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Predicting tooth loss in older age: Interplay between personality and socioeconomic status

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Abstract

Objectives: A low number of natural teeth, indicating poor oral health, is associated with various adverse outcomes to the extent that it has been proposed as a screening marker of life quality in older age. To further understand the mechanisms underlying oral health, this study investigates the associations between the number of natural teeth and personality traits in older age. **Methods:** In 793 members of Lothian Birth Cohort 1936, the number of remaining natural teeth was determined at clinical assessment at age around 73 years. Personality traits were measured using the 50-item International Personality Item Pool. Associations between personality traits and the number of teeth were estimated with zero-inflated negative binomial models, controlling for sex, age, educational level, occupational social class and childhood cognitive ability. **Results:** Low Conscientiousness was associated with both absence and low count of natural teeth at age 73. The latter association was moderated by socioeconomic circumstances, appearing among people with lower educational levels and occupational social class but not among people in better socioeconomic circumstances. The associations were to a small extent mediated by smoking. **Conclusions:** People in socially less advantageous circumstances may need to make a stronger personal effort to maintain oral health compared to those in more affluent conditions and therefore lower Conscientiousness might be a relative disadvantage for them. These findings can be used for identifying people at risk of poor oral health and for designing personality-targeted interventions. They can also help to explain the links between Conscientiousness and various other health outcomes.

Introduction

Poor oral health, often operationalized as the number of natural teeth still in place, is associated with numerous adverse outcomes including cardiovascular disease (Mucci et al., 2009), mortality (Tu et al., 2007), low quality of life (Brennan, Spencer, & Roberts-Thomson, 2008) and self-esteem (Starr, Hall, Macintyre, Deary, & Whalley, 2008). These associations are independent of age effects. As a result, absence of natural teeth has been proposed as a screening marker for old age life quality (Starr & Hall, 2010). It is therefore important to know the predictors of tooth loss, especially in old age when both tooth loss and its health correlates are more prevalent and life-course risks of poor health are likely to have accumulated. Among the already well-established predictors of tooth loss are rural residency, lower levels of education, social class and life-long cognitive ability, and smoking (for a review see Starr & Hall, 2010).

Additionally, oral health may be related to people's personality traits, which summarize temporally stable behavioral, emotional and thinking patterns. That several personality traits, especially Emotional Stability (often inversely called Neuroticism) and Conscientiousness, are consequential for health is increasingly well documented (e.g., Kern & Friedman, 2008; Lahey, 2009). Emotional Stability and Conscientiousness may also have roles in oral health. First, people low in Emotional Stability are more prone to dental anxiety (Vassend, Røysamb, & Nielsen, 2011), which is predictive of tooth loss (Armfield, Slade, & Spencer, 2009). Second, low Conscientiousness—low orderliness, self-discipline, diligence—may be predictive of lower number of teeth because less Conscientious people may be less persistent in oral health care. Low Conscientiousness is also associated with smoking (Terracciano & Costa, 2004), another predictor of poor oral health. It may also be that the effect of low Conscientiousness is stronger for people in poor socioeconomic circumstances because they may need to make a greater personal effort for retaining oral health. For people in more affluent conditions, social and material resources that facilitate health care may be more easily available, regardless of their personality. The present study will test these hypotheses.

Method

Participants

The Lothian Birth Cohort 1936 (LBC1936) is a study of healthy ageing. Between 2004 and 2007, 1,091 surviving participants (548 males) of the Scottish Mental Survey 1947 (Deary, Whiteman, Starr, Whalley, & Fox, 2004) were recruited to the study. At this first wave of testing in old age, they varied in age from 67.7 to 71.3 years [mean (M) = 69.6, standard deviation (SD) = 0.8]. All were living independently in the community. Full details on the background and recruitment of LBC1936 are available elsewhere (Deary et al., 2007). The second wave of testing was carried out about three years later. The number of remaining natural teeth (available for 793 people; 379 women; mean age 72.5 years, SD = 0.7, range 71.0 to 74.1) was measured at the second testing wave. Personality traits were measured at both testing waves.

