### ORIGINAL ARTICLE

# **Objective and subjective oral health care needs among adults with various disabilities**

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#### Abstract

*Objectives* The present study explored the objective and subjective oral health care needs and the association between both among Belgian adults with disabilities.

*Materials and methods* A two-stage sampling methodology was used to select a sample of adults (22–65 years old) with disabilities, from various types of residential settings, day care centers, and sheltered workplaces and spread over the ten provinces. Oral screenings were performed by 28 trained dentists; subjective oral health care needs were collected through questionnaires.

*Results* Seven hundred seven adults with disabilities were recruited; from 656 (93 %), permission was obtained for an oral examination. In 467 (78 %) and 407 (68 %) participants, dental plaque and calculus, respectively, were observed. In 343 (56 %) participants, untreated caries lesions (into dentine) were recorded; 203 (33 %) participants had 20 or less teeth. The prosthetic replacement of missing teeth was poor. Exactly 228 (40 %) participants stated that they had a problem in the oral region, and 264 (48 %) indicated that they were in need of an appointment with a dentist. Barriers to consult a dentist were reported by 244 (42 %); fear (n=87; 37 %), followed by financial and transportation problems (both, n=68; 29 %), was the most frequently reported barrier.

*Conclusions* The preventive as well as curative oral care needs in Belgian adults with various forms of disabilities are very high.

*Clinical relevance* Efforts to tackle these vast oral health care needs should take into account the differences in needs

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Department of Oral Health Sciences, Oral Health Research Unit, KU Leuven, Kapucijnenvoer 7 blok a bus 7001, 3000 Leuven, Belgium e-mail: roos.leroy@med.kuleuven.be and demands between subgroups and should comprise the improvement of access to proper care.

**Keywords** Oral health · Special care · Disabilities · Adults · Epidemiology

#### Introduction

Health disparities between individuals with disabilities and the general population have been well documented [1-5]. Often, individuals with disabilities have unrecognized and/ or poorly managed medical conditions and do not receive adequate preventive measures [6, 7]. The same holds for oral health. For instance, a recent systematic review confirmed that people with intellectual disabilities have poorer oral hygiene, higher prevalence and greater severity of periodontal disease, higher rates of untreated caries experience, and more missing teeth [5]. In a cross-sectional study, it was reported that persons with a chronic mental illness had higher rates of mucosal lesions, plaque, and calculus accumulation than controls without a psychiatric history [8]. Besides, oral care was identified as the most prevalent unmet health care need among children with special health care needs, affecting considerably more children than any other health care need category [9].

Currently, our knowledge of the oral health status and oral health care needs among adults with disabilities, who are residing in Belgium, is very limited. So far, only data collected during the Special Olympics games in 2008 have been published [10]. However, Special Olympics are organized specifically for individuals with intellectual impairments, and only those who have the capacity to compete in sports can attend. As a result, the participants are more likely to be younger, healthier, have less severe disability, and be better supported and integrated in society, and hence, may not be regarded as representative for all individuals with intellectual impairments [11]. Moreover, the screening and inquiry performed within the frame of the Special Smiles program is very rudimentary.

As the National Institute for Health and Disability Insurance (NIHDI) wanted to lay the foundations of a policy towards better oral care for citizens with special needs and because of the paucity of available data, the NIHDI ordered a study to assess the oral health status and oral care needs in Belgian citizens with special needs. The present manuscript is the first report that describes the objective and subjective oral health care needs and the association between both in Belgian adult citizens with various types of disabilities.

#### Material and methods

#### Sampling

As there is no official database that comprises the target population (i.e., all individuals with disabilities older than 21 and younger than 65 years residing in Belgium), an ad hoc method had to be applied to select a random sample of adults with disabilities that would reflect the actual target population as well as possible. Therefore, a two-stage sampling methodology was used, first to select care facilities and second to sample people within these facilities. Official lists of various types of residential settings, day care centers, and sheltered workplaces were used; care was taken to select facilities from the various ideological backgrounds and spread over the ten Belgian provinces. For practical and financial reasons, it was not feasible to select individuals from all Belgian care facilities. In order to increase the variability and to minimize the "facility effect," a maximum of 12 individuals/setting was selected. If the originally selected dwelling refused participation, an alternative setting with comparable characteristics and located in the same region was contacted.

Once participation of the facility was confirmed, the officially provided information on number and type of care recipients was checked and updated. The chief project administrator, assisted by the facility contact person, selected the candidate participants randomly. The chief project administrator then sent information letters for both the facility and the candidate participants, together with copies of the informed consent forms and questionnaires.

In the study protocol, formulated by the National Institute for Health and Disability Insurance, it was stipulated that the oral health status of 800 individuals with disabilities (children and adults) had to be examined and reported on. In the present report, the adults' (between 21 and 65 years) oral health status is described; the results of the children and adolescents will be reported in a separate manuscript. Individuals were only examined if they themselves or their guardian had signed an informed consent. Approval for the study was obtained from the Ethical Committee of the University Hospital Ghent (2010/126).

#### Clinical examination

The oral health examinations were carried out between April and September 2010, on the premises of the care facility. The participants were not informed about the exact date of the oral examination, so that no extra brushing could be performed. They were examined sitting on an ordinary chair or in their wheelchair or lying in bed. Teeth were examined using a disposable dental mirror and periodontal probe (Perio 11C, HS 1004057); cotton rolls were available in case the dentist wanted to remove food debris, plaque, or saliva. The dentists wore a head lamp to improve visibility. When possible, a systematic approach was adopted by examining the various clinical parameters in a predefined sequence. Nevertheless, sometimes behavioral difficulties hampered the examination of certain parameters or teeth, which was the main reason for missing data. Examinations were not performed during regular dental care; hence, no radiographs were taken.

