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Diabetes Risk Factors in Middle Income Pakistani School Children

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Abstract: To assess the risk factors for diabetes such as dietary habits, physical fitness score, physical activity, body mass index (BMI) and family history of diabetes amongst school children. A cross-sectional study was conducted on 103 children (ages 8-12 years), from middle-income families from two schools of Karachi. Data of physical fitness score was taken by a physical fitness test and BMI was calculated by measuring weight and height. Dietary records were taken by 24 hours self reported diet recall charts of two weekdays. Health knowledge was obtained by a questionnaire given to children and a separate questionnaire was given to mothers to get this information. Majority of the children took less healthy food from the choice given to them; according to the self reported dietary intakes, 88% had poor intake of vegetables, 84% had poor intake of milk while 80% had poor intake of fruits. More than 40% of the children consumed soft drinks and fast foods daily. A child on the average watched 2.9 hours of TV/per day on weekdays and 3.5 hours of TV of weekends. Physical fitness score of 45% of the children was unsatisfactory while 29% of children had BMI $\geq$ 20 Kg/m^2. Eighty four percent of the children had first or second degree relative with diabetes. Majority of the children had high risk factors for diabetes with unhealthy diet and low physical activity patterns augmented by strong family history of diabetes. This shows that these children are at increased risk of developing diabetes in later years and preventive measures are required early in life, including lifestyle and behavioral changes to save our future generations from developing diabetes. This information will help in designing interventions for better lifestyle and eating habits which may reduce the later incidence of diabetes in children at adulthood.

Key words: Risk factors, children, diabetes, diet, physical activity, family history

Introduction

The global burden of non-communicable diseases is emerging as a major public health challenge and these are projected to account for 73% of global mortality by the year 2020 (White, 2000). World Health Organization (WHO) estimates that Non-communicable diseases accounted for at least 40% of all deaths in developing countries (WHO, 1996).

The most common and problematic non-communicable conditions are heart disease (Christopher, 1996), hypertension and diabetes (Coleman *et al*., 1998).

Over the last 30 years, type 2 diabetes has changed from being seen as a relatively mild ailment associated with aging and the elderly to one of the major contemporary causes of premature mortality and morbidity in most countries. In virtually every developed society, diabetes is ranked among the leading causes of blindness, renal failure and lower limb amputation. Through its effects on cardiovascular disease (70-80% of people with diabetes die of cardiovascular disease), it is now one of the leading causes of death (Diabetes Atlas, 2003).

It is estimated that currently some 194 million people worldwide have diabetes and that this will increase to 333 million by 2025. By the year 2025 the region with the largest number of persons with diabetes is expected to be the South-East Asian Region with about 82 million people with diabetes (Diabetes Atlas, 2003).

Pakistan is estimated to have 7 million people with diabetes. Currently it is 8th in the world according to WHO estimation of prevalence of diabetes and by the year 2025 is expected to be 4th with 15 million people with diabetes, representing a 2 fold increase in caseload (Global Burden WHO, 1998; Diabetes Atlas, 2003).

Previously Type 2 diabetes has been considered to be the disease of adults but epidemiological studies has recognized Type 2 diabetes in youth to be frequent in population of native North Americans and shown that some 30 percent of new cases of diabetes have been occurring in the 2nd decade of life, largely accounted for in minority population and associated with obesity (Haffner *et al*., 1991; Harris *et al*., 1998). Similarly in Japanese School Children, Type 2 diabetes is seven times more common than Type 1 and its incidence has increased more than 30 fold over the past 20 years, concomitant with changing food pattern and increasing obesity rates (Kitagawa *et al.*, 1994). Of the non-autoimmune forms of diabetes seen in the young only Type 2 diabetes is increasing in incidence.

