

Original**Energy and Nutrient Intakes and Recommendations from a Survey of Children
in a Coastal City in Central Japan**

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ABSTRACT: *Background:* Childhood obesity is a world-wide problem but Japan is an exception. We tried to find the dietary factors for this through a nutrition survey in Japan. *Methods:* A cross-sectional dietary survey was conducted in Okazaki City, a mid-size city, in the central part of Japan and facing the Pacific Ocean. The subjects were 10 year old children (35 boys, 30 girls) and 13 year old children (39 boys, 33 girls). Height and weight were measured. Energy and nutrient intakes were measured by the photograph method using Calorie Smile software on 2 non-consecutive days including 1 school day and 1 weekend day. *Results:* Weight for height was mostly within the normal range (within 0.8-1.2 mean). However, the average energy intake was lower than the recommended level, especially for the older children. Protein intake was adequate if compared with the recommendation in grams but was deficient when compared with the recommended value as percentage of energy (13-20%). Average lipid intake was close to the upper limit of lipid recommendation (30% of energy), indicating that about half of the students took more than the upper limit. Dietary fiber intake did not reach the recommended values. Ca intake was close to the recommended amount on the school day, but significantly lower on the weekend day. Energy and nutrient intakes were lower on the weekend day than on the weekday. *Conclusion:* Despite the lower energy intake than recommendation, the weight for height of the children were mostly in the normal range, suggesting the energy requirements was too high. If the protein requirement is defined as 13-20% of energy recommendation, about 30% of children took lower than the minimum level, suggesting this method is improper. Results of energy and nutrients intakes and the recommendations were inconsistent and further studies are necessary to find the proper direction of child nutrition.

Key words: school children, energy, nutrients, intake, recommendation

INTRODUCTION

Childhood obesity is a world-wide problem but Japan is an exception. Among the 38 OECD member countries in 2018, the obesity rate of Japanese children was 17.5%, which was the second lowest (median 31.4%) (1). Obese children are at greater risk of developing hypertension and metabolic disorders. Psychologically, obesity can lead to poor self-esteem, eating disorders and depression. Childhood obesity is particularly concerning as it is a strong predictor of obesity in adulthood, which is linked to diabetes, heart disease and certain types of cancer (2). It is worth considering the factors in the low prevalence of obesity in Japanese children. From our previous study of 7-, 10-, and 13-year-old children in an area of western Japan, energy intake was lower than the recommendation, especially in older children (3). It is necessary to confirm these results in other parts of Japan and we conducted this study in a central part of Japan. We tried to evaluate the new method for DRI of protein in Japan. It is expressed as 13-20% of

protein is difficult to understand because among the various nutrients, the protein requirement has been most thoroughly studied mainly by nitrogen balance. This was never expressed as a percentage of energy. We should consider the fact that the protein requirement does not change in proportion to energy intake. According to the US/Canadian Dietary Reference Intakes, the recommendation for protein of 0.8 g protein/kg/d is “the average daily intake level that is sufficient to meet the nutrient requirement of nearly all (98%) healthy individuals (5). The panel also states that “no additional dietary protein is suggested for healthy adults undertaking resistance or endurance exercise According to the national nutrition survey in Japan, average protein intake of Japanese is about 1.2g/kg body weight, about 50% higher than the recommendation (6). In this study we tried to evaluate the energy and nutrient recommendations by comparing with the actual intakes ..

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METHODS

This was a cross-sectional dietary survey conducted in November 2018 at all elementary school and junior high schools in Okazaki City. Of the approximately 200 children who agreed to participate, 65 10-years old children (35 boys, 30 girls) and 72 13-years old children (39 boys, 33 girls) completed the survey. Children were asked to take photos of all food items and beverages consumed on two non-consecutive days (1 school day and 1 weekend day) and to send them using the Calorie Smile software with/without some notes (7) (Photo 1). Calorie Smile software was introduced to the children and their families before the data collection took place. The dietary survey was completed by the children themselves or with the help of an adult. To estimate size and weight of foods, foods were placed on squared paper and sized (Photo 2).

