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# Measuring oral health behaviour in Flemish health care workers: an application of the Theory of Planned Behaviour

A. Defranc[1], S. Van den Broucke[1], R. Leroy[1], K. Hoppenbrouwers[1], E. Lesaffre[1], L. Martens[2], M. Debyser[3] and D. Declerck[1]

[1]*Catholic University Leuven;* [2]*University of Ghent;* [3]*Child and Family.*

***Objective*** This study describes the development and validation of a questionnaire to measure the determinants of oral health related behaviour in health care workers, based on the Theory of Planned Behaviour (TPB). ***Research design*** A preliminary questionnaire was drafted containing 78 self report items measuring three behaviours related to oral health (i.e. dietary habits, oral hygiene habits and dental attendance), as well as the attitudes, perceived social norms and self-efficacy for each behaviour. The questionnaire was completed by 201 health care workers for the initial validation and 966 other health care workers for a replication. ***Outcomes*** A principal component analysis with Procrustes rotation toward an a priori three component structure on the original sample yielded high congruence measures for reported dental attendance, but not for dietary habits and oral hygiene habits. Subsequent exploratory Varimax rotations and discarding of redundant items resulted in three component solutions explaining 43% of the variance in dietary habits, 57% in oral hygiene habits and 66% in dental attendance, respectively. For all three behaviours, these components corresponded to the dimensions of the TPB. Internal consistency of the scales was satisfactory, with Chronbach's alpha's ranging from 0.51 to 0.87. Scale scores accounted for a significant proportion of the variance in the intention to avoid sweet snacks, to brush teeth, and to attend dental check-ups, and of the frequency of consumption of sweet drinks and frequency of brushing. A confirmatory factor analysis on the larger sample of 966 health care workers provided excellent goodness of fit indices, confirming the construct validity of the scales.

*Key words: behaviour, determinants, health care workers, oral health, questionnaire*

## Introduction

Over the last decades, oral health has improved markedly among inhabitants of most industrialized countries (Marthaler *et al*., 1996), and especially among children. Despite this improvement, however, differences in oral health exist within the population, and a strong polarisation in the prevalence of caries is seen. A high percentage of the pathology is found in a small group of the population, with 10 to 15% of the children accounting for about half of all the caries lesions (Marthaler *et al*., 1996; Spencer *et al*., 1997). This is also the case in Flanders (i.e., the Northern part of Belgium), where a large prospective study into oral health among Flemish children aged 7 to 12 years (Signal Tandmobiel Project®) revealed a significant polarisation (Vanobbergen *et al*., 2000).

Oral pathology in children can cause complications such as inflammation, fever, persistent headache and cerebral abscesses, and can have major repercussions on the quality of life of children and their families (Locker, 2004). Oral health is to a great extent determined by behavioural factors. Frequent consumption of snacks and drinks containing sugar, inadequate oral hygiene habits, parental smoking and delaying preventive visits to the dentist have been identified as important risk factors for caries development and the presence of plaque in young children (Harris *et al*., 2004; Martens *et al*., 2004). Oral health in young children is also facing new threats, such as tooth erosion caused by the excessive consumption of soft drinks (Dugmore and Rock, 2004). Moreover, in a large part of the population children seldom visit a dentist before their fourth birthday, unless they suffer from severe forms of rampant caries or early childhood caries (Creighton, 1998). This illustrates the general indifference regarding oral health with which health workers and educators are frequently confronted. Usually, a dental problem has to affect speech, chewing ability, taste perception, or aesthetics before parents become aware of the importance of oral health. In this regard, health care workers can play an important role: they can provide parents with information and advice concerning a healthy diet and oral hygiene habits, and refer them to the dentist for checkups. Moreover, they can set the example by performing appropriate oral health practices themselves.

Promoting oral health related behaviour among health care workers, however, requires an understanding of the determinants of this behaviour. To that effect, use can be made of preventive behaviour change models. One of the most influential models in this regard is the Theory of Planned Behaviour (TPB; Figure 1) (Ajzen, 1991).

