

Familial and cultural perceptions and beliefs of oral hygiene and dietary practices among ethnically and socio-economically diverse groups

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Objective The aim of this international study was to develop a valid and reliable psychometric measure to examine the extent to which parents' attitudes about engaging in twice-daily tooth brushing and controlling sugar snacking predict these respective behaviours in their children. A supplementary objective was to assess whether ethnic group, culture, level of deprivation or children's caries experience impact upon the relationships between oral health related behaviours, attitudes to these respective behaviours and to dental caries. **Clinical setting** nurseries, health centres and dental clinics in 17 countries. **Participants** 2822 children aged 3 to 4 years and their parents. **Main outcome measures** Dental examination of children and questionnaire to parents. **Results** factor analysis identified 8 coherent attitudes towards toothbrushing, sugar snacking and childhood caries. Attitudes were significantly different in families from deprived and non-deprived backgrounds and in families of children with and without caries. Parents' perception of their ability to control their children's toothbrushing and sugar snacking habits were the most significant predictors of whether or not favourable habits were reported. Some differences were found by site and ethnic group. **Conclusions** this study supports the hypothesis that parental attitudes significantly impact on the establishment of habits favourable to oral health. An appreciation of the impact of cultural and ethnic diversity is important in understanding how parental attitudes to oral health vary. Further research should examine in a prospective intervention whether enhancing parenting skills is an effective route to preventing childhood caries.

Key words: Child, dental health, behaviour, attitudes, parent, efficacy

Introduction

Societal contexts can inhibit healthy choices. However, within those constraints, behaviours adopted by individuals can make a negative or positive contribution to health. For children, parents and family members' influence on oral health in particular is central (Mattila *et al.*, 2000).

Less than twice daily tooth brushing and sugar snacking between meals have been identified as key behaviours explaining the presence of dental caries in children (Harris *et al.*, 2004). It is unclear how parents' attitudes to childhood caries influence dental caries related behaviours in their children. The current paper outlines the approach used to test a theoretically based construct of parental attitudes towards toothbrushing and sugar-snacking

The principal research question is to examine the extent to which parents' attitudes about engaging in twice-daily tooth brushing and controlling sugar snacking predict these respective behaviours in their children. A supplementary objective is to assess whether ethnic group, culture, level of deprivation or children's caries experience impact upon the relationships between oral health related behaviours, attitudes to these respective behaviours and to dental caries. These research questions have been formulated within an international consortium (Pine *et al.*, 2004) and are addressed by developing a valid and reliable psychometric measure.

Method

Questionnaire construction and development

Attitudinal items associated with the two oral health behaviours (tooth brushing and sugar snacking) were developed from the Theory of Planned Behaviour (Ajzen, 1991), Health Belief Model (Rosenstock *et al.*, 1988) and the Health Locus of Control (Wallston *et al.*, 1978) model. Thoughts about disease can mediate behaviour and outcome to that disease, therefore assessments of parents' attitudes to dental caries were also included. This paper considers the first part of the model (see Figure 3 in Pine *et al.*, (2004)) seeking to investigate how parental attitudes may impact on their children's behaviours of twice daily toothbrushing and sugar snacking.

The questionnaire was developed in English and also included questions on reported behaviour in relation to their child's current and past dietary and toothbrushing habits, dental attendance and family structure. For administration in countries where English is not the main language, translation into the country's primary language was conducted by a native speaker, pre-tested and then back translated by another native speaker to ensure comparability to the original form.

Sample selection

Researchers were asked to recruit 100 children and parents at each site, with 50% as "caries free" and 50% with at least 3 decayed teeth. The researcher classified parents according to their child's caries status and as either deprived or non-deprived. The classification of deprivation was based upon local measures. In order to provide a standard measure of deprivation across this

international study, mother's education level was used as the classification of deprivation (Pine *et al.*, 2004). Mothers educated beyond secondary school were classed as non-deprived and those educated up to secondary school were classed as deprived.

Statistical methods

Item analysis and internal consistency of the measure

Standard psychometric measure development techniques from psychological research were applied (Frazer and Lawley, 2000). The aim is to determine the set of items which provide a valid and reliable measure.

Item analysis was conducted on attitudes relating to toothbrushing behaviour, sugar behaviour and childhood dental caries. The analysis was undertaken by calculating total item means, standard deviations, and item-total correlation, which were used to determine internal reliability of each item in relation to the questionnaire as a whole (Kline, 1986). Items with low internal reliability were excluded (Litwin, 1995). Cronbach's alpha coefficient was used to test internal consistency

Factor analysis

Factor analysis using the Principal Components method was conducted for parental attitudes towards toothbrushing, sugar behaviours and dental caries separately. The factor loadings were taken from the rotated component matrix, which was generated using the varimax method. Cronbach's alpha was calculated for each factor to check reliability. Factors were given a title based on the content of the statements within the factor. New variables were created containing factor scores, which were calculated as the sum of the Likert scale responses for each item within the factor.

Logistic regression

Forward stepwise logistic regressions were undertaken to determine whether any of the parents' responses (as measured by the factors) contributed to the variation in their children's reported toothbrushing and sugar behaviour. The combination of reported individual children's sugar-related behaviours that resulted in the lowest numbers of children with caries were as follows. Children who "don't drink sugary drinks in bed", "don't eat sweets or chocolate every day or most days", "don't drink sugary drinks every day", and "don't add sugar to drinks". Overall, 20% of the sample reported this favourable combination of behaviours.

The first regression took reported tooth brushing twice per day as the outcome behaviour and the factors extracted from the factor analysis on toothbrushing items as the predictors. The second regression took the composite sugar behaviour variable described above, as outcome and the factors extracted from the factor analysis on the sugar-related items as the predictors. Logistic regressions were carried out for the whole data set as well as each of the two largest ethnic groups separately, i.e. white and Chinese families. For the whole sample, data were weighted so each site, within each continental group contributed equally. Caries status, deprivation level (mothers' education) and the factors relating to attitudes

towards tooth decay were entered as additional variables to control for their influence.

