comparison with the 9- to 10-yr old group, who would be ages 12 to 13 yr at the end of the study.

The results from the Thailand study showed that the fluoridated xylitol and sorbitol gum group had lower decayed, missing, and filled teeth (DMFT) and DMFS scores than either the fluoride rinse group or the fluoridated sucrose gum group. Results from the French Polynesia study showed that the subjects started with much higher DMFT and DMFS mean scores initially than the subjects in Thailand. Although the results with the fluoride gum sweetened with the sugar alcohols were better than any of the other treatments, the overall caries incidence in this population is very high. The presence of fluoride in the chewing gums confounds the results of the sugar alcohols. The authors describe this study population as a community experiencing an increase in the prevalence of the disease. This study group does not reflect the general population of the United States.

In another WHO field trial, Kandelman and coworkers (Ref. 30) evaluated the effects of xylitol intervention on dental caries in French Polynesian children, ages 7 to 12 yr. Of 746 subjects enrolled in this 32-mo study, 468 completed the study. Subjects in the xylitol groups consumed 20 g of xylitol daily in various food products, such as chewing gum, hard candy, chocolate, and gumdrops. The control group received no xylitol-containing products.

The results showed significantly reduced caries increment rate by 37 percent to 39 percent in the xylitol groups compared to the controls. This study was neither randomized nor blinded. Results support the observation that xylitol-containing products are less cariogenic than the sucrose-containing products.

Frostell and coworkers (Ref. 31) determined the effect on caries increment in children, ages from 2½ to 4 yr, of substituting HSH for sucrose in candy. During this 1½- to 2½-yr study, subjects in the test group consumed candies made with HSH and chewing gum made with sorbitol. The control group consumed sucrose candies and gum. Investigators monitored the intake of candies by use of coupons which the parents used at local stores to buy the candy. An analysis of the coupons used showed that parents of the children in the test group used a smaller number of coupons than the parents of the children in the control group. Based on inquiries, the investigators discovered that the parents of the subjects in the HSH group had also given the children other candy in addition to HSH candy. The consumption of HSH candy was reported from 50 to 75 percent of the total candy consumption.

The results showed no significant differences in caries scores after 1½ to 2½ yr with HSH candy consumption compared to sucrose candy consumption. When investigators analyzed the data of those children whose parents consumed the correct candy for their group, the differences in caries increment between the groups were still not significant but showed a trend towards a lower incidence of caries in the HSH group. The results of this study were confounded by poor compliance, inter-examiner variability, lack of blinding, and inconsistent results and do not support significant dental benefits from the use of HSH.

Glass (Ref. 32) evaluated the cariogenicity of sorbitol chewing gum with regular use by children, ages 7 to 11 yr old, living in a nonfluoride area. In this 2-yr study subjects were randomly assigned to either a no-chewing group (control) or to the one which chewed gum twice daily. Subjects in the gum group were provided two sticks of gum daily for use at school and four sticks of gum for use at home when school was not in session.

The results showed that over the 2-yr study period, mean caries increments were 4.6 new decayed and filled (DF) surfaces for the sorbitol gum group (n=269) and 4.7 new DF surfaces for the no-gum group (n=271). The difference between the groups was not statistically significant. Although the results of this study suggest that adding sorbitol-containing gum to the diet did not result in any additional dental caries, the effect of chewing gum per se on the incidence of dental caries was not considered.

4. Summary of Evidence Relating Sugar Alcohol and Dental Caries: Short-Term Studies

Ikeda et al. (Ref. 33) evaluated the cariogenicity of maltitol and a polysaccharide alcohol using an intraoral cariogenicity test (ICT) and rat tests. Most of the details of the methods used in the ICT were not provided, making the results difficult to interpret. Bovine enamel fragments were extraorally dipped in 3-percent solutions of sucrose (control), maltitol, or the polysaccharide alcohol for 1 min every day. After 1 wk, hardness was measured. The higher the value for hardness means a softer enamel and a greater loss of enamel.

The results showed a decalcification score for maltitol of 1.66 compared to a score of 2.70 for sucrose. These differences were significant. In the animal study, one group was provided a feed with 26-percent maltitol and 30-percent starch, a second group was provided a feed with sucrose instead of maltitol, and a third group consumed a diet without sucrose. Results showed a caries score of 45.8 for the sucrose group, 3.2 for the maltitol group, and 5.2 for the no-sucrose group. Differences between the sucrose group and the other groups were statistically significant.

Yagi (Ref. 34) evaluated the effects of maltitol on changes in enamel hardness. Enamel decalcification was measured using an ICT with a denture containing two bovine enamel slabs. Four subjects wore the dentures for 7 days. Each day, one enamel slab was exposed to a 3-percent maltitol solution and the other to a 3-percent sucrose solution. Enamel hardness was measured at the end of the wk.

The results showed that the average change in hardness compared to pretreatment levels for the enamel in maltitol was 1.47 micrometers compared to 3.35 micrometers for the enamel in sucrose. Differences between the two measurements were significant. The authors noted that there were considerable differences in individual responses to sucrose and maltitol. They attributed these differences to the oral environment (e.g., plaque bacteria and quality and quantity of saliva). However, general observations were that sucrose causes significant loss of enamel, as evidenced by changes in enamel hardness, compared to the effect of maltitol on tooth enamel.

Leach et al. (Ref. 35) evaluated in situ the effect on remineralization of artificial caries-like lesions in human enamel with sorbitol. Ten adult subjects wore cast bands containing enamel on one lower first molar tooth for two 3-wk periods during which they continued to use normal oral hygiene procedures. Artificial caries lesions were made in each enamel slab and covered with gauze to encourage the formation and accumulation of plaque on the enamel surface. Subjects were given snack foods (chocolate bar, raisins, cream-filled wafers, and cream-filled, iced cupcake) and instructed to consume one each morning and afternoon between meals. During the first experimental period, subjects chewed, for 20 min each, five sticks per day of commercial sugarless gum after meals and snacks. The gum was sweetened primarily with sorbitol and small amounts of mannitol, HGS, and aspartame. During the second experimental period, snacks were consumed but without chewing gum (control).