According to this model, volitional behaviour like deciding what to eat or drink, whether or not to brush the teeth or whether to visit a dentist, is to a large extent determined by the intention to perform that behaviour.

Correspondence to: Dr. Stephan Van den Broucke, Research Group for Health Psychology Catholic University of Leuven, Tiensestraat 102, 3000 Leuven, Belgium. E-mail: stephan.vandenbroucke@psy.kuleuven.be

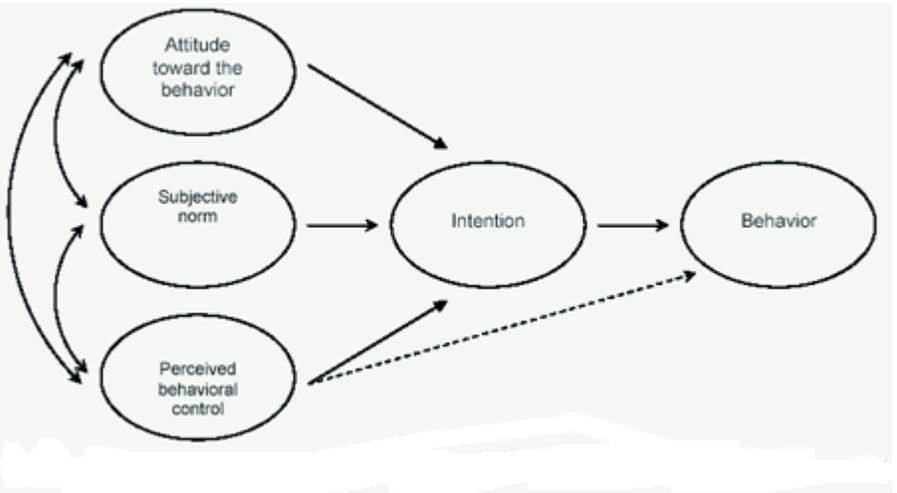


**Figure 1.** *Theory of Planned Behaviour (Ajzen, 1991)*

This intention is in itself a function of three cognitive variables: attitudes towards the behaviour, perceived social norms, and perceived behavioural control. An "attitude" can be defined as the positive or negative evaluation of the expected outcome of the behaviour. "Social norms" refer to the perceived social influence to engage in the behaviour and are derived from the behaviour and/or feedback of significant others (i.e., implicit or explicit norm, respectively). The extent to which these norms influence behaviour depends on the motivation to comply with them. "Perceived behavioural control" is the degree to which an individual believes that the behaviour is under his or her control. Like attitudes and social norms, this belief has an impact on intention. However, since the performance of behaviour can be hindered by factors that are beyond volitional control, perceived behavioural control can also predict behaviour directly.

Meta-analytic reviews of the TPB have demonstrated its ability to predict a broad range of preventive behaviours, including smoking cessation, physical activity, food choice, condom use, seatbelt use and breast self examination (Godin and Kok, 1996). Armitage and Conner (2001) reported that attitude, subjective norm and perceived behavioural control in combination accounted for a frequency weighted average of 39% of the variance in intention across 154 applications, and that intentions and perceived behavioural control explained 27% of the variance in behaviour across 63 applications. This means that a significant percentage of the variance of intentions and behaviour is uniquely or jointly explained by the components of the model.

Recent investigations have drawn on concepts of the TPB model to assess the impact of parental attitudes and perceived control on habits favourable to oral health, showing that parents' perceived ability to control their children's brushing and snacking habits were significant predictors of these behaviours (Adair *et al*., 2004). However, to our knowledge, no studies have thus far investigated the value of the TPB as a model to predict oral health related behaviour. Some studies used a predecessor of the TPB, the Theory of Reasoned Action (TRA) to predict oral health behaviour (McCaul *et al*. 1988; Tedesco *et al*., 1993), finding that the model accounted for a significant proportion of the variance for brushing and flossing. However, it is generally agreed that the TPB provides a better prediction of preventive behaviour than the TRA, which does not include perceived behavioural control (Armitage and Conner, 2001; Godin and Kok, 1996). Moreover, the existing studies focus on health behaviour of the population, and not of health care workers. It is therefore worthwhile to investigate the value of the TPB in predicting oral health related behaviour of the latter.