In logistic regression analyses, the Nagelkerke R² measure was used as an estimate of the “percentage of variance explained.” This statistic imitates multiple R² from linear regression, which is not itself applicable to logistic regression.

Results

Study participants

Overall, 2822 parents with children aged 3 or 4 years, 50% of children with caries and 50% caries free, 47% classified as deprived using local measures and 53% classified as non-deprived participated in the study in 27 sites in 17 countries. Ages of the parents (or other adult family members completing the questionnaire) ranged from under 20 years (1%), 20–30 years (32%), 31–40 years (56%) and over 40 years (11%). 84% of respondents were the child’s mother, 13% father, 2% grandparent and the remaining 1%, other relatives or guardians.

Results of factor analysis

Factors derived from the Final Principal Components analysis of all the questionnaire data are given in Figures 1 to 3. Three factors or attitudes were identified for tooth brushing behaviour. The first has been titled *importance and intention to brush child’s teeth*. The second factor reflects *parental efficacy in relation to child toothbrushing*. Parental efficacy is defined here as parents’ belief in their ability to take action and administer parental control (Swick and Broadway, 1997) and is derived from the notion of self-efficacy (Bandura, 1982; Bandura, 1997). The third factor derived from the analysis has been titled *attitudes towards prevention* (Figure 1). For sugar behaviour, two factors were identified and these were similar in content to tooth brushing behaviour. The first,

factor 1 was *parental importance and intention to control child sugar snacking*. The second, factor 2 has been titled *parental efficacy in relation to controlling child sugar snacking* (Figure 2). Three factors were elicited for attitudes towards dental decay: first, *perceived seriousness of tooth decay in children*, second, *chance control – decay occurs by chance* and the third factor, *external control – preventing decay is the dentist’s responsibility* (Figure 3).

A separate factor analysis was carried out for the data from the USA, weighting data so that each ethnic/racial group (African-American, Chinese-American, Mexican-American and white Americans) contributed equally. From the analysis of US data, factors extracted were similar to the whole international sample with the following differences. The factor *Importance and intention to brush their child’s teeth* included the item: ‘If we brush our child’s teeth twice a day, we can prevent our child getting tooth decay in the future’. As this item loaded onto this factor and not the prevention factor, as in the whole sample, the latter factor had two items loaded and this was not extracted from the US only analysis.. Factors *Importance and intention to control child sugar snacking* and *parental efficacy in relation to controlling child sugar snacking* were identical to the whole sample. For attitudes towards dental caries, the *perceived seriousness of tooth decay in children* factor and *External control – preventing decay is the dentist’s responsibility* factor were identical to the whole sample factors. The *Chance control – decay occurs by chance* factor did not contain the items: ‘Tooth decay runs in families’ and ‘some people just naturally have soft teeth’.

Comparisons of parental attitudes (factor scores) for each site and country

Mean factor scores for each site are displayed in Tables 1, 2 and 3. Each table is ordered with sites of most

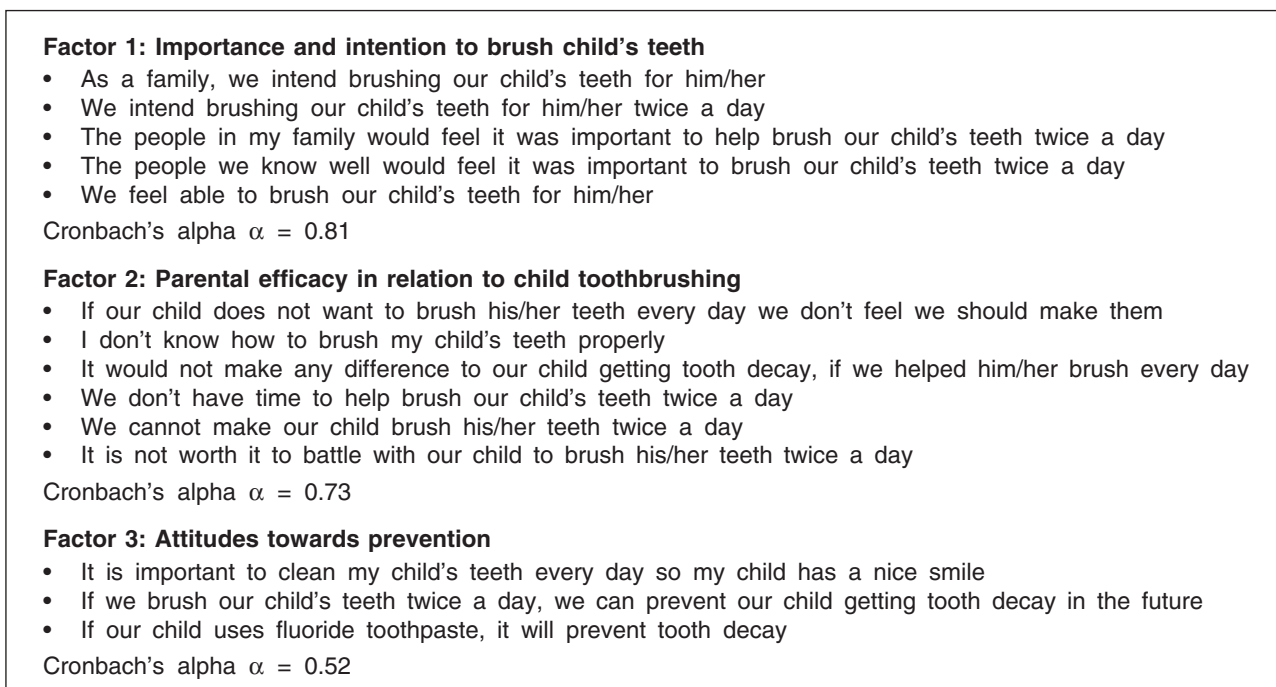


Figure 1. Factors extracted as parental attitudes towards child toothbrushing behaviour.

