eating habits and physical activity among children (27,28). Several clinical trials in adults have shown that even moderate weight loss can reduce the risk of development of type 2 diabetes (29–31). However, the efficacy of dietary and exercise programs in the prevention of type 2 diabetes among youth still remains to be studied. A recent study by Urakami *et al.* (16) reported a reduction in the incidence of type 2 diabetes in Tokyo during 2001–2004, possibly due to a decreased frequency of childhood obesity associated with improved eating habits and physical activity among children. An interventional trial of the effect of lifestyle alterations should be begun in obese children residing in all areas of Japan to establish its efficacy in the prevention of type 2 diabetes as well as the so-called metabolic syndrome in children.

## SUMMARY

The increase of childhood type 2 diabetes is observed not only in Japan but is also reported in various countries including the United States, especially among young people with risk factors for type 2 diabetes (*i.e.* pubertal age, obesity, family history of type 2 diabetes, high-risk racial or ethnic group, etc.) (2–4). It is, therefore, principal to establish a screening program to detect children with having type 2 diabetes at the early stage and create a strategy for prevention and treatment of the disease during childhood worldwide.

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DIABETES RESEARCH AND CLINICAL PRACTICE

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# Waist circumference estimation from BMI in Japanese children

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**Abstract**

Waist circumference, not BMI, is one of the factors in the definition of metabolic syndrome in adults. In children, waist circumference is also a well known predictor of metabolic syndrome. However, waist circumference measurement is not as commonly recorded as weight and height measurements in physical examinations in schools. This means BMI data is available for every child, but waist circumference is not. Therefore, we investigated whether there is an alternative way to estimate waist circumference even in those children whose waist circumference measurement has not been taken. We evaluated the relationship between BMI and the waist circumference of schoolchildren using a relatively large-scale population-based cohort in Japan. There was a significant linear relationship between BMI and waist circumference noted in each age- and sex-divided group [9–10-year-old boys: waist = 13.99 + 2.63BMI ($r = 0.940$, $p < 0.001$), 9–10-year-old girls: waist = 15.09 + 2.61BMI ($r = 0.933$, $p < 0.001$), 12–13-year-old boys: waist = 23.67 + 2.22BMI ($r = 0.880$, $p < 0.001$), 12–13-year-old girls: waist = 23.83 + 2.15BMI ($r = 0.859$, $p < 0.001$)]. This means it is possible to estimate waist circumference from height and weight, at least among those age groups of children in Japan. This estimation could be an alternative way and useful in detecting childhood metabolic syndrome or obesity disease in which a waist circumference figure is necessary.


*Keywords:* Waist circumference; BMI; Children

Waist circumference, not body mass index (BMI), is one of the factors in the definition of metabolic syndrome in adults [1,2]. In children, waist circumference is also a well-known predictor of metabolic syndrome [3–5], although definitions for childhood metabolic syndrome are still different between studies. In Japan, a waist circumference of 80 cm has been established as one of various cutoff points for childhood obesity disease [6]. In these definitions, waist circumference is included as a means by which to detect abdominal obesity, but BMI is not. Moreover, compared to BMI, waist circumference is an even better predictor of cardiovascular disease risk factors [7].

However, in physical examinations in schools, waist circumference measurement is not as commonly recorded as weight and height measurements by which BMI can be calculated. This means BMI data is available

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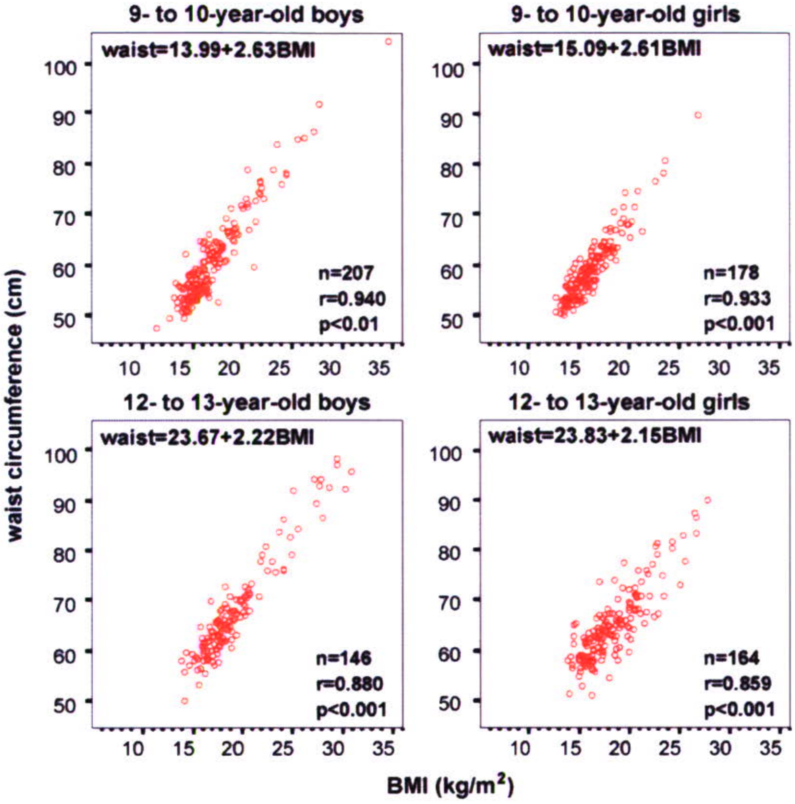


Fig. 1. The linear relationship between BMI and waist circumference in each age- and sex-divided group. *r*: Pearson's correlation coefficients.

for every child, but waist circumference is not. To know what is the waist circumference in children is becoming important, as mentioned above. Therefore, we investigated whether there is an alternative way to estimate waist circumference even in those children whose waist circumference measurement has not been taken.

