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Evaluation of a parent-designed programme to support tooth brushing of infants and young children*

Abstract: *Objectives:* This study developed and tested an intervention to help parents establish a routine of brushing their young children's teeth twice a day. *Methods:* Community-based participatory research methods were used to engage parents in the design of the intervention to maximize its relevance and acceptability to others. Input was obtained by interviews and focus groups. The resulting intervention was four 90-min small-group sessions that provided educational information, direct instruction, practice and peer-to-peer problem-solving. A pre- to post-non-randomized design was used to evaluate the intervention's effect to increase or maintain parents' twice daily brushing. *Results:* Intervention participants were 67 primary caregivers of children under six years of age. Of the 67 initial participants, 50 completed a post-intervention questionnaire administered 4 to 8 weeks following the intervention. The proportion of parents who reported brushing their young children's teeth twice a day increased significantly from 59 per cent prior to the intervention to 89 per cent post-intervention (McNemar's $X^2 = 10.71$, $P = 0.002$). There were concomitant and statistically significant increases over the study period in parents' confidence for brushing twice a day, attitudes about the importance of brushing and their self-efficacy for tooth brushing. Parents' knowledge of children's oral health, assessed by a 15-item scale developed for this study ('Things to Know About Baby Teeth'), also increased significantly. *Conclusions:* Twice daily tooth brushing is a low-cost, effective strategy to reduce the risk of childhood caries. As demonstrated here, community-based efforts can help parents achieve this important health behaviour.

Key words: campaigns; care; caries; dental hygiene; dental hygiene counseling; knowledge; methods/techniques; motivation; oral health; problems; status; toothbrushing

Abbreviation
TTK15 things to know about baby teeth

Introduction

Caries can be prevented through regular use of fluoridated toothpaste (1). Frequency matters. Brushing teeth more than once a day, versus less often, reduces the occurrence of caries (2, 3). Evidence suggests relatively few parents meet this recommendation although the estimates of brushing frequency, and the research methods and questions used to derive this information, vary. For example, based on a questionnaire completed at home by parents of children enrolled in Head Start programmes in

Maryland, USA, Vargas and colleagues (4) reported that 65 per cent of parents brushed their children's teeth 'more than once a day'. An interview study of low-income families with infants and preschool children in Washington State, USA, found that 55 per cent of parents brushed their children's teeth 'twice a day' or more (5). The average frequency of brushing based on in-person interviews of over 700 parents of low-income preschool children in Detroit, Michigan, USA, was reported to be approximately nine times per week (6). An international study of caries in children in mixed-income groups found variation in brushing both between countries and between racial/ethnic subgroups. Within the USA samples, twice-a-day brushing of four-year olds ranged from 64 per cent among African American children to 50 per cent among white children (7).

There are several reasons why tooth brushing is a worthwhile focus for health promotion intervention. In the international study described above, the tooth brushing behaviour most strongly associated with children being caries free at four years of age was the onset of brushing by the parent before age two (7). Among the oral health attitudes and beliefs examined in that study, the best predictor of being caries free was parents' perceived skill to carry out tooth brushing as part of their child's daily routines (8). Beginning brushing when the first tooth erupts (9) maximizes its health benefits and places tooth brushing in the mix of other mildly intrusive caregiving behaviours that parents learn to do for their infants and that infants grow to tolerate. Early initiation is important also because once established, tooth brushing habits persist (10, 11).

In short, tooth brushing is a specific, demonstrable behaviour that should begin early and occur often. Programmes to help parents create a habit of brushing their young children's teeth show it is a behaviour that is also amenable to change. Most programmes have been developed and tested outside the USA. They vary in terms of mode of delivery (e.g. person-to-person versus mailed materials) and frequency of intervention contacts. For example, a study conducted in England by Davies *et al.* (12) documented benefits of a series of 'gifts' by mail to more than 1000 parents of infants 8 through 32 months of age. The gifts included written educational pamphlets, a trainer cup, toothpaste and a toothbrush. Parents who received the repeated mailings, relative to those who did not, were more likely to report favourable feeding behaviours, initiation of tooth brushing prior to age 12 months and twice daily tooth brushing. The effects of intervention, while statistically significant overall, benefited some participants but not others. Among those in the test group, only one-third to one-half adopted the targeted behaviours.

