Community Dental Health (2012) **29,** 162–167
Received 28 January 2010; Accepted 9 January 2012

doi:10.1922/CDH_2647Johnson06

When Can Oral Health Education Begin? Relative effectiveness of three oral health education strategies starting pre-partum

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Objective: To test the impact of oral health education provided to pregnant mothers on subsequent practices within the infant's family. ***Research design:*** A quasi-experimental intervention trial comparing the effectiveness of 'usual care' to one, or both, of two oral health education resources: a 'sample bag' of information and oral health care products; and/or a nine-minute "Healthy Teeth for Life" video on postnatal oral health issues. ***Participants:*** Women attending the midwife clinic at approximately 30 weeks gestation were recruited (n=611) in a public hospital providing free maternity services. ***Results and Conclusions:*** Four months after the birth of their infant, relative to the usual care condition, each of the oral health education interventions had independent or combined positive impacts on mother's knowledge of oral health practices. However young, single, health care card-holder or unemployed mothers were less likely to apply healthy behaviours or to improve knowledge of healthy choices, as a result of these interventions. The video intervention provided the strongest and most consistent positive impact on mothers' general and infant oral health knowledge. While mothers indicated that the later stage of pregnancy was a good time to receive oral health education, many suggested that this should also be provided after birth at a time when teeth were a priority issue, such as when "baby teeth" start to erupt.

Key words: *health education, dental caries, child welfare, prevention, ante-natal, dental health knowledge attitudes and practice*

Introduction

Good oral health practices from birth can reduce dental caries in childhood and influence adult health, lessening the burden on health services (Gussy *et al*., 2008; Herman, 1995; Mattila *et al*., 1998). Strategies targeting parents of infants from birth have found new mothers particularly receptive to advice on infant oral healthcare before and just after delivery (Herman, 1995; Ramos-Gomes *et al*., 2002). However, parental knowledge of oral disease risk factors and the preventive actions they implement are limited and often at odds with the evidence (Mattila *et al*., 1998; Pereira *et al*., 2004).

Caries in the deciduous dentition is a predictor of caries in the permanent dentition (Douglass *et al*., 2001; Mattila *et al*., 1998; Watson *et al*., 1999). Babies are born without the main microbial agent of dental caries (mutans streptococci) and mothers are considered as the main source of transmission of these (Li *et al*., 1995; Masuda *et al*., 1985; Thorild *et al*., 2002). In addition, dentally harmful behaviours are often well-established by the time a child first visits a dental clinic, and can be difficult to correct (Bowsher, 1997; Douglass *et al*., 2001; Wendt *et al*., 1996).

Four key messages critical to oral health are: reduced frequency of sugar consumption and good nutrition; good oral hygiene; appropriate use of fluorides and regular dental care (Pine and Harris, 2007; Queensland Health, 2006; Ramos-Gomes *et al*., 2002). These require knowledge of when toothbrushing and dental visits should commence, how oral bacteria are transferred, healthy feeding practices including use of comforters, and fluoride use.

Strategies such as visits to birthing units by oral health professionals, distribution of oral health information, toothbrush and toothpaste had been previously used in Queensland hospitals although the practice had not been evaluated. Research had shown health education videos to be an inexpensive strategy for increasing pregnant women's breastfeeding knowledge with a positive impact on subsequent breastfeeding behaviours (Susin *et al*., 1999). Birthing units and midwives have been shown to make significant contributions to promoting oral health and were therefore seen as a appropriate delivery channels for this study (Bowsher, Hunter, *et al*., 1996).

Redlands Women and Birthing Unit, in Queensland, Australia, operates a free maternity service: this is in an outer-urban/semi-rural area of the State capital, Brisbane. The service has up to 100 births per month, but no dental health education was provided prior to this project. Although Queensland legislated to introduce water fluoridation in 2007, and this commenced in 2009, the water supply was not fluoridated during this study period.

This study aimed to test whether oral health education improves knowledge and changes behaviour intentions with respect to: oral health practices; transfer of cariogenic microflora from mother to child; use of comforter and/or prolonged use of feeding bottle; fluoride recommendations and diet.

