Effectiveness of a health education intervention based on the Health Belief Model to improve oral health behaviours among adolescents

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ABSTRACT

Background : Oral diseases remain a global problem affecting many communities in the world. Since oral diseases are related to behaviours of an individual, they can be largely prevented by modifying their health behaviours. Adolescence is a challenging time and they would be benefited from oral health promotion interventions. Health Belief Model has shown to be effective in modification of an individual's health behaviors. **Objective :**To determine the effectiveness of a health education intervention, based on the Health Belief Model to improve oral health behaviours of 15-year-old school children in the Kegalle district. **Methods:** The study included three groups of students; 208 in each group selected from 06 comparable schools. The intervention group received HBM based health education intervention. One control group received a didactic education intervention while the other acted as an inactive control group. Oral health related perceptions, oral health related behaviours and oral health status of the students in three groups were assessed before the intervention and after a follow up period of six months and compared. **Results :**There were no statistically significant differences in oral health related perceptions, oral health related behaviours and oral health status between groups prior to the intervention. Following the intervention all above variables improved significantly in the HBM group while only the level of plaque and the use of fluoride toothpaste improved in the didactic education group. **Conclusions :**An oral health education intervention based on the HBM significantly improved oral heath related perceptions, behaviours and oral health status of the 15-year-old students in the Kegalle district.

Keywords: Adolescents, Education intervention, Health Belief Model, Oral health

Introduction

Several theoretical models have been developed to explain and predict health-related behaviours and the Health Belief Model (HBM) which was developed in the 1950s is one of most widely used in health behaviour research. The HBM was developed in order to understand why people failed to use a free screening programme for tuberculosis and since then it has been used to predict several health related behaviours including screening for breast cancer, receiving immunization, injury prevention and life behaviours such as sexual risk behaviours. It is based on the

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concept that health behaviour is determined by an individual's beliefs about disease and his/her perceptions about the benefits of taking action to control them [1]. The original model included four constructs; perceived severity, perceived susceptibility, perceived benefits and perceived barriers. However two additional constructs namely cues to action and self-efficacy have been added to the later versions of the model [2].It has been shown that oral health education programmes are effective in improving oral health related practices in adolescents [3,4]. However Brukiene and Aleksejunien[5]following a review of the literature concluded that use of psychological theory–based oral health education interventions is a better alternative to conventional oral health education in modifying oral health-related behaviours in adolescents. In fact some researchers have used various theory-based interventions to improve oral self-care practices in adolescents in recent times [6-8].The burden of oral disease is high among adolescents in Sri

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Lanka with 52 and 75% of 15-year-olds having dental caries and periodontal disease respectively [9]. As it is well established that oral diseases are related to lifestyles and behaviours if the high burden of oral disease among these adolescents is to be reduced it is necessary to implement programmes to develop their personal skills and motivate them to follow favourable oral behaviours. Therefore the aims of this study were to assess the effectiveness of a health education intervention based on the HBM to promote behaviours that are conducive to oral health and improve oral hygiene in adolescent school children and to determine the HBM constructs associated with oral health related behaviours in these children.

Material and methods

The data for the present paper was obtained from a broader study on oral health behaviours in 15-year-old students attending public schools in Kegalle district of Sri Lanka. The methods and results relevant to achieve the objectives of the present study will only be presented here. Ethical clearance for the present study was obtained from the Ethical Review Committee of the Post Graduate Institute of Medicine, University of Colombo. Approval for the study was obtained from zonal directors of education of Kegalle district and the principals of the respective schools. Written informed consent was obtained from parents of the selected students. This intervention study was conducted among 15-years-old school children attending public schools in the Kegalle district, Sri Lanka and involved one intervention group and two control groups. Formula for hypothesis testing for two population proportions for one-sided test was used to calculate the sample size. The percentage of 15-year-olds with in Kegalle district reported in the National Oral Health survey was used as the baseline value (34.5%) to calculate the expected improvement in oral hygiene status following the intervention. As no intervention studies have been conducted to improve oral health using the HBM in Sri Lanka, for the purpose of calculating the sample size information from the study by Solhi et al [6] was used. According to that study oral hygiene status improved by 24% in the test group and 12% in the control group following an intervention based on the HBM. Therefore using the anticipated percentages of having good oral hygiene after the intervention in the test (34.5+ 24=58.5%) and   control (34.5+12=46.5%) group with a power of 90% at 5% level of significance, a minimum sample of 189 students was required per group. To compensate for non-responses 10% was added giving a final intended sample of