The present study aimed to develop and validate a self report questionnaire based on the Theory of Planned Behaviour to assess attitudes, social norms, perceived behavioural control, intended behaviour and self-reported behaviour in health care workers with regard to three important behaviours related to oral health: dietary habits, oral hygiene habits and dental attendance. With this questionnaire, specific determinants of this behaviour can be targeted for preventive interventions.

## Material & Methods

The study involved a pilot and a replication study. The participants in the pilot study were 201 health care workers from the region of Diksmuide, Flanders (Belgium), representing a wide variety of professions: social nurses (7.5%), family physicians (14.9%), pharmacists (7.0%), paediatricians (0.5%), school physicians (7.5%), teachers (3.5%), volunteer workers for the preventive health care service for young children (Child and Family) (2.0%), dentists (28.4%), gynaecologists (0.5%), and other (28.4%). The latter included child minders, speech therapists, physical therapists, psychologists, school counsellors, social workers, a child psychiatrist, a medical secretary, an ophthalmologist, and a health administrator from the local government. All subjects participated voluntarily in the study. Seventy-three percent were female, which reflects the overrepresentation of women in these health care professions. Their age ranged from 23 to 74 years, with a mean age of 41.47 years ($SD$ = 9.79).

The participants in the replication study were 966 employees from the preventive health care service for young children (Child & Family) and health care workers from four different regions in Flanders (Waregem, Tielt, Tielt-Winge and Berlaar). This group included nurses

(10.3%), family physicians (13.5%), pharmacists (7.5%), paediatricians (0.9%), school physicians (2.8%), teachers (15.4%), volunteers for Child & Family (3.5%), dentists (12.1%), gynaecologists (0.6%), and other (33.4%). All participants voluntarily participated in the study. Eighty one per cent of this sample were female, and their ages ranged between 20 and 83 years old, with a mean age of 41 (*SD* = 9.64).

The questionnaire was administered to the participants using an anonymous procedure. Questionnaires were sent by mail, to be returned in a pre-stamped envelope. The response rates were 57% for the pilot sample and 49% for the replication study, which is comparable to the average response rate for mailed physician questionnaires (i.e., 61% percent for small samples and 52% for large sample surveys; Cummings *et al*., 2001).

*Instrument*

A provisional questionnaire was developed with items measuring three oral health related behaviours (dietary habits, oral hygiene habits, dental attendance) as well as the determinants of these behaviours featured in the Theory of Planned Behaviour (attitudes, social norms and perceived behavioural control). The questionnaire was drafted in Dutch, the mother tongue of the participants. Attitude items were operationalised as expected outcomes without specifically asking for the evaluation of the outcome, since the latter was usually obvious. Thus, 7 items were formulated to measure the behaviours (e.g., brushing frequency) and 71 items to measure the behavioural determinants:

- With regard to **dietary habits,** 8 items measure *attitude* (e.g., "a candy or a biscuit in between is tasty"; "snacks containing sugar are harmful to the teeth"); 13 items measure *subjective norms*, 8 of which focus on *social influences* (e.g., "My dentist advises against consuming sweet snacks") and 5 on *motivation to comply* (e.g., "When it comes to a healthy diet, I find the opinion of my partner important"); 6 items measure *perceived behavioural control* (e.g., "I manage to avoid snacks containing sugar"; "I find it difficult to drink water instead of soft drinks"); and 1 item measures *intention* ("From now on, I intend to avoid snacks (food or drinks) as much as possible").
- With regard to **oral hygiene habits,** 10 items measure *attitude* (e.g., "Daily brushing reduces the risk of caries", "Daily brushing is time-consuming"), 9 items measure *subjective norms*, 6 of which focus on *social influence* (e.g., "My partner finds it important that I brush my teeth daily") and 3 on *motivation to comply* (e.g., "When it comes to oral hygiene, I set great store by the opinion of my dentist"); 4 items measure *perceived behavioural control* (e.g., "I do not have enough time to brush in the morning after breakfast", "I manage to brush my teeth twice a day"), and 1 item *intention* ("I intend to brush my teeth at least twice a day").
- With regard to **dental attendance**, 8 items measure *attitude* (e.g., "Frequent check-ups by the dentist reduce the risk of a toothache"; "A visit to the dentist is a traumatic experience"); 6 items measure *social norms* (e.g. "My dentist finds it important that I regularly come for a check-up"), 4 items measure *perceived behavioural control* (e.g., "There are all sorts of reasons that stop me from going to the dentist for a check-up twice a year"; "I manage to visit the dentist for a check-up twice a year"), and 1 measures *intention* ("I intend to go to the dentist twice a year for a check-up").

