Abstract

Objective: The aim of the present study was to employ the theory of planned behaviour (TPB) to predict and explain intentions and motivations to brush teeth among primary school children in Northern Ireland (NI). Design: Primary schools in NI were sorted by a number of key stratification variables and then randomly sampled. Twenty-seven schools took part in the research, and a questionnaire that incorporated both direct and indirect constructs of the TPB, related to tooth brushing behaviour, was administered to a sample of 867 year six school children. Results: Multiple regression analyses provided support for the TPB; together the TPB constructs predicted 57.1% of the variance in intentions to brush teeth. Correlational analyses confirmed self-efficacy as having the strongest association with intentions, followed by attitude, subjective norm and perceived control. Conclusion: The findings obtained in the present study suggest that the TPB is a useful framework for investigating children's tooth brushing intentions, and provides the foundation for designing an intervention aimed at encouraging tooth brushing behaviour among children.

Introduction

Poor oral health can negatively affect physical and psychological health and wellbeing (Sheiham, 2006). As a result, those with poor oral health are more likely to have reduced quality of life (Watt, 2005; WHO, 2003; Low, Tan and Schwartz, 1999), experience pain and suffering (Nuttall et al., 2006), feel embarrassment and have low self-esteem (Agou et al., 2008), encounter problems with eating, chewing and smiling (Steele et al., 1998), and have sleepless nights (Petersen et al., 2005; WHO, 2003). For children, those with poor oral health are often subject to peer bullying (Seehra, Newton and Dibiase, 2011) and their education can be adversely affected as they are 12 times more likely to miss days at school (Gift, Reisine and Larach, 1992). Northern Ireland (NI) has the poorest levels of oral health in the United Kingdom (UK) (HSCIC, 2015) with its children suffering the highest levels of dental caries in Europe (DHSSPS, 2007). Over half of 8 and 12 year olds (56% and 57%) have obvious decay experience in their primary/permanent teeth compared to the UK average (46% and 34% respectively) (HSCIC, 2015).

Tooth brushing contributes to solving many of the issues aforementioned. There is evidence to suggest that tooth brushing habits are most effectively sustained when they have been established at an early age. Not only does this result in a healthier mouth (Perinnetti, Caputi and Varvara, 2005) but, because good oral hygiene methods commenced early in life are more likely to be regularly continued throughout adolescence and into adulthood (Astrom, 2004; Kuusela et al., 1996). Adopting adequate tooth brushing habits during early childhood is therefore essential, especially as this is a crucial stage of child development when health-related behaviours that are practised routinely are more likely to be habitual (Almet et al., 2008; WHO, 1996). Evidence also indicates that children who adopt daily tooth brushing will reduce their risk of developing dental caries in their permanent and primary teeth by almost 13%, compared to those who have irregular tooth brushing habits (Twetman, 2009; Donaldson, 2008; Whelton et al., 2008; Parnell et al., 2007; Sheiham, 2001). Given these deterimental effects of poor oral health, there is a call for identifying the determinants of childrens tooth brushing behaviour in order to provide evidence for developing effective interventions designed to encourage good oral practices.

Psychological research evidence shows that intervention strategies aimed at changing attitudes and, ultimately, behaviour, are more successful if they are guided by empirically validated

theory (Abraham and Michie, 2008; Michie and Abraham, 2004). A theoretical framework deemed particularly effective in the context of behaviour change is the Theory of Planned Behaviour (TPB). The TPB suggests that individuals consider the implications of their actions before they decide to engage or not to engage in a given behaviour (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). According to the theory behaviour is determined by intentions, which in turn are the result of a combination of: attitude; subjective norm*; and perceived control (Ajzen, 1991; Ajzen 1985). Indeed, the TPB has been endorsed by the National Institute for Health and Care Excellence (NICE) as an evidence based way of predicting health behaviour (Taylor et al., 2006), and has emerged as one of the most effective models for understanding, predicting and evaluating health-related behaviours (Ogden, 2012).