Methods

In this quasi-experimental, longitudinal (pre-post) design study with ethics approval from Bayside Health Service District, mothers' participation was invited during

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scheduled visits to the clinic at ~30 weeks gestation. The nature of the interventions and the limited staffing in this busy clinic precluded dedicating resources to fully-randomised allocation schedule. Instead, all eligible mothers were consecutively approached over an extended period from 2001 to 2006, with recruitment to the Usual Care group and each of three experimental groups occurring sequentially until the projected group sample size of 170 each was achieved.

Post-intervention questionnaires were mailed to consenting participants when their baby was ~20 weeks of age; these collected current knowledge, attitude and parenting practices with respect to oral health.

A control group received 'Usual Care', with no information within the birthing unit or take-home resources related to oral health issues for mother or infant. The 'Video' intervention consisted of a nine-minute "Healthy Teeth for Life" video (Queensland Health, 2001), loaned to mothers to view at the clinic, or at home; a DVD format (production cost ~AUD $1.20 each) was introduced in 2004 and these were given to mothers with DVD players to take home. Loans continued to be available for mothers without DVD players. There was no process to check if the video or DVD were actually viewed at home. The 'Bag' intervention consisted of a free "Oral Health for your Infant" pack for mothers to take home (~AUD $1.70 each): these contained an adult toothbrush and toothpaste (for the mother), a Colgate "Zero to Six" oral health pamphlet, a Johnson & Johnson "Teeth & teething" pamphlet and a fridge magnet with details of local oral health services. A third intervention group, 'Combination', were offered both of these resources.

Socio demographic data collected at baseline were: (i) mother's age, ethnicity, main language spoken at home, educational attainment, employment status, health care card holder status (*viz* eligibility for free health care from the State Government); (ii) child's age, hospital of birth, birth order in family; (iii) family composition and marital status of mother. Multiple variables collected pre- and post-intervention covered oral health practices of mothers (mother's brushing frequency, time since mother's last dental visit), baby feeding behaviour (breastfeeding at 20 weeks, mother's opinion on whether baby should sleep with a bottle, what they would dip baby's dummy [pacifier] into), baby dental care (when parent will commence teeth cleaning for baby, when parent will take baby to first dental visit) and belief about how oral bacteria are transmitted.

As trial interventions were not randomised, characteristics of participants across the four groups were considered in detail. Any substantial imbalances at baseline across the groups were identified as potential confounders and bivariate analyses of post-intervention results extended to adjust for these. Outcomes were summarised as percentages, and compared statistically across the intervention groups using (i) Likelihood Ratio Chi-Squared tests at the bivariate (unadjusted) level, and (ii) in multivariable logistic regression models that incorporated any identified confounding variables, thus producing adjusted estimates. Odds ratios of 1.5 or higher, or equivalently, 0.7 or lower, were considered to be effect sizes of public health interest. As such, and to inform future larger studies, irrespective of whether or not they attained statistical significance, they are reported here as contextually significant, with their corresponding 95% confidence intervals. Group differences are reported as statistically significant at the conventional $p<0.05$ level (two-tailed).

Results

Overall, 691 mothers were approached; 679 provided data either pre- or post-intervention. Consent status of 68 could not be confirmed and these were excluded from analyses due to ethical conflict. Post-intervention follow-up was completed for 376 (62%). Numbers in the four groups remained similar throughout. Participants mean age was 28.0 years (sd 5.0) and nearly half (42%) were first-time mothers; parity ranged from 1-9.

Almost one third (30%) of participants were holders of a current health care card; 8% were single parents at baseline. The birth order of the child included was first 43%, 31% second and 14% third. Only 3% of mothers indicated that their highest completed level of education was less than Year 10 (compulsory high school). About one-fifth (21%) had completed Year 10, and 34% had completed year 12. Technical and Further Education had been completed by 24%, and 17% had completed University. Compared to the general Redlands population, study participants were more highly-educated and less likely to be single parents (Australian Bureau of Statistics, 2001). The majority (81%) of participants reported their ethnicity as Australian, the remaining were too few and diverse to analyse separately.