Although the use of single items to measure intentions prohibits the possibility to establish the reliability of the intention scales, direct measures of intention are more parsimonious, and are often used in tests of the TPB (Godin & Kok, 1996). All items were phrased as statements to be rated on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = no opinion, 4 = agree, 5 = strongly agree). In addition, a number of items were included asking for personal and demographic characteristics and professional activity and its relation to oral health education.

The responses of the participants in the pilot test on the provisional questionnaire were entered into an SPSS data file. First, the distribution of the responses was inspected for each item to eliminate items with a low discriminative power. Next, the remaining items were subjected to a series of Principal Component Analyses (PCAs) to examine the underlying structure of the questionnaire. These PCAs were performed for each behaviour (dietary habits, oral hygiene habits and dental attendance) separately. The intention items, which were measured by only one item per behaviour, were not included in these analyses. To examine the extent to which the theoretical dimensions of the TPB (attitude, subjective norm and perceived behavioural control) could be reproduced, for each PCA the number of components to be extracted was fixed at three, and a Procrustes rotation was performed on the unrotated factor pattern matrix towards a hypothetical structure reflecting the items' expected loading on either attitudes, subjective norm or perceived behavioural control. Since the sample of the pilot study only included 201 participants, we had to rely on a Procrustes rotation, instead of confirmatory factor analysis, to test the model fit. When the hypothetical structure of the TPB model could not be reproduced, a Varimax rotation was performed on the unrotated factor pattern matrix to identify the underlying dimensions of the questionnaire in an explorative way. Items with a high loading on a given component were combined into scales, the internal consistency of which was tested by means of Cronbach's alpha. Multiple regression analyses were applied to evaluate whether the scales measuring attitude, subjective norm and perceived behavioural control could predict intention, and whether intention and perceived behavioural control could predict behaviour, as presumed by the Theory of Planned Behaviour. To verify if the scales obtained in the pilot sample could be reproduced, the data of the second sample were entered into a principal component analysis, and confirmatory factor analysis was performed with LISREL 8.50, using a polychoric correlation matrix and asymptotic covariance matrix of the variables retained in the pilot study for input. The latter were generated by Prelis 2.5. Parameters were estimated by the weighted least squares method.

## Results

### *Item analysis*

Although some of the items were skewed, all showed sufficient variation across the response categories (i.e., less than 95% of responses on a single category). When a more stringent criterion was applied (standard deviation less than .75), a low discriminative power was found for 16 items: 3 for dietary habits, 7 for oral hygiene habits and 6 for dental attendance. These items were discarded.

### *Factor analysis*

The factor solutions resulting from the Principal Component Analyses accounted for 38% of the total variance for dietary habits, 48% for oral hygiene habits and 65% for dental attendance, respectively. The Procrustes rotation towards the a priori structure yielded congruence measures ranging from .63 to .88 for dietary habits, from .78 to .93 for oral hygiene habits and from .91 to .94 for dental attendance.

