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Oral health and healthcare utilization in Belgian dentate adults

Peter Bottenberg[1] | Jacques Vanobbergen[2] | Dominique Declerck[3] | Joana C. Carvalho[4]

[1]Oral Health Research Cluster, Free University of Brussels (VUB), Brussels, Belgium

[2]Community Dentistry and Oral Public Health, Dental School, Ghent University, Ghent, Belgium

[3]Department of Oral Health Sciences, KU Leuven Population Studies in Oral Health, Leuven, Belgium

[4]Faculty of Medicine and Dentistry, Catholic University of Louvain (UCL), Brussels, Belgium

Correspondence
Peter Bottenberg, Oral Health Research Cluster, Free University of Brussels (VUB), Laarbeeklaan 103, 1090 Brussels, Belgium.
Email: pbottenb@vub.be

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Abstract

Objectives: In 2012-2014, the Belgian National Oral Health Data Registration and Evaluation Survey, integrated in the Health Interview Survey (HIS), was carried out. The present study investigated, in a sample of 1340 dentate adults (≥25 years), the association between oral healthcare utilization, oral health status and sociodemographic status.

Methods: A multistage, stratified cluster sampling procedure was used. Oral examination for caries experience (World Health Organization, D_3MFT-Index), periodontal status (Dutch Periodontal Screening Index, DPS-Index), number of teeth present and occlusal contacts without wearing removable dentures was performed by calibrated examiners. Oral healthcare utilization data were retrieved from the records of the Belgian Intermutualistic Agency. Participants' oral health and sociodemographic data were linked to registered oral care utilization in the previous 5-year period. Regular attenders (annual attenders and those with at least one registered contact in three different years) were compared with irregular attenders (those having had dental visits but not according to the definition of regular attenders) and nonattenders. Data were weighted to compensate for sampling and participation bias.

Results: Six hundred and seventy-nine participants attended regularly, of whom 276 annually; 256 did not attend in the reference period. The overall D_3MFT-Index was not noticeably different between attendance patterns (varying between 11 and 13), although regular attenders had more restored teeth than nonattenders ($P < 0.01$). No difference was seen for DPS-Index and number of teeth/occluding pairs (χ^2 test, $P > 0.05$). Females, participants with higher education, older participants and those in employment had higher rates of regular attendance.

Conclusions: Regular attenders had fewer untreated caries lesions, but neither lower caries experience nor lower DPS-Index than irregular attenders. Regular attendance was associated with sociodemographic variables.

KEYWORDS
caries, dental health, epidemiology, health services research, periodontal diseases

1 | INTRODUCTION

Regular dental attendance combined with preventive advice is supposed to contribute to better self-care by the patient and to minimize further therapeutic interventions. Debate has been ongoing whether regular dental attendance indeed achieves that aim and whether it is a useful measure in terms of cost-effectiveness and quality of life as well as how frequently it should be scheduled.[1,2] In the United Kingdom, the National Health Service longtime advocated a 6-month recall interval.[3] Dental attendance may be

prevention-driven or problem-oriented.[4] In the latter case, the patient seeks dental care only in order to resolve a problem such as pain, loss of a restauration or a denture issue. In some cases, an all-too-frequent attendance is considered a problem.[5,6]

Previous studies on dental attendance and oral healthcare utilization dealt with specific groups such as migrants, elderly patients or groups with a low socioeconomic profile.[7-9] Healthcare utilization was also subject of studies on inequalities in access to health care.[10,11] Further, oral healthcare utilization was shown to differ according to gender, age, Socio Economic Status (SES) and educational background.[12] Nihtilä et al[13] studied dental attendance following a change in legislation in Finland, showing that attendance increased after extending social security coverage.

In studies relating oral healthcare utilization to oral health status, either healthcare utilization or oral health or both were based on self-reported data.[14-16] The latter may hamper validity of the data due to recall bias.[17] Furthermore, some studies were limited to dental decay as sole oral health indicator, to limited geographical regions[16] or, if periodontal health data were presented, to a certain age group.[14,16,18] To overcome this limitation, oral healthcare utilization records available at official registries can be used in combination with the data of oral health examinations.

In Belgium, oral health care is provided by dental practitioners on a fee-for-service basis. The obligatory healthcare insurance system provides reimbursement of dental healthcare procedures for all residents. These procedures include examination, radiography, professional tooth cleaning, endodontics and direct restorations, whereas sealants, orthodontics, extractions, periodontal and prosthetic services are limited in extent or to certain age groups. Data on oral healthcare utilization of the Belgian population are available at the "Intermutualistic Agency" (IMA), an office centralizing and analysing data from health insurance funds. To monitor general health and its determinants, a Health Interview Survey (HIS) is carried out every 4 years. In 2012-2014, the Oral Health Data Registration and Evaluation Survey (OHDRES 2013) was integrated into the Health Interview Survey. The OHDRES 2013 consisted of a self-administered oral health questionnaire and an oral health examination.[19]

The present study investigates, in a representative sample of the Belgian population aged 25 years and older, the association between oral healthcare utilization, oral health status and sociodemographic status. The frequency of oral healthcare utilization of participants was measured in terms of their attendance pattern of recorded dental visits. Regular attendance was modelled using two definitions: the conventional annual attendance and alternatively at least one registered contact in three different years within the examined 5-year period, based on a definition by Richards & Ameen.[15] The aim of this study was to explore differences in oral health between annual, regular and irregular/nonattenders and whether dental attendance was associated with sociodemographic differences.

