ORIGINAL ARTICLE

Recent Change in the Annual Incidence of Childhood Type 2 Diabetes in the Tokyo Metropolitan Area

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Abstract. This study evaluated recent changes in the annual incidence of childhood type 2 diabetes in the Tokyo metropolitan area. From 1974 to 2004, a total of 236 students were diagnosed as having type 2 diabetes by the urine glucose screening program at school. The overall incidence of type 2 diabetes was 2.55/100,000. Overall, 83.9% of students with diabetes were obese; junior high school students had a significantly higher incidence than primary school students (0.75 vs. 6.27/100,000). The annual incidences over the 5-yr periods from 1974–2004 were 1.73, 3.23, 3.05, 2.90, 2.70 and 1.41/100,000, respectively. The incidences in 1974–1980 and 2001–2004 were significantly lower than those in 1981–1985, 1986–1990 and 1991–1995, because primary school students in 1974–1980 had a significantly lower incidence (0.27/100,000), and junior high school students in 2001–2004 had a somewhat lower incidence (3.66/100,000) than during 1981–2000. In recent years, Japanese children’s lifestyle and eating habits have gradually improved, and this may have contributed to the trend toward decrease in the incidence of type 2 diabetes in 2001–2004 in the Tokyo metropolitan area.

Key words: childhood type 2 diabetes, urine glucose screening program at school, the incidence of diabetes, obesity, change in children’s lifestyle

Introduction

In the 21st century, type 2 diabetes is increasing in prevalence all over the world, and approximately 150–160 million people worldwide now suffer from it (1, 2). The majority of patients with type 2 diabetes are adults. However, several studies have demonstrated that the incidence of childhood type 2 diabetes has increased and continues to be on the rise (3–5). It is noteworthy that some ethnic groups including Hispanics, African-Americans and Asians are at high risk of developing type 2 diabetes in youth as well as during adulthood (3, 4). We previously reported that the incidences of children with type 2 diabetes as detected by urine glucose screening at school in the Tokyo metropolitan area in 1974–1980, 1981–1985, 1986–1990 and 1991–1995 were 1.73, 3.23, 3.05 and 2.90, respectively (6). The incidences from 1981–1995 were significantly higher than in 1974–1980. On the other hand, there was no statistically
significant change in incidence after 1981. A similar trend toward increase in frequency of type 2 diabetes among school students has been reported in other Japanese prefectures (7–9). Among the children with type 2 diabetes in our study, more than 80% had obesity. Increased prevalence of obesity among Japanese children may be related to the increase in the number of children with this disorder during the past 20–30 years.

Recently, significant concern regarding childhood obesity and associated metabolic disorders has spread in the Japanese population and many Japanese people have accordingly changed their eating habits and physical activities. The Ministry of Education, Culture, Sports, Science and Technology of Japan reported a recent trend toward decrease in the prevalence of obesity among school-age children (10). This trend is expected to prevent or reduce the tendency toward increase in the prevalence of type 2 diabetes in Japanese children.

In the present study, we examined annual changes in the incidence of childhood type 2 diabetes as detected by the urine glucose screening program in the Tokyo metropolitan area. The relationships among frequency of type 2 diabetes, prevalence of obesity, and change in children’s lifestyle are also discussed.

Method

We have annually screened primary school children, aged 6–12 yr, and junior high school children, aged 13–15 yr, residing in the Tokyo metropolitan area for glucosuria concomitant with proteinuria and hematuria, since 1974. Urinalysis is carried out using glucose oxidase tapes with a morning urine specimen. If a urine test is positive, a subsequent urine test is requested on another morning. An oral glucose tolerance test (OGTT) is performed when positive results are obtained on both the initial and the second urine tests to confirm diabetes. For the OGTT, 1.75 g/kg (maximum 75 g) of glucose is used, and the U.S. Public Health Service criteria and/or World Health Organization criteria for the diagnosis of glucose intolerance are followed. HbA1c, serum cholesterol, serum triglyceride, urinary ketone bodies, etc. are also examined (6).

For the period from 1974 to 2004, we determined the annual incidences of school-age children with type 2 diabetes as detected by the screening program and compared them over 5-yr periods. Relationships among factors leading to the development of type 2 diabetes, such as obesity and lifestyle are also examined.

