The effect of a brief computer-assisted intervention on oral health-related behaviours among adolescents

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Abstract

Aim The aim of this study was to see if a brief, computer-assisted intervention tool could be pleasant to use for adolescents. Another aim was to evaluate if the computer programme could affect adolescents' oral health-related behaviours.

Materials and methods Study design: For oral health promotion on schoolchildren, a computer-assisted intervention with personal feedback was performed. The effectiveness of the programme on participants' oral health behaviours as well as the feasibility of the programme were evaluated by responses of the participants. The study was conducted on 13–15 year-old schoolchildren (n=112). The computer programme included 19 questions about oral health-related behaviours and it provided personal feedback and tips towards better oral health. Additionally, the participants gave feedback about the programme. After four weeks, the intervention was repeated, the same questions were asked again, and the effect of the intervention on oral health behaviours was evaluated.

Results More than half of the children considered the computer programme useful, girls (56.9%) more often than boys (44.9%) ($p = 0.057$). Almost everyone reported having learnt new information through the programme. Most of the new information concerned oral hygiene and the effects of different beverages on dental health (over 40% on both issues). Both genders reported having changed their oral health behaviours towards better habits. Girls generally improved their meal quality, while boys cut down on snacking and used more xylitol products. The computer-assisted intervention gave positive results and the programme seemed to be easy and pleasant to use for both adolescents and oral health professionals. Statistics: The results concerning the computer programme were described as frequencies, distributions and graphically. Chi-square test or Fisher's exact test was used when compared distributions between different questions and gender as well as questions and groups. The participants were categorised into three groups according to their sum scores (calculated from responses to the questions on oral health-related behaviours). The differences between the sum scores at baseline and after the intervention were analysed with the paired samples t-test.

Conclusions Information technology seems to have a remarkable potential in motivating patients towards better oral health behaviours.

KEYWORDS Adolescent, Computer-assisted, Information technology, Oral health, Oral health promotion, Questionnaire.

Introduction

In the late 1970s, the World Health Organization (WHO) set up the goal of a maximum of three caries-infected teeth on children under 12 years of age. Finnish adolescents succeeded to reach, and even exceed, that goal in the 1990s: in 1975, the DMFT-index (decayed, missing or filled teeth) was around 7 per child, and by 1997, the index dropped to 1.1. According to the latest available information from the year 2000, the DMFT-index has slightly increased, being now 1.2 in Finland [Nordblad, 2004]. A more recent practice-based study has indicated cessation, or even degradation, of improvement in dental caries prevalence [Käkilehto et al., 2013]. From 1985 to 1995, the proportion of children with caries-free primary molars increased; however, in the birth cohort of 2000, there were signs of deterioration. Undoubtedly, dental caries is still common in Finnish adolescents; 45% of young males and 37% of young females were reported to have need for restorative treatment, even when excluding wisdom teeth [Tanner et al., 2013]. The corresponding figures for adults older than 30 years of age show a better oral health status: 25% of males and 14% of females had had at least one tooth needing restorative treatment [Koskinen et al., 2012]. It seems that caries prevalence is higher in Finnish adolescents than in adults. The primary cause of treatment for adolescents is caries, while adults need restorative treatment mainly for other reasons, such as cracks of fillings [Suominen et al., 2008; Tanner et al., 2013]. One important reason for teenagers' poor oral health can be their inadequate oral health-related behaviours. Almost half of Finnish secondary school pupils (children aged 13–15 years) have reported brushing their teeth less than twice a day. In addition, almost 70% of pupils do not eat all the intended components of their free school lunch, and every fifth pupil has reported eating sweets during school hours at least once a week [WHO, 2013].

Dietary and oral hygiene intervention among secondary schoolchildren has been shown to have positive effects on children's oral health behaviours [Anttonen et al., 2011]. The more personal and empowering the intervention is, the more effective it is [Hausen et al., 2007]. According to Tolvanen, when adolescents were exposed to both individual and population-based oral health promotion, as well as clinical

non-invasive procedures, their oral health behaviours significantly improved [Tolvanen, 2011].

