Title

Frailty as a determinant of dental attendance among community-dwelling older adults.

Running title

Frailty and dental attendance

Authors

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Conflict of interest

The authors declare no conflicts of interest associated with this manuscript or directly related to the content of this article.

Authors contribution

NDW, DV and BJ conceptualised and designed the study. NDW and DV collected the data. NDW and BJ cleaned the data and BJ conducted the analysis. BJ, GT, LDV and NDW interpreted the data. BJ and GT drafted the initial manuscript. BJ, GT, LDV and NDW reviewed and revised the manuscript critically for important intellectual content. All authors approved the final manuscript as submitted.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Abstract

While many determinants of dental attendance among older adults have been identified, no study has focused on the role of frailty. The aim of this study was to assess the association between different levels of frailty and dental attendance among home-dwelling older adults, in Belgium.

Materials and methods: This was a cross-sectional study on a random sample of home-dwelling adults aged 60 and over from two Belgian cities. Data were collected with a structured questionnaire through a participatory peer-research method. Time since last dental attendance was the dependent variable. The independent variable was frailty, assessed with the Comprehensive Frailty Assessment Instrument, including physical, psychological, social, and environmental subdomains. Covariates were age, gender, having a partner, educational level, and household income, as well as self-perceived oral health. Data analysis included descriptive, bivariate (Chi-Square, ANOVA, Kruskal-Wallis) and binomial logistic regression analyses.

Results: The sample consisted of 1329 older adults with a mean age of 72.5 years (SD 8.9, range 60 to 103). In the low frailty group, 73% attended the dentist in the previous 12 months, while it was 62% and 54% in the medium and high frailty group respectively. In the fully adjusted model, the initial gradient in the relationship between overall frailty and dental attendance remained; those in the medium and the high frailty groups were respectively 1.46 (95% CI: 1.09, 1.95) and 1.67 (95% CI: 1.15, 2.43) times more likely to report no dental attendance in the previous year than the low frailty group. Similar associations could be seen in the physical and environmental frailty subdomains.

Conclusion: Frailty is consistently associated to less favourable dental attendance, independently from age, gender, socioeconomic factors, family composition, and self-perceived oral health. Once frailty has been detected, good interprofessional communication and care is needed to avoid drop-out of older adults from the oral healthcare system.

Introduction

Good oral health is important to maintain function, wellbeing and quality of life but is an often neglected element in the process of healthy ageing.[1–5] Oral diseases remain very prevalent worldwide and the demographic transition towards ageing societies and epidemiological changes in oral health make this an even more pressing issue.[6–8] A considerable decline in edentulousness, combined with the cumulative nature of oral diseases and consecutive dental treatments over the last decades, have resulted in many older adults with a heavily restored dentition, making it difficult to maintain their mouth healthy and clean once motor and cognitive skills decline.[9] Moreover, there is a higher risk for oral pathology among older adults due to dry mouth.[10] Preservation of optimal oral health across the lifespan, including regular follow-ups by dental professionals, remains one of the major challenges in oral healthcare.

Regular dental attendance is not only important for early detection of pathology and provision of preventive care but also contributes to better oral health and OHRQoL.[11–13] A study by Manski et al. among older adults (+ 50 years) in Europe showed considerable variation in dental attendance among countries, ranging from 23% in Poland to 82% Sweden.[14] Nevertheless, in all European countries, dental attendance is lower in older people irrespective of the social welfare regime.[14] Apart from Sweden, there were no European countries with 50% of their oldest citizens (>85 years) reporting regularly attending a dental professional. Previous research has identified several determinants of regular dental attendance among older adults, such as higher income and education, being female, having a partner, a high density of dental practitioners, good health and oral health status, perceived need and regular early life dental attendance patterns.[14–18]

While many of these factors have been well examined, considerably less attention has been given to the role of common conditions in older people that could affect dental attendance, such as frailty. Frail persons are characterised by declined functioning and greater vulnerability to stressors. Moreover, they are at risk of adverse outcomes, including falls, hospitalisation, and mortality. There is no clear definition of frailty as a concept, but there is a global consensus that it is multidimensional, an extreme consequence of the normal ageing process and dynamic, making it possible to fluctuate between different frailty severity states along the life-course.[19] There is a large variety in frailty measurement instruments going from a physical approach to a more holistic approach including psychosocial and environmental factors.[20]

