

Pediatrician-recommended use of sports drinks and dental caries in 3-year-old children

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Objectives: To determine whether children advised by a pediatrician to take sports drinks consume them more frequently than do other children and whether these children have an increased risk of dental caries. **Methods:** The subjects were 522 mother/child pairs who attended a dental checkup for 3-year-olds at one of ten community health centers in Nagasaki, Japan. Pearson's chi-square test was used to compare the prevalence of children with or without dental caries according to child-related variables. Multiple logistic regression was performed to assess the relationship between the presence of dental caries and child-related variables taken from a dental checkup and a questionnaire. **Results:** A high frequency of sports drink consumption was strongly associated with dental caries in children. The highest proportion of mothers answered that they were advised by a pediatrician to give sports drinks to their children. However, these children consumed sports drinks significantly less frequently than did children who did so for reasons other than pediatrician recommendations. In addition, these children were significantly less likely to have dental caries than were children who consumed sports drinks for other reasons. **Conclusions:** Pediatrician-recommended consumption of sports drinks does not lead to more frequent consumption of these beverages or to dental caries in 3-year-old children.

Keywords: Beverages, dental caries, preschool children

Introduction

Dental caries is the most common chronic disease of childhood (Selwitz *et al.*, 2007). Contemporary fluid consumption patterns in children are now more diverse than in the past, because the intake of soft drinks has increased, whereas the consumption of water and milk has declined (Harnack *et al.*, 1999; Heller *et al.*, 1999; Shenkin *et al.*, 2003). The replacement of milk with sweetened beverages has increased the risk of caries in young children (Marshall *et al.*, 2003) because fermentation of carbohydrates by oral bacteria produces acid, which dissolves dental enamel. Furthermore, the consumption of acidic drinks, such as fruit juices and carbonated beverages, contributes significantly to the potential for dental erosion (Luo *et al.*, 2005; Sohn *et al.*, 2006), which is the chemical dissolution of the dental hard tissues without bacterial involvement.

Sports drinks generally have a low pH and contain sugars to provide energy (typically about 6–7% in the form of mixtures of glucose, short chain glucose polymers, and sucrose) and electrolytes to replace those lost through sweating. Therefore, sports drinks may contribute to both erosive and cariogenic processes (Hooper *et al.*, 2004). Sports drinks have a pH below 5.5, which is thought to be the critical point in enamel decalcification; thus, consumers should be aware of the potential risk of these popular drinks to induce dental caries (Hooper, 2004). In Japan, sports drinks are among the most popular beverages,

particularly for preschool children. Indeed, a previous study found that frequent consumption of sports drinks was strongly associated with dental caries in 1.5- and 3-year-old Japanese children (Mitoh, 2006). In addition, many pediatricians routinely advise parents to give their children sports drinks as an oral rehydration therapy to enhance intestinal sodium and water absorption during bouts of mild dehydration, diarrhea, or fever.

Children given sports drinks on the advice of their pediatrician may consume these beverages more frequently than do other children, because their parents are under the impression that sports drinks are healthy. If so, this medical advice may lead to dental caries. We examined whether children advised by pediatricians to take sports drinks consumed them more frequently than did other children and whether they had an increased risk of dental caries.

Subjects and Methods

All municipal governments in Japan administer an oral health examination of 3-year-old children as a requirement of the Law of Child and Maternal Health. Free health checkups, including dental examinations, are available for all children at the health centre located in their district of residence. The national average attendance rate for checkups at 3 years of age was 87.5% in 2005 (Dental Health Division of Health Policy Bureau, Ministry of Health, Labor, and Welfare, 2005).

This study was carried out from December 2005 to March 2006 as part of the Study on the Dental Health of Nagasaki Preschool Children and their Mothers. The subjects were children who attended a dental checkup for 3-year-olds at one of ten community health centers provided by the municipal government in Nagasaki, Japan.

