

The accelerating epidemic of type-2 diabetes in children and adolescents

Manju Dewan

Post Graduate Department of Zoology, DAV College, Sector 10, Chandigarh

ABSTRACT

The occurrence of type- 2 diabetes in youth has increased dramatically over the past 20 years. Adolescents and young adults are fastly entering into the domain of the disease. The emergence of type 2 diabetes mellitus in children in Indian population presents a new challenge. 2048 children had undergone questionnaire and dietary survey and health examination. The scrutiny of the subjects for blood sugar levels along with various other parameters involved in this study revealed that 1.12% subjects were diabetics as compared to 1.56% with impaired glucose level. This shows a total ignorance on the part of parents about their children's' health status. The study brought forth a hard fact that periodic health checkup is necessary to prevent the agony of this disease. It is further pointed out that such surveys are very rare particularly in the underdeveloped and developing countries. It is worthwhile to conduct surveys to detect such cases so that timely remedy can be provided.

KEY WORDS: TYPE 2 DIABETES, CHILDREN, ADOLESCENTS, HEALTH, DISEASE

INTRODUCTION

Type 2 diabetes is rising rapidly amongst children and adolescents worldwide. The incidence of type 2 diabetes in youth has increased dramatically over the past 20 years. Type-2 diabetes is a significant and increasing burden in adolescents and young adults. Overweight is, at present, the most common health problem faced by

the children in both develop and developing countries which leads to the development of Type-2 diabetes (Han et al., 2010). This has been attributed to the fact, that the prevalence of obesity is not increasing but the degree of obesity also increases in affected children and adolescents (May et al., 2012). Type-2 diabetes mellitus is a complex metabolic disorder of heterogeneous etiology with social, behavioral, and environmental risk factors

Article Information:*Corresponding Author: manjudewan72@gmail.com

Received 27/03/2018 Accepted after revision 19/06/2018

Published: 30th June 2018 Pp- 285-290

This is an open access article under Creative Commons License,
Published by Society for Science & Nature, Bhopal India.

Available at: <https://bbrc.in/>

Article DOI: <http://dx.doi.org/10.21786/bbrc/11.2/14>

unmasking the effects of genetic susceptibility (Kiess, 2003). Clear strategies for research, prevention and treatment of the disease in these vulnerable patients are the need of the hour. Understanding the unique pathophysiology of type-2 diabetes in youth, as well as the risk of complications and the psychosocial impact, will enable industry, academia, funding agencies, advocacy groups and regulators to collectively evaluate both current and future research, treatment and prevention approaches. Type-2 diabetes mellitus is still rare in childhood and adolescence, but recent reports indicate an increasing prevalence around the world possibly due to increasing prevalence of obesity in children and adolescents (Thomas, 2013, Kristen et al, 2016).

MATERIALS AND METHODS

2048 children had undergone questionnaire and dietary survey and health examination. Out of these, 1017 were from urban population and 1031 from rural population. Children and adolescents aged 10-19 years were selected randomly for questioning regarding the different aspects of epidemiology and their health examination was done. The permission from parents of the children, undergoing examination and questionnaire survey was also taken on the self-designed consent form. The Centers for Disease Control and Prevention (CDC) suggests two levels of concern for children based on the BMI-for-age charts.

At the 85th percentile and above, children are “at risk for overweight”. At the 95th percentile or above, they are “overweight”. The cutoff for underweight of less than the 5th percentile is based on recommendations by the World Health Organization Expert Committee on Physical Status 1998. The diagnostic criteria for diabetes mellitus have been modified from those previously recom-

mended by WHO (1985). The revised criteria of report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (2003) for the diagnosis of diabetes was used.

RESULTS AND DISCUSSION

The emergence of type-2 diabetes mellitus in children in Indian population presents a new challenge. The scrutiny of the subjects for blood sugar levels along with various other parameters involved in this study revealed that 1.12% subjects were diabetics as compared to 1.56% with impaired glucose level from the already mentioned area. Such children, along with impaired glucose level and diabetic cases were totally ignorant about their health status viz a viz this disease.