A study by Blinkhorn and colleagues (13) suggests one limitation of a one-size-fits-all approach to parent-focused health promotion. Effective tooth brushing requires something more than knowing, or being told, it is important. Their study, of 268 mothers, asked questions about oral hygiene and included direct observation of mothers brushing their preschool children's teeth. They report most mothers (71%) knew they should brush twice daily, but only half knew they should use a small amount of toothpaste and less than half (40%) showed adequate tooth brushing. A study conducted in Finland with nearly 1500 mothers of three-year-old children found most mothers reported daily tooth brushing (78%) but that the youngest mothers and those in rural areas had the poorest tooth brushing habits (14, 15). This study is one of very few to consider characteristics other than family income as having a potential influence on home oral hygiene.

As little as one in-person instructional session in how to brush a young child's teeth can reduce risk of tooth decay (16). Instruction, combined with the opportunity to tailor programme elements to specific barriers or parent characteristics, has the potential for even greater reach. An example of this is a study of the effects of comprehensive dental education provided in families' homes periodically over the child's first three years of life. Intervention components were delivered by an oral health educator and adjusted as needed to answer the mother's questions. Relative to families who did not receive this service, at age three, children of mothers who received the in-person services had significantly lower rates of caries and gingivitis; the oral hygiene of mothers improved too over their own baseline behaviour (17).

Deliberate efforts and opportunities for affected individuals to participate in the design and implementation of interventions is a hallmark of community-based participatory research (CBPR). Personal- and community-level health interventions developed with adherence to CBPR principles, including collaboration, colearning and power-sharing (18), can result in programmes with greater contextual relevance and longevity than programmes designed as a one-way transmission of information from 'experts' to people 'in need' (19).

The purpose of this study was to use the principles of CBPR to develop and test an intervention to support parents' twice daily tooth brushing of their infants and young children.

Study population and methodology

Setting

Participants were primary caregivers of children less than one year (with at least one erupted tooth) through five years of age enrolled in one of the three community-based early education programmes for children of low-income families.

The setting was a community in Lewis County, a rural county located in the south-western region of Washington State, USA. At the time of the study, most county residents (95%) were white and eight per cent were Hispanic or Latino of any race. The majority (92%) spoke English as their primary language. Fifteen per cent of the county's adults ages 25 years and older lacked a high school diploma; for 33 per cent, the highest educational attainment was high school graduation or its equivalency. Twenty-seven per cent of families in which all children were younger than 5 years of age had income levels below the federal poverty level (20).

Theoretical basis and design of the intervention

Our research methods reflect a community-based participatory approach in which local knowledge and involvement is essential to understand health problems and design effective interventions (21). In this study, we engaged parents in the design of the intervention to maximize its relevance and acceptability to other parents within this community. We invited parents' and other community members' participation in a number of ways.

We formed a committee of community residents including one general dentist, four professionals in early childhood health or education and two low-income mothers with young children to guide our research process. The parents on the committee were paid a stipend. Community residents were also hired and trained as members of the research team to collect interview and questionnaire data from parent participants and to organize and conduct the intervention.

We gathered input to design the intervention through interviews and focus groups. One-to-one interviews were conducted with 45 parents of infants and children through five years of age. Interview questions asked about when, or if, parents had begun brushing their child's teeth, why they began, how often they brushed, and barriers and sources of support for twice daily tooth brushing. Findings from this phase of the study were published previously (5) and are consistent with Fishbein's Integrative Model of health behaviour which posits that strong intention, high self-efficacy, necessary skills, accurate health beliefs, and lack of constraints predict behavioural performance (22). Interview participants who brushed their children's teeth twice a day, versus less often, expressed high self-efficacy and high self-standards for brushing. Those who brushed less often were more likely to hold false beliefs, have lower self-standards, describe more external constraints (e.g. lack of time or an uncooperative child) and had fewer ideas to overcome these barriers (5).

