Extended Theory of Planned Behavior Applied to Oral Hygiene in Peruvian Undergraduates*

Teoría extendida de la conducta planificada aplicada al comportamiento de higiene oral en universitarios peruanos

Teoria estendida do comportamento planejado aplicada à higiene bucal em graduandos peruanos

Rene Palomino Cordova
Universidad Privada Antonio Guillermo Urrelo. Cajamarca, Perú
renepalomino2211@gmail.com
https://orcid.org/0000-0002-2268-4963

DOI : https://doi.org/10.11144/Javeriana.uo41.etpb
Submission Date: 7 March 2022
Acceptance Date: 17 October 2022
Publication Date: 29 November 2022

Orfa Ruth Colqui Loyola
Universidad Privada Antonio Guillermo Urrelo. Cajamarca, Perú
colquident18@gmail.com
https://orcid.org/0000-0003-3724-7691

Rafael Antonio Leal Zavala
Instituto Nacional de Salud, Centro Nacional de Salud Pública. Lima, Perú
lealzavala@gmail.com
https://orcid.org/0000-0003-3718-5347

Yvonne A. B. Buunk-Werkhoven
SPOH ARTS, International Optimizing Health Psychology. Amsterdam, The Netherlands
yvonne@spoh-arts.com
https://orcid.org/0000-0001-8524-9574

ABSTRACT

Background: There is considerable evidence in favor of applying the Theory of Planned Behavior to oral hygiene, proving to be an adaptable and highly explanatory model. However, more evidence is needed to apply an extended version of this theory to various populations in South-America. **Purpose**: To analyze the psychometric characteristics of an Oral Hygiene Questionnaire, a scale developed by Buunk-Werkhoven, and to describe the prediction level of Extended Theory of Planned Behavior to oral hygiene behavior. **Methods**: This was a non-experimental and cross-sectional study in which a non-probabilistic sample of 644 Peruvian undergraduate students was surveyed to respond the Oral Hygiene Questionnaire. **Results**: There are acceptable and good reliability coefficients of the Oral Hygiene Questionnaire subscales, and the Confirmatory Factorial Analysis shows items that fit the standardized measurement model of four exogenous first-order constructs. Regarding the structural model, absolute, comparative, and parsimony fit statistic was applied. Additionally, variables of the Extended Theory of Planned Behavior explained 31 % and 26 % of intention variance and oral hygiene behavior, respectively. **Conclusion**: The assessment and structural model based on the Extended Theory of Planned Behavior show good empirical evidence to apply it to oral hygiene of Peruvian undergraduates.
Keywords: behavior; dentistry; healthy behavior; oral hygiene; psychological theory; theory of planned behavior; undergraduate student

Authors' Note: [a] **Correspondence:** renepalomino2211@gmail.com; colquident18@gmail.com; lealzavala@gmail.com; yvonne@spoh-arts.com

RESUMEN

Antecedentes: Existe amplia evidencia a favor de la aplicación de la Teoría de la Conducta Planificada a la higiene oral que demuestra ser una propuesta flexible y altamente explicativa. Sin embargo, se requiere mayor evidencia de la pertinencia de dicha teoría en su versión extendida al aplicarse en diversos grupos poblacionales de países suramericanos. **Objetivo:** Analizar los indicadores psicométricos del Cuestionario de Higiene Oral, instrumento desarrollado por Bunnk-Werkhoven, así como determinar el nivel de predicción de las variables de la Teoría Extendida de la Conducta Planificada aplicado al comportamiento en la higiene oral. **Métodos:** Se realizó un estudio no experimental de corte transversal en el que se encuestó a una muestra no probabilística de 644 estudiantes universitarios peruanos, quienes completaron el Cuestionario de Higiene Oral. **Resultados:** Existen coeficientes de confiabilidad aceptables y buenos para las subescalas del Cuestionario de Higiene Oral y el Análisis Factorial Confirmatorio (CFA) reveló que los ítems que comprenden el instrumento de medición se ajustan a un modelo de medida estandarizado de cuatro constructos exógenos de primer orden. En cuanto al modelo estructural, se aplicaron estadísticos de ajuste absoluto, comparativo y parsimonioso. Asimismo, las variables de la Teoría Extendida de la Conducta Planificada explicaron el 31 % y 26 % de la varianza en la intención, así como el comportamiento en higiene oral. **Conclusiones:** El modelo de medición y estructural basado en la Teoría Extendida de la Conducta Planificada presenta evidencia empírica favorable para aplicarse al comportamiento en higiene oral en estudiantes universitarios peruanos.
Palabras clave: comportamiento; conducta saludable; estudiante universitario; higiene oral; odontología; teoría de la conducta planificada; teoría psicológica

RESUMO

Antecedentes: Existe considerável evidência a favor da aplicação da Teoria do Comportamento Planejado à higiene bucal, revelando-se um modelo adaptável e altamente explicativo. No entanto, mais evidências são necessárias para aplicar uma versão estendida dessa teoria a várias populações na América do Sul. **Objetivo**: Analisar as características psicométricas de um Questionário de Higiene Oral, escala desenvolvida por Buunk-Werkhoven, e descrever o nível de predição da Teoria Estendida do Comportamento Planejado para o comportamento de higiene bucal. **Métodos**: Este foi um estudo não experimental e transversal no qual uma amostra não probabilística de 644 estudantes universitários peruanos foi pesquisada para responder ao Questionário de Higiene Oral. **Resultados**: As subescalas do Questionário de Higiene Oral apresentam coeficientes aceitáveis e bons de confiabilidade, e a Análise Fatorial Confirmatória apresenta itens que se enquadram no modelo de mensuração padronizado de quatro construtos exógenos de primeira ordem. Com relação ao modelo estrutural, foi aplicada a estatística de ajuste absoluto, comparativo e de parcimônia. Adicionalmente, as variáveis da Teoria Estendida do Comportamento Planejado explicaram 31 % e 26 % da variância da intenção e do comportamento de higiene bucal, respectivamente. **Conclusão**: A avaliação e o modelo estrutural baseados na Teoria Estendida do Comportamento Planejado apresentam boas evidências empíricas para aplicá-la à higiene bucal de estudantes peruanos.
Palavras-chave: comportamento; comportamento saudável; higiene oral; odontologia; teoria psicológica; teoria do comportamento planejado; estudante universitário

