assess the ability to manage daily oral hygiene and the cause of impaired oral hygiene. The instrument is initially aimed for use by the dental team in the ageing population.

Background: Oral hygiene is an important component of oral health. Inability to manage oral hygiene combined with other risk factors often results in poor oral health and impaired quality of life.

Methods: A guideline for instrument development was used during the construction of the instrument. The method included three phases: I. planning: the purpose and target group of the instrument were determined, and a literature review and qualitative focus-group study were conducted; II. construction: objectives were formulated, and a pool of items was built; and III. evaluation and validation, which included two pilot studies, interviews, item analyses and revision of the instrument.

Results: The planning and construction phases resulted in an instrument with 47 items comprising three parts: (a) interview, (b) clinical examination and (c) observation of activities of daily living (oral hygiene). After two pilot studies, the instrument was found to have good content validity. Analyses of qualitative and quantitative data resulted in a reduction in the number of items to 33.

Conclusion: OHAI can be a valuable tool as a preventive method to identify older adults at risk of impaired oral health. However, the instrument needs further evaluation before wider use.

KEYWORDS

evaluation, instrument design, older adults, oral hygiene ability

1 | INTRODUCTION

The population of older people is steadily increasing, in both numbers and proportions, in most countries. Approximately 125 million people worldwide were aged 80 or older in 2005; this number is expected to rise to over 400 million by 2050.[1]

In Western countries, the oral health of adults has been changing in recent decades.[2] Today, older adults retain most of their teeth for life, often with technically complex replacements for lost teeth that place great demands on their ability to perform daily oral hygiene.[3] More risk factors, such as medication-induced dry mouth,[4] dietary changes,[5] and impaired oral and upper motor skills,[6] often result in an inadequate ability to manage oral hygiene, which, in turn, may be reflected in impaired oral health, well-being and quality of life.[7] Effective and adapted preventive measures, largely involving oral hygiene, are therefore necessary.[8]

Older adults living independently often develop oral diseases. Clinical studies indicate that management of oral hygiene may decrease because of disease, loss of strength or motivation, or any of several other factors.[9,10] As most older adults gradually move into a

frail part of life, those providing them personalised care and assistance with self-care must be aware of the possible effects of visual, cognitive and motor function impairments on oral health.[11] Hence, there is a need for an instrument to identify whether and why older adults might develop problems with self-performed oral hygiene.

A variety of activities of daily living (ADL) instruments have been developed to assess a person's ability to manage daily life.[12] None of them have oral hygiene as an assessment criterion. Indices developed in dentistry mostly focus on the effect of oral hygiene (ie measuring plaque after an intervention).[13-15] Three main indices are available to assess an older person's ability to manage oral hygiene. The Tooth brushing Ability Test (TAT)[16] and the Activities of Daily Oral Hygiene instrument (ADOH)[17] are mainly intended to measure upper motor skills or the result of oral cleaning (plaque). The third instrument, the Oral Hygiene Performance Test (OHPT),[18] also assesses upper motor skills, but tooth brushing is done on a typodont and does not involve the person's mouth.

Several instruments have been developed for nursing staff to assess oral health of people living in nursing homes or admitted to hospital such as the Revised Oral Assessment Guide (ROAG),[19] the Brief Oral Health Status Examination (BOHSE),[20] the Dental Hygiene Registration scale (DHR)[21] and the Oral Health Assessment Tool (OHAT).[22] These instruments assess oral health rather than oral hygiene ability.

Dental professionals who work with older adults have requested an instrument for use in their daily work with people whose oral hygiene is impaired. The instrument should identify the cause of the impaired oral hygiene and whether the person's ability to manage oral hygiene may be improved. Older adults' capacity for self-care is a complex matter influenced by several factors. Therefore, a new instrument to assess a person's ability to perform daily oral hygiene should have a multidimensional approach, considering many factors, which first need to be identified.

The purpose of the current study was to describe the development of a more complete standardised instrument to assess:

- older adults' ability to self-manage oral hygiene,
- possible cause(s) of impaired oral hygiene and
- possible need for help and support.

The new instrument, the Oral Hygiene Assessment Instrument (OHAI), could be an important tool to identify needs for individual care interventions in clinical work, but it could also be useful in research and education.

2 | MATERIAL AND METHODS

This was an explorative study to develop a standardised instrument to assess older adults' ability and need for support in daily self-management of oral hygiene. The instrument was designed to identify older adults having difficulty with self-care and the cause(s) of the problem.

