

# IDENTIFYING AND MONITORING ORAL HYGIENE BEHAVIOR AND ORAL COMFORT IN INDIVIDUAL PATIENTS IN A PRIVATE ORAL HYGIENE CLINIC

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## Abstract

Oral care professionals try to promote or maintain individual optimal oral hygiene behavior (OHB) in daily practice in order to increase the effectiveness of their oral comfort interventions. The present research describes the evaluation of individual OHB and subjective oral discomfort by using the Mondix-i®.

261 patients in a private dental hygiene clinic in Groningen, The Netherlands completed a short questionnaire at their appointment for screening, monitoring and treatment. The first author treated the patients on a recall-routine, provided them with tailored advices about their oral health, which she did based on her own professional daily practical experience. The data collection was based on a draft version of the Mondix-i®. This new measure includes two simple questions; “How do you estimate or do you evaluate your *general* health?” and “How do you estimate or do you evaluate your *oral* health?”, as well as the OHB index and an Oral Discomfort scale, a two dimensional scale to monitor psychological discomfort and physical discomfort. The present findings suggest that patients’ oral hygiene behavior in daily practice can be promoted, maintained and/or changed in the right/desired direction and indicate that oral discomfort play an important role in oral health care. Moreover, the results indicated that intrinsic motivated older patients’ oral hygiene behavior can be also improved by promoting support by significant others, such as the oral hygienist and the patients’ social environment.

**Keywords:** self-employed oral hygienist, oral hygiene behavior, oral discomfort, private oral hygiene clinic

## Introduction

It is well-established among (oral) health professionals, that behavior has an important role in determining the status of oral health, and that oral hygiene behavior is an essential aspect of general health throughout life. Oral care professionals, in particular oral hygienists, try to promote or maintain individual optimal oral hygiene behavior (OHB) in daily practice (Buunk-Werkhoven et al. 2010; Buunk-Werkhoven et al. 2012; Brein et al. 2016; Buunk-Werkhoven, Burrekers 2017; Burrekers, Gortzak et al. 2020) and in public campaigns (Buunk-Werkhoven et al. 2018; Buunk-Werkhoven et al. 2021) in order to increase the effectiveness of their oral comfort interventions (Ghaffari et al. 2018; Buunk-Werkhoven, Reyerse 2020).

To substantiate and illustrate the historical narrative of the first author as a self-employed oral hygienist with more than 40 years of clinical experience and as a participating researcher in this study, a brief description of the developments in the dental hygienist profession in the Netherlands, including career and practical experiences follows. Ten years after the education of Dental Hygiene was initiated her professional as a 2-years program in the Netherlands, the author began her 2-years educational training period in Utrecht, the capital-city of the country’s central province of Utrecht. From 1992 the study was extended into a 3-years program, and in 1995 the training period was changed from a 3 to a 4 year bachelors training program. At first dental hygienists had to work under the supervision of dentists, but in 1992 this policy approach changed into working ‘by referral from a dentist’ and in 2006 the oral hygienists became directly accessible for patients. In 2010, approximately a third of all oral hygienists practice self-employed in their own clinic or in combination with other employees (Jongbloed-Zoet et al, 2012). Nowadays many oral hygienists work as independent entrepreneurs within a larger conglomerate of multiple practices. In July 2020, the Dutch government started an experiment for oral hygienists who completed their studies from 2006 and were later granted more treatment powers. After registration, the registered oral hygienist may independently perform certain reserved treatments, such as administering anesthesia, taking X-rays and filling primary cavities. During the term of the study, up to and including December 2023, the researchers were advised by a sounding board group, which was set up in consultation with the Ministry of Health, Welfare and Sport (according Evaluatie Experiment Artikel 36a Wet BIG geregistreerd mondhygiënist, 2024).

Immediately after obtaining her diploma, the author as a newly graduated oral hygienist moved back to Groningen and worked in several fields of dental hygiene, for instance, in orthodontics, in a general dental practice, and in an institution for mentally and physically retarded persons, but also in a periodontal clinic and as a lecturer at the School of Oral Hygiene, University of Applied Sciences, Hanzehogeschool Groningen (in collaboration with Dental School /UMCG). Finally, as a volunteer, since 2008, she participated in a prevention

project aimed at promoting oral health for primary school children in the Dominican Republic (Buunk-Werkhoven, Burrekers et al. 2011; Buunk-Werkhoven, Burrekers 2019; Burrekers, Doorman-Vasquez et al. 2020).

