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Abstract

Obesity in children is a serious public health problem, and TV viewing is considered a potential risk factor. Since, however, no relevant association studies have been conducted in Japan, we evaluated the association between TV viewing and obesity using a population-based study conducted in a Japanese town. All 616 preschool children in the town were enrolled in February 2008, and a self-administered questionnaire to collect children's and parents' characteristics was sent to the parents. We dichotomized the time spent TV viewing and evaluated associations by logistic regression using a "less than 2h" category as a reference. The questionnaire was collected from 476 participants (77.3%), of whom 449 were available for the final analyses. Among them, 26.9% of preschool children reported 2 or more hours of TV viewing per day and 8.2% were defined as obese. In logistic regression analyses, there was no positive association in unadjusted (odds ratio [OR]1.11, 95% confidence interval [95% CI]:0.50-2.49) or adjusted models for exclusively breastfed status, sleep duration, or maternal factors (OR1.11, 95% CI:0.50-2.51). We also found no positive association between TV viewing and overweight status, possibly owing to the influence of social environment, low statistical power, or misclassification.

KEYWORDS: TV viewing, obesity, preschool children

Original Article

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Obesity in children is a serious public health problem, and TV viewing is considered a potential risk factor. Since, however, no relevant association studies have been conducted in Japan, we evaluated the association between TV viewing and obesity using a population-based study conducted in a Japanese town. All 616 preschool children in the town were enrolled in February 2008, and a self-administered questionnaire to collect children's and parents' characteristics was sent to the parents. We dichotomized the time spent TV viewing and evaluated associations by logistic regression using a "less than 2h" category as a reference. The questionnaire was collected from 476 participants (77.3%), of whom 449 were available for the final analyses. Among them, 26.9% of preschool children reported 2 or more hours of TV viewing per day and 8.2% were defined as obese. In logistic regression analyses, there was no positive association in unadjusted (odds ratio [OR] = 1.11, 95% confidence interval [95% CI]: 0.50-2.49) or adjusted models for exclusively breastfed status, sleep duration, or maternal factors (OR = 1.11, 95% CI: 0.50-2.51). We also found no positive association between TV viewing and overweight status, possibly owing to the influence of social environment, low statistical power, or misclassification.

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Obesity is recognized as a serious public health problem, even in children [1]. Over 22 million children under the age of 5 and 155 million school-age children are severely overweight worldwide [2]. The same problem is present in Japan [3, 4]. Childhood obesity is a risk factor for a number of chronic diseases in adult life, including heart disease, some cancers, and osteoarthritis [5]. Furthermore, a number of other physical and mental health problems are

reported to be associated with obesity [2].

Although several genetic or lifestyle factors that induce obesity are recognized, sedentary behaviors, including TV viewing, are attracting a great deal of attention as possible risk factors for obesity, because any child can be sedentary [6-26]. Indeed, recent studies have consistently demonstrated positive associations between TV viewing (2 or more h per day) and overweight status in children (Lumeng *et al.* 2006; Steffen *et al.* 2009) [13, 26]. Therefore, the American Academy of Pediatrics recommends that total media time be limited to less than 2h per day in children aged 2 years and older [27]. In contrast to

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Western countries, there has been no study evaluating the association between TV viewing and obesity in Japanese children. Because the prevalence of obesity and the social environment of children in Japan are different from those in Western countries, the effect of sedentary behaviors (for example, TV viewing) on obesity might be modified by these factors. Therefore, in the present study, we evaluated the association between preschool children's TV viewing and their weight status using population-based cross-sectional data of a Japanese town.

Materials and Methods

Study design and participants. In February 2008, the municipal office staff of a town conducted a population-based cross-sectional study to investigate the descriptive features of maternal and child health in the town. M town is in a rural area in Okayama prefecture, Japan, with a population of about 15,000. In the present study, all of the town's 616 preschool children, who were 2 to 6 years of age, and their parents were chosen as the target population using the population registry of this town. A self-administered questionnaire was sent to the parents by M town's municipal office staff. Parents supplied information about their own and their children's basic characteristics and their children's lifestyle factors and then returned the survey by mail. To increase the follow-up rate, municipal office staff reminded the parents to return the completed questionnaire. We assumed that participants agreed to participate in the study if they returned the questionnaire.

Measurements. A measurement of interest for us (exposure measure) was the time spent (hours) watching TV or playing video games per day (TV viewing). We asked the parents to select an answer from 4 categories: less than 1, 1 to 2, 2 to 3, and greater than 3h per day. Given that the American Academy of Pediatrics recommends less than 2h of media per day, we dichotomized the above 4 categories into "less than 2h" or "greater than or equal to 2h." Then, we used the "less than 2h" category as a reference.