Analysis of Variance (ANOVA)

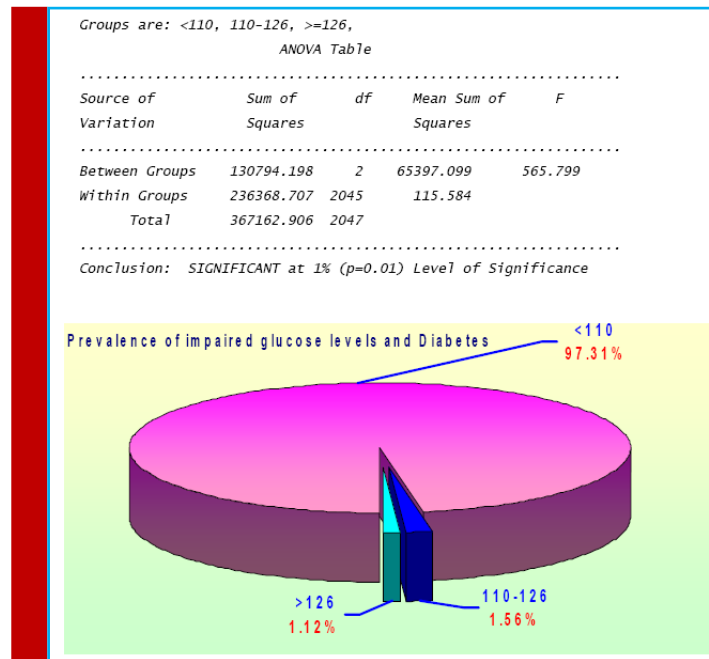
By subjecting the various observations to statistical analysis, certain factors became quite apparent when comparisons between normal subjects and those having different status of diabetes mellitus were made. When all inter-group comparisons were attempted in order to obtain a clear picture of the status of children among themselves, significant results have been obtained.

The observations given above embodied quite revealing information from 2048 subjects studied. This shows a total ignorance on the part of parents about their children’s health status. The study brought forth the fact that periodic health checkup is necessary to avoid the agony of this disease. It is further pointed out that such surveys are very rare particularly in the underdeveloped and developing countries. It is worthwhile to conduct surveys to detect such cases so that timely help can be provided. The present work is the first of this nature from Chandigarh in Northern India.

Table 9. Prevalence of impaired glucose levels and diabetes in total population

Sub-Group	N			%					
	1993	97.32							
110-126	32	1.56							
	23	1.12							

Sub Group	Mean	SD	SEM	SESD	CV	Range	Skew	Kurt.	
1 <110	79.532	10.620	0.238	0.168	13.35	1.000	0.139	5.350	
2 110-126	114.094	4.276	0.756	0.534	3.75	0.064	0.914	2.850	
3 >=126	144.087	22.494	4.690	3.317	15.61	0.210	1.095	2.491	



In India, the incidence of diabetes mellitus is increasing because of intake of high carbohydrate rich food by the children and adolescents. It is therefore necessary to make the general population aware about their health status by conducting periodic health checkups. Such incidents are not restricted to Punjab or other parts of India but are global. It had been noticed that half of the 16 million Americans with diabetes are undiagnosed as had been studied by Harris *et al.*, 1987, Harris, 1993, U.S. Department of Health and Human Services, 1993. Four million Americans with known diagnosis of diabetes are hospitalized annually in this country (Levetan *et al.*, 1998). In the U.S., estimates are as high as 5,000 new cases are added per year (Lawrence *et al.*, 2014).

Prevalence increases with age, tripling from age 10–14 years to 15–18 years (Dabelea *et al.*, 2014). Diagnosis of type-2 diabetes is estimated to be delayed by an average of 10 years after the actual onset of disease. The present study corroborate very well with this observation as 1.56% subjects are having impaired glucose levels which are likely to become diabetics and 1.12% subjects were diabetics. In fact, this group is one which needs an immediate attention of the subject himself, parents and the health authorities. An early study in 1991 of rural areas in Delhi indicated that the prevalence rate for type-2 diabetes ranged from 0.4-1.5% (Ahuja *et al.* 1991).

This study had not included impaired glucose levels and subjects were only from rural area. Data regarding type-2 diabetes in children and adolescents is very scarce in this area. Over the last decade, it has become apparent that type-2 diabetes extends its wings not

only into the young adult population but is also found in adolescents and even, occasionally, in children. The limited data, that is currently available, present a rather uncertain picture, with a rather wide range of prevalence and incidences of type 2 diabetes in children and adolescents. The transition from prediabetes to type-2 diabetes in adults is usually a gradual phenomenon that occurs over 5–10 years (Weiss *et al.*, 2005). Therefore, the early presentation of type-2 diabetes in youth raises the possibility of an accelerated process in pediatric age compared with adults, thus shortening the transition time between IGT and type-2 diabetes. In fact, an interesting report by Gungor and Arslanian (2004) suggested that despite a relatively robust initial insulin secretion, the deterioration in β -cell function in youth with type-2 diabetes is more accelerated than that was observed in adults.