In 1992, she started her own practice, a private oral hygiene clinic, for 1 day a week, located in a professionally furnished room in her own home near the city center. A few years later, after a personal move from the house, a second treatment room with a different dental chair was set up and several colleagues worked together in the clinic. After the author quit her job after 11 years in the periodontal clinic in 1997, about 200 patients followed her to her own practice. In 2003, the fully equipped practice moved to a former garage building, which was converted into an oral hygienists group practice with 3 treatment rooms. From that moment on, there was a collaboration with 3 colleagues on two treatment chairs. In 2006 a dentist started her oral care team practice in the third room (Buunk-Werkhoven, Burrekers 2017). In 2018, the private practice moved again to another location in the city of Groningen; from that time on, her solo practice will continue, where she will work until her retirement 2 years from now (Burrekers, Gortzak et al. 2020). The clients who visit the solo oral hygiene clinic live in the whole north part of the Netherlands: from the east of the province Groningen to the west of the province Friesland. Groningen is the capital of the province Groningen with a population of about 203000 inhabitants, including 32700 students. The patient population of the practice exists mostly of elderly people living independently, between 50-80 years of age. Many of them (about three-thirds) visit the oral hygienist 3 or 4 times a year. Another quarter visits the oral hygiene clinic 2 times a year or less (Buunk-Werkhoven, Burrekers 2017; Burrekers, Gortzak et al. 2020).

It is not only known that oral health promotion is an integral part of general health promotion (Artnik et al. 2008; Buunk-Werkhoven et al. 2009), but also that adequate oral hygiene behavior is more than just 'tooth brushing and flossing' (Buunk-Werkhoven 2010). Appropriate oral hygiene behavior performed by individuals reduces dental plaque / biofilm and improves gingival and periodontal health. Teeth and tongue can be brushed several times a day, but for a sufficient maintenance of oral hygiene, it is necessary to brush them at least once a day before sleeping (Artnik et al. 2008, Buunk-Werkhoven, Dijkstra et al. 2011<sup>a</sup>). However, without a proper regimen of self-driven OHB, it is more likely that pathogenic microbial deposits will accumulate and result in chronic periodontitis, which in turn could lead to significant pain, discomfort, and ultimately, tooth loss (Brein et al. 2016). Dentists and/or oral hygienists should be visited at least once a year for professional screening, monitoring and treatment if needed. Visits to oral hygienists are also important for any additional information on optimal oral hygiene behavior (OHB), behavior that refers to the preventive actions people take –tailored to different target groups and in diverse contexts– to care for their teeth and oral health, for example, tooth brushing and the use of interdental aids (Buunk-Werkhoven, Burrekers 2017; Burrekers, Gortzak et al. 2020; Buunk-Werkhoven et al. 2021; Elsenberg et al. 2022). Clearly, these oral health related behaviors can have different relations with self-perceived oral comfort. People with substantial number of visits and previous experience with oral care including oral pathology or the consequences that have debilitating effects on oral function –which may manifest in a higher oral discomfort– may be more motivated to engage in actions to cope with or to avoid reoccurring pain or other problems with their teeth, mouth or dentures (Buunk-Werkhoven et al. 2009; Buunk-Werkhoven et al. 2010; Buunk-Werkhoven et al. 2012).

Since the second author has developed the index for oral hygiene behavior (OHB index), which includes all brushing details, such as frequency, duration, force, method, moments of toothbrushing and other potential components of personal oral hygiene regimens, like the use of interdental cleaning methods (such as the daily use and frequency of toothpicks, interdental brushes and dental floss), fluoride concerning toothpaste usage, and tongue cleaning, this method appears to be worldwide a useful index for assessing and evaluating the oral self-care practices of individuals. In a study by Brein et al. (2016), the utility of viewing OHB as a series of three unique behaviors, namely toothbrushing, interdental cleaning and tongue cleaning, was highlighted as an effective oral hygiene measure. Moreover, this OHB should be performed regularly and is essential for maintaining optimal oral health. A one-to-one oral hygiene advice (OHA) within the oral hygiene clinic or dental setting is often provided as a means to motivate individuals and to help achieve improved levels of oral health (Soldani et al. 2018). Recently, it was emphasized that the use of the OHB index can be considered as one of the new approach from the behavioral sciences that have the potential to change individual oral health behavior (Trella et al. 2022; 2023).