Using these photos, researchers estimated the weight of food, entered this into the software to calculate energy and nutrient intakes, and then compared them to the recommendations for Japanese. Typical dishes, with ingredients and weights are integrated into the software. When children's meals are different or they eat items other than those in the data base, adjustments can be made. SPSS was used to analyze the data. Ethical approval was obtained from the City Board of Education.



Photo 1. Calorie Smile software



Photo 2: Photos of meals sent by children

RESULTS

Figure 1 and 2 show the weight for height of 10 and 13 years old children, respectively. Obesity and thinness in Japanese children are defined as more than 20% or less than 20% of the standard weight for height, respectively. The red line is $\pm 20\%$ of standard body weight for height. In other words, the point between the two red lines is a normal weight child.

In 10 years old children only 4 boys and no girls were overweight and no boy and only 1 girl was underweight (Figure 1). The results indicate that weight for height of most of the children were normal.

In 13 years old children only 1 boy and 1 girl were overweight and 1 boy and no girl was underweight (Figure 2). The results indicate that weight for height of most of the children were normal.

These results indicate that most of the children in this city, their weight for height was within a normal range.

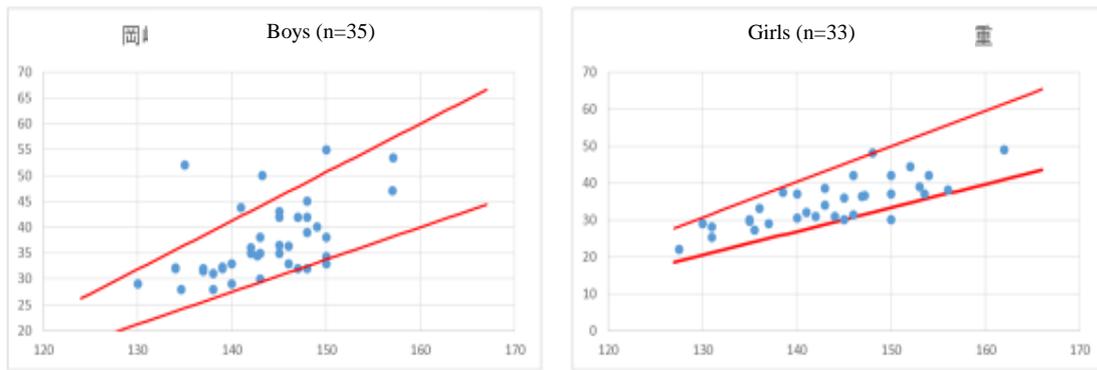


Figure 1: Weight for height of 10-year-old boys (left) and girls (right)

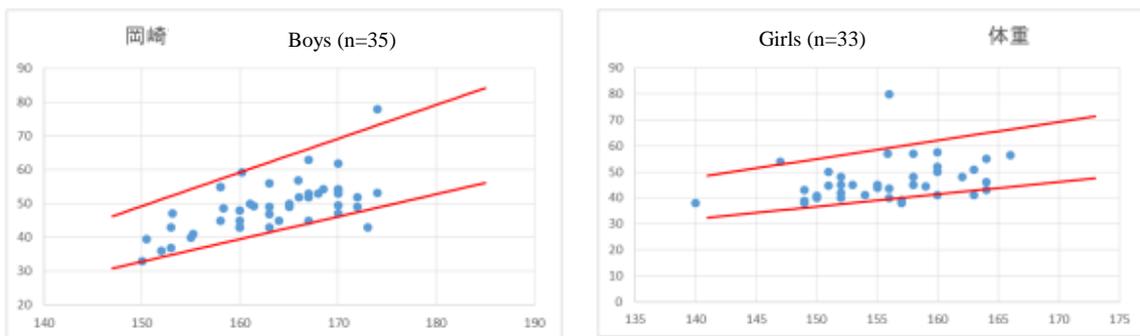


Figure 2: Weight for height of 13-year-old boys (left) and girls (right)