Caries experience up to the  $D_3$  level (level of cavitation) was scored on all teeth according to the criteria published by WHO [12]. Caries experience was described using proportions: proportion of adults with untreated dental caries (i.e.,  $D_3>0$ ), missing teeth due to caries experience (M>0), filled teeth (F>0), and proportion of adults with caries experience (DMFT>0). In addition, the restorative (F/D+F) and care indexes (M+F/M+D+F) at tooth level were computed.

Oral hygiene level was first assessed at mouth level, i.e., absence vs presence of visible accumulation of dental plaque and/or calculus. In those participants in whom it was feasible, the presence or absence of dental plaque was also assessed at tooth level, more precisely on the buccal surfaces of teeth 16, 12, 24, 36, 32, and 44, according to the method described by Silness and Löe [13]. Complying with recent publications on periodontal epidemiology, no mean plaque scores were calculated [14, 15]. Rather the proportion of the sample with plaque accumulation on none, one to six reference teeth were reported.

Since, in this focus group, a full periodontal examination was not feasible, it was opted to assess periodontal health by means of the Dutch Periodontal Screening Index (DPSI), which is a modification of the Community Periodontal Index of Treatment Needs (CPITN) [16]. Each tooth was examined, but only the highest score (between 0, healthy, and 5, pockets of >5 mm) per sextant was recorded. Again, no mean scores were calculated, but the proportion of the sample with a certain score as highest individual score was reported.

Dentist-examiners also recorded the nature of the disability (intellectual, physical, sensory, social, or psychiatric); in case of doubt, they were assisted by the daily caretakers. In order to protect the privacy of the participants, the examiners had no access to the medical records.

#### Dentist-examiners

All examinations were performed by 28 dentists, who had participated in an extensive training session with clinical slides and exercises. The dentist-examiners received during the training a detailed handout and all clinical slides on memory stick, so that they could review and practice at home before they started the screenings. Due to time constraints and because of logistical limitations, no clinical calibration sessions could be organized.

#### Questionnaire

Data on dental attendance, access to oral care, and subjective oral care needs were obtained through structured questionnaires, addressed to the participant. One of the questions found out whether the questionnaire had been completed by the participant independently or whether he/she received help from others (e.g., a member of his/her family, a care giver, or a social worker). The ten questions were kept very simple in order to optimize understanding.

#### Data collection and analysis

The clinical data were recorded by an accompanying person on an examination sheet. Clinical as well as questionnaire data were entered by a secretary into Excel files with data validation in order to minimize faulty input. During data cleaning, illogical or contradictory data were verified and, if possible, corrected on the basis of the original examination sheet. The excel files were then converted into SAS<sup>®</sup> files, which were analyzed using SAS software version 9.2 (SAS Institute Inc. 2009; Cary, NC).

 $X^2$  and Kruskal–Wallis tests were performed in order to evaluate the statistical significance of observed differences between subgroups. Logistic regression analyses resulted in odds ratios and 95 % confidence intervals. For all statistical tests, *p* values below 0.05 were considered statistically significant.

# Results

#### Sample

facilities were contacted; 47 % accepted, 41 % refused, and 11 % never responded in spite of several follow-up calls at different times of the day. Nevertheless, 707 adults with various types of disabilities were recruited, of whom 656 (93 %) gave permission for an oral examination. The majority of questionnaires (70 %) were completed by the participants with help; 15 % did so without any help, and 11 % were not able to complete the questionnaire (Table 1). The nature of the disability was assessed for 574 individuals; the participants were homogenously distributed over the various types of residential and employment settings (Table 2).

Number of teeth present (wisdom teeth included)

All participants younger than 25 had at least 24 teeth; 8 % of the 25–34 age group had less than 20 teeth, and that proportion increased to 20 % in the 35–44 age group and up to 52 % in the 45–64 age group (Fig. 1a). No significant gender differences were observed. When these data were analyzed per subgroup, it was apparent that the proportion of adults who had 20 or less teeth ranged between 25 and 53 % (Fig. 1b).

Oral hygiene and periodontal health

In the majority of participants, dental plaque and calculus were observed (Table 3). No significant gender differences or differences between the various subgroups were observed. Analyses at tooth level disclosed that in 30 % of participants, dental plaque was observed on more than three index teeth. In half of the participants, signs of gingivitis were observed (highest individual score 1 or 2); presence of shallow (4–5 mm) pockets was recorded in 23 %. Subgroup analyses revealed that the subgroup with the highest proportion of participants with (shallow or deep) periodontal pockets was the group with psychiatric problems.

# Caries experience

In 56 % of participants, untreated caries lesions  $(D_3>0)$  were observed, and in 64 %, teeth were missing (M>0) (Table 3). The group with the highest proportion of participants with untreated caries was those with physical disabilities or psychiatric problems.

Prosthetic replacement of missing teeth

Exactly 24 % of participants presented with a fixed or removable prosthesis on the day of the examination. When the presence or absence of prostheses was evaluated, considering the number of remaining natural teeth, it was disclosed that one fourth and one third of participants who had an edentulous maxilla or mandible, respectively, had no prosthesis (Table 4). For those participants with only few

The facilities' readiness for participation was limited, especially in the French speaking part of Belgium. In total, 150