We evaluated the relationship between BMI and the waist circumference of schoolchildren using a relatively large-scale population-based cohort in Japan. The participants in this study are from the 2004 health promotion plan targeted only to children ages 9–10 and 12–13 in Ina town, Saitama prefecture, located approximately 30 km north of metropolitan Tokyo: 203 boys (participation rate: 99.0%) and 174 girls (98.9%) ages 9–10, and 140 boys (95.9%) and 159 girls (98.8%) ages 12–13. The main activity involved in the health promotion plan is a detailed health examination in conjunction with annual health checks at school per Japanese school regulations. We have reported the results of this health promotion plan previously [8–10].

The children underwent physical examinations. Measurements of height, weight, and waist circumference were taken. Waist circumference was measured at the navel level, while another examiner checked verticality from the side. We then investigated the relationship between BMI and waist circumference with Pearson's correlation coefficients using the SPSS program.

The results are as shown in Fig. 1. There is a significant linear relationship between BMI and waist circumference noted in each age- and sex-divided group [9–10-year-old boys: waist = 13.99 + 2.63BMI ($r = 0.940$, $p < 0.001$); 9–10-year-old girls: waist = 15.09 + 2.61BMI ($r = 0.933$, $p < 0.001$); 12–13-year-old boys: waist = 23.67 + 2.22BMI ($r = 0.880$, $p < 0.001$); 12–13-year-old girls: waist = 23.83 + 2.15BMI ($r = 0.859$, $p < 0.001$)]. This means it is possible to estimate waist circumference from height and weight, at least among those age groups of children in Japan. Of course, the best way is to measure waist circumference itself, but in Japan it is culturally somewhat difficult to conduct waist circumference measurement that involves the raising of clothes because this activity is considered shameful. Therefore, estimation using height and weight could be an alternative way for those who do not have waist circumference data and useful in detecting childhood metabolic syndrome or obesity disease in which a waist circumference figure is necessary.

Further investigations are necessary to evaluate whether there is a similar linear relationship between BMI and waist circumference in other age groups of children and adolescents.

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DIABETES RESEARCH AND CLINICAL PRACTICE

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# Childhood obesity and its relation to serum adiponectin and leptin: A report from a population-based study

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**Abstract**

This study examined the relationships between serum adiponectin (AD) and leptin (LP) levels, and obesity using a population-based cohort consisted of 315 (9–10 year olds: G1) and 308 (12–13 year olds: G2) school children. Serum AD, LP and other markers were compared according to the presence of obesity.

The prevalence rates of obesity were 14.9% in G1 and 9.4% in G2. The medians of serum AD (μg/dl: non-obese/obese) were statistically lower in obese children (9.6/8.3 in G1, $p < 0.05$; 8.9/6.6 in G2, $p < 0.05$), and the medians of serum LP (ng/dl) were statistically higher in obese children (3.7/12.5 in G1, $p < 0.05$; 2.9/8.4 in G2, $p < 0.05$). The serum LP levels were significantly positively correlated with percent overweight (POW) irrespective of age and sex, and the serum AD levels were significantly negatively correlated with POW except for boys in G1. Multivariate regression analyses revealed that LP, LDL-cholesterol and gender in G1, and LP, AD, blood pressure and gender in G2 were significantly correlated with POW.

A large-scale, population-based study revealed that AD was lower and LP higher in obese children, and that the obese status in G2 was related to a worse metabolic profile than the case in G1.



*Keywords:* Children; Obesity; Leptin; Adiponectin

## 1. Introduction

Increasing prevalence of childhood obesity is a global problem, and especially so in Asian countries [1–3]. Obesity is a serious healthcare issue, as it is associated with hyperinsulinemia, diabetes mellitus [4], dyslipidemia hypertension and atherosclerosis [5]. Adipocytokines, including leptin and adiponectin have been proven to be one of the determinants of insulin resistance [6,7]. Obese adults are reported to have higher serum leptin and lower serum adiponectin levels, compared to non-obese subjects [8,9]. Similar findings regarding serum leptin in children have been reported from Taiwan and the United States [10,11], and regarding adiponectin have been reported by studies based on Pima Indians and Japanese children [6,12,13]. However, these results were not derived from population-based samples,

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but from relatively small population samples, and conclusions derived from this data cannot be applied to the general population. From a public health perspective, it is very important to be able to identify children in the general population who are at risk for becoming obese or developing metabolic syndrome.