Imbalances across groups at baseline were identified in age, education level, card-holder and employment status, in mother's opinion on baby sleeping with a bottle, the age at which the mother first intended to bring baby to a dental visit and mother's knowledge about acquisition of oral bacteria. These were adjusted for in multivariable modelling analyses.

Regarding attrition bias, mothers completing the post-study questionnaire (376) were more likely to be older ($p<0.001$), have a higher level of education ($p=0.001$), be currently employed ($p=0.001$) and less likely to have a health care card ($p=0.008$). They were also more likely to: have visited the dentist in the last year ($p=0.070$); intended to breastfeed only ($p=0.047$) and to strongly disagree with letting baby sleep with the bottle ($p=0.005$) .

Mother's brushing frequency was collapsed into unhealthy (brushing 0-1 times per day) and healthy (2 or more/d). The proportion of mothers brushing two or more times/d at pre-intervention (80%) was similar to post-intervention (78%). The percentages of mothers brushing twice or more per day were similar across the groups: the Usual Care and Video intervention groups, at 76% and 73% respectively, and in the 'Bag' group and in the Combination group (81% and 82% respectively) (Table 1). These differences did not attain statistical significance ($p=0.359$).

Since recommendations on the frequency of dental visits are now related to individual risk, time since last seeing a dentist was collapsed into unhealthy (more than a year or never) and healthy (up to a year ago) as per traditional recommendations (National Collaborating Centre for Acute Care 2004; Woolfolk *et al*., 1999).

Table 1. Impact of Intervention: Post-intervention dental practices of the mother

	Usual Care	*Video*	*Bag*	*Combination*	*p*
Number of respondents*	106	89	92	89	
Mother's brushing frequency (%)					
None or once / day	24.5	27.3	18.7	18.0	
Twice / day	68.9	69.3	72.5	77.5	
More than twice / day	6.6	3.4	8.8	4.5	
Correct (healthy) response (%)	75.5	72.7	81.3	82.0	0.359
Unadjusted odds ratio (95% CI)	1.00	0.87 (0.46-1.65)	1.42 (0.71-2.82)	1.48 (0.74-2.98)	
Adjusted odds ratio (95% CI)**	1.00	0.88 (0.44-1.75)	1.89 (0.66-2.94)	1.41 (0.66-3.02)	0.537
Time since mother's last dental visit (%)					
Within the last year	38.7	46.1	36.3	32.6	
1 – 2 years	29.2	19.1	20.9	27.0	
More than 2 years/ never	32.1	34.8	42.9	40.4	
Correct (healthy) response (%)	38.7	46.1	36.3	32.6	0.303
Unadjusted odds ratio (95% CI)	1.00	1.35 (0.76-2.40)	0.90 (0.50-1.61)	0.77 (0.42-1.38)	
Adjusted odds ratio (95% CI)**	1.00	1.28 (0.70-2.32)	0.82 (0.44-1.52)	0.65 (0.34-1.22)	0.214

* maximum number, missing data were minimal and excluded in calculations, as were 'not applicable' responses
** adjusted for mother's age-group, mother's highest level of education, holder status of a Health Care Card, employment status, pre-intervention attitude to infant sleeping with bottle, and pre-intervention that source of oral bacteria in infant is via others' mouth contact.

