

Investigating the relationship between multimorbidity and dental attendance: a cross-sectional study of UK adults

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Key points

Presents one of the first studies to investigate the association between dental attendance, long-standing health conditions and multimorbidity, and any variation in this relationship by socioeconomic status.

Shows little evidence of an association between singular long-standing health conditions and dental attendance, however, multimorbidity was associated with dental attendance.

Shows that the association between dental attendance and multimorbidity did not vary by socioeconomic status.

Introduction Regular dental attendance is related to better oral health. However, long-standing health conditions (LSHCs) may be related to dental attendance and this relationship may vary by socioeconomic status. **Method** Data were collected from wave two (2013–2015) of the Yorkshire Health Study (n = 7,654). Data included dental attendance, LSHC, age, gender, education-level, smoking, body mass index, and area-level deprivation. Logistic regression (attend or not) was used to analyse associations with LSHC and multimorbidity. **Results** Overall, 63.1% (n = 4,826) of individuals attended the dentist. Of these, 37.8% (n = 2894) had no LSHC, 26.0% (n = 1987) had one LSHC and 36.4% (n = 2784) had two or more LSHC. The presence of a singular LSHC was not associated with dental attendance (OR = 0.91 [0.81, 1.04]), however, those with two or more LSHCs were more likely to attend the dentist (OR = 0.81 [95% CI 0.72, 0.92]). Interactions between individual-level education, as a marker of socioeconomic status, and LSHC revealed few associations with dental attendance. **Conclusion** Multimorbidity was associated with dental attendance such that those with multimorbidity were more likely to attend. These important findings highlight the increasing challenge of multimorbidity for global healthcare systems.

Introduction

Dental attendance is related to better oral health and oral health-related quality of life.^{1–3} In the UK, 39% of adults do not regularly attend the dentist, resulting in a considerable proportion of the population who may experience poor oral health.² Given the high associated costs in treating many oral conditions, focusing on prevention rather than treatment may help reduce overall costs. Dental attendance facilitates the timely intervention and prevention of dental disease.^{4,5} Consequently, understanding the factors associated with dental attendance is important to help develop effective health policies aimed at promoting attendance.

A better appreciation of dental attendance patterns will improve understanding of how the overall burden of dental disease can be reduced. Dental attendance varies by factors such as age, gender, socioeconomic status and cost of treatment.^{6,7} For example, males are not just less likely to go for regular dental check-ups than females overall,⁷ but younger males in particular are at risk, with fewer than half of men aged 16–24 (42%) and 25–34 (44%) attending regular dental check-ups.⁷ There are also wide social inequalities in dental attendance, with individuals of low socioeconomic status less likely to attend their dentist.^{8,9} Similarly, inequality exists for oral health outcomes, with low socioeconomic status associated with poorer oral health outcomes.^{10,11} Importantly, the burden of disease is also greater among this group.

Research on factors for attendance has focused on socio-demographic, behavioural and social characteristics. Research rarely considers if other factors, such as long-standing health conditions influence dental attendance. Long-standing health conditions relate to a broad set

of health conditions that can be defined as any ongoing, long-term, or reoccurring conditions that impacts on people's lives.^{12,13} This is concerning given that emerging evidence suggests that some individuals with chronic diseases are at greater risk of dental disease and may attend less often.¹⁴ For example, individuals with multiple sclerosis, had a 9% higher risk of decayed, missing or filled teeth compared to those with no long-standing health condition.¹⁵ Similarly, a more recent study suggested that decreased levels of personal mobility were associated with difficulties in accessing dental care in individuals with multiple sclerosis.¹⁶ Considering the growing evidence of a bidirectional relationship between diabetes mellitus and chronic periodontal disease,^{17–19} investigating dental attendance in individuals with long-standing health conditions will be important for both early intervention and disease prevention.

Although long-standing health conditions present far-reaching challenges for healthcare systems worldwide, these systems are largely configured for individual diseases rather than multimorbidity. Multimorbidity is the

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Box 1 Flow of participants excluded due to missing or incomplete data