INTRODUCTION

Oral hygiene represents a set of rules to prevent the mouth's soft and hard tissue susceptibility to any disease (1). Oral hygiene requires daily removal and elimination of microbial film deposits (biofilm or dental plaque) from the tooth surface. To this end, people must be duly committed and instructed on how to perform adequate oral hygiene and having the necessary tools to perform it. Two steps are essential for an adequate oral hygiene: removing interdental plaque, using an interdental brush or dental floss, and performing conventional brushing of dental surfaces. In addition to the technique, effective biofilm removal requires a people to be engaged to perform their oral hygiene (2).

Buunk-Werkhoven, *et al.* (2), citing the American Dental Association, recommend following a brushing regimen of at least two daily sessions lasting approximately two minutes, after having breakfast and before going to sleep. A correct oral hygiene involves brushing gently, without pressure, step by step, making small strokes, with a variety of massages near the gums, completing with interdental flossing and cleaning the tongue. This will serve to assess whether the oral hygiene behavior (OHB) is performed completely and efficiently (2).

Despite the complexity that characterizes oral hygiene, it represents one of the strategies with proven effectiveness to reduce oral diseases, specifically caries and periodontal diseases (3). Both diseases represent a problem for global public health. In the case of Peru, oral cavity pathologies are considered among the 12 priority problems for the health system, where about 90.4 % of the population has dental caries (4).

There are various behavioral theories to explain the mechanisms leading a person to adopt a healthy behavior, as is the case of oral hygiene. These theories can be classified into continuum models (e.g., Health Belief Models, Self-Efficacy Theory, Planned Behavior Theory, and Behavioral Theory) and phase or stage models (e.g., Transtheoretical Model, Process Model of Action in Health) (5). Even when the latter have greater explanatory power on the mechanisms for the acquisition of healthy behavior, their approaches turn out to be complex and difficult to verify empirically. In contrast, continuum models are characterized by their logical simplicity, focus on explaining behavioral motivations (5), and are more frequently used to explain oral health behavior (6,7).

Among the continuum models, the Theory of Planned Behavior (TPB) has broad empirical support in predicting intention and healthy behavior (8). It is a theory that explains behavior in specific situations, where a central role is given to the motivational variable called intention, the same one that expresses the effort that a person expects to execute a certain behavior. However, the expression of a behavior does not only depend on its intention; the latter is determined by three variables: attitude, social norm, and perceived behavioral control. These three variables interact with each other and form the behavioral intention, which in turn influences the initiation or not of a certain behavior (9).

According to Patel, *et al.* (10), various studies confirm the relevance of applying TPB to oral hygiene in different ages and contexts. Regarding the application of this theory in the prediction of oral hygiene in an exclusively young population, four antecedents were identified; three were conducted in of Romania (11-13) and one in Ethiopia (14). Their results indicate that the percentage of explained variance of oral hygiene intention from the TPB variables are heterogeneous (from 31.3 % to 66 %); Similarly, there is also diversity in the degree of association between the different variables of the TPB. This reveals that, despite being a theory of important predictive value, the level of generality of the TPB is determined by the specific characteristics of human groups, as well as the influence of each of the variables that make up said theory.

One of the studies where TPB has been applied to oral hygiene in a university population was carried out by Dumitrescu (13). However, in that study only the prediction of intention was assessed, but not oral hygiene behavior or other variables were considered. The importance of addressing the oral hygiene of university students is related to the opportunities involved in preventing dental diseases and achieving future oral hygiene, especially at a stage where there is a greater number of risk behaviors and less vigilance by parents (15-17).

The flexibility of the TPB to include other variables in the proposed explanatory models makes it possible to achieve a greater explained variance of behavior, as well as a greater generalization of the theory to various research contexts. However, considering the criterion of simplicity that should characterize all explanatory scientific models (18), caution is required in the inclusion of additional predictor variables, proposing a judicious deliberation and submitting their respective empirical exploration (8). In recent years, multivariate models have been proposed that include other predictive variables of oral hygiene behavior (i.e., visits to the dentist, knowledge about oral health, and expected social results). These types of models are known as Extended Theory of Planned Behavior (ETPB) (2) (Figure 1). Hence the importance of contributing to the application of the ETPB to oral hygiene in university students in Peru.

The aforementioned led to the following question: To what extent does the TPB in its extended version (ETPB) predict oral hygiene intention and behavior in university students from northern Peru? The design chosen to answer this question meant attending to two study goals: to analyze the psychometric indicators of the Oral Hygiene Questionnaire proposed by Buunk-Werkhoven (2) and to

evaluate the degree of adjustment of the ETPB (e.g., attitudes, social norms, perceived behavioral control, expected social outcomes, and oral health knowledge) in predicting oral hygiene intention and behavior. Likewise, we sought to confirm the following hypotheses: There is a significant relationship between the variables of the ETPB (perceived behavioral control, social norms, attitude, expected social results, and knowledge of oral health) and the intention and behavior of oral hygiene.

