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Modeling the theory of planned behavior for intention to improve oral health behaviors: the impact of attitudes, knowledge, and current behavior

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Abstract: The aim of this study was to test the efficiency of an extended model of the theory of planned behavior (TPB) in predicting intention to improve oral health behaviors. The participants in this cross-sectional study were 153 first-year medical students (mean age 20.16, 50 males and 103 females) who completed a questionnaire assessing intentions, attitudes, subjective norms, perceived behavioral control, oral health knowledge, and current oral hygiene behaviors. Attitudes toward oral health behaviors and perceived behavioral control contributed to the model for predicting intention, whereas subjective norms did not. Attitudes toward oral health behaviors were slightly more important than perceived behavioral control in predicting intention. Oral health knowledge significantly affected affective and cognitive attitudes, while current behavior was not a significant predictor of intention to improve oral health behavior. The model had a slightly better fit among females than among males, but was similar for home and professional dental health care. Our findings revealed that attitude, perceived behavioral control, and oral health knowledge are predictors of intention to improve oral health behaviors. These findings may help both dentists and dental hygienists in educating patients in oral health and changing patients' oral hygiene habits. (J Oral Sci 53, 369-377, 2011)

Keywords: theory of planned behavior; tooth brushing; dental flossing; dental patients; oral health knowledge.

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Introduction

Regular oral health behaviors contribute to the oral health status of people of all ages. Studies have shown that preventive dental care leads to better oral health outcomes and gains in quality of life (1).

To increase understanding of health behaviors, social cognition models have been developed and adopted in behavioral science research. These models are used to identify and explain how expectations, judgments, beliefs, and intentions lead to the performance of various behaviors (2,3). A widely used social cognition model is the theory of planned behavior (TPB) (4,5), which holds that health-related behavior can be predicted by the intention construct. Intention is influenced by attitudes, subjective norms, and perceived behavioral control towards the behavior. Attitudes are regarded as beliefs about the outcome of the health-related behavior weighted by the value of the outcome. A subjective norm is the individual belief that key people in his or her life might influence them to behave in a certain way, weighted by the level of compliance with such influence. Perceived behavioral control is the individual belief that certain factors might facilitate or impede action, weighted by the perceived control he or she has over these factors (6).

The TPB is a flexible model that is open to the inclusion of additional variables (5), which can increase

the proportion of the explained variance and allow for generalization to other research contexts. Ajzen (5) regarded knowledge as a foundation on which attitudes, subjective norms, and perceived behavioral control are built. Although there is evidence supporting the notion that amount of knowledge is associated with attitude-behavior consistency, there are limitations in the available research. One limitation is that in research on attitude-behavior consistency, knowledge has always been measured rather than experimentally manipulated. Therefore, there is no definitive evidence that knowledge per se exerts a causal influence on attitude-behavior consistency. Another important limitation is that the mechanisms that underlie the association of knowledge with attitude-behavior consistency are poorly understood. To date, three explanations have been proposed. One explanation is that increased knowledge is likely to lead to attitudes that are more stable and resistant to change. A second explanation for the impact of knowledge is that knowledge is related to attitude accessibility. The third explanation posits that attitude-relevant knowledge is associated with various subjective (metacognitive) beliefs that are related to the strength of attitudes, such as certainty and perceived knowledge (7). However, an emerging paradigm focuses on modifying and expanding the TPB model rather than utilizing the traditional theory. To close the gap between psychosocial factors (attitude, subjective norm, and perceived control) and intention, Omondi et al. (6) have proposed a modified TPB model in which the mediating role of perceived knowledge at the pre-intention phase of the TPB model is applied to behavior.

The theory of planned behavior has been successfully used to provide a better understanding and explanation of a diverse range of health-related and social behaviors, including addictive behaviors (e.g., smoking, alcohol consumption, and drug use), clinical and screening behaviors (e.g., health checks and cancer screening), eating behaviors (e.g., healthy diets), exercising behaviors, and HIV/AIDS-related behaviors (e.g., condom use) (8-10). From a database of 185 independent studies published up to the end of 1997, the TPB accounted for 27% and 39% of the variance in behavior and intention, respectively. The perceived behavioral control construct accounted for significant variance in intention and behavior, independent of theory of reasoned action variables. When behavior measures were self-reported rather than objective or observed, the TPB accounted for 11% more variance (9).