Major themes from the interviews were subsequently shared with 14 community parents in two focus groups. Focus group participants were asked to confirm and elaborate on the interview data and tell us what would help them, and parents like them, develop and maintain a habit of twice-a-day tooth brushing. Their recommendations directed the content and delivery of the intervention. The focus group participants provided four types of suggestions. First, they expressed a desire for accurate, consistent information about oral health and how best to care for their children's teeth. Their questions, and frustrations, were very concrete such as: 'What hardness or softness of tooth brush is best? And, if soft is best, why do stores sell other types?' Second, they asked for advice to help make brushing fun for their children. Third, they asked for, and suggested, tips to make tooth brushing routine. Finally, several said the frequent purchase of toothbrushes to maintain their child's interest was expensive and was an added barrier to this health behaviour.

When asked how best to get information about children's oral health to other parents, focus group participants suggested a series of educational sessions held in early evening with refreshments and childcare. The opportunity to combine learning with socialization was recommended because many parents in the community were single parents or otherwise isolated from peers.

Description of the intervention

Information gained from the interview and focus groups led to a four-session programme, 'Taking Care of Baby Teeth', held once per week for four weeks at a local preschool. The programme was led by a local parent educator trained in the intervention components by the study Principal Investigator and who completed the Web-based program Open Wide (23), an oral health educational programme for health professionals and early childhood educators.

Each of the four parent sessions was organized to include 30 min for refreshments and socialization, approximately 30 min for a facilitated parent-to-parent discussion of 'what's working, not working and what to do about it' and a 20- to 30-min educational programme. The educational programme included a presentation by a local dentist about dental disease and the benefits of brushing (Session 1), activities to reinforce oral health knowledge, dietary choices and brushing behaviours (Session 2), description of how tooth brushing is supported in the child's early education programme (Session 3) and on-site practice in brushing their child's teeth (Session 4). At each session, parents and children chose items from an array of free supplies including adult- and child-sized tooth brushes, fluoridated toothpaste for children and for adults, non-fluoridated toothpaste for infants and 2-min timers to try out at home during the coming week. Additionally, parents received one children's book, designed to encourage tooth brushing, per family. The cost of providing these materials was approximately $9.00 per family (in 2014 U.S. dollars). Further detail about the curriculum and samples from diary notes of its implementation is provided at: http://depts.washington.edu/nacrohd/resources ('Taking Care of Baby Teeth Curriculum').

We planned for parent groups of approximately eight adults, a size we anticipated would provide a range in parenting experience within the group and time enough for everyone to have an opportunity to share in the discussion. This size is consistent with guidelines for focus groups, another type of group process designed to elicit focused discussion (24). The full programme (of four sessions each) occurred in the fall, winter and spring of three years and coincided with the early childhood education programmes' months of operation.

Evaluation design and measures

We used a pre- to post-non-randomized evaluation design to determine whether the intervention influenced parents' behaviours to reach or maintain twice-a-day tooth brushing. Specific measures were selected to evaluate the primary components of

the intervention and its overall impact on the behavioural determinants specified by the Integrative Model (22) specifically: parents' accurate knowledge, behavioural beliefs and self-efficacy for twice daily tooth brushing. The data were obtained through questionnaires completed by parents within four weeks prior to the first intervention session and again four to eight weeks following the last intervention session. Additionally, we collected information about which dental supplies were taken home and, at the last group session, asked parents' their opinion of each session and of the programme overall. All study procedures, including the consent process, were approved by the Institutional Review Board of the University of Washington.