The study was conducted in Sweden in 2016-2017. The OHAI was developed in three phases: *planning*, *construction*, and *evaluation and content validation* of the instrument (Figure 1), following the guidelines proposed by Benson and Clark.[23]

2.1 | Procedure

2.1.1 | Phase I: Planning (Figure 1)

The first step was to formulate the *purpose* of the instrument and define the *target group*. The purpose of the instrument was to assess ability to manage daily oral hygiene and cause(s) of impaired oral

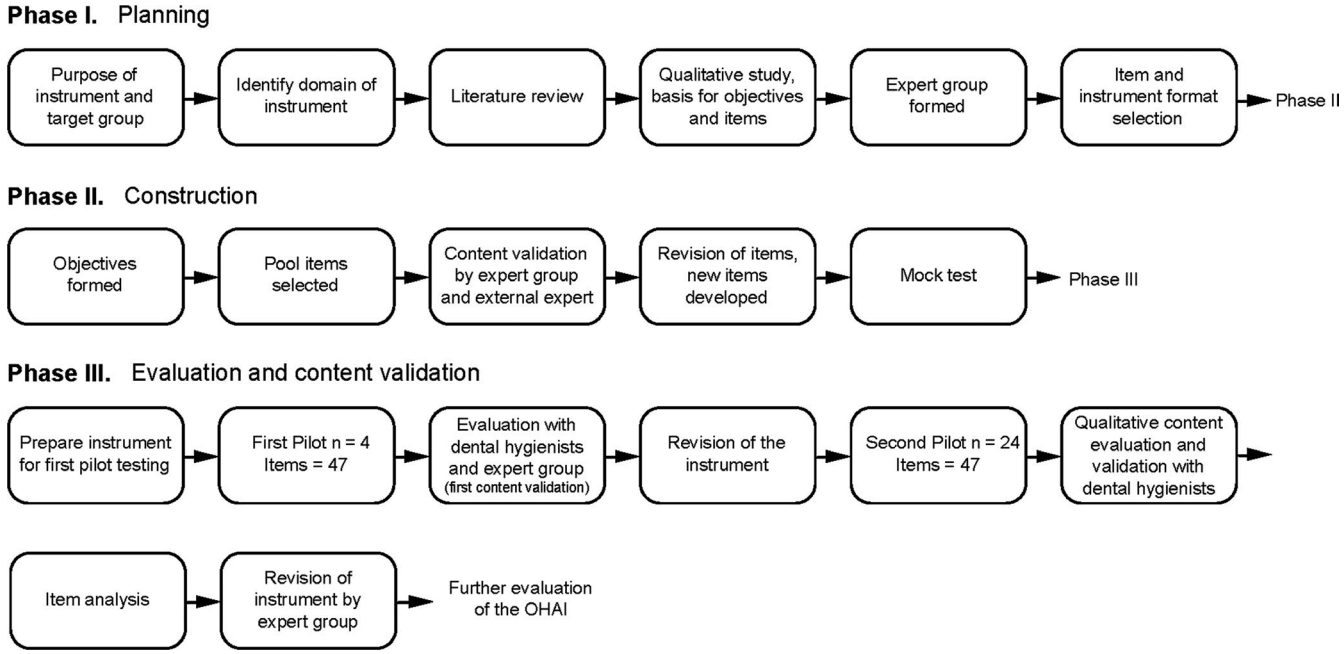

FIGURE 1 Flow chart of the OHAI development process according to guidelines proposed by Benson and Clark, Phase I. Planning; Phase II. Construction; Phase III. Evaluation and validation

hygiene in older adults. The target group was people ≥ 65 years of age with any kind of teeth or dentures.

In the second step, the *domain of the instrument* was identified as the complexity of oral hygiene ability for older adults. To ensure that no similar instrument was available, a *literature review* was conducted through searches of PubMed and other relevant databases using keywords such as 'oral assessment', 'oral hygiene ability', 'oral hygiene ability instrument', 'instrument/index/assessment', and 'oral hygiene AND older adults'. The literature review made it evident that a more complete instrument was needed and that no current instrument could serve as a gold standard in this field.

Focus groups, found to be useful in the initial phase of instrument development, were included in the Benson and Clark model.[23,24] Therefore, a *qualitative study* was conducted to identify factors affecting the ability to manage oral hygiene self-care. This published study[25] showed that three major aspects should be considered in assessing an older person's ability for oral self-care (a) *Psychological*, including attitude/motivation, cognitive ability and emotion (eg pain and fear), (b) *Environmental*, including practical conditions and social context (eg social support), and (c) *Functional*, including conditions in the oral cavity (eg oral dryness) and impaired function of the musculoskeletal system and senses. These findings formed the objectives of the instrument under construction.

An *expert group* of three dentists, one dental hygienist and one occupational therapist was then formed. Four of the members had an academic background, and all five had both a clinical background and extensive experience of providing care for older adults. The members were chosen because their professions are all important for oral health of older adults, and they each had good knowledge and experience of instrument construction and/or evaluation. The group held several meetings during the instrument's construction and the selection of the *items and instrument format*. An external expert in questionnaire methodology and statistics was also introduced at an early stage to help with the layout of the instrument and the formulation of items and response options.[26]

2.1.2 | Phase II: Construction (Figure 1)

The instrument was intended to meet the following *objectives*: assess an older person's ability to manage daily oral hygiene and discover cause(s) of impaired oral hygiene.