Since for an adequate congruence these measures should be at least .90, sufficient congruence was only attained for **dental attendance**, implying that the TPB model holds for this behaviour. This is confirmed by the results of an (explorative) Varimax rotation on the same solution, revealing that the contents of the three components resemble the dimensions of the TPB model for this behaviour. Following the removal of one item for which the loading was less than .40 on any component,

**Table 1.** Component loadings of the questionnaire measuring determinants of oral health behaviour in health care workers

| | *1* | *2* | *3* |
|---|---|---|---|
| *Dietary habits* | | | |
| A candy or biscuit in between is enjoyable | .80 | .03 | -.04 |
| A candy or biscuit in between is tasty | .73 | .22 | .04 |
| A sweet or biscuit in between relieves the routine at work | .65 | -.09 | .26 |
| Sweet snacks provide energy | .60 | .11 | .04 |
| My dentist advises me against consuming sweet snacks | -.18 | .64 | .13 |
| My partner finds it important that I eat healthy snacks | .05 | .63 | -.02 |
| My colleagues find it important not to consume too many sweet snacks | .01 | .60 | -.03 |
| In my family, we only eat healthy snacks | .29 | .59 | .11 |
| My family physician gives me the advice not to consume sweet snacks | .05 | .57 | -.04 |
| I find it difficult to drink water instead of soft drinks when I am thirsty | .15 | -.03 | .83 |
| I manage to take healthy drinks in between | .14 | .29 | .75 |
| I find it difficult not to take sugar in my coffee/tea | -.02 | -.08 | .56 |
| *Oral hygiene habits* | | | |
| Daily brushing is time-consuming | .74 | -.04 | .12 |
| Toothpaste and toothbrushes are expensive | .71 | .04 | .05 |
| Tooth brushing is boring | .71 | .15 | .31 |
| My friends and colleagues attach great importance to a good oral health | -.13 | .78 | .14 |
| Most of my friends and colleagues brush their teeth daily | .01 | .71 | .04 |
| My partner finds it important that I brush my teeth daily | .03 | .64 | .03 |
| If I have not brushed my teeth, I do not dare to face my colleagues | .41 | .54 | -.05 |
| I manage to brush my teeth twice a day | .03 | .22 | .89 |
| I fail to brush my teeth twice a day | .07 | .20 | .88 |
| I find it difficult to brush my teeth twice a day | .19 | .10 | .85 |
| I have not enough time to brush after breakfast | .20 | -.14 | .64 |
| *Dental attendance* | | | |
| A visit to the dentist is nothing to be scared of | .84 | .20 | .12 |
| A visit to the dentist is a traumatic experience | .82 | -.10 | .09 |
| A dental check-up is annoying | .82 | -.02 | .19 |
| A dental check-up is expensive | .46 | .16 | .35 |
| My family physician advises me to have my teeth examined regularly | -.02 | .77 | -.06 |
| My partner finds it important that I regularly go to the dentist for a check-up | .03 | .71 | .19 |
| My family thinks that it is normal to see the dentist regularly for a check-up | .41 | .53 | .43 |
| I manage to visit the dentist for a check-up twice a year | .00 | .20 | .88 |
| I manage to make an appointment in time with the dentist twice a year | .10 | .13 | .84 |
| There are all sorts of reasons that keep me from going to the dentist for a check-up twice a year | .30 | .03 | .80 |
| I have not enough time to see the dentist for a check-up twice a year | .37 | -.05 | .77 |

Note: 1 = attitude, 2 = subjective norm, 3 = perceived behavioural control.
Underlined values indicate the highest component loading for a given item.

the first component included four items involving negative attitudes towards going to the dentist; the second component contained four items concerning perceived control with regard to visiting the dentist twice a year; and the third component contained three items, reflecting the social influence of the family physician, partner and family members. Two items loaded high (i.e., more than .30) on another component, but in both cases the difference between the highest and second highest loading was more than .10, indicating only a small degree of overlap. An overview of the component loadings for the three behaviours is presented in Table 1.