	Number	Number         Number         Poportion         Poportion		All		Intellectual and	physical disability	Intellectua	l disability	Physical d	isability	Psychiatric	problems	p value
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$< 5$ years ago $503$ $861$ $24$ $960$ $279$ $883$ $52$ $867$ $72$ $809$ $> 5$ years ago $81$ $139$ $1$ $40$ $578$ $n=278^{b}$ $n=278^{b}$ $n=278^{b}$ $n=278^{b}$ $n=24$ $n=306$ $n=65$ $8.7$ $10$	$\varsigma$ years ago         503         86.1         24         96.0         279         88.3         52         86.7         72         80.9 $\succ$ years ago         81         13.9         1         4.0         37         11.7         8         13.3         17         19.1           Difficulties to consult dentist $n=578^{h}$ $n=24$ $n=24$ $n=306$ $n=65$ 67.0         16         24.6         55.9         80.9           No         234         57.8         15         65.5         101         33.0         49         75.4         35         40.2           No         244         42.2         9         37.5         101         33.0         49         76         70.8           No $n=24$ $n=24$ $n=24$ $n=24$ $n=24$ $n=24$ $n=311$ $n=65$ 35         40.2           No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ 35         61.9         67.0           No $228$ $39.7$ $104$ $33.4$ $23$ $39.7$ $48.9$ $40.2$	$< 5 \text{ years ago}$ 503         86.1         24         96.0         279         88.3         52         86.7         72         80.9 $> 5 \text{ years ago}$ 81         13.9         1         4.0         37         11.7         8         13.3         17         19.1           Difficulties to consult dentist $n = 578^{b}$ $n = 278^{b}$ $n = 278^{b}$ $n = 278^{b}$ $n = 376^{b}$ $n = 306$ $n = 306$ $n = 65$ $n = 87$ $n = 87$ $402$ $90$ No $334$ $57.8$ 15 $62.5$ $205$ $67.0$ 16 $246$ $57.8$ $402$ $90$ No $244$ $42.2$ $9$ $37.5$ $101$ $33.0$ $49$ $57.8$ $402$ No $346$ $60.3$ $17$ $70.8$ $52.1$ $17$ $13.4$ $29.7$ $101$ $33.4$ $23$ $90.7$ $169$ $169.3$ $101$ $100$ $165$ $51.1$ $100$ $100$ $100$ $100$ $100$ <td< td=""><td>Last visit to the dentist</td><td><math>n=584^{\rm a}</math></td><td></td><td><i>n</i>=25</td><td></td><td><i>n</i>=316</td><td></td><td><i>n</i>=60</td><td></td><td>n=89</td><td></td><td>0.156</td></td<>	Last visit to the dentist	$n=584^{\rm a}$		<i>n</i> =25		<i>n</i> =316		<i>n</i> =60		n=89		0.156
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Difficulties to consult dentist $n=578^{\rm b}$ $n=24$ $n=24$ $n=306$ $n=65$ $n=65$ $n=87$ $n=87$ $(-0.01)$ No $334$ $57.8$ $15$ $62.5$ $205$ $67.0$ $16$ $24.6$ $52$ $59.8$ $(-0.2)^{-1}$ Ves $244$ $42.2$ $9$ $37.5$ $101$ $33.0$ $49$ $75.4$ $35$ $40.2$ Subjective oral health care need $n=574^{\rm c}$ $n=24$ $n=311$ $n=58$ $n=58$ $43.2$ $43.2$ No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $43.9$ No $228$ $39.7$ $7$ $292$ $104$ $33.4$ $23$ $43$ $43.9$ Subjective oral health care demand $n=552^{\rm d}$ $n=22$ $n=22$ $n=30$ $n=30$ $n=57$ $68.2$ $104$ $33.4$ $23$ $39.7$ $43$ $39.7$ $43.9$ No $228$ $52.2$ $15$ $68.2$ $104$ $33.4$ $23$ $39.7$ $43$ $39.7$ $104$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $30.9$ $n=83$ $39.8$ No $264$ $47.8$ $7$ $31.8$ $46.0$ $28$ $49.1$ $50.9$ $50.9$ $50.9$	Difficulties to consult dentist $n=578^{\rm b}$ $n=24$ $n=24$ $n=24$ $n=87$ $n=87$ $n=87$ $(-0.01)^{-1}$ No $344$ $57.8$ $15$ $6.25$ $205$ $67.0$ $16$ $52$ $59.8$ $(-0.01)^{-1}$ Subjective oral health care need $n=574^{\rm c}$ $4.22$ $9$ $37.5$ $101$ $33.0$ $49$ $75.4$ $35$ $40.2$ No $1=7$ $n=24$ $n=24$ $n=311$ $n=58$ $a=3$ $a=3$ $a=3$ $a=3$ No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $39.7$ $43$ $48.9$ No $238$ $39.7$ $7$ $292$ $104$ $33.4$ $23$ $39.7$ $43$ $48.9$ Subjective oral health care demand $n=552^{\rm d}$ $n=22$ $n=22$ $n=300$ $n=57$ $33.7$ $33.7$ $33.7$ $33.7$ $33.7$ $33.8$ Subjective oral health care demand $n=552^{\rm d}$ $n=22$ $n=22$ $n=300$ $n=57$ $33.7$ $33.7$ $33.7$ $33.7$ $33.8$ No $288$ $52.2$ $15$ $682$ $162$ $54.0$ $29$ $33.7$ $30.9$ $30.8$ No $288$ $52.2$ $15$ $162$ $162$ $29$ $30.9$ $33.8$ $30.8$ No $288$ $52.2$ $15$ $162$ $162$ $29$ $29$ $30.9$ $30.8$ No $288$ $20.2$ $162$ $162$ $162$ $29$ $29$ $30$	Difficulties to consult dentist $n=578^{\rm b}$ $n=278^{\rm b}$ $n=24$ $n=306$ $n=65$ $n=65$ $n=87$ $=00$ No $334$ $57.8$ $15$ $65.5$ $205$ $67.0$ $16$ $24.6$ $52$ $59.8$ $=00$ Subjective oral health care need $n=574^{\rm c}$ $n=24$ $n=24$ $n=311$ $n=66$ $35$ $49$ $75.4$ $35$ $40.2$ No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $43$ $43$ $43$ No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $43$ $43$ $43$ No $228$ $39.7$ $7$ $292$ $104$ $33.4$ $23$ $39.7$ $45$ $51.1$ No $228$ $52.2$ $15$ $n=22$ $n=300$ $n=57$ $45$ $53$ $40.9$ $50.9$ No $288$ $52.2$ $15$ $n=22$ $n=300$ $n=57$ $29$ $90.9$ $293$ $39.6$ $90.9$ No $288$ $52.2$ $15$ $n=22$ $n=20$ $n=27$ $n=27$ $n=57$ $29$ $90.9$ No $288$ $52.2$ $15$ $n=22$ $166.2$ $54.0$ $29$ $209$ $33.8$ $90.9$ No $288$ $52.2$ $15$ $n=22$ $166.2$ $24.0$ $29$ $30.9$ $90.9$ $90.9$ No $288$ $52.2$ $15$ $168$ $166.2$ $29$ $209$ $90.9$ $90.9$ No<	≥5 years ago	81	13.9	1	4.0	37	11.7	8	13.3	17	19.1	
No         334         57.8         15         62.5         205         67.0         16         24.6         52         59.8           Yes         244         42.2         9         37.5         101         33.0         49         75.4         35         40.2           Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=311$ $n=58$ 37.5         17         76.6         35         60.3         43         48.9           No         346         60.3         17         70.8         207         66.6         35         60.3         43         48.9           Yes         228         39.7         7         29.2         104         33.4         23         43         48.9           No $=552^{d}$ $n=22$ $n=23$ $n=23$ $n=30$ $n=57$ $n=53$ 39.7 $45$ 51.1           No $288$ $52.2$ 15 $68.2$ $162$ $n=57$ $n=53$ $39.7$ $n=33$ $39.8$ No $288$ $52.2$ 15 $68.2$ $162$ $54.0$ $29$	No $334$ $57.8$ $15$ $62.5$ $205$ $67.0$ $16$ $24.6$ $57.8$ $59.8$ Ves $244$ $42.2$ $9$ $37.5$ $101$ $33.0$ $49$ $57.4$ $59.8$ $40.2$ Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=24$ $n=311$ $n=58$ $40.2$ $40.2$ $40.2$ Subjective oral health care need $n=57$ $0.24$ $33.4$ $23$ $43$ $48.9$ $0.019$ Ves $228$ $39.7$ $7$ $292$ $104$ $33.4$ $23$ $43.7$ $45$ $51.1$ Subjective oral health care demand $n=57^{\circ}$ $39.7$ $104$ $33.4$ $23$ $39.7$ $48.9$ $51.1$ Subjective oral health care demand $n=57^{\circ}$ $104$ $33.4$ $23$ $39.7$ $48.9$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=23$ $n=23$ $n=23$ $n=23$	No         334         57.8         15         62.5         205         67.0         16         24.6         52         59.8           Yes         244         42.2         9         37.5         101         33.0         49         75.4         35         40.2           Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=311$ $n=58$ $n=37$ $n=30$ $n=58$ 40.2           No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $48.9$ No $228$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $68.2$ $54.0$ $33$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $68.2$ $54.0$ $29$ $33.8$ $90.0$ No $288$ $52.2$ $15$ $68.2$ <	Difficulties to consult dentist	$n = 578^{\rm b}$		<i>n</i> =24		n = 306		<i>n</i> =65		n=87		<0.001
Yes24442.2937.510133.04975.43540.2Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=24$ $n=311$ $n=58$ $n=88$ $n=88$ No34660.31770.820766.63560.34348.9Ves22839.7729.210433.42339.74551.1Ves2852.21568.210433.42339.7 $n=83$ 0.051No28852.21568.216254.02950.93339.8No28852.21568.216254.02950.93339.8Ves2852.21568.216254.02950.93339.8Ves26447.8731.813846.02950.93339.8	Yes24442.2937.510133.04975.43540.2Subjective oral health care need $n=574^{\circ}$ $n=24^{\circ}$ $n=24$ $n=311$ $n=88^{\circ}$ $n=88^{\circ}$ 48.9No34660.31770.820766.63560.34348.9No34660.31770.820766.6354348.9No22839.7729.210433.42339.74551.1Subjective oral health care demand $n=552^{\rm d}$ $n=22^{\circ}$ $n=30^{\circ}$ $n=30^{\circ}$ $n=7^{\circ}$ $n=83^{\circ}$ 39.74551.1No28852.21568.216254.02950.93339.8Ves26447.8731.816254.02950.93339.8*Ecuting 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $n=17^{\circ}$ $n=17^{\circ}$ $n=12^{\circ}$ $n=57^{\circ}$ $n=18^{\circ}$ $n$	Yes24442.2937.510133.04975.43540.2Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=24$ $n=311$ $n=58$ $n=88$ 48.9No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $48.9$ Yes $228$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=22$ $n=300$ $n=57$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $162$ $33.4$ $23$ $39.7$ $45$ $9.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $162$ $33.4$ $23$ $39.7$ $n=83$ $39.8$ No $288$ $52.2$ $15$ $68.2$ $162$ $29$ $50.9$ $33$ $39.8$ Ves $264$ $47.8$ $7$ $31.8$ $162$ $29$ $50.9$ $33$ $39.8$ <sup>b</sup> Excluding 4 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $5$ $50.4$ $50.9$ $50.9$ $50.9$ <sup>c</sup> Excluding 6 participants who did not know the answer, 23 for whom it was impossible to answer the question and 64 blanks $6$ $6$ $60.2$ $60.2$ <sup>c</sup> Excluding 6 pa	No	334	57.8	15	62.5	205	67.0	16	24.6	52	59.8	
Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=311$ $n=58$ $n=88$ 0.019No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $48.9$ Yes $228$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{\rm d}$ $n=22$ $n=22$ $n=300$ $n=57$ $n=88$ $0.051$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $50.9$ $33$ $39.8$ Ves $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$	Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=311$ $n=58$ $n=88$ $n=001$ No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $48.9$ Yes $228$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $43$ $48.9$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=22$ $n=300$ $n=57$ $a=83$ $51.1$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $33.9$ $39.8$ Vest $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $33.9$ $39.8$ Vest $288$ $52.2$ $15$ $68.2$ $162$ $240$ $29$ $39.8$ $39.8$ Vest $288$ $52.2$ $15$ $88.2$ $50.0$ $33$ $39.8$ Vest $204$ $29$ $290$	Subjective oral health care need $n=574^{\circ}$ $n=24$ $n=24$ $n=24$ $n=24$ $n=311$ $n=58$ $n=88$ $0.0$ No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $48.9$ Yes $228$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $49.9$ $0.0$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $45$ $51.1$ $0.0$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $33$ $39.8$ $9.0$ Ves $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$	Yes	244	42.2	6	37.5	101	33.0	49	75.4	35	40.2	
No 346 60.3 17 70.8 207 66.6 35 60.3 43 48.9 Yes 228 39.7 7 28.2 29.2 104 33.4 23 39.7 45 51.1 Subjective oral health care demand $n=552^{\rm d}$ $n=22$ $n=22$ $n=300$ $n=57$ $n=83$ $n=83$ $n=67$ $n=83$ $n=83$ No 288 52.2 15 68.2 162 54.0 29 50.9 33 39.8 No 26 49.1 50 60.2 $n=12$ $n$	No $346$ $60.3$ $17$ $70.8$ $207$ $66.6$ $35$ $60.3$ $43$ $48.9$ Yes $28$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $43$ $48.9$ Subjective oral health care demand $n = 552^{d}$ $n = 22$ $n = 300$ $n = 57$ $a = 3$ $a = 57$ $a = 30^{d}$ $a = 50^{d}$ $a = 30^{d}$ $a = 3^{d}$ $a = $	No         346         60.3         17         70.8         207         66.6         35         60.3         43         48.9           Yes         228         39.7         7         29.2         104         33.4         23         45         51.1           Subjective oral health care demand $n=552^d$ $n=22$ $n=300$ $n=57$ 45         51.1           No         288         52.2         15         68.2         162         54.0         29         33         33.8           Ves         264         47.8         7         31.8         138         46.0         28         50.9         50.9         50.9         50.9         50.2           *Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks         46.0         28         49.1         50         60.2	Subjective oral health care need	n=574°		<i>n</i> =24		<i>n</i> =311		<i>n</i> =58		<i>n</i> =88		0.019
Yes22839.7729.210433.42339.74551.1Subjective oral health care demand $n=552^{\rm d}$ $n=22$ $n=300$ $n=57$ $n=83$ 0.051No28852.21568.216254.02950.93339.8Yes26447.8731.813846.02849.15060.2	Yes $228$ $39.7$ $7$ $29.2$ $104$ $33.4$ $23$ $39.7$ $45$ $51.1$ Subjective oral health care demand $n=552^{d}$ $n=22$ $n=22$ $n=300$ $n=57$ $n=83$ $0.051$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $50.9$ $33$ $39.8$ Yes $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ $^{a}$ Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks $30$ blanks $120$ $120$ $120$ $120$ $^{b}$ Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $30.4$ $30.4$ $30.4$ $30.4$ $30.4$	Yes       228       39.7       7       29.2       104       33.4       23       45       51.1         Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $n=83$ 0.0         No $288$ $52.2$ 15 $68.2$ $162$ $54.0$ 29 $33$ $39.8$ Yes $264$ $47.8$ 7 $31.8$ $138$ $46.0$ 28 $49.1$ $50$ $60.2$ * Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks $a$ $b$ <td>No</td> <td>346</td> <td>60.3</td> <td>17</td> <td>70.8</td> <td>207</td> <td>9.99</td> <td>35</td> <td>60.3</td> <td>43</td> <td>48.9</td> <td></td>	No	346	60.3	17	70.8	207	9.99	35	60.3	43	48.9	
Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $n=83$ $0.051$ No28852.215 $68.2$ $162$ $54.0$ 29 $33$ $39.8$ Yes264 $47.8$ 7 $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$	Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $n=83$ $0.051$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $33$ $3.9.8$ Yes $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ * Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks $ab a b a b a b a b a b a b a b a b a b $	Subjective oral health care demand $n=552^{d}$ $n=22$ $n=300$ $n=57$ $n=83$ $0.0$ No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $33$ $39.8$ Yes $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ * Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks $b$ $b$ $b$ $b$ $b$ • Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $a$ $a$ $a$ $a$	Yes	228	39.7	7	29.2	104	33.4	23	39.7	45	51.1	
No         288         52.2         15         68.2         162         54.0         29         30.9         33         39.8           Yes         264         47.8         7         31.8         138         46.0         28         49.1         50         60.2	No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $30.9$ $39.8$ Yes $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ <sup>a</sup> Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants who did not know the answer 17 for whom it was impossible to answer the question and 64 blanks $Excluding 16$ barticipants $Excluding 16$ barticipants	No $288$ $52.2$ $15$ $68.2$ $162$ $54.0$ $29$ $50.9$ $33$ $39.8$ Yes $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ $^{a}$ Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks $^{c}$ Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks $^{c}$ Excluding 46 participants who did not know the answer, 23 for whom it was impossible to answer the question and 64 blanks	Subjective oral health care demand	<i>n</i> =552 <sup>d</sup>		<i>n</i> =22		n = 300		n=57		<i>n</i> =83		0.051
Yes 264 47.8 7 31.8 138 46.0 28 49.1 50 60.2	Yes $264$ $47.8$ 7 $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ <sup>a</sup> Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks <sup>b</sup> Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks	Yes $264$ $47.8$ $7$ $31.8$ $138$ $46.0$ $28$ $49.1$ $50$ $60.2$ a Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanksb Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanksc Excluding 46 participants who did not know the answer, 23 for whom it was impossible to answer the question and 64 blanks	No	288	52.2	15	68.2	162	54.0	29	50.9	33	39.8	
	<sup>a</sup> Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks <sup>b</sup> Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks	<sup>a</sup> Excluding 44 participants who did not know the answer, 17 for whom it was impossible to answer the question and 30 blanks <sup>b</sup> Excluding 16 participants who did not know the answer, 17 for whom it was impossible to answer the question and 64 blanks <sup>c</sup> Excluding 46 participants who did not know the answer, 23 for whom it was impossible to answer the question and 32 blanks	Yes	264	47.8	7	31.8	138	46.0	28	49.1	50	60.2	
		<sup>c</sup> Excluding 46 participants who did not know the answer, 23 for whom it was impossible to answer the question and 32 blanks	<sup>b</sup> Excluding 16 participants who did	not know the	e answer, 17 fo	rr whom it was in	npossible to answer th	e question an	d 64 blanks					