The objectives of this research were therefore to: (1) predict intentions to improve oral health behaviors (brushing teeth more than twice per day, daily flossing, using mouthwash daily, visiting the dentist on a regular basis, and scaling on a regular basis) by examining the influence of attitudes, subjective norms, and perceived behavioral control, (2) explore the predictive utility of oral health knowledge across a range of intentions for oral health behaviors, and (3) use a structural network to investigate the interrelations of current oral health behavior; attitudes, subjective norms, and perceived behavioral control; and intention.

Materials and Methods

Sample

The participants of this descriptive, correlational, cross-sectional study were 153 first-year undergraduate students at the Faculty of General Medicine, University of Medicine and Pharmacy "Carol Davila" who were invited to participate in this survey at the end of the 2009–2010 academic year. The mean age of the participants was 20.16, and the sample consisted of 103 females and 49 males (demographic data were missing for one person). In addition, the sample was ethnically homogeneous (100% whites). Upon entry, all participants gave written informed consent for their participation. The study was conducted in full accordance with established ethical principles (World Medical Association Declaration of Helsinki, version VI, 2002).

Instruments and measures

The research data were gathered by using a structured questionnaire in Romanian. The questionnaire consisted of 56 items and was constructed based on a literature review and on Ajzen's TPB (10). It examined the effect of the theory's constructs on intention to improve oral health behaviors. All variables were scored consistently so that higher mean scores reflected more-positive attitude, more-positive subjective norm, and higher perceived behavioral control towards oral health behaviors. The overall alpha coefficient of the instrument was 0.93.

Current oral hygiene behavior

We assessed both personal oral home care (e.g., frequency of tooth brushing, frequency of dental flossing, frequency of mouthwash use) and professional dental health care (e.g., frequency of dental visits or reason for last dental visit). After the item scores were assigned weights, the item values were calculated and summed. The summary oral hygiene behavior score ranged from 5 to 25. A high summary score indicated a high level of oral hygiene behavior (OHB).

Measures of behavioral intention

The measures of behavioral intention assessed how likely participants were to regularly engage in certain oral health behaviors, using a 7-point scale ranging from (1) extremely unlikely to (7) extremely likely. The intention items were: I will brush my teeth more than twice per day, I will floss my teeth daily during the next month, I will use mouthwash daily, I will visit the dentist on a regular basis, and I will undergo dental scaling on a regular basis. The Cronbach's alpha of the scale was 0.839.

Affective attitude toward the behavior

Five items assessed the affective associations with oral health behaviors. Each item asked participants to report how they felt when considering regular toothbrushing, flossing, mouth washing, dental visits, and scaling (unpleasant/pleasant). Participants responded using a 7-point scale with 1 and 7 anchored by each end of the semantic differential. The Cronbach's alpha of the scale was 0.755. The mean of the five items was used as the measure of affective attitude.

Cognitive attitude toward the behavior

Attitudes toward oral health behaviors were measured with five items that assessed the expected value of engaging in regular oral health behaviors. Each question consisted of a semantic differential (harmful/beneficial) anchoring each end of a 7-point response scale following the prompt, "For me [*performing the oral health behavior (e.g., flossing my teeth daily)*] on a regular basis is…" The mean of the items was used as the overall measure of cognitive attitudes ($\alpha = 0.812$).

Subjective norms

Two items (for each behavior), measured by 7-point scales, were used to assess subjective norms, namely, "Most people who are important to me would like me to [*perform the oral health behavior (e.g., floss my teeth daily)*]" and "I feel social pressure to [*perform the oral health behavior (e.g., floss my teeth daily)*]" (disagree completely/agree completely). The mean of the items was used as the measure of social norms ($\alpha = 0.910$).

