Gender Modifies Effect of Perceived Stress on Orofacial Pain Symptoms: National Survey of Adult Oral Health

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Aims: *To determine in a representative sample of the Australian adult population the relationship between age, gender, and two components of perceived stress (distress and control) and to investigate whether the relationship of perceived stress and temporomandibular disorder (TMD)-related orofacial pain symptoms was modified by gender or age.* ***Methods:*** *Data were from the National Survey of Adult Oral Health conducted in Australia in 2004–2006 and were collected from 3,954 adults aged 18 to 91 years. TMD-related orofacial pain symptoms were evaluated using seven validated screening questions. Perceived stress was measured with the 14-item Perceived Stress Scale and was investigated to empirically test its two theoretical components (distress and sense of control), using principal components analysis.* ***Results:*** *Prevalence of TMD-related orofacial pain symptoms was 10.1% in the Australian adult population. Prevalence was higher in females than in males, inversely related to age, and positively related to distress and current cigarette smoking. Principal component analysis confirmed the theoretical presence of two factors labeled here as distress and control. An inverse relationship of age and distress was more pronounced in females than in males (*P *value for interaction = .005). In the adjusted binary logistic regression model, age, smoking, and distress remained positively associated with symptoms. A sense of control was protective against TMD-related orofacial pain symptoms, but only for males (P value for interaction = .040).* ***Conclusion:*** *The higher prevalence of TMD-related orofacial pain symptoms in females was better explained by their lower perception of control than from a greater perception of distress.* J OROFAC PAIN 2011;25:317–326

Key words: effect modification, emotional stress, facial pain, population-based study, sex

Psychological stress is implicated in the onset and progression of several chronic conditions in which pain is the major symptom. In temporomandibular disorders (TMD), pain is in the orofacial region. These disorders involve the masticatory muscles, tendons, or temporomandibular joints. Musculoskeletal symptoms include muscle or joint pain in the perioral or preauricular regions and jaw dysfunction such as limited or difficult jaw opening or closing or difficult biting or chewing. Elevated levels of psychological distress, depression, or anxiety are risk factors for TMD.[1–4] The prevalence, pain sensitivity, and negative responses to pain are higher in females than in males and are highest throughout the reproductive years,[5–7] and this has prompted some investigators to examine hormonal mechanisms to better understand gender and age differences in pain perception and pain processing.[8–10]

An alternative explanation may relate to gender- and age-differences in distribution of perceived stress. Support comes from normative data for the United States population[11] where perceived stress scores were inversely related to age. What is not known is whether perceived stress and age might account for observed gender-variation in prevalence of orofacial pain symptoms. It is plausible, for example, that a reduction in perceived stress with aging may be accompanied by a reduction in orofacial pain symptoms in progressively older adults.

Theorists differ in their understanding of psychological stress and, hence, its role in health. Some view it as a physiological response in an individual, while others see it as a stimulus in the external environment. In his landmark theoretical work, Lazarus portrayed psychological stress as a consequence of two cognitive processes.[12] The first is the individual's subjective appraisal of an event as potentially threatening or not. This primary appraisal recognizes that all individuals do not uniformly respond in the same way to the same objective event. When events are interpreted as threatening, the individual makes a secondary appraisal. This involves an evaluation of one's own personal resources as adequate or inadequate to master, tolerate, or reduce the threatening event. Only when a person judges the threat to overwhelm their ability to control it, does stress manifest; thus stress is a consequence of the interplay of both factors. Stress cannot arise in the presence of a threat unless it is appraised as uncontrollable.[13] For this reason, the study of stress is informed by measurement of both the primary appraisal of an event and the secondary appraisal of the controllability of a threat. The centrality of the cognitive appraisal process in these processes suggests that perceived stress is critically important in understanding the role of stress in influencing health outcomes. According to its authors, the Perceived Stress Scale (PSS) was intentionally developed to measure these two components as theorized by Lazarus.[14] However, the authors recommended that the scale be scored as a single construct, effectively losing the ability to separately examine each component. This study followed others in exploring the factors underlying this scale and examining them empirically. The aims of this study were to determine in a representative sample of the Australian adult population the relationship between age, gender, and two components of perceived stress (distress and control) and to investigate whether the relationship of perceived stress and TMD-related orofacial pain symptoms was modified by gender or age.