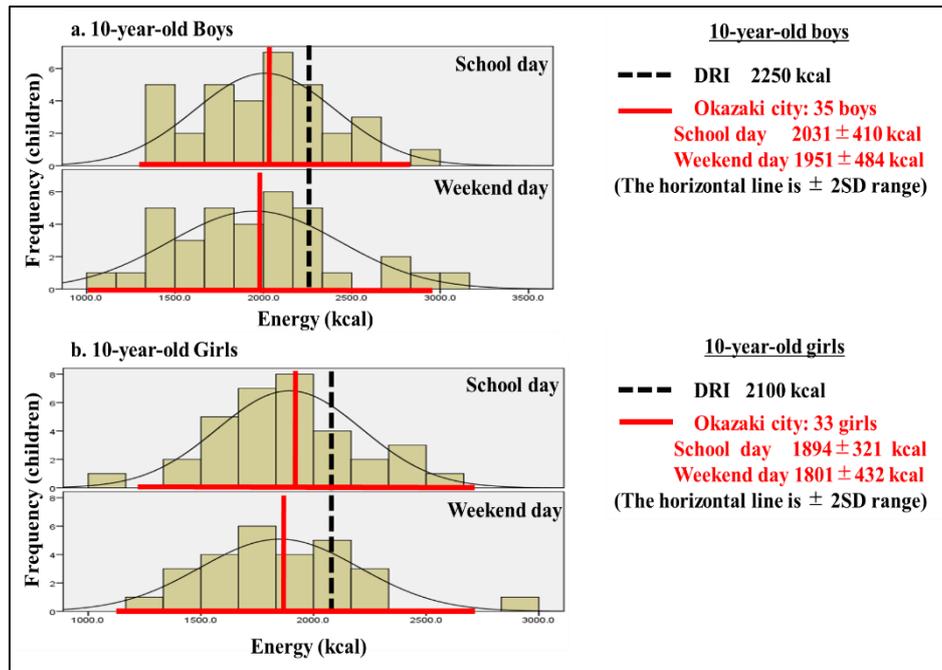


Figure 3: Energy intake of 10-year-old children

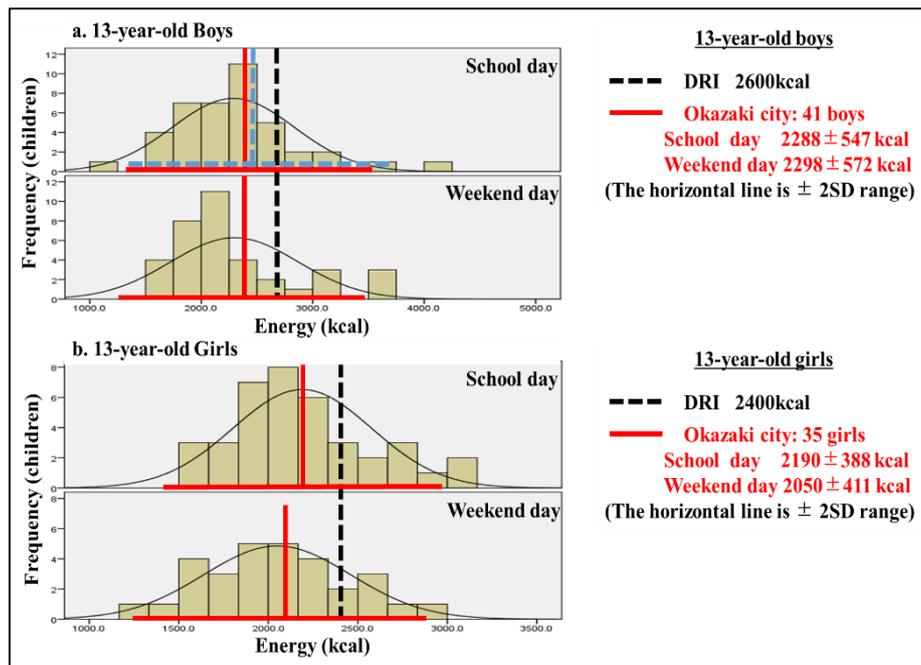


Figure 4: Energy intake of 13-year-old children

Figure 3 shows energy intake of 10-year-old children, the energy intake was lower than the recommendation about 200 kcal on school day, and about 300 kcal on weekend day. Figure 4 presents energy intake of 13-year-old children. For 13-year-old

boys, energy intake was about 300 kcal lower than the recommendation in both days. For 13-year-old girls, energy intake was about 200 kcal and 350 kcal lower than the standard on school day and weekend day, respectively.

