

**Response to Tinanoff and Palmer:  
Dietary Determinants of Dental Caries and Dietary  
Recommendations for Preschool Children**

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Sugar, notably sucrose, is the undisputed dietary etiological agent of caries. What remains less apparent is the form and method of consumption that places a preschool child at increased risk of developing early childhood caries (ECC). As suggested in Tinanoff and Palmer, the traditional cause of ECC, inappropriate use of the baby bottle, can no longer be considered to be the sole etiology. When reviewing papers that examine the relationship between bedtime bottle use and ECC, only half show a significant relationship (1). However, to eliminate the baby bottle as a cause, or at least a risk marker, for early childhood caries would be premature. In fact, very little is known about the behaviors associated with bottle use that might make it a significant etiological factor. Most studies have only asked the question "did your child ever go to bed with the bottle?". Few studies have investigated related behaviors, such as whether the child quickly finishes the bottle, or whether the child uses the bottle ad lib during the day or what foodstuff is in the bottle.

In a detailed survey carried out in Britain, it was found that the caries prevalence was twice as high if sweetened beverages were consumed in bed at night rather than plain milk (2). Increased caries incidence with bottle contents other than plain milk has also been documented by others (3,4, 5). Wendt and Birkhed (6) found caries was more likely if a sugar containing liquid was placed in the bottle at any time, day or night. However, some studies have found no association between bottle content and caries (7,8,9).

The method of bedtime bottle use also has been found to influence caries risk. If the bottle is removed after feeding, no increased caries risk is noted. However, if the bottle remains in the bed, the child is at greater risk of developing ECC compared to those children who had no nighttime bottle (10). Other studies have shown that behaviors such as falling asleep with the bottle, being propped with a bottle, using the bottle during sleep, having the bottle nipple in the mouth during the night or having constant access to the bottle both night and day were more common in children with ECC than without (7,11,12,13,14). Although some of these findings are not supported by statistical analysis, the trends suggest that the bottle still needs to be considered as a risk factor. Clearly, further information is required to determine the bottle's role in ECC development, particularly concerning content and method of use. If nothing else, bottle use may serve as a marker for other poor dietary habits. Parents who exhibit permissive use of a baby bottle, or who use the baby bottle as a method to solve childhood behavioral problems, may extend this behavior to the use of other foods.

If bottle use is not the only etiological agent for ECC, then what are the specific dietary habits in preschool children that could be linked to caries risk? The answer to this question remains elusive. Studies linking specific dietary factors to caries risk in preschool

children are limited, possibly because most attention in the past has been centered on bottle use, or possibly because obtaining accurate dietary information for preschool children is difficult. The few studies examining the diet of preschool children do link frequent sucrose consumption with dental caries (5,6,15,16,17). However, in these and other studies of preschool children, it has been found that frequency of tooth brushing with fluoridated toothpaste is often more strongly related to caries experience than dietary factors (5,18,16,19,20,21). In fact, some authors have suggested that changing oral hygiene measures may be a more effective prevention strategy for ECC than attempting to modify diet (16).

Some studies have attempted to define which high-risk sucrose habits are most likely to be linked to caries risk in preschool children. Wendt et al. (18) found that consumption of sugar containing drinks was predictive of caries active preschool children. Grindefjord et al. (19) found that the presence of caries in children prior to the age of 2.5 years was associated with candy consumption, while the development of caries between 2.5 and 3.5 years was associated with candy consumption and consumption of sugar-containing drinks. Wendt and Birkhed (6) found that consumption of a variety of sugar containing products, such as soft drinks, candy, ice cream, and biscuits were all individually associated with increased caries risk. Gibson and Williams (16) found that among children who brushed their teeth once a day or less, both the total quantity and the frequency of candy consumed was positively associated with caries prevalence, but the intake of other sugar-containing foods or drinks was not. Thus, the majority of studies suggest that sugar containing drinks and candy are the main etiological factors for dental caries. Of course, it cannot be ruled out that frequent consumption of such sugar containing foods and drinks is simply a marker for other dietary agents that don't achieve significance in studies due to limitations in study design or other confounding factors.