Perceived behavioral control

For each behavior, perceived behavioral control (PBC) was assessed by four indicators, all measured by 7-point scales. One item measured how easy or difficult (PD) performance of the behavior was perceived to be: "For me it is difficult to [*perform the oral health behavior (e.g., floss my teeth daily)*]" (disagree completely/agree completely). One question measured how confident (CON) the respondent was that he or she would be able to successfully perform the behavior: "If I wanted to, I would not have problems successfully [*performing the oral health behavior (e.g., floss my teeth daily)*]" (disagree completely/agree completely). One item was phrased to reflect perceived control (PC): "I have full control over [*performing the oral health behavior (e.g. flossing my teeth daily)*]" (disagree completely/agree completely). Finally, one item evaluated the locus of control (LOC): "It is completely up to me whether I [*perform the oral health behavior (e.g. floss my teeth daily)*]" (disagree completely/agree completely). The mean of the items was used as the measure of PBC ($\alpha = 0.900$).

Oral health knowledge

All participants were requested to complete a questionnaire adopted from Al-Omiri et al. (11), which included six items designed to evaluate participant knowledge of the causes of dental caries and gum diseases, the meaning of gum bleeding and how to prevent it, and the meaning of dental plaque and its effects. The sum of the correct items ranged from 0 to 35 and was used as the measure of oral health knowledge. The higher the total score, the higher the individual's knowledge of oral health issues.

For each construct, there were very few missing values: 100%, 99.39%, 99.39%, 98.04%, and 94.77% of respondents provided responses to all items measuring affective attitude, cognitive attitude, intention, subjective norm, and perceived control, respectively. In the few cases with missing values, those who provided no responses to any of the items for the various constructs were excluded from the analyses.

Statistical analysis

Descriptive analysis, the Student t test, and correlation analyses were performed using a statistical software package (SPSS 17.0, Inc., Chicago, IL, USA). All reported *P* values are two-tailed, and *P* values less than 0.05 were considered to indicate statistical significance.

Structural Equation Modeling Analysis (SEMA) was carried out using AMOS 7.0 (SPSS, Inc.). As compared with multiple regression techniques, SEMA has advantages for analyzing complex causal patterns in oral epidemiology. For example, it allows latent variables to be modeled, which reduces the likelihood of regression dilution. The estimation technique uses maximum likelihood methods. The model fitting also results in measures of goodness-of-fit indices for hypothesis testing. The fit tests reported in the present study are the comparative fit index (CFI), goodness-of-fit index (GFI), Tucker-Lewis Index (TLI), root mean square error of approximation

Table 1 Self-reported frequency of oral hygiene behaviors by sex

Variables	Description	Total		Females		Males	
		No.	%	No.	%	No.	%
Toothbrushing frequency	Less than once a day	2	1.3	1	1.0	1	2.0
	Once a day or less	15	9.8	7	6.8	8	16.3
	Twice a day	93	60.8	59	57.3	33	67.3
	More than twice a day	39	25.5	33	32.0	6	12.2
	No answer	4	2.8	3	3.0	1	2.0
Flossing frequency	Never	89	58.6	60	58.3	28	57.1
	Once a month	14	9.2	9	8.7	5	10.2
	Once a week	13	8.6	8	7.8	5	10.2
	More than once a week	21	13.8	16	15.5	5	10.2
	Every day	13	8.6	8	7.8	5	10.2
	No answer	2	1.3	2	1.9	1	2.0
Mouth washing frequency	Every day	31	20.3	2	1.9	24	49.0
	More than once a week	25	16.3	42	40.8	6	12.2
	Once a week	12	7.8	10	9.7	3	6.1
	Once a month	16	10.5	9	8.7	9	18.4
	Never	67	43.8	16	15.5	7	14.3
	No answer	2	1.3	24	23.3	0	0
Last dental visit	More than 2 years ago	23	15.0	14	13.6	8	16.3
	1-2 years ago	24	15.7	17	16.5	7	14.3
	6-12 months ago	51	33.3	34	33.0	17	34.7
	Less than 6 months ago	33	21.6	25	24.3	8	16.3
	Last month	21	13.7	13	12.6	8	16.3
	No answer	1	0.7	0	0	1	2.0
Reason for dental visit	For check-up, tooth cleaning, or scaling	82	53.6	59	57.3	23	46.9
	Treatment or pain	58	37.9	37	35.9	21	42.9
	No answer	13	8.5	7	6.8	5	10.2

Table 2 Means and standard deviations (SDs) of TPB variables in the model predicting improvement in oral health behaviors