Several cross-sectional and longitudinal associations have been demonstrated between worse oral health measures and the presence of frailty or aspects of frailty.[21–23] Moreover, frail older persons have higher healthcare and homecare utilization than robust older persons.[24] However, little is known about

the association of frailty with dental attendance among older adults. A Mexican study on older adults aged over 70 years old showed that not using dental services over the previous year was associated with being physically frail.[25] Yet, there are no studies on the association in the opposite direction (i.e., frailty as a determinant of dental attendance), neither in a European context nor using a frailty measure that goes beyond the physical aspects of frailty. Accordingly, the aim of this study was to assess the association between different levels of frailty and dental attendance among home-dwelling older adults aged 60 years and over, using a more holistic approach to frailty.

Materials and Methods

This was a cross-sectional study based on a random representative sample of community-dwelling adults aged 60 and over from two Belgian cities (Ghent and Mechelen with 261,475 and 86,304 inhabitants respectively). To reduce response bias, non-responders were replaced by persons from the same sex and age group (60 to 69 years, 70 to 79 years and over 80 years).

Data were collected in 2018 within the Belgian Ageing Studies[26], a research project assessing quality of life and living conditions of older adults at municipality level. Data collection took place with a structured self-administered questionnaire through a participatory peer-research method. Local older volunteers were responsible for guiding, monitoring, and supervising the research process as well as for data collection. Previous findings from the Belgian Ageing Studies have shown that this approach results in high response rates and more complete questionnaires and minimises socially desired responses.[27] The ethical committee of the Vrije Universiteit Brussel approved the study protocol (B.U.N. 143201111521).

The dependent variable in this analysis was the time since last dental attendance (<1year, 1-5years, >5years). For the regression analysis, dental attendance was dichotomised (<1 year vs 1 year or more). A 1 year cut-off point was chosen rather than 5 years because that recall interval would be preferable considering the possibility of greater risk for oral pathology as people age.

The main independent variable was frailty, assessed with the Comprehensive Frailty Assessment Instrument (CFAI). The CFAI is a self-reported instrument of 23 questions designed and validated to assess frailty in community-dwelling older persons.[28,29] It is a multi-dimensional instrument applying a holistic approach to frailty and includes physical (limitations in certain activities), psychological (mood disorders and emotional loneliness), social (social loneliness and social support network) and environmental (actual housing and environment) subdomains. Subdomains comprise 4 to 8 items.[29] The environmental subdomain is unique among the frailty assessment instruments but highly relevant because people depend on their environment in the context of ageing in place, a commonly applied policy in ageing societies. For each CFAI subdomain, an overall score can be calculated, and each of the

four subdomains contributes equally to a total frailty score which can range between 0 and 100. The theoretical model applied during the development of the CFAI, includes increased health care utilization as one of the adverse outcomes of frailty and therefore, the CFAI was used to assess the association between frailty and oral healthcare utilization. Participants were categorised into low, mild and high frailty groups, for both the overall frailty score and the subdomain scores, through previously established cut-off points based on a large dataset of 33629 community-dwelling older adults in Belgium; for the overall frailty score, the cut-offs were 21.9 for mild and 38.8 for high levels of frailty.[30]

Covariates comprised demographic data (age and gender), socio-economic data (educational level and household income), marital status (having a partner or not) as well as self-perceived oral health. Concerning the latter, participants were categorised as having poor self-perceived oral health if they reported at least one of the following at the time of the survey: oral pain, functional problems (chewing, speaking), problems with their oral aesthetics, denture-related problems, or other oral problems by means of a yes/no question. Data on age, household income and educational level were collected as categorical variables, using 4 different categories (Table 1).

Data analysis included a descriptive analysis of the demographic (age, gender, having a partner) and socio-economic (educational level and household income) variables as well as frailty and dental attendance. Bivariate associations between the independent variable (frailty), the covariates and the outcome (dental attendance) were assessed with Chi-Square, One-way ANOVA and Kruskal-Wallis tests. To avoid bias due to missing data, multiple imputation (fully conditional specification method with linear regression as model for scale variables and 5 iterations) was applied to the different items of the CFAI and the covariates mentioned above. All imputed variables also served as predicting variables and, for age, a minimum and maximum value were set of 60 and 103 years respectively. Finally, binomial logistic regression models based on the pooled dataset were employed to assess the association between frailty (total CFAI score as well as the 4 different sub-domains) and dental attendance, unadjusted and adjusted for demographic variables (age and gender), socio-economic position (educational level and household income), having a partner and self-perceived oral health. For sensitivity analysis, a complete case analysis was also run. All analysis used SPSS for windows version 27 (SPSS Inc., Chicago, IL, USA).