The current study, therefore, assesses the relationship between adipocytokines and obesity in children in general, using a population-based cohort in Japan.

## 2. Methods

The current health promotion plan was initiated in 1994 for the promotion of a healthy lifestyle in children who live in Ina-town, Saitama Prefecture [14,15]; this area hosts a population of approximately 35,000 and is located approximately 30 km north of metropolitan Tokyo. Occupations of the residents range from farming through to commuting to work in Tokyo. The main activity involved in the health promotion plan is a detailed health examination – including blood sampling and lifestyle intervention, if necessary – in conjunction with annual health checks at school as per Japanese School Law. The subjects of this study were participants in the health promotion plan, which was conducted in September 2002; the subjects comprised 169 boys (participation rate: 98.3%) and 146 girls (99.3%), aged 9–10 years (i.e., fourth-graders), from all three public elementary schools in Ina-town, and 158 boys (98.8%) and 150 girls (97.4%) aged 12–13 years (i.e., first-graders) from all three public junior high schools in Ina-town. The participants represented almost the entire children of the same age in the town.

The children underwent physical examinations consisting of venous blood sampling to measure serum levels of total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL), plasma glucose (PG), leptin and adiponectin. Measurements of height, weight and systolic blood pressure were also taken.

TC, TG, LDL and PG were measured with routine automated laboratory methods. The levels of LDL were determined by Cholestest-LDL kit (Daiichi Pure Chemicals, Japan) [16]. Adiponectin levels were determined with commercially available ELISA kits (Otsuka Pharmaceutical Co Ltd., Japan) with intra- and inter-assay coefficients of variation below 10%, which was reported in a paper by Arita et al. [17]. Leptin levels were measured using commercially available RIA kits (Linco Research Inc.) with intra- and inter-assay coefficients of variation below 10%, as described previously [18]. Blood collection was usually performed 2 to 3 h after eating breakfast because of recommendations by the Institutional Review Board (IRB).

Blood pressure was measured in the right arm with a standard mercury sphygmomanometer, with the subjects sitting in a relaxed state.

Obesity, for purposes of this study, was defined as a body weight at least 120 percent overweight (POW) compared to the sex- and age-matched ideal standardized body weights for Japanese children [19].

Serum adiponectin, leptin and other markers for obese children were compared to non-obese subjects. The correlation between leptin, adiponectin and POW was examined by univariate regression analyses. Step-wise multivariate regression analyses were employed to assess the potential predictors of POW with the independent variables of adiponectin, leptin, LDL, TG, PG SBP and sex.

As leptin and adiponectin distributions were skewed, each variable was expressed as a median and intraquartile range in parentheses. Non-parametric analyses using the Wilcoxon rank sum test were employed for comparison. Spearman's correlation coefficients were employed for univariate regression analyses. Statistical analyses were conducted using the SPSS program and SAS software.

The study protocol was approved by the two independent IRB at Jikei University School of Medicine and Showa University School of Medicine. Written informed consent was obtained from all participants and their parents.

## 3. Results

### 3.1. Prevalence of obesity

The prevalence rates of obesity were 17.8% for boys and 11.6% for girls in the 9–10-year-old group, and 12.0% for boys and 6.7% for girls in the 12–13-year-old group. The highest prevalence was observed in boys aged 9–10 years.

### 3.2. Adiponectin and leptin levels according to obesity status

The levels of serum adiponectin were statistically lower in obese children compared to non-obese, with the exception of girls in the 12–13-year-old group (Table 1). The levels of serum leptin were statistically higher in obese children compared to non-obese, irrespective of age and gender (Table 1).

### 3.3. Clinical variables according to obesity status

Regarding TC, TG, LDL, PG and SBP, 9–10-year-old obese boys and girls had higher levels in all variables with the exception of PG. Obese boys aged 12–13 years had higher levels in TG and SBP, and 12–13-year-old obese girls had higher levels in TC and SBP compared to non-obese subjects (Tables 1 and 2).

### 3.4. Regression analyses

The serum leptin levels were significantly positively correlated with POW irrespective of age and sex, and the serum adiponectin levels were significantly

Table 1
Percent overweight (POW), systolic blood pressure (SBP), and serum adiponectin and leptin according to age, sex and obesity status

