**Associations between mental and oral health in Spain: a cross-sectional study of more than 23,000 people aged 15 years and over**

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Background: This study aimed to investigate associations between mental health and several parameters of oral health, controlling for a variety of important covariates, in a large representative sample of Spanish people. Methods: Data from the Spanish National Health Survey 2017 were analysed. Mental (i.e., depression, chronic anxiety, other psychiatric disorders) and oral health (i.e., dental caries, dental extraction, dental filling, gingival bleeding, tooth movement, dental material, missing tooth) were evaluated. Control variables included sex, age, marital status, education, smoking, alcohol consumption, and physical multimorbidity. Associations between psychiatric conditions (independent variables) and the number of poor oral health outcomes (dependent variable) were assessed using Poisson regression models. The associations were investigated in the overall population, in married participants and in those who were single/widowed/divorced/separated. Results: There were 23,089 participants [54.1% women; mean (standard deviation) age 53.4 (18.9) years]. The prevalence of at least one psychiatric condition was 15.4% in the overall sample, while the mean (standard deviation) number of poor oral health outcomes was 2.9 (1.4). There was a positive association between any psychiatric condition and the number of poor oral health outcomes [incidence rate ratio (IRR)=1.10; 95% confidence interval: 1.07-1.12], and there was a significant interaction between any psychiatric condition and marital status. The association was stronger in those participants who were single/widowed/divorced/separated. Limitations: Cross-sectional study. Oral and mental health were assessed with Yes/No questions. Exposure, outcome and covariates were self-reported.

**Introduction**

Psychiatric conditions are common and present a global public health concern. For example, in a recent review, it was found that common mental disorders had a pooled one-year period prevalence estimate of 17.6% [95% confidence interval (CI): 16.3–18.9%] across 59 countries, while the pooled lifetime prevalence of common mental disorders was 29.2% (95% CI: 25.9–32.6%) (Steel et al., 2014). Psychiatric conditions are related to psychological and physical stress and thus may increase the risk of developing and alter the course and outcome of chronic diseases (Firth et al., 2019; Rugulies, 2002; Suls and Bunde, 2005; Wittchen and Jacobi, 2005).While there is a plethora of literature on the relationship between psychiatric conditions and physical chronic diseases such as obesity (Martin-Rodriguez et al., 2015), heart disease (De Hert et al., 2018) and cancer (Goldacre et al., 2007; Penninx et al., 1998),little is known about the association between psychiatric conditions and poor oral health (e.g., dental caries, periodontal diseases, oro-dental trauma) (World Health Organization, 2018).

Poor oral health is highly frequent throughout the globe and Europe. Figures suggest that dental caries vary from 20% to 90% among young children in Europe, while almost one third of people aged 65-74 years have no natural teeth (World Health Organization, 2018).Thus, it is important to identify population groups who are at high risk of poor oral health to inform the implementation of interventions to prevent against such conditions. One population group who are likely to be at increased risk are those with poor mental health likely owing to this group exhibiting poorer lifestyle behaviours (Khalid et al., 2016; Rebar AL et al., 2015; Wootton et al., 2019) and experiencing higher levels of psychological stress. Some literature does show that those with poor mental health are at an increased risk of worse oral health (Ababneh et al., 2010; Arnaiz et al., 2011; Bell et al., 2012; Delgado‐Angulo et al., 2015; Jovanović et al., 2010; Okoro et al., 2012; Purandare et al., 2010; Saman et al., 2014; Wennström et al., 2013). However, this research has some important limitations. First, to the best of our knowledge, no study adjusted the analyses for multimorbidity, although it is known to be associated with both mental (Langan et al., 2013) and oral health (Islas-Granillo et al., 2019). Second, studies have included only one or two oral health outcomes, and this may not accurately depict overall oral health status. Third, no study has analysed the role of marital status in the relationship between mental and oral health, although marital status is associated with both conditions (Marcenes and Sheiham, 1996; Spiker, 2014). It is plausible that poor mental health may have a lower impact on oral health in married couples because there is someone to take care of the individual with poor mental health (such as providing appropriate nutrition and assisting in oral hygiene practices). Finally, only one study on the relationship between mental and oral health has been carried out in Southern Europe (Arnaiz et al., 2011),where lifestyles such as diet are different to the rest of the globe.

