



T Kamalikhah
Ss Mazllomi Mahmood abad
N Khalighinejad
F Rahmati-Najarkolaei

Authors' affiliations:

T Kamalikhah and Ss Mazllomi Mahmood
abad, Department of Health Education,
Shahid Sadoughi University of Medical
Sciences, Yazd, Iran

F Rahmati-Najarkolaei, Health Research
Center, Baqiyatallah University of Medical
Sciences, Tehran, Iran

N Khalighinejad, Torabinejad Research Cen-
ter, Isfahan University of Medical Sciences,
Isfahan, Iran

Correspondence to:

F. Rahmati Najarkolaei
Health Research Center
Baqiyatallah University of Medical Sciences
Tehran,
Iran
Tel.: +982182482469
Fax: +021-88600062
E-mail: fatemeh_rahmaty@yahoo.com

Dental flossing behaviour and its determinants among students in a suburb area of Tehran–Iran: using Transtheoretical Model

Abstract: *Objectives:* Oral health problems are a global concern particularly among underprivileged groups. This study aimed to use TTM model to assess the flossing behaviour and its determinants among students in a suburb area and compare the flossing behaviour between boys and girls using TTM. *Methods:* Cluster sampling was employed to recruit 653 high school students from eight schools in Tehran suburban area, Iran. Two self-administrated questionnaires: (i) stage of change questionnaire and (ii) TTM constructs questionnaire including demographic features, decisional balance (perceived benefits and barriers), self-efficacy and process of change were used to assess the flossing behaviour and its psychological determinants. The statistical analysis of the data included Kruskal–Wallis test, *t*-test, ANOVA, Spearman correlation and binary logistic regression using SPSS ver15 software. *Results:* In this study, 301 (46.1%) and 352 (53.9%) of participants were women and men, respectively. Nearly half of the students (51.4%) were in precontemplation stage with the rest distributed among the other stages of flossing behaviour change. There was no statistically significant difference between genders regarding the stages of change ($P < 0.05$). Flossing behaviour is related to TTM constructs such as self-efficacy, perceived benefits, low perceived barriers and process of changes. *Conclusion:* According to the results of this study, TTM is useful in determining the stages of interdental cleaning behaviour among students. However, further interventional researches are suggested to support the potential for eventual use of the TTM as a framework for understanding the determinants of interdental cleaning behaviour.

Key words: health behaviour; models; oral health; students

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Introduction

Despite great improvement in the oral health, oral health problems remain a global concern particularly among underprivileged groups and rural districts in developing countries (1). It has been reported that more than 51 million school hours are lost annually because of illnesses related to dental problems (2). Iran has a young population with approximately 40% of the population younger than 20 years (3, 4), and more than 4 000 000 students were educated in Iranian schools in 2011–2012 academic years (5). Studies have confirmed a marked decline in dental caries in school-age children. The mean value of DMFT (D = decayed teeth;

M = missing teeth; F = filled teeth; T = permanent teeth) has decreased from 4.1 to 2.1 in 15-year-old students between 2004 and 2008 (6, 7). However, studies indicate that general level of oral health is not satisfactory, particularly among children in Iran (8, 9). Therefore, high priority must be placed on the school-age children in oral health.

Significant neglect of brushing oral surfaces and insufficient use of floss has been reported in different countries (10–13). An effective caries prevention technique is self-performed oral health measures like interdental cleaning (14). Despite great efficacy of dental floss in reducing interproximal caries (15), the prevalence of flossing behaviour is not satisfactory in Iran (8, 16, 17). It is stated that only 0.05% of 6–12 years old and 29% of high school students use dental floss (14, 18).

To improve our understanding of the health behaviours, social cognition models were adopted in behavioural science research (15, 19). These models indicate that positive attitudes towards self-care behaviours may increase the chance of adopting such behaviour (14).

