DOI: 10.1111/j.1365-263X.2008.00954.x

An overview of oral health promotion in adolescents

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International Journal of Paediatric Dentistry 2009; 19: 163–171

Objective. The aim of this study was to overview the effectiveness of different strategies used to promote oral health in adolescents.

Methods. A search of the MEDLINE via OVID database was performed through September 2007. The studies aiming to modify oral health-related lifestyle in adolescents with experimental pre- to post-test controlled study design were targeted. Oral health-related knowledge, attitudes, oral hygiene status, gingival health, and caries status were used as outcome measures for the evaluation of changes in adolescent oral health-related behaviour.

Results. All studies evaluating knowledge showed cognitive gains. Only slight or no improvement in attitude was reported. The average improvement in oral hygiene was 30–50%. A wide range 0–50% of the effects on gingival health was presented. However, the relapse in oral hygiene status towards baseline values was also observed. Only studies employing professionally applied preventive measures in conjunction with educational activities reported significantly lower caries incidence.

Conclusion. The limited success of the behavioural interventions and the lack of diversity in methods used do not allow identification of the best ways to promote oral health towards adolescents. Therefore, alternative approaches for oral health promotion in adolescents should be explored.

Introduction

Health promotion has been defined as the process of enabling people to increase control over and to improve their health[1]. One of intervention strategies in health promotion is health education, which in order to achieve optimum health focuses on lifestyle changes, namely changes in knowledge, attitudes, and behaviour[2].

Health promotion in dentistry is targeted at the two most common oral diseases – dental caries and periodontal disease[3]. Both of them have a multifactorial aetiology, and for the elimination of their risk factors a number of healthy behaviours must be adopted, such as regular mechanical removal of bacterial plaque, proper diet, and daily fluoride application[3]. Therefore, dental caries and periodontal disease could well be seen as behavioural diseases[4].

The maintenance of good oral hygiene was considered to be a central issue in dental health promotion[5]. Oral health promotion has been targeting at different age groups – from preschool children[6,7] to the elderly[8,9]. One of the key issues for success in health promotion is to identify the best time for delivering the intervention[10]. The recent theories in health promotion emphasize the importance of the social context in the determinants of health[11]. Although it was suggested that the sooner oral health-related behaviours were initiated in life, the higher the probability for successful long-term maintenance[4,12], it was shown that there are socially critical periods in human life, which may have particular importance in determining health status in a long-term perspective[13]. The earliest critical period is believed to be the transition from primary to secondary school. It has been shown that relatively stable patterns of health-related behaviours are established during adolescence[14], and it is difficult to change these behaviours during the adult years[15].

On the other hand, puberty, when the child tends to protest and to oppose parents and teachers, was reported as the most difficult period for health education[16]. A perception of dental health as being a low priority might

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hinder the acceptance of the responsibility for learning and maintaining health-related behaviours in adolescents[17–19]. In general, teenagers tend to underestimate risks (i.e. they usually perceive themselves as not vulnerable or minimally susceptible to health problems)[20,21]. Moreover, the historical separation of oral health care from general health care[22] could possibly influence the attitude towards oral health as it was reported that for adolescents, healthy teeth are less valuable than their general health[19]. 'Memory problems' and the difficulty of finding time are the most commonly reported barriers to oral hygiene activities in this age group[22,23].

Consequently, adolescence can be considered as a difficult and challenging, although critical, period of life for health promotion. Therefore, it is important to know what has already been done and what approaches are most successful in oral health promotion targeting at adolescents.

A few available reviews of oral health promotion have either focused on adult populations or on general populations including both adults and healthy or disabled children[24–26]. Knowledge specifically related to oral health promotion in adolescents has not been previously evaluated. Therefore, this work aimed to overview the effectiveness of different strategies used to promote oral health in adolescents. This report is not a traditional systematic review aiming to find clear evidence about one specific question, but it gives a general insight as to what effects can be expected in adolescents after exposure to oral health-related behavioural interventions.

Methods

The MEDLINE via OVID database was searched for papers published from 1967 to September 2007. The following keywords and phrases were used: 'health education'; 'public health dentistry'; 'health promotion'; 'healthy people programs'; '(behavior or behaviour) therapy'; '(behavior or behaviour) modification'; '(behavior or behaviour) change'; '(behavior or behaviour) control'; '(behavior or behaviour) intervention'; 'lifestyle modification'; 'oral hygiene'; 'toothbrushing'; 'dental plaque'; 'health knowledge, attitudes, practice'; 'motivation'; 'dental devices, home care'.