Contrary to dental attendance, the a priori structure of the TPB could not be reproduced for dietary habits or oral hygiene habits. To examine the underlying structure of these items, a Varimax rotation was performed on the three components which had resulted from the Principal Component Analysis. For **dietary habits**, this analysis did not produce an interpretable solution, which was mainly due to the effect of the items measuring motivation to comply. After removal of these items, as well as of five other items which obscured the interpretation, a three component solution was obtained which explained 43.3% of the total variance. The first component consisted of five items measuring the social influence of the dentist, family physician, partner, family and colleagues. The second component included four items measuring positive attitude towards the consumption of sugary snacks. The third component contained three items concerning the perceived ability to avoid sweet drinks. All items loaded high on only one component. For the items regarding **oral hygiene habits**, removal of the "motivation to comply" items and one other item resulted in an interpretable three component solution explaining 56.9% of the total variance. The first component comprised four items concerning perceived control of tooth brushing; the second contained four items reflecting the social influence of partner, friends and colleagues; and the third included three items referring to a negative attitude towards tooth brushing. Only one item loaded more than .30 on another component, and again the difference between the highest and second highest loading was more than .10.

**Table 2**. Number of items, internal consistencies and correlations for the scales of the questionnaire measuring determinants of oral health behaviour in health care workers

| *Scale* | | *N* | *Chronbach's alpha* | *Correlations* | |
|---|---|---|---|---|---|
| | | | | *2* | *3* |
| *Dietary habits* | | | | | |
| 1. | Attitude | 4 | .68 | .15* | .18* |
| 2. | Subjective norm | 5 | .60 | | .12 |
| 3. | Perceived control | 3 | .64 | | |
| *Oral hygiene habits* | | | | | |
| 1. | Attitude | 3 | .68 | 15* | .30** |
| 2. | Subjective norm | 4 | .60 | | .21** |
| 3. | Perceived control | 4 | .85 | | |
| *Dental attendance* | | | | | |
| 1. | Attitude | 4 | .76 | .28** | .47** |
| 2. | Subjective norm | 3 | .51 | | .34** |
| 3. | Perceived control | 4 | .87 | | |

* p <.05; ** p <.01

**Table 3**. Multiple regressions for the contribution of attitude, subjective norm and perceived behavioural control to the intention regarding dietary habits, oral hygiene habits and dental attendance.

| *Scale* | | $R^2$ | $\beta$ | *t* | *p* |
|---|---|---|---|---|---|
| *Dietary habits* | | .34 | | | |
| 1. | Attitude | | .24 | 3.83 | < .001 |
| 2. | Subjective norm | | .49 | 7.93 | < .001 |
| 3. | Perceived control | | .04 | .67 | .50 |
| *Oral hygiene habits* | | .52 | | | |
| 1. | Attitude | | -.05 | -.94 | .35 |
| 2. | Subjective norm | | .12 | 2.14 | .03 |
| 3. | Perceived control | | .71 | 12.58 | < .001 |
| *Dental attendance* | | .61 | | | |
| 1. | Attitude | | -.00 | -0.4 | .97 |
| 2. | Subjective norm | | .06 | 1.22 | .23 |
| 3. | Perceived control | | .76 | 13.86 | < .001 |

*Reliability analysis*

The internal consistency coefficients (Cronbach alpha) for the scales deriving from the PCAs ranged from 0.51 to 0.87 (see Table 2). While generally .70 is regarded as an acceptable level for the reliability coefficient, lower thresholds are often used in the literature (Reynaldo & Santos, 1999). Moreover, Cronbach alpha is known to be very sensitive to the number of items in a scale. Given the low number of items for the scales in this study, the alpha values suggest that the obtained scales are reasonably homogenous. Table 2 also lists the Pearson correlations between the scales of dietary habits, oral hygiene habits and visit to the dentist, respectively. These correlations are rather low for dietary habits, moderate for oral hygiene habits and strong for dental attendance. With the exception of one (between attitude and subjective norms towards dietary habits), all correlations reach statistical significance at the .05 level.

*Prediction of oral health behaviour and intentions*

The results of the multiple regression analyses revealed that for **dietary habits**, attitude, subjective norm and perceived control accounted for 34% of the variance in the intention to avoid snacks and sugary drinks (Table 3). This intention was mostly predicted by subjective norm ($\beta$ = .49, $p$ < .001) followed by attitude ($\beta$ = .24, $p$ < .001), while the $\beta$-value of perceived control failed to reach statistical significance. With regard to **oral hygiene habits**, 52% of the variance in intention to brush at least twice a day was accounted for by the predictors in the model of TPB. For this intention, perceived control was the best predictor ($\beta$ = .71, $p$ < .001), followed by subjective norm ($\beta$ = .12, $p$ = .03). Attitude was not a significant predictor of the intention for this behaviour. Finally, with regard to **visiting the dentist** for a check-up twice a year, 61% of the variance in intention could be explained by the dimensions of the TPB. Perceived control contributed significantly to the prediction of this intention ($\beta$ = .76, $p$ < .001), while both attitude and subjective norm did not reach significance.