We used obesity as an outcome measure. Height and weight were collected in the questionnaire completed by parents, and were reported to the nearest 0.1cm and 0.1kg, respectively. Although this infor-

mation was obtained by a self-administered questionnaire, recent data suggest high validity of self-reporting by parents for height and weight measurements of children [28, 29]. Body mass index (BMI) was calculated as weight in kg divided by the square of height in m. Obesity was defined on the basis of the age and sex-specific criteria of the International Obesity Task Force (IOTF) [30]. The working group of the IOTF set international cut-off points for BMI by sex between 2 and 18 years, defined to pass through BMI levels of 25 and 30 kg/m² at age 18. We defined children as obese if their BMI was above the cut-off point of BMI = 25 kg/m².

Based on previous studies [13-20, 31, 32], we considered the following variables as potential confounders: children's lifestyle factors (sleep duration and being exclusively breastfed) and maternal characteristics (obesity [BMI ≥ 28 kg/m²], education, and smoking).

Statistical analysis. We first compared children's and maternal characteristics between the 2 categories of TV viewing using a *t*-test or chi-square test. Then, we used a logistic regression model to evaluate the associations between TV viewing and obesity, and estimated odds ratios (ORs) and their 95% confidence intervals (CIs) using the "less than 2h" category as a reference. We first estimated crude ORs and then adjusted for potential confounders. We selected *p* values of less than 0.05 to show statistical significance. All data analysis was performed using the statistical software package SPSS 16.0 J (SPSS Japan, Inc, Okayama, Japan).

Results

Questionnaires were returned by the parents of 476 (77.3%) out of 616 preschool children enrolled in the study. We excluded questionnaires that included no information on TV viewing (*n* = 4) and those that included no information on height and weight (*n* = 23). After exclusions, 449 preschool children were available for the final analyses.

About half of the final sample was male (226 preschool children, 50.3%), and the mean age was 4.5 years (standard deviation: 1.4). More than one fourth (26.9%) of preschool children were exposed to greater than or equal to 2h of TV per day. Thirty-seven preschool children (8.2%) were obese. The

numbers of obese children were 12 (9.9%) in the less than 1 h of TV viewing group, 15 (7.2%) in the 1-2 h group, 10 (9.7%) in the 2-3 h group, and 0 (0%) in the greater than 3 h group.

The characteristics of preschool children separated on the basis of TV viewing categories are shown in Table 1. The prevalence of obesity and the mean birth weight were almost the same between the two TV categories. The numbers of exclusively breastfed children were 87 (26.5%) in the 2 or more h group and 23 (19.0%) in the less than 2 h group. Preschool children exposed to 2 or more h of TV per day were less likely to have breakfast every day ($p < 0.01$) and more likely to snack frequently ($p < 0.01$).

The results of logistic regression analyses for 449 preschool children are shown in Table 2. Compared with the reference category, there was no significant increase in the numbers of obese individuals in the greater than or equal to 2 h TV viewing group, with both unadjusted (OR = 1.11, 95% CI: 0.50-2.49) and adjusted models (OR = 1.11, 95% CI: 0.50-2.51). Because breakfast habits and snack consumption may be intermediate variables, we did not use these variables as confounders.

Discussion

In the present study, we utilized a cross-sectional study in a Japanese town and did not find positive associations between TV viewing and obesity in preschool children. As far as we know, this is the first study to explore this association in Japan.

Why we did not find positive associations deserves consideration. As mentioned in the introduction, several studies in Western countries have demonstrated positive associations between TV viewing and obesity in children. Lumeng *et al.* found that exposure to 2 or more h of television per day was associated with an increased risk of overweight status at 36 months (OR = 2.92, 95% CI: 1.36-6.24) [13]. In another cross-sectional study, a positive, although not significant, relationship between 2 or more hours of TV viewing and children's weight status was observed (OR = 1.72, 95% CI: 0.9-3.3) [26]. Compared with these previous studies, the point estimate of the present study was slightly low (OR=1.11). Indeed, a mechanism for explaining the association between TV viewing and obesity may be the combination of reduced physical activity and adoption of unhealthy eating pat-

Table 1 The demographic characteristics of children and mothers according to the dichotomized TV viewing categories (n = 449)