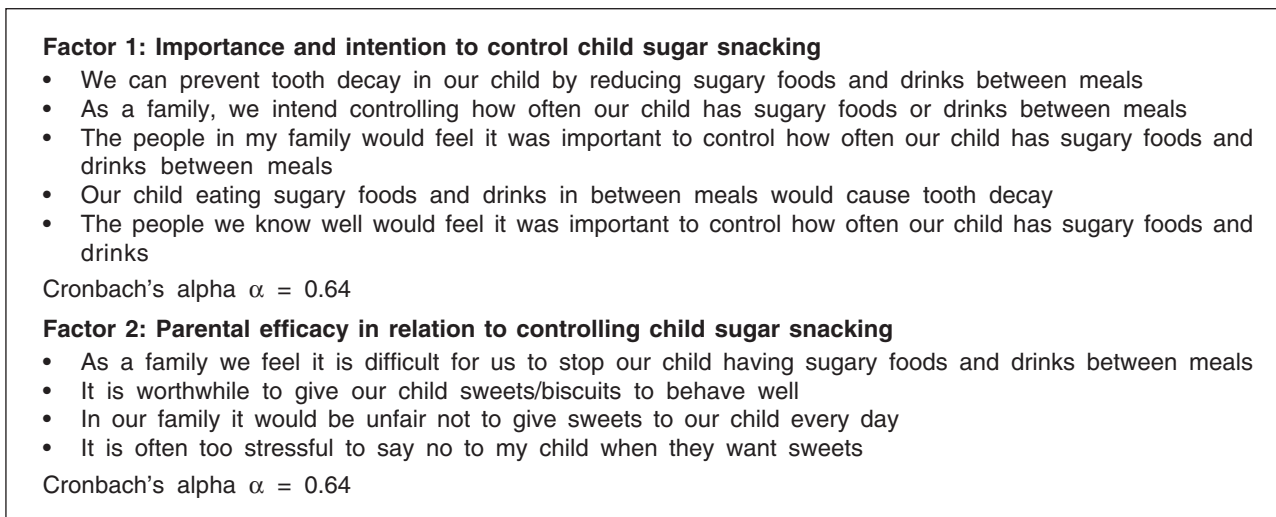


Figure 2. Factors extracted as parental attitudes towards child sugar snacking.

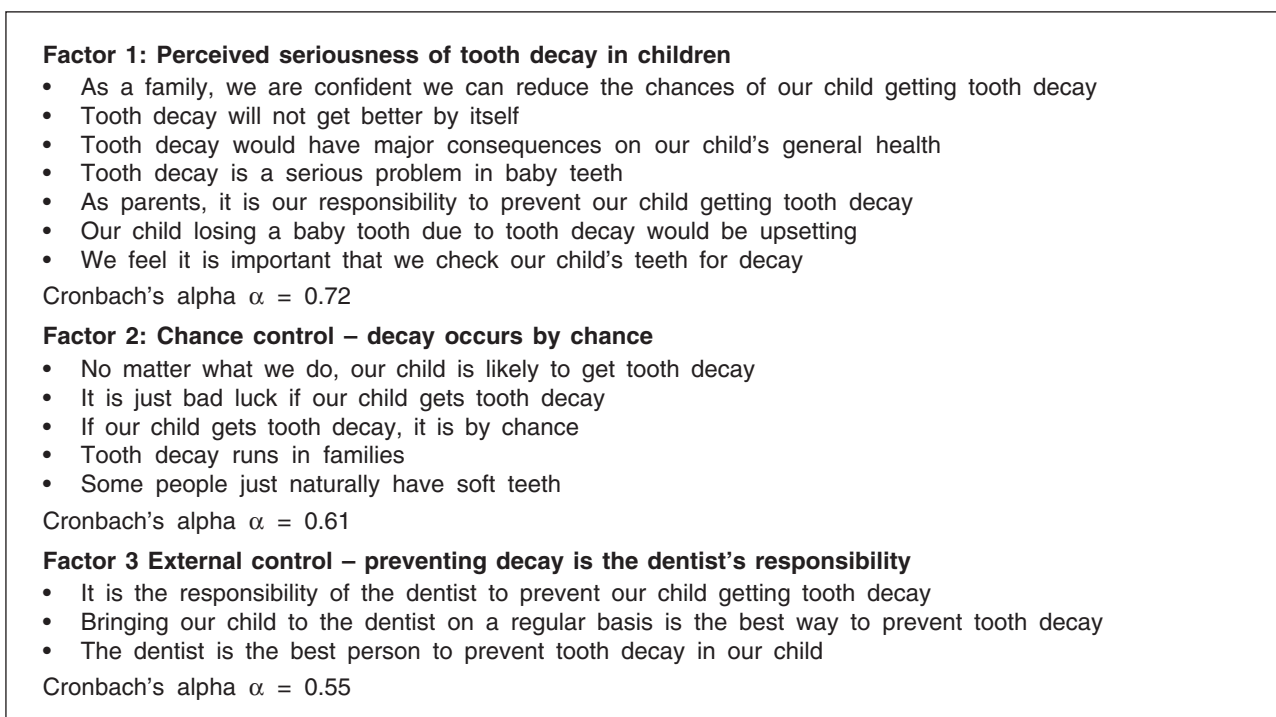


Figure 3. Factors extracted for parental attitudes towards dental decay

positive attitudes (highest mean factor scores) at the top. Table 1 presents the factor scores for parental attitudes about their children's toothbrushing. Of note, is that all scores are over 3 for all factors, except at one site. Therefore, most parents tend to hold slightly positive to very positive attitudes in relation to the importance of children's toothbrushing, their ability to support the habit and in their attitudes towards its value in preventing tooth decay. In this study sample, families from Scandinavia (Norway and Denmark) are very positive across all these parameters. In contrast attitudes of study parents in China tend to be more neutral. Attitudes of parents in the USA are different depending on their ethnic background. For example, in this study, Mexican Americans are very positive about the value of toothbrushing and their intention to brush their children's teeth twice daily. However, they are less likely to believe