To measure the impact on the actual behaviour, two outcome measures were used to assess **dietary habits**: the self-reported consumption of sugary drinks and of sugary snacks. Consumption of sugary *drinks* was significantly predicted by both intention and perceived behavioural control ($R^2$ = .29; $\beta$ = -.46, $p$ < .001; $\beta$ = -.21, $p$ < .001 respectively), while the consumption of sugary *snacks* was significantly predicted by intention only ($R^2$ = .14; $\beta$ = -.35, $p$ < .001). For **oral hygiene habits**, intention and perceived behavioural control were both very good predictors for the reported frequency of tooth brushing ($R^2$ = .60; $\beta$ = .29, $p$ < .001; $\beta$ = .55, $p$ < .001, respectively). In contrast, neither intention nor perceived behavioural control provided a significant contribution to the prediction of **dental attendance**, as measured by the reported frequency of preventive visits to the dentist ($R^2$ = .02; $\beta$ = -.19, $p$ = .11; $\beta$ = .23, $p$ = .051, respectively).

*Replication*

Principal component analyses on the data of the larger sample yielded three component solutions explaining 47.79%, 61.24% and 63.47% of the variance for dietary habits, oral hygiene and dental attendance, respectively. For the confirmatory factor analysis testing the three-factor model represented in Table 1 for each behaviour, the model fit was evaluated by means of various goodness of fit indices. In addition to chi-square, use was made of chi-square divided by the degrees of freedom, which is less sensitive to sample size. For this estimate, values below three are considered satisfactory (Bollen and Long, 1993). Other indices were the root mean square error of approximation (RMSEA), the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI; adjusted for degrees of freedom), and the comparative fit index (CFI). For the RMSEA, values below .05 are considered as a good fit, values between .05 and .08 as acceptable, and values higher than .08 as reasonable errors of approximation in the population (Browne and Cudeck, 1992). The GFI should be above .90 (Bentler, 1992), as should the AGFI and the CFI.

For **dietary habits,** the fit indices turned out to be marginally sufficient, with $\chi^2$= 251.92 (51 df, p < .001), $\chi^2$ /df = 4.94, RMSEA = .065, CFI = .88, GFI = .98, and AGFI = .97. The modification indices revealed a high cross-loading of one item, which was designed to measure subjective norm, but loaded high on attitude. After removal of this item, the model showed a good fit to the data ($\chi^2$ = 128.35, df = 41, $\chi^2$ /df = 3.13, RMSEA = .047, CFI = .94, GFI = .99, AGFI = .98). For the items associated with **oral hygiene habits**, model fit was improved by allowing the error variances of two subjective norm-items to correlate. The model met all criteria for a good fit to the data, with $\chi^2$= 80.61 (31 df, p < .001), $\chi^2$/df = 2.60, RMSEA = .042, CFI = .99, GFI = .99, AGFI = .99). Likewise, a good model fit was obtained for the items measuring **dental attendance** when allowing correlation between the error variances of two items. Although the $\chi^2$ of 160.10 (40 df, p < .001), $\chi^2$/df = 4) was somewhat elevated, the RMSEA and CFI of respectively .056 and .97, and the GFI and AGFI of respectively .99 and .98 all indicated excellent fit to the data. In summary, the results of the confirmatory factor analyses indicate that the three-factor model obtained in the exploratory analysis in the pilot sample can be regarded as valid.

Reliability analysis of the scales obtained in this sample produced Cronbach alpha internal consistency coefficients of .58 (attitudes), .61 (subjective norm) and .63 (perceived control) for dietary habits; of .60 (attitudes), .59 (subjective norm) and .88 (perceived control) for oral hygiene habits; and of .74 (attitudes), .51 (subjective norm) and .88 (perceived norms) for dental attendance. These values are comparable to those obtained in the pilot sample, adding further to the validity of these scales.