Results

The total sample consisted of 1329 older adults with a mean age of 72.5 years (SD 8.9, range 60 to 103) and 21.3% belonged to the high frailty group (Table 1). Looking at the different frailty subdomains, the highest proportion of highly frail participants could be found in the social subdomain (22.7%). Most participants (63.2%) visited the dentist over the previous year whereas for 18.3% of the participants,

it was more than 5 years since their last dental attendance. The bivariate analysis demonstrated that higher levels of overall frailty were associated with lower dental attendance in the previous year. In addition, a higher prevalence of dental attendance in the previous year was associated with younger age, higher education level, higher household income, having a partner and having no self-perceived oral health problems.

Before imputation, the original dataset had 6.5% missing responses resulting in 39.4% (n = 524) of the participants having incomplete data and 22.7% (n = 302) of the participants where the overall frailty based on 23 items could not be calculated. Participants were more likely to have missing CFAI items if they were in an older age group, a lower income group or had a lower educational background, were female or did not have a partner.

The crude association between overall frailty and dental attendance showed that older adults with medium and high frailty had a higher probability of not visiting the dentist in the previous year than those belonging to the low frailty group, with ORs of 1.74 (95% CI: 1.33, 2.29) and 2.54 (95% CI: 1.85, 3.49) respectively (Table 2). Even after adjusting for age and gender (model 2), socioeconomic position (model 3), family composition (model 4) and self-perceived oral health (model 5), the consistent association between overall frailty and dental attendance remained; those in the medium and the high frailty group were respectively 1.46 (95% CI: 1.09, 1.95) and 1.67 (95% CI: 1.15, 2.43) times more likely than to the low frailty group to report no dental attendance in the previous year. These results were similar to the complete case analysis (see appendix).

The regression models for the different subdomains of the CFAI are represented in Table 3. The physical and environmental subdomains showed an association that remained in the fully adjusted model, with older adults with high physical and environmental frailty scores being 1.58 (95% CI: 1.09, 2.28) and 1.46 (95% CI: 1.03, 2.08) times more likely to not have visited the dentist over the previous year than those with the lowest physical and environmental frailty scores respectively. In contrast, the crude association with the psychological subdomain was fully explained after adjustment for age, sex and socioeconomic position and the social frailty domain was not significantly associated with dental attendance at any stage in the analysis.

Discussion

The findings showed a clear and consistent association between overall frailty and dental attendance, as well as for physical and environmental aspects of frailty. The higher the frailty level, the lower the probability of dental attendance over the previous year. Even after adjustment for important covariates, older adults in the highest frailty group were 1.67 times more likely than the low frailty group to report no dental attendance in the previous year.

As far as we know, this is the first study looking at the association between frailty and dental attendance in home-dwelling older adults in a European context. Moreover, the study used a more comprehensive approach to assess the impact of psychological, social, and environmental elements of frailty besides the more common physical aspects. Our analyses showed the added value of taking a holistic approach towards frailty as all 4 subdomains contribute to the overall frailty scores but not in an equal way. The estimates indicated a stronger and more robust to adjustment association with dental attendance for the physical subdomain and the high frailty group of the environmental subdomain, while the respective estimates for the psychological more modest and the significant association disappeared in the adjustment process. For the social frailty subdomains, there was no significant association at any stage. There is clear evidence that problems with transport and mobility are major barriers for dental attendance among older adults.[31–33] Moreover, a higher density of dental practitioners, limiting the distance to a dental practice, improves access to dental care.[15,34] The present study corroborates these results as the physical frailty subdomain includes questions around limitations when going for a walk, walking up a hill or stairs, doing less or very demanding activities, which can contribute to physical access barriers.