The qualitative focus-group study within the project[25] covered a wide range of factors that inspired the choice and construction of items for the instrument. Several items were selected from existing validated instruments found in the literature review, and new ones were constructed by members of the expert group. The expert group and the external expert on questionnaires and statistics performed a thorough *content validation* of the chosen items and the instrument. During this phase, different prototype versions of the instrument were discussed in the expert group. Some items were *revised*, and some new items were *developed*. The first versions of the instrument and a manual were established.

As a first basic test of the instrument, a *mock test* and an interview were conducted with a dentist acting as a test subject. The dentist was disguised as an older person with earplugs, some fingers taped together and glasses greased with petroleum jelly for worse eyesight. This test was conducted to determine the feasibility of the instrument and the possible experience of those undergoing the test. It was also an opportunity to discuss the instrument's structure, relevance and clarity with someone experienced in the dental care of older adults who was otherwise uninvolved in its development.

At this stage, the props needed for the instrument were selected, based not only on their ease of use in dental clinics, but also their applicability in nursing homes and hospital wards. A mouth mirror, a probe and a lamp or flashlight were needed to assess oral health. A toilet bag with a toothbrush, toothpaste, hand cream, hairbrush and comb was included to assess the ability to self-perform oral hygiene. Hand cream and a hairbrush were included to determine whether the older adults could distinguish visually and cognitively between hand cream and toothpaste and a hairbrush and a toothbrush and use them appropriately.

2.1.3 | Phase III evaluation and validation (Figure 1)

Two pilot studies were conducted to test and improve the items, confirm the instrument's content validity and reduce the number of items.[27]

The instrument had 47 items for the *first pilot test*. Two dental hygienists, one from general practice and one from specialist care tested the instrument on two persons each (n = 4). Inclusion criteria were age ≥65 years and having at least one natural tooth. Two of the participants lived independently and two lived in a nursing home. After the four examinations, the dental hygienists were interviewed about their experience of the instrument and the separate items. The first pilot study was discussed, and the interviews were analysed in the expert group. The instrument was then *revised* to obtain a more user-friendly instrument.

The revised instrument also consisted of 47 items and was tested in a *second pilot* by three dental hygienists and one dentist on 24 older adults in four groups (13 men, 11 women) in Region Västra Götaland, Sweden. Inclusion criteria in the second pilot study were the same as in the first pilot. Three of the groups included more or less dependent older adults with neurocognitive disorder, stroke and Parkinson's disease. The fourth group were independent older adults that considered themselves essentially healthy, "the healthy group."

It was expected that the four different groups would reflect different factors that may affect the ability to perform oral hygiene.

The group with a neurocognitive disorder had been living in a nursing home for several years and were consecutively chosen from a dental check-up recall list. The patients with stroke were newly admitted to a stroke ward and randomly selected by the department nurse. The persons with Parkinson's disease and those essentially healthy were consecutively chosen from an annual check-up list at a public dental clinic. The characteristics of the participants in both

TABLE 1 Characteristics of the participants in pilot studies 1 (n = 4) and 2 (n = 24) merged together. Age, number of diseases and drugs given in mean ($\bar{x}$), minimum and maximum (min-max) value

		Gender	Age		Diseases		Drugs	
Group	n	male/female (n)	$\bar{x}$	min-max	$\bar{x}$	min-max	$\bar{x}$	min-max
Healthy	8	4/4	81.4	75-86	1.5	1-3	4.1	1-8
Neurocognitive disorder	8	4/4	89.0	83-97	3.1	2-5	8.9	6-14
Stroke	6	4/2	81.8	73-86	3.0	2-5	6.3	2-13
Parkinson's disease	6	3/3	70.3	65-78	2.0	1-3	6.0	2-9
Total	28	15/13	81.3	65-97	2.4	1-5	6.4	1-14

pilot studies are shown in Table 1. Two dental hygienists experienced in hospital dentistry carried out the examinations on the groups with neurocognitive disorder and stroke. The group with Parkinson's disease and the healthy group were examined by a dentist (author IGL) and a third dental hygienist.

The three dental hygienists were trained in using the instrument and manual. During the first examination, they were observed and supported by one of the authors (IGL). After the examinations, one of the authors (IGL) conducted *qualitative interviews* with the dental hygienists using an interview guide with semi-structured open questions such as "How did you perceive the instrument as a whole, and the different parts?" "How did you feel when asking the questions?" and "How did the person tested react to the questions?" A conventional manifest content analysis was applied to interpret the text material. Content analysis is defined by Hsieh and Shannon[28] as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns."

The expert group revised the instrument based on the analysed interviews and an item correlation analysis (Spearman's rho).

Ethics

The study complied with the World Medical Association, 2013 Helsinki Declaration. In the invitation letter, the participants were informed that participation was voluntary, that they could withdraw from the study at any time and that confidentiality was guaranteed during processing of the data. On the day of the interview, each participant also received this information verbally and they themselves or a related person (n = 1) signed a consent form. The study was approved by the Regional Ethical Review Board in Gothenburg, Sweden (reg. no 419-16).

3 | RESULTS

3.1 | Phases I and II

The first two phases, planning and construction (Figure 1), resulted in an instrument consisting of three parts:

Part I. An interview questionnaire including questions on

- demographics (background, medication and housing) and
- day-to-day life (emotions, attitude/motivation, cognitive ability, practical barriers and social conditions).