Materials and Methods

The Human Ethics Research Committee of The University of Adelaide approved this study, and signed informed consent was obtained from all participants.

Study and Sampling Designs and Study Population

Data were from the population-based cross-sectional National Survey of Adult Oral Health, 2004–2006.[15] The survey was designed to describe the distribution and determinants of oral health in the Australian population. A three-stage, stratified clustered sampling design was used to select the target population.

The sampling frame was an electronic database of all listed telephone numbers in Australia. The first sampling stage selected residential postcodes, the second stage selected households within sampled postcodes, and the third selected at random one household occupant aged 15 years or more. Estimates were weighted to take account of differing probabilities of selection due to sampling design and to adjust to known gender and age distributions for the Australian population.

Data Collection

Data collection used three modalities. First, a telephone interview collected information about sociodemographic characteristics and smoking status. Cigarette smoking was investigated since evidence points to a relationship between smoking status and chronic pain conditions, including lower back pain,[16] and pain intensity and functional impact in TMD.[17,18]

Telephone interviewees were eligible for inclusion in the oral epidemiologic examination component of the survey if they reported having some or all of their own natural teeth. These examinations collected clinical information about dental conditions. The clinical examination did not assess TMD. Instead, a questionnaire mailed to the examined participants collected self-report information on TMD-related orofacial pain symptom experience and perceived stress. The multiple response categories of the PSS made its inclusion unfeasible in the telephone interview. Consequently, this scale and other wordy questions were included in the questionnaire mailed to the examined adults.

TMD-related Orofacial Pain Symptoms

The questionnaire contained seven screening questions to assess current TMD-related orofacial pain symptoms. Three questions asked about pain in the jaws, jaw joint, or preauricular region, and four questions addressed jaw function disturbance such as difficulty opening the mouth wide and freely (see Table 1). These questions came from a Canadian survey of the general public, where a positive response to two or more items had 73% sensitivity and 75% specificity in predicting clinical TMD.[19] The case definition for TMD-related orofacial pain symptoms used in this study required one or more affirmative responses to the three pain questions (Q1, Q2, and Q3 in Table 1) *and* at least one affirmative response to the four jaw function disturbance questions (Q4, Q5, Q5, and Q7 in Table 1). The presence of both pain and functional disturbance was specified so that this case-classification would be consistent with principles underlying the current benchmark criteria for diagnosis of TMD, which requires that cases have a positive history of pain and that pain is elicited during palpation and/or jaw maneuver.[20]

The telephone interview also contained a single-item question that asked "During the last month, have you had pain in the face, jaw, temple, in front of the ear, or in the ear?" Responses were used in this analysis to evaluate potential bias due to nonparticipation in the questionnaire.

Table 1 Screening Questions for TMD-like Orofacial Pain

Q1:	Do you have pain in the jaw joint(s) when opening your mouth wide?
Q2:	Do you have pain in the jaw joint(s) while chewing?
Q3:	Do you have pain in your face just in front of the ears?
Q4:	Does your jaw lock or get stuck so that you cannot open your mouth freely?
Q5:	Do you find it difficult to open your mouth as wide as you would like?
Q6:	Are the muscles around your jaws tender when you wake up in the morning?
Q7:	Do your jaw muscles ever feel tired or stiff?

Explanatory Variables

Perceived stress was evaluated using the 14-item PSS, purposefully developed to measure Lazarus's theoretical perspective.[14] Responses are made on a five-point scale of frequency ranging from "not at all" to "very often." For participants missing one or two PSS items, the item-specific mean value obtained by all respondents was imputed.