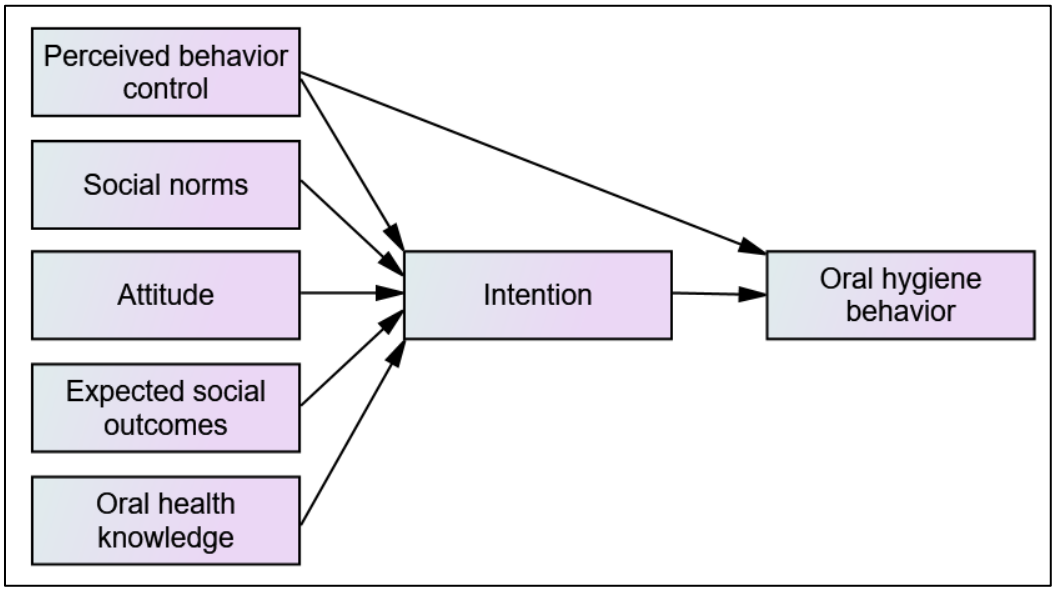

FIGURE 1
Extended Theory Planned Behavior
Source: Buunk-Werkhoven, *et al*., 2011, p. 252. (2)

MATERIALS AND METHODS

Design and Sampling

A non-experimental cross-sectional cohort study was conducted. A non-probabilistic sampling was used and the size of the sample was determined through the rule of proportions by parameters, a strategy suggested when using the Structural Equations Model (SEM), where samples greater than 200 subjects are required in order to avoid imprecise estimates in standard errors (19). As inclusion criteria, Peruvian university students identified as male or female were considered; they were also given the option of choosing the category others in case they did not identify as male or female. In addition, the study included undergraduate students between the VI and X cycles in various professional careers (majors). Those students unwilling to be part of the study or who were not present during the application sessions of the survey were excluded.

Data collection was conducted through two self-report and online application instruments, which made up of 51 items. These instruments were administered between January 4 and February 12, 2021. The first instrument is an *ad hoc* questionnaire with five items referring to the socio-demographic characteristics of participants in the study (e.g., sex, age, study center, professional career [major], and cycle of studies). The second instrument, the Oral Hygiene Questionnaire, developed by Buunk-Werkhoven, *et al.* (20), comprises 46 items aimed at measuring psychosocial variables that explain oral hygiene intention and behavior (OHB) based on the EPBT. For this study, the Spanish version of the Oral Hygiene Questionnaire, applied in Uruguay (20) and the Dominican Republic (21), was used.

The psychosocial variables evaluated through the Oral Hygiene Questionnaire are distributed according to seven scales: attitudes towards oral hygiene behavior (ATT), social norms (SN), perceived behavior control (PBC), expected social outcomes (ESO), oral health knowledge (OHK), intention (I), and oral hygiene behavior (2,14,20,21). There is evidence of satisfactory reliability indices for the scales evaluated by the Oral Hygiene Questionnaire (Cronbach's alpha values: ATT = 0.94; I = 0.70; SN= 0.87; PBC = 0.85) (21). With the exception of the OHK scale, the items that make up the different scales are multiple choice alternatives with a Likert-type format and are distributed as follows: ATT = 9 items; SN = 5 items; CPP = 3 items; ESO = 6 items; I = 8 items and OHB= 8 items). A higher score obtained in the sum of the items that make up each subscale represents a greater expression of the measured attribute. Regarding the OHK scale, it comprises 7 items with dichotomous alternatives (No = 0; Yes = 1); the higher the score achieved, the greater the OHK.

The study was developed considering the principles of respect for people and justice. In order to guarantee the anonymity, autonomy, and free judgment of the participants, all information regarding their participation in the study was provided. Likewise, permission was obtained from the Research Ethics Committee of the Cajamarca Regional Teaching Hospital, Peru (No. 008-2020-CEI-HRDC).

Data Analysis

Initially, a correlation analysis was performed between the main latent variables or study constructs to establish the direction, magnitude, and significance of the associations between them. Likewise, prior to the analysis of the SEM, we verified that the scores were adapted to normal univariate and multivariate distributions. For the former normality, asymmetry and kurtosis values of less than 3 and 10, respectively, are expected (19); while for the latter normality, Mardia's asymmetry and kurtosis test were used.