Original sample: 13,100 individuals
 Age: 368 missing (no numerical value) or invalid (<18 years of age) resulting in 12,732 participants
 Gender: 23 missing or invalid (not numerical value of 1 or 2) resulting in 12,709 participants
 Long-standing health conditions: 317 missing or invalid resulting in 12,392
 Dental attendance: 3,307 missing or invalid resulting in 9,085 participants remaining
 Education (Wave 1): 1431 missing (not numerical value of 1–5) resulting in 7,654 individuals
 Resulting analytical sample: n = 7,654

presence of two or more long-standing health conditions and therefore represents the overall disease burden and individual experiences. The chronic health conditions individuals with multimorbidity experience may present a significant barrier to dental service utilisation.^{20–22} Moreover, any association between multimorbidity and dental attendance may be amplified by socioeconomic status. For instance, individuals of low socioeconomic status are at greater risk of multimorbidity^{23,24} and have the greatest number of long-standing health conditions constituting their multimorbidity.^{25,26} Furthermore, the onset of multimorbidity also occurs ten to 15 years earlier in people living in the most deprived areas compared with the least deprived.²⁷

This study is among the first internationally to investigate associations between long-standing health conditions and dental attendance and any amplification effect by socioeconomic status.

Methods**Participants**

Cross-sectional data from wave two (2013–2015) of the Yorkshire Health Study (YHS) (formerly the South Yorkshire Cohort Study) were used.²⁸ The YHS employed a two-stage sampling approach for initial data collection which has been reported previously in detail.²⁸ Briefly, the YHS is an observational cohort study collecting information on the residents (aged 18–86 years) from the Yorkshire and Humberside region in England. It aims to inform National Health Service and local authority health-related decision making in Yorkshire. Data were collected on current and long-standing health conditions, healthcare usage and health-related behaviours.

While the data are self-reported, we selected the YHS since few alternative sources included measures for both dental attendance and long-standing health conditions. Participants in the cohort are slightly older than in the actual population with a higher proportion

of females. Most participants also reported of being White ethnicity (94.1%), which was over representative of the ethnic group (2011 Census; 90.5%). Total sample size was based on complete data for age, gender, area-level deprivation, long-standing health conditions and dental attendance response, which resulted in an analytical sample of 7,654 individuals (Box 1). Ethical clearance was granted by the ethics committee of the Leeds Beckett University.

Outcome – long-standing health conditions

Long-standing health conditions were based on the question: ‘do you have any long-standing illness, health problem, condition or disability?’ (Yes/No). The number of and the specific condition were also then specified. Examples include but were not limited to: insomnia, pain, heart disease, cancer, depression, stroke and high blood pressure (Table 1). The number of long-standing health conditions were then summed to indicate the total number of long-standing health conditions. Multimorbidity was defined as a total of two or more long-standing health conditions combined.

Exposure – dental attendance

Dental attendance was self-reported based on the question: ‘in the last three months how many times have you visited the following: dentist?’ This was then split into a binary outcome of ‘attended’ or ‘not attended’ which were defined as never visiting the dentist within the last three months, and having visited ≥ 1 occasion in the past three months.

Covariates

Based on previous literature, we controlled for individual-level factors that may explain an individual’s dental attendance. Non-modifiable personal characteristics of age (years), gender (male or female), ethnicity (white or non-white) and education (low = none; moderate = school, college; high = university) were each included since they each display associations to dental attendance.^{1,2,4,6,9} An individual’s smoking status (‘I smoke daily’; ‘I smoke occasionally but not every day’; ‘I used to smoke daily but not now’; ‘I used to smoke occasionally but now not at all’; ‘I have never smoked’) was also included due to the well-known associations with periodontal disease.¹⁹ Self-reported height (cm) and weight (kg) were used to calculate body mass index; obesity defined as ≥ 30.00 . Finally, the index of multiple deprivation (IMD) 2015 was used as a marker of area-level deprivation as it provides a multidimensional measure of deprivation (based on 37 separate indicators, organised across seven distinct domains of: income deprivation; employment deprivation; health deprivation and disability; education, skills and

Table 1 The prevalence of long-standing health conditions

Long-standing health condition	Male	Female	Overall
Tiredness/fatigue	14.1%	15.1%	14.7%
Pain	18.9%	18.7%	18.8%
Insomnia	5.0%	7.4%	6.4%
Anxiety/nerves	7.4%	12.1%	10.1%
Depression	6.6%	8.2%	7.5%
Diabetes	9.3%	4.9%	6.8%
Breathing problems	9.7%	9.6%	9.6%
High blood pressure	23.6%	18.1%	20.4%
Heart disease	8.2%	4.2%	5.9%
Osteoarthritis	7.9%	11.8%	10.1%
Stroke	2.2%	1.1%	1.6%
Cancer	4.2%	2.3%	3.1%

training deprivation; crime; barriers to housing and services; and living environment deprivation). IMD scores were assigned to the lower super-output area (LSOA) of each individual, as determined by their geocoded postcode. A LSOA is a geographical area that typically contains a minimum population of 1000 and a mean of 1500. We used the IMD 2015 since it provides a multidimensional measure of deprivation and is commonly used by local governments.²⁹

