

Title: Oral health and depressive symptoms: findings from the English Longitudinal Study of Ageing

Abstract

Aim: We assessed the cross-sectional association between depressive symptoms and oral health using a nationally representative sample of older adults aged 50 years and older living in England.

Methods: Data came from wave 7 (2014-15) of the English Longitudinal Study of Ageing (ELSA). Multiple logistic regression analyses were conducted to assess the association between depressive symptoms, measured through the 8-items Center of Epidemiologic Studies-Depression (CES-D) scale and three oral health outcomes namely self-rated oral health; edentulousness and oral impacts.

Results: The analytical sample comprised 3,617 individuals. The proportion of participants that reported poor self-rated oral health, being edentate and having at least one oral health impact in the last six months was 19.8%, 7.7%, and 8.9% respectively. Around a tenth of the participants reported having depressive symptoms (10%). All unadjusted associations between depressive symptoms and the oral health measures were statistically significant. After accounting for potential confounders, only the relationship between depressive symptoms and self-rated oral health remained significant (OR=1.38; 95%CI 1.01-1.89). Socio-economic and general health-related variables appeared to influence the associations between depressive symptoms and oral health, particularly edentulousness and oral impacts.

Conclusion: Depressive symptoms were associated with poor self-rated oral health in older English adults.

Background

Population ageing is a global phenomenon that has far-reaching economic and socio-political consequences and implications (1). In England, the proportion of adults aged 65 years and over has increased substantially in the last few decades, from 13.0% in 1971 to 17.5% in 2014 (2). By 2040, almost one in seven people are expected to be aged over 75, with the fastest population growth among those aged 85 years and over (3).

This demographic change adds significant pressures on the National Health Service (NHS) as the burden of disease increases in older societies (3). Older adults are more likely to experience long-term disabilities, chronic conditions and multi-morbidities (4). In fact, according to the Global Burden of Disease study, around 23% of the global disease burden is attributable to conditions suffered by those aged 60 and over (5,6).

Mental health disorders are one of the leading contributors to the burden of disease later in life (7). In England, depression represents the most prevalent mental health condition among those aged 65 years and over; affecting approximately 22% of men and 28% of women (4). Depressive disorders have been shown to be linked to considerable physical, cognitive, and overall functional disability and even mortality (please, see listed refs in my comment).

The chronic character and the cumulative effect of oral diseases make older adults particularly vulnerable to experience poor oral health (8). This is important, as good oral health is a fundamental element in healthy ageing as it has a substantial impact on physical health and psychosocial functioning (9). Moreover, research has demonstrated that poor oral health is an indicator of socio-economic disadvantage (10).

There is a growing body of literature recognising the bi-directional association between oral health and mental health (11,12). This includes studies that have specifically looked at the relationship between depression and oral health outcomes (13,14). Evidence has shown that individuals with depressive symptoms are more likely to have poorer self-perceived oral health and quality of life, worse oral health, and be less likely to use dental health services compared to individuals without depressive symptoms (13–16).

Few studies have, however, focused on older adults. A recent systematic review and meta-analysis examined the association between depression and oral health in adults and older

adults investigating the direction of the associations used in the included studies. The results showed that depression was significantly associated with oral disorders, in particular with caries, tooth loss and edentulousness. This review also highlighted that periodontitis and edentulousness increased the risk of subsequent depressive symptoms (14).

Only very limited research has explored the association between depression and oral health in a UK context. Using longitudinal data from the English Longitudinal Study of Ageing (ELSA), Rouxel and colleagues, demonstrated that a worsening in oral health had a negative effect on depressive symptoms. However, a recovery from depressive symptoms was not related with changes in oral health impacts over a four-year period (17).

To further investigate this relationship, the purpose of this study was to assess the association between depressive symptoms and three oral health outcomes, namely self-rated oral health; edentulousness; and oral impacts.

Methods

Study population

This study was a secondary analysis of data from the seventh wave (2014-15) of ELSA. ELSA is a nationally representative cohort study of community-dwelling adults aged 50 years and over. The households that participated in the Health Survey for England in 1998, 1999, and in 2001 provided the sampling frame for the first ELSA wave (2002-03). Data collection for ELSA takes place every two years; participants complete a computer-aid personal interview and a self-completion questionnaire. In addition, physical assessment data are collected every four years. Further details on the survey design and methodology are available elsewhere (18). ELSA obtained ethical approval from the Multi-centre Research and Ethics Committee.

Measures

Outcomes

Self-rated oral health was assessed by asking participants “would you say your dental health (mouth, teeth and/or dentures) is... in the last 12 months”: excellent; very good; good; fair or

poor. We dichotomised participants' responses into "good" (excellent/very good/ good) and "poor" (fair/poor).