in their ability to implement these behaviours than African-American or white American parents, meaning that the behaviour is less likely to occur despite good intentions. Table 2 shows a similar trend for Mexican-Americans in relation to intentions being more positive than parents' attitudes towards being able to control their children's sugar snacking. In fact, overall factor scores in Table 2, for parents' perceived ability to control sugar snacking in their children are lower than parents' perception of the importance that they should do so. There are only three exceptions to this pattern, these are the study parents from Belgium, Norway and Denmark who strongly believe that they can control their child's sugar snacking but do not believe as strongly in the importance of doing so. Their beliefs about the importance of twice daily toothbrushing are much stronger.

Table 1. Factor scores (mean, sd) of parental attitudes towards tooth brushing by country, site and *racial/ethnic group* ordered within each factor from most (top of table) to least positive attitudes.

<i>Importance and intention to brush child's teeth</i>		<i>Parental efficacy in relation to child toothbrushing</i>		<i>Attitudes towards prevention</i>	
Denmark <i>White</i>	4.34 (0.65)	Norway <i>White</i>	4.40 (0.52)	Madagascar <i>African</i>	4.24 (0.64)
Norway <i>White</i>	4.28 (0.59)	Denmark <i>White</i>	4.33 (0.67)	Mexico <i>Mexican</i>	4.22 (0.68)
Tanzania <i>African</i>	4.15 (0.70)	Scotland <i>White</i>	4.31 (0.44)	USA <i>Mexican-American</i>	4.17 (0.76)
USA <i>Mexican-American</i>	4.13 (0.80)	Northern Ireland <i>White</i>	4.29 (0.53)	South Africa <i>Black African</i>	4.13 (0.76)
England <i>Chinese</i>	4.06 (0.61)	Wales <i>White</i>	4.25 (0.61)	Denmark <i>White</i>	4.10 (0.67)
Thailand <i>Thai</i>	4.04 (0.53)	USA <i>African-American</i>	4.20 (0.52)	Tanzania <i>African</i>	4.04 (0.59)
Mexico <i>Mexican</i>	4.03 (0.70)	USA <i>White</i>	4.16 (0.49)	Norway <i>White</i>	3.97 (0.66)
Wales <i>White</i>	4.01 (0.65)	Tanzania <i>African</i>	4.09 (0.79)	USA <i>White</i>	3.96 (0.59)
USA <i>White</i>	4.00 (0.80)	Ireland <i>White</i>	4.03 (0.57)	Thailand <i>Thai</i>	3.94 (0.49)
Scotland <i>White</i>	4.00 (0.67)	England <i>Chinese</i>	3.87 (0.61)	Northern Ireland <i>White</i>	3.92 (0.69)
England <i>Pakistani</i>	3.92 (0.43)	Belgium <i>White</i>	3.86 (0.61)	Scotland <i>White</i>	3.91 (0.60)
Ireland <i>White</i>	3.90 (0.61)	England <i>Pakistani</i>	3.84 (0.31)	USA <i>African-American</i>	3.88 (0.71)
Czech Republic <i>White</i>	3.87 (0.49)	USA <i>Mexican-American</i>	3.81 (0.80)	Pakistan <i>Pakistani</i>	3.88 (0.43)
Northern Ireland <i>White</i>	3.86 (0.80)	South Africa: Capetown <i>Cape Coloured</i>	3.79 (0.58)	England <i>Chinese</i>	3.88 (0.55)
South Africa <i>Black African</i>	3.80 (0.73)	Italy <i>White</i>	3.74 (0.58)	South Africa: Capetown <i>Cape Coloured</i>	3.85 (0.64)
Madagascar <i>African</i>	3.74 (0.69)	Thailand <i>Thai</i>	3.73 (0.54)	Germany <i>White</i>	3.83 (0.50)
South Africa :Capetown <i>Cape Coloured</i>	3.71 (0.69)	China: Hong Kong <i>Chinese</i>	3.66 (0.53)	Singapore <i>Chinese</i>	3.81 (0.49)
USA <i>Chinese</i>	3.70 (0.59)	Singapore <i>Chinese</i>	3.65 (0.57)	USA <i>Chinese</i>	3.80 (0.56)
Pakistan <i>Pakistani</i>	3.68 (0.54)	Pakistan <i>Pakistani</i>	3.63 (0.53)	China: Hong Kong <i>Chinese</i>	3.76 (0.59)
Singapore <i>Chinese</i>	3.67 (0.59)	China: Guangzhou <i>Chinese</i>	3.63 (0.48)	England <i>Pakistani</i>	3.74 (0.48)
China: Hong Kong <i>Chinese</i>	3.65 (0.67)	Germany <i>White</i>	3.60 (0.62)	China: Guangzhou <i>Chinese</i>	3.74 (0.64)
USA <i>African-American</i>	3.61 (0.94)	USA <i>Chinese</i>	3.53 (0.52)	Wales <i>White</i>	3.72 (0.66)
Germany <i>White</i>	3.56 (0.58)	Czech Republic <i>White</i>	3.50 (0.72)	Ireland <i>White</i>	3.72 (0.62)
Italy <i>White</i>	3.39 (0.54)	South Africa <i>Black African</i>	3.38 (0.65)	China: Shanghai <i>Chinese</i>	3.68 (0.54)
China: Shanghai <i>Chinese</i>	3.35 (0.75)	China: Shanghai <i>Chinese</i>	3.33 (0.59)	Belgium <i>White</i>	3.67 (0.64)
China: Guangzhou <i>Chinese</i>	3.21 (0.72)	Madagascar <i>African</i>	3.33 (0.72)	Italy <i>White</i>	3.66 (0.56)
Belgium <i>White</i>	3.20 (0.71)	Mexico <i>Mexican</i>	2.87 (0.83)	Czech Republic <i>White</i>	3.65 (0.55)