Data analysis

Participants' characteristics were summarised using descriptive statistics and were split into those who attended and did not attend and an overall descriptive statistic for study sample. The number of long-standing health conditions were split into 0, 1 and >1 and logistic regression was used to investigate the association between long-standing health conditions and dental attendance (attend or not). Odds ratios (ORs) are presented alongside corresponding

95% CI. Finally, we then calculated subgroup-specific estimates of long-standing health conditions and dental attendance across levels of education. Following STROBE (strengthening the reporting of observational studies in epidemiology) guidelines, we used logistic regression with a single reference category to estimate the separate and combined associations of long-standing health conditions and deprivation on odds of not attending the dentist. Due to the high statistical power in the dataset and assumption that data were missing at random missing data were dealt with by list-wise deletion. All analyses were performed in STATA IC version 14.

Results

Descriptive statistics

Table 2 shows descriptive statistics for those respondents who attended a dentist and those who did not attend a dentist. Overall, 4,826 (63.1%) individuals attended while 2,828 (36.9%) did not attend. Those who attended were older (61.6 years) compared to those who did not attend (54.8 years). A larger proportion of those attending were classified as low education. While there was no difference for area-level deprivation in the least deprived quartile, a slightly higher percentage of non-attendees were from the most deprived quartile. There were few differences by obesity status, however, a higher proportion of smokers did not attend. Importantly, a larger proportion of those who attended the dentist had multimorbidity relative to those non-attendees.

Associations between long-standing health conditions and dental attendance

Table 3 presents the results from the logistic regression model which investigates the association between long-standing health conditions and dental attendance. In the fully adjusted model, there was no association between the presence of one long-standing health condition and dental attendance (OR = 0.92 [95% CI 0.81, 1.04]). We also investigated the association between specific health conditions but all were nonsignificant and effect sizes were very small (results not presented). The only statistically significant association was between multimorbidity and dental attendance. Individuals with two or more long-standing health conditions (multimorbidity) were 19% less likely to not attend the dentist in the previous three months (OR = 0.81 [95% CI 0.72, 0.91]).

Table 2 Descriptive statistics of study sample by those who attended the dentist, those who did not and overall

	Attendee 63.1% (n = 4,826)	Non-attendee 36.9% (n = 2,828)	Overall % (n = 7,654)
Age			
Years (Mean, (SD))	61.6 (13.52)	54.8 (15.45)	59.05 (14.64)
Sex			
Male	41.7 (2,011)	45.2 (1,279)	43.0 (3,290)
Female	58.3 (2,815)	54.8 (1,549)	57.0 (4,364)
Education status			
Low	15.7 (757)	11.0 (312)	14.0 (1,069)
Moderate	53.8 (2,597)	51.8 (1,464)	53.1 (4,061)
High	30.5 (1,472)	37.2 (1,052)	25.2 (1,524)
Area-level deprivation (IMD)			
Q1 (most deprived areas)	24.6 (1,187)	27.1 (765)	25.5 (1,952)
Q2	26.5 (1,278)	24.6 (696)	25.8 (1,974)
Q3	24.8 (1,195)	24.2 (683)	24.5 (1,878)
Q4 (least deprived areas)	24.2 (1,166)	24.2 (684)	24.2 (1,850)
Smoking			
'I smoke daily'	3.9 (189)	5.8 (164)	4.6 (353)
'I smoke occasional but not every day'	1.6 (78)	2.9 (82)	2.1 (160)
'I used to smoke daily but not now'	24.5 (1,181)	21.3 (601)	23.3 (1,782)
'I used to smoke occasionally but now not at all'	13.6 (656)	11.6 (327)	12.8 (983)
'I have never smoked'	56.4 (2,722)	58.4 (1,654)	57.2 (4,376)
Obesity			
Not obese	83.5 (4,032)	83.7 (2,369)	83.6 (6,401)
Obese	16.5 (794)	16.3 (459)	16.4 (1,253)
Number of long-standing health conditions			
0	33.8 (1,630)	44.3 (1,253)	37.6 (2,883)
1	26.2 (1,266)	25.5 (721)	26.0 (1,987)
2 or more	40.0 (1,930)	30.2 (854)	36.4 (2,784)