Statistical analysis

Frequencies of the data were analyzed using Fisher’s exact probability test to detect differences among the groups. Findings of p<0.05 were considered statistically significant, while those of p<0.1 were considered evidence of a statistical tendency.

Results

Annual incidence of type 2 diabetes as detected by the screening program in the Tokyo metropolitan area

During the period from 1974 to 2004, a total of 9,242,259 school students, 6,225,971 primary school students and 3,016,288 junior high school students, residing in the Tokyo metropolitan area were screened for glucosuria to detect diabetes. A total of 236 students including 47 primary school students and 189 junior high school students were identified as having type 2 diabetes through this screening program. The overall incidence of type 2 diabetes from 1974–2004 was 2.55/100,000, and junior high school students had an incidence of type 2 diabetes significantly higher than primary school students (0.75 vs. 6.27/100,000, p<0.0001).
Comparison of annual incidences of type 2 diabetes over 5-yr periods

Annual incidences of type 2 diabetes as detected by the screening program for the 5-yr periods from 1974–2004 were 1.73, 3.23, 3.05, 2.90, 2.70 and 1.41/100,000 students examined in 1974–1980, 1981–1985, 1986–1990, 1991–1995, 1996–2000 and 2001–2004, respectively. The incidence in 1974–1980 was significantly lower than those in 1981–1985, 1986–1990 and 1991–1995 (p=0.0038, 0.0091, 0.0226, respectively) and tended to be lower than that in 1996–2000 (p=0.0672). The incidence in 2001–2004 was also significantly lower than those in 1981–1985, 1986–1990 and 1991–1995 (p=0.0056, 0.0120, 0.0194, respectively) and tended to be lower than that in 1996–2000, too (p=0.0557) (Fig. 1).

Comparison of annual incidences of type 2 diabetes over 5-yr periods in primary school and junior high school students

Figures 2 and 3 depict the comparison of annual incidences of type 2 diabetes over 5-yr periods in primary school and junior high school students. For primary school students, the incidence in 1974–1980 of 0.27/100,000 was significantly lower than those in 1981–1985 (p=0.0363) and 1996–2000 (p=0.0016) and tended to be lower than those in 1986–1990 (p=0.0849) and 1991–1995 (p=0.0789). That in 2001–2004 of 0.46/100,000 tended to be lower than that in 1996–2000 (p=0.0747). For junior high school students, the incidence in 1974–1980 of 5.25/100,000 tended to be lower than that in 1981–1985 (p=0.0945); that in 2001–2004 of 3.66/100,000 was significantly lower than in 1981–1985 (p=0.0315) and tended to be lower than that in 1991–1995 (p=0.0622).

The incidences in 1974–1980 and 2001–2004 were compared with those from 1981–2000 in the above two groups. Primary school students in 1974–1980 had a significantly lower incidence of 0.27/100,000 than that in 1981–2000 of 0.97/100,000 (p=0.0091). On the other hand, there was no significant difference in incidence between 1974–1980 and 1981–2000 for junior high school students (5.25 vs. 6.89/100,000, p=0.1776). Comparing 1981–2000 and 2001–2004, junior high school students tended to have a lower incidence in the latter period (6.89 vs. 3.66/100,000, p=0.0576). For the same periods, there was no significant difference in incidence among primary school students (0.46 vs. 0.97/100,000, p=0.2675).

Frequency of obesity

In total, 198 out of 236 (83.9%) students with type 2 diabetes had percent over weight more than 20% and were judged to be obese. There was no significant difference in the prevalence of obesity between primary school students and junior high school students (40/47.85.1% vs. 158/189:83.6%, p>0.9999), nor was there any significant change in the incidence of obesity among students identified as having type 2 diabetes during 1974–2002.