| | 9–10 years old | | | 12–13 years old | | |
|---|---|---|---|---|---|---|
| | Obesity − | Obesity + (%) | Total | Obesity − | Obesity + (%) | Total |
| *N* | | | | | | |
| Boys | 139 | 30 (17.8) | 169 | 139 | 19 (12.0) | 158 |
| Girls | 129 | 17 (11.6) | 146 | 140 | 10 (6.7) | 150 |
| Total | 268 | 47 (14.9) | 315 | 281 | 29 (9.4) | 308 |
| POW (%) | | | | | | |
| Boys | −2.5 (−8.5–4.5) | 32.8 (26.8–45.2) | 0.2 (−7.2–14.3) | −2.6 (−9.2–4.0) | 27.4 (23.2–38.9) | −1.5 (−8.4–8.1) |
| Girls | −2.5 (−8.0–7.1) | 34.9 (28.7–38.4) | −1.1 (−7.4–9.7) | −6.1 (−13.8–3.7) | 30.5 (24.7–46.6) | −5.0 (−13.5–4.4) |
| Total | −2.5 (−8.5–6.0) | 33.2 (27.0–40.5) | −0.3 (−7.4–11.8) | −4.5 (−10.9–3.8) | 29.0 (24.0–38.9) | −2.5 (−10.3–7.0) |
| SBP (mmHg) | | | | | | |
| Boys | 110 (102–118) | 119 (114–130)* | 112 (104–120) | 104 (99–116) | 120 (106–131)* | 106 (100–117) |
| Girls | 108 (102–116) | 118 (110–126)* | 110 (102–118) | 105 (98–115) | 117 (112–124)* | 106 (98–116) |
| Total | 110 (102–118) | 118 (114–126)* | 110 (103–120) | 104 (98–115) | 120 (112–125)* | 106 (99–116) |
| Adiponectin (ng/dl) | | | | | | |
| Boys | 9.7 (7.2–12.0) | 7.6 (5.6–10.2)* | 9.5 (6.9–11.6) | 8.5 (6.8–11.0) | 6.4 (5.3–10.8)* | 8.3 (6.6–10.8) |
| Girls | 9.6 (7.5–11.9) | 8.3 (5.8–8.7)* | 9.2 (7.3–11.5) | 9.5 (7.7–12.1) | 8.3 (5.9–9.4) | 9.4 (7.6–12.1) |
| Total | 9.6 (7.3–12.0) | 8.3 (5.6–9.9)* | 9.3 (7.0–11.6) | 8.9 (7.3–11.2) | 6.6 (5.8–9.4)* | 8.7 (7.0–11.1) |
| Leptin (ng/dl) | | | | | | |
| Boys | 2.8 (2.1–5.0) | 10.6 (8.3–14.9)* | 3.7 (2.2–7.3) | 2.0 (1.5–2.8) | 7.0 (5.3–10.8)* | 2.2 (1.6–3.4) |
| Girls | 4.1 (3.2–6.2) | 13.0 (10.4–18.5)* | 4.5 (3.3–7.1) | 4.6 (3.0–6.2) | 13.3 (9.2–15.5)* | 4.7 (3.1–6.8) |
| Total | 3.7 (2.4–5.5) | 12.5 (8.6–16.4)* | 4.1 (2.5–7.1) | 2.9 (1.9–5.0) | 8.4 (6.8–11.8)* | 3.2 (2.0–5.9) |

Values are expressed as median and intraquartile range in the parenthesis. The obese status was defined as a body weight at least 120 percent overweight compared to the sex- and age-matched ideal standardized body weights for Japanese children according to ref. [19].

* $p < 0.05$ by Wilcoxon rank sum test.

negatively correlated with POW with the exception of 9–10-year-old boys (Fig. 1).

Multivariate regression analyses revealed that the higher level of leptin and LDL, and male gender in the 9–10 age group and the higher levels of leptin and SBP, the lower level of adiponectin and male gender in the 12–13 age group were the significantly correlated with POW (Table 3).

## 4. Discussion

The prevalence of childhood obesity is increasing worldwide. Nonetheless, information regarding childhood obesity and its relationship to adipocytokines in children is still limited. This is the first study to observe adiponectin and leptin levels in groups with or without obesity, within a population-based cohort of children in Japan.

As was reported in adult and childhood populations [6,10–13], the serum leptin level was higher and the adiponectin level was lower in obese children, irrespective of age and sex, as compared to those in the current study who were not obese.

Regarding the age-specific levels of these adipocytokines, several reports have been published. The level of serum leptin increased with age, with a peak noted at 16–20 years [20]; the levels of serum adiponectin do not change with age in 18–80-year-old women [21]. In the current study, the serum leptin and adiponectin levels in girls were the same between 9–10 years and 12–13 years. In contrast, both values in the 12–13-year-old boys group were lower than those in the 9–10-year-old boys group. Similar findings have been reported in Germany and in Ohio, USA, with adiponectin values of post-pubertal children lower than in pre-pubertal children, especially in boys [22,23]. These studies indicate that the low adiponectin level in adolescent boys was significantly related with plasma androgen levels [23]. Regarding leptin, Huang et al. reported that the plasma leptin levels were significantly higher in girls than boys aged 10–19 years old, possibly due to a stimulatory effect of estradiol on leptin concentration in girls and a suppressive effect of testosterone on leptin concentration in boys [24].

