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Experience of racism and tooth brushing among pregnant Aboriginal Australians: exploring psychosocial mediators

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Objectives: Despite burgeoning evidence regarding the pathways by which experiences of racism influence health outcomes, little attention has been paid to the relationship between racism and oral health-related behaviours in particular. We hypothesised that self-reported racism was associated with tooth brushing, and that this association was mediated by perceived stress and sense of control and moderated by social support. ***Methods:*** Data from 365 pregnant Aboriginal Australian women were used to evaluate tooth brushing behaviour, socio-demographic factors, psychosocial factors, general health, risk behaviours and racism exposure. Bivariate associations were explored and hierarchical logistic regression models estimated odds ratios (OR) and 95% confidence intervals (CI) for tooth brushing. Perceived stress and sense of control were examined as mediators of the association between self-reported racism and tooth brushing using binary mediation with bootstrapping. ***Results:*** High levels of self-reported racism persisted as a risk indicator for tooth brushing (OR 0.51, 95%CI 0.27,0.98) after controlling for significant covariates. Perceived stress mediated the relationship between self-reported racism and tooth brushing: the direct effect of racism on tooth brushing was attenuated, and the indirect effect on tooth brushing was significant (β coefficient -0.09; bias-corrected 95%CI -0.166,-0.028; 48.1% of effect mediated). Sense of control was insignificant as a mediator of the relationship between racism and tooth brushing. ***Conclusions:*** High levels of self-reported racism were associated with non-optimal tooth brushing behaviours, and perceived stress mediated this association among this sample of pregnant Aboriginal women.. Limitations and implications are discussed.

Key words: *racism, toothbrushing, psychosocial factors, psychological stress, control, Australian Aborigines*

Introduction

Pregnancy is a time when attention to optimal oral health behaviours is paramount (US DHHS, 2000). Poor oral health may lead to adverse birth outcomes such as pre-term low birth weight (Bassani *et al*., 2007; Cota *et al*., 2006; Kunnen *et al*., 2007; Novak *et al*., 2006) and maternal oral flora is one of the greatest predictors of the oral flora of her offspring (Ercan *et al*., 2007). High levels of oral flora lead to consequent risk of early childhood caries (Smith *et al*., 2002). Regrettably, Indigenous Australians experience higher levels of pregnancy-related risk behaviours, such as tobacco smoking and alcohol consumption (Campbell *et al*., 2012) and adverse birth outcomes, such as pre-term low births, in relation to non-Indigenous Australians (AIHW, 2012). It is also recognised that Indigenous Australians have worse dental disease outcomes, worse oral health-related quality of life and poorer self-rated oral health than their non-Indigenous counterparts (Roberts-Thomson *et al*., 2008).

Tooth brushing is recognised as an important oral health-related behaviour associated with prevention of both dental caries (Macpherson *et al*., 2013) and periodontal disease (Tu *et al*., 2008). Among populations at risk of dental diseases, tooth brushing behaviours are known to be less than optimal (Fadavi *et al*., 2009; Khocht *et al*., 2010), and rates of tooth brushing among Indigenous Australians have been less-than-optimal as well (Jamieson *et al*., 2010).

While the importance of social factors in oral health has been demonstrated in several studies (e.g. Armfield *et al*., 2013; Ravaghi *et al*., 2012), there has been little documentation on the role of social determinants of tooth brushing more specifically. Ronis *et al*., (1993) found that the likelihood of daily brushing was higher among persons with higher socioeconomic status. Buunk-Werkhoven and colleagues (2011) postulated that socio-psychological consequences played a role in oral self-care, with attitudes, social norms, perceived behavioural control and oral health knowledge explaining one-third of variance in self-reported oral hygiene behaviour, including tooth brushing, in their study.