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Table 2 Socio	demographic	characteristics	of the	sample
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	All participa	ants (n=707)
	Number	Proportion
Age (year)		
Median (Q1–Q3)	43.0 (33.0–5	52.0)
Mean (SD)	42.6 (11.42)	)
Gender		
Female	312	44.1
Male	395	55.9
Language		
Dutch	411	58.1
Frans	296	41.9
Nature of disability (%) <sup>a</sup>		
Intellectual disability	395	68.8
Physical disability	98	17.1
Sensory disability	19	3.3
Social disability (e.g., autism)	30	5.2
Psychiatric problems	111	19.3
Other	26	4.5
Living conditions		
Assisted living <sup>b</sup>	69	12.0
Independent living <sup>c</sup>	55	9.6
Protected living <sup>d</sup>	58	10.1
Day center/assisted employmente	127	22.1
Home for those who are employed	69	12.0
Home for those who are not employed	1	
Occupational home <sup>f</sup>	57	9.9
Nursing home <sup>g</sup>	53	9.2
Sheltered workplace	86	15.0
Psychiatry		
Sheltered living	70	12.2
Psychiatric clinic	61	10.6
Unknown	2	<1

<sup>a</sup> As assessed by the dentist-examiners; data available for n=574; as multiple disabilities are possible total is >574 and the sum of percentages exceeds 100

