

ORIGINAL**Study on the necessary survey days for energy intake in school children assessed by 7 day survey**

Atsuko Yamaguchi¹, Nobuko Tanaka², Yoko Eguchi³, Kazue Kuno⁴,
Noriko Wakikawa¹, Nobuko Sarukura¹, Mina Fukinbara¹, and Shigeru Yamamoto^{1,5}

¹International Nutrition, Ochanomizu University Graduate School of Humanities and Sciences, Tokyo ;
²Department of School Lunch Program, Ministry of Education, Science and Sports, Tokyo ;³Department of School Lunch Program, Saga Prefecture Office, Saga ;⁴Department of Health and Nutrition Science, Faculty of Health and Social Welfare Sciences, Nishikyushu University, Saga ; and ⁵International Nutrition, Jumonji University, Saitama, Japan

Abstract : Theoretically, the longer the period of a nutrition survey, the more reliable the results. However, a long survey can impose a burden on subjects and cause the results to become inaccurate. For adults, a 3 non-consecutive day survey is usually recommended ; however, for school children, at least in Japan, it has not been determined whether this is necessary. In this study we conducted a survey of 7 days and tried to find the minimum number of days necessary to determine the energy intake. The subjects were about 300 children aged from 6 to 7, 10 to 11 and 13 to 14 years old in a city in the western part of Japan. The weighing method was used for the school lunch and other meals were surveyed by 24-recalling method. For the 6-7 year-old school children, guardians were asked to keep dietary records. The final number of subjects who were able to complete the 7-day survey was 139. Energy intakes for each weekday were not statistically different ($p > 0.05$) and those for each weekend did not differ ($p > 0.05$). Average energy intakes on weekdays were higher than those on weekend days in 10-11 and 13-14 year-old children. The average intakes of energy in 10-11 and 13-14 year-old children were lower than Japanese estimated energy requirements (EER). However, body weight of more than 90% of subjects was within the normal range. The results suggest that a survey of one weekday is reliable for all weekdays and that of one week-end day is reliable for any weekend day and also indicate the necessity of further studies of EER in rapidly growing children. *J. Med. Invest.* 59 : 111-115, February, 2012

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INTRODUCTION

The dietary habits of Japanese school children have been changing in accordance with lifestyle. It

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Address correspondence and reprint requests to Shigeru Yamamoto, Professor, Ph.D., RD, International Nutrition, Graduate School of Human Life Sciences, Jumonji University, 2-1-28 Sugawara, Niiza-City, Saitama 352-8510, Japan and Fax : +81-48-260-7613.

is important to ensure a proper nutritional intake in children not only for physical and mental development, but also to establish good health habits to sustain them as adults. Energy is the most important factor in preparing meals, especially school meals, and also for body weight control. According to the 2007 National Health and Nutrition Survey in Japan (1), the ratios of obese and slightly obese in 12 to 14 year-old children changed from 2000 to 2006 : boys from 19.5% to 7.9%, girls from 25% to 20.3%.

On the other hand, the ratios of thin and slightly thin children in the same age group changed as follows : boys from 29.2% to 37.7% and girls from 18.2% to 29.7%. In response to this situation, a licensing system for nutrition teachers was established to help Japanese school children acquire proper dietary habits (2). For guiding school children in proper eating habits, it is important to know their actual daily eating habits, especially their energy intake. In general, conducting surveys covering three non-consecutive days is recommended for surveys when the subjects are adults (3). However, the number of days available to estimate dietary habits of school children are often limited. In this study, we made a first attempt at establishing the number of survey day(s) necessary to determine energy intake.

METHODS

Study area and subjects

A census was conducted in a prefecture on three groups comprised of a total of about 300 schoolchildren aged from 6 to 7, from 10 to 11 (in elementary school), and from 13 to 14 (in junior high school). Each group consisted of about 100 children, made up more or less equally of boys and girls.

Survey period

The survey was conducted for seven consecutive days including either 4 weekdays and 3 weekend days or 5 weekdays and 2 weekend days in November 2009. An investigation of physical status was conducted before the commencement of the survey.