The environmental frailty subdomain is focussing primarily on the quality of housing, the distance to facilities and whether people like their neighbourhood. Older adults prefer to age in their own house and neighbourhood due to the psychological connection, because it gives them a feeling of autonomy and creates an identity.[35,36] However, housing and neighbourhoods are often not adapted to the changing needs of older adults and can become a burden with a negative impact on quality of life.[37] Moreover, the needs among older adults are very diverse, making the success of “aging in place” policies very challenging.[38] We showed that environmental frailty is associated with lower dental attendance over the previous year, which supports the importance of including oral health in more broader policies on ageing in place.

Limitations

The study was based on a large cross-sectional sample from two cities in Belgium, and so its representativeness is limited to those and not the country and no assumptions can be made on the evolution over time. Moreover, there was no data collection on the number and profile of the non-responders but previous research with the same methods has shown that 65-85% of the invited persons in the first round of data collection agreed to participate.[27] The outcome variable for dental attendance also has limitations. First, it was measured through a questionnaire and not from official healthcare records. The use of questionnaires to collect dental attendance is standard practice but it may lead to less precise findings due to potential recall or social desirability bias. Furthermore, dental

attendance over the previous year is not the same as having regular dental check-ups as it also includes emergency visits. In future studies, the question on dental attendance should be more precise about the reason for dental attendance. Moreover, there is little to no evidence to suggest the benefit of a certain time period for a dental recall interval as this should depend on a persons' risk profile.[39] Therefore, using 1 year as a cut-off point in the analysis is somewhat arbitrary but considering the epidemiology of oral pathology among older adults and the possible changes in their risk profile, it seemed a better choice than 5 years. Moreover, it will probably lead to less recall bias. Nevertheless, it is an important standard variable to collect as it provides information on access to care, which is essential for older people with an increased risk for (oral) health problems. As a last limitation, the analyses adjusted for a range of key variables but it would have been even better if there were also data available on number of natural teeth or other key oral health variables like caries or periodontal disease, to be included in the adjustment process, as oral status is an important predictor of dental attendance in older adults.[31,40,41] Due to lack of data availability, other key comorbidities were also not included.

The main findings seem to be in contrast with the literature on general healthcare consumption as several recent papers showed that frailty is associated with higher healthcare use and costs among home-dwelling older people.[42–45] The lower dental attendance among frail persons cannot be explained by better oral health status. A recent systematic review on the associations between oral health and frailty showed that frail persons had higher caries prevalence, worse self-reported oral health, worse chewing ability and dry mouth, more edentulousness and more non-use of complete dentures.[46] Therefore, the findings of our study might indicate an example of the inverse care law being present in dental care for frail persons whereas in general medical care, this does not seem to be the case. Qualitative research has shown that frail home-dwelling older adults refrain from visiting the dentist because they lack believe in the benefits of dental visits and trivialize oral care in the general context of their impaired health and old age.[47] Frailty might as such reinforce the predominant reason for non-attendance among older adults above 50 years old being the perception that regular dental treatment is 'not necessary' or 'not usual'.[18]

From a health policy perspective, the finding of lower dental attendance among older adults with the highest frailty levels and frail persons having a higher risks of poor oral health has two important implications: increasing the focus on prevention to avoid the need for professional treatment; and removing experienced barriers to professional care. Either way, there is a need for better integration of oral and general healthcare systems and improved oral health literacy both among older adults and also healthcare professionals being active in care for older people.[48] These are in line with recent policy documents of the World Health Organization (WHO) and the world Dental Federation (FDI).[49,50]

Healthcare settings with an embedded frailty screening could empower and inform older frail home-dwelling adults and their (informal) carers to have regular dental check-ups. A good skill-mix, including oral health, of essential healthcare staff and social workers is essential in that respect.

Conclusion

A higher level of overall frailty is associated with a higher probability of not attending the dentist over the previous year. There was a gradient in the association that remained significant after adjustment for age, education level, household income, having a partner and the presence of self-perceived oral health problems. The main drivers for the association were the physical and environmental subdomains. Once frailty is detected, good interprofessional communication and care is needed to avoid drop-out of older adults from the oral healthcare system and allow for early detection of oral health problems.