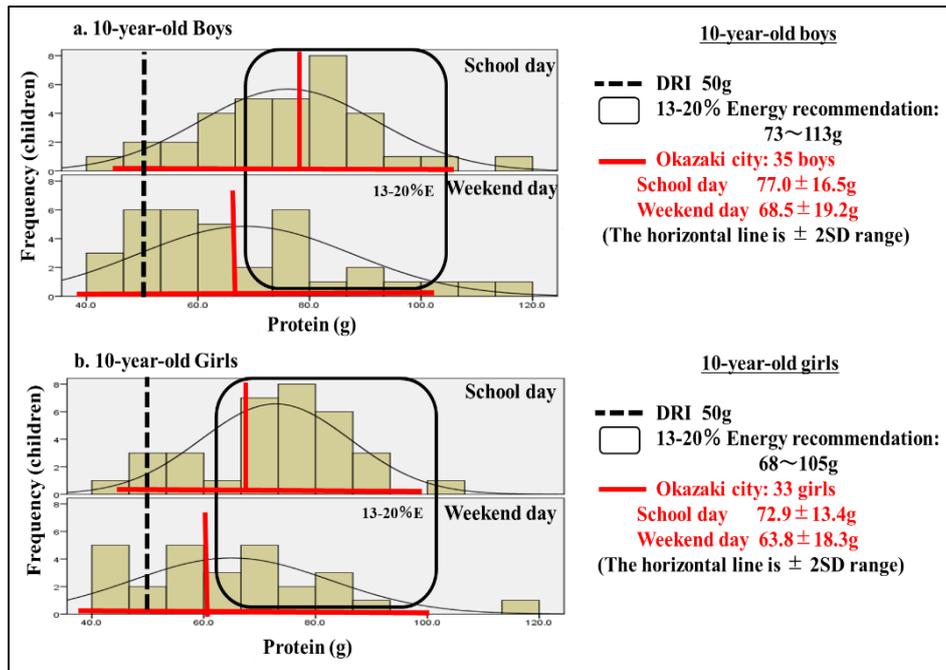


Figure 5: Protein intake of 10-year-old children

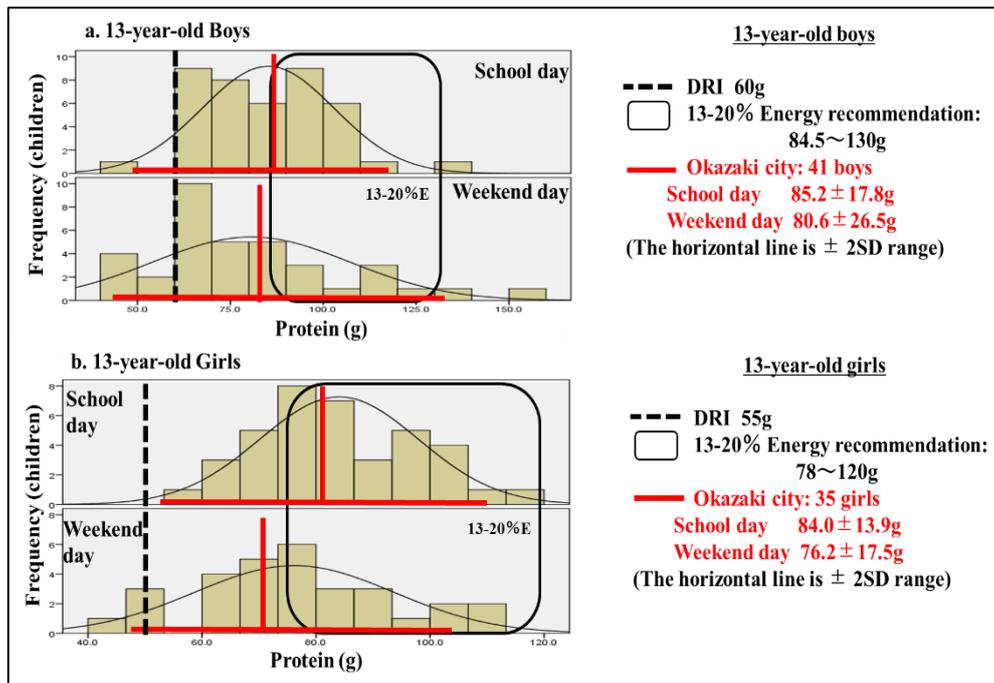


Figure 6: Protein intake of 13-year-old children

Figure 5 and 6 shows the protein intake of 10-year-old and 13-year-old children, respectively. Comparing Okazaki's data of protein intake with a target amount of 13-20% energy recommendation, many children were deficient. On the other hand, as before the revise, when expressed the recommendation in absolute gram