Part II. An assessment of

- the oral cavity (oral dryness, oral status, oral function) and
- the capacity for self-care and obstacles to managing oral hygiene

Part III. An observation of ADL covering

- tooth brushing ability (motor skills),
- knowledge of cleaning and rinsing,
- eyesight and
- cognitive ability.

Most of the items in the questionnaire (Part I) were derived from other instruments in the literature review investigation, for example questions about quality of life and frailty. When adequate questions were missing, new questions were formulated.

After an evaluation of their different aspects, three published instruments were found to be useful in constructing items for the clinical examination (Part II): the Revised Oral Assessment Guide (ROAG),[19] the Nordic Orofacial Test-Screening (NOT-S)[29] and the mirror test.[30] Four items on oral function (eg open your mouth wide, put out your tongue) were selected from the NOT-S, and items on plaque/debris retention (later removed), dental status and oral dryness were chosen from the ROAG; however, the response alternatives were modified.

The ADL part of the instrument (Part III) concerned oral hygiene performance and was constructed by the expert group based on other ADL instruments.[12,31] The survey took about 20 minutes to complete.

3.2 | Phase III

The third phase, evaluation and validation of the instrument (Figure 1), included a basic mock test and two pilot studies. The test subject in the mock test found the instrument relevant, saw no problems in accomplishing the three parts of the instrument and had no negative feedback.

3.2.1 | Pilot study 1

The instrument used in Pilot 1 consisted of 47 items. In the interviews aiming to validate the instrument, the two dental hygienists considered the items well-formulated and the different parts of the instrument easy to execute. Thus, content validity seemed to be good. However, they considered the instrument too long and suggested it be shortened:

> I thought it was fun to use the instrument. A lot of questions, though! It would be good with a shorter instrument… but (it was) good.
>
> (Dental hygienist at dementia ward)

Item reduction I

After Pilot 1, some items were deleted by the expert group, and a few related to social support and assistance were reworded for clarity or/and split up. The additional items resulting from splitting replaced the deleted items, so the second version of the OHAI also consisted of 47 items.

3.2.2 | Pilot study 2

After Pilot 2, with the revised OHAI, the three dental hygienists were interviewed individually, and their interviews were analysed by the expert group using content analysis. The results showed that both the whole instrument and its separate parts were easy to use. The questions were considered relevant and the clinical examination and observation parts unproblematic:

> Good, fun, they thought it was fun to put out their tongue and imitate me.
>
> (Dental hygienist at a dementia ward)

The dental hygienists perceived personal hygiene as the most difficult issue to ask about, as they felt it went beyond the remit of their profession:

> The patients did not react negatively to any of the questions. However, I thought it was difficult to ask the question about personal hygiene. Everyone that I asked managed this themselves. The patients did not react, but it was a difficult question for me to ask.
>
> (Dental hygienist at a public dental clinic)

Two of the dental hygienists thought the instrument was important, as it allowed them to observe impairments in oral hygiene management in their patients that they had previously missed:

> The whole test went well. I've got another understanding now, seeing that I often overestimate the patient's ability and think they can do much more than they can; now I realise how much they cannot do.
>
> (Dental hygienist at a dementia ward)

The observational part started with the person opening a toilet bag. The dental hygienist who examined the patients in the stroke ward found this to be a poor start of the test, as it may often be a difficult task for this group of patients, and a poor model situation, since people rarely keep their oral hygiene tools in a toilet bag at home:

> The observation part, [asking participants] to open a toilet bag, is not a good start, especially if it's difficult.
>
> (Dental hygienist at a stroke ward)

The dental hygienist who examined participants in the healthy group found they were very receptive to the test and that "the time spent gave them a feeling of being cared for." The dental hygienist considered it well worth the time to administer the instrument.

After Pilot 2, the qualitative content analysis of the interviews with the dental hygienists, statistical analyses of the instrument and a review by the expert group, a new item reduction was performed.

Item reduction II

In the interview part of the instrument (Part I), questions about loss of spouse, marital status and number of social contacts were deleted and replaced with one question about living conditions (living alone or not). A question about loneliness was added to capture isolation/sadness. To simplify the instrument, response options were changed to yes/no on items about help with shopping and personal hygiene.

After discussion in the expert group, one question about the participant's last dental visit was deleted and one about regularity of dental attendance was kept. A question about the importance of oral health was also deleted since all participants in both pilots responded "important" or "very important," and other questions were thought to better capture participants' motivation.

Three questions in Part 1 and the mirror test in Part II were aimed at assessing xerostomia/oral dryness. The expert group considered two of the questions "Do you have problems swallowing dry food?" and "Do you need to drink to swallow food?" quite similar; the first was deemed most decisive and therefore kept, while the second was deleted.