Fig. 1 Overall incidence of type 2 diabetes as detected by the urine glucose screening program for 5-yr periods from 1974–2000. * vs. in 1974–1980, p=0.0038, 0.0091, 0.0226 and 0.0672 in 1981–1985, 1986–1990 and 1991–2000, respectively. vs. in 2001–2004, p=0.0056, 0.0120, 0.0194 and 0.0557 in 1981–1985, 1986–1990 and 1991–2000, respectively.
In the present study, we evaluated the annual incidences of type 2 diabetes detected by the urine glucose screening program during 1974–2004 in 5-yr periods and found a trend toward decrease in incidence after 2000. Overall, the incidence of type 2 diabetes in junior high school students was significantly higher than that in primary school students. The incidence in junior high school students during 2001–2004 was significantly lower than that in 1981–1985 and tended to be lower than that in 1991–1995. The trend toward decrease in incidence after 2000 was most strongly associated with the decrease in incidence among junior high school students. Other Japanese studies have also demonstrated decreased incidence of childhood type 2 diabetes in recent years. Yokota et al. (8) reported that the incidence of children with type 2 diabetes detected by the urine glucose screening program in Yokohama City increased during 1982–1996, but decreased from 1997–2001. Kikuchi et al. (9) reported that the incidence of type 2 diabetes in junior high school students in Niigata City was increasing until 1998, but that in 1999–2003 decreased compared with that in 1994–1998. These reports suggest that the incidence of childhood type 2 diabetes, especially in junior high school students, has recently tended to decrease in Japanese children (11).

As reported in the present study, most of children with type 2 diabetes were obese. Each year, the Ministry of Education, Culture, Sports, Science and Technology of Japan publishes frequency tables with information on the height and weight of Japanese school children of each age and sex (10). The data for height and weight are obtained at the schools in April of each year. The data used for this study were based on information collected from 270,720 primary and 225,600 junior high school students every year. These samples corresponded to 2.0–5.0% of all primary and junior high school students in Japan.
According to the results reported in this study, the frequency of obesity in school-aged children was increasing until 2000, though subsequently this trend weakened. The prevalence of obesity in children of 12 yr of age has decreased in both genders since 2000. The prevalence of obesity was lower after age 12 than at 12 yr of age, and about 10% of boys and less than 9 to 10% of girls were found to be obese after 12 yr of age. The peak ages for both obesity and development of diabetes are during puberty because insulin resistance increases by 30% during this period (12, 13). The decrease in tendency toward obesity in Japanese children after 12 yr of age may have in part contributed to the recent trend toward decrease in the incidence of childhood type 2 diabetes.

A report by the Ministry of Education, Culture, Sports, Science and Technology of Japan also demonstrated that children residing in suburbs were more obese than those residing in cities (10). No differences were found in eating habits between these two groups, though children in cities played more sports, i.e. more often participated in recreational physical activities and more frequently participated in a sports clubs such as tennis or soccer teams. Parents in suburbs more frequently used cars to go anywhere, which is found to be related to decreased physical activity and higher prevalence of obesity in their children. Since Tokyo is the capital of Japan, trends toward change in the lifestyle of children residing in cities are probably reflected in the results of our study.

The Japanese Ministry of Health, Labour and Welfare publishes a Nationwide Nutrition Survey each year (14). According to such surveys, daily energy intake increased to 2210 kcal between 1946–1970, but has gradually decreased since 1975 and reached less than 2,000 kcal in 2000. On the other hand, intake of total fat and animal fat has increased more than 3.5-fold during the past 5 decades. Adolescents in particular ingest more animal protein and fat than previously. Kitagawa et al. (15) suggested that the increase in consumption of animal protein and fat may be related to the increase in the incidence of obesity and type 2 diabetes in youth. Recently, significant concern regarding childhood obesity and associated metabolic disorders has spread in the Japanese population. Children are likely to ingest fewer sugar-sweetened beverages and snacks as well as calorically dense and fat-rich foods than in the past. In addition, children tend to avoid sedentary activities and participate in various sports. These trends may be responsible in part for the decrease observed in the prevalence of obesity. Ritchie et al. (16) reviewed prevention of type 2 diabetes in youth, and concluded that this disease is potentially prevented or delayed following early and appropriate intervention (17, 18), and that improvement of eating habits and physical activity is the most efficacious means of such prevention. An interventional trial conducted not only with obese children with high risk of development of diabetes but young people in general should be started as early as possible in all the prefectures of Japan (11).

In summary, childhood obesity in primary and junior high school students rapidly increased in Japan, contributing to the increase in incidence of childhood type 2 diabetes after 1980. The majority of students with this disease have been identified by urine glucose screening tests at school. However, this trend has recently weakened. Children’s lifestyle and eating habits have gradually improved, and this may have contributed to the trend toward decrease in the incidence of type 2 diabetes in 2001–2004 in the Tokyo metropolitan area.

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