Each municipal government used records of registered inhabitants to identify mothers of 3-year-old children. All of the mother/child pairs were invited to a dental checkup for 3-year-olds and were sent a package that contained a description of the objective of this study and a questionnaire. Written informed consent was obtained from each mother. The study design and procedures for obtaining informed consent were approved by the ethics committee of Nagasaki University Graduate School of Biomedical Sciences.

Dentists or dental hygienists from Nagasaki University Hospital interviewed the mothers to confirm their questionnaire responses before dental examinations. The questionnaire was derived from the National Health and Nutrition Survey, Health and Welfare Survey, and Dental Disease Survey, and included demographic variables such as gender, birth order, and child-rearing habits, as well as variables related to the dental health behaviors of children, including the frequency of sports drink consumption, home dental care (fluoride mouth rinses or toothpastes), and professional dental care (topical application of fluoride or pit and fissure sealing). The caries experience of the children was recorded as decayed, missing, and filled teeth (dmft) based on the World Health Organization diagnostic criteria (1997). Examiner reliability of the examination could not be verified because general practitioners in the respective municipalities conducted the oral health examination. The children were examined under artificial light using a dental explorer and mirror.

Information on the dental checkup was mailed to the parents of all 696 three-year-olds living in the jurisdiction. Of these, 541 mother/child pairs (77.7%) attended the dental checkups for 3-year-olds and 536 mothers (77.0%) returned the questionnaire. Fourteen subjects with incomplete questionnaires were excluded from the study. Ultimately, 522 mother/child pairs (75.0%) were studied.

The collected data were analyzed using SPSS version 12.0 for Windows (SPSS Japan, Tokyo, Japan). The children were divided into two groups: those with and those without dental caries. Pearson's chi-square test was used to compare the prevalence of children with or without dental caries according to each child-related variable; a probability of $<.05$ was considered significant. Multiple logistic regression was used to estimate the effect of child-related independent variables on dental caries in children by means of odds ratios (ORs) and 95% confidence intervals (CIs).

Results

The prevalence of dental caries in the subjects was 36.4%, and the mean dmft score was 1.6. The prevalence of sports drink use was 82.6%. Children who drank sports drinks frequently were much more likely to have dental caries. Children who consumed sports drinks three times a week or more had a significantly higher risk of dental caries (OR, 3.74; 95% CI, 1.88–7.42; Table 1). In ad-

dition, children were more likely to have dental caries if they were born second or later, were fed in bed, ate more between meals, or did not practice preventive dental care at home. "Frequency of consuming sports drinks" was not associated with either "habitual feeding in bed" or "frequency per day of eating between meals" (data not shown).

We examined responses to the question asking why children began to consume sports drinks (Figure 1). The highest proportion of mothers (37.6%) answered that they began to give sports drinks on the advice of a pediatrician. Furthermore, children who consumed sports drinks for reasons other than the advice of a pediatrician consumed them significantly more frequently (Table 2) and were significantly more likely to have dental caries (OR, 1.68; 95% CI, 1.05–2.68; Table 1) compared with children who consumed these beverages based on a doctor's advice. When queried regarding "other reasons" for providing their children with sports drinks, 18.3% of mothers answered "concern for child's health," 16.7% of mothers answered "viewing advertising on TV or in stores," and 16.2% of mothers answered "consumption by other family members" (Figure 1). Children who were given sports drinks because of consumption by other family members consumed them significantly more frequently overall compared with children whose mothers reported other reasons (data not shown).

Furthermore, we found that 95% of mothers who gave sports drinks to their children on the advice of a pediatrician did so when the child was ill. In contrast, less than 25% of mothers reported giving their children sports drinks "after sweating or having a bath" or "when the children want a drink" (data not shown).