Measures

Teeth. People's number of remaining natural teeth (including third molars) was determined at clinical assessment with the help of a trained nurse. Seventy two (9.1%) of the participants were edentulous whereas the number of teeth had a fairly normal-like distribution among dentulous participants (M = 18.34, SD = 7.48, skew = -0.48, kurtosis = -0.64). These numbers indicate that the dental health of the participants tended to be better than that of Scottish population in general, in which about 29% of people aged between 64 and 75 are edentulous (Bromley & Given, 2011).

Personality. Personality traits were measured with the 50-item International Personality Item Pool (IPIP; Goldberg, 1999). The 50-item IPIP has 10 items for each of the five-factor model (FFM) personality traits: Emotional Stability, Extraversion, Intellect, Agreeableness, and Conscientiousness. Participants rated how well they believed each of the 50 items described them on a 5-point Likert-type scale [from 'very inaccurate' (0) to 'very accurate' (4)]. Personality traits were very stable in this cohort over the three yeas (Mõttus, Johnson, & Deary, 2011): therefore, to obtain more reliable personality scores and to reduce the number of tests, personality trait scores

were averaged over the two testing occasions. To facilitate the interpretation of regression results, the resulting personality scores were transformed to standard scores ($M = 0$, $SD = 1$).

Co-variates. Because tooth loss is associated with lower life-time cognitive ability, educational level, and social class (reviewed above), the associations between personality traits and number of teeth were adjusted for these variables. Cognitive ability was measured at age 11 with the Moray House Test no. 12, which provided a validated baseline measure of individual differences in life-time cognitive ability (for details see Deary et al., 2004). Raw age 11 scores were adjusted for age at time of testing and transformed to standard scores ($M = 0$, $SD = 1$). Highest level of educational attainment was coded in five ordinal categories: (0) 'no qualification', (1) 'O-level' (now Standard Grade; a qualification obtained after the fourth year in secondary school, typically at ages 14 to 15, (2) 'A-level' (entry requirement for undergraduate study), (3) 'Semiprofessional' (a qualification for occupations that require training and standards), and (4) 'degree'. Occupational social class prior to retirement was coded in six ordinal categories: (1) 'unskilled', (2) 'semiskilled', (3) 'skilled manual', (3.5) 'skilled non-manual', (4) 'intermediate', and (5) 'professional' (Office of Population Censuses and Surveys, 1980). Women who reported a higher occupational social class for their spouse were classified according to their spouse. Educational level and social class were treated as continuous variables as they had clearly-ordered levels. Additionally, to investigate the possible mediating role of smoking status participants were asked whether they were current smokers (coded as 2; 8% of particiapants), ex-smokers (1; 44%) or had never smoked (0; 48%).

Analytical procedures

The complete lack of teeth possibly meant that people's remaining teeth had been removed at some point (sometimes earlier in life) and they used dental prosthesis instead. Therefore, because edentulousness may have reflected a qualitatively different dental status than any number of existing teeth, zero-inflated negative binomial models were used to test the associations between the number of teeth and personality traits. These models combine simultaneously two regressions: one models the absence of the outcome (being edentulous *vs* dentulous) and the other models the

variability in the outcome when it is present (tooth count).

Results

In bivariate analyses, both the complete absence and lower counts of exiting natural teeth were associated with lower Intellect, Conscientiousness, childhood cognitive ability, educational level and occupational social class, and with being a current or past smoker (Table 1).

When the personality-number of teeth associations were adjusted for the contributions from sex, age at testing, childhood cognitive ability, educational level and occupational social class, low Conscientiousness remained a significant predictor of both the absence and low counts of existing natural teeth (with <10% reduction in effect sizes compared to bivariate associations). The effect of Intellect was largely attenuated and no longer significant after co-variate adjustment (educational level alone attenuated the effect by 50%). To illustrate the effect sizes, in the adjusted model a standard deviation higher score in Conscientiousness was associated with 34% decreased odds of having no teeth as opposed to the odds of having any number of natural teeth [odds ratio (*OR*) = 0.66, 95% confidence intervals (*CI*s) 0.51, 0.84], and 5% increased odds of having an additional tooth (*OR* = 1.05, *CI*s 1.02, 1.09). Including smoking status as an additional categorical co-variate reduced the effect sizes by 9.3% and 11.3% for the Conscientiousness-absence of teeth and Conscientiousness-the number of remaining teeth associations, respectively (Table 1).