In the clinical examination (Part II), 43% of participants were found to have "clean teeth, no food scraps present" (Table 3). Since there is no need to use the instrument on individuals with good oral hygiene, a major change was made to the instrument. The question "Are the teeth covered with plaque or food scraps?" was deleted from the clinical examination part. Instead, it was decided that in the validation studies to come, the test should start with two screening items: "Presence of plaque and/or food scraps?" (moved from the clinical examination part of the instrument) and "Do you manage your oral hygiene yourself?" These screening questions, however, are not part of the instrument. In the clinical part (Part II), one of two questions about tongue mobility was deleted, as the items and the answers in the two pilot studies were quite similar.

The ADL part (Part III) consisted of 11 items with three response alternatives: 1 = manages, 2 = manages with help (ie the dental

TABLE 2 Content of OHAI items (N = 33) in abbreviated form separated in: Part I. Questionnaire, items (n = 19). Part II. Clinical examination items (n = 6). Part III. Observation ADL items (n = 8)

Part 1. Questionnaire		Part 2. Clinical examination	Part 3. Observation ADL
Background, social context	**Dental care and xerostomia**		
1. Medication	9. Regular dental care.	1. Function-clench jaws	1. Pick up toothbrush.
2. Diseases	10. Who handled contacts with the dental service?	2. Lick lips	2. Pick up toothpaste.
3. Disabilities	11. Importance of dental care.	3. Function-blow out cheeks.	3. Unscrew cap.
4. Housing	12. Regularity of oral hygiene.	4. Mirror test: oral dryness	4. Apply toothpaste.
5. Living conditions	13. Knowledge of oral hygiene.	5. Dental status-position of teeth, missing teeth.	5. Brush
6. Help with shopping, y/n Help with personal hygiene, y/n	14. Bleeding when brushing-what to do?	6. Dental status-prostetics, dentures.	6. Pick up toothpick.
7. Loneliness	When brushing, how often: 15. Pain? 16. Disgust or gagging?		7. Use toothpick.
8. Quality of Life	17. Problems swallowing dry food? 18. Xerostomia-how often? 19. Problems chewing?		8. Rinse mouth with water.

hygienist guided the person through the task) and 3 = does not manage at all (Min score: 11 = good ability; Max score: 33 = no ability). The patients with either a stroke diagnosis or a neurocognitive disorder had high scores in the ADL part (Mean; SD; range: 18.5; 5.6; 11-27 vs. 18.1; 6.9; 12-33). In the Parkinson group, one participant was totally dependent, and the rest performed the tasks well independently (Mean; SD; range: 15.7; 7.2; 11-30). The healthy group showed the best ability to manage oral hygiene (Mean; SD; range: 12.1; 1.4; 11-14).

In the ADL part, the dental hygienists considered the first activity "Opens the toilet bag" an unusual task in association with oral hygiene. In the correlation analyses of the observational part, this activity was strongly correlated to "Unscrews the cap from the toothpaste tube," r_s = .718, P < .001). For these reasons, "Opens the toilet bag" was deleted and the toilet bag was replaced by a plastic box to be opened by the dental staff. Another activity in the observational part, "Removes the protective plastic around the toothbrush," was also deleted as it correlated strongly with "Takes out the toothbrush" (r_s = .735, P < .001) and "Unscrews the cap from the toothpaste tube" (r_s = .718, P < .001). "Brings the toothbrush to the mouth" correlated strongly with several of the activities; for instance, "Takes out the toothbrush (from the toilet bag)" and "Unscrews the cap from the toothpaste tube" (r_s = .825, r_s = .718, respectively, P < .001) and was deleted.

Pilot study 1 and 2 resulted in a third version of the instrument consisting of 33 items (and two opening screening items). The items included in the OHAI instrument are shown in an abbreviated form in Table 2. The full version will be available when the instrument has been further validated in a larger sample.

4 | DISCUSSION

This study aimed to describe the development of a new instrument, the OHAI, intended to assess a person's ability to manage daily oral hygiene, the cause of their impaired oral hygiene and their possible

TABLE 3 Number of subjects with "Clean teeth, no plaque or food scraps," "Plaque and/or food scraps, locally," and "Plaque and/or food scraps, generally" in the four groups of patients in pilot studies 1 (n = 4) and 2 (n = 24) merged together

	Oral hygiene		
	Clean	Not clean locally	Not clean generally
Group	n	n	n
Healthy	3	5	-
Neurocognitive disorder	1	6	1
Stroke	3	3	
Parkinson´s disease	5	-	1*
Total	12 (43%)	14 (50%)	2 (7%)

*The only one with assisted dental care in this group.

need for help and support. The instrument is initially intended for dental health professionals working with the ageing population. To date, the instrument has been tested only by dental professionals.

Many aspects must be considered when assessing an older person's ability for self-care. To our knowledge, this is the first instrument to consider the complexity that oral hygiene presents for older adults. The instrument therefore consists of three different parts capturing the complexity found in the results from the previous qualitative study.[25] In Part I, questions about medication, dependency, loneliness, quality of life, regular dental care and problems with food intake were asked to capture social support/pressure, practical conditions, emotions and cognition. In Part II, a clinical examination was performed to capture dental status (eg crowded teeth), oral motor function and oral dryness, all of which impair self-cleaning and make oral hygiene difficult in different ways. Part III, the observational/ADL part, dealt with the ability to perform oral hygiene and captured several aspects such as dexterity, cognitive capacity, senses (eg eyesight), motivation and attitude.