Statistical Analysis

Data were analyzed in STATA statistical software, version 11.1 IC (Stata). Survey estimation commands corrected the standard errors of estimates by the Taylor series linearization method to take account of the complex survey design. PSS items were tested in an unweighted principal components analysis with orthogonal (varimax) rotation. Three criteria were considered for the retention of components: the number of eigenvalues greater than one, the plot of Cattell's scree test, and a parallel analysis specifying 50 repetitions. All three criteria supported retention of two components that accounted for 53.8% of the variance. Inspection of the factor loading scores empirically confirmed the theoretical presence of two dimensions, the seven negatively worded items loaded onto the first component that represented perceived distress and the seven positively worded items loaded onto the second component that represented an ability to control stressors. Factor loadings were consistent with those of earlier studies.[11,21,22] For brevity, the two components were labelled "distress" and "control." Each component, ie, subscale, had good internal reliability, with a Cronbach coefficient alpha of 0.82 for distress and 0.73 for control. The subscale scores had a mean equal to zero and a standard deviation of one. From each subscale score were produced distributional-based tertiles and their values were labeled as low, moderate, or high.

To determine the nature of the relationship between age and perceived stress, continuous distress and control subscale scores were regressed on age. Nonlinear transformations of age (age-squared, log of age, and the inverse of age) were also investigated and age-squared was selected because it maximized *R*-squared of the distress model. Subsequent modeling tested for effects of gender, gender*age interaction and gender*age-squared interaction. The models' estimated means for distress and control were then computed at four selected values of age and the results were plotted to depict the gender-specific patterns of variation in the relationship between age and each measure of stress.

The study then investigated whether the association between perceived stress and odds of TMD-related orofacial pain symptoms varied across levels of gender and age in unadjusted analysis and after adjustment for cigarette smoking status (current, former, never), body mass index categories , educational attainment (secondary school, vocational training, university), household income (< AUD $60,000, ≥ AUD $60,000), and tooth retention categories.

These bivariate analyses were performed using Pearson's chi-square test or Fisher's Exact test and unconditional binary logistic regression. The latter produced estimates of the odds ratios (OR) with their corresponding 95% confidence intervals (CI). To screen for potential confounding, unadjusted OR were compared against stratum specific OR by using the change-in-estimate criterion[23] of a percent change in the unadjusted effect estimate of 10% or more.

To investigate whether the relationship of perceived stress and TMD-related orofacial pain symptoms was modified by gender or age, a logistic regression model was first fitted with gender as the sole independent variable to observe the log transformed OR, ie, the estimated regression coefficient. To this model was additionally fitted age centered at mean age and the square of centered age (Model 2) and the change in the coefficient for gender was observed. Model 3 additionally fitted continuous distress and control subscale scores that were transformed to unit-normal variates (ie, z-scores). In the final model (Model 4), the product term of gender*control was fitted to test for effect modification. Predicted probabilities for males and females, adjusted for covariates, were plotted to aid interpretation. Interactions between age and control and between age and distress in the relationship with TMD-related orofacial pain were also examined.

Results

The telephone interview identified 12,845 people eligible for the oral examination and subsequent questionnaire. Of these, 5,505 were examined and 4,144 completed a questionnaire, with 3,954 providing valid responses used in this analysis. Hence, the response rate among examined adults was 71.8%. Previous analyses of nonparticipation found only small differences in distribution of sociodemographic and oral health variables between people who were examined and those who were not. In addition, analyses showed only small biases due to nonresponse in estimates of oral disease prevalence.[15] Furthermore, only small differences were found in frequency of TMD-related orofacial pain symptoms between people who completed the questionnaire and people who completed only the telephone interview.

Prevalence of TMD-related orofacial pain symptoms was 10.1%. It was significantly higher in females (12.6%) than in males (7.5%) and decreased in monotonic fashion across the four age categories (Table 2). Country of birth, socioeconomic position, body mass index, and tooth retention were not significantly associated with symptoms (Table 2). Compared with adults who had never smoked, current smokers had significantly higher mean distress scores, although control scores did not differ across smoking categories (results not tabulated).