The majority of oral health related research underpinned by the TPB that has been conducted, tends to focus on the application of fissure sealants, flossing and use of dental services. While these studies support the utility of the TPB, where variances ranging from 31% to 46% have been explained for intention, samples have been restricted to 15+ years (Bonetti et al., 2010; Luzzi and Spencer, 2008; Lavin and Groake, 2005). To date, only a small number of studies have identified the factors that influence tooth brushing behaviour where the theory has predicted variances of 32% (Buunk-Werkhoven, Dijkstra and van der Schans, 2011) and 76.9% (Pakpour and Sniehotta, 2012). Consistently, in both studies, perceived control emerged as the most significant predictor of tooth brushing intention, explaining more of the variance compared to the other TPB variables (attitude and subjective norm). Furthermore, research driven by the TPB has tended to focus on adolescent and adult populations, with none aimed specifically at assessing and improving the health behaviour of children. In fact, as far as the authors are aware, there have been no published research studies applying the TPB among a sample of primary school children (under 12 years) and in the area of oral hygiene, i.e. tooth brushing. This is surprising given the popularity and success of the theory, and the growing importance of providing children with the skills to improve knowledge, attitude and behaviour to enable them to make appropriate decisions with the goal of establishing healthy lifetime habits (Kwan et al., 2005; WHO, 2003). Accordingly, given the limited work in this area, the present study aims to explore the attitudes and motivations of young people towards tooth brushing. Specifically, to identify which of the TPB variables are influential in their decisions to brush their teeth, and to assess their association with tooth brushing intentions.

Methods

A cross-sectional design was employed whereby, in line with TPB research protocols, a self-completed questionnaire survey was utilised to collect data. Ethical approval was granted by the Ulster University Research Ethical Committee. The study took place in Northern Ireland (NI) during 2011.

To achieve the target sample a list of all primary schools in NI was obtained from the Department of Education for NI (DENI). The sample sought to be representative of each of the five Education Authority (EA) areas in NI, and of children from different socio-economic groups based on the extent of receipt of free school meals. The DENI uses free school meal (FSM) entitlement as a social indicator of deprivation, a state that is based on an aggregate level measure of relative poverty, low income and social disadvantage. Therefore, those schools receiving higher numbers of free school meals are reckoned to have a greater number of children from correspondingly deprived backgrounds.

The list of schools was stratified by both EA and socio-economic group, and a stratified random sampling technique was employed to select schools to contact. Assuming a response rate in the region of 50% for research of this nature (Francis et al., 2004), contact was initially made with 50 primary schools, comprising ten from each EA area, care being taken to ensure that, within each EA area, a range of FSM percentages were selected. A letter detailing the aims, objectives and procedures of the study, along with an invitation to participate, was posted to each of the selected schools. Of the 50 schools contacted, 27 agreed to participate in the study. The researcher made contact via telephone and email with the 27 consenting schools and arranged suitable dates and times to visit each of them to administer the questionnaire measure with their year six class (one class per each school). Completed questionnaires were received from 867 pupils: 442 male and 425 female, aged 9-10 years (mean age 9.74 years).

The questionnaire

The findings from an elicitation study were used to construct the questionnaire (the questionnaire development process is reported in Davison, McLaughlin and Giles, 2016), which was subsequently divided into three sections. The first section gathered demographic information (gender, age and school attended) and section two assessed respondent's behavioural characteristics relating to tooth brushing. Specifically, tooth brushing behaviour was assessed by self-report, measured by asking respondents: Do you brush your teeth? (yes or no); How many times per day do you brush your teeth? (0-4 times per day); When do you

brush your teeth? (in the morning, after eating, before bed, or at another time); and Do you enjoy brushing your teeth? (yes, it is Ok or no). The final section of the questionnaire incorporated all key constructs contained within the TPB and, as such, was operationalised using both direct and belief-based measures.

Direct Measures

[Insert Table 1 here]

In line with Francis et al.'s (2004) recommendations, a generalised model of intention, attitude, subjective norm, perceived control and self-efficacy was adopted in this research study. Three items assessed each of the variables in line with the TACT principle of 'brushing teeth every morning and every evening this coming week'. Behavioural intention was assessed using the following three items, each rated on a five-point likert scale ranging from strongly agree to strongly disagree: I am going (have decided/will try) to brush my teeth; I have decided to brush my teeth; and I will try to brush my teeth. Attitude was measured using three evaluative semantic differential scales (good-bad, happy-sad, pleased-displeased) in response to the item: 'Brushing my teeth makes me feel…'. Subjective norm was derived using the following three items, each rated on five-point agree-disagree scales: People who care about me would like me to brush my teeth; People who care about me would want me to brush my teeth; and, People who care about me think I should brush my teeth. Perceived behavioural control was assessed from responses to three items, using a five-point agree-disagree scale: It is mostly up to me whether or not I brush my teeth; I can generally decide whether or not I brush my teeth; and, It is mainly my decision whether or not I brush my teeth. In addition to perceived behaviour control, three items were included to assess self-efficacy: I think I will find it easy to brush my teeth; I am sure I will be able to brush my teeth; and, I am confident that I can brush my teeth, each using a five-point scale ranging from strongly agree to strongly disagree. Reliability estimates of the direct measures are presented in Table 1.