One of the models for determining health-related behaviours in social sciences and assessing population willingness for adopting a new behaviour is transtheoretical model (TTM). TTM has been successfully implemented in different studies determining oral and dental self-care behaviours (14, 16, 20, 21). This model consists of four constructs: stages of change, decisional balance (including perceived benefit and barriers), self-efficacy and processes of change. It is well known that determining stage of change in a population using TTM gives health policy makers an opportunity to implement effective oral and dental health interventions. The TTM staging measurement tool can provide insight into people's readiness to change their oral hygiene behaviours and would aid practitioners in the delivery of oral health messages (22). TTM has been implemented in Iran, and it has positively influenced the stages of change (14, 16). However, there are limitations in generalizing the results of conducted studies to other populations with different social and cultural backgrounds, which necessitates the implementation of the TTM in other age groups with different demographic features (14). Considering the important role of flossing behaviour in preventing dental caries, this study was designed to assess the TTM applicability in evaluating flossing behaviour and its determinants among students in a suburb area and to compare the flossing behaviour between boys and girls using TTM.

Study population and methodology

Study design

The present descriptive-analytical and cross-sectional study included 653 high school students in Tehran's suburban area–Pakdasht–Iran during 2013. List of all governmental high schools were provided (58 schools), and eight of them were selected using cluster random sampling, and in each school, three classes were randomly selected.

During the first days of spring semester, the questionnaires were handed out to the selected students prior to the beginning of formal classes. After considering the ethical issues, students were instructed in completing the questionnaires and then were asked to complete them. The response rate was 96%. The study design was approved by the ethic committee of Yazd University of Medical Sciences. Consent forms were obtained from students and their principals. Also questionnaires remained anonymous, and all results were kept confidential.

Questionnaires

A questionnaire consists of three sections: (i) demographic information including age, gender, parent's educational level, income, frequency of daily brushing and students' levels of education; (ii) stages of change questionnaire; and (iii) TTM constructs questionnaire was used to assess the flossing behaviour and its psychological determinants.

Stages of change questionnaire

The stages of change instrument, developed by Tilliss *et al.* (23), are a valid and reliable instrument, which was implemented in our study. This instrument utilizes a four-question algorithm to determine subject's stage relative to adoption of interdental cleaning behaviour. According to individual's responses, participants were located in each five stages of change. Table 1 provides the key utilized for staging subjects. The Kappa coefficients of four questions of the stages of change were 0.78, 0.75, 0.45 and 0.75, respectively.

The TTM constructs questionnaire

The TTM constructs questionnaire consists of

- 1 Self-efficacy assessment: After reviewing relevant literatures (24, 25), self-efficacy scale was developed by authors. It was a 14-item scale to measure the self-efficacy towards interdental cleaning behaviour by asking the students to indicate their level of confidence to do the specific tasks like 'I know how to floss my teeth properly'. A 4-point Likert-type scale with possible range of 14–56 was used. Higher scores indicate higher self-efficacy.
- 2 Decisional balance assessment: Decisional balance section evaluated the perceived barriers and perceived benefits using statements like 'Flossing causes pain and gingival bleeding' and 'Flossing can reduce the rate of dental caries', respectively. The interdental cleaning perceived benefits and perceived barriers scales were 11 and 9 items. A 5-point Likert-type scaling was used (1 = totally agree, to 5 = totally disagree). After recoding the negatively stated sentences, the theoretical ranges were 11–55 for perceived benefits and 9–45 for perceived barriers.
- 3 Process of change assessment: The processes of changes section included consciousness-raising (5 items), dramatic relief (6 items), environmental re-evaluation (4 items),

Table 1. Key for determining stage of change based on responses to the stages of change instrument (Tillis et al., (23))