Linear regression modeling of the relationships between age and perceived distress in the two genders revealed a significant curvilnear effect of age ($P = .01$ for age-squared) and interactions between gender and age ($P < .01$ for age*gender and for age-squared*gender). Predicted means from the model showed that younger females perceived significantly higher levels of distress than males of the same age (P value for interaction = .005) (Fig 1a). At older ages, males and females did not differ significantly in their average levels of perceived distress. There were also statistically significant interactions between age*gender ($P = .03$) and age-squared*gender ($P = .04$) in the model for control (Fig 1b), although the age-gradient and degree of interaction were less pronounced than for distress.

In bivariate analysis, a statistically significant inverse relationship was observed between tertiles of perceived distress and prevalence of TMD-related orofacial pain in females (Table 3, $P < .001$), although not for males (Table 3, $P = .26$). The association for males ($P = .022$) and females ($P < .001$) was significant when distress was modeled as a continuous variable.

In contrast, higher tertiles of control had a marked protective effect on symptom prevalence for males but not for females (Table 3), and the same pattern was observed when control was modeled as a continuous variable.

In unadjusted logistic regression analysis, the log odds of TMD-related orofacial pain symptoms was 0.57 greater in females compared to males (Table 4, Model 1) and the 95% CI excluded the null value of zero, signifying a statistically significant effect of gender. This effect of gender was similar after adjusting for main effects of age and smoking (Model 2), and with additional adjustment for main effects of distress and control (Model 3, Table 4). However, there was significant effect modification of gender and control (parameter estimate for interaction = 0.24, 95% CI = 0.01, 0.47). The interaction represented a stronger association between control and log odds of TMD-related orofacial pain symptoms in females than in males.

When parameter estimates from Model 4 were used to compute predicted probabilities of TMD-related orofacial pain, the plotted data showed that, for people with scores above the mean of zero on the control subscale z-score, there was a significantly lower probability of symptoms in males than in females (Fig 2). The interaction of gender and distress was nonsignificant ($P = .29$) so it was excluded

Table 2 Selected Characteristics of the Study Population and Estimates of the Associations with TMD-like Orofacial Pain Symptoms (n = 3,954)

	Unweighted no. of subjects	Estimated population %	Orofacial pain symptom prevalence (SE)	*P*	OR	95% CI
All subjects	3,954	100.0	10.1 (0.8)			
Gender						
Male	1,518	50.3	7.5 (1.3)	.007	Ref	
Female	2,436	49.7	12.6 (1.0)		1.8	1.2, 2.7
Age group (midpoint)						
< 35 (30)	169	33.4	12.6 (2.0)	.005	2.9	1.7, 5.1
35 to 54 (45)	473	40.0	10.5 (1.0)		2.4	1.5, 3.7
55 to 64 (60)	816	13.7	8.0 (1.1)		1.8	1.1, 2.8
≥ 65 (75)	823	12.9	4.7 (0.9)		Ref	
Country of birth						
Australia	3,039	78.5	10.1 (0.9)	.925	Ref	
Other	912	21.5	9.9 (1.5)		1.0	0.7, 1.4
Missing	3					
Educational attainment						
Secondary school	1,303	32.3	10.8 (1.5)	.072	1.1	0.7, 1.8
Vocational training	1,311	32.4	12.1 (1.7)		0.7	0.5, 1.0
University qualification	1,338	35.3	7.7 (1.0)		Ref	
Missing	2					
Household income ($AU)						
< $60,000	2,364	53.0	10.8 (0.9)	.115	1.3	0.9, 2.0
≥ $60,000	1,391	47.0	8.2 (1.3)		Ref	
Missing	199					
Smoking status						
Current	553	15.6	15.5 (2.7)	.015	1.7	1.1, 2.8
Former	1,276	28.8	8.1 (1.3)		0.8	0.5, 1.3
Never	2,125	55.6	9.6 (1.1)		Ref	
Body Mass Index						
Underweight, normal	1,662	47.4	9.2 (1.2)	.439	Ref	
Overweight, obese	2,088	52.6	10.5 (1.2)		1.2	0.8, 1.7
Missing	204					
Number remaining teeth						
< 20	577	9.3	8.9 (1.5)	.746	0.9	0.6, 1.4
20 to 24	779	14.9	10.4 (1.5)		1.1	0.7, 1.6
25 to 27	952	22.2	11.2 (1.9)		1.2	0.7, 1.9
≥ 28	1,646	53.7	9.7 (1.2)		Ref	
Distress (a)						
Low	1,394	33.4	6.6 (1.3)	.001	Ref	
Moderate	1,259	33.3	9.1 (1.5)		1.4	0.8, 2.5
High	1,301	33.3	14.5 (1.4)		2.4	1.5, 3.8
Control (b)						
Low	1,260	33.3	11.8 (1.6)	.0493	1.7	1.1, 2.5
Moderate	1,313	33.4	11.0 (1.5)		1.5	1.0, 2.3
High	1,381	33.3	7.4 (0.9)		Ref	