Racism – the inequitable distribution of opportunity, benefit or resources across ethnic/racial groups expressed through attitudes, beliefs, behaviours, norms and practices (Berman and Paradies, 2010) – is prevalent in Australia towards Aboriginal and Torres Strait Islander peoples (hereafter jointly referred to as 'Aboriginal') (Cunningham and Paradies, 2013). Racism has been associated with depression (Paradies and Cunningham, 2012a; Priest *et al*.,

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2011a), poor self-rated health (Paradies and Cunningham, 2012b; Priest *et al*., 2011b), childhood illness (Priest *et al*., 2012), non-optimal dental service utilisation (Jamieson *et al*., 2013) and adverse birth outcomes in both mother and child (Priest *et al*., 2013). Evidence suggests that psychosocial factors, such as perceived stress, sense of control, and social support, can mediate and/or moderate the association between self-reported racism and health outcomes (Brondolo *et al*., 2009; 2011; Gibbons *et al*., 2012; Moradi and Hasan, 2004; Priest *et al*., 2013).

Previous studies indicate that stress has the strongest influence on the racism/health outcomes causal pathway (Brondolo *et al*., 2011). Stress can lead to changes in behaviour (Gee *et al*., 2012), and stress-related behaviours such as jaw-clenching were shown to contribute to experience of subsequent toothache among patients with post-traumatic stress disorder (Wright *et al*., 2004). Moreover, perceived stress was a risk indicator for poor self-rated oral health (Sanders and Spencer, 2005) and associated with perceived dental health and reason for dental visit, but not with health behaviours like flossing, mouth rinse frequency and last dental visit (Dumitrescu *et al*., 2006). Discrimination, including racially-based discrimination, may beassociated with low self-control, which may in turn be associated with negative impacts on health. For example, discrimination can lead to anger, and controlling anger can deplete self-control (Gibbons *et al*., 2012). Sense of control can have an impact on important oral health factors such as oral health-related quality of life (Sanders and Spencer, 2005). Social support has been shown to be associated with less impact from oral problems (Sanders and Spencer, 2005), and may buffer the impact of racism on health, for example by enhancing participation in social activities that may provide distraction and positive experience to counter negative impacts of racism (Brondolo *et al*., 2009).

There is some evidence on the role that psychosocial factors play in tooth brushing behaviours. De Silva-Sanigorski and colleagues (2013) reported that higher self-efficacy was associated with higher rates of tooth brushing among parents of Australian schoolchildren, while Ayo-Yusef and Booyens (2011) reported that poor tooth brushing habits were associated with poor mental health states among South African adolescents in resource-poor settings. In Romania, non-optimal tooth brushing has been associated with low-levels of self-liking, body care, body protection and perfectionism (Dumitrescu *et al*., 2009), as well as with hopelessness (Dumitrescu and Kawamura, 2009b). After adjusting for confounding in a representative sample of Finnish adults, low cynical hostility was associated with high levels of tooth brushing (Mettovaara *et al*., 2006).

The role that racism may play in tooth brushing behaviours among this or other populations has not been examined yet. This study set out to explore whether self-reported racism was associated with tooth brushing behaviour among a convenience sample of pregnant Aboriginal women in South Australia, whether stress and sense of control mediated the relationship between self-reported racism and tooth brushing, and whether social support moderated this relationship.

We hypothesise that self-reported racism will: 1, be positively associated with high levels of perceived stress and low levels of sense of personal control; 2, be positively associated with tooth brushing. We also hypothesise that: 3, the association between self-reported racism and tooth brushing will be mediated by perceived stress and sense of personal control; and that: 4, social support will moderate (attenuate) the association between self-reported racism and tooth brushing.

Methods

Data for this paper were from the baseline questionnaire used in the Baby Teeth Talk study, a randomised controlled trial of an early childhood caries intervention conducted in South Australia (Merrick *et al*., 2012; Australian and New Zealand Clinical Trials Registration number: ACTRN12611000111976). Participants were from a non-representative sample of pregnant Aboriginal women who were recruited for the trial from a range of sources including referrals from Indigenous community groups, community services and hospitals. The recruitment process involved recruiting as many eligible mothers as practicable in a given time frame to partake in the trial. We therefore did not attempt to recruit a representative sample. The study received approval from the University of Adelaide Human Research Ethics Committee, the Aboriginal Health Council of South Australia, the Government of South Australia and the Human Research Ethics Committees of participating South Australian hospitals.

The measure of *tooth brushing* was based on an item used in the 2004-2006 National Survey of Adult Oral Health (Slade *et al*., 2007). Participants were asked: 'Did you brush your teeth yesterday?' Responses were 'yes' or 'no'.