<sup>b</sup> The individual lives at home and is assisted a couple of hours per week for logistical and psychosocial matters

<sup>c</sup> The individual lives in a house which belongs to a care facility and receives assistance for many aspects of daily life

<sup>d</sup> The offered assistance is more intense compared to that in "independent living"

<sup>e</sup> Care was taken that half of the participants of this subgroup lived at home and half in a care center; assisted employment means that when an individual has too many capacities to spend his days in a day center but does not qualify for a sheltered workplace, he can work on a part-time basis under supervision of a day center in a social or cultural organization, without being paid for it

<sup>f</sup>Occupational home offers daily activities for those individuals who do not qualify for assisted employment

<sup>g</sup> The emphasis in nursing home is nursing and paramedical care

teeth per jaw, the results were in the same line. Furthermore, evaluation of the cleanliness of the removable dentures disclosed that dental plaque was present on 55 %, and calculus, on 34 % of prostheses, respectively.

#### Access to oral care and perceived barriers

Sixty percent of participants reported that they had visited the dentist during the preceding 12 months; 26 % had visited the dentist 1 to 5 years before, and another 14 %, more than 5 years ago (Table 1). Barriers to consult a dentist were reported by 42 % of participants; the highest proportion (75 %) was recorded in the subgroup of individuals with physical disabilities. Fear (37 %), followed by financial and transportation problems (both, 29 %), and difficulty in finding a skilled dentist (7 %) were the most frequently reported barriers.

#### Subjective oral care need

Forty percent of participants stated that they had a problem in the oral region; the highest proportion (51 %) was noted in the subgroup with psychiatric problems. Thirty-four percent reported pain; 30 %, functional problems (e.g., problems with chewing and talking), and 22 %, esthetic problems. Half of the participants indicated that they were in need of an appointment with a dentist, with the highest proportion in the subgroup of individuals with psychiatric problems (60 %).

Association between subjective and objective oral health status and needs

In significantly more participants who reported a problem in the oral region, untreated dental caries was recorded (odds ratio (OR) 1.98; 95 % confidence interval (CI) 1.37-2.86). Significantly more individuals who reported a problem in the mouth and more precisely functional problems had 20 or less teeth (OR 1.66; 95 % CI 1.15-2.39; OR 2.74; 95 % CI 1.54-4.87). Also, significantly more participants who indicated a problem in the oral region had not seen the dentist during the preceding 5 years (OR 1.95; 95 % CI 1.18–3.21) or reported difficulties to consult a dentist (OR 3.61; 95 % CI 2.51–5.21). In addition, in significantly more participants who had not seen the dentist recently (i.e., during the preceding 5 years), untreated dental caries (i.e.,  $D_3 > 0$ ) (OR 1.90; 95 % CI 1.10-3.28) was observed. There was also a significant association between dental attendance on the one hand and periodontal health and number of teeth present on the other hand; in significantly more participants who had not seen the dentist recently, periodontal pockets (OR 2.07; 95 % CI 1.06-4.06) and 20 or fewer teeth (OR 0.55; 95 % CI 0.33-0.91) were recorded. Finally, significantly more individuals who had not seen the dentist recently indicated barriers to oral care (OR 3.47; 95 % CI 2.07-5.81).

Fig. 1 a Number of teeth present for the various age groups (expressed in years).b Number of teeth present for the various subgroups



#### Discussion

For the very first time, data on objective and subjective oral health care needs in Belgian adults with disabilities were collected and analyzed. These data are essential if one wants to organize appropriate oral care, optimize reimbursement schemes, and tackle the barriers to proper oral health care for this disadvantaged group.