The mean factor scores in Table 3 show that most parents would regard tooth decay as a serious condition in their children. However, in half the sites a score of less than 3 was obtained for the attitude which measured whether parents believe that it is the dentist's responsibility to prevent decay. Of interest, is that this factor separated the US ethnic groups with more African-American, Mexican-American and Chinese-American families having this attitude than white Americans (Figure 4).

Mean factor scores for the whole sample combined by sub-group are presented in Table 4. These show the average attitudinal scores obtained for the 4 sub-groups of families within the sample, i.e. for parents of children with and without caries from deprived and non-deprived families (deprivation measure: mother's education level). Analyses of variance were conducted for each attitude to determine whether there were any significant differences

between the groups. All factors were found to be significantly different between groups overall and *post hoc* pairwise tests were undertaken to describe the source of these differences. For all factors, the groups with mothers with further education had more positive attitudes than those without, and within these groups, parents of caries free children had more positive attitudes than parents of children with caries. The largest differences were found in the factor measuring parental efficacy in relation to toothbrushing. Deprived families of children with caries felt least able to ensure that children brushed their teeth twice a day.

Table 5 shows the attitudes of parents (mean factor scores) towards toothbrushing and sugar snacking behaviour. In each case, parents of children with less favourable oral health behaviours are less likely to report that their children have favourable toothbrushing and sugar snacking habits.

Table 2. Factor scores (mean, sd) of parental attitudes towards child sugar snacking by country, site and *racial/ethnic group* ordered within each factor from most (top of table) to least positive attitudes.

<i>Importance and intention to control child sugar snacking</i>		<i>Parental efficacy in relation to controlling child sugar snacking</i>	
Madagascar African	4.20 (0.62)	Norway White	4.11 (0.66)
USA Mexican-American	4.19 (0.67)	USA White	3.88 (0.64)
USA African-American	4.19 (0.46)	Denmark White	3.83 (0.68)
England Chinese	4.14 (0.50)	USA African-American	3.76 (0.79)
Northern Ireland White	4.12 (0.52)	Tanzania African	3.75 (0.74)
USA White	4.07 (0.55)	Belgium White	3.73 (0.64)
England Pakistani	4.06 (0.32)	Northern Ireland White	3.62 (0.73)
South Africa Black African	4.02 (0.47)	Scotland White	3.60 (0.64)
Scotland White	4.00 (0.53)	Ireland White	3.57 (0.73)
Wales White	3.97 (0.58)	USA Mexican-American	3.57 (0.88)
Ireland White	3.97 (0.47)	China :Guangzhou Chinese	3.55 (0.52)
Singapore Chinese	3.95 (0.34)	Thailand Thai	3.53 (0.58)
Mexico Mexican	3.92 (0.59)	South Africa Black African	3.53 (0.74)
USA Chinese	3.91 (0.46)	Wales White	3.50 (0.77)
South Africa :Capetown Cape Coloured	3.86 (0.50)	Mexico Mexican	3.42 (0.69)
Tanzania African	3.85 (0.67)	USA Chinese	3.40 (0.60)
China: Hong Kong Chinese	3.84 (0.42)	Germany White	3.37 (0.55)
Pakistan Pakistani	3.84 (0.44)	South Africa: Capetown Cape Coloured	3.35 (0.70)
Denmark White	3.82 (0.52)	China :Hong Kong Chinese	3.30 (0.61)
Italy White	3.79 (0.44)	England Chinese	3.27 (0.72)
Norway White	3.79 (0.55)	Pakistan Pakistani	3.23 (0.66)
Thailand Thai	3.79 (0.49)	Madagascar African	3.21 (0.81)
China: Shanghai Chinese	3.79 (0.39)	Singapore Chinese	3.19 (0.73)
China: Guangzhou Chinese	3.70 (0.44)	Italy White	3.14 (0.57)
Czech Republic White	3.68 (0.47)	Czech Republic White	3.12 (0.75)
Belgium White	3.63 (0.55)	England Pakistani	3.06 (0.69)
Germany White	3.55 (0.37)	China :Shanghai Chinese	2.90 (0.66)

Table 3. Factor scores (mean, sd) of parental attitudes towards dental caries by country, site and *racial/ethnic group* ordered within each factor from most (top of table) to least positive attitudes.