Multivariate regression analyses revealed that higher levels of SBP and lower levels of adiponectin were significantly correlated with POW only in the 12–13-year-old group, not in the 9–10-year-old group. The results indicate that the obese status in the 12–13-year-old group was related to a worse metabolic profile than

Table 2
Plasma glucose (PG), Total cholesterol (TC), Triglyceride (TG), LDL cholesterol (LDL) according to age, sex and obesity status

| | 9–10 years old | | | 12–13 years old | | |
|---|---|---|---|---|---|---|
| | Obesity − | Obesity + | Total | Obesity − | Obesity + | Total |
| *N* | | | | | | |
| Boys | 139 | 30 (17.8) | 169 | 139 | 19 (12.0) | 158 |
| Girls | 129 | 17 (11.6) | 146 | 140 | 10 (6.7) | 150 |
| Total | 268 | 47 (14.9) | 315 | 281 | 29 (9.4) | 308 |
| PG (mg/dl) | | | | | | |
| Boys | 92 (88–95) | 93 (88–98) | 92 (88–95) | 90 (84–95) | 92 (88–95) | 90 (84–95) |
| Girls | 88 (86–93) | 92 (89–95)* | 89 (86–94) | 88 (83–92) | 91 (88–97) | 88 (84–92) |
| Total | 90 (87–94) | 93 (88–97)* | 91 (87–95) | 89 (84–94) | 92 (88–95)* | 89 (84–94) |
| TC (mg/dl) | | | | | | |
| Boys | 169 (155–186) | 186 (172–200)* | 172 (157–190) | 161 (145–176) | 162 (150–191) | 161 (145–177) |
| Girls | 170 (152–193) | 183 (172–205)* | 171 (155–195) | 172 (159–187) | 157 (134–171)* | 171 (158–187) |
| Total | 170 (155–189) | 185 (172–205)* | 172 (157–192) | 167 (151–182) | 159 (143–189) | 166 (151–183) |
| TG (mg/dl) | | | | | | |
| Boys | 64 (43–89) | 97 (63–138)* | 69 (46–99) | 50 (37–74) | 67 (47–177)* | 52 (38–79) |
| Girls | 69 (53–98) | 113 (73–126)* | 73 (54–103) | 60 (42–83) | 66 (44–88) | 60 (42–84) |
| Total | 67 (48–95) | 103 (66–138)* | 71 (50–101) | 54 (39–78) | 67 (44–130)* | 55 (40–83) |
| LDL (mg/dl) | | | | | | |
| Boys | 92 (81–109) | 114 (83–130)* | 95 (81–114) | 92 (77–105) | 102 (90–114) | 93 (78–105) |
| Girls | 95 (81–113) | 117 (105–127)* | 97 (83–117) | 103 (89–116) | 89 (74–118) | 103 (89–116) |
| Total | 94 (81–110) | 115 (91–129)* | 96 (82–115) | 97 (83–110) | 94 (84–114) | 97 (83–111) |

Values are expressed as median and intraquartile range in the parenthesis. The obese status was defined as a body weight at least 120 percent overweight compared to the sex- and age-matched ideal standardized body weights for Japanese children according to ref. [19].
* $p < 0.05$ by Wilcoxon rank sum test.

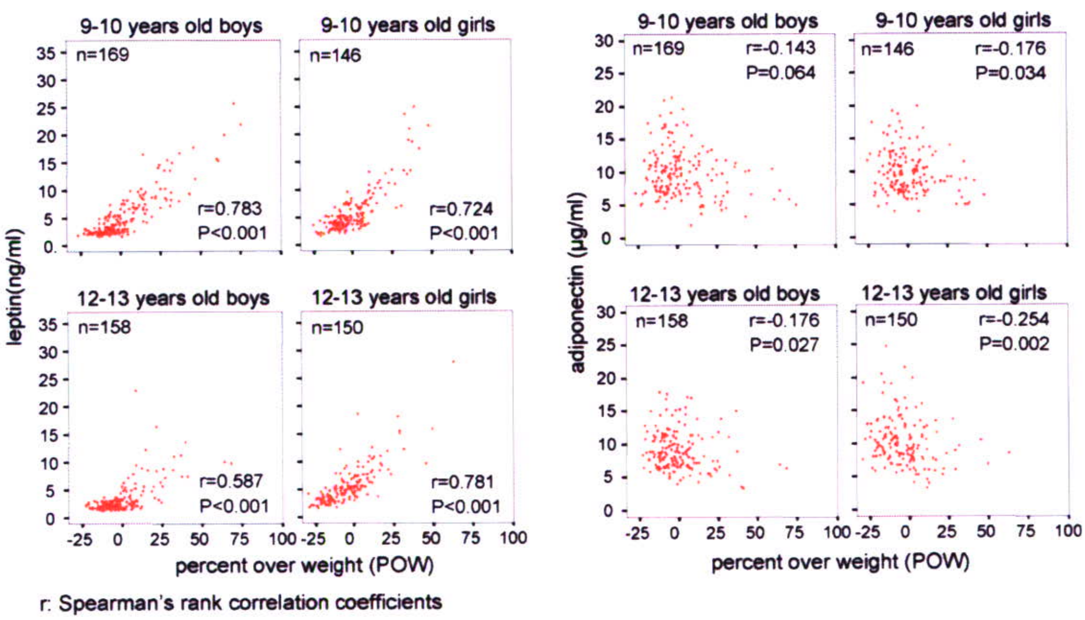


Fig. 1. Correlation between percent overweight (POW) and serum leptin/adiponectin levels in children according to age and sex from a population-based cohort. r: Spearman's rank correlation coefficients.