Another important aspect in the analysis is the verification of reliability of the questionnaires. For this purpose Jöreskov's Omega (Ω) coefficient was used, whose value interpretation was made on the basis of the following rule: Ω = 0.70-0.79 (acceptable level), Ω = 0.80-0.89 (good), and ≥ 0.90 (excellent) (23).

We also used confirmatory factor analysis (CFA) to comprehensively analyze the measurement model. Through the analysis of standardized factor loads (λ) we determined to what extent the observable variables (indicators or items) are appropriate to measure the latent variables or constructs. These factor loadings are expected to be > 0.40 (24). The quality of the measurement model was assessed, using for the evaluation of the goodness of fit of the measurement model, of four goodness-of-fit statistics from the SEM: absolute ($X^2/df < 5$), comparative (CFI ≥ 0.90), parsimonious (NF ≥ 0.90), and the root mean square residual approximation (RMSEA < 0.07) (25).

The evaluation of the fit of the model implies comparing the theory with reality. In this sense, the similarity of the estimated variance and covariance matrix (theory) with respect to reality (observed variance and covariance matrix) was analyzed. If the researcher's theory is perfect, the estimated and observed variance and covariance matrices would be the same, that is, with a zero residual (0). However, as this level of perfection does not usually occur, a model is said to have a good fit the closer these values are found in the two matrices (24).

To determine the direct and indirect effects of the exogenous variables on the endogenous variables, the analysis of the structural model was used in a sequence of five stages: a) Specification of the model, which consisted of establishing the hypothetical relationships between constructs. b) Identification of the model, which was developed using the rule of degrees of freedom (the most used for SEM) with the mathematical formula: gl = [p(p+1)/2] – q), where: p, number of observed variables and q, number of free parameters to estimate. Likewise, we tried to find if the model is overidentified, that is, gl is > 0 (25). c) Evaluation of data quality, which consisted of estimating an appropriate size for the study sample and avoiding multicollinearity between the latent constructs; that is, that the correlation between the latter is > 0.85 (19,24,26). d). Estimation of parameters, to determine:

1. The application of a hypothesis test, to find out if each variable contributes or not to the model, was assessed assuming a typical significance level of $p < 0.05$ from multivariate analysis for SEM: H_a (alternative hypothesis): β_1, β_2, β_3, β_4, β_5, β_6, and $\beta_7 \neq 0$.
2. The coefficients of determination (R^2), or proportion of the total variance of the variable explained by the regression, were calculated. The analysis of the degree of determination of the latent variables is assessed as substantial, moderate, or weak depending on the percentage of explanation obtained (67 %, 33 %, and 19 %, respectively) (27).
3. The supposed hypothetical multivariate relationships (first stage) were transformed into multiple linear regression coefficients (β); it is suggested that these regression coefficients be ≥ 0.20 and ideally > 0.30 to be considered significant (27).
4. The absence of multicollinearity was confirmed through the following criteria: variance increase factor values < 10, tolerance index (T) > 0.10 (28), and variance proportion indices $x \rightarrow 0$ (24).

e) Evaluation of the goodness of fit of the model, which allowed assessing the quality of the structural model, using four goodness of fit statistics from the SEM: absolute ($X^2/df < 5$), comparative (CFI ≥ 0.90), parsimonious (NF≥ 0.90), and the root mean square residual approximation (RMSEA < 0.07) (24).

For the statistical analysis, the SPSS v.25 software and its AMOS (Analysis of Moment Structures) environment were used, as well as the R program package and its RStudio v.4.0.5 environment, and Microsoft Excel 2016.

RESULTS

644 students from three universities in the city of Cajamarca, located in northern Peru, responded the survey. Of the total sample, 57.6 % were women, 41.5 % were men, and 0.9 % chose the other option. The average age was 21.9 years, with a range of 17 to 44 years.

Reliability of Measuring Instruments

For reasons of the context of the COVID-19 pandemic, data collection was carried out through the online version of the Oral Hygiene Questionnaire (2). Regarding the analysis of reliability of the scales that comprise the questionnaire, reliability levels between acceptable ($\Omega = 0.70$) and excellent ($\Omega \geq 0.90$) were found (attitude, $\Omega = 0.95$; social norms, $\Omega = 0.90$; behavior control perceived, $\Omega = 0.70$; expected social results, $\Omega = 0.80$; and intention, $\Omega = 0.91$). The reliability of the variables OHK and OHB was not calculated because they were indices (Table 1).

TABLE 1
Reliability and Descriptive Statistics of ETPB Variables (N = 644)

Variable	Coefficient (Ω)	Range	Mean	SD
Attitude (ATT)	0.95	9 - 63	52.57	9.14
Social norms (SN)	0.90	5 - 35	31.09	4.40
Perceived behavioral control (PBC)	0.70	3 - 15	13.18	1.74
Expected social outcomes (ESO)	0.80	6 - 30	24.57	4.05
Oral health knowledge (OHK)	----	0 - 7	4.34	1.23
Intention (I)	0.91	8 – 56	48.09	7.48
Oral hygiene behavior (OHB)	----	1 - 16	11.45	2.70

Source: the authors.

Correlation Between Latent Variables

The analysis of correlation between the main variables indicates that the OHB intention (endogenous variable) is significantly associated with the exogenous variables attitude (0.36), social norms (0.45), perceived behavior control (0.44), and expected social results (0.35). However, this correlation is not significant with respect to the OHK variable. Furthermore, intention was found to be significantly associated with OHB (0.22) (Table 2).