Self-reported racism was assessed using an adapted version of the Measure of Indigenous Racism Experiences (MIRE) instrument (Paradies and Cunningham, 2008). The MIRE instrument assesses self-reported inter-personal racism among Indigenous Australians across nine settings. The adapted version was shorter than the original, and was concerned with whether respondents experienced unfair treatment over the last 12 months (in contrast to the original version that asks respondents to identify the frequency of such experiences). Minor language-related revisions were made in this version, including the choice of 'Aboriginal' rather than 'Indigenous', to render some sub-questions more relevant to this study's context. Participants were asked: "In the last twelve months, have you felt that you have been treated unfairly in any of the following ways because you are Aboriginal?" The settings were: employment, domestic, educational/academic, recreational/leisure, law (enforcement), health care, government service provision, other service provision, public, any other situation (re-categorised according to the other 9 settings where relevant). Response options to each of the items were 'yes' or 'no'.

Regarding *covariates,* a range of variables describing socio-demographics, general health and risk behaviours were included in the analyses, all considered in previous studies as potential correlates of self-reported racism and oral health. Since continuous variables were not normally distributed, and remained non-normal when transformed, transformations were not used and such variables were re-coded into dichotomous variables, with continuous

variables split across the median. Dichotomizing was also preferred when analysing some categorical variables with categories that contained few cases, which otherwise might limit further analyses. The following covariates were used: participants' reported age (14–24yrs and 25–43yrs); current level of education (no school/primary school/high school and further education/university); place of residence ('urban' and 'rural'; being resident in South Australia's only city was considered urban, anywhere else, rural); having a Health Care Card (yes, no); car ownership (yes, no); having not gone to a dentist because of cost in the last year (yes, no); and difficulty paying a $100 dental bill (not hard at all/not very hard, a little hard/very hard/could not pay). Participants were also asked to self-rate their general health (excellent/very good/good, fair/poor), alcohol drinking behaviours (never/used to, currently drink) and tobacco smoking behaviours (never/used to, currently smoke).

Psychosocial factors considered as *mediators and moderators* included perceived stress, sense of control and social support. Perceived stress and sense of control were examined as possible mediators of the association between self-reported racism and tooth brushing and social support was examined as a possible moderator of this association.

Perceived stress was measured by the Perceived Stress Scale (Cohen *et al*., 1983), which evaluates the frequency that people appraise situations as threatening and their appraised capacity to cope with threatening situations. Examples of items (14 in total; Cronbach's alpha=0.75) included 'feeling upset because of something that happened unexpectedly' and 'feeling angered because of things that happened outside of your control'. Response options were not at all, rarely, sometimes, fairly often, and very often.

The Sense of Personal Control scale (Lachman and Weaver, 1998) evaluates personal mastery and perceived constraint and was used to assess *sense of control*. Examples of items (12 in total; Cronbach's alpha 0.83) included 'whether or not I am able to get what I want is in my own hands' and 'what happens to me in the future mostly depends on me'. The five response options ranged from 'strongly disagree' to 'strongly agree'.

Social support was assessed by five items (Cronbach's alpha 0.87) designed to evaluate the dimensions of social support as theorised by House (1981). The five response options ranged from 'strongly agree' to 'strongly disagree'. For each of three psychosocial factors – stress, control, social support - a summary score variable was created, then, not being normally distributed, dichotomised at the median ('low' and 'high') for analysis. The validity and reliability of these three scales have been supported in the Australian context (e.g. Armfield *et al*., 2013).

In the *analysis*, first, each participant's self-reported racism summary score was computed by counting the number of settings in which racism was experienced (range 0 to 9). This variable was not normally distributed and therefore was re-coded as a categorical variable. A sensitivity analysis was conducted to examine differences in the strength of associations between different categorisations of the self-reported racism summary score variable and tooth brushing. The summary score variable was examined when divided into two levels (i.e., 'no racism' (racism experienced in zero settings) compared with 'racism experienced in 1-9 settings'), and into three levels (i.e., 'no racism' compared with 'low racism', and 'high racism'). The latter tested the possibility of a dose-response relationship between self-reported racism and tooth brushing. Different three-level categorisations were examined. There were few significant differences between participants who reported 'no racism' compared with those who reported 'low racism', and more significant differences between participants who reported 'no racism' compared with those who reported 'high racism', thus indicating of a dose-response relationship. The final categorisation into 'no racism' (participants who experienced racism in no settings; n=184), 'low racism' (experiences of racism in 1-3 settings; n=107), and 'high racism' (experiences of racism in 4-9 settings; n=69), was selected in order to maximise study power and ensure sufficient numbers of participants in each category. Summary scale scores were not computed for five of the 365 participants due to missing data. Previous research on self-reports of racial discrimination across nine situations (e.g. Krieger *et al*., 2010) has similarly coded continuous measures into three-level categorical measures (e.g. 'no discrimination', 'moderate discrimination', and 'high discrimination').