Sociodemographics and oral health of the study participants

The parent questionnaires included questions about the parent's relationship to the study child, race and ethnicity, age, years of formal schooling, child's age and gender. Oral health questions included parent's rating of their own dental health and of their child's as excellent, very good, good, fair or poor (25). Parents were asked whether their child had been to a dentist and three questions about tooth brushing at home: if had they begun brushing, the frequency of brushing per day and if they thought the recommendation to brush twice a day was 'realistic' for parents of young children.

Parents' confidence in brushing

We used a readiness ruler to determine parents' confidence in brushing their child's teeth twice a day. This technique (26) asks a person to rate on a scale of 1–10 how motivated they are to change their behaviour. Low numbers (0–3) correspond to 'not ready', the midrange (4–7) with ambivalence and high numbers (8–10) with a strong motivation to change. The question we asked was 'Right now, how confident are you that, if you decided to, you could brush your child's teeth twice (or almost always twice) a day? Why did you choose that, and not a lower number?'

Things to know about baby teeth (TTK-15)

As part of the pre- and post-intervention questionnaires, parents completed a 15-item knowledge inventory of young children's oral health and development developed for the developmental, interview stage of this study. The items include recommendations for home hygiene and dental health (nine items), statements about the caries process (two items) and dental development (three items). For each item, parents indicated their level of knowledge as 'didn't know', 'sorta know' and 'know for sure'; item scoring ranges from 1 to 3 points, respectively (available at: http://depts.washington.edu/nacrohd/resources ('Things to Know About Baby Teeth'). In the intervention stage of the study, we added one item to the original 14-item set, it is 'broken baby teeth can be caused by cavities'.

Parental attitudes towards child tooth brushing and caries

Four scales included in the questionnaires were developed for the international study of Adair and colleagues described previously (8). Included in this study were the 'Importance and Intention to Brush Child's Teeth' (five items), 'Parental Efficacy in Relation to Child Toothbrushing' (six items), 'Perceived Seriousness of Tooth Decay in Children' (seven items) and 'Chance Control – Decay Occurs by Chance' (five items). Response options range from 'strongly agree' (=1) to 'strongly disagree' (=5).

Parents' choice of supplies and satisfaction with the intervention programme

Each parent was asked to maintain a checklist at the intervention site and update it weekly to report the materials and supplies they selected to take home and try in the coming week. The supplies included educational materials (photo cards showing how to brush the teeth of children of different ages and an educational brochure), oral hygiene supplies and items to help make brushing fun: a storybook about tooth brushing, two-minute timers and tooth brushing song sheets. Parents and children could choose more than one of each item (e.g. toothbrushes for all children in the home) or replenish items at any session.

At the last group session, parents were asked to evaluate the 'usefulness' of six components of the intervention, specifically:

1 Provision of free materials and supplies to support tooth brushing
2 Presentation by the community dentist
3 Parent-to-parent discussion of what works, doesn't work and what to do about it
4 Instruction in how to brush a young child's teeth
5 Learning how their child's early education programme supports tooth brushing
6 Practice tooth brushing with their child.

Each component was rated as 'useful' (3 points), 'so-so' (2 points) or 'not useful' (1 point).

Data analyses

Analyses were performed using the statistical software STATA release 10 (StataCorp LP, College Station, TX, USA). Summary data are reported as means and standard deviations for continuous data and as percentages for categorical data. Scores on the Things to Know inventory (TTK-15) were summed and divided by the number of items so the total score reflects the original metric. Scores on two of the attitude scales were reverse scored so that higher scores on all four scales indicate more favourable responses. There was one missing value on the TTK inventory for seven parents. The missing scores were replaced with the individual's average score for the remaining items. Three parents left two of the attitude scales blank, and these individuals were excluded from those analyses. Pre- to post-intervention changes in parents' confidence to brush

twice a day, brushing frequency, knowledge of children's oral health and attitudes towards brushing and caries were examined using paired *t*-tests for continuous variables and McNemar's test for the one categorical variable: brushing twice a day versus less often.