The present study illustrates the huge unmet oral care needs in individuals with disabilities. First of all, despite suboptimal screening circumstances, oral hygiene was scored as inadequate in the majority of participants (Table 3). Also in other reports, the level of oral hygiene among adults with disabilities was considered insufficient [8, 17–19]. The presence of visible plaque and calculus accumulation can be considered a proxy of many different facets, e.g., suboptimal oral hygiene practices, lack of professional debridements, salivary characteristics, and biofilm characteristics. There is, however, no doubt; proper oral hygiene is crucial in the prevention of periodontal diseases and dental caries. The lack of proper (oral) hygiene was further exemplified by the high number of removable dentures on which plaque or calculus was detected. It was already noted by others that personal (oral) hygiene is often neglected or poorly performed in dependent individuals [20]. Additionally, the results of the present study illustrate that the improved reimbursement schemes for individuals with disabilities with regard to professional debridements (reimbursed four times a year since 2005) have not reached their goal yet.

The participants also required in large numbers restorative and prosthetic care. A recent report in which data were collected in a representative sample of Belgian citizens indicated that 34 % of the general population (aged 22–64 years old) presented with untreated caries lesions (at the  $D_3$  level); in the present study, the respective proportion was 56 % [21]. This observation is in line with previous studies in which also high levels of untreated caries experience were reported in individuals with disabilities [18, 19, 22]. Without doubt, the data presented here are an understatement of the true restorative treatment need, since screening circumstances were suboptimal, and no radiographic assessment was performed.

It was suggested by others that in individuals with disabilities, teeth affected by caries and/or periodontal disease are rather extracted than treated [23]. This was also reflected

	All		Intellectual a	nd physical disability	Intellectu	al disability	Physical disability		Psychiatric problems		<i>p</i> value
	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	
Oral hygiene	n=599		n=29		<i>n</i> =351		n=61 for plaque and $n=59$ for calculus		n=80 for plaque and $n=82$ for calculus		
Dental plaque	465	77.6	24	82.8	281	80.1	40	65.6	57	71.3	060.0
Calculus	408	68.1	17	58.6	239	68.1	40	67.8	58	70.7	0.536
Periodontal health (DPSI) <sup>a</sup>	<i>n</i> =429		<i>n</i> =22		n=257		n = 44		n=51		<0.001
Score 0	83	19.3	7	31.8	54	21.0	12	27.3	2	3.9	
Score 1	111	25.9	9	27.3	75	29.2	8	18.2	7	13.7	
Score 2	121	28.2	8	36.4	68	26.5	16	36.4	13	25.5	
Score 3	47	11.0	1	4.5	25	9.7	2	4.5	16	31.4	
Score 4	53	12.4	0	0	26	10.1	9	13.6	11	21.6	
Score 5	14	3.3	0	0	6	3.5	0	0	2 (4)		
Caries experience <sup>b</sup>	$n=613^{\circ}$		<i>n</i> =30		<i>n</i> =361		<i>n</i> =57		<i>n</i> =86		
D <sub>3</sub> MFT>0	580	94.6	29	96.7	342	94.7	52	91.2	82	95.3	0.655
D>0	343	56.0	13	43.3	191	52.9	35	61.4	52	60.5	0.240
F>0	474	77.3	26	86.7	287	79.5	44	77.2	61	70.9	0.228
F>0	395	64.4	17	56.7	224	62.0	33	57.9	64	74.4	0.107
Restorative index of <1 (n=5	46) 343	62.8	13	46.4	191	58.8	35	68.6	52	70.3	0.069
Care index of <1 (n=580)	343	59.1	13	44.8	191	55.9	35	67.3	52	63.4	0.138

of >5 mm in depth, no calculus, no overhanging restorations, but presence of bleeding on probing to the bottom of the pocket; score 2, no pockets of >5 mm in depth, presence of bleeding on probing to the bottom of the pocket; and presence of calculus or overhanging restorations; score 3, presence of pathological pockets of 4–5 mm without gingival recession; score 4, presence of pathological pockets of 4-5 mm with gingival recession; score 5, presence of pathological pockets >5 mm

<sup>&</sup>lt;sup>b</sup> Wisdom teeth not included; restorative index, F/D+F; care index, M+F/M+D+F

<sup>&</sup>lt;sup>c</sup> The *n* indicates the highest number of participants examined; for some items, *n* may be smaller which may result in identical numbers, but differing proportions

	Edentulo	us	1-4 teeth	L	5-8 teeth		9–12 teeth	1	13-16 teeth	
	Maxilla ( <i>n</i> =60)	Mandible $(n=37)$	Maxilla ( <i>n</i> =45)	Mandible $(n=29)$	Maxilla $(n=62)$	Mandible ( <i>n</i> =79)	Maxilla ( <i>n</i> =185)	Mandible ( <i>n</i> =177)	Maxilla ( <i>n</i> =246)	Mandible ( <i>n</i> =285)
No prosthesis	15 (25)	11 (30)	21 (47)	11 (38)	39 (63)	42 (53)	159 (86)	141 (80)	241 (98)	270 (95)
1 bridge	0	0	0	0	3 (5)	3 (4)	11 (6)	9 (5)	3 (1)	5 (2)
More than 1 bridge	0	0	0	0	0	1 (1)	1 (1)	1 (1)	1 (<1)	0
Bridge and partial resin prosthesis	0	0	0	0	0	1 (1)	1 (1)	0	1 (<1)	1 (<1)
Bridge and partial frame prosthesis	0	0	0	0	3 (5)	1 (1)	0	1 (1)	0	1 (<1)
Partial resin prosthesis	1 (2)	4 (11)	21 (47)	8 (28)	13 (21)	11 (14)	7 (4)	14 (8)	0	5 (2)
Partial frame prosthesis	0	0	2 (4)	0	2 (3)	4 (5)	5 (3)	4 (2)	0	1 (<1)
Full denture	41 (68)	20 (54)	1 (2)	8 (28)	0	14 (18)	0	6 (3)	0	1 (<1)
Prosthesis not worn	3 (5)	2 (5)	0	2 (7)	2 (3)	2 (3)	1 (1)	1 (1)	0	1 (<1)

 Table 4 Prosthetic replacement in relation to number of missing teeth–number (proportion)

in the present study where one third of the sample had 20 or less permanent teeth (Fig. 1), whereas in the comparable age group of the general Belgian population, the respective proportion was only 16 % [21].