The pilot tests showed that the OHAI can be completed in 20 minutes, which may be acceptable for such an extensive instrument. Some of the items in the questionnaire (Part I) are already included in the regular check-up regimen in Sweden.[32] Thus, when used in a dental care clinic or in other settings with dental or health records available, the burden of the instrument is reduced for both patients and caregivers. However, in future a short form of the instrument would be desirable.

A literature review was performed in the initial stage of the development. The review showed that many instruments have been developed to assess the ability of staff in nursing homes and hospitals to provide oral hygiene to older adults.[19-21] These instruments are mostly based on plaque-recording indices that give an image of a person's oral status at a specific moment but say nothing about why their oral hygiene is poor or impaired. Only a few published instruments assess the cause of impaired oral hygiene in older adults, and they mostly focus on upper motor function and are rarely used in the clinical setting.[16-18]

Table 3 shows that a large proportion of the sample had good oral hygiene. Since the instrument was originally meant for older adults with poorer oral hygiene, this resulted in a major change in the formulation of the purpose of the instrument. The instrument therefore no longer is meant to assess the *ability* to manage oral hygiene but to assess the cause of any *inability* to manage oral hygiene. Therefore, to focus on the people most likely to be helped by the instrument, two screening items were added for the next phase: (a) presence of plaque and/or food scraps and (b) independent self-management of oral hygiene. If the results of the two screening questions show that an older person has poor oral hygiene, despite assistance, the focus should be on instructing and training the caregiver in how to perform oral hygiene on another person as suggested by Wårdh et al[33] The two screening items are not part of the instrument, but they or other questions/items (eg plaque indices) may be chosen by a professional to decide whether further testing is needed. The choice may also be to use the instrument to gauge an older persons' ability to maintain oral hygiene regardless of their current state of oral hygiene.

Content validation was performed by experts in the field and the dental hygienists who conducted the study. The interviews with the dental hygienists were analysed using content analysis, and the OHAI was found to be a stable instrument that showed good face validity, credibility and feasibility in the rather small group investigated. The instrument also seems to have good comprehensiveness and is able to capture the factors that we found important when assessing oral self-care.

The OHAI and accompanying manual were developed in the Swedish language. After further evaluation, both the instrument and the manual will be easily accessible through a website. The props required for the instrument are simple and easily obtained: two mirrors (mouth and face), a probe, a flashlight and the utilities included in the observational/ADL part of the instrument. The OHAI will preferably be used in dental clinics, but the pilot study showed that it could also be used in other settings.

An instrument like the OHAI may be valuable in nursing homes or hospital wards where the daily routine of oral hygiene is a challenge. It may explain why older adults have difficulty with the regime of oral hygiene, despite training or information, and where other actions need to be taken. Thus, the OHAI could be a useful tool and part of regular dental check-ups for older patients with poor oral hygiene and/or gingivitis. It could also be used, along with other ADL instruments, with people admitted to nursing homes and patients with stroke, who could benefit from a measure their improvement and deterioration in oral health. This would necessitate cooperation between the social services, assistance assessors and dental care, which might increase its relevance for use by other professions and in other patient groups. The instrument could also be useful in research and education.

The three groups of sick and disabled older adults in the samples in Pilots 1 and 2 were chosen because these groups often have problems with oral hygiene.[34] Individuals with a neurocognitive disorder form a very heterogeneous group that often needs help but rarely receives more than basic care.[33] The individuals may remember functions like oral hygiene learnt early in life, but in later stages of the illness forget how to perform oral hygiene. As neurocognitive disorder is a chronic disease with continuous deterioration, it is important to be alert to the patient's first need of support and later need for full assistance.[35] The sample from the stroke ward was newly admitted and in the beginning of their rehabilitation. Stroke is often combined with fatigue and depression in the initial stages, and patients will likely need help to maintain good oral hygiene habits.[36] It is also vital to notice tremor, paralysis, neglect and spatial ability in the mouth. In the stroke group, remission of symptoms is often seen during the first months and follow-up with the OHAI is important to keep preventive efforts at the right level. In Parkinson's group, all but one was living at home without assistance. All had problems with gripping and muscle fatigue, but all were well-educated in the importance of oral hygiene and had found ways to cope by using an electric toothbrush with a large grip, sitting down during brushing, and brushing when their medication had reached full effect. This group of patients requires careful follow-up, however, as the disease may

change rapidly.[37] In the group of essentially healthy older adults, some of whom had poor oral hygiene, we also found loneliness, poor social support, changed dietary habits and lost motivation to take care of their oral hygiene. This shows the importance of an instrument to capture problems associated with oral hygiene at an early stage.[38]

The older participants in this study said that they felt well cared for and that the instrument was not burdensome. The dental hygienists found it useful since it provided information about patients that they had not had earlier. However, they found it difficult to ask whether participating patients managed their personal hygiene on their own. This could reflect their own values and embarrassment about asking a potentially offensive question of someone who seems more or less capable of managing their own personal hygiene.