Attitude

The indirect measure of attitude was based on 11 outcome evaluations and the corresponding behavioural beliefs. Respondents were first required to evaluate each outcome, for example, 'having toothache' on a good/bad dimension. They were then required to indicate the likelihood that each of these outcomes would occur if they were to brush their teeth, for

example 'If I brush my teeth I won't have toothache'. Outcome evaluations were then multiplied by the corresponding behavioural beliefs and the summed product served as the belief-based measure of attitude.

Subjective Norm

The belief-based measure of subjective norm was derived from the expectations of six referents: mummy, daddy, other members of my family, dentist, friends and teacher/principal. Respondents were first required to indicate the extent to which each of their significant others would endorse their intention to brush their teeth. This was followed by a request to indicate the extent to which they were motivated to comply with the wishes of their significant others, across a five-point Likert scale (strongly agree to strongly disagree). Each normative belief was multiplied by the corresponding motivation to comply, and the summed product served as an indirect measure of subjective norm.

Perceived Control

The indirect measure of perceived control was grounded on the seven beliefs elicited from the focus group discussions. Given the age of the sample, it was decided to base this measure on single items (Ajzen & Madden, 1986) because they are generally easier to operationalise. As such, respondents were required to indicate the extent to which each of the beliefs would encourage them to, or prevent them from, brushing their teeth, for example, 'If I am tired I won't brush my teeth' (very true to very untrue).

Data Analysis

Data were analysed using SPSS Statistics version 23. Following descriptive analysis of tooth brushing behaviour, the data was analysed in two steps. Initially, multiple linear regression analysis was conducted to examine the relationship between tooth brushing intention and the direct TPB items. Summed scores of direct attitude, subjective norm, perceived control and self-efficacy were entered into the regression model as predictor variables, along with the summed score of tooth brushing intention (i.e. Int1+Int2+Int3) as the dependent variable. Next, to examine the utility of the indirect TPB items, analysis consisted of Pearson correlations and multiple linear regression analysis exploring the relationship between indirect TPB constructs

and the prediction of intention. Separately, behavioural, normative and control beliefs, each with summed tooth brushing intention were entered into the correlational analysis. Then, summed scores of indirect attitude and subjective norm were calculated to form the belief-based measures, and these along with the indirect control beliefs were entered separately into the regression model, along with the summed score of intention as the dependent variable.

Full Disclosure

This article includes full disclosure of its analysis package, including the child-friendly TPB questionnaire, an anonymised study dataset, along with the SPSS analyses outputs.

Results

Tooth Brushing Behaviour

Although 99.8% reported to brush their teeth, two respondents (0.2%) chose the 'no' response. Sixty-eight percent adhere to recommendations of twice-daily tooth brushing, while 16.5% brush their teeth once-a-day, 13% three times per day and 2% four times per day. For most (94%), tooth brushing is practiced in the morning or before they go to bed (87%), with 14% selecting that they also brush their teeth after eating or at another time (4%). Only 3% of the sample reported that they do not go to the dentist, compared to 97% who do. Of those that visited the dentist, 60% go every six months and 8% once a year (30% are unsure of how often they visit the dentist).

Predicting Behaviour

To identify the factors influencing school children's motivations to brush their teeth and to assess their strength, correlation and regression analysis were conducted on the main TPB constructs.

[Insert Table 2 here]

All of the direct TPB constructs were significantly correlated with tooth brushing intention (p < .01) with correlation values ranging from 0.103 to 0.711 (Table 2). The strongest association

with intention was self-efficacy, followed in descending order, by attitude, subjective norm and perceived control.

In terms of identifying the most important predictors of brushing teeth, the model was able to account for 57.1% of the variance, $F(4,862) = 287.23$, $p < 0.01$, in explaining tooth brushing intention. Of particular interest was the finding that self-efficacy was the strongest predictor ($\beta = 0.55$, $p < 0.01$) and that attitudes to brushing teeth ($\beta = 0.26$, $p < 0.01$), subjective norm ($\beta = 0.1$, $p < 0.01$) and perceived control ($\beta = 0.01$, $p < 0.05$) were positively and significantly, albeit to certain extents, related to intentions.