TABLE 2
Variable Correlation of ETPB

Variable	ATT	SN	PBC	ESO	OHK	I	OHB
ATT	1						
SN	.40***	1					
PBC	.28***	.47***	1				
ESO	.25***	.38***	.34***	1			
OHK	-.10	-.02	-.05	-.05	1		
I	.36***	.45***	.44***	.35***	.00	1	
OHB	.08*	.12***	.27***	.07	.00	.22***	1

Source: the authors.

Analysis of the Measurement Model

The CFA, by means of factor loadings (λ), reveals that the items that comprise the Oral Hygiene Questionnaire fit a standardized measurement model of four first-order exogenous constructs, with 23 associated indicators, or assigned to each construct, and 6 relationships between constructs (figure 2). The exogenous variable OHK was excluded from the measurement model because it is an index and has a non-significant correlation with its peers. No factor loadings (λ) < 0.40 were found. Therefore, none of these items is likely to be excluded. Their values were between 0.50 (acceptable) and 0.70 (ideal). The standardized model has 52 parameter estimates, including 23 load estimates, 23 error estimates, and 6 correlation estimates between constructs.

The goodness-of-fit indices exceeded the recommended values, adjusting very significantly at a level of $p < 0.001$ ($X^2/gl = 3.34$; CFI = 0.94; NFI = 0.92 and RMSEA = 0.06). These indicators show a conclusive adjustment of the research measurement model.

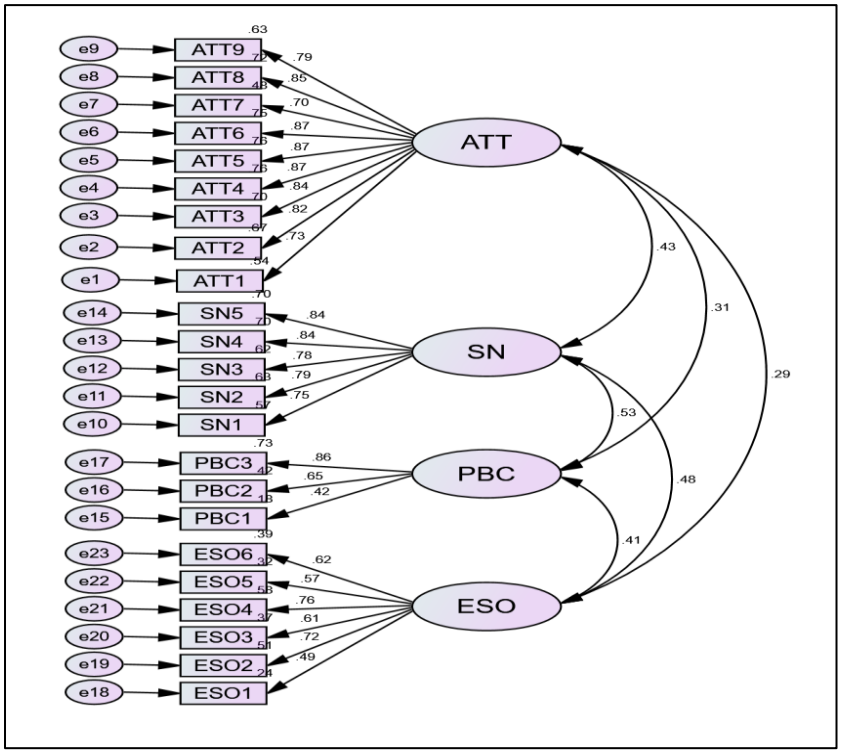

FIGURE 2
Measurement Model of ETPB Variables*
*ATT: Attitude; SN: Social Norms; PBC: Perceived behavior control; ESO: Expected Social Outcomes.
Source: the authors.

Analysis of the Structural Model

The analysis of the structural model comprised five stages. In the first stage, model specification, five exogenous variables were considered: attitude (ATT), social norms (SN), perceived behavior control (PBC), expected social outcomes (ESO) (latent variables), and oral health knowledge (OHK) (observable variable). At this stage, the five variables were related to the endogenous variable intention (I), and the latter is directly related to OHB. The perceived behavior control affects OHB directly and indirectly through the OHB intention variable (mediating variable). These relationships are recursive (unidirectional relationships) (Figure 3). The observable variables (items) and their respective errors are part of the external structural model, while the relationships between latent variables are part of the internal structural model.

In the second stage, we determined that the structural model is recursive overidentified (df=1 150). In the third stage, we determined that the sample size used satisfies the minimum value established by the rule of proportions by parameters. In the fourth stage, we established three fundamental statistics:

a. Hypothesis tests, assuming a p value < 0.05 (Figure 3 and Table 3).
   H_1: Perceived behavioral control has a significant effect of 0.27 on intention. The observable variable that contributes the most is PBC3 ($\lambda = 0.82$).
   H_2: Social norms have a significant effect of 0.16 on intention. The observable variables that contribute the most are SN4 and SN5 ($\lambda = 0.84$), respectively.
   H_3: Attitude has a significant effect of 0.17 on intention. The most important observable variables that explain attitude (ATT) are ATT4, ATT5, and ATT6 ($\lambda = 0.82$), respectively.

H_4: The expected social results have a significant effect of 0.14 on the intention. The variables that contribute the most are ESO2 ($\lambda = 0.51$) and ESO4 ($\lambda = 0.58$).

H_5: Oral health knowledge has no significant effect on intention since its value is 0.05.

H_6: Perceived behavior control (PBC) has a direct effect of 0.38 on OHB. The observable variable that contributes the most is PBC3 ($\lambda = 0.82$).