In the present study, the original oral hygiene behavior (OHB index) was evaluated, fine-tuned and added to the Mondix-i® (Buunk-Werkhoven et al. 2012), which included subjective oral discomfort (Buunk-Werkhoven et al. 2024). This version of the Mondix-i® measure has been proposed -among other things- to monitor and/or evaluate individual OHB and to guide patients in an oral hygiene practice by a self-employed oral hygienist. There remains a lack of research applying an index of key, performed oral hygiene behavior in the Netherlands, and little research of this kind is intended for all oral health professionals and practitioners.

Thus this practical investigation fills a gap in understanding behavior in the field of oral hygiene and periodontology (periodontal therapy). Moreover, the purpose of this research was also to learn more about how a Dutch self-employed oral hygienist in the Northern Netherlands has been providing oral care and oral comfort to patients for more than 40 years. In addition, this study may provide insight into what patients think about their oral hygiene behavior and oral comfort for a possible successor to this solo oral hygiene clinic

## Methods

### Research design and Ethics Statement

Data collection in the oral hygiene clinic was carried out according to universal ethical principles. Participation was voluntary, patients were told what participation meant, and no pressure was exerted to participate in this simple evaluation study, that was conducted in accordance with the Declaration of Helsinki. An extensive formal written informed consent was waived and only verbal informed consent was obtained.

### Participants and procedure

From 8 March up to and including 23 July 2024 during regular working hours, 261 patients of a private oral hygiene clinic in Groningen, The Netherlands completed a short questionnaire before their periodic appointment for screening, monitoring and (maintenance) treatment. Following completion of the questionnaire the first author treated the patients on a recall-routine, provided them with tailored advices about their oral health, which she did based on her own professional daily practical experience.

### Measures

The paper and pencil questionnaire included 32 items, including a few demographic questions on gender and age, and were open-ended, multiple choice, or to be answered on bipolar adjective rating or Likert scales.

Patients' perceived *general* health and patients' perceived *oral* health were valued by themselves by answering the question: "How do you estimate or evaluate your *general* health?" and the question: "How do you estimate or evaluate your *oral* health?" respectively, using a number ranging from: "0 = very poor to 10 = extremely good perceived general/oral health" on a verbal 'Ladder Scale' like the Self-Anchoring Striving Scale (Cantril, 1965). Also, if desired, patients could write down their comments.

First, patients were asked to fill out what kind of toothbrush they used a manual toothbrush, a powered toothbrush, or a combination of both types of toothbrushes.

The index for oral hygiene behavior (Buunk-Werkhoven, Dijkstra et al. 2011<sup>a</sup>; Buunk-Werkhoven et al. 2009) was used for assessing and evaluating OHB, which is currently being developed into the Mondix-i® (Buunk-Werkhoven et al. 2012). 8 items with respect to tooth brushing, interdental cleaning and tongue cleaning. For example, the item "I brush my teeth as follows:" was supported by pictures showing different brushing methods.

Oral comfort was measured by using a two dimensional scale to monitor *psychological* discomfort and *physical* discomfort (Buunk-Werkhoven et al. 2024; 2025). Psychological discomfort (6 items, Cronbach's  $\alpha = .82$ ) encompasses the affective aspects of oral discomfort, including tension, dissatisfaction and embarrassment related to oral health conditions or treatments. For example, the question, "Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?" Physical discomfort subscale (5 items, Cronbach's  $\alpha = .81$ ) evaluates sensory experiences, such as pain and eating problems directly associated with teeth, mouth, or dentures. For example, the question, "Have you had painful aching in your mouth?" Responses were scored on a five-point Likert scale (i.e., 0 = 'never', 1 = 'sometimes', 2 = 'regularly', 3 = 'often', 4 = 'very often'). Moreover, zero was defined as the maximal positive result indicative of total absence of problems and 4 corresponds to a maximal negative answer or always a problem. Per subscale a total score for each respondent was calculated as the sum of 6 items, with a total score between 0 to 24, or respectively 5 items, with a total score between 0 to 20. A total score of all 11 items in this Oral Discomfort scale (Cronbach's  $\alpha = .86$ ) is between 0 to 44.