Table 3
Factors associated with percent overweight (POW), assessed by the step-wise multiple regression analyses by age

| 9–10 years old | | | 12–13 years old | | |
|---|---|---|---|---|---|
| Independent variables | $\beta$ | $p$ | Independent variables | $\beta$ | $p$ |
| Leptin | 0.824 | <0.001 | Leptin | 0.692 | <0.001 |
| Sex (girls/boys) | −0.139 | <0.001 | Sex (girls/boys) | −0.321 | <0.001 |
| LDL | 0.066 | 0.041 | SBP | 0.198 | <0.001 |
| | | | Adiponectin | −0.088 | 0.023 |

Variables included in the model: adiponectin, leptin, plasma glucose (PG), low density lipoprotein cholesterol (LDL), triglyceride (TG), systolic blood pressure (SBP), sex.

that seen in the 9–10-year-old group, probably due to increased secretion of gonadal hormones after puberty [23,24].

A limitation of this study was that it was based on cross-sectional data, and not as a follow-up study. Therefore, markers in 9–10-year-old children were not necessarily predictors for 12–13-year-old children. We plan on following the participants of this study who were aged 9–10 years for the next three years, to identify possible predictors of obesity status and adipocytokines.

Another limitation is that we did not obtain markers for puberty status (e.g., Tanner's stage) of the study participants. However, there are more than 600 children participating in the study and it is technically impossible to obtain information from all participants.

The current study indicates that serum leptin level is higher and serum adiponectin lower in obese children than those in non-obese children, within a population-based cohort in Japan. A follow up study is warranted, especially regarding the values of adipocytokines and the levels and types of obesity in the study participants.

## Acknowledgements

We are indebted to all study participants and their parents. The authors would like to thank all the members of the Board of Education in Ina-town of Saitama Prefecture and Ina-town Conference for the Promotion and Operation of Childhood Lifestyle-Related Diseases Prevention Examination (Chairman: Dr. Michio Sato, Yoshihito Toriyama). This study was supported by a grant from the Ministry of Education, Culture, Sports, Science and Technology, Japan (Basic Research (A2), #14207020, 2002–2004 and Basic Research (A), #17209024, 2005–2008).

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DIABETES RESEARCH AND CLINICAL PRACTICE

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# Gender differences in the relationship between percent body fat (%BF) and body mass index (BMI) in Japanese children

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**Abstract**

The purpose of the present study was to examine whether gender differences exist in the relationship between percent body fat (%BF) and body mass index (BMI) in Japanese children using a population-based cohort. Subjects are comprised of 187 boys and 163 girls aged 9–10, and 137 boys and 155 girls aged 12–13. Percent BF was measured using a bipedal biometrical impedance analysis (BIA) device. The relationship between %BF and BMI was investigated as a function of age and gender with Pearson's correlation coefficient. Strong linear relationships existed between %BF and BMI, especially in girls (9–10-year-old boys: $r = 0.779$, $P < 0.0001$; 9–10-year-old girls: $r = 0.975$, $P < 0.0001$; 12–13-year-old boys: $r = 0.786$, $P < 0.0001$; 12–13-year-old girls: $r = 0.975$, $P < 0.0001$). These results indicate that %BF can be predicted from BMI in Japanese children aged 9–10 and 12–13 years. The correlations in boys were not as strong as those observed in girls, that is, less variability was explained for girls than for boys. Further study will be necessary to ascertain whether the strong correlation seen among girls will be observed in different age or ethnic groups, and to ascertain the mechanism that produces this gender difference.



*Keywords:* Percent body fat; BMI; Gender difference; Children; Japanese

Obesity is the condition of increased body weight caused by excessive accumulation of fat. Measuring percent body fat (%BF) is an ideal way to diagnose obesity. However, a device to measure %BF is expensive and cannot be used everywhere. Instead of %BF, calculating BMI (weight (kg)/height ($m^2$) establishes a simple way to assess obesity [1–5].

Accumulated data indicate a strong correlation between %BF and BMI [6–10], and show that it is possible to estimate %BF from BMI [8–10]. However, it is also known that %BF is highly variable, yielding different values even when people have the same BMI [11]. Some individuals who are overweight are not "overfat" or obese (e.g., bodybuilders and athletes). Moreover, age, gender and ethnic differences exist in this relationship [7,9,10,12,13]. However, data for gender differences among children are limited. Therefore, we examined whether gender differences exist in

