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PREVALENCE OF DISTURBANCES IN GLUCOSE REGULATION IN OBESE CHILDREN AND ADOLESCENTS IN SERBIA

Summary: Childhood obesity is one of the most important present public health issues. Complications of obesity once observed only in the population of obese adults, like type 2 diabetes and other disturbances in glucose regulation, are emerging in the pediatric population along with the pandemic of obesity. Prevalence of these co-morbidities of obesity varies widely in the populations of children and adults in different regions, with significantly higher observed prevalence in USA compared with European countries. Results of the study performed in Institute for Mother and Child Health Care of Serbia "Dr Vukan Čupić" in a group of 301 obese children and adolescents, discovered prevalence of type 2 diabetes was 0,3%, and of other disturbances in glucose regulation, namely impaired glucose regulation and impaired glucose tolerance 16%. Although these results are not suggestive of pediatric type 2 diabetes epidemic in Serbia, high established prevalence of other disturbances in glucose homeostasis emphasizes the need for prevention and early treatment of obesity in order to avoid a decline in life expectancy in future generations of adults in Serbia.

Keywords: obesity, children, impaired glucose regulation, type 2 diabetes

Introduction

Overweight and obesity in population of adults as well as in children and adolescents, are health disorders of substantial epidemiological and clinical significance, thus

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representing one of the most important public health issues (1). Rise in the prevalence of obesity is followed by an increased risk of associated endocrine, cardiovascular and other diseases in the population of children and adolescents. Type 2 diabetes mellitus and other disturbances in glucose regulation are important complications of childhood obesity. Increase in the prevalence of these co-morbidities has been observed in the youth along with worldwide epidemic of obesity (2, 3).

Pandemic of childhood obesity and associated co-morbidities, including type 2 diabetes, is associated with a substantial increase in incidence of metabolic, cardiovascular and other diseases not only in pediatric population, but also in the adult life. Obesity in childhood is a significant prognostic factor for adult obesity. Overweight in the population of preschool and school-aged children is associated with substantially increased risk for overweight in adolescence. Also, women and men in their twenties are at more than ten times greater risk for overweight if their body mass index in the age of 15-17 years was ≥85. percentile for the appropriate age and gender (4, 5). According to these findings, it could be concluded that obese children and adolescents become obese adults, and timing in the age of 7 to 13 years is considered to be of greatest importance for the prevention and treatment of overweight and obesity (6). It has also been established in recent studies that atherosclerosis starts in adolescence and that prevalence of cardiovascular risk factors in childhood, directly associated with the degree of obesity, results in increased number of cardiovascular events in the adulthood (6-9).

The best understanding of the consequences of worldwide childhood obesity epidemic may be acquired through the results of the research performed in USA. These results indicate that due to observed increase in the prevalence of obesity amongst children and adolescents, a potential decline in life expectancy in future generations of adults could be expected. In other words, as a result of obesity pandemic in youth, the children of today could be the first generation of children to live a shorter life than their parents (1, 10).

Prevalence of obesity in the population of children and adolescents in Europe is definitely high and rising, but this disorder is still most frequent in the youth living in USA (11, 12). Research results indicate that total prevalence of overweight and obesity in children and adolescents in USA is as high as 54.3% (12, 13). The prevalence of overweight in children and adolescents in countries of northern Europe is significantly lower, ranging between 10% and 20%, and although observed prevalence in countries of southern Europe is higher (20-35%), it is still two times lower compared to USA (3). Besides well established socioeconomic and cultural differences, the fact that children of certain ethnic origins, namely African-american and Hispano-american, are much more prone to obesity significantly influences the prevalence of obesity to be higher in American children and adolescents compared to their European peers (3, 12). According to the results of the "Study of population health in Serbia" performed in 2006. 18% of children and adolescents aged 7-19 years were overweight, with

one third of them being obese, which correlates with established prevalence of other countries in the region (14).

Prevalence of impaired glucose regulation in obese children and adolescents

Complications of obesity once observed only in the population of obese adults, like type 2 diabetes mellitus (T2DM) and other disturbances in glucose regulation, are emerging in the pediatric population along with the pandemic of obesity (1, 3, 15). Although positive family history and ethnic origin are certain risk factors, obesity is considered to be the most important risk factor for the development of T2DM in children and adolescents (3, 16, 17). Along with pandemic of obesity in youth, an increase in the prevalence of type 2 diabetes has been observed in the pediatric population, though still not regarded as epidemic (15, 18). Substantial rise in the prevalence of pediatric type 2 diabetes and nearly equal incidence of type 1 and type 2 diabetes in children and adolescents has been observed in several studies performed in USA, while available data regarding other regions are less pronounced, but still confirm the certain increase in the prevalence of this disease in youth (19-22).