Variables	Total		Females		Males		*P* value
	Mean	SD	Mean	SD	Mean	SD	
Improving oral hygiene intention (INT)	4.93	1.53	5.10	1.58	4.57	1.37	*0.04*
Attitudes (ATT)	4.58	1.22	4.70	1.29	4.33	1.05	*NS*
- Affective (A-ATT)	4.16	1.30	4.21	1.39	4.04	1.09	*NS*
- Cognitive (C-ATT)	5.00	1.39	5.18	1.44	4.62	1.21	*0.02*
Subjective norms (SN)	4.06	2.03	3.95	2.11	4.30	1.84	NS
Perceived behavioral control (PBC)	4.76	1.15	4.74	1.20	4.80	1.05	*NS*
- Performance difficulty (PD)	3.03	1.68	2.83	1.70	3.47	1.56	*0.02*
- Confidence (CON)	5.35	1.77	5.34	1.80	5.36	1.73	*NS*
- Perceived control (PC)	4.81	1.64	5.02	1.69	4.38	1.46	*0.02*
- Locus of control (LOC)	5.76	1.72	5.75	1.75	5.79	1.67	*NS*
Knowledge (KNW)	22.59	3.01	22.91	2.98	21.93	3.00	NS

(RMSEA), and standardized root mean square residual (SRMR). If the *P* value of the chi-square test exceeded 0.05, the SEMA model as hypothesized was retained. However, if *P* was less than 0.05, the SEMA model was rejected. CFI and TLI range from 0 to 1. TLI values greater than 0.95 are acceptable, while CFI values greater than 0.90 indicate adequate fit. SRMR and RMSEA values less than 0.05 are widely considered to indicate good fit, and values below 0.08 indicate adequate fit.

Results

The results are presented in three sections. First, descriptive statistics of current oral health behaviors are described. Second, correlations between attitude, intention, subjective norm, perceived control, oral health knowledge, current oral health behavior, and intention to improve oral health behaviors are reported. Finally, we report the results of structural equation modeling of the complex interrelationships among the study variables.

Sample characteristics

The student's responses regarding oral health behaviors are presented in Table 1. Regarding frequency of tooth brushing, 84.3% of students did so twice or more

Table 3 Intercorrelations among TPB variables in the model predicting improvement in oral health behaviors

Variables	Correlation coefficients†											
	INT	ATT	ATT-A	ATT-C	SN	PBC	PD	CON	PC	LOC	KNW	OHB
Improving oral hygiene intention (INT)	1											
Attitudes (ATT)	0.693***	1										
- Affective (A-ATT)	0.571***	0.901***	1									
- Cognitive (C-ATT)	0.683***	0.916***	.650***	1								
Subjective norms (SN)	0.163*	0.147	0.153	0.116	1							
Perceived behavioural control (PBC)	0.398***	0.376***	0.280***	0.399***	0.306***	1						
- Performance difficulty (PD)	-0.156	-0.151	-0.207*	-0.072	0.080	0.328***	1					
- Confidence (CON)	0.435***	0.347***	0.274**	0.354***	0.301***	0.797***	-0.018	1				
- Perceived control (PC)	0.539***	0.548**	0.459***	0.533***	0.245**	0.752***	-0.085	0.537**	1			
- Locus of control (LOC)	0.316***	0.292***	0.221**	0.307***	0.201*	0.816***	-0.008	0.679***	0.607***	1		
Knowledge (KNW)	0.216**	0.253**	0.194*	0.263**	-0.032	0.065	-0.212**	0.138	0.210**	0.179*	1	
Current oral health behaviours (OHB)	0.329***	0.367***	0.382***	0.289***	-0.061	0.159*	-0.183*	0.184*	0.311***	0.150	0.209**	1

***$P < 0.001$, **$P < 0.01$, *$P < 0.05$, † Pearson's correlation

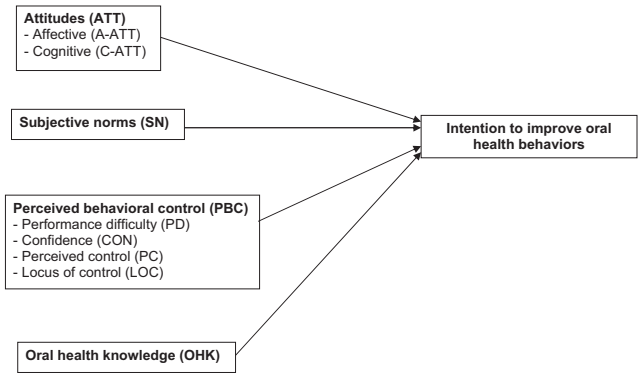

Fig. 1 First unifying hypothesis to explain determinants of intention to improve oral health behaviors.