Note: Q1 = quartile 1 (IMD score ≤10,700); Q2 = quartile 2 (IMD score 10,701-21,411); Q3 = quartile 3 (IMD score 21,412-26,942); Q4 = quartile 4 (IMD score ≥ 26,943). Education category: low = no education; moderate = school, college or other qualifications; high = University. IMD = Index of multiple deprivation, Q1 most deprived, Q4 least deprived

It is plausible that the association between dental attendance and multimorbidity may differ by level of socioeconomic status. Table 4 therefore presents the results stratified by education-level (low, moderate and high) as a proxy measure of socioeconomic status. Comparisons were made relative to individuals within the high education category with no long-standing health conditions as this was hypothesised as the most favourable combination. Results show that only two out of eight potential associations were statistically significant. Those classified as low education and a singular long-standing health condition (OR = 0.72 [0.52, 0.98]) and moderate education and two long-standing health conditions (OR = 0.72 [0.61, 0.86]) were less likely not to attend the dentist. Moreover, the wide confidence intervals throughout all effects tested suggest a large margin of error around that point estimate of the effect.

Discussion

The purpose of this study was to investigate associations between long-standing health conditions and dental attendance. Analysis of the large UK sample revealed that those with multimorbidity were more likely to attend the dentist. However, subgroup analyses by education category revealed little variation by socioeconomic status in this association. Findings in this study contribute to the international research evidence base, which, to the authors knowledge, has not investigated the relationship between multimorbidity and dental attendance. The findings within this study are increasingly important as multimorbidity represents an increasingly challenging issue for global healthcare systems.

Overall, 63.1% of individuals in this study attended the dentist. This reflects recent estimates in the Adult Dental Health Survey whereby 61% of UK adults were attending regularly.² This study also confirmed previous research as a greater proportion of females and older adults in this study reported greater dental attendance.² Interestingly, a higher proportion of attendees in this study were classified as low education. While this contrasts to some evidence,^{6,9} this study used individual-level education to define socioeconomic status. In contrast, other studies have used area-level deprivation as a proxy for socioeconomic status; it may be that these measures may represent different aspects of socioeconomic status.³⁰ While research has explored dental

Table 3 Results investigating the association between multimorbidity and dental attendance

Variable	Odds ratio [95% CI]
Number of long-standing health conditions	
0	REF
1	0.92 [0.81,1.04]
2+	0.81 [0.72,0.91]*
Age	
	0.97 [0.97,0.97]*
Sex	
Female	REF
Male	0.75 [0.68,0.82]*
Education category	
Low	REF
Moderate	1.00 [0.86,1.17]
High	1.12 [0.95,1.33]
Index of Multiple Deprivation	
Q1 (Most deprived areas)	REF
Q2	0.84 [0.74, 0.97]*
Q3	0.91 [0.80, 1.01]
Q4 (least deprived areas)	0.87 [0.76, 1.05]
Smoking	
'I smoke daily'	REF
'I smoke occasional but not every day'	0.99 [0.67, 1.47]
'I used to smoke daily but not now'	0.74 [0.58, 0.95]*
'I used to smoke occasionally but now not at all'	0.64 [0.49, 0.83]*
'I have never smoked'	0.73 [0.57, 0.92]*
Obesity	
Obese	REF
Not obese	1.05 [0.92, 1.21]

Note: REF=reference category. Q1 = quartile 1; Q2 = quartile 2; Q3 = quartile 3; Q4 = quartile 4. Education category: low = no education; moderate = school, college or other qualifications; high = University. IMD = Index of multiple deprivation; Q1 = most deprived, Q4 least deprived. p<0.05 = *

attendance variation by sociodemographic factors such as gender or age, a lack of research has investigated variation in dental attendance by long-standing health conditions.

This study is one of the first internationally to investigate the association between long-standing health conditions and dental attendance. Interestingly, findings within this study reveal no association between the presence of a singular long-standing health condition and dental attendance. While this null association may seem surprising, it may

be that individuals within this study were able to manage one long-standing health condition such that it did not impact upon dental attendance. It is possible that healthcare providers may in fact adequately prepare and support patients to manage their oral health alongside a singular condition.³¹ Further research is needed to determine how factors such as length of time since diagnosis and severity of condition may influence the level of burden an individual may have from their long-standing condition.^{31,32} Despite this, managing two or

Table 4 Results investigating if the relationship between multimorbidity and dental attendance differs by education level