Ref = the reference category.

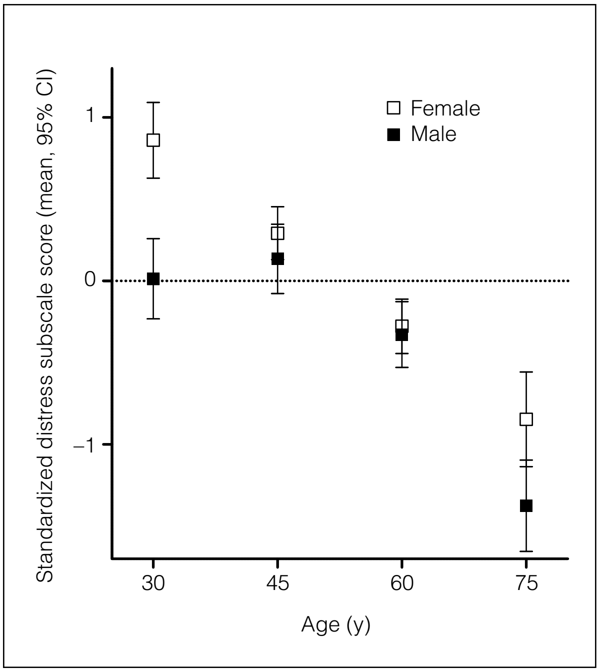

Fig 1a Graph showing predicted unadjusted relationship of age and standardized score on the Distress subscale of the 14-item PSS, stratified by gender among the participants in the National Survey of Adult Oral Health, Australia, 2004–2006. Predicted values of distress were obtained from a linear regression model using age in years, gender, and the interaction. Plotted values are at four values of age shown on the horizontal axis. (*P* value for interaction = .005).

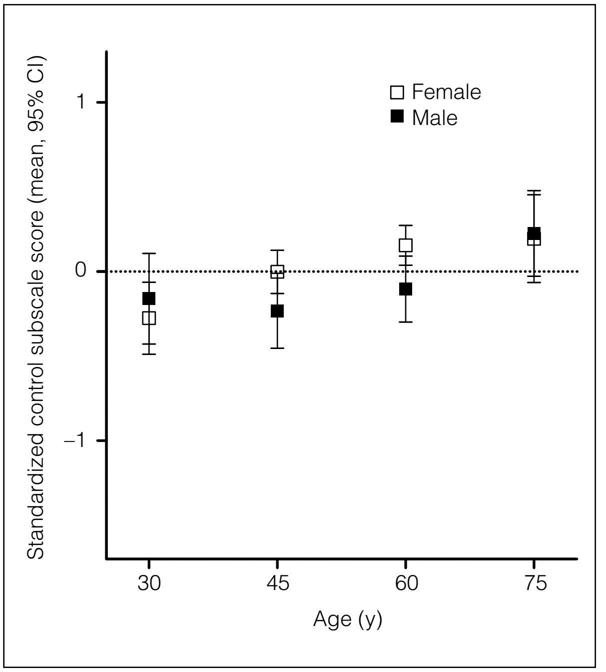

Fig 1b Graph showing predicted unadjusted relationship of age group and standardized score on the Control subscale of the 14-item PSS, stratified by gender among the participants. Predicted values of control were obtained from a linear regression model using age in years, gender, and the interaction. Plotted values are at four values of age shown on the horizontal axis. (*P* value for interaction = .204)