The following bivariate associations were explored using χ^2 tests and simple logistic regressions: self-reported racism and tooth brushing; self-reported racism and all covariates; tooth brushing and all covariates. All variables that showed at least marginally significant ($p<0.10$) bivariate associations with self-reported racism and/or with tooth brushing (see Table 3) were considered for inclusion in hierarchical logistic regression models with self-reported racism as the independent variable and tooth brushing as the outcome variable. In the first step, the independent variable self-reported racism was entered and its association with tooth brushing was examined. Covariates were then entered in blocks at separate steps, and at each step tested variables $p\geq0.10$ were removed from the model. The following socio-demographics were entered in the second step: place of residence, level of education, having a Health Care Card, car ownership, having not gone to a dentist because of cost in the last year and difficulty paying a $100 dental bill. Self-rated general health and smoking behaviours were entered in the third step. Age and alcohol drinking status were not significantly associated with self-reported racism and/or tooth brushing (see Table 3) and were therefore not tested in regression models. The Wald test was used to assess model fit at each step of the analysis. Variance inflation factors of less than three for variables across all models indicated that multicollinearity was not present. Interaction (i.e. effect modification) between self-reported racism and significant covariates in the final model was also explored, as well as between self-reported racism and social support (with removal set at $p\geq0.10$). Perceived stress and sense of control were explored as potential mediators but not as covariates. Each mediator was tested separately, and the choice of covariates examined was based on findings from the multivariate analyses. Probit-based binary mediation with bootstrapping (5,000 replications) was used to produce point estimates along with bias-corrected non-parametric percentile confidence intervals.

Analyses were conducted using SPSS v21 and Stata Intercooled v12.1 for Mac was used for the mediation analyses.

Results

Survey data on self-reported racism were available from 365 participants who were identified as Aboriginal and/or Torres Strait Islanders. Racism summary scores were computed for 360 participants, due to missing data. Just under half of them (48.9%) reported experiencing racism in the past year, with 29.7% reporting 'low racism' (racism in 1-3 settings) and 19.2% reporting 'high racism' (racism in 4-9 settings). Racism was especially prevalent in public settings, followed by law (enforcement) settings and domestic settings (Table 1). The general frequencies of study variables are shown in Table 2.

Bivariate associations between study covariates, self-reported racism and tooth brushing are shown in Table 3. Low levels of self-reported racism were significantly and positively associated with urban residence, with having a Health Care Card and with high levels of perceived stress. High levels of self-reported racism were significantly and negatively associated with tooth brushing, with owning a car, and with high levels of sense of control and social support, and significantly and positively associated with having not gone to the dentist because of cost during the last year, having difficulty paying a $100 dental bill, fair or poor self-rated general health, and high levels of stress. Tooth brushing was significantly and negatively associated with having a Health Care Card, currently smoking tobacco, and high levels of stress. Tooth brushing was also significantly and positively associated with higher level of education, owning a car, having not gone to the dentist because of cost (opposite to the expected direction), and high levels of control and social support.

In the multivariable analysis (n=336), in the final model a significant relationship persisted between high levels of self-reported racism (reference category: 'no racism') and tooth brushing when controlling for significant covariates (OR 0.51, 95%CI 0.27,0.98, p=0.042). Significant covariates of this association included Health Care Card (OR 0.19, 95%CI 0.06,0.56, p=0.002) and car ownership (OR 1.88, 95%CI 1.11,3.18, p=0.019). 'Low racism' was insignificant as a predictor of tooth brushing (OR 1.19, 95%CI 0.66,2.16, p=0.559). All interaction terms were insignificant when tested in this model, including the interaction between self-reported racism and social support (low racism: OR 1.49, 95%CI 0.56,3.99, p=0.425; high racism: OR 1.03, 95%CI 0.32,3.36, p=0.955).

