Short-Term Effects of Hygiene Education for Preschool (Kindergarten) Children: A Clinical Study

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Aim: To evaluate the outcomes of short (15 minutes) oral hygiene vs. hand hygiene education for preschool children 4 weeks after these interventions.

Materials and Methods: Sixty-one preschool children (age range 4–6 years) attending four kindergarten classes participated in a 15-minute health education programme on the importance of body cleanliness for general health. In addition, specific instructions on oral hygiene were provided for two randomly selected classes (30 children), while the remaining two classes (31 children) were given instruction of hand and nail cleaning. The oral hygiene status was assessed using the plaque control record (PCR). The cleanliness of the hands and fingernails was determined using a hand hygiene index (HHI) and a nail hygiene index (NHI). All three parameters were assessed before the intervention as well as 4 weeks thereafter.

Results: Four weeks after education, the PCR had improved for all children from 79.95% to 72.35% ($p < 0.001$). The NHI had improved from 74.91% to 61.71% ($p < 0.001$). In addition, the mean PCR of the children given oral hygiene instruction decreased from 83.67% to 72.40%, while the mean PCR of the children given hand and nail cleaning instruction decreased from 76.23% to 72.29% (interaction effect 'time x type of instruction': $p = 0.044$). Girls' PCR improved significantly more than boys' PCR (Girls, 80.98 vs. 69.71; boys, 78.33 vs. 75.31; $p = 0.021$).

Conclusions: The results of the study show that even a short, school-based educational intervention at an early age may affect children's oral health promotion significantly. Teachers should, therefore, be encouraged to educate children from an early age about oral hygiene promotion.

Key words: children, health education, oral hygiene instruction, motivation, prevention

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In 2000, the first ever US Surgeon General Report on Oral Health clearly documented that children from socio-economically disadvantaged and/or under-represented minority backgrounds were vulnerable to suffering from poor oral health (Evans and Kleinman, 2000; USDHHS, 2000). It pointed to the fact that caries is the most prevalent chronic childhood disease in the USA. It is seven times more common that hay fever, 14 times more common than bronchitis, and five times more common than asthma. Dental caries has a 58.6% incidence rate among children and adolescents between 5 and 17 years of age, with 18% of children aged 2 to 4 years, 52% of children aged 6 to 8 years, and 61% of adolescents by age 15 having caries in the USA (USDHHS, 2000).

While caries in itself affects children's quality of life in a significant manner (Inglehart et al, 2002), there is also clear evidence that it affects children's general health. In 1999, it was demonstrated that children with early childhood caries had significantly lower weight than caries-free children before dental rehabil-

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itation (Acs et al, 1999). However, following their dental rehabilitation, these children's weight increased and was no longer significantly different from the weight of caries-free children in the caries-free group (Ayhan et al, 1996). Relationship between children's height and caries experience has been further substantiated (Low et al, 1999; Nicolau et al, 2005). In addition to the effects of childhood caries on children's height and weight, research has also shown that there was a relationship between obesity in children and higher rates of decayed, missing and filled teeth due to caries (Willershausen et al, 2004).

High rates of caries in combination with the growing evidence of how caries affects children's lives should alarm oral health providers, who are well aware of the fact that caries is largely a preventable disease. While a substantial decline in childhood caries may be achieved by delivering fluorides to preschool and grade-school children (Marthaler, 1967; Scheinin et al, 1974; Marthaler et al, 1994; Marthaler and Meyer, 2004), such programmes may not be available to children at large. However, one universally available and highly successful way of oral disease prevention is optimal self-performed plaque control (Axelsson and Lindhe, 1981a; Axelsson et al, 1991). The success of oral self-care in preventing both caries and periodontal disease has been demonstrated beyond any doubt in the Karlstad studies for adolescents as well as for adults (Axelsson and Lindhe, 1974; Axelsson et al, 1976; Axelsson and Lindhe, 1977; Axelsson and Lindhe, 1981b; Axelsson et al, 2004). One major challenge, therefore, is to find ways to motivate children at an early age to develop good oral health promotion habits. Oral health promotion programmes for children around the world have shown that children's oral health-related knowledge can be increased (Woolley, 1980; Flanders, 1987; Rubinson and Tappe, 1987), that their oral health-related behaviours may be changed (Stapf, 1975; Buischi et al, 1994), and that their oral health status can be improved (Schwarz et al, 1998; Ohara et al, 2000). It is surprising that not more oral health education is implemented in early preschool (and kindergarten) programmes. Educators may be reluctant to introduce oral health topics because of the erroneous assumption that only time-intensive programmes could be successful. The aim of the present study was, therefore, to demonstrate that even short educational interventions may lead to improvements in children's hygiene status. It is hypothesised that brief (15 minute) instructions towards specific hygiene concerns may result in positive outcomes assessed one month after education.