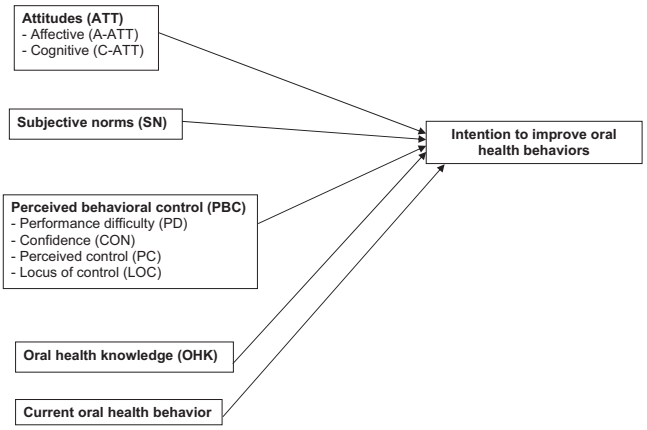

Fig. 3 Second hypothesized model of intention to improve oral health behaviors, with current oral health behavior as a predictor.

a day. However, regarding oral hygiene aids, 58.6% reported never using dental floss and 43.8% never used mouthwash. Regarding professional dental care, 84.3% of students had at least one dental visit in the last 2 years and 68.6% had seen the dentist in the last 12 months, especially for treatment or pain. No significant differences were observed between males and females regarding oral health behavior. The means for each of the direct cognitive measures were quite high, indicating strong intention and favorable attitude, subjective norm, and perceived behavioral control toward improving oral health behaviors (Table 2). However, as compared with males, females had significantly higher scores for improving oral hygiene intention, cognitive attitudes, and perceived control and a lower score for perceived performance difficulty.

Interscale correlations

Intention was significantly positively correlated with attitude, subjective norm, perceived behavioral control, oral health knowledge, and current oral health behaviors. The other components of the model were also significantly correlated with each other (Table 3).

Structural equation modeling

The hypothesized structural model was tested using SEM. The first structural model included (1) paths from TPB components and improving oral health behavior intention and (2) correlations among the TPB predictors. The initial model (Fig. 1) was verified using the AMOS technique. The model was modified based on an inspection of the analysis of the initial model, after which the final model was constructed (Fig. 2). This model fitted well with the whole sample: $\chi^2 = 0.503$ (d.f. = 1, $P = 0.468$), GFI = 0.999, CFI = 1.000, RMSEA = 0.000, TLI = 1.032, and SRMR = 0.039; 51.5% of the variance associated with exercise intention was accounted for by its five predictors.

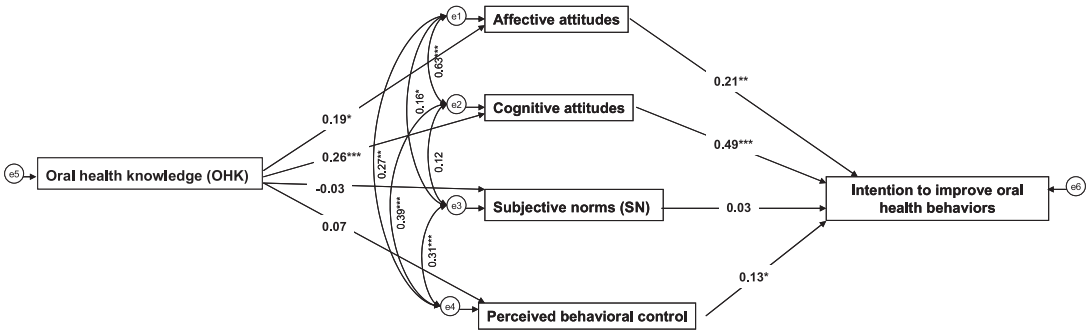

Fig. 2 Structural equations modeling analysis (SEMA). The variance (r^2) of each factor is explained by its relationships with other factors, which may interact among themselves. The strength of the relationship between two factors is indicated by the path coefficients, the significance of which is indicated by an asterisk (*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$). Circles labeled e1–e9 indicate the measurement error of corresponding observed variables. Single-headed arrows indicate the hypothesized direction of causality, and double-headed arrows indicate nondirectional associations. Numbers adjacent to arrows represent the standardized direct effect.