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Table 1. Frailty, sociodemographic and -economic characteristics of the overall sample and by dental attendance (n=1329)

		Dental attendance		
	Total sample [n (%)]	< 1 year ago [n (%)]	1 - 5 years ago [n (%)]	> 5 years ago [n (%)]
Frailty				
Overall frailty (n=1027) ***				
Low	414 (40.3%)	304 (73.4%)	58 (14.0%)	52 (12.6%)
Medium	391 (38.1%)	243 (62.1%)	80 (20.5%)	68 (17.4%)
High	222 (21.3%)	121 (54.5%)	44 (19.8%)	57 (25.7%)
Mean frailty score (SD)	27.7 (14.1)	25.9 (13.7)	29.8 (13.3)	32.2 (15.4)
Physical frailty (n=1106) ***				
Low	721 (65.2%)	505 (70.0%)	119 (16.5%)	97 (13.5%)
Medium	223 (20.2%)	113 (59.6%)	46 (20.6%)	44 (19.7%)
High	162 (14.6%)	78 (48.1%)	39 (24.1%)	45 (27.8%)
Mean subdomain score (SD)	2.3 (2.9)	1.9 (2.7)	2.7 (3.0)	3.2 (3.3)
Psychological frailty (n=1174)				
Low	771 (65.7%)	512 (66.4%)	131 (17.0%)	128 (16.6%
Medium	297 (25.3%)	177 (59.6%)	60 (20.2%)	60 (20.2%)
High	106 (9.0%)	60 (56.6%)	23 (21.7%)	23 (21.7%
Mean subdomain score (SD)	2.2 (2.9)	2.0 (2.8)	2.4 (3.1)	2.5 (3.3)
Social frailty (n=1222)				
Low	293 (24,0%)	197 (67.2%)	53 (18.1%)	43 (14.7%)
Medium	652 (53.4%)	412 (63.2%)	119 (18.3%)	121 (18.6%)
High	277 (22.7%)	168 (60.6%)	55 (19.9%)	54 (19.5%)
Mean subdomain score (SD)	3.6 (3.1)	3.5 (3.0)	3.9 (3.1)	3.7 (3.4)
Environmental frailty (n=1188)**				
Low	654 (55.1%)	434 (66.4%)	115 (17.6%)	105 (16.1%)
Medium	336 (28.3%)	218 (64.9%)	59 (17.6%)	59 (17.6%)
High	198 (16.7%)	106 (53.5%)	41 (20.7%)	51 (25.8%)
Mean subdomain score (SD)	2.8 (4.0)	2.6 (3.9)	2.9 (3.9)	3.6 (4.7)
Sociodemographic characteristics				
Age (n=1301) ***				
60-69 years	573 (44.0%)	406 (73.0%)	83 (14.9%)	67 (12.1%)
70-79 years	403 (31.0%)	241 (62.6%)	72 (18.7%)	72 (18.7%)
80+ years	325 (25.0%)	146 (46.9%)	75 (24.1%)	90 (28.9%)
Gender (n=1270)				
Male	563 (44.3%)	337 (59.9%)	115 (20.4%)	111 (19.7%)
Female	707 (55.7%)	465 (65.8%)	121 (17.1%)	121 (17.1%)
Partner (n=1250) ***				
Yes	794 (63.5%)	534 (67.3%)	142 (17.9%)	118 (14.9%)
No	456 (36.5%)	255 (55.9%)	90 (19.7%)	11 (24.3%)
Socioeconomic characteristics				
Education (n=1231) ***				
No degree/primary education	245 (19.9%)	110 (44,9%)	62 (25.3%)	73 (29.8%)
Lower secondary education	312 (25.3%)	172 (55.1%)	67 (21.5%)	73 (23.4%)
Higher secondary education	341 (27.7%)	231 (67.7%)	53 (15.5%)	57 (16.7%)

Higher education	333 (27.1%)	260 (78.1%)	47 (14.1%)	26 (7.8%)
Household income (n=1046) ***				
< 999€	44 (4.2%)	17 (38.6%)	13 (29.5%)	14 (31.8%)
1000€ – 1499€	283 (27.1%)	148 (52.3%)	62 (21.9%)	73 (25.8%)
1500€ – 1999€	221 (21.1%)	129 (58.4%)	50 (22.6%)	42 (19.0%)
≥ 2000€	498 (47.6%)	369 (74.1%)	70 (14.1%)	59 (11.8%)
Self-perceived health				
Oral problems (n=1222) **				
Yes	293 (24.0%)	163 (55.6%)	69 (23.5%)	61 (20.8%)
No	929 (76,0%)	610 (65.7%)	158 (17.0%)	161 (17.3%)

*** *p* – Value ≤ 0.001 for Chi-Square test, Oneway ANOVA or Kruskal-Wallis Test
** *p* – Value ≤ 0.01 for Chi-Square test, Oneway ANOVA or Kruskal-Wallis Test
* *p* – Value < 0.05 for Chi-Square test, Oneway ANOVA or Kruskal-Wallis Test

Table 2bis. Binomial logistic regression models for the association between frailty and the lack of dental attendance over the last year.