208 students per group. Three groups were included in the study; one test (HBM group) and two control groups (didactic education group and inactive control group). According to education authorities students who had their 15th but not the 16th birthday were in the grade 10 class. The sample was selected from six randomly selected Sinhala medium co-education public schools with more than 100 students in grade 10 classes in Kegalle district; two schools to carry out the intervention and two schools each as the control groups. Students with diagnosed medical problems and those were residing outside the district were excluded from the sample. Three grade 10 classes were randomly selected from each of the six schools by the school authorities and the first author then randomly selected 104 students from the three classes to be included in the sample. Oral   health   related perceptions, oral health related behaviours and oral health status of the students in all three groups were assessed at baseline. The data were collected by means of a questionnaire and an oral examination. The questionnaire developed and validated for the present study was used to assess perceptions about oral/disease based on the constructs of the HBM and included 26 items. The response to each item was indicated on a 5-point scale and was scored out of 5; strongly disagree=1, disagree=2, no opinion=3, agree=4 and strongly agree=5. However for items which assessed the perceived barrier construct, scores were reversed; strongly disagree=5 to strongly agree=1, higher scores indicating   less   perceived   barriers.   Perceived susceptibility to oral diseases was assessed by 5 items (scores ranged from 5-25), perceived severity of oral diseases by 5 items (scores ranged from 5-25), perceived benefits of having good oral health by 4 items (scores ranged from 4-20), perceived barriers to maintain good oral health by 7 items (scores ranged from 7-35), cues to good oral healthcare practices by 4 items (scores ranged from 4-20), and self-efficacy by 1 item (scores ranged from 1-5). A total score for the different constructs of the HBM was obtained by summing up the scores of the items of that construct. Higher scores indicated greater agreement with that particular construct. However with regards to the perceived barrier construct a higher score indicated less perceived barriers to maintain good oral health. Items under each construct were given equal weight when determining perceptions. The questionnaire also included 4 items to assess `whether the participants carry out recommended oral health practices; tooth brushing twice a day, use of fluoridated toothpaste, consumption of sugary snacks/drinks ≤2times/day in between meals and visit a dentist at least once a year for a checkup. Responses to these items were indicated

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as "yes" if action is taken and "no" if not. Presence/absence of dental plaque and gingival bleeding on probing were recorded on 4 four surfaces (Mesial, distal, buccal and palatal /lingual) of all available teeth by a trained and calibrated dentist. The first author administered the HBM questionnaire to the selected students of the three groups in a suitable place provided by the school authorities. This was followed by an oral examination conducted by a dentist while the participant was seated on a high back chair. Following the administration of the HBM questionnaire and the oral examination, the first author conducted the HBM based health educational programme to improve oral health behaviours of the test group. The programme included a power-point presentation titled "good oral health for better life" based on the HBM constructs followed by a group discussion to clarify matters related to their oral health and to resolve myths and misconceptions about oral health. Subsequently the correct tooth brushing techniques for effective plaque removal was demonstrated. A printed leaflet designed according to the six constructs of the HBM was distributed among the students to act as a cue to follow good oral health practices. Having administered the HBM questionnaire and carrying out the oral examination to Control group 1, the first author conducted a didactic oral health education programme in the form of a lecture on the etiology, consequences and methods of prevention of common oral diseases. This was followed by a group discussion similar to the one conducted for the test group and tooth brushing demonstration for effective plaque removal. All students in the selected classes were given the health education intervention as it is unethical to give the benefits of the intervention only to

the selected students in the class. The HBM questionnaire was administered to Control group 2 and was also subjected to an oral examination. This group did not receive a specific education intervention but only a brief talk on the value of good oral health. However their treatment needs were identified during the oral examination and necessary instructions were given to obtain the required treatment. After a follow up period of six months, oral health related perceptions, oral health related behaviours and oral health status of the students were assessed using the same methods employed at baseline. The oral examination, administration of the questionnaire and data recording were carried out by the same persons involved in data collection at baseline. Data were analyzed using SPSS 17.0 software. As the distributions of the HBM construct scores were skewed non-parametric tests were used in the data analysis. Unadjusted and adjusted logistic regression models were fitted to determine the different HBM constructs associated with oral health-related behaviours. The HBM construct scores were included as continuous variables in the model.