(black bar), most children were sufficient. For example, for 10-year-old boy, the actual protein intake in weekend day was 68.5g, higher than the requirement in gram (60g), but lower than the requirement in percentage of energy (13-20%E = 73-113g).

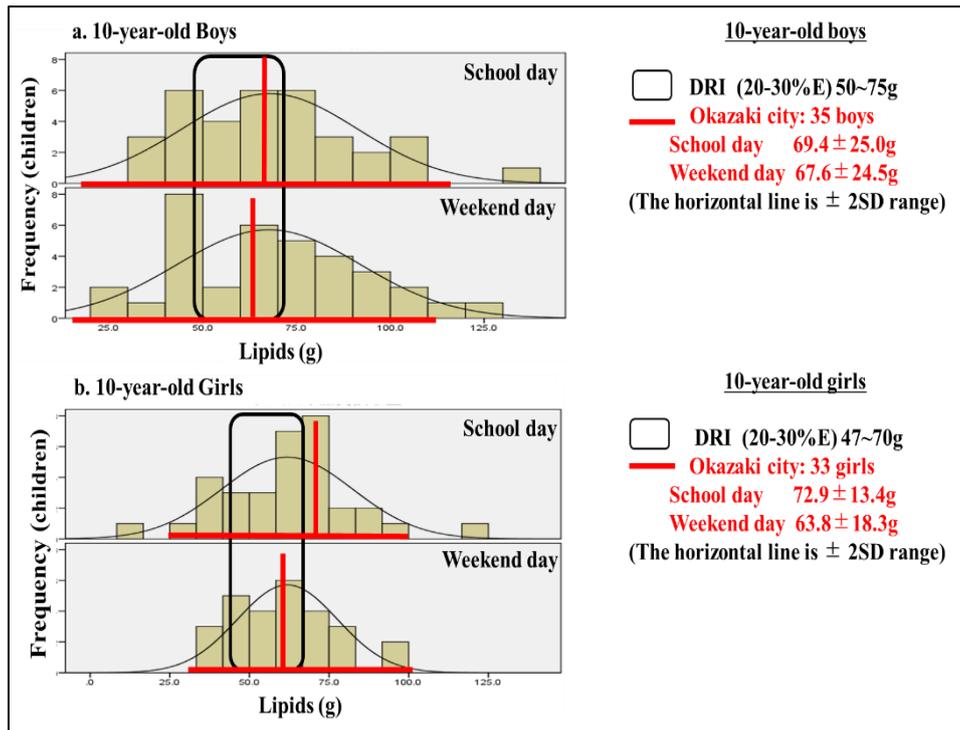


Figure 7: Lipid intake of 10-year-old children

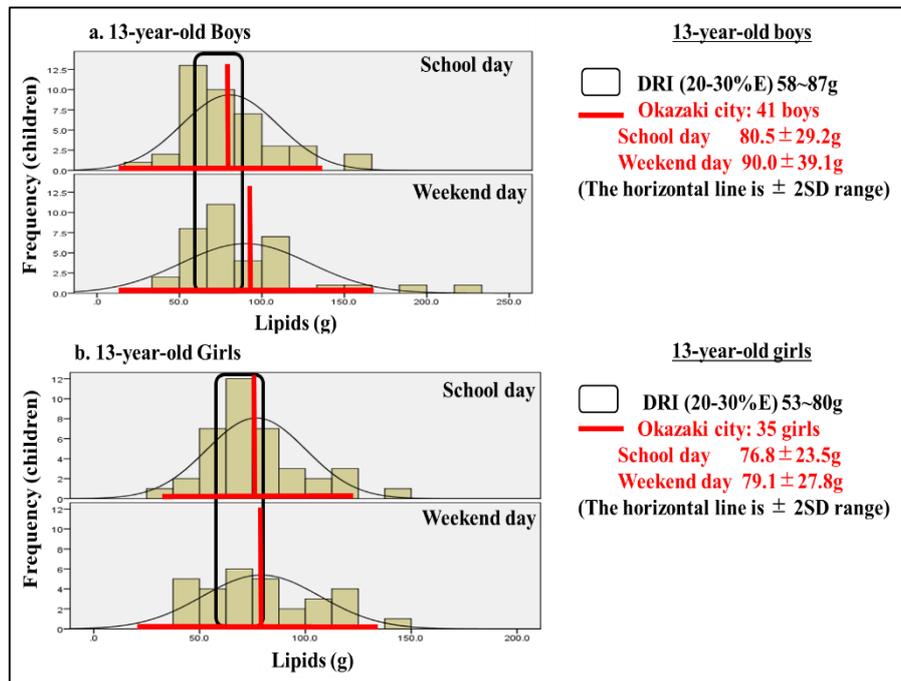


Figure 8: Lipid intake of 13-year-old children

Figure 7 and 8 presents the lipid intake of 10-year-old and 13-year-old children, respectively. Lipid intake was shown to be widespread on both sides of the black frame (dietary intake