The search was limited to publications in English. The relevant publications were identified after having reviewed the abstracts. In search of further relevant studies, the reference lists of all included studies were examined. Multiple published papers from the same study contributed only once to the review, unless they used different outcome measures.

This work aimed to give an overview of different strategies used to promote oral health in adolescents, thus only minimal exclusion criteria were applied. The inclusion criteria were: (i) studies targeting at adolescents (12–18 years old); (ii) studies aiming to modify oral health-related lifestyle (knowledge, attitudes, or oral hygiene behaviour); (iii) studies with pre- to post-test design (randomized controlled trials and quasi-experimental studies); and (iv) controlled studies (i.e. studies either with a negative (no intervention) control group or with a positive (alternative intervention) control group).

The exclusion criteria were: (i) studies aiming to modify diet behaviour were not included as diet assessed through self-reports was not considered as a reliable and valid measure of lifestyle change, particularly in this age group; (ii) studies where a control group was absent were excluded because results of these studies did not enable valid conclusions, if the achieved changes occurred due to the particular intervention or due to other unknown factors; and (iii) studies targeting at disabled adolescents were excluded as strategies of health promotion in adolescents with specific needs were considered to be substantially different from strategies targeting at healthy adolescents.

Oral health-related knowledge, attitudes, oral hygiene status (dental plaque scores), gingival health, and caries status were used as outcome measures for the evaluation of changes in adolescent oral health-related behaviour. Although it was reported that the changes obtained in plaque control may not have a great clinical impact in terms of improvement in oral health[17], dental plaque still provides a tangible and visible entity for behavioural changes around which educational activities can be focused[27].

The following information was gathered from the included studies: (i) study design-related features such as sample size and study duration; (ii) demographic characteristics: age and gender; (iii) specifics related to the intervention strategies (i.e. methods used, the length of follow-up period, and the number of sessions used for interventions); and (iv) characteristics related to outcome measures, baseline, and follow-up results.

Results

A total of 31 studies met the inclusion criteria. A noted interest in changing oral health-related behaviour in adolescents in the period of 1970–1990 could be identified, and fewer studies in this age group were carried out afterwards.

Interventions used to modify oral health-related behaviour in adolescents

Majority of the reviewed studies used conventional lectures on aetiology and prevention of dental diseases and/or instructions in tooth-brushing and flossing as a tool to modify oral health-related behaviour in adolescents. In a few studies, self-assessment of oral hygiene status was used to motivate adolescents to adhere to oral hygiene regimens.

Only three studies attempted to base their interventions on psychological models or theories related to human behaviour. The study by Albino *et al.*[28] evaluated changes in the oral health behaviour of a group of adolescents who received preventive dental treatment along with a comprehensive 3-year instructional and motivational programme. Part of this programme was based on the belief consistency model according to Rokeach's approach to behaviour change[28]. Following this method, individuals are made aware of inconsistencies within their value–attitude systems. Significant differences among the groups were observed only after the implementation of the belief consistency programme: students who had participated in the programme activities had significantly lower plaque scores.

Another study based on the mentioned belief consistency model and the behaviour rehearsal approach, focused on teaching individuals to give themselves subvocal instructions on behaviour[17]. Both models were compared to the traditional instruction group and controls (no intervention). The multivariate analyses, however, revealed no significant differences between the three intervention groups and the control group[17].

The principles of social learning theory in oral health promotion for adolescents were applied in the study by Søgaard *et al.*[29]. The results showed that children from a lower socioeconomic class benefited more from theory-based interventions, whereas their counterparts from a high socioeconomic background were able to take advantage of the traditional programme[29].

It should be noted that the majority of the reviewed studies reported only short-term results (up to 6 months)[30–34]. Another important consideration is that there was a tendency of relapse in knowledge and/or oral hygiene with time[17,35–38]. Although there were follow-up studies where the maintenance of improved oral hygiene in adolescents after a longer period was shown[18,28,39,40], these findings cannot be defined as an actual long-term success as the results were achieved in conjunction with the reinforcement programmes. Only one study reported a period of 44 weeks with improved oral hygiene status in the absence of any repeated interventions[35].

Subjective measures

Despite some differences in methods used to convey the information to adolescents regarding their oral health (traditional lectures, slide presentations, mass media campaigns, fear appeals, etc.), all studies demonstrated cognitive gains. It is important to consider that the improvements in knowledge were measured differently. Some studies reported the number of children who improved their knowledge with regard to different oral health questions (maximum 80%)[31,39,41], whereas others presented the differences in the mean numbers of the pre- and post-test knowledge scores[33,34,37,42]. Following the latter approach, the 11–55% increase in knowledge was achieved.