Explaining Behaviour

Correlational analyses (Table 3) further revealed which beliefs played an important role in influencing one's intention to brush their teeth. The beliefs underlying attitude that were most strongly connected to intentions ($p < 0.01$) were with 'removing food from being stuck in my teeth' ($r = 0.27$) and 'having clean teeth' ($r = 0.26$). In addition outcomes such as: 'will stop teeth from rotting or falling out'; 'will have a nice smile'; 'won't have a build-up of plaque'; 'won't have bad breath'; 'won't get sore gums'; and will have strong teeth' were also among the beliefs to have a higher correlation with tooth brushing intentions. Respondent's perceptions of the opinions and support of their parent/s (daddy and mummy), family, and friend/s were highly correlated with their intention to tooth brush. In fact, daddy ($r = 0.36$) had the strongest association with intention. Barriers such as: 'being tired' ($r = 0.38$); 'in a rush' ($r = 0.36$); 'at the weekend if I am staying at home' ($r = 0.32$); and 'forgetting' ($r = 0.29$) showed the strongest associations with intentions among the sample. The belief about bullying: 'I brush my teeth so I won't get bullied'; had a significant negative correlation with intentions, indicating that there was a tendency for respondents who saw this factor as a facilitator to have a weaker tendency not to intend to brush their teeth.

 [Insert Table 3 here]

The behavioural beliefs explained 18% of the variance in intention to brush teeth, $F (11, 855) = 11.40$ $p < 0.05$. Removing food from being stuck in teeth ($\beta = 0.19$), having clean teeth ($\beta = 0.17$) and having a nice smile ($\beta = 0.11$) were the beliefs most strongly associated with intention. However, brushing teeth to stop them from rotting or falling out ($\beta = 0.09$) and to remove plaque ($\beta = 0.03$) also uniquely contributed to the variance in intention ($p < 0.05$).

Similarly, 17% of the variance in intention to brush teeth was accounted for by the normative beliefs, $F(6, 857) = 30.12$, $p < 0.01$. Although one's father ($\beta = .25$, $p < .01$) emerged as the most popular referent, one's mother ($\beta = .20$, $p < .01$) and close friends ($\beta = .17$, $p < .01$) were also influential. The control beliefs accounted for 22% of the variance in intention, $F(7, 858) = 35.30$, $p < 0.01$. Being tired ($\beta = .21$, $p < 0.01$) most significantly related to reducing intention, but being in rush ($\beta = .15$, $p < 0.01$), weekends ($\beta = .15$, $p < 0.01$) and forgetting ($\beta = .12$, $p < 0.01$) were also associated.

Discussion

This study demonstrates that the TPB can usefully be employed to predict tooth brushing intention of Northern Ireland's school children. Analyses revealed that all of the TPB constructs contributed significantly (albeit to varying extents) to the prediction of intention, explaining 57.1% of the variance. In fact, the unique contribution of the models components to the prediction of intention is marginally higher than that reported in previous TPB-based studies with school children and physical activity (Martin et al., 2009; Foley et al., 2008; Trost et al., 2002), where variances of between 10% - 56% have been explained. In respect of oral health research, 44% and 46% of the variance in intention to dental floss has been explained with adolescents (Rise et al., 1998) and university students (Lavin and Groarke, 2005), and 76.9% of the variance in tooth brushing behaviour has been found with adolescents (Pakpour and Sniehotta, 2012). The results of the study provide support for the utility of the TPB in that attitude, subjective norm, perceived control and self-efficacy predicted intention to brush teeth. Furthermore, the present findings serve to identify which beliefs to target when designing an intervention. Investigation of the indirect measures identified removing food, having clean teeth, to stop teeth from rotting or falling out; to remove plaque and to have a nice smile, as the main motivators for children to brush their teeth. Further, being tired, in a rush, when staying at home at the weekends, and forgetting emerged as significant barriers to children's tooth brushing habits. Such results are similar to the findings of Pakpour and Siehotta (2012) which suggests that an intervention simultaneously targeting PBC and action planning might prove to be effective when promoting tooth brushing amongst school children.

In line with previous research self-efficacy contributed most significantly to the prediction of tooth brushing intentions amongst this target group. These results confirm the importance of

self-efficacy perceptions in oral self-care care behaviour with similar findings reported in the context of dental flossing and the uptake of public dental services (Luzzi and Spencer, 2008; Tedesco et al., 1993). In relation to tooth brushing behaviour it does not appear to be physical difficulties which act as barriers, but rather the regular daily performance of such behaviours which prove to be difficult for some children (Zhou, Sun, Knoll, Hamilton and Schwarzer, 2015). These findings clearly have practical implications and suggest the need for behaviour-change interventions to target self-regulatory tasks such as self-monitoring (Michie, Atkins & West, 2014), which have been found to improve dental self-efficacy, dental planning and action control in Chinese young adults (Zhou et al, 2015).

This finding also has theoretical implications given that there is continuing speculation surrounding the distinction between the concepts of perceived control and self-efficacy. While Ajzen (2006) asserts that they are interconnected, others suggest that a distinction should be made between them (Tavousi et al., 2009; Armitage and Connor, 1999; Terry and O'Leary, 1995). This finding not only provides additional support for the differential roles played by self-efficacy and perceived control, but highlights the importance of self-efficacy within the TPB. In contrast, the evidence also suggests that in the case of tooth brushing, perceived control does not directly determine intentions. Possible explanations for this finding could be related to the age of the sample and the likelihood that the individuals concerned do not perceive 'brushing their teeth' as being entirely of their own free will.