Table 2. Impact of Intervention: Post-intervention bottle and dummy use

	Usual Care	*Video*	*Bag*	*Combination*	*p*
Number of respondents*	105	87	92	89	
Opinion on whether baby should sleep with bottle (%)					
Strongly agree	2.8	0.0	0.0	1.1	0.367
Agree	3.8	0.0	3.3	2.2	
Unsure	5.7	10.2	7.8	7.9	
Disagree	19.8	21.6	23.3	19.1	
Strongly disagree	67.9	68.2	65.6	69.7	
Correct (healthiest) response (%)	87.7	89.8	89.1	88.8	0.977
Unadjusted odds ratio (95% CI)	1.00	1.23 (0.50-3.02)	1.12 (0.46-2.69)	1.10 (0.46-2.66)	
Adjusted odds ratio (95% CI)**	1.00	1.62 (0.52-5.10)	1.03 (0.34-3.07)	1.04 (0.33-3.26)	0.835
In what would they dip baby's dummy?					
Only healthy response(s) (%)	92.3	94.4	91.0	91.0	0.805
Unadjusted odds ratio (95% CI)	1.00	1.40 (0.44-4.44)	0.84 (0.30-2.35)	0.84 (0.30-2.35)	
Adjusted odds ratio (95% CI)**	1.00	1.78 (0.50-6.13)	0.79 (0.26-2.35)	0.82 (0.26-2.53)	0.611

* maximum number, missing data were minimal and excluded in calculating percentages, as were 'not applicable' responses
** adjusted for mother's age-group, mother's highest level of education, holder status of a Health Care Card, employment status, pre-intervention attitude to infant sleeping with bottle, and pre-intervention knowledge that source of oral bacteria in infant is via others' mouth contact.

As with frequency of brushing by mothers, the interval between dental visits did not change substantially from pre-intervention levels; remaining ~40% overall.

A total of 371 mothers completed baby feeding behaviour data both pre- and post-study. At baseline, 80% said they intended to breastfeed, 13% would breast and bottle feed and 6% intended bottle only. Of 22 women who at baseline intended to bottle-feed, only one went on to breastfeed and did so until at least 24 weeks.

Over time, increasing proportions of mothers introduced bottle feeding and similar patterns of reverting to bottle or combined feeding were seen in all groups. While adjusted analysis confirmed that lower percentages of women were breastfeeding in all of the intervention groups compared to the Usual Care group this was not significant (p=0.730).

Similarly high proportions (>88%) of mothers across all four groups disagreed with infants being permitted to

sleep with a bottle; higher than the 77% who disagreed at baseline. Adjusted analyses showed (Table 2) similar odds ratios of correct responses across the groups (p=0.977).

At post-intervention, high proportions (>91%) of mothers across all four groups indicated the correct (healthy) response at post-intervention to the question about substances in which it might be appropriate to dip dummies. This was elevated from the ~40% overall from pre-intervention response levels. On adjustment for confounders, there were no significant differences across the groups.

More mothers in the Video group were aware that baby's tooth cleaning should commence once any teeth have erupted. Table 3 shows that adjustment for confounding variables did not alter the conclusion. Relative to mothers in the Usual Care group, the odds of mother's commencing cleaning on tooth eruption in the Video group was 3-fold (95%CI 1.1-7.5).

Healthy practice with respect to taking their infant for a first dental check was defined as doing so within the first two years. More mothers in all three intervention groups indicated that they would take their infant to first dental check in this period than did mothers in Usual Care group. In particular, relative to mothers in the Usual Care group, the odds ratio of mothers' awareness in the Video group was 3.6 (CI 1.4-9.2) and 2.8 in mothers in the Bag group (CI 1.1-6.9) (p=0.023). Whilst this might also be true for mothers in the Combination intervention, the data were not as convincing due to wide confidence intervals.

Table 4 shows all interventions improved mothers' knowledge about transmission of oral bacteria markedly, compared to the Usual Care group (p=0.025). The single response of "from other people's mouths" was separated from all other responses; "from the environment", "born with it", "from food", "don't know" or other or any combination of responses. This was to identify specifically if the key message of person-to-person transmission, as presented in the video, was taken up by intervention participants.

Similar conclusions may be made about mothers' knowledge of appropriate drinks for infant bottles (p<0.001), and about their knowledge of suitable strategies to help keep infant teeth healthy (p=0.023). All three interventions were effective. The reasonably narrow confidence intervals support confidence in these results. The Video intervention showed the most consistent impact on mothers' dental knowledge.

Post intervention, 69-76% of mothers could recall exposure to the intervention resources. Contamination across groups appears low with only six participants recalling an exposure to which they should not have been exposed.