Information technology (IT) has not yet been utilised for oral health promotion according to its potential. In a survey carried out in US [Walker et al., 2015], children aged 8–11 years were asked if they liked the idea of receiving reminders on tooth brushing in their personal computer. Almost all children liked the idea, feeling that it would motivate them to brush more often. In another study, receiving weekly text messages increased self-reported tooth brushing activity among young adults aged 18–24 years. Twice-a-day brushing activity increased from 51% at baseline to 73% after nine weeks of regular text message reminders [Schluter et al., 2015]. Children aged 4–10 years have also reported as having improved their dietary habits after using a computer game developed for high caries risk children. Using the computer game was in many cases as effective as oral health education given by a dental nurse educator [Aljafari et al., 2017].

The first aim of this study was to evaluate if oral health promotion through IT could be an effective way to convey oral health information to adolescents of today. The objective was to investigate adolescents' opinions about this type of computer-assisted intervention. Another aim was to evaluate whether the new information received through the computer programme could influence adolescents' oral health-related habits. The hypothesis was that adolescents find this kind of computer-aided intervention tool both useful and positive. It was also hypothesised that the computer programme will motivate children to change their oral health behaviours towards healthier ones.

Materials and methods

Computer programme

The computer programme was developed at the University of Oulu, Finland, in 2005 to investigate oral health-related behaviours of children and adolescents. Before the present study, the programme was tested and used in several other studies [Hoppu et al., 2008; Tolvanen, 2011; Anttonen et al., 2008, 2014]. The programme included a series of 19 questions about oral health-related behaviours. The respondents were asked about their meals, snacking habits, use of xylitol products, and tooth brushing activity, as described in a previous study [Anttonen et al., 2014]. At baseline, the respondents were also asked about their opinion of the programme ("Was the programme useful/clear/reasonably sized/useless?"). Additionally, the participants also reported their main sources of oral health-related knowledge (parents/school/dental clinic/public health nurse/coach/friends/internet/magazines/TV or radio).

The programme provided individual feedback and advice towards healthy behaviours based on the participants' answers at baseline. The feedback included informative pictures and entertaining facts about oral health, decrease in pH during acid erosion, oral bacteria, and steady energy levels throughout the day. The feedback was allocated by gender.

Subjects

The study was carried out in spring 2011 at two secondary schools in Oulu, Finland. All the participants were studying in classes targeted to physically active (regularly going in sports) secondary school children aged 13–15 years. This group of children was selected because analogous information of children from other schools in Oulu (not having separate classes for physically active children) was available from a previous study [Anttonen et al., 2011]. The participation was voluntary. The computer programme was installed on five laptop computers. The participants used the programme privately in a peaceful classroom setting during school hours. It took from 10 to 15 minutes to complete the programme.

In the first phase of the study, all the 112 students regularly going in sports volunteered to participate, and composed the research group. The participants answered the questions on their oral health-related behaviours and their main sources of oral health information and received feedback based on their responses. Additionally, the participants gave feedback about the computer programme and reported if they had learnt any new oral health-related information when using the programme (Yes/No/I don't know).

Due to practical reasons (e.g. participants were having sports training camps and competitions outside Oulu), 66 participants out of the original study population participated (a comfort sample) in the second phase four weeks later. The programme with the same questions on oral health-related behaviours was repeated and additionally, the participants were requested to answer the following questions: Has the information received from the programme influenced your meal timing/quality of your meals/your use of xylitol products/snacking frequency/consumption of fizzy drinks/tooth brushing? (Yes/No/I don't know). Of the 66 participants, altogether 16 did not answer to all questions.