Questions	1. How frequently do you clean between your teeth?	2. How long have you been cleaning between your teeth at your current frequency?	3. In the next 30 days, do you plan to clean between your teeth?	4. In the next 6 months do you think you might clean between your teeth?
Stage				
5 Maintenance	3 or more times week ⁻¹	6 months or more		
4 Action	3 or more times week ⁻¹	<6 months		
3 Preparation	<3 times week ⁻¹		More often	
2 Contemplation	<3 times week ⁻¹			More often
1 Precontemplation	<3 times week ⁻¹		About the same or less often	About the same or less often

self-re-evaluation (3 items), social liberation (4 items), stimulus control (5 items), counter conditioning (4 items), self-liberation (4 items), helping relationships (3 items) and reinforcement management (2 items). The responses were then scored from one to four with 'always' scoring 4 and 'never' scoring 1. The process of changes was assessed using statements like 'I pay attention to dental flossing advertisement on social media'.

Validity and reliability

To confirm content validity of the TTM constructs questionnaire, a panel of experts, consisting of three scholars in the areas of health behaviour and education, two dentists and a nurse with field experience in oral health care reviewed and assessed the questions and evaluated the appropriateness and relevance of the items to the students confirmed that items are representative of the constructs. Content validity ratio (CVR), 3-point Likert scale from 'completely necessary' to 'not necessary' was completed by panel of experts (8 expert). According to Lawshe table for eight experts (26), questions with CVR > 0.75 were acceptable. Therefore, four questions with CVR < 0.75 were eliminated. Content validity index (CVI) was assessed according to Waltz and Bausell scale. Relevance, simplicity and ambiguity of all questions were checked using 4-point Likert scale, and questions with CVI > 0.79 were considered appropriate. Three questions with CVI < 0.71 were eliminated, and three questions were revised. Total CVI and CVR of the TTM constructs questionnaire were 0.97 and 0.86, respectively. The feedback from the panel of experts was used to revise and modify the instruments. Then, the questionnaire was pilot tested with 30 students. The method of performing the pilot study was the same as the final study. The data were used to estimate the internal consistency of the scales, using Cronbach's coefficient alpha. This pilot sample was not included in the final sample. Self-efficacy, process of changes, perceived benefits and barriers yielded Cronbach's alpha of 0.92, 0.95, 0.83 and 0.75, respectively.

Statistical analysis

Data were analysed with Kruskal–Wallis test to assess difference between two genders regarding stages of change and TTM constructs. The effect of TTM constructs on stage of

change of students was assessed using ANOVA. Spearman correlation was used to investigate the relationship between stages of behaviour change and other TTM constructs. Binary logistic regression was implemented to assess the predictability of TTM constructs regarding stages of changes. Statistical analysis was performed using SPSS ver15 ($\alpha = 0.05$).

Results

In this study, 301 (46.1%) and 352 (53.9%) of participants were women and men, respectively, with mean age of 16.34 ± 1.02 . Table 2 shows the demographic features of the participants.

Of all students, 70 (10.7%) indicated that they do not brush their teeth and 213 (32.6%) students reported brushing three times a day, 301 (46.1%) two times a day and 69 (10.6%) one time during a day. Regarding flossing, 217 (33.2%) students announced they do not use dental floss, 57 (13.1%) reported everyday flossing, 29 (6.6%) 3–5 times a week and 41 (9.4%) once a week.

The stages of change regarding the flossing behaviour in different genders have been summarized in Table 3. Almost half of the students (51.4%) were in precontemplation stage. Girls showed more advanced stages. Also, there were more boys in the precontemplation and preparation stages than girls.

According to the Kruskal–Wallis test, there was a statistically significant difference between boys and girls regarding stages of

Table 2. Demographic features of the participants (n = 653)

	N	%
Gender		
Boys	301	46.1
Girls	352	53.9
Education		
First grade	218	33.4
Second grade	225	34.5
Third grade	230	32.1
Nationality		
Iranian	564	86.4
Afghan	89	13.6
Financial state		
Week	114	17.5
Moderate	318	48.7
Good	221	33.8

Table 3. Stage of change regarding interdental cleaning behaviour

Stage	Girls (%)	Boys (%)	Total (%)
Precontemplation	143 (47.5)	324 (49.6)	181 (51.4)
Contemplation	94 (31.2)	59 (16.8)	153 (23.4)
Preparation	112 (17.2)	90 (25.6)	22 (7.3)
Action	14 (2.1)	6 (1.7)	8 (2.7)
Maintenance	50 (7.7)	16 (4.5)	34 (11.3)

change and in all TTM constructs ($P < 0.05$) except perceived barriers and consciousness-raising. 'Data are not shown'.