The inconsistent findings regarding gender differences in oral health knowledge were shown. Although some studies reported one gender group being more receptive than another to dental health education[18,36,37], the others found no significant differences in oral health-related knowledge between males and females[33,41–43].

Fewer studies evaluated changes in adolescents' attitude towards dental health before and after behavioural interventions. Only slight (3.3–3.5%) or no improvement in attitude was reported[33,36,37,42]. Moreover, the changes in dental attitude appeared to be prone to deterioration over time as the effects were no longer sustained after a few months[36,37]. More positive attitudes in girls than in boys were shown[18,36,37].

Objective measures

Patient Hygiene Performance Index[35,36,40,44], Greene–Vermillion Simplified Oral Hygiene Index[32,34,42], and Plaque Index according to Silness and Löe[18,38,39,45–47] were the most widely employed indices for measuring changes in oral hygiene. A majority of the studies showed significant improvements in plaque scores in adolescents after behavioural interventions. The average reported decrease in plaque scores was 30–50%[28,30,32,34,35,40,45]. However, the regression in oral hygiene status towards baseline values was observed[17,35,36,40,47,48].

Although other studies also showed some improvements in plaque scores, they did not reach statistically significant differences when the intervention groups were compared with controls[17,44,46]. Rubinson and Stone[49] actually reported an increase in the plaque scores from pre- to post-test in the intervention group. The possibility of measurement bias, however, should be considered due to substantial differences in baseline measures among the groups studied, and due to reported inconsistencies among the examiners.

The different patterns in oral hygiene status in boys and girls can be observed as several studies reported females to have more positive and more resistant to deterioration dental practices than males[35,39,50].

Even more variation in the measurements used for evaluating gingival health in the studies aiming to promote oral health in adolescents can be observed. Only the Gingival Index according to Löe and Silness[36,38,45–47] was repeatedly employed in several studies, whereas all other studies used different indices. The studies focusing on gingival health reported a wider range of the effects observed compared to the results obtained from the studies evaluating changes in knowledge, attitude, and dental plaque. There were studies showing up to a 40–50% improvement in gingival index scores after behavioural interventions[34,45,47,50]. By contrast, others reported only slight or no improvement in gingival health[18,36,46].

Although positive changes in gingival health in some studies occurred, the differences between intervention and control groups were not statistically significant[17,29]. On the other hand, Søgaard *et al.*[29] showed that the results became significant when they were adjusted for sex, socioeconomic status, and initial gingival health.

The variation in the study design makes the interpretation of some findings difficult. For instance, there were two similar studies using the self-assessment of oral health as the motivational tool for adolescents[51,52]. Both studies achieved the significant and comparable improvements in gingival health in both intervention groups (the gingival bleeding group and the plaque group). However, the similarity of the methods used and the absence of negative controls (a group without any intervention) leave some space for uncertainty, if the achieved changes occurred due to this particular motivation programme or due to other unknown factors.

In other studies, only the final post-test data regarding gingival health were presented[28,41]. This does not enable the reader to evaluate the real magnitude of changes, if they have occurred.

There were studies evaluating the influence of oral health promotion on caries increment in adolescents. Two studies used solely educational methods as the participants were not provided with any additional sources of fluoride[48,50]. Neither study showed significant differences in caries increments between experimental and control groups.

In most cases, the educational interventions were combined with more or less comprehensive

preventive programmes (use of systemic or topical fluoride, sealants, etc.)[41,46,53–55]. There were variations in study designs as some studies used negative controls (neither education nor fluoride)[41,53], whereas in others experimental and control groups shared one of the intervention modalities (fluoride or education)[46,54,55].

Two similar studies showed contrasting results, where all participants were given fluoride and the intervention groups received additional motivational programme. In the study by Melsen and Agerbaek[46], no statistically significant differences in caries increment between groups were seen, whereas Axelsson *et al.*[55] reported 50–60% caries reduction in the intervention group after the 3-year comprehensive oral hygiene training programme. The success of the latter study may be at least partly attributed to the specifics of the study sample. Seemingly, there was a strong socioeconomic gradient as the sample was derived from a private school (i.e. from the high socioeconomic level), which was very different from the general population. The mean decayed, missing, or filled surfaces–permanent teeth (DMFS) of 12-year-old participants at the baseline was in the range 2.7–3.6, whereas the average DMFS of the general population of this age group in São Paulo was reported to be about 25 (i.e. more than six times higher).