Statistics

The results concerning the computer programme were described as frequencies, distributions and graphically. Chi-square test or Fisher's exact test was used when comparing distributions between different questions and gender as well as questions and groups. Responses to the questions on oral health-related behaviours were analysed individually for each question as well as a sum-function, because all answers were scored according to their expected effect on oral health. The more positive the effect was, the more negative score the participant received. The scores ranged from -2 to +2. The sum scores were calculated according to the participants' responses. The sum scores ranged from -66 (most favourable effect on oral health) to +16 (least favourable effect on oral health) [Anttonen et al., 2014].

The differences between the sum scores at baseline and after the intervention were analysed with the paired samples t-test.

The participants were categorised into three groups of the same size according to their sum scores. Group 1 included the children with the highest expected caries risk (score ranging from +16 to -31), group 2 the children with the second highest risk (from -32 to -43), and group 3 the children with the lowest expected caries risk (from -44 to -62). The outcomes were compared between the genders and different groups (groups 1–3) using cross tabulation. Chi-square test or Fisher's exact test was used to measure the significance of the differences between the groups.

Results were considered statistically significant with p-values < 0.05. All data were analysed using the SPSS software (version 20.0, SPSS, Chicago, Illinois, USA).

Ethical considerations

The Ethical Committee of the Northern Ostrobothnia Hospital District was informed about the study and the Committee considered that, according to the Finnish legislation, ethical

statement for the study was not needed. The questions were not intimate and participation was voluntary. The data was stored and analysed without personal identifications.

Results

Adolescents' opinion of the programme

More than half of the participants considered the computer programme as useful (51.4%). Generally, girls (56.9%) favoured the programme more compared to boys (44.9%) (p = 0.057). Both boys and girls thought that, while the programme was clear (78.5%), it was also reasonably time-consuming (80.4%). Only 12.1% of the children considered the programme useless (Fig. 1).

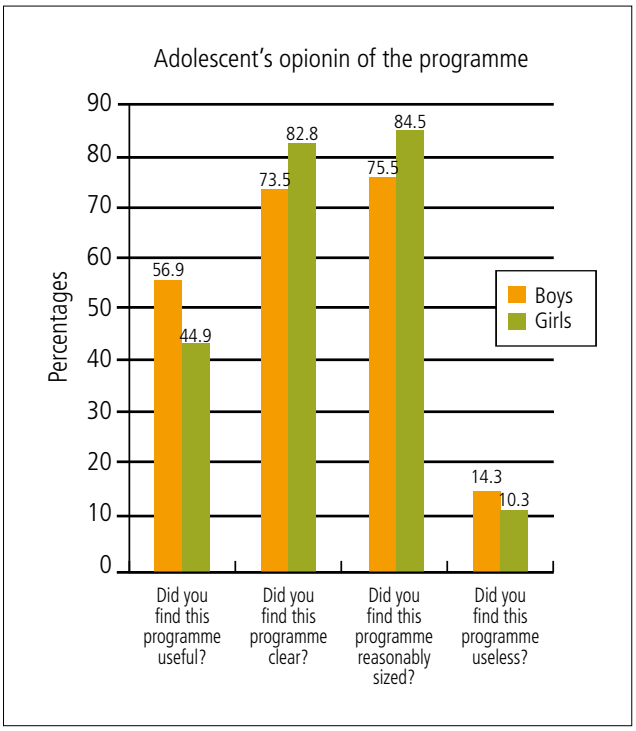

FIG. 1 Feedback from participants about the quality of the computer-assisted oral health promotion tool according to gender.

Previous sources of oral health information

The main sources of oral health information among the participants were schools (90.1%), dental clinics (81.0%) and parents (78.1%). Other important sources were coaches (53.8%), magazines (52.1%), TV/radio (50.6%) and public health nurses (45.4%). The school was a more important source of information for girls than for boys (p = 0.050). Magazines were also significantly more important as a source of information for girls than for boys (p = 0.021). Furthermore, friends' importance as a source of health information was higher for girls than for boys, although the difference was not statistically significant. The parents were a more frequent source of information for boys (86%) compared to girls (71%) (ns) (Fig. 2).