The correlation analysis between the stages of behaviour change and other demographic features showed a positive relationship between the stages of change and the amount of income ($P = 0.001$), the frequency of daily brushing ($P = 0.001$) and students' levels of education ($P = 0.025$). 'Data are not shown'.

The mean and standard deviations of the TTM constructs have been presented in Table 4 according to different stages of behaviour change. Self-efficacy and process of change were higher in contemplation, preparation, action and maintenance stages compared to precontemplation stage. Also perceived benefit score was higher in contemplation, preparation and maintenance stages than precontemplation stage.

The Spearman correlation coefficient matrix of the TTM variables is summarized in Tables 5 and 6. According to the tables, there was a positive correlation between stages of change and self-efficacy, perceived benefits and process of change, which was statistically significant ($P = 0.001$). However, there was a significant inverse relation between stages of change and perceived barriers ($P = 0.01$).

Different stages of change in this study were re-coded to 0–1 to analyse the variables using binary logistic regression. Students who were in precontemplation, contemplation and preparation stages scored 0. Code 1 was designated to students in action or maintenance stages.

The self-efficacy odds ratio (1.077) indicates that the students' self-efficacy in the action and maintenance stages is 1.077 times greater than other stages and also perceived barriers of student in the precontemplation, contemplation and preparation stages is 0.916 times greater than other stages (Table 7).

Discussion

In the present study, 51.4% and 23.4% of the students were in precontemplation and contemplation stages, respectively. Therefore, most of the students in the present study were found not to use dental floss. This is while just 50.5% of the students in Hashemian *et al.* study (16) were in precontemplation and contemplation stages. This inconsistency may be attributed to the fact that the city investigated in our study has a large rate of immigrants and slums that can affect the residents' economic, social and cultural status. The results of

Table 4. Means and standard deviations of the constructs of transtheoretical model based on the stages of change

Stages of change TTM constructs	Maintenance		Action		Preparation		Contemplation		Precontemplation		P	Result of LSD* test
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Consciousness-raising	11.24	3.74	12.28	4.21	10.09	4.25	9.93	4.51	8.68	3.53	<0.001	PC < C,P,A,M
Dramatic relief	18.54	3.54	18.35	4.46	16.53	5.74	16.76	4.83	13.88	4.95	<0.001	PC < C,P,A,M
Environment Re-evaluation	11.42	2.63	11.50	2.76	10.08	3.14	10.21	3.20	8.83	3.13	<0.001	PC < C,P,A,M
Self-re-evaluation	9.62	2.49	9.35	2.06	8.80	3.10	8.50	2.74	7.08	2.98	<0.001	PC < C,P,A,M
Self-liberation	14.18	3.65	14.50	3.77	12.54	4.23	12.81	4.11	10.69	3.94	<0.001	PC < C,P,A,M
Social liberation	14.14	3.49	15.28	3.40	12.25	4.24	11.98	4.08	10.40	3.81	<0.001	PC < C,P,A,M
Counter Conditioning	11.90	3.03	12.64	2.97	10.74	3.52	10.69	3.42	8.68	3.25	<0.001	PC < C,P,A,M
Stimulus control	12.42	4.62	12.07	3.91	10.58	3.92	9.86	3.55	8.78	3.38	<0.001	PC < C,P,A,M
Helping Relationship	7.40	2.78	8.07	2.75	6.66	2.61	6.77	2.78	5.80	2.35	<0.001	PC < C,P,A,M
Reinforcement management	2.21	5.60	5.28	1.97	5.18	1.80	5.12	1.92	4.20	1.67	<0.001	PC < C,P,A,M
Self-efficacy	47.52	8.46	42.14	11.31	37.62	12.57	35.88	12.71	30.60	11.62	<0.001	PC < C,P,A,M
Perceived benefits	45.56	5.9	46	8.1	47.03	7.5	46.32	5.5	43.23	8.8	<0.001	PC < C,P,A,M
Perceived barriers	16.84	5.44	19.84	5.79	22.10	6.27	21.97	5.63	23.36	6.53	<0.001	PC > C,P,A,M