Variable (ref)	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]	Model 5 OR [95% CI]
Overall frailty (low)	1	1	1	1	1
Medium	1.74 [1.33; 2.29] ***	1.66 [1.26; 2.20] ***	1.46 [1.09; 1.95] *	1.47 [1.10; 2.00] **	1.46 [1.09; 1.95] *
High	2.54 [1.85; 3.49] ***	2.24 [1.61; 3.13] ***	1.72 [1.20; 2.47] **	1.71 [1.19; 2.46] **	1.67 [1.15; 2.43] **
Age (60-69 years)		1	1	1	1
70-79 years		1.55 [1.18; 2.04] **	1.50 [1.12; 2.00] **	1.50 [1.12; 2.00] **	1.50 [1.12; 2.00] **
80+ years		2.56 [1.87; 3.50] ***	2.18 [1.55; 3.05] ***	2.11 [1.51; 2.97] ***	2.10 [1.50; 2.95] ***
Gender (Female)			1	1	1
Male		1.54 [1.21; 1.97] ***	1.82 [1.41; 2.38] ***	1.88 [1.44; 2.45]***	1.86 [1.43; 2.43] ***
Education (Higher education)			1	1	1
Higher secondary education			1.52 [1.07; 2.18] *	1.55 [1.08; 2.22] *	1.55 [1.08; 2.22] *
Lower secondary education			2.24 [1.51; 3.31] ***	2.31 [1.56; 3.41] ***	2.30 [1.56; 3.41] ***
no/primary education			2.79 [1.85; 4.21] ***	2.90 [1.92; 4.39] ***	2.89 [1.91; 4.37] ***
Household income (≥ 2000€)			1	1	1
1500€ – 1999€			1.34 [0.90; 2.00]	1.26 [0.84; 1.90]	1.26 [0.83; 1.89]
1000€ – 1499€			1.49 [1.05; 2.13] **	1.31 [0.88; 1.96]	1.31 [0.88; 1.95]
< 999€			3.09 [1.66; 5.72] ***	2.82 [1.51; 5.27] ***	2.79 [1.50; 5.19] ***
Partner (Yes)				1	1
No				1.23 [0.92; 1.66]	1.23 [0.91; 1.66]
Self-perceived oral health problems (No)					1
Yes					1.11 [0.83; 1.49]

Model 1: Crude association between overall frailty and the dental attendance
Model 2: Model 1 + Age and Gender
Model 3: Model 2 + Socioeconomic position (education and household income)
Model 4: Model 3 + family composition (having a partner or not)
Model 5: Model 4 + self-perceived oral health

*** $p \leq 0.001$; ** $0.001 < p \leq 0.01$; * $0.01 < p \leq 0.05$

Table 3. Binomial logistic regression models for the association between the different domains of frailty and the lack of dental attendance over the last year (n=1329)