H_7: Intention has a significant effect of 0.19 on OHB. The observable variables that explain intention to a greater extent are I6 and I7 ($\lambda = 0.85$, for both variables).

b. The coefficient of determination (R^2) was established. The results indicate that the EPBT variables explain 31 % of the intention and 26 % of the OHB.

c. The multivariate linear regression coefficients (β) determined for the prediction, considering $p < 0.05$, are: $\beta_1 = 0.27$; $\beta_2 = 0.16$; $\beta_3 = 0.17$; $\beta_4 = 0.14$; $\beta_5 = 0.05$; $\beta_6 = 0.19$; $\beta_7 = 0.38$. The prediction of OHK to intention is not significant (Table 3).

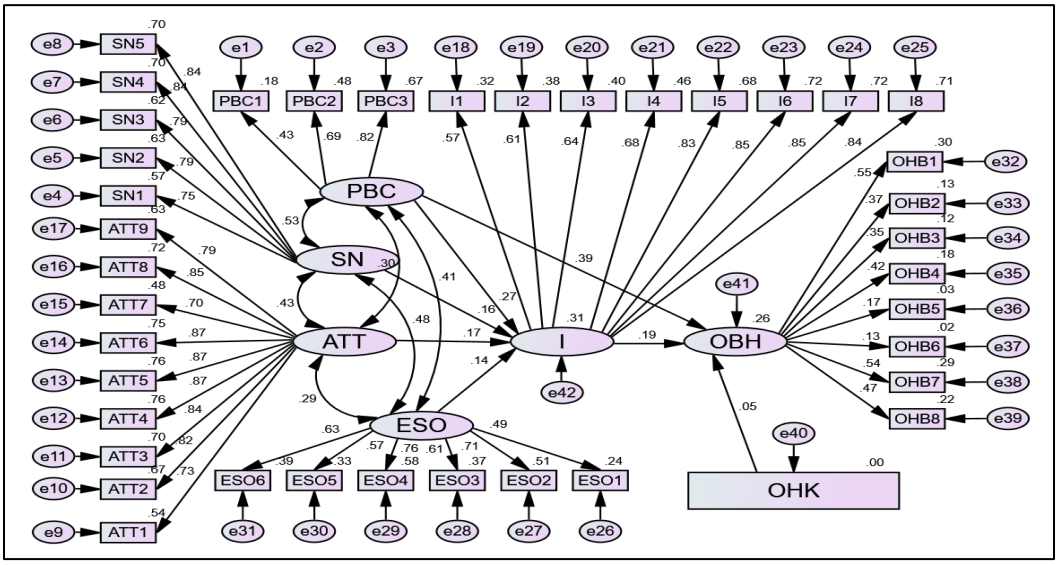

FIGURE 3
Structural Model of ETPB Variables*

*ATT: Attitude; SN: Social norms, PBC: = Perceived Behavior Control; ESO: Expected Social Outcomes; I: Intention; OHB: Oral Health Behavior; OHK: Oral Health Knowledge.

Source: the authors.

TABLE 3
Regression Coefficients of ETPB Variables

Variable	Coefficient (β)	Self-reported	T	P value
Perceived behavioral control (PBC)	β_1	0.27	6.39	0.000
Social norms (SN)	β_2	0.16	5.52	0.000
Attitude (ATT)	β_3	0.17	4.77	0.000
Expected social outcomes (ESO)	β_4	0.14	3.83	0.000
Oral health knowledge (OHK)	β_5	0.05	0.71	0.477[a]
Intention (I)	β_6	0.19	5.77	0.000
Oral hygiene behavior (OHB)	β_7	0.38	----	----

Source: the authors.

d. The values of the variance increase factor (VIF) of the exogenous latent variables ranged between 1.004 and 1.490; the tolerance statistics were between 0.671 and 0.996; and the variance

proportion indices were close to zero (0). In this sense, the statistical test indicates that the assumption of multicollinearity is not breached (Table 4).

TABLE 4
Proportion of Variance and Multicollinearity Statistics

Variable	Variance Proportion					Multicollinearity	
	ATT	SN	PBC	ESO	OHK	Tolerance	VIF
ATT	0.02	0.01	0.01	0.02	0.85	0.826	1.211
SN	0.74	0.00	0.01	0.32	0.00	0.671	1.490
PBC	0.19	0.01	0.02	0.63	0.02	0.739	1.353
ESO	0.02	0.89	0.03	0.00	0.01	0.815	1.227
OHK	0.03	0.00	0.05	0.03	0.12	0.006	1.004

Source: the authors.

In the fifth stage, the goodness-of-fit indices were significant for a $p < 0.001$, except for the NFI. The calculated values are: ratio $X^2/gl = 3.71$; CFI = 0.90; NFI = 0.811 and RMSEA = 0.065.

DISCUSSION

This study evaluated the variables of the ETPB to predict OHB of university students. The results indicate that the variables of the ETPB explain 31 % of the intention and 26 % of the OHB. The percentage of explanation of the OHB intention was slightly lower than that reported by those antecedents where similar samples were used (11,13). However, there is agreement with a study conducted with a sample of first-year university students of medicine, mostly women, which evaluated the specific intention to improve their toothbrushing behavior (R^2 = 31 %) (13). Additionally, it is important to point out that the percentage of prediction of oral hygiene found is also similar to other studies that used more heterogeneous samples (2,20,21). This difference in the degree of explanation of the ETPB may be due, in part, to the different measurement and analysis models used (14). Nevertheless, it is also important to consider the role that heterogeneity could have in the characteristics of the sample of study used. On the other hand, the degree to which the ETPB explains OHB is generally in line with the extent to which the TPB tends to predict both intention and behavior in general (29).