Edentulousness was measured through self-assessments of the presence of any natural teeth. Participants were categorised into two groups: those who reported having natural teeth (dentate) and those who reported not having any teeth (edentate).

Oral impacts was measured using a simplified version of the Oral Impacts on Daily Performances (OIDP) questionnaire for older populations (19). Participants were asked if they had had any difficulties (in the last six-months) in eating, speaking, smiling and problems with emotional stability or socialising due to their oral health. Since there was a low proportion of responders with specific difficulties, a dichotomous variable was created, that is: participants reporting at least one oral impact vs those reporting none.

Exposure

Depressive symptoms was measured using the shortened version of the Center for Epidemiologic Studies-Depression (CES-D) scale (20). This measure consists of eight items, such as whether the respondent "felt depressed", "felt sad", or "been feeling happy" in the past week. As in previous research, we summed the eight-item responses to give an overall score of depressive symptoms. Participants who scored four or more points were classified as having elevated depressive symptoms (21).

Covariates

A number of covariates were selected based on the existing literature. Gender was used as a dichotomous variable (male; female). We categorised age into three groups, namely; 50-64; 65-74; and 75 years and over. Educational attainment also comprised three categories (less than O-level or equivalent; O-level or equivalent; higher than A-level). Wealth was included as quintiles of total non-housing wealth. A binary variable of self-perceived presence of limiting long-standing illness was used. Smoking status was categorised into three groups, namely; never smoked; ex-smoker; and current smoker. We also included social isolation as a variable. As in other studies, this measure was created using participants' cohabiting status, extent of contact with their social network and their participation in social organisations (22).

Participants were then grouped into either those who were not socially isolated or those who were socially isolated (who scored ≥ 2 points).

Statistical analysis

Eligible participants for this analysis were core ELSA members at wave 7 that had complete data on depressive symptoms, oral health measures and covariates ($n=3,617$). All analyses were carried out using STATA/IC version 15 (StataCorp, College Station, TX). (add ref). We employed appropriate survey weights throughout to account for non-response and for the complex survey design. Results were considered statistically significant if p-value was below the 0.05 level.

The frequency distribution of the oral health outcomes, depressive symptoms and covariates was explored using descriptive statistics. Crude associations between the outcomes and depressive symptoms were investigated through chi-square and chi-square-for-trend tests. Then, we used multiple logistic regression to estimate the associations between the oral health measures and depressive symptoms accounting for potential confounders. Model 1 examined the strength of the association between depressive symptoms and each oral health outcome separately. Model 2 included model 1 plus age and gender; model 3 was additionally adjusted for education and wealth. Model 4 then included limiting long-standing illness and smoking status. The final model was additionally adjusted for social isolation.

Results

Table 1 shows the distribution of the oral health outcomes by socio-demographic characteristics. Our final analytical sample comprised of 3,617 individuals, of which 1,648 were males and 1,969 were females. Mean age was 68.1 (SD 8.6) years. The largest proportion of the sample was in the middle-age group (65-74 years), representing 40.03% of the sample. ELSA participants who were excluded from our analyses had worse oral health, were more likely to be depressed, less wealthy and had lower levels of educational attainment.

//////// Table 1 here – overall characteristics of the sample by outcomes////////

Overall, the prevalence of poor self-rated oral health was 19.82%. Few of the respondents were edentate (7.69%). Similarly, 8.87% of participants reported having experienced at least

one oral impact on their daily performance over the last 6 months. Around a tenth of responders were classified as having depressive symptoms (10.04%).

Individuals from the highest educational level groups as those from the wealthiest quintiles were less likely to report poor self-rated oral health, to be edentulous, and to have experienced at least one oral impact on daily performance than their least advantaged counterparts (all $p < 0.05$). Self-rated oral health and oral impact did not vary according to age and gender. Limiting-long standing illness and smoking were both associated with the three oral health measures independently. Responders who were classified as socially isolated were more likely to report being edentulous than those not socially isolated (9.14% vs 6.49%; $p < 0.05$). Neither self-rated oral health nor oral impacts were associated with social isolation.

Unadjusted and sequentially adjusted logistic regression models are presented in Table 2. Detailed models are shown in supplementary materials. Results from the bivariate logistic regression analysis showed that all three oral health outcomes were associated with depressive symptoms.

///// Table 2 here - logistic regression models, summary table /////

With regards to self-rated oral health, the crude model showed that participants with depressive symptoms were 1.9 (95%CI: 1.43-2.53) times more likely to rate their oral health as poor compared to those without depressive symptoms. After adjusting for all covariates, this association remained significant (OR=1.38; 95%CI: 1.01-1.89).