Changes in the average sum score

Mean sum scores were calculated for the children with responses to all the questions (n = 49). At baseline, their mean score was -33.86 (SD 17.1). Four weeks after the intervention, the mean sum score had improved by 2.6 points to -36.46 (ns). The mean score for the worst third at baseline (group 1) was -15.1 (SD 15.6), while their score after the intervention was -18.6 (SD18.7); improvement being 3.5 points (ns). The mean score for group 2 was -37.3 (SD 3.2) at baseline and after four weeks -40.1 (SD 14.5), which means an improvement of 2.8 points (ns). The group with the best oral health habits at baseline (group 3) had similar scores at both times, although, the score deteriorated by 0.5 points: the score was -49.7 (SD 5.8) at baseline and -49.2 (SD 9.0) after the intervention (ns).

New information received through the programme

Nearly everyone reported having received new information

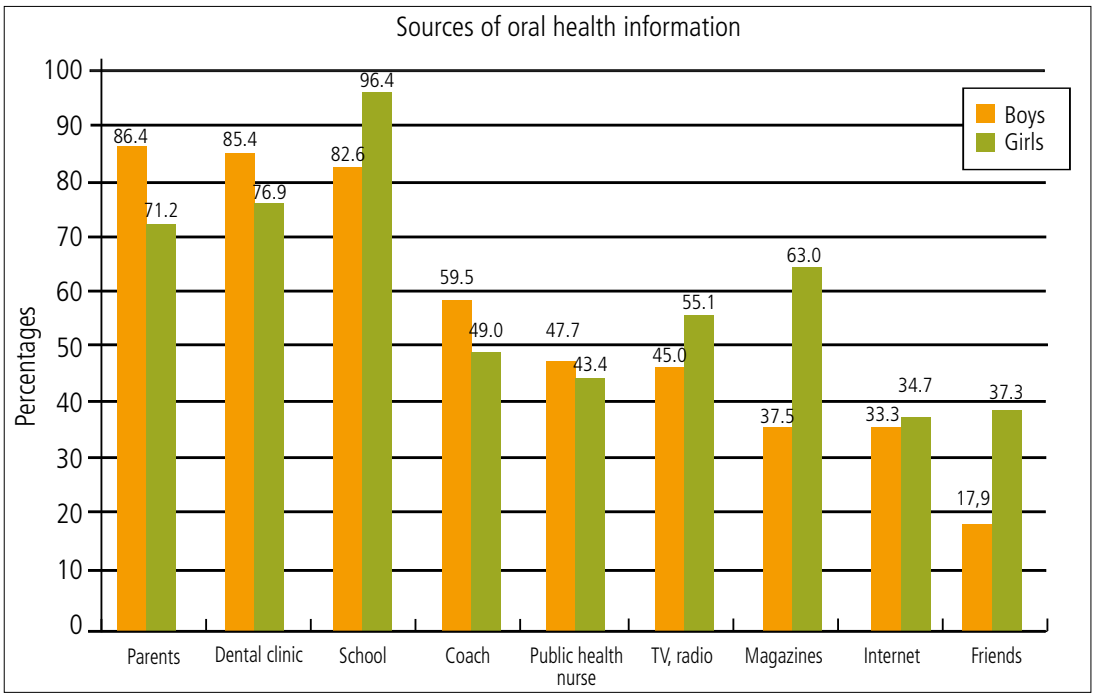

FIG. 2 Sources of previous oral health information reported by participants according to gender.