2 | MATERIAL AND METHODS

The Belgian National Oral Health Data Registration and Evaluation Survey (OHDRES 2013) was approved by the Ethical Committee of the University of Ghent, Belgium (registration number: B67020124029) and the National Committee for Protection of Privacy (registration number: HM003017284). Participants' written informed consent was obtained prior to interview and examination.

A representative sample of the population registered in the Belgian National Register (≥5 years old) was selected for the Health Interview Survey (HIS), excluding persons living in institutions like religious communities or prisons. A multistage, stratified cluster sample selection was performed (see Online Appendix).

A total of 8850 households was invited to participate in the HIS, of which 5049 households (57%), totalizing 10 829 persons accepted the invitation. Following the health interview, the household members were asked to participate in the oral health module. Initially, 4286 persons agreed to participate in the oral health module. A total of 2483 persons (58%) could be contacted by a dentist-interviewer, of which 1875 (44%) eventually participated and gave authorization to retrieve their data on oral healthcare utilization. Due to ethical committee rules and privacy legislation, a nonparticipation analysis was not permitted without the consent of the person involved. Instead, weighing was applied to compensate for the nonparticipation in multiple clustered stratification (age, gender, province, urbanization level). Details about the selection of households and their members, overall organization of the OHDRES 2013 and calibration of examiners were published in previous papers.[19-22]

Data on participants' oral healthcare utilization were retrieved from the IMA database at individual level via a personal reference code. For the present study, utilization of oral health care was defined as a contact with a dentist for any dental care procedure other than emergency care. Data were included from the 5 nearest available years (2008-2012) and were categorized into regular, irregular and nonattendance. Two definitions of regularity were tested: Annual attendance (AA, contact with the dentist at least once a year, 5/5) vs regular attendance (RA): at least three contacts with a dental practitioner registered in three different years (3/5).[15] Irregular attendance was either contrasted to nonannual attendance (NA, 1-4/5) or irregular attendance (IA): less than three yearly contacts with a dental practitioner. Several (consecutive) visits within 1 year followed or preceded by years of nonattendance were qualified as irregular attendance. Furthermore, there was nonattendance (NO): no registered contacts with a dental practitioner in the reference period.

Data collected by the HIS and used in the present study were sociodemographic variables such as age (25-34, 35-44, 45-54, 55-64, 65-74, ≥75 years old), gender (female, male), employment status, education level and smoking habits. In order to avoid bias with respect to employment status, participants who could still be studying, that is, those ≤24 years old, were excluded.

Participants completed a validated self-administered questionnaire containing questions about current nationality, country of birth, dietary habits and oral hygiene practices. For analysis, simplified categories were derived by establishing aggregate or dichotomized variables (see Online Appendix).

The oral health examination was performed by calibrated examiners at participants' home using a disposable examination kit and a

headlamp. Examination comprised dental caries experience status (D_3MFT level according to WHO criteria), periodontal status (Dutch periodontal Screening Index (DPS-Index, highest score per person), plaque index and number of occluding pairs in posterior teeth (including fixed prosthetic appliances). Data were entered online using a tablet computer and stored on a secured server.[21-25]

In order to circumvent a statistical model with nonlinear effects, oral health data were dichotomized to differentiate between favourable and unfavourable health indicators. This lead to the following categories: presence of untreated dentine caries lesions (D_3 = 0 vs D_3 > 0), restorative index defined as $F/(D_3 + F))*100$, (RI = 100% vs RI < 100%); need for specialized periodontal care (DPSI scores 0, 1, 2, and 3− vs scores 3+ and 4 indicating attachment loss). Plaque index was dichotomized into ≤0.5 or >0.5. Furthermore, number of teeth present (≥ 20 teeth vs 19 or less teeth) and having at least two functional occluding pairs of posterior teeth on each side of the dentition without wearing removable prostheses, but including fixed prosthetic appliances.[26] This follows the definition of a shortened dental arch.[27]

Statistical analysis was performed after weighting the data according to population data in order to correct for sampling and participation bias in the HIS and OHDRES (see methods details in the Online Appendix). Analysis was performed descriptively by cross-tabulating data on oral healthcare utilization vs oral health data and vs sociodemographic data. Differences between observed and expected frequencies of categorical variables were tested using χ^2 tests. Continuous variables were compared between different attendance patterns using analysis of variance. Logistic regression analyses were performed on categorized data. In the first place, a logistic regression was used to determine the odds for favourable health indicators by dental attendance pattern. Odds ratios (ORs) were calculated between each pair of attendance patterns (AA vs NA, AA vs NO, NA vs NO and RA vs IA, RA vs NO and IA vs NO). *P*-values and 95% confidence intervals were corrected for multiple testing according to the Bonferroni-Holm method. A multivariable logistic regression with adjustment for age and gender was then performed. Secondly, a logistic regression analysis was performed to determine the chance of having had annual or regular or no dental attendance in the reference period by sociodemographic variables. ORs were in a second step adjusted for age and gender. For each statistical analysis, significance was accepted at a *P*-value < 0.05. Calculations were performed using the SAS software package (version 9.4 TS1M3 with SAS/STAT 14.1; SAS Institute, INC).