The majority of mothers (86%) felt the timing of the distribution of resources (pre-birth) was satisfactory. Provision of such information at this time was considered appropriate "especially for first time mums and women without close family support" and "this does not seem to be an area covered anywhere else" and "some women or families will not seek the information once they leave the hospital". Mothers also noted that there was "not much information or contact with appropriate authorities thereafter" however many also "suggest[ed] some follow-up" or reminder at a later stage would be beneficial.

Mothers who did not feel the timing of the intervention was appropriate indicated this was because "you're receiving so much new info[rmation] when your child is born, it's hard to remember". Suggestions for better targeting were "Give specific info closer to the time eg. when teeth start coming through" or "Maybe at 3-4 months when things have settled down" or "maybe information can be sent to new parents around 3 months" or "Better shown or given information about new teeth (when their child was) about 6 months of age". One mother noted that although "it's not needed at the time, … I did eventually read all the info I received".

Discussion and Conclusions

All interventions had a positive impact on mothers' perception of allowing baby to sleep with a bottle, as well as knowledge of when to commence brushing baby's teeth; take baby for first dental visit; how oral bacteria are transferred; appropriate drinks to add to the infant bottle and how to keep teeth healthy.

The bag and combination intervention appeared to have a positive impact on mother's brushing and a negative impact on their dental visit practices although these differences were insignificant.

The "Healthy Teeth for Life" DVD/Video provided the strongest and most consistent positive impact on mother's knowledge of baby dental care and general dental knowledge. This intervention may have had a slight negative impact on mother's brushing and positive impact on their dental visit practices: the opposite impact seen in the bag and combination intervention groups. Mothers "found the video very helpful" and "very informative" and thought that it was useful to "continue to provide the video via the antenatal clinic".

Socio-demographic imbalances and dental variable imbalances were identified between groups at baseline and adjusted for in final analyses. However, there may remain residual confounding as measurement of some confounders was at gross categorical level and there was potential for other unidentified confounding biases due to the non-random allocation of participants to intervention groups. We attempted to minimise the latter by approaching consecutive series over long recruitment periods that would result in cohorts with similar characteristics in each intervention group. Due to substantial attrition over time, and of particular subgroups, we consider that the impact of interventions is generalisable only to women with characteristics of the study completers, rather than to all mothers coming through the Redlands Women and Birthing Unit. This restriction does not negate the public health importance of the study results, as they are still relevant for a substantial cross-section of the population.

We found mothers' intention to provide appropriate baby dental care varies substantially, younger (<20) and older (35 and over) mothers being the least likely to clean baby's teeth on eruption or to take them for their first dental visit by one year of age. Young and single parent mothers also reported less healthy behaviour intentions or knowledge of healthy choices, while unemployed or health care card holders reported less likelihood to take healthy actions, possibly due to financial barriers such as paying for a dental appointment.

Table 3. Impact of Intervention: Post-intervention baby dental care.

	Usual Care	*Video*	*Bag*	*Combination*	*p*
Number of respondents*	106	88	92	89	
When will commence teeth cleaning (%)					
When child is old enough	6.6	2.3	2.2	1.1	0.067
Don't know	2.8	0.0	4.4	4.5	
Once teeth erupt	81.1	92.0	84.6	79.8	
Once solids introduced	2.8	4.5	5.5	11.2	
When teeth are dirty	0.9	0.0	0.0	0.0	
Other	5.7	1.1	3.3	3.4	
Correct (healthiest) response (%)	81.1	92.0	84.6	79.8	0.079
Unadjusted odds ratio (95% CI)	1.00	2.69 (1.08-6.70)	1.28 (0.60-2.70)	0.92 (0.45-1.87)	
Adjusted odds ratio (95% CI)**	1.00	2.91 (1.14-7.45)	1.28 (0.57-2.84)	1.04 (0.47-2.30)	0.079
When to take baby to first dental visit (%)					
In the first year	7.8	17.0	13.3	10.2	**0.036**
In the second year	41.2	51.1	41.1	50.0	
In the third year	27.5	22.7	36.7	27.3	
When they are 4 or older	23.5	9.1	8.9	12.5	
Correct (healthiest) response (%)	76.5	90.9	91.1	87.5	**0.012**
Unadjusted odds ratio (95% CI)	1.00	3.08 (1.30-7.26)	3.15 (1.34-7.44)	2.15 (0.99-4.70)	
Adjusted odds ratio (95% CI)**	1.00	3.57 (1.38-9.20)	2.77 (1.10-6.95)	2.10 (0.87-5.08)	**0.023**

