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Are Stage of Change constructs relevant for subjective oral health in a vulnerable population?

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Stage of Change constructs may be proxy markers of psychosocial health which, in turn, are related to oral health. ***Objective:*** To determine if Stage of Change constructs were associated with subjective oral health in a population at heightened risk of dental disease. ***Methods:*** Stage of Change constructs were developed from a validated 18-item scale and categorised into 'Pre-contemplative', 'Contemplative' and 'Active'. A convenience sample of 446 Australian non-Aboriginal women pregnant by an Aboriginal male (age range 14–43 years) provided data to evaluate the outcome variables (self-rated oral health and oral health impairment), the Stage of Change constructs and socio-demographic, behavioural and access-related factors. Factors significant at the $p<0.05$ level in bivariate analysis were entered into prevalence regression models. ***Results:*** Approximately 54% of participants had fair/poor self-rated oral health and 34% had oral health impairment. Around 12% were 'Pre-contemplative', 46% 'Contemplative' and 42% 'Active'. Being either 'pre-contemplative' or 'contemplative' was associated with poor self-rated oral health after adjusting for socio-demographic factors. 'Pre-contemplative' ceased being significant after adjusting for dentate status and dental behaviour. 'Pre-contemplative' remained significant when adjusting for dental cost, but not 'Contemplative'. The Stages of Change constructs ceased being associated with self-rated oral health after adjusting for all confounders. Only 'Contemplative' (reference: 'Active') was a risk indicator in the null model for oral health impairment which persisted after adding dentate status, dental behaviour and dental cost variables, but not socio-demographics. When adjusting for all confounders, 'Contemplative' was not a risk indicator for oral health impairment. ***Conclusions:*** Both the 'Pre-contemplative' and 'Contemplative' Stage of Change constructs were associated with poor self-rated oral health and oral health impairment after adjusting for some, but not all, covariates. When considered as a proxy marker of psychosocial health, Stage of Change constructs may have some relevance for subjective oral health.

Key words: *stage of change, oral health, pregnancy, Australia, Aboriginal*

Background

The transtheoretical model of behaviour change, otherwise known as the Stages of Change model, assesses an individual's readiness to act on a new, healthier behaviour and provides strategies to guide the individual through the relevant stages of change (Prochaska and DiClemente, 1982). The Stages of Change model has been used widely in the field of general health, both in cross-sectional studies showing associations with health outcomes such as physical activity (Maruf *et al*., 2014), uptake of vaccinations (Patel *et al*., 2013) and tobacco smoking cessation (Djikanovic *et al*., 2013), and in health-related behaviour interventions (Hutchison *et al*., 2009; Spencer *et al*., 2006; Tuah *et al*., 2011). In the context of oral health, for example, associations between Stage of Change and interdental cleaning behaviour have been identified (Morowatisharifabad *et al*., 2011), while Ayo-Yusuf *et al*. (2009) reported associations between Stage of Change and toothbrushing behaviours.

There is evidence of Stages of Change constructs ('Pre-contemplative', 'Contemplative' and 'Active') being used as proxy markers of psychosocial health (De Cocker *et al*., 2012; Moy *et al*., 2010). Psychosocial health is acknowledged as an important indicator of both clinical and self-reported oral health status (Duijster *et al*., 2014; Sanders and Spencer, 2005). To the best of our knowledge, there has been limited examination of the Stages of Change constructs (as a measure of psychosocial health) and subjective oral health. If associations between Stages of Change constructs and subjective oral health exist, incorporating the transtheoretical model into psychosocial-based interventions aimed at improving oral health outcomes, particularly among vulnerable populations, may be beneficial (Locker *et al*., 2009; Ribeiro and Alves, 2013)

It has been argued that maternal oral flora is one of the greatest predictors of the oral flora of infants and children (Berkowitz, 2006; Caufield, 1997), with subsequent links to early childhood dental disease (Chaffee *et al*., 2014). A woman's knowledge of, and action for, her own oral health are therefore critical to the oral health of her child and may be a key to childhood caries prevention (Chou *et al*., 2013). Although pregnancy has been identified as an important time for optimal oral health care, for both maternal and infant health benefits (USDHHS, 2000), there is evidence that racial, ethnic and economic disparities related to oral hygiene practices and dental service utilisation exist during this time (Boggess *et al*., 2010).