### Statistical Analyses

The Statistical Package for Social Sciences (SPSS, Chicago, Illinois) was used for data analysis. The internal consistency of the used scales was assessed by Cronbach's alpha ( $\alpha$ ). Chi Square test, t-tests and one-way analyses of variance were performed to determine whether there were any significant differences in mean scores of the variables.

## Results

### Patient population

The 258 patients (3 missing), who filled out the questionnaire, had an average age of 65.2 years (SD = 13.2; range 12-93 years). The sample consisted of 39.5% males, 58.2% females, and two persons reported to be

gender-neutral. Males ( $n = 103$ ,  $M = 67.1$  years,  $SD = 13.7$ ) were significantly older than females ( $n = 152$ ,  $M = 63.8$  years,  $SD = 12.9$ ),  $t(1,253) = 1.96$ ,  $p = .05$ ).

### **General and oral health**

Almost 95% ( $n = 244$ ; 17 missing) rated their perceived *general* health as 'more than sufficient' with a mean value of 7.6 ( $SD = 1.0$ ) and 43.4% ( $n = 106$ ) rated it as 'good' with a value of 8.0. Their personal *oral* health was rated with the mean value of 7.1 ( $SD = 1.1$ ) by 61.8% of the patients ( $n = 249$ ; 12 missing) which means 'sufficient', and only 21 patients (8.4%) rated it as 'inadequate', with a value of 5.5 or less.

To determine differences in gender and age-groups, age was divided in two categories; the younger age group <65 years ( $n = 110$ ) and the age group of 65 years and older ( $n = 148$ ). This was done because until 2013, the age of 65 years was the official retirement age. The percentages of gender differences in these subgroups were different: 30% males and 70% females were in the younger age group, but roughly the same percentages: 47% males and 51% females in the older age group.

### **Oral hygiene behavior**

About a quarter (23.1%) of the patients ( $n = 60$ ) reported to use a manual toothbrush, 157 patients noted a powered toothbrush (60.8%), and circa one out of six (16.5%;  $n = 43$ ) reported a combined use of both types of tooth brushes. The total patient population indicated that they had adequate control over their oral hygiene self-care practices. The findings with the OHB index showed that two-third ( $n = 169$ , 65%) reported to brush their teeth once a day; only one out of five patients ( $n = 50$ , 19.2%) brushed their teeth twice a day, as recommended by professionals worldwide. More than half (56%;  $n = 145$ ) brush their teeth for 2 minutes and a third (33.9%;  $n = 88$ ) brush for 3 minutes or longer. In addition, almost 70% ( $n = 177$ ) used fluoride containing toothpaste and 15% ( $n = 38$ ) reported not using fluoride-containing toothpaste. 15% ( $n = 39$ ) cleaned their tongue daily and 41.4% ( $n = 106$ ) never did so. Of all participants, two-third reported never to use floss (66%;  $n = 169$ ), one-third reported never to use toothpicks (33.6%;  $n = 86$ ), and a bit more than a quarter reported never to use interdental brushes (26.3%;  $n = 67$ ). Only 30 patients (11.7%) used floss daily; 101 (39.5%) and 112 (48%) patients reported daily or twice a day the use of interdental cleaning methods, such as toothpicks and interdental brushes, respectively. The frequencies in percentages of the items concerning the OHB index for patients who reported to use a *manual* toothbrush ( $n = 60$ ) are presented in Table 1. No differences in tooth brushing details were found between patients who used a manual of powered type of tooth brush. Only for the duration of toothbrushing there was a difference; patients who reported to brush with a powered toothbrush brushed their teeth significantly longer than patients who reported to use a manual toothbrush,  $X^2(4, n = 216) = 14.5$ ,  $p = .006$ . Also females reported to brush their teeth longer than males,  $X^2(8, n = 256) = 16.34$ ,  $p = .04$ . In the two age groups, the older age group reported significantly more often to brush their teeth just one minute, and the younger age group reported significantly more often to brush for 3 minutes or longer,  $X^2(4, n = 257) = 13.24$ ,  $p = .01$ . Additionally, the older age group more than the younger age group reported never to clean their tongue,  $X^2(2, n = 255) = 7.20$ ,  $p = .03$ .