Cooperators

Requests for cooperation were made to elementary schools and junior high schools through the Board of Education of the city, and to research institutions such as universities, as well as to nutrition instructors and dietetic association members in the prefecture.

Survey of eating habits

Regarding the intake of school lunches, researchers measured the actual amount of each student's portion, while that of other meals, including in-between snacks, were surveyed by the 24-hour recalling method with the cooperation of the students' guardians. In the case of incomplete items or unclear descriptions on the form, the researchers confirmed details with the students directly or asked

their guardians to fill out the items.

Calculation of nutrient intakes was made in accordance with the data listed in "Standard Tables of Food Composition in Japan, the Fifth Revised and Enlarged Edition"(4) (Food Composition Table). After the survey, the researchers converted estimated average requirements into gram mass, based on the "Standard Volume-to Weight Conversion Table"(5) included in the Food Composition Table (2001), which is used for the national health survey.

The nutritional intake was calculated based on data from the meal survey and the school lunch menu, obtained through the methods described above.

Degree of obesity

This study collected data on the height and weight of school children obtained at the time of the annual checkup conducted by each school in April, 2009 or the data collected on eating habits before commencing the survey. Using these data, the degree of obesity was derived by the following equation (6).

The degree of obesity = (Actual measured weight - Weight for height standards) / Weight for height standards x 100.

Children whose values were 20% greater than average were defined as obese, while children whose values were 20% lower than the average were defined as thin. Weight for height standards were derived from mean weights using the Annual Report of School Health Statistics Research 2009 (7)

Statistical analysis

Data were assessed by one-way ANOVA and then Tukey's multiple comparison test. The level of significance was set at $p < 0.05$.

Ethical considerations

This study was conducted with the approval of the Ethics Committee of Ochanomizu University, and in accordance with the "Helsinki Declaration : Ethical Principles for Research Involving Human Subjects" with special attention paid to the following : To prevent the identification of individuals, each subject's personal information was carefully coded and obtained data were strictly managed. We obtained consent that the participation in the research was by free will from the participants and their guardians by providing explanations about the objectives and details of the survey and the intention

to use the results for oral and written presentations. Even after commencement of the study, subjects were free to drop out, either of their own volition or at the guardian's behest, and no subjects were penalized in any way.

RESULTS

Subjects

The number of the subjects to be analyzed was 139 in total : boys and girls (6-7 year old 23 boys and 29 girls, 10-11 years old 16 boys and 12 girls and 13-14 year old 31 boys and 28 girls).

Table 1 shows the bodily features of the subjects to be analyzed. Obesity rates estimated by the equation shown in methods (%) for boys and girls were 3.5 ± 11.7 and -1.9 ± 8.0 (6-7 years old), -3.0 ± 11.9 and -3.3 ± 17.4 (10-11years old) and 0.2 ± 17.4 (13-14 years old). When the distribution is normal, 95% of the subjects are between the range of mean-2SD and +2SD. When the sample size is over 30, the distribution is usually normal. Our subjects number was 139 in total. In fact among 139 subjects, 130 (93.5 %) had the normal body weight (from -20% to +20% of the standard weight for height reported by the Annual Report of School Health Statistics Research 2009 (7), only 9 (6.5%) were overweight and none was underweight.

Energy intake on weekdays and weekends

Figure 1 shows energy intake on weekdays and weekends by gender. The analysis was conducted for five weekdays with school lunch and two weekend days ; however, in the case of the school children aged from 10 to 11, due to a temporary school