Aboriginal Australians are recognised as having substantially worse general and oral health outcomes relative to their non-Aboriginal counterparts (Roberts-Thomson

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et al., 2008; Thomson, 2003). Dental care is typically sought for treatment of pain rather than for a check-up and levels of untreated dental disease are generally higher (Slade *et al*., 2007). Pregnancy for Aboriginal Australian women is recognised as a time of particularly high oral health risk, with high levels of poor self-rated oral health being noted during this period (ARCPOH, 2013).

The purpose of this study was to determine if Stage of Change constructs (considered to be a proxy marker of psychosocial health) were associated with two subjective measures of oral health; self-rated oral health and oral health impairment, among a population at heightened risk of dental disease (women pregnant by an Aboriginal male and in Australia).

Methods

This study was nested in a larger, randomised controlled trial involving prevention of early childhood caries among Aboriginal children in South Australia (Merrick *et al*., 2012). Analyses for this paper comprised the cross-sectional baseline data. To be eligible, participants needed to be residing in South Australia, non-aboriginal and pregnant by an Aboriginal male. Data were collected via questionnaire (self-report or face-to-face interview) from February 2011 to May 2012. A range of recruitment strategies were used, including referrals from Aboriginal groups, community services and hospitals. 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.

There were two outcome variables; self-rated oral health and a composite oral health impairment measure. Self-rated oral health was assessed by the question; 'How do you think your dental health is?' with response options of 'excellent', 'very good', 'good', 'fair' or 'poor'. Based on the literature, responses were dichotomised into 'excellent, very good or good' and 'fair or poor' (Turrell *et al*., 2007). A summary oral health impairment variable was created by combining three items; experience of toothache, experience of not feeling comfortable due to mouth appearance and food avoidance. These were assessed by asking 'How often during the last year did you have toothache?', 'How often during the last year did you feel uncomfortable about the way your teeth looked?' and 'How often during the last year could you not eat some foods or had to eat slowly because of problems with your teeth?' For purposes of this analysis, those who answered 'very often', 'fairly often' or 'sometimes' to all of these items were considered to have impaired oral health because of oral health-related factors. Other possible responses were 'hardly ever' or 'never'.

Stage of Change in oral health was the main exposure variable and was assessed using an 18-item scale previously validated among this population. Briefly, the scale comprises items representing four Stage of Change constructs; 1, openness to health information (Openness); 2, valuing dental health (Value); 3, inconvenience of implementing positive oral health behaviours (Inconvenience) and; 4, permissiveness regarding consumption of sweet food/beverages (Permissiveness). Response options were on a five-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. Scores were coded 0 to 4, with high summary scores indicating high levels of the four respective domains. Item responses within each construct were summed. These summed values were then ranked and percentiles (tertiles) calculated for each participant within each construct. The derived percentiles were used to place participants into one of the three Stage of Change categories. Participants whose scores fell within the lowest tertile on 'Openness' and 'Value' were placed in the 'Pre-contemplative' group. Participants whose scores fell within the middle tertile on 'Openness', 'Value', 'Inconvenience' or 'Permissiveness' were placed in the 'Contemplative' group. Participants whose scores fell within the highest tertile on 'Openness' and 'Value' and the lowest tertile for 'Inconvenience' and 'Permissiveness' were placed in the 'Active' group. The categorisations were based on those used by Weinstein and Riedy (2001).

Confounders were represented by four domains; socio-demographics, dentate status, dental behaviour and dental cost. The socio-demographic factors comprised age, education, income, car ownership and caring for other children. Age was dichotomised into '14 to 24 years' and '25 years+'. Education was dichotomised into 'High school or less' or 'Trade/TAFE (vocational training) or University'. Dentate status comprised self-reported number of teeth previously extracted ('0 to 4' or '5+'). Dental behaviour variables included usual reason for seeing a dentist ('problem' or 'check-up'), perceived need to see a dentist ('yes' or 'no'), dental fear ('little bit, fair bit, heaps' or 'no'), toothbrush ownership ('yes' or 'no') and brushing the previous day ('yes' or 'no'). Dental cost confounders included avoiding dental care because of cost ('yes' or 'no') and having difficulty paying a $100 dental bill ('not hard at all or not very hard' or 'a little bit' or 'very hard', or 'could not pay').