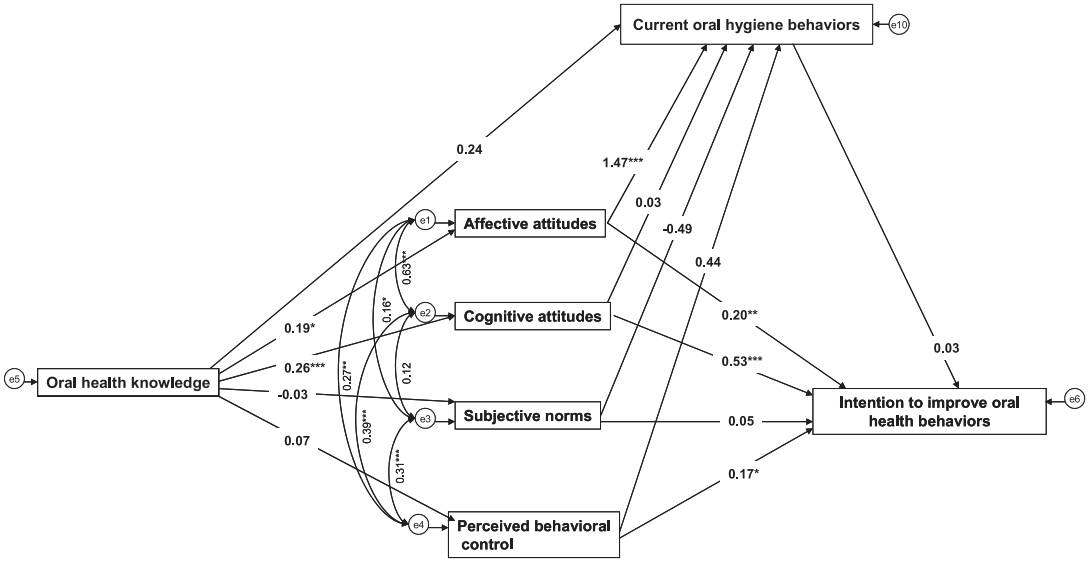

Fig. 4 Structural equations modeling analysis (SEMA) of intention to improve oral health behaviors, with current oral health behavior as a predictor. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

The second hypothesized model also assessed the effect of current oral health behaviors on intention to improve oral health behaviors (toothbrushing more than twice per day, daily flossing, daily mouth washing, visiting the dentist on a regular basis, and undergoing dental scaling on a regular basis) (Fig. 3). The final model (Fig. 4) fitted well with the whole sample: $\chi^2 = 0.236$ (d.f. = 1, $P = 0.657$), GFI = 1.000, CFI = 1.000, RMSEA = 0.000, TLI = 1.062, and SRMR = 0.03; 52.3% of the variance associated with exercise intention was accounted for by its six predictors. The hypothetical model was also tested separately among males and females. Goodness-of-fit statistics were significant between males and females. The model had a better fit among females ($\chi^2 = 0.400$ [d.f. = 1, $P = 0.527$], GFI = 0.999, CFI = 1.000, RMSEA = 0.000, TLI = 1.081, and SRMR = 0.039) than among men ($\chi^2 = 0.830$ [d.f. = 1, $P = 0.091$], GFI = 0.995, CFI = 1.000, RMSEA = 0.000, TLI = 1.028, and SRMR = 0.047).

The hypothetical model was also separately tested for personal oral (home) care (e.g., frequency of tooth brushing, frequency of dental flossing, frequency of mouthwash use) and professional dental health care (e.g., frequency of dental visits or reason for last dental visit).