### **Oral discomfort and gender**

The results of the Oral Discomfort scale show that females ( $n = 150$ ) reported more *physical* discomfort ( $M = .51$ ,  $SD = .50$ ) than males ( $n = 103$ ,  $M = .37$ ,  $SD = .32$ ), and this was statistically significant,  $t(1,251) = 2.55$ ,  $p = .01$ . Further analysis (t-test) at the item level shows that this difference was due to the fact that females ( $n = 152$ ,  $M = 1.07$ ,  $SD = .76$ ) reported significantly more *painful aching* in their mouth than males ( $n = 103$ ,  $M = .80$ ,  $SD = .55$ ),  $t(1,253) = 3.16$ ,  $p = .002$ . Also females ( $n = 152$ ) reported relatively more *psychological* discomfort ( $M = .36$ ,  $SD = .43$ ) than males ( $n = 103$ ,  $M = .24$ ,  $SD = .36$ ), but this difference was only marginally statistically significant,  $t(1,253) = 1.79$ ,  $p = .07$ . A t-test showed that females ( $n = 152$ ,  $M = .34$ ,  $SD = .57$ ) more than males ( $n = 103$ ,  $M = .19$ ,  $SD = .40$ ) reported significantly more *feeling tense* because of problems with their teeth, mouth or dentures,  $t(1,253) = 2.17$ ,  $p = .03$  and also that females ( $n = 152$ ,  $M = .31$ ,  $SD = .62$ ) found it significantly more *difficult to relax* because of problems with their teeth, mouth, or dentures than males ( $n = 103$ ,  $M = .16$ ,  $SD = .39$ ),  $t(1,253) = 2.23$ ,  $p = .03$ .

**Table 1.** Index for Oral Hygiene Behavior (OHB index) for patients ( $n = 60$ ), who reported to use a *manual* toothbrush: Percent per item.

Index for Oral Hygiene Behavior (using a <i>manual</i> toothbrush)		Percent	
Items	Values	Patients present study	Public in 2005
<b>- Frequency of tooth brushing</b>	'Twice a day'	<b>15</b>	82.8
	'Once a day'	<b>66.7</b>	16.4
	'Not every day'	<b>18.3</b>	0.8
<b>- Moments of tooth brushing</b>	<i>Once a day:</i> 'Before going to sleep'	<b>85</b>	9.7
<b>- Measure of force of tooth brushing</b>	Softly ('1, 2, 3')	<b>13.3</b>	25.1
	Softly/Forcefully ('4, 5')	<b>68.3</b>	63.7
	Forcefully ('6, 7')	<b>18.3</b>	11.3
<b>- Duration of tooth brushing</b>	'Two minutes' or 'Three minutes'	<b>48.3 / 16.7</b>	65.7
	'Longer than three minutes' or 'One minute'	<b>13.3 / 20</b>	28.1
	Shorter than 'One minute'	<b>1.7</b>	6.2
<b>- Method of tooth brushing</b>	'Bass-method'	--	17.5
	'Horizontal movement' or 'Combination of methods'	<b>13.6 / 69.5</b>	39.1
	'Vertical movement' or 'Circular movement'	<b>6.8 / 6.8</b>	43.1
<b>- Fluoride toothpaste</b>	'Toothpaste with fluoride'	<b>61</b>	76
	'Toothpaste without fluoride' or other alternatives	<b>20.3</b>	24
<b>- Interdental cleaning</b>	'At least once a day' floss or tooth picks or interdental brushes	<b>15.1 / 37.9 / 44</b>	26.7
	'Not every day' interdental cleaning	<b>25.4/27.6/28.8</b>	54.8
	'Never' interdental cleaning	<b>27.1 - 59.3</b>	18.5
<b>- Tongue cleaning</b>	'Every day'	<b>13.6</b>	20.5
	'Sometimes'	<b>47.5</b>	45
	'Never'	<b>39</b>	34.5

The percentages of a public sample in 2005 ( $n = 487$ ) has been added (Buunk-Werkhoven, Dijkstra et al. 2011).