Table 3 Prevalence of TMD-like Orofacial Pain Across Levels of Distress and Control for Males and Females (n = 3,954)

	Males			Females		
	%	95% CI	*P*	%	95% CI	*P*
Distress						
Low	5.3	2.6, 10.4	.260	8.2	5.7, 11.6	< .001
Moderate	7.6	3.8, 14.4		10.9	8.4, 14.1	
High	10.6	7.0, 15.8		17.4	13.8, 21.7	
Continuous distress score (OR)	1.2	1.1, 1.4	.022	1.3	1.1, 1.4	< .001
Control						
Low	10.5	6.2, 17.2	.038	13.1	10.0, 17.0	.781
Moderate	8.9	4.8, 15.9		13.1	10.1, 16.8	
High	3.3	1.9, 5.4		11.7	9.1, 15.0	
Continuous control score (OR)	0.8	0.7, 1.0	.020	1.0	0.9, 1.1	.401

from Model 4. Smoking status was included in the final models to control for its potential confounding of the relationship between perceived stress and TMD-related orofacial pain symptoms. There was no significant interaction effect of gender*distress ($P = .30$), age*control ($P = .08$), or age*distress ($P = .81$). The term for the square of centered age was not significant ($P = .74$) and therefore was omitted. Likewise, squared effects of distress ($P = .08$) and of control ($P = .44$) were not significant and were omitted.

Table 4 Effect of Gender on TMD-like Orofacial Pain Symptoms After Adjustment for Covariates and Psychological Stress Dimension (n = 3,954)

	Model 1*		Model 2†		Model 3‡		Model 4‖	
	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI
Male gender	Ref		Ref		Ref		Ref	
Female gender	0.57	0.15, 0.99	0.63	0.22, 1.06	0.54	0.12, 0.95	0.64	0.22, 1.07
Age centered			–0.16	–0.27, –0.05	–0.11	–0.23, –0.02	–0.12	–0.24, 0.01
Current smoker			0.61	0.13, 1.09	0.54	0.05, 1.02	0.55	0.07, 1.02
Former smoker			–0.09	–0.51, 0.33	–0.10	–0.52, 0.33	–0.08	–0.51, 0.35
Never smoked			Ref		Ref		Ref	
Distress					0.17	0.07, 0.27	0.18	0.08, 0.27
Control					–0.05	–0.19, 0.08	–0.18	–0.38, 0.03
Gender* control							0.24	0.01, 0.47

*Model 1 reports maximum likelihood estimate with gender as the only explanatory variable. Coefficients are parameter estimates from logistic regression models. 95% CI = 95% CI for the parameter estimate.
†Model 2 additionally fits age centered at mean age, and smoking status.
‡Model 3 additionally fits standardized scores for the Distress and Control subscales of the Perceived Stress Scale.
‖Model 4 additionally fits the product term of gender*control to test the effect modification of control on the relationship of gender and orofacial pain symptoms. Note that in the presence of the interaction term, the coefficient for gender applies to females of mean age in the reference category of never smoker with the mean score for distress.
Ref = the reference category.