<i>Perceived seriousness of tooth decay in children</i>		<i>Chance control – decay occurs by chance</i>		<i>External control – preventing decay is the dentist’s responsibility</i>	
Norway White	4.41 (0.46)	Northern Ireland White	3.90 (0.64)	Norway White	3.65 (0.68)
USA White	4.40 (0.41)	Tanzania African	3.86 (0.68)	Ireland White	3.39 (0.56)
Scotland White	4.32 (0.50)	Scotland White	3.80 (0.61)	Germany White	3.29 (0.50)
Northern Ireland White	4.31 (0.49)	China: Guangzhou Chinese	3.79 (0.47)	Tanzania African	3.29 (0.90)
USA Mexican-American	4.31 (0.72)	Norway White	3.78 (0.60)	Belgium White	3.24 (0.75)
Ireland White	4.28 (0.47)	Ireland White	3.77 (0.64)	Northern Ireland White	3.21 (0.68)
Wales White	4.28 (0.47)	China: Hong Kong Chinese	3.72 (0.48)	Scotland White	3.17 (0.69)
USA African-American	4.24 (0.62)	Wales White	3.68 (0.72)	Wales White	3.15 (0.73)
Belgium White	4.21 (0.53)	Singapore Chinese	3.68 (0.51)	USA White	3.14 (0.69)
Madagascar African	4.20 (0.60)	Germany White	3.67 (0.53)	Denmark White	3.09 (0.73)
Denmark White	4.18 (0.51)	South Africa Black African	3.64 (0.74)	South Africa: Capetown Cape Coloured	3.07 (0.63)
South Africa: Capetown Cape Coloured	4.16 (0.49)	England Chinese	3.62 (0.71)	China: Hong Kong Chinese	3.02 (0.60)
Mexico Mexican	4.15 (0.58)	USA African-American	3.62 (0.55)	China: Guangzhou Chinese	3.01 (0.59)
England Chinese	4.14 (0.58)	South Africa: Capetown Cape Coloured	3.61 (0.61)	England Pakistani	2.97 (0.72)
Tanzania African	4.13 (0.58)	USA Mexican-American	3.60 (0.74)	USA African-American	2.87 (0.68)
Italy White	4.13 (0.42)	USA White	3.57 (0.60)	Singapore Chinese	2.82 (0.65)
Singapore Chinese	4.10 (0.45)	USA Chinese	3.56 (0.52)	England Chinese	2.82 (0.65)
USA Chinese	4.07 (0.50)	Denmark White	3.55 (0.64)	China :Shanghai Chinese	2.81 (0.64)
China: Guangzhou Chinese	4.06 (0.45)	China: Shanghai Chinese	3.54 (0.41)	Thailand Thai	2.80 (0.69)
Germany White	4.06 (0.58)	Mexico Mexican	3.54 (0.66)	Italy White	2.79 (0.67)
China: Hong Kong Chinese	3.93 (0.52)	Belgium White	3.45 (0.64)	Czech Republic White	2.72 (0.70)
Czech Republic White	3.89 (0.40)	Madagascar African	3.34 (0.98)	USA Mexican-American	2.67 (0.73)
Thailand Thai	3.89 (0.46)	Thailand Thai	3.30 (0.63)	USA Chinese	2.62 (0.69)
Pakistan Pakistani	3.85 (0.40)	England Pakistani	3.30 (0.54)	Mexico Mexican	2.47 (0.74)
China: Shanghai Chinese	3.82 (0.46)	Italy White	3.23 (0.48)	South Africa Black African	2.38 (0.77)
South Africa Black African	3.77 (0.63)	Pakistan Pakistani	3.10 (0.60)	Pakistan Pakistani	2.25 (0.64)
England Pakistani	3.75 (0.48)	Czech Republic White	2.95 (0.57)	Madagascar African	1.75 (0.72)

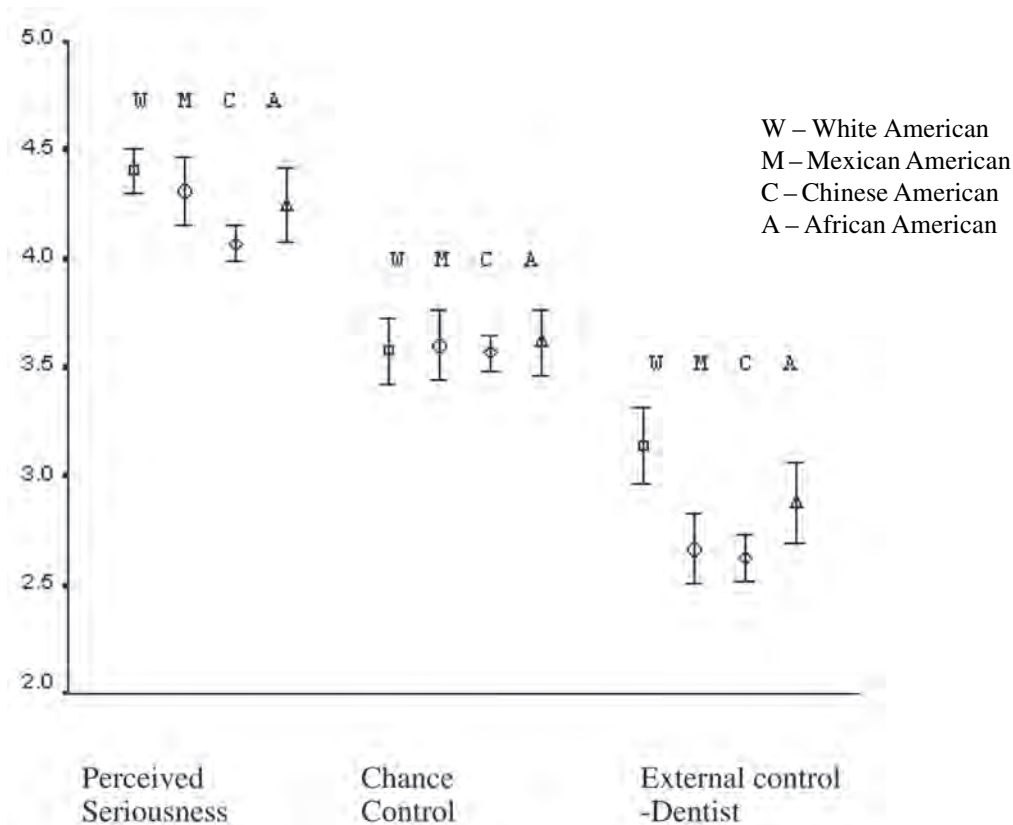


Figure 4. Factor scores (mean, 95% confidence interval as error bar) of parental attitudes towards dental caries in US families by racial/ethnic group.

Parental attitudes (factors) which predict child dental health behaviours.