	TV viewing < 2h/day n = 328	TV viewing ≥ 2h/day n = 121	P value
Children's basic characteristics			
Sex			
Boys (%)	158 (48.2)	68 (56.2)	0.08
Girls (%)	170 (51.8)	53 (43.8)	
Mean age (SD)	4.5 (1.4)	4.6 (1.3)	0.71
Mean height (SD)	102.2 (11.1)	102.4 (10.1)	0.94
Mean weight (SD)	16.4 (3.7)	16.3 (3.3)	0.80
Mean birth weight (SD)	3029.1 (392.7)	2993.2 (461.8)	0.54
Obesity (%)	27 (8.2)	10 (8.3)	0.56
Children's lifestyle factors			
Eat breakfast every day (%)	312 (95.1)	103 (85.1)	<0.01
Snack consumption; 4 days or more per week (%)	96 (29.3)	64 (52.9)	<0.01
Sleep duration; 9h or more per day (%)	177 (54.0)	66 (54.5)	0.50
Exclusively breastfed (%)	87 (26.5)	23 (19.0)	0.21
Maternal factors			
Mean age (SD)	33.5 (4.7)	33.1 (5.0)	0.46
Maternal obesity (%)	5 (1.7)	5 (4.7)	0.09
Missing values (%)	29 (8.8)	15 (12.4)	
Maternal education; less than 12 years (%)	127 (38.7)	60 (49.6)	0.02
Missing values (%)	1 (0.3)	4 (3.3)	

SD, standard deviation.

Table 2 Odds ratios (ORs) and 95% confidence intervals (CIs) for TV viewing associated with obesity in preschool children

		Unadjusted model OR (95%CI)	Adjusted model OR (95%CI)
Exposure TV viewing	< 2h/day	Reference	Reference
	> = 2h/day	1.11 (0.50–2.49)	1.08 (0.48–2.44)
Adjusted variable			
Sleep duration	< 9h/day		Reference
	> = 9h/day		1.12 (0.54–2.33)
Breastfeeding status	Not exclusively		Reference
	Exclusively		0.53 (0.20–1.43)
Maternal obesity	Not obese		Reference
	Obese		1.19 (0.14–9.87)
Maternal education	> 12 years		Reference
	< = 12 years		1.00 (0.47–2.13)
Maternal smoking	non-smoker		Reference
	smoker		1.01 (0.39–2.61)

terns. TV viewing is considered to be associated with reduced physical activity [33, 34], increased consumption of high-fat, high-sugar, or high-calorie foods [7, 8, 35–38], and low intake of fruit and vegetables [39]. The latter tendency was also observed in the present study. Both mechanisms may lead to an overweight status. Because M town is in a rural area in Japan, it is considerably different from the environment in most Western countries in terms of social environment (parks for activity, availability of unhealthy food, types of snack foods). This social environment might work as an effect modifier, leading to the null association between TV viewing and obesity observed in the present study.

Another reason for the lack of an association could be that there was not enough statistical power in this study (type two error), because this study was initially designed to investigate maternal and child health characteristics. That is, this study may include too few participants to investigate the association between TV viewing and obesity in preschool children. However, we conducted a sample calculation using Epi Info. 3. 3. 2. to determine how many participants we would need to observe significant relationships if we obtained the same point estimate as that of a previous study by Lumeng *et al.* (*e.g.*, OR = 2.92) with the prevalence observed in the present study (namely, 8% in the less than 2h category), and the result was 328. Thus, lack of statistical power is unlikely to underlie the null association in the present study.

The strengths of the present study are as follows. This is the first study in Japan to assess the association between TV viewing and obesity in preschool children. The study is population-based, with a high response rate. Thus, selection bias may be negligible.

At the same time, there are several limitations in this study. First, the cross-sectional study design may have limited the temporal association between TV viewing and obesity. Although we could not find positive associations in the present study, future studies should be longitudinal to overcome reverse causation (that is, obese children tend to watch TV). Second, all data in this study were collected from self-report questionnaires. Although the validity of self-reporting by parents of their children's size is reported to be high, as mentioned in the Material and Methods section, the validity of exposure measurement (TV viewing) may be lower. It is possible that parents whose children were obese were apt to report the time for TV viewing or playing games as somewhat lower than the actual figure, and such a differential exposure misclassification could have resulted in an underestimation of our point estimates. This potential for exposure misclassification is another possible reason why we could not find positive associations. Third, no information about physical activity was available in this study. As mentioned above, TV viewing is considered to be associated with (or to induce) reduced physical activity. Thus, physical activity level may be an

intermediate variable between TV viewing and obesity, so we may not have needed to adjust for this variable in the present study. Finally, as already mentioned, our relatively small sample size may have limited the power to detect some effects.

In conclusion, our study results did not reveal positive associations between TV viewing and obesity in preschool children in a rural area in Japan. This finding may have been induced by the presence of a social environment that differs from those in Western countries, low statistical power, or exposure misclassification. Obesity in children is a large public health issue, including in Japan, and the use of technology (TV viewing or games) is still prevalent. Therefore, further longitudinal studies with large samples and detailed questionnaires should provide further insights into preventing obesity among children in Japan.

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