Analyses were conducted to examine the roles of perceived stress and sense of control as possible mediators of the relationship between self-reported racism and tooth brushing. The analytical strategy focused on participants who reported 'high racism' (in comparison with 'no racism' as a reference category), given that only 'high racism' was found to predict tooth brushing in the hierarchical regression final model. Health Care Card, but not car ownership, remained a significant covariate in a multivariate analysis of participants reporting 'no racism' and 'high racism' (not detailed here), and was controlled for in the mediation analysis. In the first analysis, perceived stress (n=231) was found to mediate the relationship between self-reported racism and tooth brushing: the previously significant direct effect of self-reported racism on tooth brushing was attenuated, becoming insignificant, and the indirect effect of self-reported racism on tooth brushing was significant (β coefficient=-0.09; bias-corrected 95%CI -0.166,-0.028; 48.1% of effect mediated). The second mediation analysis found sense of control to be insignificant as a mediator of the relationship between self-reported racism and tooth brushing (n=234). Additional analyses conducted for participants who reported 'no racism' or 'low racism', controlling for Health Care Card and car ownership, found perceived stress and sense of control (both n=262) to be insignificant as mediators of the relationship between 'low racism' and tooth brushing. Further analyses, following the Baron and Kenny (1986) method and including all three levels of racism in the same analyses, supported these finding.

Table 1. Frequencies of individual MIRE items used in current study

Individual MIRE items[1]	*% reporting racism, %*	*(n)*	*95%CI*
1. Employment	15.2	(55)	11.4–18.8
2. Domestic	20.6	(75)	16.4–24.8
3. Educational/academic	15.7	(57)	11.9–19.5
4. Recreational/leisure	12.4	(45)	9.0–15.8
5. Law (enforcement)	22.8	(83)	18.5–27.1
6. Health care	10.7	(39)	7.5–13.9
7. Government service provision	14.5	(53)	10.9–18.2
8. Other service provision	19.2	(70)	15.1–23.2
9. Public settings	31.9	(116)	27.1–36.7

[1]Participants were asked: "In the last twelve months, have you felt that you have been treated unfairly in any of the following ways because you are Aboriginal?" The settings were:
1, Applying for work or when at work;
2, At home, by neighbours or at somebody else's house;
3, At school, university, training course, or other educational setting;
4, While doing any sporting, recreational or leisure activities;
5, By the police, security people, lawyers or in a court of law;
6, By doctors, dentists, nurses or other staff at hospitals, dental clinics or doctor's surgeries;
7, By staff of government agencies;
8, When seeking any other services;
9, By members of the general public;
10, Any other situation (re-categorised according to the other 9 settings where relevant)

Conclusions

To the best of our knowledge, this study documents the first evidence that self-reported racism is associated with non-optimal tooth brushing behaviours among pregnant Aboriginal Australian women. This association is mediated by perceived stress but not by sense of control, and is not moderated (i.e., attenuated) by social support. Furthermore, this association was documented for high levels of self-reported racism but not for low levels, indicating a threshold effect that is consistent with studies of the relationships between racism and other health outcomes (e.g. Paradies, 2006). The finding that stress significantly mediates the relationship between self-reported racism and tooth brushing supports literature that has concep-

Table 2. Frequencies of study variables, and percentage reporting racism and tooth brushing