Variable (ref)	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]	Model 5 OR [95% CI]
Physical frailty (low)	1	1	1	1	1
Medium	1.78 [1.34; 2.35] ***	1.58 [1.18; 2.13] **	1.41 [1.04; 1.92] *	1.42 [1.05; 1.92] *	1.40 [1.03; 1.91] *
High	2.37 [1.69; 3.33] ***	1.96 [1.37; 2.81] ***	1.62 [1.12; 2.35] **	1.62 [1.12; 2.34] **	1.58 [1.09; 2.28] *
Psychological frailty (low)	1	1	1	1	1
Medium	1.42 [1.10; 1.85] **	1.35 [1.03; 1.77] *	1.18 [0.89; 1.57]	1.17 [0.88; 1.55]	1.14 [0.86; 1.52]
High	1.60 [1.06; 2.41] *	1.57 [1.02; 2.41] *	1.22 [0.80; 1.85]	1.20 [0.79; 1.83]	1.17 [0.77; 1.79]
Social frailty (low)	1	1	1	1	1
Medium	1.15 [0.86; 1.53]	1.15 [0.86; 1.53]	1.09 [0.80; 1.49]	1.07 [0.79; 1.47]	1.06 [0.78; 1.45]
High	1.26 [0.90; 1.77]	1.20 [0.85; 1.70]	1.19 [0.82; 1.71]	1.17 [0.81; 1.69]	1.15 [0.80; 1.66]
Environmental frailty (low)	1	1	1	1	1
Medium	1.05 [0.80; 1.38]	1.10 [0.83; 1.47]	1.07 [0.80; 1.43]	1.07 [0.80; 1.44]	1.06 [0.80; 1.42]
High	1.80 [1.32; 2.45] ***	1.91 [1.39; 2.62] ***	1.47 [1.03; 2.08] *	1.48 [1.05; 2.10] *	1.46 [1.03; 2.08] *

Model 1: Crude association between the respective domain of frailty and the dental attendance
Model 2: Model 1 + Age and Sex
Model 3: Model 2 + Socioeconomic position (education and household income)
Model 4: Model 3 + family composition (having a partner or not)
Model 5: Model 4 + self-perceived oral health

*** $p \leq 0.001$; ** $0.001 < p \leq 0.01$; * $0.01 < p \leq 0.05$

Binomial logistic regression models for the association between frailty and the lack of dental attendance over the last year (complete case analysis).

Variable (ref)	Model 1 OR [95% CI]	Model 2 OR [95% CI]	Model 3 OR [95% CI]	Model 4 OR [95% CI]	Model 5 OR [95% CI]
Overall frailty (low)	1	1	1	1	1
Medium	1.68 [1.25; 2.27] ***	1.61 [1.18; 2.20] **	1.47 [1.04; 2.10] *	1.47 [1.03; 2.10] **	1.49 [1.04; 2.13] *
High	2.31 [1.64; 3.25] ***	1.91 [1.32; 2.75] ***	1.67 [1.09; 2.57] *	1.67 [1.09; 2.57] **	1.73 [1.11; 2.70] *
Age (60-69 years)		1	1	1	1
70-79 years		1.65 [1.20; 2.26] **	1.79 [1.26; 2.55] ***	1.82 [1.28; 2.60] ***	1.74 [1.22; 2.49] **
80+ years		3.26 [2.30; 4.63] ***	2.40 [1.61; 3.57] ***	2.36 [1.58; 3.54] ***	2.32 [1.54; 3.50] ***
Gender (Female)			1	1	1
Male		1.60 [1.21; 2.10] ***	1.82 [1.33; 2.49] ***	1.86 [1.35; 2.55]***	1.98 [1.43; 2.74] ***
Education (Higher education)			1	1	1
Higher secondary education			1.82 [1.20; 2.78] **	1.87 [1.23; 2.86] **	1.96 [1.27; 3.02] **
Lower secondary education			2.67 [1.71; 4.15] ***	2.72 [1.73; 4.26] ***	2.86 [1.81; 4.52] ***
no/primary education			2.77 [1.69; 4.55] ***	2.96 [1.79; 4.92] ***	3.00 [1.80; 5.02] ***
Household income (≥ 2000€)			1	1	1
1500€ – 1999€			1.24 [0.83; 1.86]	1.13 [0.74; 1.74]	1.08 [0.70; 1.67]
1000€ – 1499€			1.46 [0.99; 2.15]	1.19 [0.75; 1.89]	1.16 [0.73; 1.86]
< 999€			3.97 [1.74; 9.02] ***	3.38 [1.46; 7.85] **	3.29 [1.41; 7.67] **
Partner (Yes)				1	1
No				1.42 [0.97; 2.08]	1.42 [0.96; 2.10]
Self-perceived oral health problems (No)					1
Yes					1.17 [0.81; 1.68]

Model 1: Crude association between overall frailty and the dental attendance
Model 2: Model 1 + Age and Gender
Model 3: Model 2 + Socioeconomic position (education and household income)
Model 4: Model 3 + family composition (having a partner or not)
Model 5: Model 4 + self-perceived oral health

*** $p \leq 0.001$; ** $0.001 < p \leq 0.01$; * $0.01 < p \leq 0.05$