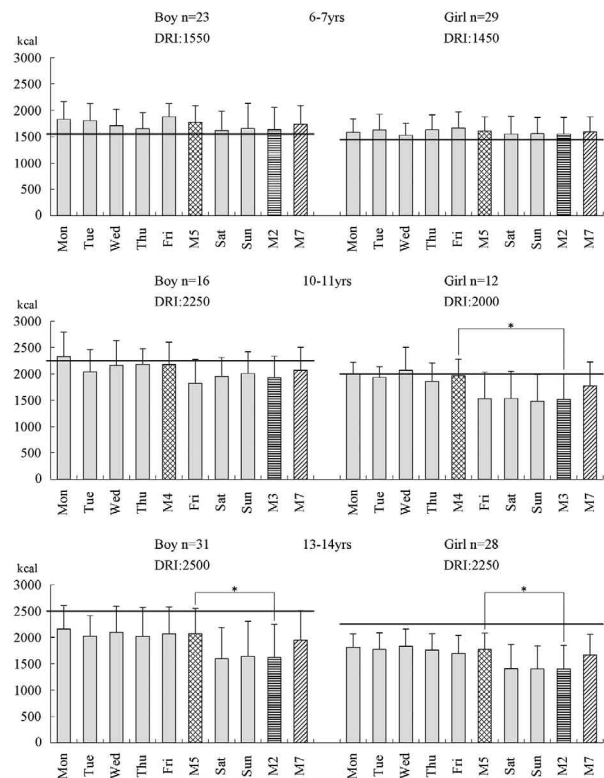


Fig. 1. Energy Intakes of 6-7, 10-11 and 13-14 yrs old children.

Data are means \pm SD. Horizontal bar indicates the value of Japanese DRI 2010. M5 : Mean values of 5 weekdays (Monday to Friday), M2 : Mean values of 2 weekend days (Saturday and Sunday), M7 : Mean values of 7 days (Monday-Sunday), M4 : Mean values of 4 weekdays (Monday to Thursday), M3 : Mean values of 3 weekend days (Friday, Saturday and Sunday). For the DRI, estimated energy requirement for level-II physical activity based on dietary reference intakes for Japanese, 2010 was used. For 6-7 and 13-14 years old groups, the analysis was conducted for five weekdays with school lunch and two weekends ; however, for 10-11 years old group, due to a temporary school closing (on Friday), weekends were defined as Friday through Sunday and the analysis was conducted for four weekdays and three weekends. * $p < 0.05$

Table 1. Bodily features of the subjects

	Boy			Girl		
	6-7 yrs. (n=23)	10-11 yrs. (n=16)	13-14 yrs. (n=31)	6-7 yrs. (n=29)	10-11 yrs. (n=12)	13-14 yrs. (n=28)
Height (cm)	127.2 \pm 6.1	139.7 \pm 7.4	158.3 \pm 9.5	124.7 \pm 5.3	142.2 \pm 6.9	154.1 \pm 6.7
Weight (kg)	27.2 \pm 4.0	33.7 \pm 7.2	45.9 \pm 7.1	24.5 \pm 3.1	34.7 \pm 7.8	47.0 \pm 10.9
Degree of Obesity (%)	3.5 \pm 11.7	-3.0 \pm 11.9	-3.3 \pm 8.2	-1.9 \pm 8.0	-3.1 \pm 17.4	0.2 \pm 17.4

(mean value \pm standard deviation)

Note 1 : The degree of obesity (Murata Method) = (actual measured weight - Weight-for-height standards/Weight-for-height standards) x 100

Weight-for-height standards were collected from the Annual Report of School Health Statistics Sports, Science and Technology). Research 2009 (the Ministry of Education, Culture, Sports, Science and Technology).

closing (on Friday), weekends were defined as Friday through Sunday and the analysis was conducted for four weekdays and three weekend days.

Subjects aged from 6 to 7

Energy intakes for each of the 7 days were statistically similar ($p > 0.05$) and the mean value of energy intake of boys was 1734 ± 351 kcal, while that of girls was $1,591 \pm 288$ kcal. It was found that both boys and girls satisfied the Estimated Energy Requirement (EER) 2010 (8).

Subjects aged from 10 to 11

Regarding the energy intakes on weekdays, there was no significant difference among four weekdays. The energy intake of boys for four weekdays was 2177 ± 423 kcal and that for girls 1964 ± 319 kcal. They were slightly lower than EER values (2,250 kcal for boys and 2,000 kcal for girls). The energy intakes on weekend days were $1,928 \pm 409$ kcal for boys and $1,516 \pm 491$ kcal for girls. The intakes against DRIs were 86% for boys and 76% for girls, respectively.