* maximum number, missing data were minimal and excluded in calculating percentages, as were 'not applicable' responses
** adjusted for mother's age-group, mother's highest level of education, holder status of a Health Care Card, employment status, pre-intervention attitude to infant sleeping with bottle, and pre-intervention knowledge that source of oral bacteria in infant is via others' mouth contact.

Table 4. Impact of Intervention: Post-intervention mother's dental knowledge.

	Usual Care	*Video*	*Bag*	*Combination*	*p*
Number of respondents*	106	89	92	89	
Belief about how oral bacteria are transmitted (%)					
Correct response only (%)	3.8	15.9	7.8	11.4	**0.025**
Unadjusted odds ratio (95% CI)	1.00	4.8 (1.5-15.2)	2.2 (0.6-7.6)	3.3 (1.0-10.8)	
Adjusted odds ratio (95% CI)**	1.00	5.1 (1.3-20.2)	3.9 (0.9-17.6)	4.2 (0.9-19.0)	0.140
Knowledge about appropriate drinks to add to infant bottle (%)					
Correct response only (%)	49.1	71.9	76.7	82.0	**<0.001**
Unadjusted odds ratio (95% CI)	1.00	2.7 (1.5-4.8)	3.4 (1.8-6.3)	4.7 (2.4-9.2)	
Adjusted odds ratio (95% CI)**	1.00	3.1 (1.6-5.8)	3.7 (1.9-7.3)	5.5 (2.7-11.3)	**<0.001**
Knowledge about strategies that help to keep infant teeth healthy (%)					
Correct response only (%)	83.0	94.4	91.1	90.9	0.066
Unadjusted odds ratio (95% CI)	1.00	3.4 (1.2-9.7)	2.1 (0.9-5.1)	2.0 (0.8-5.0)	
Adjusted odds ratio (95% CI)**	1.00	4.7 (1.4-15.6)	2.1 (0.8-5.7)	3.8 (1.3-11.4)	**0.023**

* maximum number, missing data were minimal and excluded in calculating percentages, as were 'not applicable' responses
** adjusted for mother's age-group, mother's highest level of education, holder status of a Health Care Card, employment status, pre-intervention attitude to infant sleeping with bottle, and pre-intervention knowledge that source of oral bacteria in infant is via others' mouth contact.

Overall, mothers supported receiving oral health information at the antenatal clinic; however, mothers also thought it would be helpful for them to receive this information when baby teeth commenced eruption, at age ~6 months.

Potential limitations include contamination of participants' knowledge of oral health issues given the long period over which the study was conducted and possible repeat exposure of mothers to information about the study. While the video was lent, the DVD was given to mothers to keep, although there was no way to confirm that parents actually viewed the information from either source. There is also no way to assess if mothers viewed the DVD more than once, such as when baby's teeth were erupting or when they completed the post questionnaire. There was no capacity in the data collected to separate the two formats for comparison.

Overall, our study confirms that the Healthy Teeth for Life DVD or video had the greater impact on parental oral health knowledge and behaviour intentions. Given its low cost, mothers should be given the opportunity to see this type of video presentation during ante-natal care and further investigation should be undertaken of the free distribution of such resources to new mothers, including use by fathers and other family members. Strategies to provide this type of resource at 4-6 months post-birth should also be investigated.

Acknowledgements

Special thanks to the project team; Redlands Women's and Birthing Unit staff; all mothers; Bayside Health Service District Oral Health Team and Queensland Health for funding.

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