Results

A total of 208 students were included per group at baseline. However as incomplete questionnaires were excluded, data from only 196, 191 and 197 students from the HBM, didactic education and control groups were available at baseline. Of these a few could not be contacted after the follow-up period of 6 months and therefore response rates at follow up were 97, 99 and 98% for the HBM, didactic education and control groups respectively.

Table 1: Pre- intervention and 6 month post-intervention HBM scores in the three groups

HBM constructs	HBM group-test median	range	Didactic education group median	range	Inactive control group median	range	p value
Perceived susceptibility							
Before	18	9-25	18	10-24	18	9-25	0.13
After	21	16-25	18	9-25	18	6-25	<0.001
p value	<0.001		0.13		0.08		
Perceived severity							
Before	20	11-25	20	7-25	20	5-25	0.09
After	22	13-25	20	9-25	20	5-25	<0.001
p value	<0.001		0.43		0.92		
Perceived benefits							
Before	17	11-20	17	9-20	17	4-20	0.29
After	18	14-20	17	6-20	17	4-20	<0.001
p value	<0.001		0.79		0.32		
Perceived barriers							

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	median	range	median	range	median	range	p value
Before	23	14-29	22	10-31	22	17-31	0.10
After	26	13-34	23	13-31	23	11-33	<0.001
p value	<0.001		0.70		0.65		
Cues to action							
Before	16	12-20	16	9-20	16	4-20	0.66
After	17	10-20	16	7-20	17	4-20	<0.001
p value	<0.001		0.75		0.60		
Self-efficacy							
Before	5	3-5	5	2-5	5	1-5	0.82
After	5	1-5	5	1-5	5	1-5	0.43
p value	0.19		0.64		0.49		

Difference in score before and after intervention in each group determined by - Wilcoxon Signed Rank Test; differences in scores across groups were determined by Kruskhal –wallis test

Scores of all constructs of the HBM group were significantly different to the scores of the two control groups after intervention. There were no differences in the median scores of all constructs of the HBM questionnaire in the three groups prior to the intervention. However following the intervention, except for self- efficacy, there were significant differences in relation all other constructs between the HBM and didactic group as well as the HBM and the inactive control group. In the HBM group, the median scores of all HBM constructs, except "self-efficacy" increased significantly following the intervention. But no significant improvements in the median scores were observed in the didactic and inactive control groups after the follow up period (Table 1).

Table 2: Percentage of sites with dental plaque and bleeding on probing before and after the follow up period in the three groups

	HBM group-test		Didactic education group		Inactive control group		p value
	median	range	median	range	median	range	
Dental plaque							
Before	28.6	3.6-70.4	30.4	0.0-80.4	28.6	10.7-80.4	0.43
After	10.9	0.0-42.0	25.9	0.0-80.4	28.6	7.1-80.3	<0.001
p value	<0.001		0.03		0.73		
Bleeding on probing of gingivae							
Before							
After	11.6	0.0-46.3	12.5	0.0-39.3	10.7	1.8-41.1	0.20
p value	5.4	0.0-24.1	11.6	0.0-51.8	10.7	1.8-41.1	<0.001
	<0.001		0.40		0.17		

Differences in plaque and BOP before and after intervention in each group determined by - Wilcoxon Signed Rank Test; differences in scores across groups were determined by Kruskhal –wallis test

Median % of sites with plaque and BOP of the HBM group were significantly different to those of the two control groups after intervention. Table 2 shows the median percentage of sites with dental plaque and BOP before and after the intervention in the three groups. There were no significant differences in the median percentage of sites with dental plaque and BOP between groups prior to the intervention. Following the intervention, there were significant differences between the HBM and didactic group as well as the HBM and the inactive control group. There were significant reductions in the percentages of sites with plaque and BOP following the intervention in the HBM group. The percentage of sites with plaque had also reduced in the didactic education group. However no such significant reductions was observed in the inactive control group.