Two thousand, six hundred and sixty-two cases for tooth brushing behaviour and 2745 cases for sugar behaviour were analysed in each logistic regression respectively following dropped cases due to missing data, (Table 6). The regressions were undertaken to examine the relationship between reported child behaviour and parental attitudes to the behaviour whilst controlling for the child's caries experience, mothers education, and parental attitudes towards tooth decay. As described in the statistical methods, data were analyzed for the sample as a whole and for the two largest ethnic groups (White and Chinese). The *p*-values for significance of Wald statistics and odd ratios for each of the predictors are also shown in Table 6.

For all three regression models, parental efficacy factors were the strongest predictors in both establishing toothbrushing behaviour and controlling sugar snacking for children (Table 6), this relationship was also seen when examining the mean factor scores (Table 5). The importance attached to the behaviours and intention was also influential as an additional predictive factor for toothbrushing behaviour. More of the variation in behaviours could be explained when a single ethnic group was examined. Using the Nagelkerke R^2 approximation, for the white group, parental efficacy predicted 20% of the variance in reported twice daily child tooth brushing rising to 27% with importance/intention of child tooth brushing added, compared to 10% and 13% for all ethnic groups. For reported child sugar snacking behaviour in this group, 16% of the variance was explained by parental efficacy compared to 6% for the whole group. The pattern for the

Chinese sample was similar with an estimated 20% of the variance in reported toothbrushing behaviour being explained by parental efficacy.

In the model for all ethnic groups predicting twice a day brushing, the parental efficacy factor has an odds ratio of 2.3. This means that an increase of 1 in the value of the parental efficacy factor increases the odds of parents reporting that their children's teeth are brushed twice a day by a factor of 2.3 times, after controlling for the other variables in the model. This rose to 3.9 for white families and 6.3 for Chinese families. Therefore, Chinese parents are over 6 times more likely to report that their children's teeth are brushed twice a day if they have a positive attitude towards toothbrushing. These findings are independent of the child's caries status or mother's education which were both controlled for in the model.

Discussion

This study aimed to examine whether parental attitudes towards twice daily toothbrushing and controlling children's sugar snacking could explain whether these behaviours became established. Through systematic development and analysis, a valid and reliable measure was developed within an international collaborative programme. Its application to parents from a wide range of countries, diverse ethnic groups, from deprived and non-deprived backgrounds and for those with children who had experienced caries and those who had not has allowed a comprehensive initial analysis of all these factors. This analysis indicates that parental attitudes towards these oral health related behaviours do influence

Table 4. Mean factor scores (standard deviations) for all sites combined, by deprivation (mother's education level) and child's caries status, analyses of variance examining group differences by factor and Tukey's *post hoc* tests to determine which groups have significantly different factor scores (attitudes).

<i>Children's caries status</i> <i>Mother's education level</i> <i>(deprivation proxy)</i>	<i>Caries free</i>		<i>With caries</i>		<i>p-value</i> <i>(ANOVA)</i>	<i>Significant pairwise differences between groups</i> <i>(Tukey's post hoc test)</i> <i>*p<0.05, **p<0.01</i>
	<i>Mother with further education</i> <i>GROUP A</i> <i>(n=635)</i>	<i>Mother with further education</i> <i>GROUP B</i> <i>(n=534)</i>	<i>Caries free Mother no further education</i> <i>GROUP C</i> <i>(n=726)</i>	<i>With caries Mother no further education</i> <i>GROUP D</i> <i>(n=857)</i>		
Toothbrushing factors						
Importance and intention to brush child's teeth	3.88 (0.76)	3.85 (0.70)	3.75 (0.74)	3.74 (0.65)	<0.001	AvC**, AvD**, BvD*
Parental efficacy in relation to child toothbrushing	4.10 (0.61)	3.88 (0.69)	3.70 (0.71)	3.59 (0.66)	<0.001	AvB**, AvC**, AvD**, BvC**, BvD**, CvD**
Attitudes towards prevention	3.93 (0.66)	3.91 (0.64)	3.87 (0.62)	3.81 (0.60)	<0.001	AvD**, BvD*
Sugar factors						
Importance and intention to control child sugar snacking	3.95 (0.52)	3.91 (0.53)	3.88 (0.52)	3.86 (0.53)	0.007	AvC*, AvD**
Parental efficacy in relation to controlling child sugar snacking	3.67 (0.70)	3.53 (0.76)	3.39 (0.72)	3.28 (0.70)	<0.001	AvB**, AvC**, AvD**, BvC**, BvD**, CvD*
Dental caries factors						
Perceived seriousness of tooth decay in children	4.31 (0.48)	4.15 (0.53)	4.09 (0.52)	3.97 (0.55)	<0.001	AvB**, AvC**, AvD**, BvD**, CvD**
Chance control – decay occurs by chance	3.75 (0.61)	3.57 (0.66)	3.54 (0.63)	3.42 (0.66)	<0.001	AvB**, AvC**, AvD**, BvD**, CvD**
External control – preventing decay is the dentist's responsibility	3.16 (0.77)	3.01 (0.79)	2.83 (0.79)	2.75 (0.74)	<0.001	AvB**, AvC**, AvD**, BvC**, BvD**

Table 5. Mean (s.d.) factor scores (for all sites combined) grouped by reported child toothbrushing and sugar-snacking behaviour