3 | RESULTS

The final sample consisted of 1340 dentate adults (≥25 years old) with complete records. The unweighted sample was representative for age and gender distribution for the general Belgian population but due to the underlying sampling procedure, the Brussels region was overrepresented, which was corrected by weighting (see Online Appendix). Of this sample, 256 participants did not attend a dentist in the 5-year reference period. According to the definition used, 276 were annual attenders and 808 nonannual attenders, respectively 679 were regular attenders and 405 were irregular attenders. (Table 1).

TABLE 1 Descriptive data of favourable oral health outcomes according to different attendance patterns (N/5 indicates number of years within reference period of 5 y with at least one registered contact with a dentist)

Variable	Value	Nonattender 0/5 (n = 256)	Irregular attender 1-2/5 (n = 405)	Regular attender 3-5/5 (n = 679)	Nonannual attender 1-4/5 (n = 808)	Annual attender 5/5 (n = 276)
D_3MFT	Mean (SD)	11 (8)[a,b]	11 (8)[a]	13 (6)[a]	**12 (7)[b]**	**13 (6)[b]**
No untreated dentinal decay	D_3 = 0 (%)	**48% (39;57)[c]**	**52% (45;59)[c]**	**68% (62;73)[c]**	**61% (56;66)[c]**	**66% (56;75)[c]**
Restorative index	100% (%)	**41% (31;51)[c]**	**47% (39;54)[c]**	**67% (61;72)[c]**	**58% (53;64)c**	**65% (57;74)[c]**
DPSI[d]	0-3− (%)	89% (83;94)	91% (86;95)	91% (89;94)	91% (88;94)	91% (88;95)
Number of teeth[d]	≥20 (%)	83% (76;89)	78% (72;84)	82% (77;87)	81% (77;85)	80% (72;89)
Number of occluding pairs[d]	≥2 per side (%)	68% (60;77)	74% (67;80)	74% (68;79)	73% (69;78)	74% (67;82)
Mean Plaque Index (PI)	0-0.5 (%)	**35% (26;43)[c]**	**48% (41;55)[c]**	**62% (56;67)[c]**	**54% (49;59)[c]**	**65% (55;74)[c]**
Toothbrushing frequency[d]	≥2 times day (%)	51% (41;60)	53% (46;60)	56% (50;62)	56% (50;61)	54% (44;64)
Having risky dietary habits (caries and erosion)[d]	No (%)	27% (20;35)	27% (21;33)	35% (29;40)	31% (26;36)	35% (26;44)
Smoking habit	No (%)	**63% (53;73)[c]**	**74% (70;80)[c]**	**82% (77;87)[c]**	**76% (72;81)[c]**	**86% (80;93)[c]**

Note: Percentages (95% confidence interval between brackets) and results of statistical tests (corrected for multiple testing) represent weighted data. Bold figures refer to significant differences between groups.

[a] *F*-test, $P > 0.05$.

[b] *F*-test, $P < 0.05$.

[c] χ^2-test, $P < 0.05$.

[d] χ^2-test, $P > 0.05$.

TABLE 2 Multivariable logistic regression analysis for the association between attendance pattern and dichotomized oral health outcomes. Upper part: annual attendance (AA) versus non-annual (NA) or nonattenders (NO), lower part: regular attendance (RA) versus irregular (IA) or nonattenders (NO)

		Regular attender: annual attendance (5/5) Attendance pattern and Odds ratios (95% confidence interval)		
Oral health indicator	**Reference category**	**NO vs NA (ref)**	**NA vs AA (ref)**	**NO vs AA (ref)**
Untreated decay (D_3-component, 0 vs >0)	D_3 = 0	**0.58 (0.36;0.92)**	0.83 (0.48;1.43)	**0.48 (0.28;0.83)**
Plaque index (≤0.5 vs >0.5)	PI ≤ 0.5	**0.45 (0.30;0.68)**	0.64 (0.38;1.10)	**0.29 (0.16;0.54)**
Restorative index (100% vs <100%)	RI = 100%	**0.56 (0.36;0.88)**	0.83 (0.49;1.42)	**0.47 (0.23;0.96)**
Highest DPSI (0-3$^-$ vs 3$^+$ and 4)	DPSI = 0-3$^-$	0.76 (0.37;1.56)	0.97 (0.47;2.0)	0.73 (0.36;1.49)
Number of teeth (1-19 vs ≥20)	n ≥ 20	0.72 (0.38;1.93)	0.59 (0.29;1.18)	0.82 (0.43;1.54)
Functional occlusal contacts on each side (<2 vs ≥2)	n ≥ 2	0.69 (0.39;1.19)	0.83 (0.47;1.46)	0.57 (0.29;1.11)
		Regular attender: at least 3 contacts in 3 different years/5 year period Attendance pattern and Odds ratios (95% confidence interval)		
		NO vs IA	**IA vs RA**	**NO vs RA**
Untreated decay (D_3-component, 0 vs >0)	D_3 = 0	0.91 (0.53;1.52)	**0.55 (0.36;0.83)**	**0.50 (0.30;0.78)**
Plaque index (≤0.5 vs >0.5)	PI ≤ 0.5	**0.57 (0.32;1.0)**	**0.58 (0.40;0.85)**	**0.33 (0.20;0.54)**
Restorative index (100% vs <100%)	RI = 100%	0.86 (0.49;1.52)	**0.47 (0.30;0.75)**	**0.41 (0.25;0.66)**
Highest DPSI (0-3$^-$ vs 3$^+$ and 4)	DPSI = 0-3$^-$	0.91 (0.33;2.5)	0.70 (0.37;1.33)	0.64 (0.29;1.43)
Number of teeth (1-19 vs ≥20)	n ≥ 20	1.01 (0.54;1.87)	0.93 (0.34;2.52)	0.94 (0.39;2.27)
Functional occlusal contacts on each side (<2 vs ≥2)	n ≥ 2	0.65 (0.39;1.06)	0.80 (0.40;1.59)	0.52 (0.22;1.22)