Of the five variables proposed as predictors of intention and OHB, perceived behavioral control obtained higher prediction coefficients (0.27 and 0.38, respectively). Except for OHK, the other variables predicted OHB intention. These results are different from those studies oriented towards such a population group, in which attitude obtained a higher predictive level (11-13). Other studies identify social norms as the second variable, after attitude, in the degree of prediction of OHB intention (7,20,30).

Regarding the high predictive value of perceived behavioral control, this finding has also been confirmed in another study conducted on users of dental services, in which TPB was applied to three specific OHBs: tooth brushing, interdental cleaning, and tongue cleaning (15). Consequently, the importance that TPB provides perceived behavior control as an important variable to explain those health behaviors whose adoption is complex for people is justified (29).

Although the predictive relationships between the variables turned out to be significant, one of the fit indices did not reach the value (NFI = 0.811). This may be attributable to the weak prognosis of OHK regarding the intention variable. For this reason, we suggest excluding this variable in subsequent studies. In summary, the ETPB allowed us to know the variables that explain the decision to carry out an OHB. However, this model can be improved from the re-specification process.

The findings allowed us to confirm the importance of the EPBT, as a cognitive model of behavior change, to explain adherence to healthy behavior, specifically oral hygiene, based on a specific set of motivational factors (5). Likewise, they are evidence for the dental professional about the need to know

the assessments that people have about their own OHB (5). In the case of the study population, university students, we found that the perception of ease or difficulty in achieving adequate oral hygiene turned out to be more important for being motivated or adopting OHB when compared to the attitude variables, subjective norm and expected social recognition. In this sense, the promotion of oral hygiene in young people requires special attention to strengthening personal control over OHB (31). This implies adopting measures that increase the perception of availability and access to oral hygiene resources (toothpaste, brushes, dental floss, etc.) (14). When people consider that they have greater availability of resources and opportunities, the greater the belief that they can control their own behavior (5).

Research Limitations

One of the limitations to consider in this study is the proportion of female participants (57.6 %) compared to males (41.5 %), which could have biased the results. The review of other related studies reveals the existence of apparent differences in OHB according to the gender variable (14). For example, women brush their teeth more often than men (30). Another important limitation would be represented by the type of sample selection. However, the strategy of conducting the survey during class sessions made it possible to reduce the self-selection mechanisms that are usually frequent when using online surveys.

CONCLUSIONS

The predictive power of the ETPB variables was found to explain 31 % of the variance of intention and 26 % of OHB. Attitude, social norms, perceived behavioral control, and expected social outcomes are significant determinants of the intention to perform oral hygiene behavior, with the exception of OHK. On the other hand, perceived behavioral control turned out to be the main predictor of oral hygiene intention and behavior. Finally, the measurement model and the structural model based on the ETPB present favorable empirical evidence to be applied to oral hygiene behavior in Peruvian university students.

RECOMMENDATIONS

It is recommended that the results obtained be replicated to other age groups and population. This will allow us to continue contrasting the validity and flexibility of the TPB in various sociocultural contexts.

Likewise, this study has a direct implication for the professional practice of dentists, for whom the education of patients and the promotion of their oral hygiene are not usually a priority, preferring to carry out various treatments instead of preventing oral diseases. This often leads to cost overruns and unrealistic measures in low- and middle-income countries. In addition, the results constitute evidence for health decision-makers to use in the design of their policies and strategies for the prevention and promotion of oral hygiene in the population.

References

1. Ireland R. Higiene dental y tratamiento. México DF: Manual Moderno; 2008.
2. Buunk-Werkhoven YA, Dijkstra A, van der Schans CP. Determinants of oral hygiene behavior: a study based on the theory of planned behavior. Community Dent Oral Epidemiol. 2011 Jun; 39(3): 250-259. https://doi.org/10.1111/j.1600-0528.2010.00589.x
3. Chambrone L, Chambrone L. Results of a 20-year oral hygiene and prevention programme on caries and periodontal disease in children attended at a private periodontal practice. Int J Dent Hyg. 2011 May; 9(2): 155-158. https://doi.org/10.1111/j.1601-5037.2010.00455.x
4. Instituto Nacional de Estadística e Informática (INEI). Enfermedades no transmisibles Lima, Peru: INEI; 2018.
5. Brannon L, Updegraff JA, Feist J. Health psychology: an introduction to behavior and Health. 9ª ed. Cengage Learning; 2017.