	<i>Children grouped according to reported behaviour</i>			
	<i>Child reported to have favourable brushing behaviour (twice daily) (n=1673)</i>	<i>Child reported to have less favourable brushing behaviour (less than twice daily) (n=1066)</i>	<i>Child reported to have favourable sugar snacking behaviour (n=2275)</i>	<i>Child reported to have less favourable sugar snacking behaviour (n=554)</i>
Toothbrushing factors				
Importance and intention to brush child's teeth	3.94 (0.70)	3.58 (0.68)	3.96 (0.49)	3.89 (0.53)
Parental efficacy in relation to child toothbrushing	3.97 (0.66)	3.53 (0.67)	3.78 (0.69)	3.37 (0.72)
Attitudes towards prevention	3.91 (0.62)	3.81 (0.63)		
Sugar factors				
Importance and intention to control child sugar snacking				
Parental efficacy in relation to controlling child sugar snacking				
Dental caries factors				
Perceived seriousness of tooth decay in children	4.14 (0.53)	4.05 (0.53)	4.18 (0.54)	4.10 (0.53)
Chance control – decay occurs by chance	3.61 (0.66)	3.48 (0.64)	3.66 (0.66)	3.53 (0.65)
External control – preventing decay is the dentist's responsibility	2.94 (0.79)	2.86 (0.79)	3.03 (0.79)	2.89 (0.78)

Table 6. Stepwise logistic regression models to examine the relationship between reported child behaviour and parental attitudes to the behaviour, significance of Wald statistic (p), odds ratio (OR) of each factor, and cumulative Nagelkerke R²

Racial/Ethnic group	Step 1	Step 2	Step 3	Step 4	Step 5
	<i>Behaviour – Child reported to brush twice daily</i>				
All groups combined	Parental efficacy in relation to child toothbrushing R ² 10%, p <0.001 OR 2.3	Importance and intention to brush child's teeth R ² 13%, p <0.001 OR 1.7	Perceived seriousness of tooth decay in children R ² 13%, p =0.002 OR 0.8	Child's caries status R ² 14%, p =0.001 OR 0.7	Chance control – decay occurs by chance R ² 14%, p =0.041 OR 0.9
White only	Parental efficacy in relation to child toothbrushing R ² 20%, p <0.001 OR 3.9	Importance and intention to brush child's teeth R ² 27%, p <0.001 OR 2.5	Perceived seriousness of tooth decay in children R ² 28%, p =0.004 OR 0.6	External control – preventing decay is the dentist's responsibility R ² 29%, p =0.018 OR 0.8	
Chinese only	Parental efficacy in relation to child toothbrushing R ² 20%, p <0.001 OR 6.3	Chance control – decay occurs by chance R ² 22%, p =0.001 OR 0.5	Importance and intention to brush child's teeth R ² 24%, p =0.001 OR 1.7	Attitudes towards prevention R ² 25%, p =0.043 OR 0.7	
	<i>Behaviour – Child reported to have favourable sugar snacking behaviour</i>				
All groups combined	Parental efficacy in relation to controlling child sugar snacking R ² 6%, p <0.001 OR 1.9	Child's caries status R ² 7%, p <0.001 OR 0.6			
White only	Parental efficacy in relation to controlling child sugar snacking R ² 16%, p <0.001 OR 3.1	Mother's education level R ² 18%, p <0.001 OR 2.1	Importance and intention to control child sugar snacking R ² 19%, p =0.038 OR 1.4		
Chinese only	Parental efficacy in relation to controlling child sugar snacking R ² 11%, p <0.001 OR 2.6	Child's caries status R ² 12%, p =0.014 OR 0.6			

* Caries, mothers education, and attitudes towards tooth decay indicated in italics and entered only to control for these – theoretically these variables will not directly predict the behaviours identified.

whether these behaviours are reported to occur in children and that the strength of attitudes varies between diverse ethnic groups and sites around the world.

Any study attempting to measure reported behaviour and attitudes must consider the extent to which socially acceptable answers could impact on the interpretation of the results. This study had the advantage of including measures of external validation as the potential outcome of the behaviours was assessed independently, i.e. the children's caries status. This study has found significant differences in favourable health-related attitudes in parents of children with and without caries, irrespective of material deprivation. The fact that a strong set of coherent results was developed in the analysis also supports the robustness of this international approach.

This is formative research to develop hypotheses that would benefit from greater study within and across countries. However, at this stage, a number of initial conclusions can already be drawn. Parents commonly regard tooth decay as a serious condition in their children. The majority intend to ensure their children's teeth

are brushed and sugar snacking controlled, however, for those that hold that belief, a key predictor as to whether these behaviours occur is how effective parents believe they can be in consistently implementing them.

Children are more likely to be caries free if their teeth are brushed from an early age, twice daily with fluoride toothpaste, with parental involvement and in an environment in which the frequency of sugar intake is controlled (Harris *et al.*, 2004). Supporting parents and children to prompt toothbrushing behaviour with simple toothbrushing charts has been found to be effective in increasing toothbrushing frequency in families from deprived backgrounds (Pine *et al.*, 2000). In contrast to this parenting skills approach, health education models have dominated the majority of caries prevention strategies (Watt, 2002). However, the evidence that this has been an effective approach is not strong (Kay and Locker, 1996). From the research conducted in this study, parents' attitudes towards prevention were least likely to predict the behaviour of twice daily brushing. Since this is the main factor that health education is likely to influ-

ence, the value of a purely educative approach continues to be questionable in achieving behaviour change. However findings consistently demonstrated that parents self-belief (parental efficacy) to ensure twice daily toothbrushing and control sugar snacking in their children was predictive of toothbrushing and sugar snacking behaviour. Findings show that this factor is sensitive to reported attitudinal differences between parents from ethnic group living in the same culture, i.e. the four ethnic groups in America.

Therefore, this study supports the hypothesis that the emphasis on imparting knowledge of why toothbrushing should occur and why sugar should be controlled is not likely to be the most effective route to supporting that behaviour. This research indicates that where parents accept these preventive messages many need support in implementing the behaviour.

Further research is needed to investigate parental attitudes with an appreciation of cultural diversity, and to evaluate in a prospective intervention whether supporting parents in managing child behaviour will result in more favourable oral health behaviours being established and maintained.

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