	% (n)	*% reporting racism (n)* [1]			*% reporting tooth*
		No racism	*Low racism*	*High racism*	*brushing (n)*
Age					
14 to 24 years	51.4 (178)	48.6 (85)	30.9 (54)	20.6 (36)	71.9 (123)
25 years or older	48.6 (168)	52.4 (87)	29.5 (49)	18.1 (30)	75.0 (120)
Place of residence					
Rural	51.0 (186)	56.8 (105)	25.4 (47)	17.8 (33)	69.7 (124)
Urban	49.0 (179)	45.1 (79)	34.3 (60)	20.6 (36)	77.2 (132)
Level of education					
High school or less	73.7 (269)	51.9 (137)	28.8 (76)	19.3 (51)	69.9 (179)
Further or university	26.3 (96)	49.0 (47)	32.3 (31)	18.8 (18)	82.8 (77)
Health Care Card					
No	16.5 (59)	62.7 (37)	15.3 (9)	22.0 (13)	93.1 (54)
Yes	83.5 (299)	48.6 (143)	32.7 (96)	18.7 (55)	69.4 (197)
Do you own a car?					
No	52.5 (191)	45.5 (85)	32.6 (61)	21.9 (41)	64.8 (116)
Yes	47.5 (173)	57.6 (99)	26.7 (46)	15.7 (27)	82.2 (139)
During the last year, have you not gone to the dentist because of cost?					
No	67.7 (247)	53.9 (131)	30.9 (75)	15.2 (37)	70.0 (168)
Yes	32.3 (118)	45.3 (53)	27.4 (32)	27.4 (32)	80.7 (88)
How hard would it be for you to pay a $100 dental bill?					
Not hard at all/Not very hard	19.3 (70)	63.8 (44)	24.6 (17)	11.6 (8)	77.9 (53)
A little bit / Very hard / Could not pay	80.7 (293)	47.8 (138)	31.1 (90)	21.1 (61)	72.4 (202)
Smoking status					
Used to smoke/ never smoked	47.5 (173)	52.3 (90)	30.8 (53)	16.9 (29)	78.9 (135)
Currently smokes	52.5 (191)	50.3 (94)	28.9 (54)	20.9 (39)	67.8 (120)
Alcohol drinking status					
Used to drink / Never drank	90.4 (328)	52.2 (169)	29.6 (96)	18.2 (59)	74.6 (235)
Currently drink	9.6 (35)	44.1 (15)	32.4 (11)	23.5 (8)	62.5 (20)
How do you think your general health is?					
Excellent/ Very good / Good	89.6 (326)	53.1 (171)	28.9 (93)	18.0 (58)	74.2 (230)
Fair / Poor	10.4 (38)	34.2 (13)	36.8 (14)	28.9 (11)	65.8 (25)
Stress					
Low	56.4 (198)	61.1 (121)	26.3 (52)	12.6 (25)	79.5 (151)
High	43.6 (153)	38.9 (58)	32.9 (49)	28.2 (42)	64.4 (94)
Control					
Low	54.0 (191)	44.9 (84)	31.0 (58)	24.1 (45)	67.4 (122)
High	46.0 (163)	59.5 (97)	25.8 (42)	14.7 (24)	79.0 (124)
Social Support					
Low	59.2 (215)	47.4 (101)	29.1 (62)	23.5 (50)	68.6 (142)
High	40.8 (148)	57.2 (83)	29.7 (43)	13.1 (19)	80.0 (112)
Did you brush your teeth yesterday?					
No	26.6 (93)	44.6 (41)	27.2 (25)	28.3 (26)	-
Yes	73.4 (256)	53.6 (135)	30.6 (77)	15.9 (40)	-

[1]Data in these three columns do not account for missing responses from participants with regard to level of racism. The three percentages in each row therefore sum to 100.

tualised stress as a strong factor influencing the causal pathways between racism and health outcomes (Brondolo *et al*., 2011).

Pregnancy is a time when psychosocial risks may be highly prevalent, and may contribute to pregnancy complications and poor reproductive outcomes (Joseph *et al*., 2009). Studies have shown that stress can be substantial during this time, and may have various sources (e.g. parenting stress, work-related stress, pregnancy anxiety) (e.g. Loomans *et al*., 2013). Our findings support previous research on the importance of stress as a psychosocial risk factor among pregnant women, and contribute to discussions regarding associations between stress and poor health behaviours. While significant socio-economic indicators were controlled for in this study, the relationship between racism and other stressors among this vulnerable population were not directly examined and thus requires further elucidation. There is evidence that pregnant women who experience stress may be more likely to engage in poor health practices such as missing prenatal visits and entering prenatal care late, and in poor eating habits, smoking, and drinking alcohol (Littleton *et*

Table 3. Bivariate associations between study variables, self-reported racism and tooth brushing (unadjusted OR and 95%CI)