MATERIALS AND METHODS

A total of 61 preschool children (27 boys, 34 girls; age range 5 to 7 years of age) were recruited for the study. The children attended four different kindergarten classes in the city of Visp, Canton of Valais, Switzerland; each kindergarten class had 14 to 16 children. The parents or guardians of all children were invited to an evening meeting during which information on the aims of the study were presented and discussed. Written informed consent was subsequently obtained from the parents or guardians. Two classes, with a total of 30 children, were randomly selected to receive oral hygiene instruction, while the remaining two classes, with a total of 31 children, were educated about hand and fingernail cleanliness.

At baseline, a clinical examination was performed with special emphasis on oral hygiene status and the cleanliness of the children's hands and fingernails, by applying the following parameters.

Oral hygiene: plaque control record (PCR)

Following the application of a plaque disclosing agent, the oral hygiene was assessed using the dichotomous method of presence or absence of disclosed plaque on four surfaces of all deciduous teeth present (O'Leary et al, 1972). The presence of plaque was evaluated visually without the use of a dental explorer or compressed air. The first permanent molars, if present, were not evaluated. The percentage of plaque-covered surfaces was calculated for each child to define the subject's individual mean PCR.

Cleanliness of hands and fingernails

For the purpose of this study, two index systems to assess the cleanliness of the children's hands and fingernails were developed: namely the hand hygiene index (HHI) and the nail hygiene index (NHI).

Hand hygiene index

The cleanliness of the hands was assessed separately for both hands in a very simple, dichotomous way. A hand was unclean if visible debris was found by the naked eye on the palm or dorsum of the hand. The condition of the skin was not assessed. Hence, the HHI could have a score of 0%, 50%, or 100%. A score of 0% was given if both hands were clean; a score of 50% if

Table 1 Average (mean ± SD) hygiene indicators before and 4 weeks after educational interventions for both groups and for all children combined

	Oral hygiene instruction		Hand hygiene instruction		All children	
	Before	After 4 weeks	Before	After 4 weeks	Before	After 4 weeks
PCR* (%)	83.67 ± 2.834	72.40 ± 2.832	76.23 ± 2.788	72.29 ± 2.786	79.95 ± 1.988	72.35 ± 1.986
	p < 0.001		p = 0.152		p < 0.001	
HHI** (%)	31.67 ± 6.903	30.00 ± 6.814	33.87 ± 6.791	22.58 ± 6.704	32.77 ± 4.842	26.29 ± 4.780
	p = 0.865		p = 0.304		p = 0.369	
NHI*** (%)	81.60 ± 3.883	70.83 ± 4.917	68.23 ± 3.820	52.58 ± 4.837	74.91 ± 2.723	61.71 ± 3.449
	p = 0.005		p = 0.007		p < 0.001	

** PCR was assessed as the percentage of plaque-covered tooth surfaces.*
*** HHI was assessed as 0% (both hands clean), 50% (one hand dirty), 100% (both hands dirty).*
**** NHI was assessed by scoring the left and right side of each of a child's ten fingernails as either clean (0) or dirty (5). The score ranged accordingly from 0% (both sides of all 10 fingers clean) to 100% (both sides of all 10 fingers are dirty).*

only one hand was unclean, and a score of 100% if both hands were dirty.

Fingernail hygiene index

A child's fingernail cleanliness was assessed using the NHI. This index was based on the assessment of the cleanliness of the left and the right surface of each of the ten fingernails. Each of these 20 surfaces was examined by the naked eye for visible dirt. The length or the shapes of the fingernails were not assessed. The presence of dirt was noted and a 5% value was given for each dirty surface. The scores ranged accordingly from 0% for completely clean fingernails to 100% for children whose ten fingernails were dirty on the left and the right side.

Four dental hygiene students were instructed in hygiene education and calibrated for the three index systems mentioned, by evaluating five volunteers before and after toothbrushing, hand washing, and fingernail cleaning. For the duration of the study, all four evaluators were blind to which education the children had received. The children's oral hygiene status (PCR), and their hand (HHI) and fingernail (NHI) cleanliness were recorded at baseline and one month after the original instruction had been given.

Health education

Following the baseline clinical examination, the dental hygiene students showed a standardised 15-minute presentation to all kindergarten classes about the importance of body cleanliness for a child's general health.

In an entertaining way, all children were informed of the necessity of toothbrushing, washing hands with soap, and cleaning fingernails as being important aspects of regular body hygiene.

In addition to this general information, a 15-minute programme of specific toothbrushing instruction was provided to one half of the children. The second half of the children did not receive detailed instruction in oral hygiene practices, but received a demonstration and detailed instruction on hand washing and fingernail cleaning procedures.

After this baseline examination and instruction, parents, guardians and teachers were discouraged from initiating discussions with the children about hygiene behaviours that were the subject of the interventions for the period of one month.