### Oral discomfort and age

The findings of the two age groups show that the younger age group of <65 years ( $n = 110$ ) reported more *physical* discomfort ( $M = .53$ ,  $SD = .46$ ) than the age group 65 years and older ( $n = 146$ ,  $M = .40$ ,  $SD = .42$ ), and this was statistically significant,  $t(1,254) = 2.30$ ,  $p = .02$ . Further analysis (t-tests) at item level shows that this was due to the fact that the younger age group ( $n = 110$ ,  $M = 1.10$ ,  $SD = .72$ ) reported significantly more *painful aching* in their mouth than the older age group ( $n = 148$ ,  $M = .86$ ,  $SD = .66$ ),  $t(1,256) = 2.81$ ,  $p = .005$ , and that the younger age group ( $n = 110$ ,  $M = .23$ ,  $SD = .48$ ) had significantly more to *interrupt meals* due to problems with their teeth, mouth or dentures than the older age group ( $n = 148$ ,  $M = .10$ ,  $SD = .30$ ),  $t(1,256) = 2.57$ ,  $p = .01$ . And also the younger age group ( $n = 110$ ) reported relatively more *psychological* discomfort ( $M = .35$ ,  $SD = .46$ ) than the older age group ( $n = 148$ ,  $M = .26$ ,  $SD = .36$ ), this was marginally statistically significant  $t(1,256) = 1.80$ ,  $p = .07$ . A t-test showed that the younger age group ( $n = 110$ ,  $M = .69$ ,  $SD = .83$ ) more than the older age group ( $n = 148$ ,  $M = .50$ ,  $SD = .66$ ) reported to have been significantly *more self-conscious* because of their teeth, mouth or dentures,  $t(1,256) = 2.05$ ,  $p = .04$ . The younger age group ( $n = 110$ ,  $M = .38$ ,  $SD = .70$ ) more than the older age group ( $n = 148$ ,  $M = .23$ ,  $SD = .47$ ) reported to have been significantly *more a bit embarrassed* because of problems with their teeth, mouth or dentures,  $t(1,256) = 2.08$ ,  $p = .04$ , and also the younger age group ( $n = 110$ ,  $M = .35$ ,  $SD = .58$ ) reported significantly more *feeling tense* because of their teeth, mouth or dentures than the older age group ( $n = 148$ ,  $M = .22$ ,  $SD = .45$ ),  $t(1,256) = 2.05$ ,  $p = .04$ .

Additional analysis (not reported here) showed that the effect of gender was not caused by age differences, and the effect of age differences was not caused by gender.

### Correlations

Correlational analyses were carried out to establish the direction and magnitude of the associations between the main variables and the gender and age-groups, and type of toothbrush (**Table 2**). General health was found to correlate negatively and significantly with Physical discomfort in women, and positively and significantly with Oral Health in women and in the younger age group. Psychological Discomfort was found to correlate positively and significantly with Physical discomfort; in the patient group who used a manual toothbrush, this association was a bit stronger. In both gender and age-groups, Oral Health was found to correlate negatively and significantly with Psychological as well as with Physical discomfort. In the patient group who used a

manual toothbrush, the association between Oral Health and Psychological discomfort was weaker, than for the patient group who used a powered toothbrush.

**Table 2.** Intercorrelations (Pearson's) between the main variables and the gender and age-groups.

Correlations	General health – Psychological Discomfort	General health – Physical Discomfort	General health – Oral health	Psychological Discomfort – Physical Discomfort	Psychological Discomfort – Oral health	Physical Discomfort – Oral health
Categories						
Males <sup>a</sup>	.60	-.20	.06	.48**	-.48**	-.41**
Women <sup>b</sup>	-.15	-.12	.23**	.52**	-.36**	-.46**
Younger age <sup>c</sup>	-.12	-.20*	.27**	.54**	-.48**	-.44**
Older age <sup>d</sup>	.04	-.03	.03	.48**	-.31**	-.42**
Manual toothbrush	-.22	-.24	.15	.56**	-.28*	-.48**
Powered toothbrush	-.02	-.12	.12	.48**	-.46**	-.42**

Note. <sup>a</sup>  $n = 103$ ; <sup>b</sup>  $n = 152$ ; <sup>c</sup>  $n = 110$ ; <sup>d</sup>  $n = 148$ .