## Discussion

The aim of this study was to develop a valid and reliable questionnaire for the measurement of oral health related behaviour and its determinants in health care workers, based on the Theory of Planned Behaviour. According to this model, health related behaviour is determined by intentions to perform that behaviour and by perceived control of the behaviour, while intentions are influenced by attitudes towards the behaviour, subjective norms and perceived behavioural control. Starting from this model, the concept validation approach was followed to construct the questionnaire. This approach involves three elements: the explicit definition of the concepts of interest based on theoretical views; the development and internal validation of an instrument to assess these concepts; and the external validation of the instrument, aimed at establishing its predictive validity and/or its relationship to other tools.

In accordance with this approach, a provisional questionnaire was developed to measure the TPB dimensions for three behaviours which impact on oral health: dietary habits, oral hygiene and dental attendance. Component analyses of the responses of a pilot sample of health care workers on this provisional questionnaire produced solutions for each behaviour which to a large extent reflected the theoretical model. For dental attendance, an oblique rotation of a three component solution towards the a priori structure predicted by the TPB produced an adequate degree of congruence. For dietary habits and oral hygiene habits, the data did not fit the imposed three-factor model, but an orthogonal rotation and removal of some items in both cases produced a three component solution which corresponded to the TPB dimensions of attitude, subjective norm and perceived behavioural control. The scales based on these component analyses showed satisfactory levels of internal consistency. Finally, a confirmatory factor analysis performed on a larger sample of health care workers provided excellent goodness of fit indices, attesting to the internal validity of the instrument.

In terms of external validation of the questionnaire, multiple regression analyses indicated that, as assumed by the TPB, the scales measuring attitude, subjective norm and perceived behavioural control to a varying degree contributed to the prediction of the intention to perform all three the oral health related behaviours. Dietary intentions are mostly predicted by subjective norms and attitudes, while intentions to perform oral hygiene habits and to attend dental checkups are more dependent on perceived behavioural control. The fact that not all three the determinants contribute to the prediction of intentions for each behaviour does not imply a lack of support for the TPB model, however. Indeed, it has been documented that the components of the model have a differential impact on behavioural intention depending on the stage in the process of behaviour change phase (Prochaska and DiClemente, 1992). Further, it is also possible that the contribution of the distinct determinants to the prediction of behavioural intentions varies for the various health professions. It is likely, for example, that the attitudes of dentists towards oral health behaviour are different from those of other health care workers. This issue should be the topic of further investigation.

Further adding to the external validity of the questionnaire, intentions and perceived behavioural control significantly predicted the reported consumption of sugary drinks and the frequency of tooth brushing, as hypothesized by the TPB. Contrary to this model, however, perceived behavioural control did not predict the consumption of sweet snacks, yet this must be attributed to the fact that the items that were retained for the perceived behavioural control scale following the item analysis all referred to the consumption of sugary drinks, and not to snacks. Also at odds with the TPB, preventive visits to the dentist could not be predicted by either intentions or perceived behavioural control. This may indicate that dental attendance, as opposed to oral hygiene and dietary behaviour, must be considered as less "volitional" behaviour, and is more dependent on external factors, both in the sense of stimuli to perform the behaviour (e.g. an invitation letter by the dentist) and of barriers which prevent it (e.g. lack of time, long waiting lists, …). Further research should establish the relative impact of cognitive factors, such as attitudes, social norms and perceived control, and contextual factors in the prediction of dental attendance.

Awaiting such research, however, the current study demonstrated the validity of the Theory of Planned Behaviour in predicting behaviour related to oral health among health care workers, and produced a valid and reliable questionnaire to measure the cognitive concepts featured in this model. With the help of this questionnaire, the determinants of oral health related behaviour of health care workers can be identified and targeted for preventive interventions. This way, health care workers can be encouraged to set the example by performing appropriate oral health practices themselves, and thus contribute to the promotion of oral health in children.

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