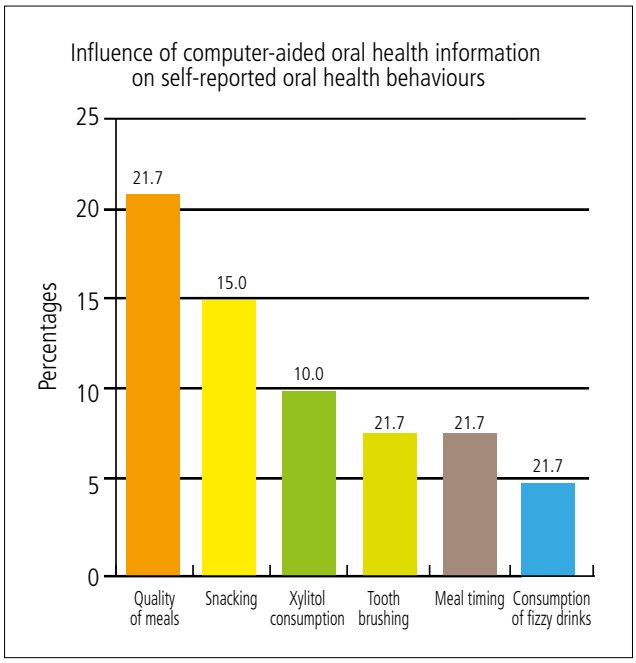

FIG. 3 Influence of the computer-assisteded oral health promotion tool on self-reported oral health behaviours.

through the computer programme on some issue. The new information mostly concerned how different drinks affect dentition; almost half of the children learnt new information about this topic. Four out of ten children reported having learnt new information about oral hygiene. About a third said that they had received new information about the number of bacteria in the oral cavity and about the amount of sugar in sweets. Girls reported having learnt about meal timing more often than boys ($p = 0.036$) (Fig. 3).

New information learnt was also analysed in association with the sum scores of the participants: children with the poorest oral health behaviours reported most often having learnt new information in general and specifically about meal timing ($p = 0.078$) and how to gain nutrients and proper kind of energy from meals ($p = 0.115$).

Self-reported changes in oral health behaviour

Both genders reported positive changes in their oral health-related behaviours because of the computer programme. Compared to boys, girls tended to improve more their meal timing (12.5% vs 3.6 %) and quality of meals (25.9% vs 17.9%), while boys tended to decrease their use of fizzy drinks (7.1% vs 3.1%) and increase the use of xylitol products (17.9% vs 3.6%) (ns) (Table 1).

Discussion

The study indicates that even a simple computer-assisted intervention tool for secondary school students can be used, and should be developed, for oral health promotion. Most of the participants found the programme useful and helpful, which is in line with the hypothesis. Those with the poorest oral health behaviours seemed to benefit the most from the tool. Girls improved their meal timing and quality of meals, while boys improved their xylitol consumption and use of fizzy drinks. Both genders had previously received oral health information from the school and from their parents, and girls had also received information from their friends and the media and boys from their coaches.

This generation's children and adolescent have lived all their lives in a society where computers and information technology, and even mobile phones, have always been accessible. Almost all of them use the internet daily [Official Statistics of Finland 2017], and a major proportion of that time, 13–17 hours weekly, is spent with different kind of social media [eBrand Suomi, 2015]. Thus, this generation is a fluent user of IT applications and devices. As previous studies have indicated, computers and other new media are pleasant to use for young adults [Walker et al., 2015; Aljafari et al., 2017]. Oral health professionals and other responsible persons should come up with new ideas and ways to deliver oral health information to adolescents by using modern media. This study indicates that computer-based interventions may be one way of doing that; yet, more studies are needed. According to our results, in everyday life, human sources are more often used to gain health-related information than computers or TV. However, some of the time spent on social media by adolescents could be easily used for educational purposes, if the educational tool was made appealing and easily accessible to adolescents.