Since the incidence and prevalence of type 2 diabetes in childhood is increasing and this increase will result as a major challenge to our society, the prevention and treatment of Type 2 diabetes in children and youth is a

daunting challenge because of the enormous behavioral influence, difficulty in reversing obesity and typical non-adherence in this age group. Emerging epidemic of Type 2 diabetes in the pediatric population, especially as seen amongst minorities in the U.S population, presents a serious public health problem (Harris *et al.*, 1998). The full effect of its epidemic will be felt as these children become adults and develop the long-term complications of diabetes.

Type 2 diabetes and its prevention in children and adolescent has been a neglected field. Studies have shown that lifestyle modifications started early will yield better results; especially in prevention of diabetes (Bourn *et al.*, 1994; Pan *et al.*, 1997). Primary prevention studies have also shown that lifestyle changes have an impact on the progression of the disease. Thus lifestyle interventions at an early age may prove to be more effective than interventions at adulthood (Bourn *et al.*, 1994).

Pakistani children are adopting more and more unhealthy lifestyle. Increased trend of sedentary entertainment such as television, computer and video games have resulted in physical inactivity, while an increased consumption of junk food (chocolates, snacks and soft drinks etc) have resulted in unhealthy dietary habits. These habits have fueled the epidemic of obesity, which is an important modifiable risk factor for diabetes, cardiovascular disease, hypertension and dyslipidemia (Khuwaja *et al.*, 2003).

Thus there is need to identify the diabetes risk factors in children which constitute more than 43% of the total country's population (Population, 2002). Thus this information would be useful in designing and implementing diabetes prevention programs.

Aim and objective: To assess the risk factors for diabetes such as dietary habits, physical fitness score, physical activity, body mass index (BMI) and family history of diabetes amongst school children.

Materials and Methods

A cross sectional survey was conducted on 103 school children between 8 - 12 years of age studying in 5th and 6th classes from two private schools of middle socio-economical status in Karachi.

After getting informed consent from the parents, the school children were informed about the aims and objective of the study and asked to participate in the survey.

The data was collected through a structured questionnaire specially developed by a research team of trained dieticians and diabetic educators and given to those children who agreed to participate in the study. The students were asked about various aspects of diet and nutrition knowledge. Questionnaire was used to assess the health knowledge, social support, self-efficacy, self-esteem and locus of control of children.

The children were interviewed by the research team and examined for risk factors during their school hours.

The mothers of these children were sent a questionnaire at home. The questionnaire for mothers included income and education status of the parents, family history of diabetes, perception of mothers about her child's health and frequency of illness and infection etc.

Diabetes risk factors: Diabetes risk factors examined in this study were self reported dietary intake, body mass index (BMI), physical fitness score (PFS) and family history of diabetes.

Dietary intake was measured by a two day 24 hours dietary recall. Research diet team of Baqai Institute of Diabetology and Endocrinology explained the diet recall charts to the children. The detailed diet history of two days was obtained.

BMI (kg/m^2) was calculated from weight and height. Height and weight was taken in school. Height measured with a portable stadiometer following standard procedures. All the children were weighed without shoes, in single layer of indoor clothing.Children having a BMI $\geq$ 20 were taken as overweight.

Physical fitness was measured by a modified Harvard step test (Keen and Sloan, 1958).

The PFS was calculated as follows:

The student was asked to step up and down (both feet) on a 30 cms high 42 cm wide stool for 5 minutes. Immediately after the student either completes the exercise or stops the exercise prematurely, heart rate is recorded at 0, 1 and 2 minutes post exercise: PFS is calculated by dividing the total time of exercise in minutes by the sum of three heart rate values measured at 0, 1 and 2 minutes post exercise (Keen and Sloan, 1958).

$$PFS = \frac{\text{Duration of Exercise in Seconds}}{\text{Sum of 3 heart rates post exercise}} \times 100$$

PFS is considered poor if less than 55, low average if between 55 and 64, high average if between 65 and 79, good if between 80 and 89 and excellent if > 90. The medium (65 - 79) range was taken as a cutoff point to separate the students between an upper and lower PFS tertile (Trevino *et al.*, 1999).