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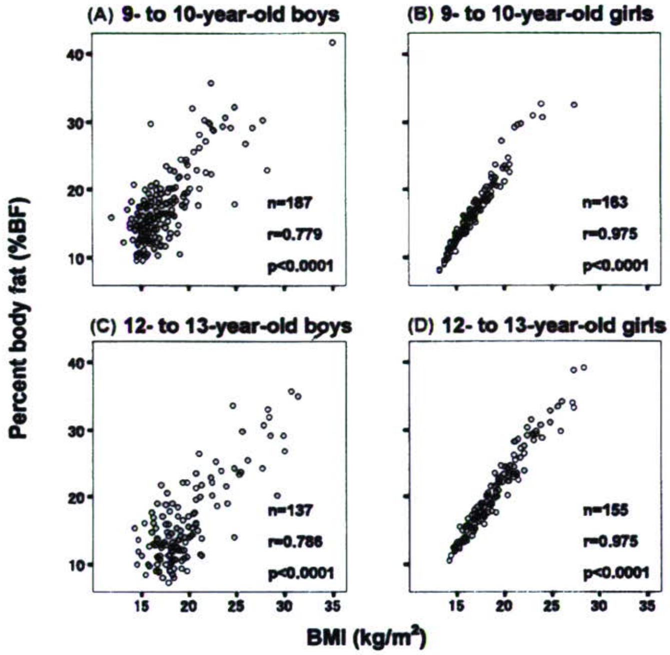


Fig. 1. The relationship between %BF and BMI in each age- and sex-divided group. (A) %BF = 1.39 × BMI-6.50, (B) %BF = 2.11 × BMI-18.89, (C) %BF = 1.35 × BMI-10.57, and (D) %BF = 1.96 × BMI-16.50; *r*, Pearson's correlation coefficient.

the relationship between %BF and BMI in Japanese children using a population-based cohort.

The subjects of this study were participants in the 2004 health promotion plan targeted to school children aged 9–10 years (4th graders) and 12–13 years (7th graders) in Ina-town, Saitama prefecture, located approximately 30 km north of metropolitan Tokyo. The cohort consisted of 187 boys (participation rate: 90.3%) and 163 girls (91.6%) aged 9–10, and 137 boys (91.3%) and 155 girls (93.9%) aged 12–13. We reported the results of this health promotion plan previously [14–18]. This study was approved by the Institutional Review Board of the Jikei University School of Medicine. Written informed consent was obtained from all participants and their parents.

The children underwent physical examinations in September 2004. Measurements of height, weight and %BF were collected. Height was measured to the nearest 0.1 cm without socks or shoes using a stadiometer. Body weight was measured by a scale to the nearest 0.1 kg, and %BF was measured by a bipedal biometrical impedance analysis (BIA) device (Model TBF-102, Tanita, Tokyo, Japan) to the nearest 0.1% in the morning, over light clothing in a standing position. BMI was calculated as weight/height$^2$ and reported in kg/m$^2$. The relationship between %BF and BMI was investigated as a function of age and gender with Pearson's correlation coefficient using the Statistical Package for the Social Sciences (SPSS).

Significant linear relationships were observed between %BF and BMI especially in girls: (9–10-year-old boys: %BF = 1.39 × BMI-6.50 ($r = 0.779$, $P < 0.0001$); 9–10-year-old girls: %BF = 2.11 × BMI-18.89 ($r = 0.975$, $P < 0.0001$); 12–13-year-old boys: %BF = 1.35 × BMI-10.57 ($r = 0.786$, $P < 0.0001$); 12–13-year-old girls: %BF = 1.96 × BMI-16.50 ($r = 0.975$, $P < 0.0001$)) (Fig. 1). These results indicate that %BF can be predicted from BMI in Japanese children aged 9–10 and 12–13 years. The correlations in boys were not as strong as those observed in girls, but the reason for this difference is unclear. One possible explanation is that individual variation in body composition (fat, muscle, bone, etc.) in boys is much larger than in girls. Further study will be necessary to determine if the strong correlation that exists between %BF and BMI among girls will be observed in different age or ethnic groups, and to ascertain the mechanism that produces this gender difference.

## Acknowledgments

We are indebted to all the study's participants and their parents. The authors also would like to thank all the members of the Board of Education in Ina-town in Saitama Prefecture, and the Ina-town Conference for the Promotion and Operation of Childhood Lifestyle-related Diseases Prevention Examination (Chairman: Dr. Michio Sato and Dr. Yoshihito Toriyama). This study was supported by a grant from the Ministry of Education, Culture, Sports, Science and Technology, Japan.

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文献9

# Pediatric Diabetes

Volume 8 • Supplement 8

## The Global Burden of Youth Diabetes: Perspectives and Potential
## A Charter Paper

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# Pediatric Diabetes

Volume 8 • Supplement 8

## Contents

# Preface

unite for diabetes

It is a singular tragedy that, despite the emergence in recent years of increasingly effective strategies for the metabolic/glycaemic control of type 1 and type 2 diabetes mellitus, this disease continues to exact a terrible toll. Perhaps no group better exemplifies the diabetes crisis gripping both developed and developing nations today than the child. Children and adolescents with diabetes represent society's most vulnerable population – and it is indeed a tragedy that young lives continue to be lost to a disease for which adequate management tools and knowledge exist.

This Charter Paper has been developed as part of the International Diabetes Federation (IDF) 'Unite for Diabetes' campaign, which seeks to raise awareness of diabetes and stimulate action to help minimize its impact. This Charter Paper has been developed by a group of experts working in close association with the Unite for Diabetes Working Group on Special Populations. Among the goals of Unite for Diabetes was to create and pass a Resolution by the United Nations (UN) calling for global awareness and action on diabetes. This Resolution passed unanimously in the General Assembly of the UN on December 20, 2006, representing an important step towards better care for everyone with diabetes.