Therefore, the present study aimed to investigate associations between mental health and several parameters of oral health, controlling for a variety of important covariates, in a large representative sample of Spanish people aged 15 years and over. The hypothesis of the study was that those with poor mental health would have worse oral health.

**2. METHODS**

**2.1. The Survey**

Data from the Spanish National Health Survey 2017 were analysed. This survey was undertaken in Spain between October 2016 and October 2017. Details of the survey method have been previously published (Ministerio de Sanidad, Consumo y Bienestar Social and Instituto Nacional de Estadística, 2017a,b).In brief, for the data collection, a stratified three-stage sampling was used in which the census sections were first considered, then the family dwellings, and then an adult (15 years or more) was selected within each dwelling. The sections were selected within each stratum with probability proportional to their size. The dwellings, in each section, were selected with equal probability by systematic sampling, prior arrangement by size of the dwelling. This procedure leads to self-weighting samples in each stratum. For the selection of the person who had to complete the Adult Questionnaire, the random Kish method was used, which assigns equal probability to all people aged 15+ years in the household. The sample was representative of the population aged 15+ years residing in Spain and consisted of 23,089 people aged 15-103 years. The method of data collection used was computer-assisted personal interviewing (CAPI), conducted in the homes of the selected participants. Trained interviewers completed the questionnaires with the information provided by the participants. All participants signed an informed consent form before responding to the survey questions. This research was conducted in accordance with the Declaration of Helsinki of 1961 and subsequent amendments (revised in Tokyo in 1989 and in Edinburgh in 2000).

**2.2. Mental health (exposure)**

Mental health was evaluated through three yes–no questions: 1. “Have you ever been diagnosed with depression?”; 2. “Have you ever been diagnosed with chronic anxiety?”; 3. “Have you ever been diagnosed with other psychiatric disorders?”

**2.3. Oral Health (Outcome)**

Oral health was evaluated through seven yes–no questions: 1. “Do you have dental caries?” (dental caries); 2. “Have you had dental extraction?” (dental extraction); 3. “Do you have dental filling?” (dental filling); 4. “Do you have gingival bleeding when you brush your teeth or spontaneously?” (gingival bleeding); 5. “Do you have tooth movement?” (tooth movement); 6. “Do you wear covers (crowns), bridges, other types of prostheses or dentures?” (dental material); and 7. “Do you have missing teeth that have not been replaced by prostheses?” (missing tooth). This questionnaire is a valid measure of self-reported dental health (Barriuso Lapresa and Sanz-Barbero, 2012).Oral health was analysed using the number of poor oral health outcomes, and this number ranged from 0 to 7.

**2.4. Control variables**

The selection of the control variables was based on past literature (Islas-Granillo et al., 2019; Murakami et al., 2018; Tanner et al., 2015). Sociodemographic variables included sex, age, marital status (married vs single/widowed/divorced/separated) and education (≤primary, secondary, ≥tertiary). Smoking status was self-reported and categorized as never, current and former smoking. Alcohol consumption in the last 12 months was self-reported and categorized as yes (any) and no (none). Physical multimorbidity was defined as the presence of two or more chronic physical conditions. Chronic physical conditions included obesity, hypertension, myocardial infarction, angina pectoris and other coronary diseases, other cardiac diseases, varicose veins of lower extremities, osteoarthritis, chronic neck pain, chronic low back pain, chronic allergy (excluding allergic asthma), asthma (including allergic asthma), chronic bronchitis, emphysema or chronic obstructive pulmonary disease (COPD), diabetes, peptic ulcer disease, urinary incontinence, hypercholesterolemia, chronic skin disease, chronic constipation, liver cirrhosis and other hepatic disorders, stroke, migraine and other frequent headaches, hemorrhoids, cancer, osteoporosis, thyroid disease, renal disease, and injury. All conditions except obesity were assessed with the question “Have you ever been diagnosed with (the condition)?”, and response options were “yes” and “no”. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared based on self-reported weight and height. Using the standard World Health Organization definition, obesity was defined as BMI≥30 kg/m2, and BMI<30 kg/m2 was considered no obesity (World Health Organization, 2018).