Discussion

The prevalence of dental caries and the mean dmft score were higher than for 3-year-old children nationwide (prevalence of dental caries, 28.0%; mean dmft score, 1.1; Dental Health Division of Health Policy Bureau, Ministry of Health, Labor and Welfare, 2005). The presence of dental caries in children was significantly associated with the frequency of sports drink consumption. This result is consistent with the fact that preschool children who consumed sports drinks three times a week or more were at risk of dental caries in a previous study (Mitoh, 2006). Our study also supports the premise that one of the most important ways to prevent dental caries is to control the frequency of sugar consumption (Harris *et al.*, 2004). Sports drinks are one of many types of soft drink, and frequent consumption of these beverages may be associated with frequent consumption of other soft drinks.

We found that the highest proportion of mothers (37.6%) began to give their children sports drinks on the advice of a pediatrician. In a previous study, 60% of parents answered that they were advised by a doctor or nurse to give their children sports drinks to prevent dehydration during illness (Yamamoto *et al.*, 1990). Thus, the reason why children begin to consume sports drinks may be very different from the reason they begin to drink other soft drinks.

Table 1. Characteristics of the subjects according to the presence of dental caries in 3-year-old children and multiple logistic regression

Dependent Variables	Dental Caries				Multivariate ^b		
	Caries-Free		Caries Present		Adjusted		
	N	(%)	N	(%)	P-value ^a	OR	(95% CI)
Frequency of consuming sports drinks							
No drinking	65	(71)	26	(29)	< 0.001	-	
Once a month or less	201	(67)	99	(33)		1	
Twice a week or less	49	(59)	34	(41)		1.38	(0.81 - 2.33)
3 times a week or more	17	(35)	31	(65)		3.74	(1.88 - 7.42)
Reasons for first sports drink use^c							
Only "advice of pediatrician"	98	(72)	39	(28)	0.005	1	
Others ^d	169	(57)	125	(43)		1.68	(1.05 - 2.68)
Gender							
Female	176	(67)	88	(33)	0.141	1	
Male	156	(60)	102	(40)		1.14	(0.75 - 1.73)
Birth order							
First	191	(68)	89	(32)	0.018	1	
Second or latter	141	(58)	101	(42)		1.73	(1.14 - 2.64)
Habitual feeding in bed							
No	329	(65)	180	(35)	0.002	1	
Yes	3	(23)	10	(77)		8.36	(1.66 - 42.20)
Frequency per day of eating between meals							
Once or less	101	(72)	40	(28)	0.013	1	
Twice	168	(64)	96	(36)		1.05	(0.63 - 1.75)
Three times or more	63	(54)	54	(46)		1.80	(1.00 - 3.25)
Preventive dental care							
Home care (Fluoride mouthrinses or toothpastes)	80	(78)	23	(22)	0.003	1	
No	74	(64)	41	(36)		1.82	(0.92 - 3.59)
Both home and professional care	108	(62)	67	(38)		2.45	(1.30 - 4.59)
Professional care (Topical application of fluoride or pit and fissure sealing)	70	(54)	59	(46)		2.62	(1.35 - 5.08)

a Pearson's chi-square test was conducted.

b Multiple logistic regression analysis was performed except for those who reported no consumption of sports drinks.

c Multiple answers were allowed.

d Others included 25 subjects who selected "advice of pediatrician" and "other reasons."

Table 2. Frequency of sports drink consumption according to reason for initial consumption(n = 431)

Reason leading to sports drinks consumption for the first time ^a	3 times a week or more		Twice a week or less		Once a month or less	
	N	(%)	N	(%)	N	(%)
Only "advice of a pediatrician" ^b	7	(5)	24	(18)	106	(77)
Others ^c	41	(14)	59	(20)	194	(66)

a Multiple answers were allowed.

b Subjects who selected only "advice of a pediatrician" consumed sports drink less frequently than others (p for trend = 0.014 by chi-square test).

c Others included 25 subjects who selected "advice of pediatrician" and "other reasons."