Type-2 diabetes mellitus was reported in children and adolescents from the United States, Canada, Japan, Hong Kong, Singapore, Bangladesh, Libya, the United Kingdom, Australia and New Zealand. The prevalence of type-2 diabetes in children and adolescents ranges from 4.1 per 1000 amongst 12-19 year olds in the United States to 50.9 per 1000 15-19 year old Pima Indians in Arizona. Between 8% and 45% of recently diagnosed cases of diabetes in children and adolescents in the United States were type-2 diabetics (Fagot *et al.*, 2000 and 2001). The emergence of type-2 diabetes coincides with worldwide trends of rising prevalence in overweight and sedentary lifestyle (Troiano *et al.* 1995).

India is poised to be among the world's top four economies by 2020 (Abdul Kalam, 1998) and is under-

going a rapid epidemiological transition: the burden of chronic diseases is overtaking the burden of infectious diseases (Fall and Barker, 1995, and Nath *et al.*, 1998). India already has the highest number of adult diabetes cases (20 million) worldwide and this number is expected to rise to 57 million by 2020 (King *et al.*, 1998 and Narayan *et al.*, 2000). There is only few data available on type-2 diabetes in children and adolescents in India. The prevalence of obesity (body mass index [BMI] exceeding the 95th percentile) among US children and adolescents aged 6–19 years has jumped from approximately 4% in 1963 to 15% in 2000. In some regions in the United States, type 2 diabetes mellitus is as frequent as type-1 diabetes mellitus in adolescents (Arslanian, 2002 and Zeitler, 2015).

Rapid urbanization and economic growth creates social dynamics that promote diabetes risk factors. These include over-weight, decrease in physical activity, increase in sedentary activities such as television viewing, and high fat and high-energy diet among adults and children. Other factors may also make Indian children and young adults more vulnerable to diabetes. These include prenatal factors (e.g., low birth weight, maternal under-nutrition), biological propensity to central obesity and insulin resistance, low lean mass, diabetes during pregnancy, impaired glucose tolerance, and urban stress (Ramachandran *et al.* 1992, 1994, 1997, 1999 and Yajnik 2001).

Type-2 diabetes in children is being increasingly reported from other Asian countries. In Japan, the incidence of type-2 diabetes in children increased over a 20-year period (6–12 years: 0.2/100,000/year in 1976 and 2.0/100,000/year in 1995; 12–15 years: 7.3/100,000/year in 1976 and 13.9/100,000/year in 1995. This increase in incidence correlated with increased reported intake of animal protein and fat (Kitagawa, 1998 and Fagot *et al.* 2000). Type-2 diabetes is being reported in children of Indian origin living in countries such as the United Kingdom (Ehtisham *et al.* 2000). There is an urban-rural gradient in adult diabetes risk in India and when the data are standardized for age and sex differences, the prevalence of diabetes in urban Indians is similar to that of Indians abroad (Ramachandran *et al.*, 1997). This finding suggests that type-2 diabetes in children of Indian origin living abroad may be an early indication of things to come to India.

The biggest challenge India is likely to face in the future is tackling diabetes among children and adolescents. The number of children falling prey to type-2 diabetes has increased manifold over the past two decades.

Rapid urbanization and economic growth have promoted risk factors for diabetes such as obesity, sedentary lifestyle, high fat and high energy diet among adults and children. Unfortunately, no systematic survey has been

conducted so far to know the trends in India. Untreated children and adolescents with type-2 diabetes are at much higher risk of cardiovascular disease, kidney failure and vision loss. New health initiatives targeting children and adolescents which are aimed to raise awareness and check the rapidly increasing cases of obesity and diabetes.

Type-2 diabetes in children is probably under-diagnosed because it can exist without symptoms. It may also be under-reported and part of the reason for this may be misclassification (Fagot *et al.*, 2000, 2001 and American Diabetes Association 2000)). The prevalence of childhood diabetes among those younger than 15 years in the early 1990s in an urban population in south India was 0.26/1000 (Ramachandran 1992) and the incidence was 10.5/100,000/year. There are two important implications of the potential emergence of type-2 diabetes in children in India. Obesity and type-2 diabetes in children may be at the epicenter of a much larger diabetes epidemic in India than currently predicted and compulsion to act against the potential diabetes epidemic in an organized and systematic manner. Most of the children having impaired glucose levels and diabetes were ignorant about their status at the time of diagnosis.

The thrifty genotype hypothesis was advanced over 40 years ago to explain the modern emergence of obesity and type-2 diabetes (Neel, 1962). This hypothesis postulates that humans survived by the genetic selection of those whose metabolic storage capabilities permitted survival during periods of famine by taking advantage of episodic periods of plenty in a feast and famine existence. Continuous feasting with an abundance of calorie-rich foods results in fat deposition without the concomitant period of fasting to maintain a normal body weight. Historically, only the prosperous met this condition, but modern food production and marketing have led to low-cost abundance, with obesity now disproportionately affecting those at the less prosperous end of the economic scale.