recommendation criteria), with some being higher and some being lower than recommended. However, if we see the average intakes, the intakes of children were close to the upper limit of the recommendation.

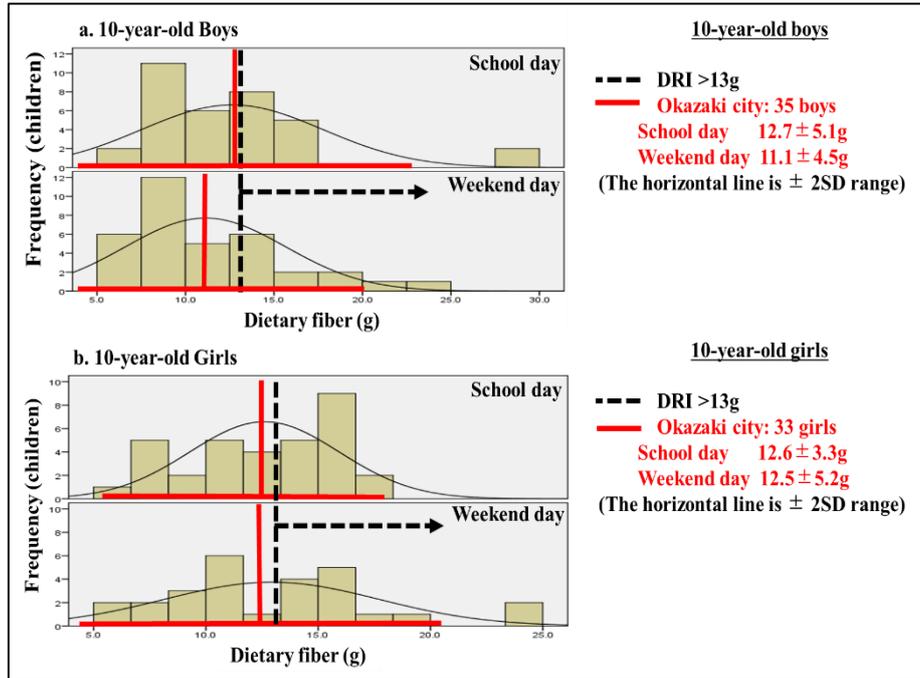


Figure 9: Dietary fiber intake of 10-year-old children

Figure 9 shows dietary fiber intake of 10-year-old children. The mean dietary fiber intake in fifth grade was close to the recommended amount. However, if

we look at the figure, about half of the children consumed less than requirement.