With respect to the prosthetic replacement of missing teeth (Table 4), the present data were not as dreadful as those reported two decades ago by Kendall (57 % of edentulous subjects did not possess any denture), yet they illustrate, unisonous to the recent report on the oral health status in athletes attending the Special Smiles program in 2008, very high prosthetic treatment needs in this group of adults with various forms of disabilities [10, 17]. It is, however, very much possible that in some of these subjects, the fabrication of a prosthesis was considered impracticable, and/or that the individual did not tolerate a (removable) denture. Unfortunately, it was not possible within the frame of the present research assignment to collect explanatory information on this aspect.

Also with regard to periodontal health (Table 3), the data reflect higher disease levels than those collected in the general Belgian population where 50 % presented with gingivitis, and 17 % had periodontal pockets [21]. The data collected in the present study should be interpreted with caution, since 35 % of participants did not allow the assessment of the periodontium. As in these individuals, lack of cooperation may also be an issue during daily oral hygiene practices and professional debridement procedures, the actual periodontal health in the study population may be much worse. Moreover, it was argued previously that the CPITN index, from which the DPSI was derived, is a very robust way to assess periodontal health, but as it was envisaged that a full periodontal exam would not have been feasible for the majority of participants, it was opted to use the DPSI index to get at least a glimpse of the periodontal status [14, 15].

As far as barriers to oral care were concerned, the results were consistent with previous studies where high costs and dental fear were also reported as major obstacles to dental treatment [24, 25]. Recent qualitative research performed in Flemish (i.e., the northern part of Belgium) adults with disabilities also indicated that in case of financial restraints, oral health care is dropped the first [26]. The results clearly indicate that although reimbursement schemes have been adapted to some extent for individuals with disabilities, they have not eliminated the financial barrier for proper oral care in this group. In addition, when efforts are made to improve access to oral care, it will be essential to address the transportation problems as nowadays, neither the logistical nor the financial aspects of transportation to a dental office have been arranged.

This study further illustrates that the needs and demands differ largely between subgroups. Hence, when one wants to set up appropriate care and improve access to care, these differences will need to be taken into account. However, when interpreting these differences, it should be kept in mind that for many individuals with mental disabilities, it is not possible to express their desires or needs.

The facilities' readiness to participate was not encouraging. Consequently, it took far more time than expected to recruit the envisaged number of participants for the present study. Also, it hindered the recruitment of a sample that would represent the target population as close as possible. Related to this topic, it needs to be discussed that there was a huge discrepancy between the instructions received from the ethical committee regarding the informed consent (when all requirements were fulfilled, it was a document of three full pages) and the very basic way (often with pictograms) that many facilities communicate with their clients, families, and caretakers. According to many facilities, the very detailed (and thus frightening) informed consent forms that had to be signed before the clinical exam could be performed, presented a significant barrier to participation. There is no doubt that the rights of individuals with disabilities should be well protected, but on the other hand, too strict regulations may hamper participation of participants with disabilities in clinical and epidemiological studies.

Data on dental attendance and subjective oral care needs were collected through questionnaires. Besides the fact that one is thus dealing with reported data, there was, in the present study, an additional point of interest; nearly 70 % of the participants received help with filling in the questionnaire. Apparently, this may have had an impact on the data, as it is unclear how well the "assistant" was informed on the actual dental attendance rates or the perceived subjective oral health care needs. However, in order to discourage the assistant to make a guess, the option "not capable to complete the question, even not with assistance" was introduced. Still, as it has been documented in the past that the reporting of pain decreases as cognitive impairment increases, and that poor verbal skills lead to difficulties in communicating pain, it is thus very well possible that, especially in individuals with intellectual disabilities, pain was underreported [27].

A limitation of the present study is the lack of a control group. This study was ordered by the NIHDI, and no funds were made available for the inclusion of a control group. Therefore, it was decided—where possible—to compare the presented data with the recently gathered data in the general Belgian population [21].

In addition, oral screenings were performed in suboptimal conditions, and individuals with insufficient cooperation could not be examined. As a result, one can speculate that the true oral health status of individuals with disabilities is worse, and hence, the treatment needs presented here are underestimated. Furthermore, when performing clinical studies, calibration sessions during which the examination methods are instructed and trained in a comparable pilot group are highly recommended. In the present study, care was taken to instruct the examiners thoroughly, to practice the criteria with a large set of clinical photos, and to supply them with written and digital documentation of the examination methods. However, it was considered impracticable to organize field sessions for the numerous examiners in this specific focus group of individuals with disabilities; an alternative way of calibration using slides would not have been feasible for several clinical parameters (e.g., periodontal health). The study was further limited by the fact that the true target population was unknown. A two-stage sampling method was applied in order to recruit a sample that would reflect the actual but unknown target population as well as possible.

Despite the limitations of the present study, it can be concluded that the preventive as well as curative oral care needs in Belgian adults with various forms of disabilities is vast. For most clinical parameters, these individuals do worse than the general population. The data clearly illustrate to politicians, health insurance organizations, and other stakeholders that urgent action is needed in several domains to tackle these inequalities, e.g., initiatives that increase awareness and improve parents' and staff's competences in assisting in daily oral hygiene practices; information campaigns for health care providers (e.g., family doctors and nurses) about the importance of preventive oral care (e.g., regular professional debridements); motivation campaigns and specialized training for dentists that focus specifically on the group of patients with disabilities; the setup of centers for specialized (oral) care; and initiatives that remove the financial and logistical barriers for proper oral health care delivery.

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Conflict of interest None.

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