Perhaps the most important reason for increasing prevalence of diabetes, obesity and type-2 diabetes is the rapidly changing imbalanced dietary habits, both in rural and urban areas, due to several factors—easy availability of convenience foods, frequent snacking on energy dense fast foods, high consumption of packaged food in place of traditional home made food, etc. This transition has resulted in excess consumption of calories, saturated fats, trans fatty acids, simple sugars, salt and a low fiber intake. It is high time to prepare to combat this menace and curb its spread. Indians are genetically more prone to diabetes. On top of this, a rapid shift in our dietary habits and life styles is resulting in a rapid rise in obesity, diabetes, metabolic syndrome and heart disease. Hence, a proper and healthy diet remains the

keystone for the prevention and management of type-2 diabetes.

ACKNOWLEDGEMENT

The author is highly thankful to UGC for providing grant for undertaking the research award.

REFERENCES

- Abdul Kalam APJ, Rajan YS. India 2020: A vision for the New Millennium. New Delhi, Penguin Books, 1998.
- Ahuja MMS. Recent contributions to the epidemiology of diabetes mellitus in India. *International Journal of Diabetes in Developing Countries*, 1991, 11:5–9.
- American Diabetes Association: Type 2 Diabetes in children and adolescents. *Pediatrics* 2000; 105:671–680.
- Arslanian SA. Type 2 diabetes mellitus in children: pathophysiology and risk factors. *J Pediatr Endocrinol Metab*. 2000;13 Suppl 6:1385–1394.
- Center for Disease Control (CDC). Body mass Index: BMI for children and teens. 2000. apps.nccd.cdc.gov/dnpabmi.
- Centers for Disease Control and Prevention: National Diabetes Fact Sheet: General Information and National Estimates on Diabetes in the United States, 2003. *Rev.ed.*
- Dabelea D, Mayer-Davis EJ, Saydah S, et al.; SEARCH for Diabetes in Youth Study. Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. *JAMA* 2014;311:1778–1786.
- Ehtisham S, Barrett TG, Shaw NJ. Type 2 diabetes mellitus in UK children: an emerging problem. *Diabetic medicine*, 2000, 17:867–71.
- Fagot-Campagna A, Narayan KMV, Imperatore G. Type 2 diabetes in children: Exemplifies the growing problem of chronic diseases. *BMJ* 2001; 322: 377–378.
- Fagot-Campagna A, Pettitt DJ, Engelgau MM, Burrows NR, Geiss LS, Valdez R, Beckles GLA, Saaddine J, Gregg W, Williamson DF, Narayan V: Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. *J Pediatr* 2000;136:664–672.
- Fagot-Campagna A, Pettitt DJ, Engelgau MM, Rios Burrows N, Geiss LS, Valdez R, et al. Type 2 diabetes among North American children and adolescents: An epidemiological review and a public health perspective. *J Pediatr* 2000; 136: 664–672.
- Fagot-Campagna A, Saaddine JB, Flegal KM & Beckles GL. Diabetes, impaired fasting glucose, and elevated HbA1c in US adolescents: the Third National Health and Nutrition Examination Survey. *Diabetes Care* 2001 ; 24 834–837.
- Fall CHD, Barker DJP. The fetal origins of coronary heart disease and non-insulin dependent diabetes in India. *Indian Pediatr* 1997; 34: 5–8.
- Gungor N, Arslanian S. Progressive beta cell failure in type 2 diabetes mellitus of youth. *J Pediatr* 2004;44:656–659.
- Han JC, Lawlor DA, Kimm SY. Childhood obesity. *Lancet*. 2010;375:1737–1748
- Harris, M.I. Undiagnosed NIDDM: Clinical a not public health issue. *Diabetes Care*, 1993; 16: 642–652.
- Harris, M.I., Hadden, W.C., Knowler, W.C. and Bennett, P.H. Prevalence of diabetes and impaired glucose tolerance and plasma glucose levels in U.S. Population aged 20–74 years. *Diabetes*, 1987; 36: 523–534.
- Kiess W, Böttner A, Raile K, Kapellen T, Müller G, Galler A, Paschke R, Wabitsch M. Type 2 diabetes mellitus in children and adolescents: a review from a European perspective. *Horm Res*. 2003;59 Suppl 1:77–84.
- King H, Aubert RE, Herman WH. Global burden of diabetes, 1995–2025: Prevalence, numerical estimation, and projections. *Diabetes Care* 1998; 21: 1414–1431.
- Kitagawa T, Owada M, Urakami T, Yamauchi K. Increased incidence of non-insulin dependent diabetes mellitus among Japanese school children correlates with an increased intake of animal protein and fat. *Clin Pediatr* 1998; 37: 111–115.
- Kristen J. Nadeau, Barbara J. Anderson, Erika G. Berg, Jane L. Chiang, Hubert Chou, Kenneth C. opeland, Tamara S. Hannon, Terry T.-K. Huang, Jane L. Lynch, Jeff Powell, Elizabeth Sellers, William V. Tamborlane and Philip Zeitler . Youth-Onset Type 2 Diabetes Consensus Report: Current Status, Challenges, and Priorities *Diabetes Care* 2016 Sep; 39(9): 1635–642. <https://doi.org/10.2337/dc16-1066>
- Lawrence JM, Imperatore G, Pettitt DJ, et al. Incidence of diabetes in United States youth by diabetes type, race/ethnicity, and age, 2008–2009 (Abstract). *Diabetes* 2014;63(Suppl. 1):A407
- Levetan, S. Claesa, Passaro Maureen, Jablonski Kathleen, Kass Mary, Ratner E. Robert Unrecognized Diabetes among hospitalized patients. *Diabetes Care*, 1998.; 21 (2) : 246–249.
- May AL, Kuklina EV, Yoon PW. Prevalence of cardiovascular disease risk factors among US adolescents, 1999–2008. *Pediatrics*. 2012;129:1035–1041.
- Narayan KMV, Gregg EW, Fagot-Campagna A, Engelgau MM, Vinicor F. Diabetes – A common, serious, costly, and potentially preventable public health problem. *Diabetes Res Clin Pract* 2000; 50 (Suppl 2): 77–84.
- Nath I, Reddy KS, Dinshaw KA, Bhisey AN, Krishnaswami K, Bhan MK, et al. Country profile: India. *Lancet* 1998; 351: 1265–1275.
- Neel, J.V. Diabetes Mellitus: a thrifty genotype rendered detrimental by progress ? *Am. J. Genet.*, 1962;14 : 353–362.
- Ramachandran A, Snehalatha C, Abdul Khader OMS, Joseph TA, Viswanathan M. Prevalence of childhood diabetes in an urban population in south India. *Diabetes Res Clin Pract* 1992; 17: 227–231.
- Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M: Rising prevalence of NIDDM in urban population in India. *Diabetologia* 1997; 40:232–237.
- Ramachandran A, Snehalatha C, Satyavani K, Sivasankari S, Vijay V: GAD65 antibodies in classification of Asian Indian