In summary, the educational intervention consisted of a first part, during which all the children were informed of the necessity of body cleanliness during a general 15-minute presentation, and a second part, in which one half of the children received oral hygiene instruction, and the other half received hand and fingernail hygiene instructions.

RESULTS

Given the fact that all children received general information about the relationship between cleanliness and health, it was expected that the PCR, HHI and NHI of all children would improve over the 4-week period following the initial assessment and instruction.

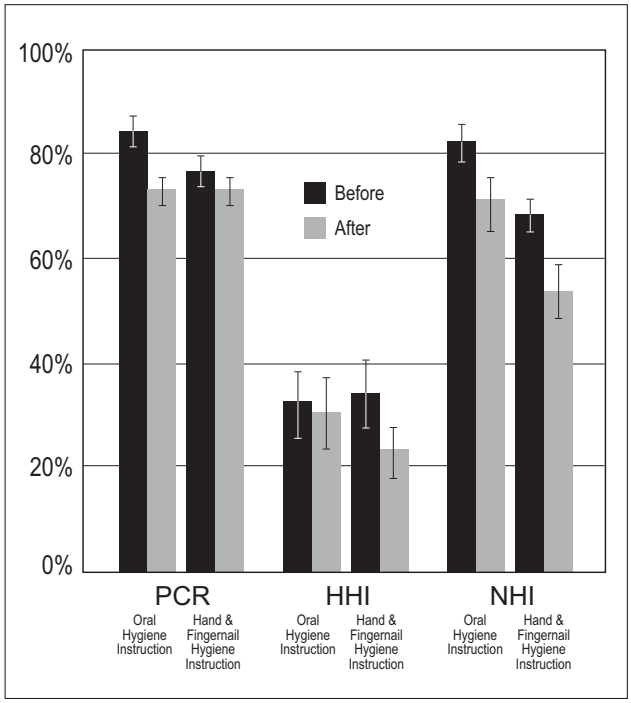

Fig 1 Oral, hand and fingernail hygiene of preschool (kindergarten) children at baseline and one month after various specific hygiene instructions.

A multivariate analysis of variance with a repeated measurement factor 'time', and the independent variable 'type of Instruction' was conducted with the three indices as dependent variables. The main effect 'time' was significant [$F (3/57) = 11.188$; $p < 0.001$]. As can be seen in Table 1, all three indices changed in the predicted direction from the baseline to the 4-week follow-up assessment. Univariate analyses of variance showed that two of the three dependent variables were significantly different at the follow-up assessment compared with the beginning measurement. The children's PCR changed from 79.95% of the tooth surfaces having plaque at the beginning of the study to 72.35% at the 4-week follow-up [$F (1/59) = 18.175$; $p < 0.001$], and the NHI changed from 74.91% of the 20 nail surfaces being dirty to 61.71% [$F (1/59) = 16.227$; $p < 0.001$].

It was also predicted that the specific targeted educational oral hygiene vs. hand/fingernail hygiene instructions should affect the children in distinct ways. Children who had received oral hygiene instruction should improve their oral hygiene status more than children who had received hand/fingernail hygiene instruction. The interaction effect of 'time' and 'type of instruction' was significant for the dependent variable PCR [$F (1/59) = 4.227$; $p = 0.044$]. As can be seen in Fig 1 as well as in Table 1, while the children with the oral hygiene instruction improved their PCR from 83.67% at the beginning to 72.40% at the 4-week follow-up, the children with the hand/fingernail hygiene instruction only improved from 76.23% to 72.29%.

In addition, an analysis of the simple effect of comparing the average before and follow-up scores of the children who had received hand and fingernail hygiene instruction showed that while these children's PCR did not differ significantly, their NHI had significantly improved from 68.23% to 52.58% [$F (1/30) = 8.419$; $p = 0.007$].

The groups of children who had received oral hygiene instruction consisted of 16 girls and 14 boys, while the groups of children who had received hand/fingernail hygiene instruction had 18 girls and 13 boys. When adding the factor 'gender' into the multivariate analysis of variance, the overall interaction effect between 'time' and 'gender' showed a tendency towards significance [$F (3/55) = 2.401$; $p = 0.078$], indicating that boys and girls had changed to different degrees from the beginning to the 4-week follow-up assessment. The 'time' x 'gender' interaction effect of the univariate analysis of variance with the dependent variable PCR was significant [$F (1/57) = 5.606$; $p = 0.021$]. As can be seen in Table 2, while the girls had decreased their PCR from 80.98% to 69.71%, the boys changed only from 78.33% to 75.31%. In addition, the girls' HHI and NHI scores had also improved to a greater degree than the boys' scores. However, these differences were not significant.