Goodness-of-fit statistics were significant for the two types of oral health behaviors. The model had a similar fit for professional dental health care ($\chi^2 = 0.146$ [d.f. = 1, $P = 0.702$], GFI = 1.000, CFI = 1.000, RMSEA = 0.000, and TLI = 1.108) and personal home care ($\chi^2 = 0.604$ [d.f. = 1, $P = 0.437$], GFI = 0.999, CFI = 1.000, RMSEA = 0.000, and TLI = 1.038).

Discussion

To our knowledge, this is the first study to examine the complex predictors of improved intention regarding oral health behaviors by accounting for the impact of oral health knowledge and current oral health behaviors in a structural equation model of data from a Romanian population. The findings indicate that intention was significantly positively correlated with attitude, subjective norm, perceived behavioral control, oral health knowledge, and current oral health behaviors. The final SEM model revealed the statistically significant influence of affective and cognitive attitudes, perceived behavioral control, and oral health knowledge, which together explained 52% of the variance in intention to improve oral health behaviors. The findings of this study are consistent with evidence from previous research, which found that TPB variables accounted for comparable percentages (27%–34%) of the variance in dental hygiene behavior (9,12,13).

Among the TPB constructs, the attitude components had the strongest effect on exercise intention. In many studies using Ajzen's theory of planned behavior, attitude consistently had the strongest effect on behavioral intention (5). This suggests that the more positive a person's attitudes, the more likely he or she is to intend to improve their behaviors. Ajzen (14) acknowledges the conceptual distinction between affective and instrumental attitude components, but combines them to form a singular construct. However, other attitude researchers (15-20) have demonstrated that these constructs are distinct. In the present study, before constructing the TPB models, we examined whether attitude should be modeled as two constructs (ie, affective and instrumental attitude) or as a single attitude construct. A model consisting of correlated constructs for affective and instrumental attitude resulted in a significantly better fit than a model with the correlation constrained to unity. Therefore, affective and instrumental attitudes were included in the TPB models as separate constructs. Our results are in conformity with those of other reports, which show that attitude is consistently positively correlated with intention and is a good predictor of intention (21-26). In dental health research, favorable attitudes regarding dental treatment were associated with the greatest number of preventive and restorative visits (27). Moreover, parental attitudes toward their children's oral health were significantly associated with their own oral health behavior and with understanding the importance of fostering oral hygiene skills in their children (11,28).

Overall, the multicomponent TPB constructs accurately predicted intention regarding oral health behavior, with the exception of the subjective norm components. This is consistent with the findings of Rhodes and Courneya (19,20), Rhodes et al. (22,29), Saunders et al. (30), and Fen & Sabaruddin (26), all of which observed that subjective norms did not significantly contribute to the prediction of behavior. The present results are also consistent with the findings of Buunk-Werkhoven et al. (13), which showed that subjective norms were not positively associated with oral health behavior.

The third social cognitive determinant is PBC, conceptualized in the present paper as an individual's perception of the amount of control (i.e., perceived controllability) one has in terms of anticipated impediments and obstacles as well as one's perceived capabilities and confidence (ie, perceived self-efficacy) regarding participating in exercise activities during leisure time. Ajzen (5) predicts that PBC influences a person's intention to perform a given behavior. The perception of self-efficacy has previously been found to be a good predictor of oral health behavior (31-38) and a health-promoting lifestyle (39), while dental locus of control beliefs is useful in determining health behavior and health status (40).

A limitation of the study was that the sample population was limited to university undergraduate students and had a large proportion of females, which may have biased the results. However, the SEM did not reveal statistically significant differences between males and females in the TPB model in the study. Finally, TPB may perform differently in different sociocultural contexts. Thus, it is important to test the applicability of the TPB in different countries and in older populations so as to strengthen the cross-validation and theoretical veracity of the findings.

In summary, our findings revealed that attitude, perceived behavioral control, and oral health knowledge are predictors of intention to improve oral health behaviors. The use of psychology models permitted elucidation of intervention effects and identification of factors associated with evidence-based practice, thus providing a basis for improving future intervention designs. Oral health education should focus on improving knowledge and attitudes and removing barriers to daily oral health care. The present findings may help both dentists and dental hygienists in educating patients in oral health and

changing patients' oral hygiene habits. Future research with the TPB and oral health behavior will likely benefit from the use of our theoretical models and appropriate interpretation of the present results.

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