Subjects aged from 13 to 14

Energy intakes for each weekday were not statistically different ($p > 0.05$) and those for each weekend did not differ ($p > 0.05$). The mean energy intake of boys for five weekdays was $2,075 \pm 476$ kcal (EER : 2,500 kcal), while that of girls was $1,774 \pm 311$ kcal (EER : 2,250 kcal). The mean energy intake of weekend days was $1,617 \pm 629$ kcal for boys and that $1,404 \pm 444$ kcal for girls. The mean energy intake on weekend days was lower than that on weekdays ($p < 0.05$) in both gender. Boys satisfied about 65% of the EER, while girls satisfied only about 64% of the EER.

DISCUSSION

The results of this study suggest that for estimating the energy intake, a survey of one weekday is reliable for all weekdays, and that of one weekend day is reliable for all weekend days. According to Marr and Heady *et al.* (9), who conducted 7-day surveys of eating habits on males aged between 30 and 67 living in London, they reported 2-3 days is necessary to obtain reliable energy intake data. Basiotis *et al.* (10) reported that in American adults the minimum number of daily food records required to estimate energy intake is 3 days. Although the previous

studies were conducted mostly in adults, Nelson *et al.* (11) conducted a survey in infants, school children, pregnant women and elderly people and reported that the survey period to estimate energy intakes can be less than seven days. We also tried an equation reported by Beaton *et al.* (12) to determine the necessary survey days required to estimate regular intakes of individuals. The equation was : $n = (1.96 \times CV \div D)^2$, where 1.96 is the 95% confidence range, CV is standard deviation (SD)/mean (%) and D is the deviation of the mean (%). Using this equation, we estimated the necessary survey days to estimate the energy intake in our subjects. The CVs was 7-9%. The results suggest that one weekday and one weekend day are enough, if 15% of deviation of the mean is used.

The energy intakes of 10-11 year-olds and 13-14 year-olds were similar in spite of different body weight and also lower than the values of Japanese EER (8). As one of the factors, we have to consider the accuracy of our survey. In our previous studies by the 24-hour recalling method for a 3 day survey in 900 children throughout the whole country also showed a similar tendency (report of the Japanese Ministry of Education, Science and Sports in 2009 unpublished). There are not other useful data for Japan, perhaps due to the difficulty of conducting surveys of school children. Another possible factor may be the strong desire to be thin among adolescents, especially girls as reported by Sano *et al.* (13). However, this is not an adequate explanation because among 139 subjects, none was underweight. If this is the case, there is a possibility that the Japanese estimated energy requirement (EER) for these age groups is too high. The basal metabolic rate (BMR) is the key to determining the EER, but BMR drops rapidly from children to young adults. For example, BMRs (kcal/day/kg body weight) at 10, 15 and 20 years old are : for boys 37.4, 27.0 and 24.0 respectively and for girls 34.8, 25.3 and 22.1 respectively. Basal metabolism rate (kcal/person) is obtained by multiplying BMR and body weight. The body weight (kg) of 10, 15 and 20 years old are : for boys 35.5, 58.4 and 63 respectively and for girls 34.5, 50.6 and 50.6 respectively. Considering the rapid changes in BMR and body weight in these age groups, our finding (a similar energy intake in 10-12 and 13-14 year-old children) may be possible. We need further studies about the energy requirements for school children.

The energy intake for weekend days was lower than that during weekdays except for the 6-7 year-old group. One of the factors contributing to the low energy intakes for these groups on weekends may be that there were many subjects who had just two meals a day on weekends because they skipped breakfast on weekend days. Missing breakfast can be correlated with age. However, further studies are required to reach a definite conclusion.

This study attempted to establish a survey period to ascertain energy intake focusing on school children, taking into account the daily eating habits of Japanese people, and suggested that it is possible to obtain reliable data by a survey conducted on one weekday and on one weekend day, thereby reducing the work load for subjects. Therefore, it can be said that the survey method described above has significant advantages.

CONFLICT OF INTEREST

None of the authors have any conflicts of interest to declare.

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