Interestingly, an unexpected 8% difference in caries increment in favour of the control group was reported[53]. The authors of the study attributed this negative difference to chance. Concurrently, the separate analysis of the data for girls showed that there was a 14% caries reduction in favour of the test group. The authors concluded that girls generally demonstrated greater benefits in caries prevention than boys[53].

Blinkhorn and Wight[41] reported a 20% lower incidence of dental decay in a group of adolescents who received regular oral hygiene instructions and topical applications of fluoride gel. This is in agreement with another study[54] where a combination of educational sessions with weekly fluoride mouth rinse and placement of sealants resulted in a significantly lower caries increment than with the application of educational sessions only (27.1% vs. 67.6%).

Discussion

Many studies focusing on oral health promotion in adolescents were reported. The majority of them, however, were performed within the period of 1970–1990, and fewer were carried out afterwards. In the last decade, a shift of focus group for oral health promotion occurred from an adolescent population to preschool children or pupils from the elementary schools[6,7,31,56]. It is possible that the decreased interest in oral health promotion in adolescents can at least be partly attributed to the limited success achieved in the past studies.

Overall, the success of behavioural interventions varied among the reviewed studies. In this context, it is important to consider the validity of the measurements chosen. For example, the measurements of plaque scores used in most studies can be criticized as being robust and subjective. All the mentioned indices for evaluation of dental plaque have scores ranging from 0 to a maximum 5, thus the possible total to record the inter-individual variations in plaque levels falls under a maximum of six categories. It was emphasized that any categorization in measurement leads to information loss[57]. Therefore, such measures reduce accuracy and enhance the possibility of measurement error. Discrepancies between objectively and subjectively evaluated results were shown in the study, where both clinical assessment by the examiner and photographic method were used[17]. It was shown that photographic methods were more sensitive to even the smallest changes in oral hygiene behaviours and were very suitable for measuring the inter-individual variations[17,57]. In addition, they have an advantage of completely blind scoring[17].

Oral hygiene procedures have been recognized for their value in reducing gingivitis more than for the prevention of tooth decay[27]. There was a substantial variation in data regarding the changes in adolescents' gingival health (i.e. the reported improvements ranged from 0 to more than 50%). Consequently, some studies seem more successful than others. It should be considered, however, that the effectiveness of the intervention expressed in percentages may not correspond with its clinical impact. For example, the decrease in the mean gingival index score

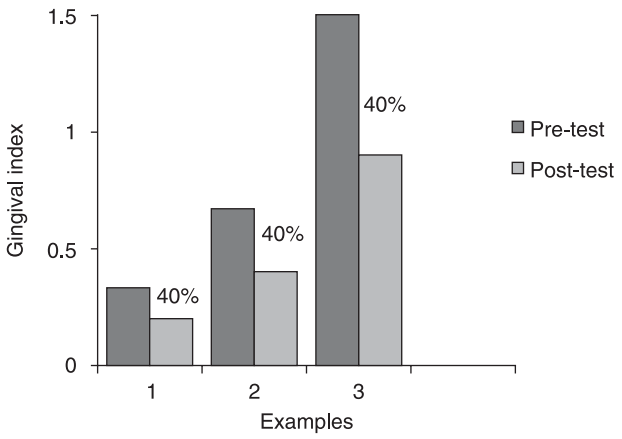

Fig. 1. Examples of the similar 40% improvements in gingival index scores.

from 1.50 to 0.9 would be interpreted as a 40% improvement in gingival health. Interestingly, the same 40% improvements from the pre-test to the post-test gingival index scores, as reported in the studies, obtained much lower clinical effect size, while showing much lower mean gingival index score at the baseline (the mean gingival index scores decreased from 0.67 to 0.40, and from 0.33 to 0.20)[34,45]. This means that the better gingival health is registered at the baseline, the smaller the changes are needed to achieve significant results. The differences in the actual effect size in three cases showing the similar 40% improvements in gingival health are illustrated in Fig. 1.

At first glance, the results regarding the influence of behavioural interventions on caries increment in adolescents look contradictory – some studies reported no change in caries increment[46,53], whereas others showed a significantly lower incidence of dental decay after implementation of combined educational and preventive programmes[41,54,55]. However, the differences among the aforementioned studies in their study design, sample sizes, and populations studied make the results not directly comparable. For instance, the study carried out in São Paulo (Brazil) used the comprehensive oral hygiene training programme and achieved significant caries reduction in the sample of 12- to 15-year-olds with high socioeconomic status[55]. It was shown that compliance with recommended behaviour is better in high socioeconomic status groups, where children have more favourable attitudes, behaviour, and oral health knowledge than the more socially disadvantaged groups[51,58]. Thus, it is still unknown if the aforementioned approach would be equally effective in pupils with lower socioeconomic background.