Note: Odds ratios were modelled with the most regular attendance pattern as reference. Two definitions of regular attendance were used: first annual attendance (AA = 5/5) and alternatively attendance minimally in three different years in the 5-y period (RA ≥ 3/5). Results are given after weighting and correction for gender, age, education level and employment status. Bold figures indicate significant Odds Ratios (95% CI), *P*-values were adjusted for multiple comparisons.

In both annual and regular attenders, mean D_3MFT was higher than in the irregular or nonattender group (Table 1). The difference was significant when annual attenders were considered ($P = 0.01$), but not for regular attenders ($P = 0.052$). However, presence of one or more untreated dentine caries lesions ($D_3 > 0$) was observed more frequently in irregular and nonattenders than in regular and annual attenders ($P < 0.001$, see Table 1). This was also reflected in the higher proportion of participants having a 100% restorative index among AA and NA vs NO ($P < 0.01$) and RA vs IA ($P = 0.03$) and NO ($P < 0.001$, see Table 1).

No significant differences were observed regarding the highest DPS-Index scores, number of natural teeth and the number of occluding pairs in posterior teeth among the groups with different attendance patterns regardless of which definition of regular attendance was used ($P > 0.05$). Participants with a mean plaque index >0.5 were most frequently found in the NO group ($P < 0.01$).

There were no significant differences regarding dietary risk or self-reported toothbrushing frequency ($P > 0.05$, Table 1). A significant higher number of nonattenders than regular attenders reported being smokers (χ^2 test, $P < 0.05$). The difference was most pronounced between annual and non (annual) attenders ($P < 0.01$).

Table 2 shows the results of the logistic regression, adjusted for age, gender, education level and employment status, assessing the association of attendance pattern with health outcomes. Annual and regular attenders had a higher probability of being free of untreated dentinal decay. Similarly, compared with regular attenders, irregular or nonattenders had a lower probability of having a Plaque Index ≤0.5 and a Restorative Index of 100. A comparable pattern was observed when annual attendance was modelled; however. the OR's were somewhat lower. Highest DPS-Index, number of teeth and occluding pairs in posterior teeth were not significantly different between attendance patterns, regardless of the definition used.

The pattern of attendance differed according to participants' age (Table 3). Mean age was significantly higher in regular attenders than in irregular and nonattenders. Nonattendance was most frequently found in the youngest age group (25-34 years old, 26%) followed by the 35-44 years old (21%) and dropped to 10% in the group of 75 years and older. Irregular attendance and nonattendance were more common in males ($P < 0.001$, Table 3).

Further, significant differences were noted with respect to educational level, employment status, country of birth and current

TABLE 3 Dental attendance by sociodemographic variables

	Nonattenders	Irregular attenders (1-2/5)	Regular attenders (≥3/5)	Nonannual attender	Annual attender
Age (SD)	45.9 (13.8)	46.5 (14.8)	51.4 (14.1)	48.2 (14.8)	53.4 (13.0)
Gender					
Female (n = 754)	37% (29;45)	47% (41;54)	56% (51;60)	52 (47;56)	56 (49;64)
Male (n = 682)	63% (55;71)	53% (46;59)	44% (39;49)	48 (44;53)	43 (36;51)
Education					
Higher (n = 959)	68% (59;76)	73% (66;80)	79% (74;84)	75 (71;80)	82 (74;89)
Lower (n = 337)	32% (24;41)	27% (20;33)	21% (16;26)	25 (20;29)	18 (11;26)
Employment status					
Employed (n = 760)	60% (51;69)	63% (56;70)	64% (59;70)	62% (57;67)	69% (60;77)
Unemployed (n = 164)	20% (12;27)	17% (11;22)	9% (6;12)	14% (10;18)	5% (1;8)
Out of labour market (n = 376)	21% (15;27)	20% (15;26)	27% (22;32)	24% (19;29)	27% (18;35)
Country of birth					
Belgium/Western (n = 1061)	75% (68;83)	83% (77;88)	95% (93;97)	88% (85;92)	97% (96;99)
Other (n = 247)	25% (17;32)	17% (12;23)	5% (3;7)	12% (8;15)	3% (1;4)
Current nationality					
Belgian/Western (n = 1110)	71% (62-79)	87% (82-92)	95% (93-98)	92 (49;58)	94 (88;99)
Other (n = 198)	29% (21-38)	13% (8-16)	5% (2-7)	8% (5;10)	6% (1;12)