For edentulousness, model 1 showed that individuals classified as having depressive symptoms were more likely to have reported being edentate than those classified as not having depressive symptoms (OR=1.95; 95%CI: 1.34-2.83). However, this association lost its significance after socio-economic variables were accounted for in Model 3 (OR=1.29; 95%CI: 0.88-1.88). An additional analysis was undertaken on a subsample of dentate participants ($n=3,339$); where those with 20 teeth or more (considered a functional dentition) were tested against those with less than 20 teeth. Similar to the results for edentulousness, the fully adjusted model showed that there was no statistically significant association between the depressive symptoms and functional dentition (results not shown).

Unadjusted results for oral impacts showed that participants with depressive symptoms were 2.29 (95%CI: 1.60-3.29) times more likely to have reported at least one oral impact in the past six months compared to responders without depressive symptoms. Nonetheless, when limiting long-standing illness and smoking status were controlled for in Model 4, the association was no longer statistically significant (OR=1.45; 95%CI=0.96-2.20).

Discussion (still work in progress)

Among the general population of older adults living in England, our findings showed that 20% were classified as perceiving their oral health as poor, around 92% were dentate, and nearly 9% were shown to have experienced at least one oral impact on their daily activities in the past six months. Poorer oral health was significantly higher among those who were less educated, less wealthy, had a limiting long-standing illness and had history of smoking.

As previous research has shown for this population, socio-economic gradients were observed for the three oral health measures analysed; those from more advantaged backgrounds reported better outcomes than those from more disadvantaged backgrounds in a step-wise, consistent manner (23)(24). There were no differences between sexes, or between age groups in the extent to which they rated their oral health or reported their oral health impacts.

Approximately one-tenth of the responders were shown to have depressive symptoms. Even though significant crude associations between depressive symptoms and all three oral health indicators were found, only one relationship remained significant after confounder variables were controlled for - the relationship between depressive symptoms and self-rated oral health. This finding is consistent with that of Hybels et al., who demonstrated that having moderate depressive symptoms was associated with poorer self-rated oral health in a large sample of community-dwelling US older adults ($p < 0.001$)(25). Similar to this, Dahl and colleagues, showed that the likelihood of perceiving poor oral health was increased for Norwegian older adults who had symptoms of psychological distress – an aggregate measure that included depressive symptoms (OR=1.89; 95%CI. 1.14-3.15) (15).

Our results showed that once confounding factors were considered, depressive symptoms were no longer significantly associated with either edentulousness or oral impacts. The association between depressive symptoms and edentulousness appeared to be confounded

the most by education and wealth, whereas the association between depressive symptoms and oral impacts was most influenced by general health-related variables (limiting long-standing illness and smoking status). Adjusting for social isolation did not explain much of the associations between depressive symptoms and the oral health outcomes.

Our findings do not reflect those of the systematic review and meta-analysis conducted by Gonzalez Cademartori et al. This review found that the likelihood of edentulousness was higher among depressed individuals than among those without depressive signs and symptoms (OR 1.17; 95% CI 1.02-1.34)(14). Our results instead, are in agreement with Hybels et al. findings, which showed no association between depressive symptoms and edentulousness (25).

To the best of our knowledge, this is the first study to assess the association between depressive symptoms and oral health among a national sample of older adults in England. The other strengths of this study include the extensive range of key potential confounding factors and the validated indices of depressive symptoms included in the analysis. This study however, had some limitations. The cross-sectional nature of the data did not allow us to assess causal relationships between depressive symptoms and oral health. The analysis did not include any clinical oral health outcomes. However, three different self-report oral health measures were used, providing information on both, current and historical oral health. Moreover, a number of studies have shown that self-reported measures are correlated with clinical measures (refs).

The main findings from this study have several implications. First, ~~policies aiming to reduce health inequalities should consider oral health as a key factor as this study showed~~ More research is needed to better understand the pathways in which mental health and oral health link together. Second, Policy, action: Multidisciplinary approach for care.

Conclusion

In conclusion, this study showed that among older adults living in England, depressive symptoms were associated with poor self-rated oral health even after accounting for a

number of relevant factors. Neither edentulousness nor oral impacts were associated with symptoms of depression after full adjustment.