Family history of diabetes was also noted since susceptibility to diabetes is strongly influenced by degree of relationship to the diabetic subject. On the mother's questionnaire; mother's were asked if the physician diagnosed them, their parents, their siblings or their children with diabetes.

Statistical Analysis: Data was entered in Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 10. Frequencies of variables was calculated in percentages.

Results

A total of 103 school children between 8 - 12 years old from 2 private schools of Karachi took part in the survey; out of these 66 (64%) were girls while 37 (36%) were boys.

It was found that our children had unsatisfactory intakes of milk, fruits and vegetables and had higher intakes of fat as shown in Fig. 1-3. According to the self reported dietary intakes, 88% had poor intake of vegetables, 84% had poor intake of milk while 80% had poor intake of fruits. More than 40% of the children consumed soft drinks and fast foods daily.

Children viewed 2.9 hours of television per day on weekdays and 3.5 hours of television viewing on weekends.

Physical Fitness Score of 45% school children was unsatisfactory. As regards the body mass index 71% had BMI less than 20 kg/m^2 while 29% were overweight With a BMI $\geq$ 20 kg/m^2 as shown in Fig. 4.

Family history of diabetes, an indicator of genetic predisposition, was also very high. Eighty four percent of the school children had first degree (Parents, Siblings) or second degree (aunts, uncles, grand parents) relatives with diabetes.

Questionnaire for Mothers: The results obtained from the questionnaire of mothers showed that 2.5% had monthly incomes of < 2000 rupees, 12.5% had monthly income between 2000-5000 rupees, 36.2% had monthly income between 5000-10000 rupees, 29% had between 10000-25000 rupees and 17% had > 25000 rupees. Majority of the families i.e. 52.5% had 4-8 family members.

The frequencies of various risk factors for diabetes are shown in Table 1.

Discussion

As no data is available about the extent of diabetes risk factors in Pakistani children which are nearly half of our population, the identification of diabetes risk factors is necessary in designing and evaluating diabetes prevention programs since risk factor values can be used as markers for selecting high-risk youth populations.

In the present study, body fat, physical fitness, reported dietary fat, reported daily fruit and vegetable intake and family history of diabetes were examined in 8-12 year olds Pakistani children. Creation of effective diabetes risk-reduction programs for children will require identification of risk factors and the collaboration of experts in diabetes, nutrition, health education, community advocacy and behavioral change.

Childhood is a time of increased physical and cognitive development during which individuals establish dietary and physical activity behaviors that are determinants of disease pattern in later life such as obesity and type 2 diabetes (Williams *et al*., 1998). Approximately 22 million children under 5 years of age are overweight across the world (Richard and Christine, 2001). Elevated blood pressure, dyslipidemia and a higher prevalence of factors associated with insulin resistance and type 2 diabetes appear as frequent comorbidities in the overweight and obese pediatric population as in the adult population. In some populations, type 2 diabetes is now the dominant form of diabetes in children and adolescents (Richard and Christine, 2001).

Disturbingly, obesity in childhood, particularly in adolescence, is a key predictor for obesity in adulthood (Dietz, 1998). Moreover, morbidity and mortality in the adult population is increased in individuals who were overweight in adolescence, even if they lose the extra weight during adulthood (Dietz, 1998; Richard and Christine, 2001).

In Asia, there is a demand for a more limited range for normal BMIs (i.e., 18.5 to 22.9 kg/m^2 rather than 18.5 to 24.9 kg/m^2) because of the high prevalence of comorbidities, particularly diabetes and hypertension (WHO-IOTF, 2000). Currently BMI data is been evaluated globally as part of a new millennium analysis of the Global Burden of Disease. WHO is analyzing data in terms of 20 or more principal risk factors contributing to the primary causes of disability and lost lives in the 191 countries within the WHO.