Univariate and bivariate distributions of fair or poor self-rated oral health and oral health impairment were determined. The high prevalence of both fair or poor self-rated oral health and oral health impairment meant that odds ratios were poor indicators of relative frequency, so prevalence ratios (PR) were determined using Poisson regression modelling (Barros and Hirakata, 2003). Blocks of the main exposure variable and confounders significant at the $p<0.05$ level in bivariate analysis were entered into six prevalence regression models. Model 1 included the main exposure variable only, Model 2 included the main exposure variable and the socio-demographic variables, Model 3 included the main exposure variable and dentate status, Model 4 included the main exposure variable and dental behaviour variables, Model 5 included the main exposure variable and dental cost factors, and Model 6 included the main exposure variables and all other confounders. The degree of attenuation was calculated as the crude PR minus the adjusted PR, divided by the crude PR and multiplied by 100.

Results

Baseline questionnaire data used for this analysis were provided by 446 mothers. The age range of the sample was 14 to 42 years (mean 25 years, sd 6). Around 55% of

participants self-rated their oral health as 'fair' or 'poor', while just over one-third had oral health impairment (Table 1). Around 12% of participants were categorised as 'Pre-contemplative' in regards to the Stage of Change model, while 46% were considered 'Contemplative' and 42% 'Active'. A statistically significantly higher proportion of pre-contemplators, those with low educational attainment, those dependent upon welfare, those who did not own a car, cared for one or more children, with five or more teeth extracted, usually visited a dentist because of a problem, had a perceived need to see a dentist, had dental fear, did not own a toothbrush, did not brush their teeth the previous day, did not visit a dentist because of cost and reported difficulty paying a $100 dental bill had fair or poor self-rated oral health. A higher proportion of those categorised as 'Contemplative' in the Stage of Change model, aged 25 years or older, who cared for one or more children, had had five or more teeth extracted, usually visited a dentist because of a problem, had a perceived need to see a dentist, had dental fear, did not own a toothbrush, did not visit a dentist because of cost and reported difficulty paying a $100 dental bill had oral health impairment.

In multivariable modelling, being 'Pre-contemplative' or 'Contemplative' were risk indicators for poor self-rated oral health in the null model (Table 2; Model 1). There was a slight attenuation in prevalence ratios after the addition of socio-demographic factors, but 'Pre-contemplative' and 'Contemplative' persisted as statistically significant risk indicators (Table 2; Model 2). 'Pre-contemplative' was no longer significant upon addition of the dentate status variable (number of teeth extracted), while 'Contemplative' remained statistically significant (Table 2; Model 3). Pre-contemplative' was also no longer significant upon addition of dental behaviour variables, but 'Contemplative' remained statistically significant (Table 2; Model 4). When dental cost variables were added, 'Pre-contemplative' remained a statistically significant risk indicator, but 'Contemplative' was no longer significant (Table 2; Model 5). When all confounders were considered together, the Stages of Change variables were no longer significant; 'Pre-contemplative' was attenuated by 39% and 'Contemplative' was attenuated by 13% (Table 2; Model 6).

When considering risk indicators for oral health impairment in the multivariable models, only 'Contem-

Table 1. Stages of Change constructs, socio-demographic and dental behaviours characteristics by poor self-rated oral health and oral health impairment