In keeping with previous research with children, subjective norm was one of the weakest predictors of tooth brushing intentions. In relation to subjective norm, this finding is perhaps not surprising given that most parents equip children with tooth brushing knowledge and endeavour to generally reinforce tooth brushing routines in order to establish consistent lifetime habits. Parents usually supervise children's tooth brushing until at least six years, with some continuing to do so until 10 years (Sandstrom et al., 2011). Such evidence may imply that children aged 9-10 years face difficulties in adopting responsibility for their individual tooth brushing regimes, reaffirming previous research that children are reliant on their parents for reminding them of, and reinforcing engagement in, daily tooth brushing practice (Davison et al., 2016).

The present study has recognisable limitations which elicits direction for future research. First, as is often the case with TPB-based research, there was no measure of actual behaviour; tooth brushing behaviour was ascertained by self-report. Given the relatively low correlations often

reported between intention and behaviour (Armitage and Conner, 2001), it is feasible that our measure of intention/motivation did not represent what happens in reality, or indeed, may have been inflated due to social desirability. Second, the way in which the behaviour was operationalised using the TACT principle may have been problematic. Children were asked how likely it was that they would brush their teeth every morning and every evening 'this coming week'. With hindsight, requiring children who typically live day-by-day to conceptualise 'this coming week' was perhaps challenging, requiring them to reflect on the week ahead, and may have increased the likelihood of them responding more positively. In future, it might therefore be advisable to define the behaviour in line with Martin et al. (2009) and refer to immediate time, i.e. today. Third, it might also be argued that tooth brushing is a habitual behaviour (Sandstrom et al., 2011) and therefore best explained by past behaviour. Certainly, this is often a criticism levied at the TPB and has caused many to add a measure of past behaviour to the variables contained within the model. According to Armitage and Conner (2001), in some cases, past behaviour may account for an additional 18% of the variance in intentions. Finally, since this study has been conducted the literature has advanced in terms of theory and as a result the TPB has come under scrutiny. While the TPB plays an important role in predicting, understanding and changing behaviour, it has been postulated that providing functionality of these variables (intention, attitude, subjective norm and perceived control) will only result from a broader theoretical approach (Sniehotta, Presseau & Araujo-Soares, 2014). The Reasoned Action Approach (Fishbein & Ajzen, 2010) is one such model as it seeks to extend the TPB by splitting attitudes, subjective norm and PBC into two sub-components in order to offer additional insights into the determinants of health behaviour.

Despite these criticisms the current study provides support for the theoretical model of the TPB and has highlighted the importance of key theoretical constructs in predicting intentions to brush teeth among school children. It has also served to elucidate the relative importance of the factors influential in affecting children's motivations and decisions to brush their teeth. It is hoped that the findings reported here will serve to identify those variables that might provide the foundation for designing an intervention aimed at encouraging tooth brushing behaviour among a particularly at-risk group.

Acknowledgements

References

Abraham, C., & Michie, S. (2008). A taxonomy of behaviour change techniques used in interventions. *Health Psychology, 27*(3), 379-387.

Agou, S., Locker, D., Streiner, D., & Thompson, B. (2008). Impact of self-esteem on oral health related quality of life of children with malocclusion. *American Journal of Orthodontics and Dentofacial Orthopedics, 134*, 484-489.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl, & J. Beckman (Eds.), *Action-Control: From Cognition to Behavior* (pp. 11-39). Heidelberg, Germany: Springer.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behaviour and Human Decision Processes, 50*, 179-211.

Ajzen, I. (2006). *Constructing a TPB Questionnaire: Conceptual and Methodological Considerations.* Retrieved from http://www.unix.oit.umass.edu/~ajzen/pdf/tpb.measurement.pdf, 2006.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting human behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I., & Madden, T. J. (1986). Prediction of goal-directed behaviour: attitudes, intentions and perceived behavioral control. *Journal of Experimental Social Psychology, 22*, 453-474.

Almet, A., Wendt, L. K., Koch, G. & Biorkhed, D. (2008). Oral hygiene and parent-related factors during early childhood in relation to approximal caries at 15 years of age. *Caries Research, 42*, 28-26.

Armitage, C. J., & Conner, M. (1999). Distinguishing Perceptions *of* Control from Self-Efficacy: Predicting Consumption of a Low-Fat Diet Using the Theory of Planned Behaviour. *Journal of Applied Social Psychology, 29*(1), 72-90.