In our children we took BMI $\geq$ 20 as overweight which showed a prevalence of 29%. This trend of been overweight in childhood and adolescence has been associated with increased risk of type 2 diabetes, hypertension and early atherosclerotic lesions, as well as obesity-related morbidities and mortality in adulthood (Williams *et al*., 2002). By using a lower BMI cutoff value of 20 we have shown a greater prevalence of overweight children as compared to other studies done in the region (Ramachandran *et al*., 2002; Khuwaja *et al*., 2003).

Thus, attempts to define diabetes risk factors in children should focus not only on genetic predisposition, but also on the environmental impact of risk-related behaviors. The purpose of identifying risk factors is to provide a basis for creation of schematic approaches at individual and community level that may decrease or delay the incidence of diseases that have long-term impact on quality of life and health care costs.

Health promotion that includes health education and organizational, economic and environmental support for behaviors conducive to improved health and decreased risk factors should include diabetes risk screening (Green and Kreuter, 1991; Glanz *et al*., 1997).

Although diet and physical activity appear to be modifiers of risk, studies have suggested that when genetic predisposition is compounded with modifiers, the risk of type 2 diabetes becomes significant in the lives of children with this profile (Trevino *et al*., 1999).

Table 1: Risk Factor for Diabetes in School Children

	(n=103)	Percentage
Poor Intake of Vegetables	91	88
Poor Intake of Milk	87	84
Poor Intake of Fruits	82	80
Poor Health Knowledge	53	51
Intake of Soft drinks and fast food	41	40
Physical Inactivity (PFS > 65)	46	45
Overweight (BMI $\geq$ 20)	30	29
Family History of Diabetes	87	84