From the preparation to the celebration of this UN Resolution on Diabetes, it is now time to act. It is our sincere wish that ***The Global Burden of Youth Diabetes: Perspectives and Potential*** will become an agent of change. By bringing together, for the first time, a comprehensive portrait of the world of child and adolescent diabetes, we seek to motivate health systems around the world to do more for their young citizens touched by type 1 and type 2 diabetes.

Each chapter concludes with a series of tangible recommendations that we sincerely hope will inspire stakeholders in the diabetes community to advocate for positive change. Progress is possible – not in the future but today, using available resources and infrastructure. Our children deserve nothing less.

In closing, it is important to mention that the goals of IDF for improving the lives of children and adolescents with diabetes join with those of a number of committed organisations. Fourteen years ago, experts from The International Society for Pediatric and Adolescent Diabetes (ISPAD) gathered to develop the Declaration of Kos – a seminal work containing pledges to work to the following objectives by the year 2000:

- To make insulin available for all children and adolescents with diabetes
- To reduce the morbidity and mortality rate of acute metabolic complications or missed diagnosis related to diabetes
- To make age-appropriate care and education accessible to all children and adolescents with diabetes, as well as to their families
- To increase the availability of appropriate urine and blood self-monitoring equipment for all children and adolescents with diabetes
- To develop and encourage research on diabetes in children and adolescents around the world
- To prepare and disseminate written guidelines and standards for practical and realistic care and education of young people with diabetes and their families, emphasising the crucial role of healthcare professionals, and not just physicians, in these tasks around the world

While these goals have not yet all been attained, they continue to represent guiding principles for the care of young people with diabetes.

Sincerely,

Professor Martin Silink
*President*
*International Diabetes Federation*

# Introduction from the Chair

## July 2007

As a pediatric diabetologist I spend my professional life attending to young persons with diabetes. I am constantly heartened by the determination, positive attitude and wisdom beyond their years demonstrated by the children and their families in my center. Despite the issues, inconveniences and concern caused by their condition, these young people bring a refreshingly positive attitude through my doors each day.

When Martin Silink asked me to Chair the Youth Charter project I was immediately excited by this unique opportunity to create a publication that can motivate positive change for young people with diabetes, in countries on every continent.

This document – this chance to evolve *from charter to change* – is the result of a great deal of hard work from a number of individuals and organizations. In addition to the International Diabetes Federation, I would like to acknowledge the International Society of Pediatric and Adolescent Diabetes (ISPAD) for their contributions to the Youth Charter. We were especially grateful to collaborate with past and present ISPAD board members for the perspective they brought on behalf of an organisation that works effectively on the advancement of care, advocacy and science of diabetes in youth. From the ISPAD Declaration of Kos 14 years ago, to the cutting edge clinical and scientific initiatives, ISPAD is truly making a difference. It is for these reasons that we are particularly proud that ISPAD has elected to enhance the voice of the Youth Charter by endorsing its aims and recommendations.

Henk-Jan Aanstoot
*Rotterdam, Netherlands*

# Editor's Note

- Throughout this document, the words 'child' and 'children' have been used for the sake of clarity and economy. These terms will cover the age range from infancy through childhood and into young adulthood, using a cut-off point of 18 years. The age range of the children discussed in the various studies used to illustrate the Charter will be specified where relevant.
- Throughout this document, the term 'diabetes' has been used. It refers to diabetes mellitus in all cases. Type 1 and type 2 diabetes mellitus are included, and discussed individually or together as relevant.

Pediatric Diabetes

# International Society for Pediatric and Adolescent Diabetes (ISPAD)

## Declaration of Kos

On September 4, 1993, on the Island of Kos, the members of the International Study Group of Diabetes in Children and Adolescents (ISGD), assembled at their 19th annual international scientific meeting and in the process of transforming ISGD into the International Society for Pediatric and Adolescent Diabetes (ISPAD), renewed their Hippocratic oath by proclaiming their commitment to implement the St Vincent Declaration to promote optimal health, social welfare and quality of life for all children and adolescents with diabetes around the world by the year 2000. They took this unique opportunity to reaffirm the commitments by diabetes specialists in the past and, in particular, unanimously pledged to work towards the following:

- To make insulin available for ALL children and adolescents with diabetes
- To reduce the morbidity and mortality rate of acute metabolic complications or missed diagnosis related to diabetes mellitus
- To make age-appropriate care and education accessible to ALL children and adolescents with diabetes, as well as to their families
- To increase the availability of appropriate urine and blood self-monitoring equipment for ALL children and adolescents with diabetes
- To develop and encourage research on diabetes in children and adolescents around the world
- To prepare and disseminate written guidelines and standards for practical and realistic care and education of young people with diabetes – and their families – emphasizing the crucial role of healthcare professionals – and not just physicians – in these tasks around the world