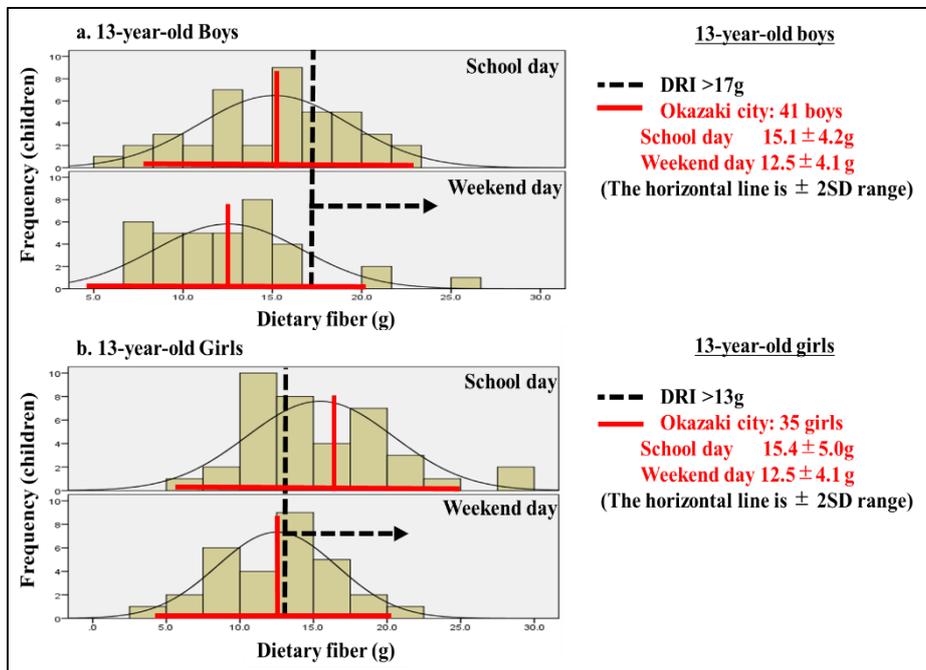


Figure 10: Dietary fiber intake of 13-year-old children

Figure 10 shows dietary fiber intake of 13-year-old children. Unlike fifth graders, dietary fiber intake in

13-year-old children was very low, especially, on the day without school lunch.