Note: Results presented as percentages (95% confidence interval in brackets) and age as mean (Standard deviation in brackets) are weighted, numbers (n) are unweighted. Two definitions of regular attenders are presented, one with annual attendance, alternatively minimal three visits on 5 y.

nationality. When adopted in a logistic regression model, adjusted for age and gender, these findings were confirmed (Table 4). The "profile" of the nonattender was being unemployed, presenting with lower educational achievement and being from foreign origin. Participants being out of the labour market had a comparable probability of regular attendance with those in employment, as had unemployed participants when compared to those out of the labour market (OR = 0.87, $P = 0.71$). However, annual attenders had a higher probability to be employed, also in contrast to participants out of the labour market who had an OR of 0.30 ($P < 0.01$) to have an annual dental visit. In annual attenders, the OR for foreign nationality became nonsignificant while for foreign origin it remained significant.

Regular attenders utilized all types of oral health care more frequently than the irregular ones. Regular attenders received more frequently advice and preventive care (60%). However, 92% of regular attenders received at least one filling and 35% at least one root canal treatment. In annual attenders, this figure amounted to 94% with at least one filling and 40% at least one endodontic treatment.

4 | DISCUSSION

The principal findings in this cross-sectional national survey study were that oral health differed between regular attenders, irregular attenders and nonattenders. Regular attenders were found to have more restorations and less untreated decay compared with irregular or nonattenders. Other outcomes, such as periodontal status, number of teeth and teeth in functional occlusion were not found to be different. Dental attendance was found to be associated with sociodemographic variables, such as age, gender, employment status and country of origin. Females, participants with higher education, older and employed participants had higher rates of regular attendance.

The strength of this study lies in the ability to precisely assess periods of dental nonattendance as well as the frequency of oral health care received in attenders in contrast to studies relying on recall of the interviewees.[17] As far as completeness of participants' oral healthcare utilization records of our sample is concerned, it is important to emphasize that most contacts between dentists and patients were captured by the system. Belgian dentists may propose, and patients may accept treatment plans in which only part of the care is covered by the compulsory healthcare service package. Thus, almost all treatments performed will have left some traces in the records and were therefore available for data analysis. Very few exceptions like dental care delivered outside the European Union or international organization staff with only a private or employer healthcare insurance, freshly arrived political refugees or homeless persons will lack in the records but they represent only a very small portion of all care delivery. In persons having had dental care abroad probably less onerous services like maintenance or solving of problems will be done in Belgium to avoid travel costs.

TABLE 4 Results of the multivariable logistic regression analysis for the association between sociodemographic variables and dental attendance

Variable	Chance (OR: odds ratio) for non-attendance, (95% CI)	Chance (OR: odds ratio) for regular (3/5 y) attendance, (95% CI)	Chance (OR: odds ratio) for annual attendance, (95% CI)
Education (higher vs lower)	**Lower: OR = 1.90 (1.19;3.02)[a]**	**Lower: OR = 0.51 (0.34;0.78)[a]**	**Lower: OR = 0.48 (0.27;0.85)[a]**
Nationality (Belgian/Western vs other)	**Other: OR = 5.26 (3.13;8.33)[b]**	**Other: OR = 0.21 (0.11;0.40)[b]**	Other: OR = 0.52 (0.21;1.33)[c]
Country of birth (Belgian/Western, vs other)	**Other: OR = 3.33 (2.08;5.26)[b]**	**Other: OR = 0.20 (0.13;0.36)[b]**	**Other: OR = 0.18 (0.09; 0.38)[b]**
Employment (employed vs unemployed vs out of the labour market)	**Unemployed: OR = 2.08 (1.02;4.35)[a]**	**Unemployed: OR = 0.39 (0.20;0.75)[a]**	**Unemployed: OR = 0.22 (0.09;0.56)[b]**
	Out of labour market: OR = 1.88 (1.0;3.33)[c]	**Out of labour market: OR = 0.52 (0.32;0.85)[a]**	**Out of labour market: OR = 0.30 (0.14;0.61)[a]**

Note: Chance of having had no dental attendance, regular attendance (3/5 y) or annual attendance is modelled after weighting and correction for age and gender. Bold OR values are significant ($P < 0.05$). Odds ratios for nonattendance were not affected by different definitions of regular attendance. Significant OR are printed bold, superscript letters refer to the result of the statistical test.

[a]$P < 0.05$.

[b]$P < 0.001$.

[c]Not significant ($P > 0.05$).