\* $P < 0.05$ ; \*\* $P < 0.01$ .

## Discussion

The present study shows that this fine-tuned version of the OHB index, which was added to a draft version of the Mondix-i® measure (Buunk-Werkhoven et al. 2012), appears to be a useful method for assessing and evaluating oral hygiene self-care practices of the patients in an oral hygiene clinic in Groningen, The Netherlands.

### Oral hygiene behaviour (OHB index)

Since the original OHB index (Buunk-Werkhoven, Dijkstra et al. 2011<sup>a</sup>; Buunk-Werkhoven et al. 2009) is intended to indicate actual or reported oral hygiene behavior, the OHB index is not a scale and calculating reliability (Cronbach's  $\alpha$ ) to check the internal consistency of the items is not very meaningful and therefore unnecessary (Brein et al. 2016). Although many culturally adapted versions of the OHB index have been used multiple times in other contexts (Buunk-Werkhoven et al. 2008; Buunk-Werkhoven, 2010; Buunk-Werkhoven, Dijkstra et al. 2011<sup>b</sup>; Buunk-Werkhoven, Burrekers 2011; Patel et al. 2019), in 2016, in the USA, Brein et al. have analyzed separately tooth brushing, interdental cleaning, and tongue brushing. In the present study the frequencies for the items in the OHB index for patients, who reported to use a *manual* toothbrush ( $n = 60$ ) corresponds closely to the reported oral hygiene behavior of the public population in 2005 (Buunk-Werkhoven, Dijkstra et al. 2011<sup>a</sup> - **Table 1**). The differences in an Uruguayan and in an American context were also considered (Buunk-Werkhoven et al. 2008; Brein et al. 2016).

In contrast to the previous findings of the Dutch public in 2005 (16.4%), of the patients in 2008 in Uruguay (19%), and of the patients in 2013 (26.2%) in the USA, in this study, 66.7% of the patients reported to brush their teeth once a day. This finding supports the fact that the basic behavior of systematically brushing teeth twice a day is not practiced enough (Nahum-Shani et al. 2024). In other contexts, about the same percentage as in the present study, i.e., 65%, brush their teeth for 2 or 3 minutes (65.7% in 2005, 53% of the patients in 2008 in Uruguay, and of the 61% of the American patients in 2013). In addition, 20% reported not using fluoride-containing toothpaste, in comparison to 24% in 2005, 8% in 2008 in Uruguay, and 9% in 2013 in the USA. 13.6% cleaned their tongue daily and so did 20.5% in 2005, 44% in 2008 in Uruguay, and 53% in 2013 in the USA. In the present study, 15% to 44% of the patients reported to use floss and/or tooth sticks and/or interdental brushes at least once a day. In 2005, 26.7% of the Dutch public, 59% of the Uruguayan patients, in the USA 38% of the patients.

Unlike a study in which the original OHB index was adapted and interpreted with the OHB-9 questionnaire, suggesting that multiple OHB versions with different numbers of items had been used previously (Elkerbout et al. 2023), in the current study patients were first asked (in order to keep the OHB index intact and to be able to interpret the findings adequately) to indicate what type of toothbrush they used: a manual toothbrush, an electric toothbrush or a combination of both types of toothbrushes. Almost two-third (60.8%) of the patients reported to use a powered toothbrush. In Utrecht, in a periodontal clinic, 85% of patients used a power toothbrush.

In the present study, patients who reported to use a manual toothbrush brushed their teeth significantly shorter than patients who reported to use a powered toothbrush. Also males reported to brush their teeth shorter than females, mostly the older age group brush their teeth just one minute and reported never to clean their tongue. As Brein et al. (2016) concluded, tooth brushing may be the most appropriate intervention behavior.