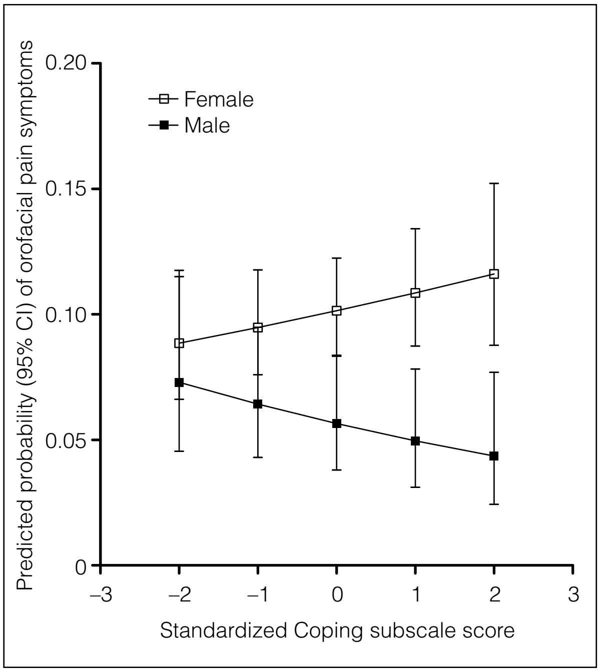

Fig 2 Predicted probabilities from a logistic regression model (shown in Model 4 of Table 4) of TMD-like orofacial pain symptoms for males and females according to nominated values of the control subscale. Probabilities are adjusted for age in years, smoking status, and score on the Distress subscale of the PSS, National Survey of Adult Oral Health (n = 3,755), Australia, 2004–2006. Effect modification *P* value = .040

Discussion

Key Findings

This study is the first to examine the association of perceived stress and reported TMD-like orofacial pain symptoms in a nationally representative sample. One in 10 adults met the case definition for orofacial pain symptoms, which is known to have high sensitivity for clinically diagnosed TMD. Gender differences in reported symptoms were dependent on control. Specifically, gender differences were small among people who had low levels of control, whereas in people with higher control scores, gender differences were pronounced due primarily to a protective effect of control in males.

A novelty of this study was the separate examination of the two dimensions of perceived stress in their relationship with orofacial pain symptoms related to TMD. It was revealed that, while distress was associated with a higher probability of orofacial pain symptoms for males and females, this did not account for the excess pain reports in females. Rather, gender differences in probability of orofacial pain symptoms were better explained by females failing to benefit from control. The null effect for control in females in part supports cross-sectional findings from the North Finland birth cohort that coping did not attenuate the putative association of stress on facial pain among adults.[24]

The findings offered empirical support for the theoretical work of Lazarus proposing two separate but related components. The partitioning of distress and control also revealed a substantial and significant inverse age gradient in distress. Although evident for males and females, the gradient was modified by gender and this effect resulted in a substantially steeper age gradient in perceived distress for females in whom orofacial pain prevalence was higher. Perceptions of adequate control resources were greater at older ages for females, while for males, perception of control was stable across all age groups.

The representative population sample was another strength, which permitted the results to be generalized to the full range of demographic groups in Australia. In contrast, clinical studies frequently restrict enrollment to relatively narrow age groups. A further benefit is that cases and controls are classified from a known population, hence, avoiding problems of treatment-seeking bias that limits generalizability in studies of referred patients. More importantly, this population-based sampling overcame potential biases in estimating associations, such as Berkson's bias, when studying cases and controls recruited from health care settings.

Comparisons with Findings from Other Studies

The female to male ratio of TMD-related orofacial pain symptoms of 1.7 is in the range (1.5–2.0) of that published in reviews.[6,10] This collective evidence stands in contrast to findings from a telephone survey in Hong Kong. That study reported no sex differences in self-reported prevalence of symptoms associated with TMD.[25] The present findings build on those of an experimental study that compared gender differences in two coping strategies on pain perception in 50 healthy students. In that study, males benefited from sensory-focused coping, while females failed to benefit from both sensory- and emotion-focused coping. In fact, for females, concentrating on emotional focusing increased affective pain experience.[26] Such findings suggest that females are not only more likely than males to report orofacial pain, but also their coping strategies in general may differ in ways that are unhelpful to managing pain symptoms and may even be detrimental.