Table 3: Oral health related-behaviours before and after follow up period in the three groups

	HBM group-test		Didactic education group		Inactive control group		p value
	n	%	n	%	n	%	
Use fluoride toothpaste							
Before	132	69.5	124	65.6	132	68.4	0.71
After	182	95.8	178	94.2	157	81.8	<0.001
p value	<0.001		<0.001		0.006		
Brush teeth twice/day							
Before	154	81.1	157	83.1	163	84.5	0.67
After	174	91.6	151	79.9	151	78.2	0.001
p value	0.003		0.50		0.15		
Consume sugary snacks ≤2/day							
Before	78	41.1	75	39.7	92	47.7	0.24
After	79	41.6	77	40.7	74	38.3	0.80
p value	1.00		0.91		0.10		
Visit a dentist at least once/year							
Before	22	11.6	23	12.2	22	11.4	0.97
After	71	37.4	30	15.9	30	15.5	<0.001
p value	<0.001		0.37		0.29		

Differences in behaviours before and after intervention in each group determined by – Mc Nemar test; differences in scores across groups were determined by Chi square test

Oral health-related behaviours did not differ between groups prior to the intervention. However except sugary snack consumption there were significant differences in the oral health-related behaviours between groups after the follow up period. Except sugary snack consumption, the percentages of the students who followed favourable oral health behaviours increased significantly after the intervention in the HBM group. There were significant improvements in fluoride toothpaste use in the didactic education   and inactive control group as well (Table 3).

Table 4: Multiple logistic regression analysis for HBM constructs associated with recommended oral health related behaviours following intervention in the HBM group controlling for gender (n=190)

	unadjusted			adjusted		
Variable	OR	95% CI	p value	OR	95% CI	p value
Use fluoride toothpaste						
Perceived susceptibility	1.51	1.07-2.13	**0.02**	1.04	0.93-2.11	0.09
Perceived severity	1.61	0.86-1.57	0.32	0.86	0.52-1.40	0.54
Perceived benefits	1.54	0.98-2.41	0.06	1.29	0.71-2.34	0.39
Perceived barriers	1.14	0.94-1.38	0.17	1.08	0.85-1.37	0.49
Cues to action	1.26	0.90-1.76	0.16	0.95	0.56-1.62	0.86
Self-efficacy	2.28	1.01-5.20	**0.04**	1.81	0.60-5.49	0.29
Brush teeth twice/day						
Perceived susceptibility	1.18	0.92-1.51	0.19	0.99	0.69-1.44	0.99
Perceived severity	1.33	1.06-1.66	**0.01**	1.23	0.93-1.63	0.13
Perceived benefits	1.38	1.003-1.90	**0.04**	1.12	0.71-1.78	0.59
Perceived barriers	1.17	1.02-1.35	**0.03**	1.11	0.54-1.31	0.18
Cues to action	1.16	0.90-1.50	0.24	0.79	0.52-1.21	0.28
Self-efficacy	2.61	1.30-5.25	**0.007**	2.25	1.01-5.03	**0.04**
Consume sugary snacks ≤2/day						
Perceived susceptibility	1.09	0.94-1.26	0.25	1.08	0.90-1.30	0.39
Perceived severity	1.07	0.94-1.23	0.26	1.08	0.90-1.30	0.35

Perceived benefits	0.95	0.79-1.14	0.63	0.68	0.52-0.90	**0.008**
Perceived barriers	1.10	1.01-1.20	**0.03**	1.09	0.99-1.21	0.07
Cues to action	1.18	1.01-1.38	**0.04**	1.26	1.01-1.57	**0.03**
Self-efficacy	1.13	0.70-1.83	0.59	0.82	0.45-1.48	0.51
Visit a dentist at least once/year						
Perceived susceptibility	1.02	0.88-1.19	0.69	0.86	0.71-1.04	0.13
Perceived severity	1.09	0.95-1.26	0.18	0.92	0.77-1.10	0.38
Perceived benefits	1.35	1.11-1.65	**0.003**	1.52	1.13-2.03	**0.005**
Perceived barriers	1.08	0.99-1.18	0.07	1.05	0.94-1.16	0.34
Cues to action	1.11	0.94-1.30	0.18	0.92	0.78-1.21	0.83
Self-efficacy	1.56	0.92-2.64	0.10	1.24	0.67-2.29	0.47

Oral health behaviours dichotomized as 0=if no and 1=if yes
Oral health behaviours were associated significantly with several HBM constructs in unadjusted model. However the significance was lost in some associations when the behaviours were controlled for other constructs.