diabetic subjects with onset between 20 and 40 years. *Diabetes Care* 1999; 22:175–176.

Ramachandran A, Snehalatha C, Shyamala P, Vijay V, Viswanathan M. Prevalence of diabetes in pregnant women – A study from southern India. *Diabetes Res Clin Pract* 1994; 25: 71–74.

The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus from the American Diabetes Association, Alexandria, Virginia *Diabetes Care* 2003; 26:S5–S20,

Thomas Reinehr. Type 2 diabetes mellitus in children and adolescents *World J Diabetes*. 2013 ; 4(6): 270–281.

Troiano RP, Flegal KM, Kuczmarski RJ, Campbell SM, Johnson CL. Overweight prevalence and trends for children and adolescents. The National Health and Nutrition Examination Surveys, 1963 to 1991. *Arch Pediatr Adolesc Med* 1995; 149: 1085–1091.

U.S. Department of Health and Human Services: Diabetes in the United States : A strategy for prevention. U.S. department

of health and human services, Public Health Service Centres for disease control and National Center for chronic disease prevention and Health promotion. Division of Diabetes Translation, 1993.

Weiss R, Taksali SE, Tamborlane WV, Burgert TS, Savoye M, Caprio S. Predictors of changes in glucose tolerance status in obese youth. *Diabetes Care* 2005; 28:902–909 pmid:15793193

World Health Organization Study Group on Diabetes Mellitus Technical Report Series, 727, WHO Geneva, 1985.

World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation on Obesity, Geneva, 3–5, June 1997. World Health Organization: Geneva; 1998.

Yajnik CS. The insulin resistance epidemic in India: Fetal origins, later lifestyle, or both? *Nutr Rev* 2001; 59: 1–9.

Zeitler P, Chou HS, Copeland KC, Geffner M. Clinical trials in youth-onset type 2 diabetes: needs, barriers, and options. *Curr Diab Rep* 2015;15:28.