Like in the Brein et al. study, tongue cleaning was most strongly predicted by female gender, younger age, and perceptions of social pressure. Thus, while one-on-one oral hygiene advice (OHA) in an oral hygiene clinic or in the dental setting is often provided as a way to motivate individuals and help them achieve an improved level of oral health, it is unclear whether individual instruction method(s) in practices might be most effective and efficient (Soldani et al. 2018). In the oral hygiene clinic in Groningen, the way in which the oral hygienist provides patients with information and instructions, including the necessary treatments, proves to be effective in maintaining and/or improving oral health. Whereas a study by Vysniauskaite in Lithuania (2009) showed that brushing teeth twice a day contributes to better gum health in the elderly, in the present study the older patients mainly brushed once a day and also for a short time, while their perceived general health was rated as more than sufficient to good, and their perceived oral health was rated as sufficient. In the second author's 2005 baseline study, it was shown that the majority (82.8%) of uninstructed public and 72% of the patients in the USA (Brein et al. 2016) brushed their teeth twice a day, while in the current study only 15% reported brushing twice daily. After all, with a variety in type of toothbrush, in frequencies, in duration and in other details of cleaning, it is important for teaching/instructing to clean the teeth conform the '*inside, outside, upside, backside*' brushing order, starting in the lower jaw and continuing the same ordering in the upper jaw. The Dutch BBBA - teeth brushing sequence (Buunk-Werkhoven et al. 2018), and known since 2020 in Spanish as the Adentro, Afuera, Arriba, Atras - system (sistema AAAA; Burrekers et al. 2020)

### **Oral discomfort and (oral) health**

It is believed that factors such as nutrition, optimal oral care and vitality that contribute to general health differences also contribute to differences in oral health. The patient population in this study, which can be characterized as elderly people living independently, was assessed as 'more than sufficient' in terms of perceived general health and personal oral health was assessed as 'sufficient'. These patients are apparently intrinsically motivated to perform adequate self-care and to visit the self-employed oral hygienist regularly, which can also be interpreted as patients with a high degree of compliance. Also, the scores of these patients were mostly low on the Oral Discomfort scale (Buunk-Werkhoven et al. 2024), and it can be assumed that they mainly experience oral comfort. This is in contrast to the findings of research by Hoeksema (2016) showed that 75% of older people in nursing homes are found to have poorer oral hygiene and oral care problems that have not been treated. In nursing homes, patients are generally not screened and/or checked and most of them no longer visit a dentist or dental hygienist, and the elderly people are mainly toothless while the younger people do have their own teeth. In the present study the younger age reported more painful aching in their mouth, they had more to interrupt meals due to problems with their teeth, and the younger age group reported to have been more self-conscious of their teeth and more embarrassed and more feeling tense because of their teeth and mouth, than the older age group. An explanation for these discomforts could be that the younger group makes more use of social media and the expressions on it about white teeth and appearance in general. From observations of this very experienced oral hygienist it is assumed that young people under 35 years are very critical about small brown spots, deposits on the teeth and they also have themselves treated more often for a cosmetic dental cleaning.

### **Limitations, implications**

The present study was conducted within in an oral hygiene practice by a self-employed oral hygienist, which selected for patients who were actively seeking oral care. It is possible that as a result, these patients placed more value on oral hygiene and health in general than the general public, which may have positively skewed measurements of OHB. Furthermore, the findings of this patient population this oral hygiene clinic in Groningen highlight the multifaceted nature of OHB, which is a multidimensional concept with a single or a set of unique behaviors related to perceived oral comfort, health and oral health.

This study has implications for both current clinical practice and future efforts in understanding and modifying oral hygiene through applied health and social behavioral research. Thus, oral health practitioners must guide all patients how to properly clean their teeth, mouth, between their teeth and tongue, but promote them to selfevaluate these efforts too, so that the patients understand the details of the OHBs that lead to successful outcomes.

The current version of the Mondix-i® measure has been proposed to monitor and/or evaluate individual OHB and to guide patients in an oral hygiene practice by a self-employed oral hygienist. The *Mondix-i®* may be used in oral health care practices to identify, monitor and evaluate individual's perceived general and oral health, daily oral self-care, and oral (dis)comfort. The results of this Mondix-i® measure may be useful for discussing the progress of oral self-care with the patient. In future applied and/ clinical research this new measure will be translated and measured or fine-tuned in other populations and countries. Future studies could benefit from surveying patients in other oral hygiene clinics or people outside of the oral care or dental practice environment.

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