Many previous studies of TMD-related orofacial pain symptoms have been limited to population segments, such as the elderly,[27] the middle-aged, and older[7] residents of a single city,[19,28] or were sampled from a medical practice.[29] A prominent exception was the 2002 United States National Health Interview Survey, which measured self-report temporomandibular-type pain in a representative sample of 30,978 adult males and females. Although overall prevalence in that study at 4.6% was approximately half that found in this Australian national survey, similar age and sex prevalence distributions were observed.[30]

The authors know of only one study to report perceived stress scores at the population level.[11] That study used the 14-item PSS as a unidimensional scale to report normative data from a national probability sample in the United States. The present study showed greater age effects because it stratified by gender and separately examined the two theoretical components of stress. It found that distress, more so than control, followed an age gradient. Several studies, apart from this, have confirmed empirically the theoretical view of perceived stress as bidimensional.[21,31,32] The authors have previously observed that control but not distress explained socioeconomic differences in tooth loss.[33] Yet few other studies have analyzed the PSS dimensions separately.

Despite its strengths, the PSS is prone to scoring bias arising when the control items are reversed to obtain a single measure of perceived stress. Although this complies with the authors' recommendation of "reversing the scores on the seven positive items,"[14] it assumes that the two dimensions are reciprocals of each other, such that reversing scores for the control dimension yields a valid estimate of distress. The misspecification of perceived stress as a "single unidimensional environmental variable" has been noted previously[34] and misconstrues the theoretical underpinning of psychological stress.[12] The present finding that control was distributed differently than distress across age and between the genders is evidence that one dimension is not the reciprocal of the other.

Another finding that current smokers were more likely than former or never smokers to report orofacial pain even after adjustment for age, gender, and perceived stress is consistent with at least two previous studies.[17,18] Riley et al[18] summarize mechanisms that may explain this effect as intraoral factors such as impaired wound healing, as well as a pharmacologic effect of nicotine, and psychological or sociocultural differences between people who smoke and those who do not that may impact their pain experience or sensitivity. These findings build on evidence from nationally representative surveys in Norway[35] and the United Kingdom[36] of an association between current smoking and musculoskeletal pain.

Limitations of the Study

Since the study measured exposure and outcome at one point in time, the possibility of reverse causation cannot be ruled out, ie, that TMD-related orofacial pain symptoms caused or worsened perceived stress. While this possibility exists, prospective cohort evidence shows that psychological morbidity, including anxiety, depression, perceived stress, and mood, are predictive of pain sensitivity and elevated risk of TMD.[4,37]

It can be concluded that perceived control was protective against TMD-related orofacial pain symptoms, but only in males. However, it should be noted that sex differences in associations may be explained by unmeasured confounding from unmeasured or yet-unknown confounders.

But by far, the most compelling factor limiting comparison with earlier studies is the heterogeneity across studies in definitions for orofacial pain, as well as study designs, settings, and effect measures. The present study labeled the PSS subscales "distress" and "control" and thereafter inferred their construct validity. Other researchers have labeled the PSS components "perceived distress" and "perceived coping,"[31] "stress" and "counter stress,"[38] "distress" and "control,"[22] and perceived control"[39]; the distress items were not included in the last named study. It is important to recognize the subjectivity in assigning such labels. More important is recognition of the theoretical bidimensional nature of perceived stress that arises from appraisals of a threatening event in light of available resources.[12] Maintaining both dimensions permits examination of interactive effects such as control under low and high stress loads.

This study did not address styles of coping. Understanding health consequences of coping styles is an important field of inquiry. It confined investigation to perceptions of control and distress seeking to show whether one or both contribute to gender differences in this condition. Nor did this study measure somatization, depression, or coping, all of which are recognized risk factors for TMD, often exerting effects differentially in men and women. However, these psychosocial characteristics are assessed using lengthy questionnaires that were beyond the scope of this population-based survey. Despite these caveats, the value of a large nationally representative study of males and females far outweighs the limitations of this study. It can be concluded that perceived control was protective against orofacial pain symptoms, but only in males.

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