		Total (%)	*Fair or poor self-rated oral health*		*Oral health impairment*[a]	
			n	*(%)*	*n*	*(%)*
Overall		446	242	(54.3)	151	(33.9)
Stages of Change	Pre-contemplative	53 (11.9)	**37**	**(69.8)**	**20**	**(37.7)**
	Contemplative	207 (46.4)	**121**	**(58.5)**	**85**	**(41.1)**
	Active	186 (41.7)	**84**	**(45.2)**	**46**	**(24.7)**
Age	14-24 years	221 (52.2)	112	(50.7)	**59**	**(26.7)**
	25+ years	202 (47.8)	116	(57.4)	**84**	**(41.6)**
Education	≤High school	317 (71.6)	**179**	**(56.5)**	109	(34.4)
	>High school	126 (28.4)	**60**	**(47.6)**	41	(32.5)
Income	Job	62 (14.1)	**27**	**(43.5)**	19	(30.6)
	Welfare	379 (85.9)	**212**	**(55.9)**	131	(34.6)
Car owned	Yes	225 (50.9)	**111**	**(49.3)**	71	(31.6)
	No	217 (49.1)	**128**	**(59.0)**	79	(36.4)
Number of children cared for	0	131 (31.8)	**55**	**(42.0)**	**30**	**(22.9)**
	1 or more	281 (68.2)	**167**	**(59.4)**	**107**	**(38.1)**
How many teeth extracted	0 to 4	250 (83.1)	**122**	**(48.8)**	**87**	**(34.8)**
	5 or more	51 (16.9)	**40**	**(78.4)**	**26**	**(51.0)**
Usual reason for seeing a dentist	Problem	276 (64.5)	**176**	**(63.8)**	**120**	**(43.5)**
	Check-up	152 (35.5)	**57**	**(37.5)**	**28**	**(18.4)**
Perceived need to see a dentist	Yes	378 (85.7)	**229**	**(60.6)**	**141**	**(37.3)**
	No	63 (14.3)	**10**	**(15.9)**	**9**	**(14.3)**
Scared of dentist	Little bit, fair bit, heaps	179 (40.5)	**123**	**(68.7)**	**81**	**(30.8)**
	No	263 (59.5)	**116**	**(44.1)**	**69**	**(38.5)**
Own a toothbrush	Yes	416 (93.9)	**218**	**(52.4)**	**135**	**(32.5)**
	No	27 (6.1)	**21**	**(77.8)**	**15**	**(55.6)**
Brushed yesterday	Yes	320 (75.1)	**153**	**(47.8)**	103	(32.2)
	No	106 (24.9)	**71**	**(67.0)**	35	(33.0)
Not gone to dentist because of cost	Yes	157 (35.5)	**104**	**(66.2)**	**69**	**(43.9)**
	No	285 (64.5)	**134**	**(47.0)**	**80**	**(28.1)**
Hard to pay a $100 dental bill?	Not at all or not very hard	87 (19.7)	**26**	**(29.9)**	**14**	**(16.1)**
	A little bit or very hard, or could not pay	354 (80.3)	**212**	**(59.9)**	**136**	**(38.4)**

[a]In the last year, had toothache and felt uncomfortable about appearance & avoided foods very often, fairly often or sometimes; Bold indicates $p<0.05$

Table 2. Risk indicators for poor self-rated oral health

Stage of Change constructs	*Model 1 PR (95% CI)*	*Model 2[a] PR (95% CI)*	*Model 3[b] PR (95% CI)*	*Model 4[c] PR (95% CI)*	*Model 5[d] PR (95% CI)*	*Model 6[e] PR (95% CI)*
Pre-contemplative	**1.59 (1.20,2.11)**	**1.43 (1.07,1.91)**	1.35 (0.94,1.94)	1.35 (0.96,1.89)	**1.43 (1.06,1.93)**	0.97 (0.64,1.48)
Contemplative	**1.30 (1.04,1.61)**	**1.27 (1.02,1.58)**	**1.23 (1.00,1.58)**	**1.22 (1.00,1.50)**	1.20 (0.99,1.48)	1.13 (0.90,1.41)
Active	ref	ref	ref	ref	ref	ref

Bold indicates p<0.05
[a]Adjusting for socio-demographic factors; education, income, car own, childcare,
[b]Adjusting for dentate status; number of teeth extracted
[c]Adjusting for dental behaviour; usual reason for seeing a dentist, need to see a dentist, scared of dentist, toothbrush ownership, brushed yesterday
[d]Adjusting for dental cost; avoid dentist because of cost, difficulty paying $100 dental bill
[e]Adjusting for all confounders

Table 3. Risk indicators for oral health impairment[†]

Stage of Change constructs	*Model 1 PR (95% CI)*	*Model 2[a] PR (95% CI)*	*Model 3[b] PR (95% CI)*	*Model 4[c] PR (95% CI)*	*Model 5[d] PR (95% CI)*	*Model 6[e] PR (95% CI)*
Pre-contemplative	1.19 (0.91,1.57)	1.13 (0.86,1.50)	1.35 (0.89,2.04)	1.07 (0.84,1.38)	1.09 (0.83,1.43)	1.16 (0.74,1.83)
Contemplative	**1.19 (1.04,1.36)**	1.14 (0.99,1.31)	**1.23 (1.03,1.46)**	**1.20 (1.05,1.38)**	**1.13 (1.00,1.30)**	1.14 (0.94,1.38)
Active	ref	ref	ref	ref	ref	ref