**2.5. Statistical analysis**

The statistical analysis was performed with R 3.5.2 (The R Foundation) (R Core Team, 2018). Differences in the sample characteristics and in poor oral health outcomes by mental health status were assessed by chi-squared tests for all variables except age (t-test), and p-values were corrected using the Benjamini and Hochberg adjustment method. Associations between psychiatric conditions (independent variables) and the number of poor oral health outcomes (dependent variable) were assessed using Poisson regression models. The associations were investigated in the overall population, in married participants and in those who were single/widowed/divorced/separated. Models were adjusted for sex, age, marital status (except for those categorized by marital status), education, smoking, alcohol consumption, and physical multimorbidity. The control variables were included in the models as categorical variables with the exception of age which was included as a continuous variable. There were missing data for the following variables: marital status (n=39, 0.17%), smoking (n=22, 0.10%), alcohol consumption (n=26, 0.11%), obesity (n=1070, 4.63%), dental caries (n=387, 1.68%), dental extraction (n=13, 0.06%), dental filling (n=30, 0.13%), gingival bleeding (n=26, 0.11%), tooth movement (n=26, 0.11%), dental material (n=18, 0.08%), and missing tooth (n=13, 0.06%). Complete-case analysis was carried out (only participants for which we had no missing data were included in the analyses, while participants with any missing data were excluded). Results from Poisson regression analyses are presented as incidence rate ratios (IRRs) and 95% CIs. CIs and p-values were corrected using the Benjamini-Yekutieli and the Benjamini-Hochberg adjustment method, respectively. The level of statistical significance was set at p < 0.05.

**Results**

There were 23,089 people aged 15 years and over included in the present study [54.1% women; mean (standard deviation) age 53.4 (18.9) years; **Table 1**]. The prevalence of at least one psychiatric condition was 15.4% in the overall sample, while the mean (standard deviation) number of poor oral health outcomes was 2.9 (1.4). Female gender, single/widowed/divorced/separated, ≤primary education, never smoking, no alcohol, and physical multimorbidity were more frequent in individuals with than in those without any psychiatric condition. Dental caries (25.9% versus 19.6%), dental extraction (87.8% versus 75.9%), gingival bleeding (18.5% versus 13.9%), tooth movement (8.5% versus 4.8%), dental material (57.0% versus 42.9%), and missing tooth (66.6% versus 58.2%) were significantly more common in the group with at least one than in the group with no psychiatric condition, whereas dental filling was less frequent (63.9% versus 67.0%; **Figure 1**). The results of the Poisson regression models are displayed in **Table 2**. There was a positive association between any psychiatric condition and the number of poor oral health outcomes (IRR=1.10; 95% CI: 1.07-1.12), and there was a significant interaction between any psychiatric condition and marital status (p-value=0.10). The association was stronger in participants who were single/widowed/divorced/separated (IRR=1.11; 95% CI: 1.08-1.15) than in those who were married (IRR=1.08; 95% CI: 1.04-1.11). Findings were corroborated for depression and chronic anxiety, but not for other psychiatric disorders.

**Discussion**

In this large representative sample of Spanish people aged 15-103 years, it was found that after controlling for important covariates, including multimorbidity, those with any psychiatric condition had a higher number of poor oral health outcomes than those without any psychiatric condition. Moreover, the association was stronger in participants who were single/widowed/divorced/separated compared to those who were married.