A limitation of the study is the low participation rate attributable to the strict privacy protection legislation and some logistic problems characteristic for this kind of field work. However, a weighting of the data was performed to correct for the possible effects of selection bias. The number of participants seemed sufficient to provide a general analysis of the Belgian population without allowing a further subdivision into different regions or subgroups. Further, the data shown were derived from a cross-sectional sample. This may limit the number and strength of conclusions to be drawn from the data.

In the literature no standardized definition of a regular attender could be found by the authors. A "regular" attender according to older standards used in the British National Health Service was defined as a person attending twice a year.[3] Traditionally, a (once or twice) annual visit is regarded as a regular attendance, although the evidence for a benefit in terms of oral health is lacking.[1,2] In this study, an alternative definition was contrasted to this, being at least three annual visits in a 5-year period.[15] It could be shown that both definitions yielded comparable findings, but there were some nuances. Oral health indicators did not improve drastically between "regular" and annual attenders, differences tended to level off when absence of dentinal decay or plaque index were considered. However, annual attenders had a significantly higher D_3MFT (mainly composed of the *F*-component), showing that in this group a high number of participants needed or obtained restorative treatment.

In a prospective study performed by Thomson et al and a study by Gilbert et al, the distinction was made between self-reported "routine" and "problem-oriented" attenders, showing that routine attenders had better oral health indicators.[14,28]

In our study, the group of regular or annual attenders was probably composed of both types of profiles described above. Further detailed analysis of oral healthcare utilization should be undertaken in the future.

The present data show that regular dental attendance was associated with oral health as well as with sociodemographic variables. However, only a part of oral health outcomes was different between regular, irregular or no attendance in the reference period. This was particularly true for untreated caries experience. The mean D_3MFT values did not differ much but regular or annual attenders had less untreated cavities. This is in line with other studies, for instance data from the 1998 UK oral health examination showing less untreated cavities in (former) regular attenders.[29]

Furthermore, regular attenders showed a significantly better oral hygiene as expressed by the plaque index. This finding was confirmed by data from a cohort study in teenagers.[30] Although self-reported brushing frequency was not significantly higher in regular or annual attenders, apparently quality of brushing was better. Possibly, more health awareness or education and motivation may have played a role in that, which is also reflected in the observed lower frequency of current smokers in regular attenders (Table 1).[31]

Young adults (age group of 25-34 years) were more frequently irregular or nonattenders when compared to their proportion in the total population which is in agreement with surveys from Sweden, New Zealand and California.[14,32,33] Young adults are facing high expenses (housing, children) and tend to postpone oral health care. As the rate of caries progression seems to be low in adulthood treatment may be postponed until severe symptoms develop.[34] The high rate of utilization of invasive procedures in regular attenders may indicate a kind of "catch-up" in dental care from the age of the mid-thirties upwards.

Regarding periodontal health, no statistically significant difference between regular and irregular attenders was observed in this study. Also, in other studies, no difference was reported, such as in the UK adult oral health survey (data from 1998).[35] Another study in an older population group in Sweden confirmed that dental visits

as such did not influence periodontal health outcome.[36] Possible explanations for these findings can be that awareness for periodontal disease in the population was low leading to a limited demand.[37] Awareness of dentists for diagnosis and referral may also have influenced this.[38] Furthermore, the frequency of visits may have a limited influence on severe periodontitis outcome when risk factors are not adequately controlled.[39] The basic package of periodontal services provided within the Belgian public health service may pose economic barriers to referral to a periodontist.

Regular attenders presented more frequently higher educational achievements.[40] A collinearity between educational level, socioeconomic status and health behaviour may not be excluded. As low educational achievements lead to a higher probability of being unemployed or having lower salary, this may reflect economic barriers for dental attendance, since patients have to prefinance ambulant care (dental or medical) to be reimbursed later. However, even in the presence of financial incentives, increased attendance in socioeconomic risk groups was only partially achieved.[41]

Regular dental care (be it routine or problem-based) was higher in employed participants. The ORs for annual or regular attendance (Table 4) were significantly lower for unemployment but also for persons out of the labour market. Possibly, economic aspects may have played a role herein. This is confirmed by the lower probability of recipients of social benefits for annual or regular attendance. Despite being entitled to a higher reimbursement, this group still needs to prefinance dental care and this might act as a barrier.

This might also be the case for poor caries experience outcome and low dental attendance in migrants with non-European background (Tables 2 and 4), as supported by other studies.[42] Diverse cultural backgrounds or being migrant decreases the probability of regular dental attendance, or oral check-up visits, even when correcting the data for SES.[43,44] Possible impact of an oversampling of the culturally and ethnically more diverse Brussels Region by HIS may be the reason why a higher proportion of non-Western foreign nationalities (15%) than in the general Belgian population (5%) was found in the subsample of this study. Moreover, selection of age groups and limitation to dentate persons in our sample and the fact that origin was not a criterion for HIS sampling made weighting using nationality impossible.