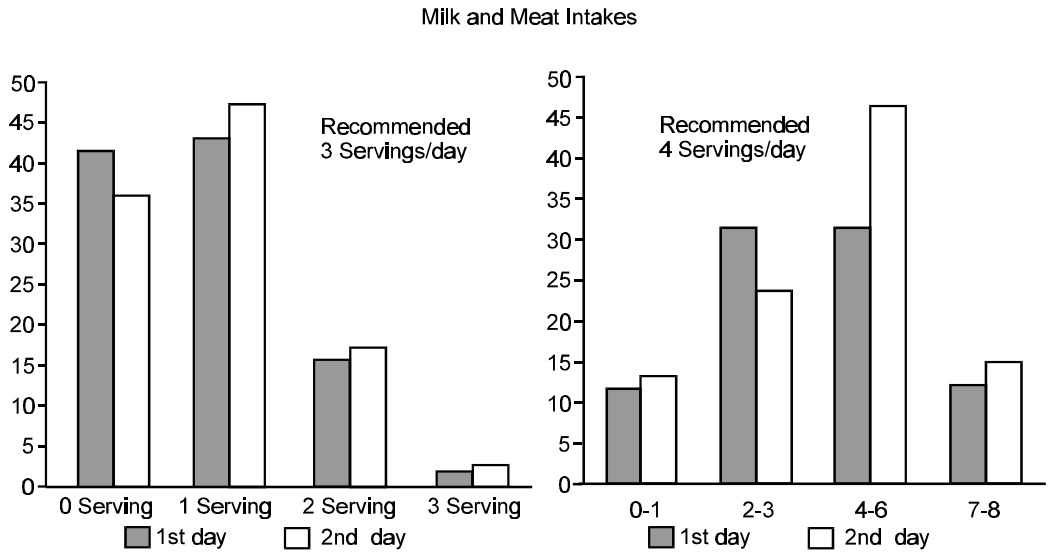

Fig. 1: Milk and Meat Servings

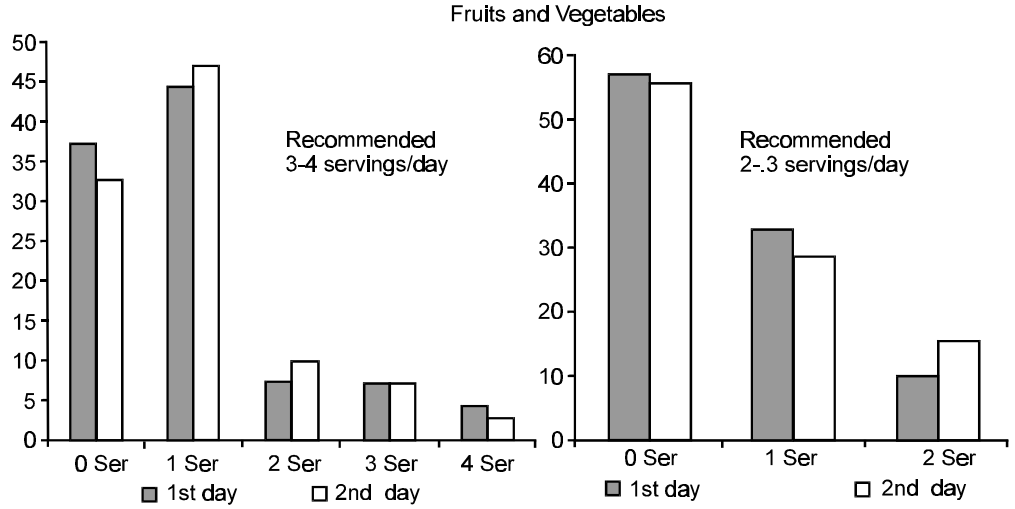

Fig. 2: Fruit and vegetable servings

type 2 diabetes becomes significant in the lives of children with this profile (Trevino *et al*., 1999).

The benefits of an active lifestyle in children include weight control, lower blood pressure and an increased physical activity in adulthood. Unfortunately because of increased television viewing of around 3 hours/day in our children and lack of outdoor physical activities have resulted in 45% of our children been physically unfit with unsatisfactory PFS.