The prevalence of type 2 diabetes mellitus widely varies in different regions, with significantly higher observed prevalence of this disease in USA and Asian countries compared to Europe (23). According to the results of several studies performed in USA, the prevalence of type 2 diabetes in obese children and adolescents ranges from 1.,3% to 6%, and the prevalence of impaired glucose tolerance 17-25% (24-26). Results of the studies performed in Europe suggest that the prevalence of these disorders in obese children and adolescents is significantly lower compared to USA. According to the results of these studies, the prevalence of type 2 diabetes and impaired glucose tolerance in obese children and adolescents is 0.1% and 4-5% in Italy, 0.1% and 7.1% in Poland, 0.2% and 5.0% in France, 1.5% and 5.3% in Germany, 1.9% and 17.3% in Hungary and 0% and 11% in Great Britain (2, 3, 27-31).

Higher observed prevalence of pediatric type 2 diabetes in USA and Asia compared to Europe is largely due to the fact that certain ethnic groups, namely African-american, Mexican, Asian and Native-american children, are at significantly higher risk for type 2 diabetes compared to the rest of the population (3, 16, 21, 23).

Impaired glucose regulation in obese children and adolescents in Serbia

Research performed in the Mother and Child Health Care Institute of Serbia "Dr Vukan Čupić" in Belgrade investigated a group of 301 children and adolescents (176

girls and 125 boys) aged 5.2 – 18.9 years, with body mass index value greater than 90. percentile for the appropriate age and gender. Children with genetic syndromes and other causes of secondary obesity were excluded from the study, and the main goal of the research was to investigate the prevalence of type 2 diabetes and other disturbances in glucose homeostasis in overweight children and adolescents in Serbia. Acquired data included demographics, anthropometric and other clinical exam data, while laboratory analyses included the oral glucose tolerance test with glucose and insulin levels, serum transaminases, triglycerides, HDL, LDL and total cholesterol levels. In order to assess the factors associated with impaired glucose regulation, group of obese children with disturbances in glucose regulation and group of the obese children with normal glucose homeostasis were compared by means of parametric and non-parametric statistical tests.

In total of 301 investigated children and adolescents, 49 (16.3%) had impaired glucose regulation. Within the group of children with disturbances in glucose regulation, T2DM was discovered in one adolescent girl, 13 had impaired fasting glucose, 25 impaired glucose tolerance, while ten had both impaired fasting glucose and impaired glucose tolerance. It was observed with statistical significance that when compared to subjects with normal glucose homeostasis, children with impaired glucose regulation had higher levels of insulin at 120. minute during oral glucose tolerance test, higher levels of triglycerides and higher values of HOMA insulin resistance index (Table 1). It was also observed that girls were at higher risk for disturbances in glucose homeostasis and that impaired glucose regulation was more frequent in later stages of pubertal development. There were no statistically significant differences between children with and without disturbances in glucose regulation regarding the degree of obesity and other investigated characteristics.

Table 1: Phenotype differences in groups of obese children with and without disturbances in glucose regulation

	Normal glucose homeostasis	Impaired glucose regulation	p
Insulin at 120. minute during OGTT (mIJ/l)[1]	115.2 ± 100.6	181.9 ± 144.5	< 0.01
Triglycerides (mmol/l)	1.3 ± 0.8	1.5 ± 0.7	< 0.05
HOMA insulin resistance index	4.9 ± 4.3	6.7 ± 5.3	< 0.01

[1] OGTT – oral glucose tolerance test

Conclusion

Observed prevalence of type 2 diabetes in investigated group of overweight children and adolescents is in concordance with the established prevalence of this disease in other European countries. Known prevalence of type 2 diabetes in the subpopulation of obese children and adolescents in USA is up to 20 times higher compared to observed prevalence in Serbia. Such pronounced difference in the prevalence of T2DM in overweight and obese children and adolescents in Serbia compared to USA is most probably due to differences in ethnical composition and consequent higher risk for type 2 diabetes in the population of children and adolescents in USA. On the other hand, results of our study revealed a significant prevalence of impaired fasting glucose and impaired glucose tolerance in studied obese children, which together with the increasing prevalence of childhood obesity in our country, emphasizes the need for prevention and early treatment of obesity in order to avoid a decline in life expectancy in future generations of adults in Serbia

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