A further analysis of attitudes by exploring the questionnaire data in more detail is a challenging topic for further research. This might show associations with health knowledge and behaviour and might yield more information on barriers and possible incentives for increasing not only attendance but also efficacy in terms of oral health outcomes such as a better periodontal health and oral function, besides the reduction of dental caries.[45] The influence of migration on dental attendance and oral health behaviour in general is an interesting topic for further research.

5 | CONCLUSION

In conclusion, even in a country with nearly universal coverage for basic oral healthcare expenditures, there are segments of the population not attending a dentist over long periods. Oral healthcare expenditures are covered by social security; however, they need to be prefinanced by the patient so young adults and low SES groups may postpone necessary dental care.

Some oral health indicators were not associated with dental attendance pattern. Dental attendance in Belgium seems still to a large extent being driven by complaints and care seems to be largely oriented towards intervention. Regular attenders presented significantly less untreated caries, but no lower caries experience and DPSI than irregular ones. The challenge is not necessarily directed towards increasing dental attendance but towards a measurable improvement of oral health. Further studies of challenges and incentives to reach this goal should be undertaken.

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CONFLICT OF INTEREST

None of the authors declares having a conflict of interest.

AUTHOR CONTRIBUTION

PB, JC, JVO and DDC planned and supervised the data collection. PB formulated the hypothesis, coordinated statistical analysis and drafted the manuscript. PB and JC discussed the manuscript. JVO and DDC discussed methodology, results and proofread the manuscript. All authors agreed with the submitted manuscript and the choice of the journal.

ORCID

Peter Bottenberg https://orcid.org/0000-0001-8538-9868

REFERENCES

1. Riley P, Worthington HV, Clarkson JE, Beirne PV. Recall intervals for oral health in primary care patients. *Cochrane Database Syst Rev*. 2013;(12):CD004346.
2. Worthington HV, Clarkson JE, Bryan G, Beirne PV. Routine scale and polish for periodontal health in adults. *Cochrane Database Syst Rev*. 2013;(11):CD004625.
3. Davenport CF, Elley KM, Fry-Smith A, Taylor-Weetman CL, Taylor RS. The effectiveness of routine dental checks: a systematic review of the evidence base. *Br Dent J*. 2003;195:87-98.
4. Gilbert GH, Duncan RP, Vogel WB. Determinants of dental care use in dentate adults: six-monthly use during a 24-month period in the Florida Dental Care Study. *Soc Sci Med*. 1998;47:727-737.
5. Vedsted P, Fink P, Sørensen HT, Olesen F. Physical, mental and social factors associated with frequent attendance in Danish general practice. A population-based cross-sectional study. *Soc Sci Med*. 2004;59:813-823.