Results

The study period was October 2007 through June 2010. The four-session programme, 'Taking Care of Baby Teeth' occurred nine times total. One programme was reduced from four to three sessions because of a devastating winter flood.

Participants

Seventy-eight primary caregivers were invited to participate in the study. Sixty-seven of them consented to participate, completed the pre-intervention questionnaire and attended at least one session. Most caregivers (87%) were mothers. Ten parents brought a spouse or partner to one or more sessions. The average group size was eight adults; the range was from 1 to 13.

Sixty-one per cent of the parent participants attended two-thirds or more of the sessions offered. A description of these individuals and the study children is given in Table 1. In families with more than one child in the age range for the study, we chose the youngest child as the study participant. Thus, the data describe 67 parents and 67 children.

The largest racial group was of white, non-Hispanic parents (67%); 25 per cent were Latino or Hispanic of any race. Eighteen per cent were <18 years of age, and 36 per cent had neither completed high school nor obtained the equivalent of a high school diploma. Seventy-eight per cent described their own dental health status as good, very good or excellent. Approximately one-half of the study children were boys (51%), and nearly half (47%) were <24 months of age at the time of the pre-intervention questionnaire. Pre-intervention, the majority of parents (94%) endorsed the recommendation to brush a young child's teeth twice a day as realistic, yet only 52 per cent reported doing so. Child's age was not significantly associated with brushing frequency; parents of 48 per cent of children younger than 24 months and parents of 56 per cent of children 24 months or older said they brushed their children's teeth twice a day (data not tabled). Six parents reported they had not begun brushing their child's teeth. Among the 61 parents who reported brushing, 34 per cent said they brushed for their child, 10 per cent said the child did this on his/her own, and 56 per cent said it was a combined activity.

Eighty-five per cent of the children were reported to be in good, very good or excellent dental health. For the group as a whole, 41 per cent had visited a dentist, for any reason, at least once. Ten children (18%) were reported to have an appointment scheduled for a first dental visit. Age was associated with having had a dental visit. Children <12 months of age were least likely to have had a dental visit (9 of 10 had not); however, 30 per cent of children ages 36 months and older (7 of 23) had not yet been to a dentist (data not tabled).

Table 1. **Sociodemographics, dental health and oral hygiene behaviours of programme participants prior to the intervention**

Parent participant	% (count)
Relationship to child (*n* = 67)	
Mother	87 (58)
Other (father or grandmother)	13 (9)
Race/ethnicity (*n* = 64)	
White non-Hispanic	67 (43)
Other non-Hispanic	8 (5)
Hispanic or Latino, any race	25 (16)
Age (*n* = 65)	
<18 years	17 (11)
18–19 years	13 (9)
20–29 years	45 (29)
30 years or older	25 (16)
Formal education (*n* = 64)	
Less than high school	36 (23)
High school graduate	30 (19)
Training beyond high school	25 (16)
College graduate	9 (6)
Self-rated dental health status (*n* = 65)	
Excellent, very good or good	78 (51)
Fair or poor	22 (14)
Child in age range for the study	
Gender (*n* = 67)	
Male	51 (34)
Female	49 (33)
Age (*n* = 67)	
<12 months	21 (14)
12–23 months	26 (17)
24–35 months	19 (13)
36–47 months	19 (13)
48 months or older	15 (10)
Parent-rated dental health status (*n* = 65)	
Excellent, very good or good	85 (55)
Fair or poor	15 (10)
Child has received a dental visit (*n* = 56)	
Yes, at least once	41 (23)
Not yet, but scheduled	18 (10)
No, never	41 (23)
Parent reports brushing twice daily is realistic (*n* = 64)	
Yes	94 (60)
No	6 (4)
Frequency of home tooth brushing (*n* = 67)	
Not yet brushing	9 (6)
Once day or less	39 (26)
Twice a day or more	52 (35)
Who typically brushes the child's teeth (*n* = 61)	
Parent brushes the child's teeth	34 (21)
Child brushes for him/herself	10 (6)
Parent and child brush the child's teeth together	56 (34)