In the present study, we used a 24-h dietary recall and 2

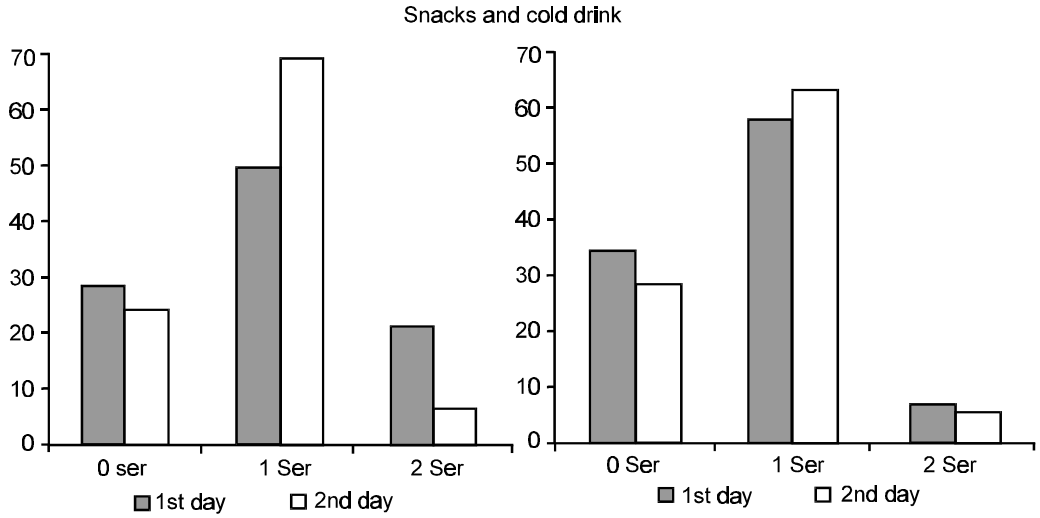

Fig. 3: Snacks and cold drinks servings

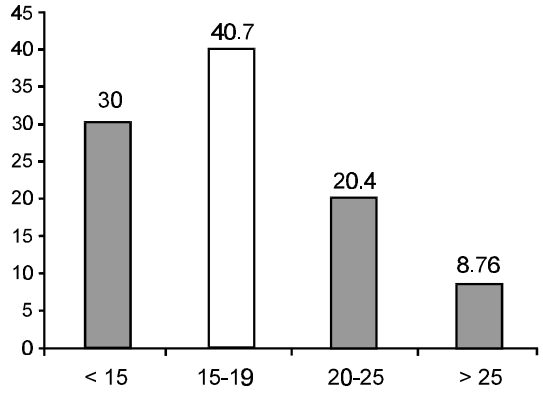

Fig. 4: Body mass index

days of food records and the dietary reference values were taken from HHANES report (Roche *et al*., 1990). Management of body weight is associated with learned behaviors that are proven by food choices, dietary practices and activity patterns. Investigators using a food frequency questionnaire based on the HHANES model reported that 88% of our children (8-12 years) ate less than the recommended servings of fruits and vegetables. This study also reveals that 40% of our children ate junk food and soft drinks every day. These results are higher than those seen in a study done in 14-18 years old boys which showed unhealthy dietary habits in 31% of the boys (Khuwaja *et al*., 2003).

Traditionally, dietary guidelines to promote weight management and health have been established by governmental health agencies (Callaway, 1997). However, understanding these guidelines is difficult for the public at large and for children specifically. Similarly consumption of fast food among our children seems to have an adverse effect on dietary quality in ways that plausibly could increase risk for obesity as seen in American Children (Giammattei, 2003).

Research projects on diet/activity intervention programs for children have been implemented globally to decrease risk for chronic diseases, such as the Child and Adolescent Trial for Cardiovascular Health (CATCH) Study (Lytle *et al*., 1996). Some have targeted minorities and low socioeconomic populations (Trevino *et al*., 1998). Measures of both dietary and physical activity outcomes have been minimal, but positive. Those that have been most successful have encouraged manipulation of dietary intake, physical activity and environmental dynamics in a triadic model. There is definitely a need to continue to explore effective and efficient methods that encourage children to adopt lifestyles that decrease risk for diseases like diabetes. Because environmental factors are such strong modifiers of diabetes risk, the role of the family, school and community must be assessed as a modifying variable in diabetes risk in our children.

Children will follow the behavioral norms of their community and can be influenced by social interaction within their own cultural environment (Elder *et al*., 1998). Because the majority (84%) of students had a first- or second-degree relative with type 2 diabetes, genetic predisposition may also contribute to the increased incidence of finding new type 2 diabetes in our children. Familial clustering of type 2 diabetes is often used as a proxy for genetic predisposition (Haffner *et al*., 1988). Nonetheless, despite a higher genetic predisposition, a study in Mexican-Americans reported that environmental factors appear to override genetic factors in their expression of type 2 diabetes (Stern *et al*., 1992).

A limitation of this study is that percentage of body fat could not be measured. Also the lack of reference values for BMI and physical fitness levels in Pakistan children is

a handicap. Further limitations of the study included small sample size and use of a specific age group. Laboratory tests such as fasting insulin, fasting blood sugars and fasting lipid profile were not done in this study due to financial difficulties. These investigations would have strengthened our assessment that there is a rapidly emerging epidemic of type 2 diabetes mellitus in our children and youth globally (Dean, 1998; Neufeld, 1998; Ramachandran *et al*., 2002). Thus both health policy decision makers and primary care providers need to implement more aggressive measures to alter the modifiable risk factors in children and adults (Neufeld *et al*., 1998).

Conclusion: The goal of our study was to identify that a large proportion of school children have modifiable risk factors for diabetes such as physical inactivity, unhealthy dietary habits and increased BMI. Because of high diabetes risk factor levels and increasing occurrence of type 2 diabetes in our youth, early-age screening should be encouraged and early-age diabetes prevention programs should be explored further.

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