Armitage, C., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471-499.

Astrom, A. N. (2004). Stability of oral health-related behaviour in a Norwegian cohort between aged of 15 and 23 years. *Community Dental Oral Epidemiol, 32*, 354-362.

Bonetti, D., Johnston, M., Clarkson, J. E., Grimshaw, J., Pitts, N. B., Eccles, M., Steen, N., Thomas, R., Maclennan, G., Glidewell, L., & Walker, A. (2010). Applying psychological theories to evidence-based clinical practice: identifying factors predictive of placing preventive fissure sealants. *Implementation Science, 5*(25), 1-14.

Buunk-Werkhoven, Y. A. B., Dijkstra, A., & van der Schans, C. P. (2011). Determinants of oral hygiene behaviour: a study based on the theory of planned behaviour. *Community Dentistry and Oral Epidemiology, 39*, 250-259. doi: 10.1111/j.1600-0528.2010.00589

Davison, J., McLaughlin, M. & Giles, M. (2016). The design and psychometric assessment of a child-friendly TPB based questionnaire. *Journal of Public Health.* doi: 10.1093/pubmed/fdw120

Department of Health, Social Services and Public Safety. (2007). *Oral Health Strategy for Northern Ireland*. Belfast: DHSSPS.

Donaldson, M. (2008). An Evaluation of Investing for Health Funded Caries Prevention Schemes. Retrieved from http://www.dhsspsni.gov.uk/anevaluationofinvestingforhealthfundedcariespreventionschemes.pdf

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley.

Fishbein, M., & Ajzen, I. (2010). Predicting and Changing Behaviour: The Reasoned Action Approach. New York: Taylor and Francis Group.

Foley, L., Prapavessis, H., Maddison, R., Burke, S., McGowan, E., & Gillanders, L. (2008). Predicting Physical Activity Intention and Behaviour in School-Age Children. *Pediatric Exercise Science, 20,* 342-356.

Francis, J. J., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, Kaner, E. F. S., & Bonetti, D. (2004). *Constructing Questionnaires Bases on the Theory of Planned Behaviour: A Manual for Health Services Researchers.* Newcastle: Centre for Health Services Research.

Gift, H. C., Reisine, S. T., & Larach, D. C. (1992). The social impact of dental problems and visits. *American Journal of Public Health*, *82*(12), 1663-1668.

Health and Social Care Information Centre. (2015). *Children's Dental Health Survey.* National Statistics.

Kuusela, S., Honkala, E., & Rimpela, A. (1996). Tooth brushing frequency between aged of 12 and 18 years – longitudinal prospective studies of Finnish adolescents. *Community Dental Health, 13*, 34-39.

Kwan, S.Y.L., Petersen, P.E., Pine, C.M., & Borutta, A. (2005). Health-promoting schools: an opportunity for oral health promotion. *Bulletin of the World Health Organization*, *83*(9), 677-685.

Lavin, D., & Groarke, A. (2005). Dental floss behaviour: A test of the predictive utility of the Theory of Planned Behaviour and the effects of making implementation intentions. *Psychology, Health and Medicine*, *10*(3), 243-252. doi: 10.1080/13548500412331334127

Low, W., Tan, S., & Schwartz, S. (1999). The effect of severe caries on the quality of life in young children. *Paediatric Dentistry*, *21*(6), 325-326.

Luzzi, L., & Spencer, A.J. (2008). Factors influencing the use of public dental services: An application of the Theory of Planned behaviour. *BMC Health Services Research*, *8*, 93-106. doi: 10.1186/1472-6963-8-93

Martin, J. J., McCaugtry, N., & Shen, B. (2009). Physical Activity and Fitness in Inner City Hispanic American Children. *Hispanic Health Care International*, *7*(1), 21-29.

Michie, S., & Abraham, C. (2004). Interventions to change health behaviors: evidence-based or evidence-inspired? *Psychology and Health, 19*(1), 29-49.

Michie, S., Atkins, L. & West, R. (2014). *The behaviour Change Wheel: A Guide to Designing Interventions*, 1st edn. London: Silverback.

Nuttall, N. M., Steele, J. G., Evans, D., Chadwick, B., Morris, A. J., & Hill, K. (2006). The reported impact of oral condition on children in the United Kingdom, 2003. *British Dental Journal, 200*, 551-555. doi: 10.1038/sj.bdj.4813586

Ogden, J. (2012). *Health Psychology*: *A textbook* (5th ed.). Open University Press: McGraw-Hill.