*LSD, least significant difference.

PC, Precontemplation; C, Contemplation stage; P, Preparation stage; A, Action; M, Maintenance stage.

Table 5. Matrix of Spearman correlation coefficient: variables of the transtheoretical model (TTM)

Variables	Stages of change	Self-efficiency	Perceived benefits	Perceived barriers
Stages of change	1			
Self-efficiency	0.373**	1		
Perceived benefits	0.188**	0.315**	1	
Perceived barriers	-0.225**	-0.438**	-0.104	1

**Significant difference ($P = 0.01$).

this study indicate that high percentage of high school students do not floss their teeth, which increases the probability of proximal caries and gingivitis. Therefore, health policy makers should give special attention to improve students' oral health and preventive behaviours. Also there were more boys in the precontemplation and preparation stages of change than

girls, which indicates that girls are more likely to implement interdental cleaning behaviours which is in agreement with other studies (27, 28).

According to the TTM, individuals can progress through precontemplation and contemplation stages towards the final stages of behavioural changes by raising their knowledge about outcomes of a particular issue as well as increasing their self-efficacy, perceived benefits and reducing perceived barriers (29). In our study, there was a positive relationship between stages of change and the amount of income and students' levels of education. This finding indicates that low level of education (30) and low income may negatively affect the oral health and preventive oral health behaviours. Also students' stage of change showed a positive and significant relation with the processes of change constructs. This indicates that high scores in the processes of change would consequently enhance the chance of adopting healthy behaviours like flossing.

Table 6. Matrix of Spearman correlation coefficient: process of change and stages of change

Variable	Stages of change	CR	DR	ROE	SR	Social L	Self-L	CC	SC	HR	RM
Stages of change	1										
CR	0.226*	1									
DR	0.311**	0.424**	1								
ROE	0.269**	0.460**	0.799**	1							
SR	0.306**	0.442**	0.780**	0.811**	1						
Social L	0.303**	0.524**	0.718**	0.761**	0.787**	1					
Self-L	0.283**	0.537**	0.747**	0.762**	0.759**	0.783**	1				
CC	0.331**	0.457**	0.745**	0.745**	0.756**	0.775**	0.781**	1			
SC	0.273**	0.549**	0.500**	0.540**	0.571**	0.693**	0.604**	0.633**	1		
HR	0.208**	0.588**	0.543**	0.589**	0.592**	0.627**	0.636**	0.614**	0.66**	1	
RM	0.267**	0.506**	0.618**	0.663**	0.670**	0.665**	0.713**	0.677**	0.58**	0.691**	1

* $P = 0.05$.

** $P = 0.01$.

CR, consciousness-raising; DR, dramatic relief; ROE, re-evaluation of the environment; SR, self-re-evaluation; Social L, social liberation; Self-L, self-liberation; CC, counter conditioning; SC, stimulus control; HR, helping relationship; RM, reinforcement management.