Discussion

According to the HBM, health related perceptions of an individual influences health related behaviours [10]. Therefore the main objective of the HBM based educational programme was to change oral health related perceptions and thereby improve oral health related behaviours and oral hygiene status of the participants. Although some HBM based intervention studies have shown to be effective in promoting a range of behaviour changes conducive to health such changes cannot be solely attributed to the HBM based intervention since control groups have not been included in those studies. As traditional didactic interventions have shown to improve oral health related behaviours of school children [11,12], it was considered important and relevant to include a didactic education group in the present study so that the effectiveness of the HBM based intervention could be compared with the didactic method in improving oral health behaviours and oral hygiene status. The effectiveness of the interventions were determined by comparing oral health related perceptions, oral health related behaviours and oral hygiene status in the three groups prior to the intervention and after a follow up period of six months. It was evident from the results that following the intervention a significant increase occurred in all but one construct of the HBM in the test group and also the post intervention scores of the HBM group were significantly different from those of the control groups. This indicates that the HBM intervention was effective in changing oral health related perceptions of this group. Similar findings have beenreported in other studies as well. For example Solhi et al [6] found that an oral health education programme based on the HBM significantly improved oral health related perceptions related to all constructs of the HBM in 12-year-old Iranian female students while a HBM based educational programme to increase

oral health behaviours of pregnant women has also shown that oral health related perceptions related to all constructs of the HBM changed significantly following the intervention [13]. However the self-efficacy construct which refers to the motivation of an individual for health action and measured using one item did not show a significant improvement in the test group. This could be attributed to a ceiling effect of measurement. According to the findings, a high percentage of students in the test group had obtained the maximum score of 5 for the self-efficacy construct indicating that they were well motivated towards following positive health action prior to the intervention. As a result further improvement in the score was not possible following the intervention. In contrast no significant changes were observed in relation to the HBM constructs in the didactic education group or the inactive control group after 6 months. However an education program directed at community health care workers and women has been successful in changing their perceptions regarding oral health and self-efficacy [14]. Except for sugar consumption all oral health related behaviours considered improved significantly following the HBM based intervention in the test group. Similarly in their study [6] found that "twice a day bushing" and "visit to the dentist" increased significantly following a HBM based intervention. It has been observed that quality of tooth brushing and dental flossing had also increased significantly among pregnant mothers after a HBM based education intervention [13]. It is noteworthy that there was a significant increase in the percentage of students who used fluoridated toothpaste after 6 months in the control groups as well. The students in the control groups had many questions regarding the role of fluoride toothpaste in preventing dental caries and the first author spent a considerable time clarifying

them. Therefore they may have realized the importance of fluoride toothpaste and increased its use. This may be a plausible explanation for this finding. Also the HBM intervention was effective in reducing plaque levels and BOP in the test group and improvements in tooth brushing frequency following the intervention may have contributed to this. A significant reduction in dental plaque was observed in didactic education group as well but the percentage reduction was less compared to the HBM group. Other researchers have also observed improvements in oral hygiene status following HBM interventions [6].The present study also assessed the various HBM constructs associated with oral health related behaviours in the test group following the intervention. Several studies have determined the relationship between HBM constructs and tooth brushing and dental visiting behaviours but to the best of knowledge this is the first study to have assessed the associations between HBM constructs and use of fluoride toothpaste and consumption of sugary snacks less than twice/day; two recommended oral health related behaviours to promote oral health. The findings indicate that different HBM constructs are associated with different behaviours and therefore suggests that HBM constructs differ in their ability in predicting oral health behaviours. Carpenter [15] following a meta-analysis of 18 longitudinal studies which included a study on dental visiting behaviour as well has concluded that of the HBM constructs perceived benefits and barriers are the strongest predictors of health behaviour. Several HBM constructs were associated with the four oral health related behaviours in the unadjusted model but they lost their significance when controlled for other constructs of the HBM in the adjusted model indicating that the association between the particular construct and the oral health behaviour may have been mediated by other constructs. In fact the findings of a recent study based on an extended HBM shows the existence of certain mediating relationships between different constructs of the HBM [16]. Perceived susceptibility to oral disease did not emerge as a predictor of any of the behaviours considered and confirms the findings of other studies. According to Carpenter[15] a possible explanation for why perceived susceptibility is unrelated to behaviour is that individuals who have already been diagnosed with a disease may not differ in their perception of susceptibility.

Conclusion

Health Belief Model was effective in improving the oral health related perceptions, oral health behaviours (brushing teeth twice a day/use of fluoridated toothpaste/ low frequency sugar consumption / visit dentist at least once a year) and oral hygiene status of the students.

Acknowledgement

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