[†]In the last year, had toothache and felt uncomfortable about appearance and avoided foods very often, fairly often or sometimes
Bold indicates p<0.05
[a]Adjusting for socio-demographic factors; age, childcare
[b]Adjusting for dentate status; number of teeth extracted
[c]Adjusting for dental behaviour; usual reason for seeing a dentist, need to see a dentist, scared of dentist, toothbrush
[d]Adjusting for dental cost; avoid dentist because of cost, difficulty paying $100 dental bill
[e]Adjusting for all confounders

plative' was a risk indicator in the null model (Table 3; Model 1). 'Contemplative' was no longer significant upon addition of the socio-demographic factors (Table 3; Model 2). There was a slight increase in the 'Contemplative' prevalence ratio after addition of the dentate status variables (Table 3; Model 3). 'Contemplative' persisted as a statistically significant risk indicator upon addition of both dental behaviour (Table 3; Model 4) and dental cost factors (Table 3; Model 5), but was not significant when all confounders were considered together (Table 3; Model 6). In the final model, 'Pre-contemplative' was attenuated by 3% and 'Contemplative' was attenuated by 4%.

Discussion

The findings indicate that, in a convenience Australian sample of non-aboriginal women pregnant by an Aboriginal male, 'Pre-contemplators' and 'Contemplators' had poorer self-rated oral health and greater oral health impact than those classified as 'active' in bivariate analyses. In multivariable analyses, the 'Pre-contemplative' and 'Contemplative' Stage of Change constructs were both associated with poor self-rated oral health and oral health impairment after adjusting for some, but not all, covariates.

A gradient was noted between level of Stage of Change and poor self-rated oral health, with the prevalence of fair/poor self-rated oral health among those categorised as 'Pre-contemplative' being over one and a half times that of their counterparts categorised as 'Active'. Evidence suggests that poor self-rated oral health is associated with both non-ideal dental visiting patterns and higher levels of dental disease experience (Thomson *et al*., 2010; Zaitsu *et al*., 2011). Oral health initiatives that encompass components of the transtheoretical model in their design, such as motivational interviewing and other brief forms of psychotherapy (Miller and Rollnick, 2012), may have some utility among those being demonstrably 'Contemplative', whereas those who are 'Pre-contemplative' may not be ready to consider any change in their oral health behaviour.

Other variables that remained statistically significant in the final model for poor self-rated oral health included receiving an income from welfare, caring for one or more children, usually visiting the dentist because of a problem, perceived need for dental care and avoiding the dentist because of cost. For oral health impairment, additional variables that were statistically significant in the final model were usually visiting a dentist because of a problem and perceived need for dental care. It is likely that the Stage of Change constructs are proxy markers of other social and psychological phenomena contributing to variation in our outcomes of interest (Furuta *et al*., 2012). Zubrick and colleagues (2011) suggested that the prominent social determinants driving health inequalities among Australian Aboriginal groups were social support and stressful living conditions. Additional psychosocial factors such as a sense of personal control and self-efficacy have also been used to explain the health and socio-economic status relationship among Indigenous

populations both in Australia (Blair *et al*., 2005) and elsewhere (Galliher *et al*., 2011).

The oral health impairment composite measure comprises specific items about the frequency with which problems with the teeth or mouth impose functional limitation, impairment or disability. The broader construct of the global self-rated oral health item, on the other hand, is not confined to specific referents and may be interpreted in different ways based on norms, expectations and health standards. For example, it has been reported that those who rate their oral health as poor are also more depressed, unhappy and perceive their mental health less favourably than those with good self-rated oral health (Matthias *et al*., 1995). While the two oral health measures assess different dimensions of perceived oral health, it is important in the context of this study that the Stage of Change constructs were significantly associated with both after adjusting for some, but not all, hypothesised confounding variables.

Attention has recently shifted from individual-level determinants of Australian Aboriginal health to the role of broader socio-political factors. In the oral health context, this has been demonstrated in New Zealand where changes in economic policy in the early 1990s were associated with widening inequalities in caries experience between Maori and non-Maori children (Thomson *et al*., 2002). In Australia, the role of colonisation, government policies of child separation and covert racism on many health outcomes among the Aboriginal population cannot be ignored (Cunningham and Paradies, 2013).

In summary, this study has presented evidence that Stages of Change constructs, when considered to be proxy markers of psychosocial health, may have some utility in contributing to the knowledge base of understanding the drivers of two conceptually separate measures of oral health; self-rated oral health and oral health impairment. When considered as a proxy marker of psychosocial health, Stage of Change constructs may have some relevance for subjective oral health, although further work is required to understand this relationship more clearly.

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