When considering socioeconomic differences, some behavioural studies conducted in socially deprived adolescents failed to show statistically significant improvements in dental health[46,53], whereas others reported significantly lower caries incidence[41,54]. There are at least two possible explanations for these findings. Firstly, the successful studies have in common the professionally applied preventive measures (topical fluoride, sealant applications) in conjunction with educational activities. This approach was shown to be more effective in caries reduction than home- or school-based use of fluoride tablets[41,53]. The effectiveness of oral health promotion has been related to a pharmacological effect of fluoride rather than to differences in lifestyle[25,59]. Moreover, it is important to consider that the method of delivery of fluoride (professional vs. self-applied) may be of key importance.

Secondly, the difference in statistical significance of the aforementioned studies can be attributed to the differences in the sample size. Small difference in the effect size may not be shown as significant in a small sample, whereas the same difference can reach statistical significance in a big sample. This tendency was clearly confirmed by this review as all studies with sample size exceeding 500 individuals achieved statistically significant results[18,28,39,41,54].

This overview of oral health promotion in adolescents is in agreement with other reviews stating that despite the great number of studies done, it remains unclear which type of educational intervention is more effective and how best to promote oral health[25,60]. It is apparent that a definite conclusion cannot be drawn under the premise that available research did not employ the diverse approaches to effectively solve this problem. The majority of researchers investigating changes in oral health-related behaviour used only different versions of the same educational approach based on the simple conveying of information

regarding the aetiology of oral disease and instructions in toothbrushing and/or flossing. In the early 1980s, 'closing the knowledge gap' was pointed out as the major task for improving oral health[27]. Following the model 'knowledge–attitude–behaviour', changing knowledge was considered as the first step towards behaviour modification. Unfortunately, it has been shown that the improvements in knowledge did not necessarily transform into more positive attitudes[61], nor did the achieved positive attitudes always influence the behaviours of the individuals[46,53]. In addition, even if changes in oral health behaviours occurred, they appeared to be less resistant to deterioration over time than health knowledge[36]. This means that problems raised in the 1970s[17] of transforming knowledge into positive behaviours among adolescents towards preventive dentistry remain unsolved and still exist to this day.

Research in health promotion has been shown to be time consuming, difficult, and not always coming up with clear solutions to particular health problems[41]. However, until dental researchers find preventive procedures which do not depend on an individual's behaviour[17], oral health promotion will continue to be an important issue, and attempts to find effective intervention strategies with adolescent oral health behaviour should be continued.

It has been suggested that the strong theoretical base would enhance the effect of oral health behaviour interventions targeting adolescents[19]. However, the full potential of the behavioural and social sciences to promote health-protective behaviours has not been fully realized[62]. A systematic review of interventions in adults identified only four randomized controlled trials where attempts to improve adherence to oral hygiene instructions were based upon psychological models or theories[26]. It was concluded that there was tentative evidence that psychological approaches to behaviour management can improve oral hygiene and oral hygiene-related behaviour.

Even fewer attempts in the use of psychological models or theories in oral health promotion in adolescents were found. Therefore, theory-based approaches for oral health promotion in adolescents should be explored as an alternative to traditional oral health promotion strategies.

Conclusion

The majority of the studies targeting oral health promotion towards adolescents reported only short-term and varying effects of oral health-related behaviour. The present knowledge suggests that a relapse of adolescent oral health-related behaviour in time should be expected in the absence of a subsequent reinforcement. As there was a lack of diversity in methods employed to motivate adolescents to adhere to oral hygiene regimens, it cannot be inferred which intervention is the best to promote oral health to this cohort. The main challenge for future research in oral health promotion is not only to find the effective ways to change an individual's behaviour, but also to achieve sustained improvements in it that translate to improved oral health. Therefore, alternative approaches for oral health promotion in adolescents should be explored.

What this paper adds

- This work gives an overview of available knowledge about oral health promotion in adolescents.
- The paper identifies that it is still unknown which way is the best to promote oral health in adolescents.

Why this paper is important to paediatric dentists

- The paper gives knowledge and insight for paediatric dentists as to what effects can be expected in adolescents after exposure to oral health-related behavioural interventions.

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