It took about 10–15 minutes for each child to answer the questions and receive information. Most of the participants thought that this was a reasonable amount of time to spend on the programme. Therefore, in the future, it is important to develop applications which are easy and pleasant to use and not too time-consuming or laborious. The study was conducted in a quiet location during school hours, and the children used

	Boys (%)	Girls (%)	Group 1 (%)	Group 2 (%)	Group 3 (%)
Meal timing	18.4	22.4	23.8	14.3	5
Different drinks' effect on dentition	42.9	49.1	33.3	50	30
Effect of meals on sport performance	12.2	25.9	9.5	19	20
Oral hygiene	46.8	36.2	38.1	33.3	36.8
Steady energy gain	29.8	15.8	38.1	20	10
Effect of drinks on oral health	40.4	53.4	38.1	60	50
Amount of sugar in sweets	29.8	36.8	33.3	31.6	40
Amount of bacteria in oral cavity	26.5	36.8	33.3	23.8	31.6

TABLE 1 New information received through the computer programme.

the programme independently [Anttonen et al., 2014]. This is important for the results, as teenagers can be prone to answer according to the public opinion. In this respect, the situation simulated a personal contact.

It was pleasant to notice that the adolescents had received oral health-related information from a variety of sources instead of from dental professionals only. It is important that a child has a healthy environment for growing, with responsible and considering adults. It was a particularly positive surprise to see that coaches also provide information about oral health issues. Athletic boys with high energy consumption tend to consume large amounts of sweets and chocolate [Anttonen et al., 2014], and therefore, continuous and multi-professional oral health promotion is important. In addition, healthier snacks should be available for children and their use should be encouraged during activities.

It has been previously hypothesised that girls look up to exterior role models such as people in magazines and other media. According to a previous study [Walker et al., 2015], the primary motivator for children's tooth brushing is the idea of 'perfect teeth' presented in the media: children want their teeth to look 'clean and white', not 'yellow and gold'. That is of course a goal to pursue. It might, at the same time, bring unnecessary pressure on teenagers regarding their appearance, as teenagers often have tendency to self-consciousness and even low self-esteem.

Children's self-reported oral health-related behaviours changed in terms of meal timing and xylitol usage. As a result of the intervention, boys consumed less fizzy drinks and more xylitol products. That is a major achievement, as boys tend to quench their thirst with fizzy drinks more often than girls [Lukkari et al., 2008]. Fizzy drinks are also a main cause for both being overweight and having dental caries among children [Hooley et al., 2012]. Perhaps the most significant result of this study was that so many participants received new information about the harmfulness of drinks through the computer programme: for example, almost half of the children learnt new information about how different drinks affect dentition. This, of course, was the main aim of the intervention.

The children in the study were active young athletes. Athletes might be considered to have excellent knowledge about health issues and beneficial health-related behaviours. This study, however, shows that there is always room for improvement as for diet and oral hygiene. Energy and sports drinks presumably used by young athletes contain a lot of sugar or have a low pH value. This threats dentition not only by dental caries but also dental erosion [Vered et al., 2014].

These results could be questioned by stating that the participants are just claiming that they have improved their oral health habits; however, the results are supported by changes in sum scores, so there is some proof of improvement. The mean sum scores of the children improved by 2.6 points, i.e. by 7.7% compared to the original sum score. The group with the worst presumed oral health habits improved their habits the most (by 3.4 points), while the group with the best habits kept their good sum score throughout the test period (deterioration being 0.5 points). That is a delightful piece of news: this new technology seems to reach those with the poorest oral health. It has been known to be challenging to motivate these adolescents to improve their oral health behaviours.

A limitation of this study is the small study population, which influences the statistical significance of the outcome. Due to their school activities, only half of the children could participate in both sessions. In addition, not everyone answered all the questions in the computer programme. It should also be noted that the test period was only four weeks, which is quite short to demonstrate long-term impacts of the computer programme. Furthermore, the study comprised only a survey without clinical examination. Investigating long-term effects would require a longer follow-up period and maybe repeated or continuous intervention.

Conclusion

The study shows that a computer-based intervention tool may be an effective way to deliver new information about oral health to secondary-school students. However, more studies with larger study population and longer study periods are needed. A computer programme is an easy and pleasant tool for both oral health professionals and children; yet, the contents of the programme must be carefully considered. The results gave a positive signal for further investigation.

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