	Self-reported racism		*Tooth brushing*
	Low racism	*High racism*	
Age (ref. 14 to 24 years)			
25 years or older	0.89 (0.54–1.45)	0.81 (0.46-1.44)	1.17 (0.72-1.91)
Place of residence (ref. Rural)			
Urban	**1.70 (1.05-2.74)***	1.45 (0.83-2.53)	1.47 (0.91-2.38)
Level of education (ref. High school or less)			
Further or university	1.19 (0.70-2.03)	1.03 (0.55-1.93)	**2.07 (1.36-3.78)***
Health Care Card (ref. No)			
Yes	**2.76 (1.27-5.98)****	1.10 (0.54-2.21)	**0.17 (0.06-0.48)*****
Do you own a car? (ref. No)			
Yes	0.65 (0.40-1.05)	**0.57 (0.32-1.00)***	**2.52 (1.53-4.15)*****
During the last year, have you not gone to the dentist because of cost? (ref. No)			
Yes	1.06 (0.63-1.78)	**2.14 (1.21-3.78)****	**1.80 (1.03-3.11)***
How hard would it be for you to pay a $100 dental bill? (ref. Not hard at all/Not very hard)			
A little bit / Very hard / Could not pay	1.69 (0.91-3.14)	**2.43 (1.08-5.47)***	0.74 (0.40-1.40)
Smoking status (ref. Used to smoke/ Never smoked)			
Currently smokes	0.98 (0.61-1.57)	1.29 (0.74-2.26)	**0.56 (0.37-0.91)***
Alcohol drinking status (ref. Used to drink / Never drank)			
Currently drink	1.29 (0.57-2.92)	1.53 (0.62-3.79)	0.57 (0.27-1.21)
How do you think your general health is? (ref. Excellent/ Very good / Good)			
Fair / Poor	1.98 (0.89-4.39)	**2.50 (1.06-5.87)***	0.67 (0.33-1.37)
Stress (ref.) Low			
High	**1.97 (1.19-3.24)****	**3.51 (1.95-6.30)*****	**0.47 (0.29-0.76)****
Control (ref. Low)			
High	0.63 (0.38-1.03)	**0.46 (0.26-0.82)****	**1.81 (1.11-2.98)***
Social Support (ref. Low)			
High	0.84 (0.52-1.37)	**0.46 (0.25-0.85)***	**1.83 (1.10-3.04)***
Did you brush your teeth yesterday? (ref. No)			
Yes	0.94 (0.53-1.66)	**0.47 (0.26-0.86)***	-

* p≤0.05, ** p≤0.01, *** p≤0.001

al., 2010). The impact of stress on tooth brushing may be a significant addition to this list.

In light of the substantial disparities in oral health outcomes and in non-optimal tooth brushing behaviours among Aboriginal and Torres Strait Islander peoples as well as other ethnic/racial minority groups in Australia and internationally, the findings of this study can provide new and important evidence to inform efforts targeting the reduction of such disparities. Increased knowledge about the role of self-reported racism in tooth brushing behaviours highlights the importance of studying racism as a psychosocial factor amenable to change through system-based interventions, for example, in workplaces and hospital settings. Given that racism is preventable (Paradies *et al*., 2009), once supported these findings are also highly relevant to consider across policy, decision-making and service delivery contexts; providing for the first time data regarding racism as a critical determinant of oral health disparities likely to be amenable to change.

The findings of this study must be interpreted in the context of several limitations. The cross-sectional nature of the study design limits definitive conclusions about directions of causality (Gee and Walsemann, 2009). Although evidence from longitudinal studies suggests that racism precedes ill health, the converse cannot be ruled out in this study. Furthermore, while the measure used for assessing tooth brushing ('Did you brush your teeth yesterday?') is straightforward and minimises respondents' recall bias, it is also limited since it imposes a specific event sampling frame ('yesterday'), and provides a non-conservative estimate of tooth brushing frequency (once instead of twice a day) and no assessment of its adequacy (e.g. the amount of time spent on tooth brushing). Finally, the recruitment process, especially constraints dictated by the need to recruit as many eligible participants, meant that this sample was not selected to be representative of the Australian Aboriginal population. Further research among pregnant Aboriginal women and using representative samples is therefore required, preferably using longitudinal cohort designs.

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