6. Smits FT, Brouwer HJ, ter Riet G, van Weert H. Epidemiology of frequent attenders: a 3-year historic cohort study comparing attendance, morbidity and prescriptions of one-year and persistent frequent attenders. *BMC Public Health*. 2009;9:36.
7. Hullah E, Turok Y, Nauta M, Yoong W. Self-reported oral hygiene habits, dental attendance and attitudes to dentistry during pregnancy in a sample of immigrant women in North London. *Arch Gynecol Obstet*. 2008;277:405-409.
8. Burr JA, Lee HJ. Social relationships and dental care service utilization among older adults. *J Aging Health*. 2013;25:191-220.
9. Bedos C, Brodeur JM, Boucheron L, et al. The dental care pathway of welfare recipients in Quebec. *Soc Sci Med*. 2003;57:2089-2099.
10. Kaylor MB, Polivka BJ, Chaudry R, Salsberry P, Wee AG. Dental services utilization by women of childbearing age by socioeconomic status. *J Community Health*. 2010;35:190-197.
11. Wu B, Liang J, Luo H, Furter R. Racial and ethnic variations in preventive dental care utilization among middle-aged and older Americans, 1999–2008. *Front Public Health*. 2013;1:65.
12. Tchicaya A, Lorentz N. Socioeconomic inequalities in the non-use of dental care in Europe. *Int J Equity Health*. 2014;13:7.
13. Nihtilä A, Widstrøm E, Elonheimo O. Heavy consumption of dental services; a longitudinal cohort study among Finnish adults. *BMC Oral Health*. 2013;13:18.
14. Thomson WM, Williams SM, Broadbent JM, Poulton R, Locker D. Long-term dental visiting patterns and adult oral health. *J Dent Res*. 2010;89:307-311.
15. Richards W, Ameen J. The impact of attendance patterns on oral health in a general dental practice. *Brit Dent J*. 2002;192:697-702.
16. Afonso-Souza G, Nadanovsky P, Chor D, Faerstein E, Werneck GL, Lopes CS. Association between routine visits for dental checkups and self-perceived oral health in an adult population in Rio de Janeiro: the Pro-Saude Study. *Community Dent Oral Epidemiol*. 2007;35:393-400.
17. Montero J, Albaladejo A, Zalba JI. Influence of the usual motivation for dental attendance on dental status and oral health-related quality of life. *Med Oral Patol Oral Cir Bucal*. 2014;19:e225-e231.
18. Bof de Andrade F, Drumond Andrade FC, Noronha K. Measuring socioeconomic inequalities in the use of dental care services among older adults in Brazil. *Community Dent Oral Epidemiol*. 2017;45:1-8.
19. Declerck D, Bottenberg P, Carvalho J, et al. Development and implementation of an oral health data registration and evaluation system for the Belgian population. *J Dent Oral Craniof Epidemiol*. 2013;1:45-54.
20. https://his.wiv-isp.be/SitePages/Home.aspx. Accessed October 6, 2018.
21. Carvalho JC, Bottenberg P, Declerck D, van Nieuwenhuysen JP, Vanobbergen J, Nyssen M. Validity of an information and communication technology system for data capture in epidemiological studies. *Caries Res*. 2011;45:287-293.
22. Carvalho JC, Bottenberg P, Declerck D, et al. Validation of the oral survey-B system for electronic data capture in national oral health surveys. *Caries Res*. 2016;50:288-294.
23. WHO. *Oral Health Surveys: Basic Methods*, 5th edn. Geneva, Switzerland: World Health Organisation. ISBN 978 92 4 154864 9.
24. Van der Velden U. The Dutch periodontal screening index validation and its application in The Netherlands. *J Clin Periodontol*. 2009;36:1018-1024.
25. Silness J, Löe H. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand*. 1964;22:121-135.
26. Tramini P, Montal S, Valcarel J. Tooth loss and associated factors in long-term institutionalised elderly patients. *Gerodontology*. 2007;24:196-203.
27. Gerritsen AE, Witter DJ, Creugers N. Long-term follow-up indicates unimpaired oral health-related quality of life for people having shortened dental arches. *J Dent*. 2017;65:41-44.
28. Gilbert GH, Duncan RP, Heft MW, Dolan TA, Vogel WB. Oral disadvantage among dentate adults. *Community Dent Oral Epidemiol*. 1997;25:301-313.
29. Aldossary A, Harrison VE, Bernabé E. Long-term patterns of dental attendance and caries experience among British adults: a retrospective an analysis. *Eur J Oral Sci*. 2015;123:39-45.
30. DeDonno MA. Dental anxiety, dental visits and oral hygiene practices. *Oral Health Prev Dent*. 2012;10:129-133.
31. Polk DE, Weyant RJ, Manz MC. Socioeconomic factors in adolescents' oral health: are they mediated by oral hygiene behaviors or preventive interventions? *Community Dent Oral Epidemiol*. 2010;38:1-9.
32. Hjern A, Grindefjord M, Sundberg H, Rosen M. Social inequality in oral health and use of dental care in Sweden. *Community Dent Oral Epidemiol*. 2001;29:167-174.
33. Tomar SL, Azevedo AB, Lawson R. Adult dental visits in California: successes and challenges. *J Public Health Dent*. 1998;58:275-280.
34. Mejàre I, Stenlund H, Zelezny-Holmlund C. Caries incidence and lesion progression from adolescence to young adulthood: a prospective 15-year cohort study in Sweden. *Caries Res*. 2004;38:130-141.
35. Morris AJ, Steele J, White DA. The oral cleanliness and periodontal health of UK adults in 1998. *Brit Dent J*. 2001;191:186-192.
36. Renvert S, Persson RE, Persson GR. A history of frequent dental care reduces the risk of tooth loss but not periodontitis in older subjects. *Swed Dent J*. 2011;35:69-75.
37. Varela-Centelles P, Diz-Iglesias P, Estany-Gestal A, Seoane-Romero JM, Bugarín-González R, Seoane J. Periodontitis awareness amongst the general public: a critical systematic review to identify gaps of knowledge. *J Periodontol*. 2016;87:403-415.
38. Lee JH, Bennett DE, Richards PS, Inglehart MR. Periodontal referral patterns of general dentists: lessons for dental education. *J Dent Educ*. 2009;73:199-210.
39. Giannobile WV, Braun TM, Caplis AK, Doucette-Stamm L, Duff GW, Kornman KS. Patient stratification for preventive care in dentistry. *J Dent Res*. 2013;92:694-701.
40. Petersen PE, Kjøller M, Bøge L, Krustrup U. Changing dentate status of adults, use of dental health services, and achievement of national dental health goals in denmark by the year 2000. *J Public Health Dent*. 2004;64:127-351.
41. Trohel G, Bertaud-Gounot V, Soler M, Chauvin P, Grimaud O. Socioeconomic determinants of the need for dental care in adults. *PLoS ONE*. 2016;11:e0158842.
42. Lambert M, De Reu G, De Visschere L, Declerck D, Bottenberg P, Vanobbergen J. Social gradient in caries experience of Belgian adults 2010. *Community Dent Health*. 2018;30:160-166.
43. Marino R, Morgan M, Hopcraft M. Transcultural dental training: addressing the oral health care needs of people from culturally diverse backgrounds. *Community Dent Oral Epidemiol*. 2012;40:134-140.
44. Erdsiek F, Waury D, Brzoska P. Oral health behaviour in migrant and non-migrant adults in Germany: the utilization of regular dental check-ups. *BMC Oral Health*. 2017;17:84.
45. Baelum V. Caries management: technical solutions to biological problems or evidence-based care? *J Oral Rehab*. 2008;35:135-151.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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