Of the 67 initial parent participants, 50 completed the post-intervention questionnaire. Comparisons of the pre-intervention characteristics (recall Table 1) of those who did and not complete the post-intervention questionnaire revealed one significant difference: proportionately more mothers than 'other' parents provided these data (Pearson $X^2 = 5.00$; $P = 0.025$). The proportion of parents who reported twice daily brushing prior to the intervention was 59 per cent among those who completed the post-intervention questionnaire and 53 per cent among those who did not; this difference was not statistically significant.

Parents' confidence in brushing, brushing frequency, knowledge and attitudes

Table 2 displays the pre- and post-intervention scores for parents who completed both sets of questionnaires. Prior to the intervention, the average confidence score was 8.40 (of 10); scores ranged from 1 to 10, and the median was 9.0. The average total score on the Things to Know Inventory (TTK-15) was 2.25 (SD = 0.38) of 3.0 points. Pre-intervention scores on the attitude scales ranged from 4.18 (SD = 0.57) for Efficacy for Tooth Brushing to 4.55 (SD = 0.46) for Perceived Seriousness of Tooth Decay. The maximum possible score for each scale is 5.0.

Scores on these same measures, obtained four to eight weeks following the intervention period, are presented in Table 2 also. There were statistically significant improvements on five of seven measures. Parents' confidence in achieving or maintaining twice daily tooth brushing increased to a mean of 9.47 (SD = 1.0); the range, post-intervention, was from 6 to 10 [t (1,47) = 3.50, $P < 0.001$]. Parents' report of home behaviour showed a similar pattern. The proportion who reported brushing their children's teeth twice daily increased from 59 to 89 per cent (McNemar's $X^2 = 10.71$, exact significance probability = 0.002). Prior to the intervention, 24 parents reported brushing less than twice daily. Following the intervention, 18 of the 24 reported brushing twice per day. Of the 26 parents who reported brushing twice a day prior to the intervention, 3 reported brushing less often following the intervention.

Table 2. **Pre- to post-intervention differences in parents' confidence in brushing their child's teeth, brushing frequency, knowledge of children's oral health and attitudes towards brushing and caries**

Variable	*n*	Pre % (count) or M (SD)	Post % (count) or M (SD)	*P*
Parents' confidence and brushing frequency				
Confidence for brushing twice a day (mean, SD)	47	8.40 (2.19)	9.47 (1.00)	<0.001†
Brushes child's teeth twice a day (%, count)	50	59% (26)	89% (41)	0.002*
Knowledge of children's oral health				
Things to know inventory: TTK-15 (mean, SD)	48	2.25 (0.38)	2.62 (0.33)	<0.001†
Attitudes towards brushing and caries				
Importance and intention to brush (mean, SD)	49	4.33 (0.56)	4.60 (0.43)	0.003†
Efficacy for tooth brushing (mean, SD)	49	4.18 (0.57)	4.42 (0.56)	0.005†
Perceived seriousness of decay (mean, SD)	48	4.55 (0.46)	4.60 (0.46)	0.341†
Tooth decay occurs by chance (mean, SD)	48	4.03 (0.65)	4.11 (0.67)	0.403†

*McNemar's test with exact McNemar's significance probability.
†Paired *t*-test.

Average total scores on the TTK-15 increased from a mean of 2.25 (SD = 0.38) to 2.62 (SD = 0.33). The difference is statistically significant [t (1,47) = 6.69, $P < 0.001$] and equivalent to nearly one standard deviation in the pre-intervention scores. Scores on the two scales that reflect parents' attitudes towards tooth brushing increased significantly also. The average increase was 0.27 points on Importance and Intention to Brush [t (1,48) = 3.18, $P = 0.003$] and 0.23 points on Efficacy for Tooth Brushing [t (1,48) = 2.92, $P = 0.005$]. Total scores for the two scales pertaining to dental decay also increased, but the differences did not reach statistical significance.