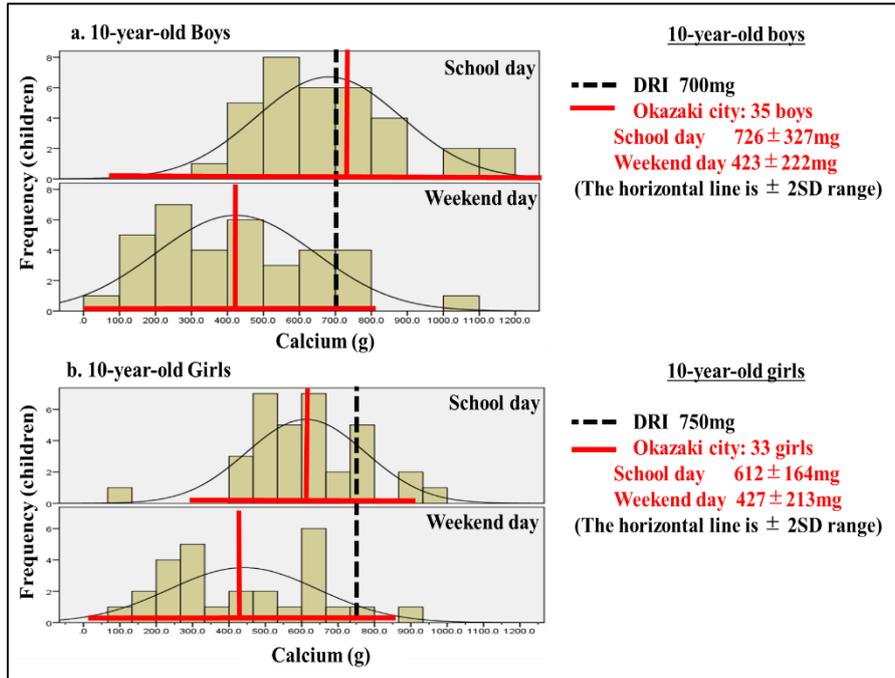


Figure 13: Calcium intake of 10-year-old children

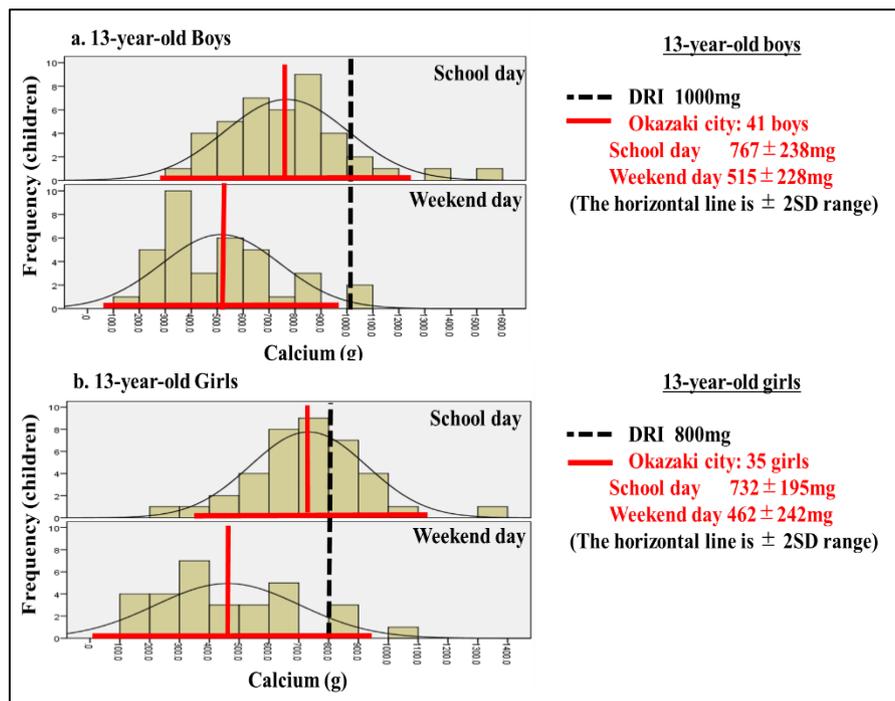


Figure 14: Calcium intake of 13-year-old children

Figure 13 and 14 show the Calcium intake of 10-year-old and 13-year-old children, respectively. Calcium intake was close to the recommended

amount on school day. However, it was significantly lower on weekend day.

DISCUSSION

Our study showed that despite a low energy intake relative to the recommendation, the height and weight of the children were mostly in the normal range. Only 4 out of 68 children aged 10 years and 4 out of 76 children aged 13 years were not within the normal range (Figure 1 and 2).

Energy intakes of 10- and 13-year-old children were about 200 kcal and 300 kcal lower than the recommendations, respectively (Figure 3 and 4). About 70% of the children had an energy intake that was lower than the recommendation. We observed similar results in a 7-day nutrition survey of 200 children in a city in western Japan (2). These results indicate that the current energy recommendation does not fit well with the actual energy intake. In fact, the current energy requirement is based primarily on the results of studies done more than 50 years ago when the level of physical activity was much higher than now. In Japan, the estimated energy requirement has been revised every 5 years, but the basic data are old and only their expression has been changed, sometimes per body surface area, sometimes per body weight, etc. If children can maintain their health with a lower energy intake than the recommendation, the professionals must reconsider that children do more physical activity or decreased the recommendation.

The New protein recommendation was announced as 13 – 20% of energy. If we use these values, more than 30% of children consume less protein than the recommendation (Figure 4 and 5). However, if we use the traditional method (g protein), most of the children satisfied the requirements. There have been very few studies of protein requirements over the last 50 years and they were never estimated using energy intake. Lipids and carbohydrate are usually recommended as percentages of energy, perhaps because their main role is the supply of energy. However, protein is not the same as these nutrients. It is very difficult to estimate the protein requirement using percentages of energy requirements and recommendations.

Lipid intake is recommended as 20-30% of energy. The average lipid intake of children was close to the upper limit of lipid recommendation (Figure 7 and 8). It means that about half of the children took high lipid foods. As we discussed above, there is a possibility that the energy recommendation is too high, which means that if the proper energy recommendation is lower than the present recommendation, more than 50% of children take the upper limit of lipids.

Both fiber (Figure 9 and 10) and Ca (Figure 11 and 12) intakes was lower than the recommendation, especially week end days when they did not have school lunch. It means that school lunch helps to increase fiber and Ca intakes.

In conclusion, there have been poor studies about the dietary recommendations, mostly more than half a century. During the time, life-style of Japanese has changed a lot. New studies and reconsideration of the present recommendations must be studied.

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