DISCUSSION

The present study demonstrated that a single general health education of only 15 minutes followed by 15 minutes of specific instructions about oral hygiene or hand/fingernail cleanliness affected the health of kindergarten children as assessed 4 weeks after the education. These results should encourage preschool and kindergarten teachers to consider introducing such topics in their curricula. In addition, the effects of specific instructions were demonstrated. Children who had specifically received oral hygiene instruction improved their oral hygiene significantly more than children who had not received such instruction. On the other hand, children who specifically got instruction in hand and nail cleaning demonstrated significantly cleaner hands and nails after 4 weeks than their fellow students. While this study cannot answer the question of whether these effects will be sustained over time, the fact that changes resulted from these brief

Table 2 Average (mean ± SD) hygiene indicators before and 4 weeks after educational interventions for girls and boys

	Girls		Boys		All children	
Before	Before	After 4 weeks	Before	After 4 weeks	Before	After 4 weeks
PCR* (%)	80.98 ± 2.653	69.71 ± 2.605	78.33 ± 2.974	75.31 ± 2.916	79.95 ± 1.988	72.35 ± 1.986
	p < 0.001		p = 0.228		p < 0.001	
HHI** (%)	42.54 ± 6.306	29.69 ± 6.488	20.33 ± 7.069	22.12 ± 7.273	32.77 ± 4.842	26.29 ± 4.780
	p = 0.239		p = 0.832		p = 0.369	
NHI*** (%)	73.84 ± 3.671	58.51 ± 4.661	75.92 ± 4.115	65.81 ± 5.225	74.91 ± 2.723	61.71 ± 3.449
	p = 0.001		p = 0.049		p < 0.001	

** PCR was assessed as the percentage of plaque-covered tooth surfaces.*
*** HHI was assessed as 0% (both hands clean), 50% (one hand dirty), 100% (both hands dirty).*
**** NHI was assessed by scoring the left and right side of each of a child's ten fingernails as either clean (0) or dirty (5). The score ranged accordingly from 0% (both sides of all 10 fingers clean) to 100% (both sides of all 10 fingers are dirty).*

interventions with kindergarten children are remarkable. They suggest that short educational interventions at such an early age can affect children's oral health-related behaviour, and ultimately their oral health status. Given the degree to which children suffer from untreated caries (Inglehart et al, 2002), educational programmes aiming at caries prevention should be developed and implemented worldwide. While this study focused on the role that teachers may play in educating preschool children about hygiene issues, programmes for parents need to be developed as well (Inglehart and Tedesco, 1995) in order to ensure that healthy habits of oral health promotion are developed early in life.

Research with adults analysed the outcomes of various programmes for delivering oral hygiene education (Söderholm and Egelberg, 1982; Walsh et al, 1985). The results of these studies indicated that comprehensive and complex plaque control programmes were not necessary to increase the effects of basic plaque control instructions. The results of the present study support these findings that very basic and short health education presented in a playful manner and adapted to the educational level of preschool and kindergarten children may be effective in modifying their hygiene related behaviour.

While this study showed that a relatively short intervention that consisted of 15 minutes of general instruction combined with 15 minutes of a targeted instruction affected the children's hygiene status significantly over the period of one month, programmes that use repeated instructions to reinforce the initial information might be even more effective. Research with adult periodontal patients support this hypothesis that repeated instructions are effective (Axelsson and Lindhe, 1981c). Research also shows that a lack of regular maintenance care visits after successful periodontal therapy leads to a relapse of the therapeutic outcomes to pre-treatment levels (Leu, 1977; Axelsson and Lindhe, 1981c; Kerr, 1981).

One additional finding of the present study was the fact that the kindergarten girls had improved their oral hygiene status significantly more from the beginning to the 4-week follow-up appointment than the boys. Since the enthusiasm of preschool boys in performing personal hygiene may be limited compared with girls, who could be more easily motivated (Syrjala et al, 1992a; 1992b), it might be worthwhile to consider if other methods of educational intervention should be used to motivate boys. Given the recent findings of a cross-sectional study of periodontal health in adults in Switzerland, which showed that in all age cohorts, from 20 to over 80 years, oral hygiene standards were significantly lower in males than in females (Schürch and Lang, 2004), it seems crucial to socialise boys at an early age into more constructive behavioural patterns concerning their oral hygiene practices. It may be speculated that gender differences in personal hygiene may be the result of early childhood socialisation patterns. Positive health promotion efforts targeted at children at an early age may hopefully lead to constructive lifelong oral health promotion.

CONCLUSIONS

In conclusion, a single short health education session provided by oral health professionals resulted in sig-

nificant improvements in the kindergarten children's hygiene status. Specific instructions in either oral hygiene or hand cleaning practices improved the children's oral hygiene status and the cleanliness of their hands and fingernails, respectively. These effects were found 4 weeks after the educational intervention. Efforts should be made to educate children at an early age for both general and specific health issues. The power of even short educational interventions should not be underestimated.

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