Parents' opinion of the intervention

Fifty-six parents kept a checklist of the tooth brushing supplies and materials they chose to take home. All of the items were selected by one-third or more of the families (Table 3). The most popular educational items were a photo card showing how to brush a toddler's teeth, selected by 48 per cent, and a photo card of healthy and unhealthy teeth, selected by 46 per cent. Two-thirds or more chose adult or child oral

Table 3. **'Taking care of baby teeth' materials and supplies chosen by families***

	% who chose this item (count)
Educational materials	
Photo card showing how to brush a toddler's teeth	48 (27)
Photo card of healthy and unhealthy teeth of children	46 (26)
Photo card showing how to brush a preschooler's teeth	43 (24)
Photo card showing how to brush an infant's teeth	39 (22)
Brochure 'A parents' guide: caring for children's teeth'	38 (21)
Supplies	
Children's toothpaste with Fluoride	79 (44)
Adult tooth brush(es)	73 (41)
Additional child tooth brush (es)	71 (40)
Toothpaste with fluoride	64 (36)
Tooth and gum cleaning gel marketed for infants, without fluoride†	55 (31)
Ways to make brushing fun	
Children's storybook about tooth brushing	95 (53)
Two-minute timer	88 (49)
Tooth brushing song sheets	36 (20)

Parents and children could choose more than one of each item (e.g. toothbrushes for all children in the home) and choose new items, or replenish items, at any session.
*56 of 67 families kept supply checklists.
†At the time of the study, recommendations to use fluoridated toothpaste with children under age two years were not widely known. At the urging of the dentist member of our community advisory group, we provided non-fluoridated tooth gel as a choice for parents.

hygiene supplies. The storybook and a two-minute timer were the most popular items recommended to help make brushing fun.

Table 4 summarizes parents' opinions of the 'usefulness' of the primary components of the intervention. They rated the availability of the free materials and supplies most highly; the average rating was 2.96 of 3.0 points, and only one parent said she did not find these useful. The second most highly rated component was the timed tooth brushing practice with their child (or, if needed as a stand-in, with an oversized puppet named 'Ollie', a dog). The third most highly rated component was the parent-to-parent discussion of 'what works, what doesn't and what to do about it', included in every session. This activity was rated 2.81 points on average and was the only activity to earn no ratings of 'not useful'. The informational sessions were rated lowest, and two of these received the greatest number of 'not useful' ratings.

Discussion

The Taking Care of Baby Teeth programme embodied many characteristics common to effective behavioural interventions (27): the content was delivered person-to-person, in repeated contacts and over a span of time. It was designed to help parents of young children acquire new, needed skills and provide meaningful social and instrumental support (28); these elements – delivered through on-site practice, peer-to-peer problem-solving and the provision of child-oriented oral hygiene supplies – were the most highly rated components of the programme. The preference for active engagement in programme activities was reflected in parents' lower ratings of the passive learning segment 'How to Brush a Young Child's Teeth', compared with its more highly rated counterpart 'Timed Brushing with Child (or the puppet, Ollie)' in which parents were timed in an actual tooth brushing session. At every session, there was ample time to discuss what was working and not at home, and parents were encouraged to try new approaches in the upcoming week that were tailored to their experience. Feedback by peers and the parent educator emphasized positive results, shared empathy for parent-child struggles, and appreciation for parents' perseverance.

The programme was effective. It resulted in an increase, from 59 to 89 per cent, in the proportion of parents who reported brushing their young children's teeth twice a day. The validity of this result is bolstered by concomitant increases in parent's confidence and self-efficacy for tooth brushing as measured four to eight weeks following the intervention. In contrast, measures of attitudes towards the caries process, a topic that received relatively less attention in the intervention, did not show significant changes. The fact that three of 26 parents reported a decrease in brushing frequency over time suggests post-intervention scores were not likely inflated due to social desirability bias. It is not known whether the positive behavioural changes were maintained long term. The post-intervention data, collected 4 to 8 weeks beyond the intervention, indicate maintenance for this period, at least.