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Table 1: Descriptive characteristics of analysed participants (N= 3,617).

| Variables | | Total N (%) ¹ | Self-rated oral health % ² | | Edentulousness % ² | |
|--------------------------------|---------------------------------|--------------------------|---------------------------------------|------------------|-------------------------------|------------------|
| | | | Fair or Poor (N=717) | p-values | Total tooth loss (N=278) | p-values |
| Depressive symptoms | | | | | | |
| | No depressive symptoms | 3,254 (89.96) | 19.07 (17.42-20.8) | <0.001 | 6.76 (5.88-7.75) | <0.001 |
| | Depressive symptoms | 363 (10.04) | 31.02 (25.68-36.9) | | 12.4 (9.12-16.64) | |
| Age | | | | | | |
| | 50-64 | 1,322 (36.55) | 19.12 (16.57-21.95) | 0.197 | 2.18 (1.48-3.20) | <0.001 |
| | 65-74 | 1,448 (40.03) | 22.25 (19.94-24.73) | | 8.82 (7.30-10.63) | |
| | 75+ | 847 (23.42) | 20.73 (17.86-23.90) | | 18.85 (15.97-22.1) | |
| Gender | | | | | | |
| | Men | 1,648 (45.56) | 21.3 (18.9-23.92) | 0.265 | 6.15 (5.01-7.52) | 0.010 |
| | Women | 1,969 (54.44) | 19.5 (17.51-21.66) | | 8.55 (7.29-9.99) | |
| Educational attainment | | | | | | |
| | Less than o-level or equivalent | 1,318 (36.44) | 24.99 (22.23-27.96) | <0.001 | 12.38 (10.6-14.43) | <0.001 |
| | O-level or equivalent | 1,039 (28.73) | 18.98 (16.34-21.93) | | 4.82 (3.62-6.40) | |
| | Higher than A-level | 1,260 (34.84) | 15.82 (13.33-18.67) | | 3.38 (2.48-4.62) | |
| Total non-housing wealth | | | | | | |
| | Quintile 1 | 447 (12.36) | 30.55 (25.22-36.46) | <0.001 | 9.46 (7.05-12.58) | <0.001 |
| | Quintile 2 | 623 (17.22) | 21.65 (18.21-25.54) | | 14.36 (11.5-17.71) | |
| | Quintile 3 | 750 (20.74) | 20.64 (17.48-24.19) | | 6.98 (5.38-9.03) | |
| | Quintile 4 | 869 (24.03) | 16.48 (13.77-19.72) | | 4.49 (3.23-6.21) | |
| | Quintile 5 | 928 (25.66) | 15.26 (12.58-18.37) | | 3.20 (2.15-4.74) | |
| Limiting long-standing illness | | | | | | |
| | No | 2,528 (69.89) | 17.07 (15.31-18.99) | <0.001 | 5.23 (4.38-6.25) | <0.001 |
| | Yes | 1,089 (30.11) | 28.7 (25.53-32.10) | | 12.76 (10.7-15.1) | |
| Smoking status | | | | | | |
| | Never smoked | 1,385 (38.29) | 14.57 (12.48-16.94) | <0.001 | 3.65 (2.82-4.70) | <0.001 |

| | | | | | | |
|------------------|-----------------------|---------------|---------------------|--------------|-------------------|--------------|
| | Ex-smoker | 1,912 (52.86) | 21.74 (19.54-24.11) | | 9.09 (7.75-10.63) | |
| | Current smoker | 320 (8.85) | 34.75 (28.54-41.51) | | 12.75 (9.32-17.2) | |
| Social isolation | | | | | | |
| | Not socially isolated | 2,323 (64.22) | 18.94 (17.05-20.99) | 0.013 | 6.49 (5.49-7.67) | 0.007 |
| | Socially isolated | 1,294 (35.78) | 23.28 (20.48-26.33) | | 9.14 (7.5-11.02) | |

¹Unweighted

²Weighted

Bold values indicate $p < 0.05$

P-value calculated with chi-square or chi-square test-for-trend where appropriate

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Table 2: Results from the step-wise logistic regression analysis.

| | 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) |
|-------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Self-rated oral health | | | | | |
| No depressive symptoms | 1 | 1 | 1 | 1 | 1 |
| Depressive symptoms | 1.90 (1.43-2.53)** | 1.99 (1.49-2.65)** | 1.62 (1.20-2.19)* | 1.40 (1.03-1.91)* | 1.38 (1.01-1.89)* |
| Edentulousness | | | | | |
| No depressive symptoms | 1 | 1 | 1 | 1 | 1 |
| Depressive symptoms | 1.95 (1.34-2.83)** | 1.68 (1.16-2.45)* | 1.29 (0.88-1.88) | 1.09 (0.74-1.63) | 1.09 (0.73-1.62) |
| Oral impacts | | | | | |
| No depressive symptoms | 1 | 1 | 1 | 1 | 1 |
| Depressive symptoms | 2.29 (1.60-3.29)** | 2.21 (1.52-3.2)** | 1.78 (1.21-2.62)* | 1.45 (0.96-2.20) | 1.45 (0.95-2.19) |

*p<0.05

**p<0.001

Model 1= unadjusted model

Model 1 + Age + gender

Model 2 + sociodemographic variables

Model 3 + presence of long-standing illness

Model 4 + smoking

Model 5 + social isolation

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