The present findings support those of previous work that found poor mental health to be associated with worse oral health (Ababneh et al., 2010; Arnaiz et al., 2011; Bell et al., 2012; Delgado‐Angulo et al., 2015; Jovanović et al., 2010; Okoro et al., 2012; Purandare et al., 2010; Saman et al., 2014; Wennström et al., 2013), and adds to this work through showing that such associations still hold after controlling for multimorbidity and that the association exists with several oral health outcomes in a large representative sample of Spanish people aged 15 years and over. There are several plausible pathways to explain the observed association between poor mental health and worse oral health. First, antipsychotic drugs, some antidepressants and lithium can cause xerostomia, which is associated with several dental disorders, including caries, gingivitis, glossitis, stomatitis, parotiditis, fissured tongue and tongue atrophy, and oral ulcers (Friedlander and Norman, 2002).Second, owing to the clinical characteristics of psychiatric disorders, a high prevalence of this population lack the skills, physical dexterity and/or motivation to adopt and maintain good oral hygiene habits (Arnaiz et al., 2011).Moreover, data suggests that the majority of this population visit the dentist only when they have serious oral problems (Arnaiz et al., 2011).Third, those with mental health complications experience high levels of psychological stress which is associated with poor oral health (Green et al., 1986).Chronic stress has a negative effect on the immune response and consequently resulting in periodontal breakdown (Green et al., 1986).Likewise chronic periodontal disease may lead to the translocation of bacterial products such as lipopolysaccharide (LPS), which may contribute to peripheral immune activation (Gomes et al., 2018). A substantial body of evidence implicates peripheral inflammation in the pathophysiology of common mental disorders, such as depression and anxiety (Köhler et al., 2017; Michopoulos et al., 2017). Therefore, at least some of the associations herein reported could be bidirectional in nature.

It should be noted that there was a significant interaction between any psychiatric condition and marital status in the relationship with the number of poor oral health outcomes. To the best of our knowledge, this is the first time that this interaction has been observed in the studied population. There is limited literature to explain why being married was associated with a significant decrease in the strength of the association between any psychiatric condition and the number of poor oral health outcomes, although marital status is associated with both mental and oral health. One previous study found that married persons were more likely to believe in the benefit of preventive practices in relation to oral health, which may partly explain the observed associations (Nakazono et al., 1997). Future research of a qualitative nature is required to better understand and explain the observed relationship.

The large representative Spanish sample, the adjustment for multimorbidity, the inclusion of several oral health outcomes, and the consideration of marital status are clear strengths of the present study. However, findings must be considered in light of the studies limitations. First, the study was cross-sectional and it is not known whether poor mental health leads to poor oral health or vice versus. It is likely to be bidirectional. Future research using a longitudinal experimental design is required. Second, both oral and mental health were assessed with single Yes/No questions, and the reliability of those assessments is unclear. Exposure, outcome and covariates were self-reported potentially introducing bias into the present findings. Future work is thus also required examining the present association using objective measures. Third, this study did not include homeless people, although the prevalence of poor mental and oral health is high in this population (de Lurdes Pereira et al., 2014; Fazel et al., 2008). Finally, data on income and poverty was not available and thus was not controlled for in the statistical models. Those suffering from poverty are more likely to suffer from mental disorders, while there is very limited health insurance for dental care in Spain.

In conclusion, our hypothesis was confirmed and the present study showed that those with poor mental health have worse oral health but being married has some protective benefits. Taking together, these findings show that patients with psychiatric disorders should be followed in dental practices on a regular basis in order to prevent and to treat oral disorders. Furthermore, primary care physicians and other health professionals (e.g., physiotherapists, social workers, psychologists) also play a major role in the oral health education of individuals with psychiatric conditions. Finally, future longitudinal studies and randomized controlled trials need to be carried out to analyse the direction of the associations, to identify mediating factors involved in these relationships, and to investigate whether the present associations are observed in other populations.

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