The development of high-risk dietary practices appear to be established at a very young age, probably by 12 months of age; and such practices are maintained throughout early childhood (6, 15,18,19,22,23). Attempts to characterize families with high caries risk dietary behaviors have often been unsuccessful (24), although individuals from lower social classes often are associated with increased consumption of sugar containing foods (15,16). Also, mother's sugar consumption has been significantly associated with the child's sugar habits (25).

The relationship between dietary factors and caries development is clearly logical. The lack of consistent findings is probably due to the multi-factorial nature of the carious process as well as the difficulty of assessing diet. Several methods of dietary evaluation are

currently utilized: one or seven day diet histories; short answer questions investigating food frequencies; complex diet histories administered by training nutritionists; and direct observation by a trained recorder. Accurate and detailed information of the type necessary to identify cariogenic dietary agents at the individual level is only achieved by complex diet histories or direct observation (26,27). Both methods are expensive and time consuming. In addition, obtaining diet information for preschool children presents some unique problems. Infant and toddler diets undergo rapid changes as children are weaned to pureed food, to finger food, to solid food and then to self-feeding (26). Such problems are compounded by toddlers' finicky eating habits in addition to their frequent habit of preferring one food in one month and another food, the next. Furthermore, many children are cared for by multiple adults at day care centers, babysitters and later Head Start and preschool programs, thereby compounding the problem of obtaining accurate dietary information.

An additional factor affecting United States populations is that practically all the dietary studies performed on preschool children have been completed outside the United States. The cultural variation in dietary habits that can occur between countries and between different racial-ethnic groupings within countries makes extrapolation of this dietary information to United States children difficult. Therefore United States information regarding which dietary behaviors need to be established in order to subsequent the target risk assessment and prevention programs.

The dietary recommendations provided by Tinanoff and Palmer are based on decreasing frequent consumption of sugar. As such, in the absence of further scientific evidence regarding the exact dietary factors at play in children, these recommendations provide sensible information for parents to develop a dentally healthy diet for their child. However, it remains to be answered who will transmit this information to parents. Currently dental professionals are not in a position to provide this information. Most children do not see a dentist until the age of three years, if at all (28). By this time, cariogenic diets are well established, difficult to change, and the carious process is already underway. Therefore, non-dental professionals need to have this responsibility. In particular, prenatal educators, pediatricians, family physicians, nurse practitioners and WIC nutritionists are well placed to have frequent contact with parents and their children at this critical time of dietary development.

Access to well timed dietary counseling is only part of the solution. It remains to be seen whether dietary behaviors can be successfully modified to decrease caries risk. As Tinanoff and Palmer discussed, only a few studies have been published on this topic. Although most are encouraging, caution must be exercised in instituting caries preventive

programs based on this limited data. Currently most health professionals have focused on merely providing dietary information. Although such information is valuable, it only addresses one of the several necessary psychological stages involved in behavior change. The stages in behavior change begin with pre-contemplation, when there no intention exists to change behavior. This stage may be due to a lack of awareness of the health issues involved, denial or simply an unwillingness to change. Next, there is a contemplative stage, which may exist for a prolonged period. In this stage, change is considered, as well as there is awareness of the reasons for change. Providing information facilitates the progression from pre-contemplative to the contemplative stage. The next stage involves initial steps to change, followed by action in which behavior is actually modified. Lastly, there is maintenance to prevent relapse and consolidate the changes into daily life (29). Consideration of these stages, the desired behavioral aim must be present when designing any dietary intervention.

In summary, ECC is a highly prevalent and disabling disease, and now finally is starting to receive the attention and research that it deserves. However, we find ourselves in a position where there are more questions than answers regarding its etiology and prevention. The questions currently before us regarding early childhood caries and diet are:

- Do we have a full understanding of which dietary behaviors are placing children at risk?
- Can we minimize the dietary changes needed to allow for better acceptance?
- Can we determine if such changes will effectively alter caries risk?
- Can we identify those children requiring dietary modification?
- Are we able to provide the necessary access to proposed preventive programs?
- Can we present the information in a way that facilitates and maintains behavior change?

It is clear that we are only just starting to assemble the information necessary to answer these questions. Frequent sucrose consumption is clearly an important key in the etiology of ECC, yet the specific behaviors and their accompanying risk factors continue to be elusive. Further research will be required before effective dietary-based caries prevention programs can be implemented.

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