Pakpour, A. H., & Sniehotta, F. F. (2012). Perceived behavioural control and coping planning predict dental brushing behavior among Iranian adolescents. *Journal of Clinical Periodontology*, *39*, 132-137.

Parnell, C., Connolly, E., O'Farrell, M., Cronin, M., Flannery, E., & Whelton, H. (2007). *Oral Health of 5-year-old children in the North East 2002*. Navan: Health Services Executive.

Perinnetti, G., Caputi, S., & Varvara, G. (2005). Risk/prevention indicators for the prevalence of dental caries in school children: results from the Italian OHSAR Survey. *Caries Research, 39,* 9-19.

Petersen, P.E., Bourgeois, D., Ogawa, H., Estupinan-Day, S., & Ndiaye, C. (2005). The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*, *83*(9), 661-9.

Rise, J., Astrom, A. N., & Sutton, S. (1998). Predicting Intentions and use of Dental Floss among adolescents: an application of the Theory of Planned Behaviour. *Psychology and Health, 13*, 223-236.

Sandstrom, A., Cressey, J., & Stecksen-Blicks, C. (2011). Tooth-brushing behaviour in 6-12 year olds. *International Journal of Paediatric Dentistry, 21*, 43-49. doi: 10.1111/j.1365-263X.2010.01080

Seehra, J., Newton, T., & Dibiase, A. T. (2011). Bullying in schoolchildren – its relationship to dental appearance and psychosocial implications: an update for GDPs. *British Dental Journal, 210*, 411-415. doi: 10.1038/sj.bdj.2011.339

Sheiham, A. (2001). Dietary effects on dental diseases. *Public Health Nutrition, 4*, 569-591. doi: 10.1079/PHN2001142

Sheiham, A. (2006). Dental caries affects body weight, growth and quality of life in pre-school children. *British Dentistry Journal, 201*(10), 625-626.

Sniehotta, F. F., Presseau, J. & Araujo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review*, 8(1), 1-7. doi: 10.1080/17437199.2013.869710

Steele, J. G., Sheiham, A. Marcenes, W., & Walls, A. W. G. (1998). *National diet and Nutrition Survey: People aged 65 years and over* (Volume 2: Report of the Oral Health survey). London: the Stationery Office.

Tavousi, M., Hidarnia, A. R., Montazeri, A., Hajizadeh, E., Taremain, F., & Ghofranipour, F. (2009). Are perceived behavioural control and self-efficacy distinct constructs? *European Journal of Scientific Research, 30*(1), 146-152.

Taylor, D. T., Bury, M., Campling, N., Carter, S., Garfied, S., Newbould, J., and Rennie, T. (2006). A review of the use of the Health Belief Model (HBM), the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB) and the Trans-Theoretical Model (TTM) to study and predict health related behaviour change. Review undertaken on behalf of NICE. Retreived from: http://www.nice.org.uk/guidance/ph6 /evidence/behaviour-change-review-4-models2.

Tedesco, L. A., Keffer, M. A., Davis, E. L., & Christersson, L. A. (1993). Self-Efficacy and Reasoned Action: Predicting Oral Health Status and Behaviour at One, Three and Six Month Intervals. *Psychology and Health, 8*(2-3), 105-121. doi: 10.1080/08870449308403172

Terry, D. J., & O'Leary, J. E. (1995). The theory of planned behaviour: The effects of perceived behavioural control and self-efficacy. *British Journal of Social Psychology*, *34*, 199-220.

Trost, S. G., Pate, R. R., Dowda, M., Ward, D. S., Felton, G., & Saunders, R. (2002). Psychosocial Correlates of Physical Activity in White and African-American Girls. *Journal of Adolescent Health*, *31*, 226-233.

Twetman, S. (2009). Caries prevention with fluoride toothpaste in children; an update. *European Archives of Paediatric Dentistry*, *10*, 162-167.

Watt, R.G. (2005). Strategies and approaches in oral disease prevention and health promotion. *Bulletin of the World Health Organization*, *83*(9), 711-717.

Whelton, H., Freeman, R., Kingston, R., Sadlier, D., Ormsby, M., & O'Mullane, D. (2008). Equilibrium salivary-fluoride levels (18-ESF) as a measure of toothbrushing frequency [Abstract]. *Proceedings of the Pan European Federation of the International Association for*

Dental Research, Retrieved from https://iadr.confex.com/iadr/pef08/techprogram/abstract_111741.htm

World Health Organization. (1996). *The Status of School Health.* Report of the School Health Working Group and the WHO Expert Committee on Comprehensive School Health Education and Promotion. Geneva: WHO.

World Health Organization. (2003). *Oral Health Promotion: An Essential Element of a Health-Promoting School*. WHO Information Series on School Health Document Eleven. Geneva: World Health Organization.