6. McCaul D, Oneill HK, Glasgow E. Predicting the performance of dental hygiene behaviors: an examination of the Fishbein and Ajzen Model and self-efficacy expectations. J Applied Socia1 Psychol. 1988 Feb; 18(2): 114-128. https://doi.org/10.1111/j.1559-1816.1988.tb00009.x
7. Buunk-Werkhoven YAB, Dijkstra A, Bink P, Van Zanten S, Van Der Schans CP. Determinants and promotion of oral hygiene behaviour in the Caribbean and Nepal. Int Dent J. 2011; 61(5): 267-273. https://doi.org/10.1111/j.1875-595X.2011.00071.x
8. Ajzen I. The theory of planned behavior: Frequently asked questions. Hum Behav Emerg Technol. 2020 Dec; 2(4): 314-324. https://doi.org/10.1002/hbe2.195
9. Ajzen I. The Theory of planned behavior. Organ Behav Hum Decis Process. 1991 Dec; 50: 179-211. https://doi.org/10.1016/0749-5978(91)90020-T
10. Patel J, Kulkarni S, Doshi D, Reddy BS, Reddy MP, Buunk-Werkhoven YAB. Determinants of oral hygiene behaviour among patients with moderate and severe chronic periodontitis based on the theory of planned behaviour. Int Dent J. 2019 Feb; 69(1): 50-57.
11. Dumitrescu AL, Wagle M, Dogaru BC, Manolescu B. Modeling the theory of planned behavior for intention to improve oral health behaviors: the impact of attitudes, knowledge, and current behavior. J Oral Sci. 2011; 53(3): 369-377. https://doi.org/10.2334/josnusd.53.369
12. Zetu I, Zetu L, Dogaru CB, Duţă C, Dumitrescu AL. Gender Variations in the Psychological Factors as Defined by the Theory of planned of oral hygiene behaviors. Procedia Soc Behav Sci. 2014 Apr; 127: 353-357. https://doi.org/10.1016/j.sbspro.2014.03.270
13. Dumitrescu AL, Duţă C, Dogaru CB, Manolescu B. Predicting undergraduates' intentions to improve oral health behaviors: the importance of self-identity - a pilot study. J Dent Hyg. 2013 Aug; 87(4): 224-234.
14. Shitu K, Alemayehu M, Buunk-Werkhoven YAB, Handebo S. Determinants of intention to improve oral hygiene behavior among students based on the theory of planned behavior: a structural equation modelling analysis. PLoS One. 2021 Feb; 25 16(2): e0247069 http://doi.org/10.1371/journal.pone.0247069
15. Al-Raash EA, Qasim AA. Dental health knowledge , attitude , and behaviors regarding oral hygiene status among university students at Mosul City. Int J Enhanc Res Med Dent Care. 2019 Jan; 6(1l): 1-9.
16. Kojima A, Ekuni D, Mizutani S, Furuta M, Irie K, Azuma T, *et al*. Relationships between self-rated oral health, subjective symptoms, oral health behavior and clinical conditions in Japanese university students: a cross-sectional survey at Okayama University. BMC Oral Health. 2013 Nov 6; 13: 62. https://doi.org/10.1186/1472-6831-13-62
17. Schüz B, Sniehotta FF, Wiedemann A, Seemann R. Adherence to a daily flossing regimen in university students: effects of planning when, where, how and what to do in the face of barriers. J Clin Periodontol. 2006 Sep; 33(9): 612-619. https://doi.org/10.1111/j.1600-051X.2006.00967.x.
18. Glynn I. Elegance in science: the beauty of simplicity. Oxford, UK: Oxford University Press; 2010.
19. Kline RB. Principles and practices of structural equation modeling. 4ª ed. New York: Guilford; 2015.
20. Buunk-Werkhoven YAB, Dijkstra AP, van der SC, Jaso ME, Acevedo S, Parodi G. Evaluación y promoción de la actitud hacia la higiene oral en pacientes de la Facultad de Odontología de la Universidad Católica del Uruguay. Act Odontol. 2008 Nov; 5(2): 13-20.
21. Buunk-Werkhoven YAB, Burrekers SY, Jongboer A, Quant DFM, van Maanen-Schakel NWD. Determinants of oral hygiene behavior in the Dominican Republic. Int Dent J. 2011 Dec; 61(6): 328-333. https://doi.org/10.1111/j.1875-595X.2011.00083.x
22. Bollen KA. Structural equations with latent variables. Contemporary Sociology. New York: John Wiley & Sons; 1989.
23. DeVellis RF. Scale development: theory and applications. 4a ed. Los Angeles, CA: SAGE; 2016.
24. Hair Jr. WC, Black JF, Babin BJ, Anderson RE. Multivariate data analysis: Pearson New International Edition. 7ª ed. New Jersey: Pearson/Prentice Hall; 2014.
25. Cupani M. Análisis de ecuaciones estructurales: conceptos, etapas de desarrollo y un ejemplo de aplicación. Rev Tesis. 2012; (1): 186-199.
26. Ady Hamene NA. Structural equation modelling: confirmatory factor analysis (PowerPoint slides). 2017. p1-52. https://doi.org/10.13140/RG.2.2.25615.38565
27. Chin WW. The partial least squares approach to structural equation modelling. In: Marcoulides GA, editor. Modern methods for business research. New York: Psychology Press; 1998 Jan. pp. 295-236.
28. Pallant J. SPSS survival manual: a step by step guide to data analysis using IBM SPSS. 6th.ed. Routledge.
29. Armitage CJ, Conner M. Efficacy of the Theory of Planned Behaviour: a meta-analytic review. Br J Soc Psychol. 2001 Dec; 40(4): 471-499. http://doi.org/10.1348/014466601164939
30. Ericsson JS, Östberg A-L, Wennström JL, Abrahamsson KH. Oral health-related perceptions, attitudes, and behavior in relation to oral hygiene conditions in an adolescent population. Eur J Oral Sci. 2012 Aug; 120(4):335-341. https://doi.org/10.1111/j.1600-0722.2012.00970.x
31. Soltani R, Sharifirad G, Mahaki B, Eslami AA. Determinants of Oral Health Behavior among Preschool Children: Application of the Theory of Planned Behavior. J Dent (Shiraz). 2018 Dec; 19(4): 273-279.

*Original research

How to cite this article: Palomino Cordova R, Colqui Loyola OR, Leal Zavala RA, Buunk-Werkhoven YAB. Extended planned behavior theory applied to oral hygiene in Peruvian undergraduates. Univ Odontol. 2022; 41. https://doi.org/10.11144/Javeriana.uo41.etpb