Education level	0 long-standing health conditions		1 long-standing health conditions		2+ long-standing health conditions	
	Attend/not n	Odds Ratio (OR [95% CI])	Attend/not n	Odds ratio (OR [95% CI])	Attend/not n	Odds Ratio (OR [95% CI])
Low	153/75	0.86 [0.62, 1.18]	191/70	0.72 [0.52, 0.98]*	413/167	0.83 [0.66, 1.05]
Moderate	839/631	0.96 [0.82, 1.12]	681/372	0.84 [0.70, 1.01]	1077/461	0.72 [0.61, 0.86]*
High	638/547	REF	394/279	1.01 [0.83, 1.23]	440/226	0.84 [0.69, 1.04]

Adjusted for age, sex, and area-level deprivation, individual-level education, smoking status and obesity. $p < 0.05 = *$

more long-standing health conditions may be significantly more challenging.^{20,31}

This study demonstrates that multimorbidity was associated with dental attendance; those with multimorbidity were 19% more likely to attend the dentist. Previous research suggests individuals with multimorbidity suffer a greater functional impairment than those with a singular long-standing health condition.³³ However, while the functional impairment associated with multimorbidity may potentiate difficulties in accessing regular dental care, the opposite was true in this study. Our findings therefore confirm previous research which showed that patients with multiple sclerosis attended the dentist more than the general population.¹⁶ It is plausible that individuals with multimorbidity may be more accustomed to regular contacts with healthcare services. This also supports previous research which shows the majority of primary care medical consultations in England were for individuals with multimorbidity.³⁴ In this context, those with multimorbidity may require more frequent dental appointments due to the potential for greater incidence of dental disease.³² Moreover, it is possible that this association differs when stratified by socioeconomic status.

This study extended international research by investigating if the relationship between multimorbidity and dental attendance varied by socioeconomic status. However, findings show little evidence that the broader social context in which multimorbidity may operate is important for predicting dental attendance.²⁶ The relationship between socioeconomic status and oral health is well established,^{2,4,14} those of lower socioeconomic status are more likely to report barriers to attendance and are less likely to attend the dentist regularly.^{35,36} Despite this, the combination of multimorbidity and low socioeconomic status was not associated with dental attendance in this study. Future research may want to explore if specific long-standing

health conditions and unique challenges associated with particular conditions influence the individuals dental attendance patterns. Moreover, particular combinations of long-standing health conditions may influence dental attendance and offer a feasible target for interventions. Research may also benefit by investigating motivation behind dental attendance. For instance, previous research has suggested that despite greater attendance at the dentist, multiple sclerosis patients attended more for urgent dental care rather than for routine examinations.¹⁶

The findings within this study should be viewed in light of its limitations. First, data were cross-sectional limiting the ability to draw causal inferences. Longitudinal data may help assess change in long-standing health conditions and dental attendance. Second, while a large sample of UK adults was used within the Yorkshire and Humber region, it may not be generalisable to other areas of the UK. Moreover, the sample was under-represented in terms of younger, male and non-white ethnicities compared to the actual population recorded at the 2011 Census.²⁸ Third, this study classified individuals into 'attend' and 'not-attend', however, 'reported' and 'actual' attendance may vary if objectively measured.³⁷ Fourth, while this study classifies attendance as attending in the last three months not all individuals require visitation every three months to be deemed a regular attendee. The choice of the last three months for the dental attendance is a major limitation for transfer to practice as it does not fit well with the time intervals recommended for dental recall appointments usually used in adults in the UK (six to 12 months). This choice of time interval was due to standardisation across the different health professionals enquired about in the Yorkshire Health Survey. Fifth, we were unable to distinguish what treatment individuals received when attending the dentist. For instance, it does not specify whether they

attended for emergency appointments or a regular check-up. Despite these limitations, data in this study was consistent with trends of previous studies whereby there was lower attendance from males and also those of lower socioeconomic status. Moreover, while a more appropriate measure of six to 12 months would have been useful for comparison with recommended recall, it is reassuring that the overall percentage of attendance is almost identical to that reported in the recent Adult Dental Health Survey.²

Conclusion

This study used a large and unique UK dataset to investigate the association between dental attendance and long-standing health conditions and explored any interaction by socioeconomic status. The key finding was that those with multimorbidity were more likely to attend the dentist relative to those individuals with no long-standing health condition. Despite a plausible mechanism, there were no interactions by socioeconomic status as measured by education level. We provide novel UK evidence that presents the first study internationally to investigate the relationship between multimorbidity and dental attendance.

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