A strength of the study is that the instrument was based on a focus-group study[25] including potential administrators (dental hygienists) and takers (older adults) whose opinions were considered during the development of the instrument. The method of Benson and Clark,[23] used in the present study, included such a qualitative study in the step-by-step development of the new instrument. The development of the OHAI also fulfils the requirements of the Appraisal of Guidelines for Research and Evaluation II.[39] Another strength is that the OHAI combines elements of already existing instruments. An additional strength of the study is the interdisciplinary approach reflected in the inclusion of different relevant professions in the study: three dentists, a dental hygienist and an occupational therapist. The occupational therapist was included because occupational therapists work closely with elderly people who require rehabilitation, especially those who have had stroke or a broken hip. Occupational therapists also are well versed in ADL instruments. Collaboration across disciplines is vitally important in oral health and its connection to general health.

One limitation of the study could be the overrepresentation of dental staff, which might have influenced the dynamics of the group. Therefore, an external expert in questionnaire methodology and statistics was introduced at an early stage to help with the layout of the instrument and the formulation of items and response options. A second limitation might be that the sample size (N = 28) allowed content validation but not tests of construct validation or reliability. Because these studies were pilot studies, however, a large sample was not required to allow us to draw some inferences for future research. A third limitation is that the dental hygienists worked in the same region as, and were acquainted with the interviewer (first author), and they may have been reluctant to offer any significant critique of the instrument. They were not, however, in any position of dependence nor had they any other discernible reason to be insincere in their responses. Selection bias may also be present in the sample of older adults, but we believe our selection served its purpose for the pilot studies. The last limitation is that the instrument needs further refining, which we plan for in the next phase of validation and reliability testing in a large sample. The upcoming study will also include interviews with the older adults own opinions of the instrument.

5 | CONCLUSION

The developed instrument, the OHAI, can be a valuable tool as a preventive method to identify older adults at risk of impaired oral health. However, the instrument needs further evaluation before wider use.

ACKNOWLEDGEMENTS

The authors would like to thank dental hygienists Camilla Broqvist, Annette Carlsson and Ann Katrin Larsson for their participation in this study. The study was supported by grants from the Gothenburg Dental Association; the Dementia Fund for Research, Stockholm, Sweden; and the Swedish Order of Freemasons, Grand Lodge of Sweden.

ORCID

Ingela Grönbeck Lindén https://orcid.org/0000-0002-6301-3859

REFERENCES

1. United Nations. *World Population Ageing 2015 (ST/ESA/SER. A/390)*. New York, NY: United Nations, Department of Economic and Social Affairs, Population Division.
2. Department of Health, United Kingdom. Meeting the challenges of oral health for older people: a strategic review. *Gerodontology* 2005;22(Suppl 1):3-48.
3. Norderyd O, Koch G, Papias A, et al. Oral health of individuals aged 3–80 years in Jönköping, Sweden during 40 years (1973–2013). II. Review of clinical and radiographic findings. *Swed Dent J*. 2015;39(2):69-86.
4. Villa A, Wolff A, Aframian D, et al. World Workshop on Oral Medicine VI: a systematic review of medication-induced salivary gland dysfunction: prevalence, diagnosis, and treatment. *Clin Oral Investig*. 2015;19(7):1563-1580.
5. Andersson P, Westergren A, Karlsson S, Rahm Hallberg I, Renvert S. Oral health and nutritional status in a group of geriatric rehabilitation patients. *Scand J Caring Sci*. 2002;16(3):311-318.
6. Holm-Pedersen P, Schultz-Larsen K, Christiansen N, Avlund K. Tooth loss and subsequent disability and mortality in old age. *J Am Geriatr Soc*. 2008;56(3):429-435.
7. van der Putten GJ, de Baat C, De Visschere L, Schols J. Poor oral health, a potential new geriatric syndrome. *Gerodontology*. 2014;31(Suppl 1);17-24.
8. Åström AN, Ekbäck G, Ordell S, Nasir E. Long-term routine dental attendance: influence on tooth loss and oral health-related quality of life in Swedish older adults. *Community Dent Oral Epidemiol*. 2014;42(5):460-469.
9. Fried LP, Tangen CM, Walston J, et al. Cardiovascular Health Study Collaborative Research Group. 2001. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 2001;56(3):146-156.
10. Strömberg E, Hagman-Gustafsson ML, Holmén A, Wårdh I, Gabre P. Oral status, oral hygiene habits and caries risk factors in home-dwelling elderly dependent on moderate or substantial supportive care for daily living. *Community Dent Oral Epidemiol*. 2012;40(3):221-229.
11. Lambert NM, Tepper LM. Prevention of oral disease for long-term care and homebound elderly. *N Y State Dent J*. 2010;76(5):42-45.

12. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The Index of ADL: a standardized measure of biological and psychosocial function. *JAMA*. 1963;21(185):914-919.
13. Greene JC, Vermillion JR. The simplified oral hygiene index. *J Am Dent Assoc*. 1964;68:7-13.
14. Martens LV, Meskin LH. An innovative technique for assessing oral hygiene. *ASDC J Dent Child*. 1972;39(1):12-14.
15. Podshadley AG, Haley JV. A method for evaluation oral hygiene performance. *Public Health Rep*. 1968;83(3):259-264.
16. Felder R, Reveal M, Lemon S, Brown C. Testing tooth brushing ability of elderly patients. *Spec Care Dentist*. 1994;14(4):153-157.
17. Bauer JG. The index of ADOH: concept of measuring oral self-care functioning in the elderly. *Spec Care Dentist*. 2001;21(2):63-67.
18. Doherty S, Ross A, Bennett R. The Oral Hygiene Performance Test: development and validation of dental dexterity scale for the elderly. *Spec Care Dentist*. 1994;14(4):144-152.
19. Andersson P, Hallberg IR, Renvert S. Inter-rater reliability of an oral assessment guide for elderly patients residing in a rehabilitation ward. *Spec Care Dentist*. 2002;22(5):181-186.
20. Kayser-Jones J, Bird WF, Paul SM, Long L, Schell ES. An instrument to assess the oral health status of nursing home residents. *Gerontologist*. 1995;35(6):814-824.
21. Fjeld KG, Eide H, Mowe M, Hove LH, Willumsen T. Dental hygiene registration: development, and reliability and validity testing of an assessment scale designed for nurses in institutions. *J Clin Nurs*. 2017;26(13–14):1845-1853.
22. Chalmers JM, King PL, Spencer AJ, Wright FA, Carter KD. The oral health assessment tool—validity and reliability. *Aust Dent J*. 2005;50(3):191-199.
23. Benson J, Clark F. A guide for instrument development and validation. *Am J Ther*. 1982;36(12):789-800.
24. Streiner DL, Norman GR. *Health measurement scales: a practical guide to their development and use*. Oxford, UK: Oxford University Press2008. [Published on Oxford Scholarship Online: September 2009]. doi:https://doi.org/10.1093/acprof:oso/9780199231881.001.0001. http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199231881.001.0001/acprof-9780199231881. Accessed 8 January, 2019.
25. Grönbeck Lindén I, Hägglin C, Gahnberg L, Andersson P. Factors affecting older persons' ability to manage oral hygiene: a qualitative study. *JDR Clin Trans Res*. 2017;2(3):223-232.
26. Wenemark M. The respondent's perspective in health-related surveys: the role of motivation. [master´s thesis]Linköping, Sweden: Linköping University; 2010. ISBN978-91-7393-346-9.
27. Aiken LR. *Psychological testing and assessment*, 12th edn. Boston, MA: Allyn and Bacon; 2003.
28. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res*. 2005;15(9):1277-1288.
29. Bakke M, Bergendal B, McAllister A, Sjögreen L, Asten P. Development and evaluation of a comprehensive screening for orofacial dysfunction. *Swed Dent J*. 2007;31(2):75-84.
30. Henricsson V. Objective evaluation of mouth dryness. A methodological study. *Swed Dent J*. 1994;97(Suppl):1-55.
31. Mahoney FI, Barthel DS. Functional evaluation: the Barthel index. *Md State Med J*. 1965;14:61-65.
32. 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.
33. Wårdh I, Jonsson M, Wikström M. Attitudes to and knowledge about oral health care among nursing home personnel-an area in need of improvement. *Gerodontology*. 2012;29(2):787-792.
34. Ástvaldsdóttir Á, Boström AM, Davidson T, et al. Oral health and dental care of older persons – a systematic map of systematic reviews. *Gerodontology*. 2018;35(4):290-304.
35. Chalmers JM, Pearson A. A systematic review of oral health assessment by nurses and carers for residents with dementia in residential care facilities. *Spec Care Dentist*. 2005;25(5):227-233.
36. Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. *Lancet*. 2011;377(9778):1693-1702.
37. Siciliano M, Trojano L, Santangelo G, De Micco R, Tedeschi G, Tessitore A. Fatigue in Parkinson's disease: a systematic review and meta-analysis. *Mov Disord*. 2018;33(11):1712-1723.
38. Tonetti MS, Bottenberg P, Conrads G, et al. Dental caries and periodontal diseases in the ageing population: call to action to protect and enhance oral health and well-being as an essential component of healthy ageing—consensus report of Group 4 of the Joint EFP/ORCA Workshop on the Boundaries Between Caries and Periodontal Diseases. *J Clin Periodontol*. 2017;44(Suppl 1):135-144.
39. AGREE Next Steps Consortium 2017. The AGREE II Instrument [Electronic version]. http://www.agreetrust.org Accessed October 10, 2018.

How to cite this article: Grönbeck Lindén I, Andersson P, Dahlin-Ivanoff S, Gahnberg L, Hägglin C. Development of an instrument to assess oral hygiene ability in older adults: The oral hygiene ability instrument. *Gerodontology*. 2019;00:1–9. https://doi.org/10.1111/ger.12437