Next, interaction terms between personality traits and occupational social class or educational level (one combination at a time) were added to the adjusted models. Consistently with the hypothesis, Conscientiousness had significant interaction terms with both occupational social class (*p* < 0.001) and educational level (*p* < 0.01) in the parts of models that predicted the count of existing teeth but not in the parts that predicted absence of any teeth. For instance, when the participants were divided into two groups based on their occupational social class ['unskilled' to 'skilled non-manual' (*N* = 326) *vs* 'professional' or 'intermediate' (*N* = 455)], Conscientious was significantly associated with the absence of teeth (*OR* = 0.64, *CI*s 0.45, 0.89) and the count of existing teeth (*OR* = 1.12, *CI*s

1.05, 1.20) in the group with lower occupational social class but not among the participants with higher occupational social class (respectively: *OR* = 0.69, *CI*s 0.47, 1.02; *OR* = 1.01, *CI*s 0.97, 1.05). Note that the effect sizes for the associations between the absence of teeth and Conscientiousness were similar for both groups of occupational social class but due to the small number of people in the higher social class group without any teeth (*N* = 30) the association was non-significant in this group; in contrast, the effect sizes were notably different for the counts of existing teeth. A similar, albeit slightly less pronounced interaction was observed when the sample was split on the basis of educational levels. Among the participants in the low occupational social class group, the odds ratios also adjusted for smoking status were *OR* = 0.69 (*CI*s 0.52, 0.92) for the absence of any teeth and *OR* = 1.08 (*CI*s 1.02, 1.13) for the count of existing teeth. No significant interactions with educational level or social class appeared for other personality traits.

Discussion

The present study showed that older people's personality differences were associated with the number of natural teeth they still had. In line with the hypotheses, low Conscientiousness predicted both absence of natural teeth as opposed to having any of them at all, and a relatively lower count of teeth among dentulous participants. There was no evidence for low Emotional Stability—which was hypothesized to have predisposed people to dental anxiety (Vassend et al., 2011) and therefore avoiding dental treatment—being a risk factor for poor oral health.

These findings suggest that behaviors associated with higher Conscientiousness may favor better oral health (a relatively higher number of teeth, but possibly also its correlates like absence of periodontitis and caries). Smoking was considered as one potential pathway from low Conscientiousness to low number of teeth, but its effect appeared to be small. An alternative pathway may have been related to eating sweet foods, which is related to poor dental health (Worthington, Clarkson, & Davies, 1999). However, it has been previously shown in the same sample that Conscientiousness is not associated with eating more sweet foods (Mõttus, McNeill, Jia et al., 2011), so this explanation cannot be valid for these people. Alternative plausible explanations

include low Conscientiousness—low orderliness, self-discipline, and diligence—being related to poor oral health care (e.g., insufficient brushing and flossing) and failure to seek regular dental checks and timely treatment. It is noted that since 1948 all Scots have had access to public dental healthcare, which currently includes free examinations and largely covers dental treatment (more information can be found at http://www.scotland.gov.uk). It is not therefore likely that income differences (beyond what could controlled for by considering educational level and occupational social class) confounded the Conscientiousness-number of teeth associations.

The finding that the association of low Conscientiousness and lower count of existing teeth were apparent only among people with lower education and occupational social class was both consistent with the prediction and theoretically meaningful. This finding may suggest that people in socially less advantageous circumstances have to make stronger personal efforts to maintain oral health: that is why lower Conscientiousness gives them a relative disadvantage. In contrast, people who are better off (and perhaps generally healthier) are in a better position to maintain good oral health as they are exposed to less adversity to start with and therefore higher Conscientiousness is of less further benefit. For example, people in better socioeconomic circumstances may be embedded in social contexts where taking care of teeth and regularly visiting dentists is normative and, as a result, they may adhere to this lifestyle regardless of their own personality dispositions. In contrast, people in less affluent circumstances may lack such organized social context that would simply 'carry them along' in terms of dental health care. It will be interesting to see if the protective effect of Conscientiousness being conditional on socioeconomic circumstances will generalize to other aspects of health and ageing beyond tooth loss.