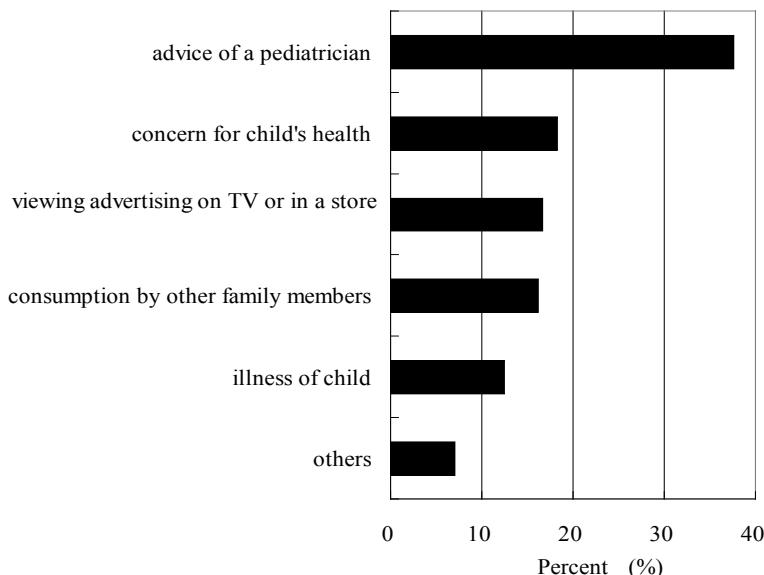


Figure 1. Reasons why mothers gave sports drinks to their children for the first time. The questionnaire allowed multiple answers. “Others” represents reasons for providing children with sports drinks other than the five reasons listed in the figure.

Contrary to our hypothesis, we found that children who began to consume sports drinks for reasons other than the advice of a pediatrician consumed them significantly more frequently and showed significantly more dental caries than did children who drank them on the advice of a pediatrician. However, we do not know whether pediatricians advised mothers to stop giving sports drinks to their children after the illness ended or whether mothers obeyed them. Furthermore, we found that children who consumed sports drinks because of consumption by other family members drank them significantly more frequently than did children who did so for other reasons. Food acceptance has been shown to be largely dependent upon two characteristics: sweetness and familiarity (Tahmassebi *et al.*, 2006).

Our results suggest that, although sports drinks generally have a low pH and contain sugars, and may therefore contribute to erosive and cariogenic processes, consuming them on the advice of a pediatrician and consuming them infrequently (except during illness) do not increase dental caries.

Our study has several limitations that must be acknowledged. First, no information was collected on the characteristics of the parents who took advice from pediatricians and those who did not. Following the advice of a pediatrician may be an indicator of parents’ being more health conscious or health oriented. These parents may better understand the cariogenicity of sports drinks and limit their children’s consumption, except during periods of illness. Second, we did not collect information regarding the kind of sports drinks, the consumption of soft drinks other than sports drinks, and erosion of dental enamel. Third, we do not know whether pediatricians advised mothers to stop giving sports drinks to their children after the illness resolved. Fourth, no information was collected on the children’s toothbrushing habits by

themselves or by their mothers, but only information on whether home care involved toothpaste with fluoride. It was previously found that 89.8% of mothers of Japanese preschool children brushed their children’s teeth more than once a day (Ogasawara *et al.*, 1990); thus, the mothers in our study may have exhibited little variation in brushing their children’s teeth. Finally, prospective cohort studies that include these data will be necessary to demonstrate the risk factors of dental caries more clearly.

The Cochrane Database of Systematic Reviews (Marinho *et al.*, 2003) reported that preventive behaviors such as topical fluoride application (toothpastes, mouth rinses, gels, or varnishes) reduced tooth decay in children. We found that home care was associated with the lowest risk of dental caries in children. The frequent use of low-concentration topical fluoride at home (toothpastes and mouth rinses) may effectively prevent dental caries in children. Although professional preventive dental care was associated with more dental caries in children, it is likely that these 3-year-old children had dental caries and, thereafter received professional preventive dental care after treatment. Indeed caries-free small children do not typically visit dental clinics.

In conclusion, frequent consumption of sports drinks is a risk factor for dental caries in preschool children; however, consuming these beverages on the advice of a pediatrician and consuming them infrequently or only during illness do not increase the risk of dental caries.

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