Table 7. Binary logistic index of model constructs

Variables	B	SE	Wald	P	Odds ratio	95% CI for EXP (B)	
						Lower	Upper
Constant	1.756	1.085	2.618	0.106	0.173		
Perceived self-efficacy	0.075	0.014	26.558	0.000	1.077	1.047	1.108
Perceived benefits	0.031	0.020	2.315	0.128	0.970	0.932	1.009
Perceived barriers	0.088	0.023	15.098	0.000	0.916	0.876	0.957
Constant	5.16	0.59	75.59	0.000	0.000		
Consciousness-raising	0.027	0.038	0.516	0.473	1.027	0.957	1.107
Dramatic relief	0.051	0.039	1.707	0.111	1.052	0.967	1.128
Environment re-evaluation	0.008	0.076	0.010	0.918	1.008	0.877	1.181
Self-re-evaluation	0.003	0.085	0.001	0.970	0.997	0.839	1.173
Social liberation	0.101	0.063	2.551	0.110	1.106	0.979	1.254
Self-liberation	0.022	0.060	0.140	0.708	0.978	0.867	1.095
Counter conditioning	0.056	0.073	0.589	0.443	1.058	0.924	1.233
Stimulus control	0.104	0.052	3.935	0.047	1.109	1.003	1.229
Helping relationship	0.057	0.078	0.538	0.309	0.892	0.822	1.116
Contingency control/management	0.114	0.112	1.034	0.309	0.892	0.704	1.093

SE, standard error; B, beta-coefficient of logistic regression.

$P = 0.05$.

There was a direct relation between flossing behaviour, perceived benefits and self-efficacy in our study. However, inverse relationship was observed between flossing behaviour and perceived barriers. Students who believe their abilities in using dental floss and recognize their susceptibility to oral diseases including gingivitis, dental caries or halitosis would perform oral health behaviours more frequently.

Moreover, results of the present study revealed that higher scores in self-efficacy might motivate individuals/students to progress through final stages of behaviour changes, which is in agreement with other studies (31–34). Also Dumitrescu *et al.* (35) found that adults who are regularly using dental floss have more self-confidence, self-sufficiency and self-control than those who have not adopted this preventive behaviour. These findings may indicate that students are more likely to adopt a new healthy behaviour by improving their self-efficacy.

According to Glanz *et al.* (29), individuals can progress through final stages of behavioural change if perceived benefits overcome perceived barriers in the primary stages. In this study, students' perceived benefits score was higher in contemplation, preparation and maintenance stages compared to precontemplation stage. However, perceived barriers score was higher than perceived benefits in the first stages of behaviour change, which can negatively affect the chance of adopting a healthy behaviour (29). As suggested by Anderson (36), perceived barriers could be reduced through group discussions and perceived benefits may be enhanced through movie sessions and face-to-face conversations.

In this study, self-efficacy was the strongest predictor of adopting healthy behaviours. According to binary logistic regression results, any improvement in self-efficacy would consequently increase the chance of adopting flossing behaviour. Also, perceived barrier (OR = 0.916) was shown to affect the adopting and maintaining the behaviour as any decrease in perceived barrier may enhance the chance of adopting healthy behaviours. Despite the limitations of the current study, such as restriction to one population group, lack of valid oral health index to evaluate the oral health and lack of long-term follow-up, the results of the present study can be generalized to high school student in both genders especially in suburb areas in Iran or other eastern countries due to randomized sampling. Our findings confirmed that TTM is useful in determining the stages of interdental cleaning behaviour. However, further interventional researches are suggested to support the potential for eventual use of the TTM by dental health providers as a framework for understanding the determinants of interdental cleaning behaviour and for planning intervention programs to improve flossing behaviour among students.

Clinical relevance

Scientific rationale for study

Oral health behaviours are major factors in the prevention of dental diseases. In this study, the flossing behaviour and its

determinants were assessed using transtheoretical model (TTM).

Principal findings

High percentages of students in this study are in precontemplation and contemplation stages. This finding indicates that most of the students do not use dental floss, which increases the probability of dental caries.

Practical implications

The TTM is useful in determining the stages of interdental cleaning behaviour. Further researches are suggested to implement theory-based intervention in order to improve the flossing behaviour among students.

Declaration of Interest

The authors report no conflict of interests.

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