Zhou, G., Sun, C., Knoll, N., Hamilton, K. & Schwarzer, R. (2015). Self-efficacy, planning and action control in an oral self-care intervention. *Health Education Research,* 30(4), 671-681.

Theory of planned behaviour construct	n items	Sample Items	Omega	GLB	Coefficient *H*
Table 1: Details of the direct measures contained within the questionnaire and reliability estimates.					
Intention	3	I am going (have decided/will try) to brush my teeth: agree/disagree	0.85	0.85	0.85
Attitude	3	Brushing my teeth makes me feel: good/bad; happy/sad; pleased/displeased	0.85	0.84	0.85
Perceived control	3	It is mostly up to me whether or not I brush my teeth (I can generally decide/it is mainly my decision): agree/disagree.	0.71	0.72	0.72
Subjective norm	3	People who care about me would like me to (want me to/think I should) brush my teeth: agree/disagree.	0.69	0.72	0.73
Self-efficacy	3	I think I will find it easy to (I am sure I will be able to/I am confident that I can) brush my teeth: agree/disagree.	0.78	0.79	0.80

Note: GLB=Greatest lower bound. Omega, GLB and Coefficient H calculated using psych R package.

Table 2: Predicting behavioural intention: correlation (and 95% CI) and multiple regression analysis of the direct measures.								
Variable	Mean	SD	1	2	3	4	R^2	Beta
1. Intention	4.55	0.62	-					
2. Attitude	4.47	0.64	.561** (0.51-0.60)	-				.258**
3. Subjective Norm	4.66	0.54	.361** (0.3-0.42)	.278** (0.22-0.34)	-		0.571	.103**
4. Perceived Control	3.83	1.02	.180** (0.11-0.24)	.157** (0.09-0.22)	.223** (0.16-0.29)	-		.007*
5. Self-efficacy	4.35	0.70	.711** (0.68-0.74)	.500** (0.45-0.55)	.340** (0.28-0.4)	.103** (0.04-0.17)		.546**

Note: **$P<0.01$; * $P<0.05$; R^2=squared multiple correlation; Beta=standardised regression coefficients.

Table 3: Correlation and multiple regression analysis of the indirect measures.						
	N	Mean	SD	r	Beta	R^2
Attitude						
Won't have toothache	867	20.40	5.57	0.12**	-.01	
Will have strong teeth	867	23.45	3.39	0.15**	-.00	
Won't have bad breath	867	21.30	4.84	0.16**	-.02	
Will remove food from being stuck in my teeth	867	19.87	5.14	0.27**	.19**	
Will have clean teeth	867	23.89	2.84	0.26**	.17**	
Will stop teeth from rotting or falling out	866	22.99	4.01	0.19**	.09*	0.18
Will have a nice smile	867	21.05	5.31	0.19**	.11**	
Won't have funny coloured teeth	867	22.95	4.18	0.12**	-.00	
Won't have to visit the dentist	867	18.43	6.99	0.09**	-.09	
Won't get sore gums	867	19.91	5.68	0.15**	-.01	
Won't have a build up of plaque	867	22.26	4.48	0.17**	.03*	
Subjective Norm						
My mummy thinks I should brush my teeth	867	21.31	5.12	0.27**	.20**	
My daddy thinks I should brush my teeth	867	20.74	5.60	0.36**	.25**	
Other members of my family think I should brush my teeth	867	18.73	6.34	0.28**	.09*	0.17
My dentist thinks I should brush my teeth	864	21.67	5.00	0.22**	.08*	
My friends thinks I should brush my teeth	867	13.96	6.89	0.25**	.17**	
My teacher/principal think I should brush my teeth	867	15.19	7.23	0.14**	-.10*	
Perceived Behavioural Control						
If I am tired I won't brush my teeth	867	3.85	1.21	0.38**	0.21**	
If I had nicer toothpaste I would brush my teeth more often	867	2.70	1.51	-0.16**	-0.03	
Sometimes I can forget to brush my teeth	867	2.93	1.42	0.29**	0.12**	
If I got a treat for brushing my teeth I would brush my teeth more often	867	3.23	1.54	-0.14**	-0.02	0.22
I brush my teeth so I won't get bullied	866	1.97	1.34	-0.03	0.04	
If I am in a rush I won't brush my teeth	867	3.90	1.21	0.36**	0.15**	
At the weekend, if I am staying at home I don't brush my teeth	867	4.35	1.03	0.32**	0.15**	

Note: *$P<0.05$; **$P<0.01$; r=Pearson product moment correlation coefficient; R^2=squared multiple correlation; Beta=standardised regression coefficients.