In practical terms, these findings may help to identify people at higher risk of developing poor oral health in older age, along with the psychological, social and health consequences this entails. The results may also inform interventions that aim at improving oral health: it is likely that interventions tailored to the dispositional characteristics of people at greater risk may be more effective than those that ignore these characteristics. This study suggests that barriers related to low

Conscientiousness (combined with social disadvantage) are more suitable targets for improving oral health than those related to other personality dispositions including Emotional Stability.

As a theoretical implication, poor oral health, which appears to be predictive of various common health outcomes (including, among others, cardiovascular problems and mortality, as was reviewed above) may partially mediate the well-established but poorly understood links from Conscientiousness to various health outcomes including mortality (Kern & Friedman, 2008).

The strengths of the study include people with older age (risks related to personality dispositions could have accumulated over life-span, raising the likelihood of being detectable) and multiple measurements of personality traits (which implied improved reliability of personality ratings). Another important strength was related to the narrow age range and residential area of the participants. In particular, dental practices may vary greatly over time and regions (Starr & Hall, 2010): having participants of the same age from the same area made it likely that everyone had received roughly similar dental treatment and advice over life-span. Among the limitations are the lack of information on other aspects of oral health (e.g., caries or periodontitis, which may have been some underlying causes of tooth loss), income levels and general physical health across life-course (which may have acted as mediators/confounders in the Conscientiousness-tooth loss links).

To conclude, people's levels of Conscientiousness may be among the contributors to their oral health in old age, which in turn has implications for their health more generally and social and psychological well-being. As a general remark, it is possible that old age is especially well suited for investigating the personality correlates of health, as the possible health-related effects of behavioral choices accumulate over lifespan and there is more variance in health outcomes.

Acknowledgement

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Table 1. Predictors of the absence and the number of existing natural teeth.

	Absence of all teeth [1]		Higher count of teeth if any existed [2]	
	Estimate	St. Error	Estimate	St. Error
Bivariate analyses				
Age	0.126	0.176	-0.028	0.024
Sex (female)	0.098	0.248	0.033	0.035
Age 11 cognitive ability	-0.398	0.115***	0.054	0.018***
Educational level	-0.606	0.126***	0.067	0.013***
Social class	-0.587	0.142***	0.075	0.019***
Smoking				
Non-smoker	0.000	0.000	0.000	0.000
Ex-smoker	0.675	0.299*	-0.163	0.035***
Current smoker	2.227	0.361***	-0.380	0.077***
Emotional Stability	-0.229	0.123	0.008	0.017
Extraversion	-0.052	0.125	0.000	0.017
Intellect	-0.324	0.125***	0.058	0.017***
Agreeableness	-0.111	0.122	0.015	0.018
Conscientiousness	-0.455	0.120***	0.057	0.018**
Controlling for possible confounders [a]				
Intellect	0.127	0.143	0.022	0.019
Conscientiousness	-0.420	0.128**	0.053	0.018**
Additionally controlling for smoking status [b]				
Conscientiousness	-0.381	0.132**	0.047	0.018**

NOTE: N = 734 to 793. Estimates are on the log scale and represent the unit change in the outcome as a function of the unit change in predictor (e.g., standard deviation in case of personality and cognitive ability).

[1] Zero-inflation model (binomial distribution with logit link).

[2] Count model (negative binomial distribution with log link).

Different signs in zero-inflation and count models are expected as the former predicts lower (zero count) and the latter higher values.

[a] Controlling for age, sex, childhood cognitive ability, educational level, and occupational social class.

[b] Controlling for age, sex, childhood cognitive ability, educational level, occupational social class, and smoking status.