Table 4. **Parents' feedback on the curriculum***

Session or activity	Average rating	Count of 'not useful'
Materials and supplies to support tooth brushing	2.96	1
Timed brushing with child or Ollie	2.87	1
What works? parent-to-parent discussion	2.81	0
What happens at school	2.67	5
Guest dentist	2.66	1
How to brush a young child's teeth	2.41	5

*49 parents rated each session or activity as 'useful' (3 points), 'so-so' (2 points) or 'not useful' (1 point).

This programme was novel compared with other tooth brushing interventions in that it involved parents in its design and in its delivery. In the design phase, parents recommended active participation by parents. We speculate a high level of participation by parents in the sessions led to a new group norm. It is interesting to consider that social norms can affect health behaviours that occur in private. A study of low-income pre-adolescents identified peer influence and the importance of being liked by others as predictors of their tooth brushing frequency (11). It is possible the small-group format used in this study harnessed these influences and in doing so, reinforced a new social norm for tooth brushing. For example, one mother shared that she (and the entire parent group) disagreed with her neighbour's opinion that tooth brushing 'shouldn't be fun'. We did not foresee that parental couples would attend the programme but this was welcome – it appeared to provide additional support for the new group norm and specific support to the spouse or partner.

It is reasonable to assume that parents who volunteered for this study were more highly motivated to achieve the behavioural goal than would a random sample of parents of young children. Prior to the intervention, study parents had high confidence and nearly all (94%) thought twice daily brushing was a realistic standard. The Integrative Model of health behaviour, the theoretical foundation for this intervention, posits intention as the primary determinant of behaviour and that strong intention, the necessary skills and lack of constraints are necessary and sufficient conditions for behavioural performance. It is likely this tooth brushing intervention was well suited for its participants' level of behavioural intent.

Consistent with the principles of CBPR (18), we would not assume without verification that the intervention programme described here is generalizable to other communities of parents of young children. As discussed above, the small-group format and emphasis on parent-to-parent problem-solving were preferences of this specific community. In other communities, transportation, safety or time constraints might be barriers to the format that worked well for this parent group. With regard to the focus of the intervention, the behavioural goal of twice daily brushing is worth pursuing. Studies of parents' attitudes towards caries prevention measures find parents of preschool children consider tooth brushing more important than the use of fluorides or dietary habits (29).

As carried out in this study, our CBPR approach was appreciated by the university-based and community-based research partners. The process could be replicated elsewhere and to address other child health concerns. In this study, parent participants seemed pleased and a little surprised by their authority to direct the intervention's content, format and scope (e.g. to include parents of preschool children of all ages rather offer age-specific – younger and older – preschool age groups). The resulting programme was both effective and well regarded by other community parents.

Clinical relevance

Twice daily tooth brushing is a low-cost strategy to reduce risk of childhood caries. As demonstrated, guidance for parents to brush their young children's teeth need not be confined to the dental office. Early childhood programmes and informal community-based programmes such as playgroups are in a position to help ensure all children receive the benefits of tooth brushing by helping parents develop this habit. The cost of the intervention was <$10.00 per family (for the cost of adult and child tooth brushing supplies and a children's book) and is considerably less than the expected health benefits associated with a reduction in tooth decay.

Our finding that brushing frequency was not related to children's age is consistent with results of a previous study conducted in this same community (5) and suggests future intervention efforts include families with children of all ages.

Competing interests

The author declares no competing interests.

Author's contributions

CEH conceived the study, is the primary author of the intervention protocol, conducted the data analysis and is primary author of this paper. PM contributed to the study's concept and drafting the paper.

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