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OBESITY AND METABOLIC SYNDROME IN CHILDREN AND YOUTH: A HEALTH RISK WE CANNOT AFFORD

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ABSTRACT

Ample observational and empirical evidence has been provided that indicates that childhood metabolic syndrome risk factors inevitably lead to significantly more profound health risk factors of developing potent adulthood metabolic syndrome. Much of these data has been provided from medical, nutritional, health, pediatric, physical education and associated communities. Perhaps the most visible and observable health risk factor among children (here referred to as youth) is the childhood obesity. Childhood obesity has reached epidemic proportions in western industrialized countries and is also becoming significantly more prevalent in Slovenia.

The youth inactivity is attributed directly to epidemic and perhaps exponential occurrence of obesity in pediatric and youth populations. The symptoms and signs of metabolic syndrome have previously been attributed mostly to the adult population; however, similar observations have been identified and observed in young and very young segment of population. The typical risk factors of metabolic syndrome in youth, in adolescents, and in adulthood have been commonly identified to be: stress, overweight and obesity, sedentary life cycle, aging, diabetes mellitus, coronary heart disease, lipodystrophy and several others.

This presentation will review and address several well known risk factors of developing metabolic syndrome in young years that directly contributes to adult obesity and are exhibited in significantly higher rates of hypertension, dyslipidemias, and insulin resistance, which are all risk factors for coronary heart disease, the leading cause of death in North America and may also apply to Slovenia. Many of these risk factors are modifiable (nutrition, smoking, sedentary life style, vigorous physical activity, reduction in TV and computer game times, etc.) with specific emphasis on very young, young, adolescents and profound consequences for adulthood. Several recommendations will be proposed that may contribute to reduction of health risk factors among youth. The

references have been generated from scientific literature and available information from various data bases in the United States, Center for Disease Control, National Institutes of Health, World Health Organization and several other relevant sources.

These data and facts are very relevant to Slovenia because the inevitable truth is that these risk factors are "creeping up" into Slovenian society and it is my hope that you will be proactive and address these issues and act proactively rather than just stand by and observe the decline of health, especially among youth that will result in very costly financial burden of Slovenia for many years and decades to come.

***Keywords**: metabolic syndrome, child obesity, nutrition, physical activity, child diabetes*

DEBELOST IN PRESNOVNI SINDROM PRI OTROCIH IN MLADINI: ZDRAVSTVENO TVEGANJE, KI SI GA NE MOREMO PRIVOŠČITI

IZVLEČEK

Številna opazovanja in znanstveni dokazi kažejo na to, da dejavniki tveganja za presnovni sindrom, ki so prisotni že v otroštvu, v dobi odraslosti neizogibno vodijo do bistveno bolj zaskrbljujočih tveganj za zdravje in povečajo možnost razvoja izrazitega presnovnega sindroma. Veliko teh podatkov je bilo pridobljenih v medicinski, prehranski, zdravstveni in pediatrični stroki ter od učiteljev telesne vzgoje in z njimi povezanih skupnosti. Najbolj opazen in izrazit dejavnik tveganja za zdravje med otroki in mladimi je morda prav debelost. Otroška debelost je v zahodnih industrijskih državah že dosegla razsežnosti epidemije, vse bolj razširjena pa postaja tudi v Sloveniji.

Neaktivnost mladih je moč neposredno povezati z epidemičnim in hitro rastočim pojavom debelosti pri otrocih in mladostnikih. Simptomi in znaki presnovnega sindroma so bili v preteklosti pretežno povezani predvsem z odraslo populacijo, vendar v zadnjem obdobju podobne ugotovitve opažajo tudi pri mladem in najmlajšem delu prebivalstva. Značilni dejavniki tveganja za presnovni sindrom pri otrocih, mladostnikih in odraslih ljudeh so pogosto opisani kot stres, prekomerna telesna teža in debelost, sedeč življenjski slog, staranje, sladkorna bolezen, bolezni srca in ožilja, lipodistrofija in številni drugi.

Pričujoči prispevek vsebuje pregled in obravnavo nekaterih znanih dejavnikov tveganja za razvoj presnovnega sindroma v mladosti, ki neposredno prispevajo k debelosti

pri odraslih in se kažejo v bistveno višjih stopnjah hipertenzije, dislipidemije in odpornosti na inzulin. Vsi našteti dejavniki pa so tudi dejavniki tveganja za bolezni srca in ožilja, ki so vodilni vzrok smrti tako v Severni Ameriki kot tudi v Sloveniji. Mnoge od teh dejavnikov tveganja lahko še posebej pri otrocih, najstnikih in mladostnikih spremenimo (nezdrava prehrana, kajenje, sedeč življenjski slog, povečana telesna dejavnost, skrajšanje časa, porabljenega za igranje računalniških igric in gledanje televizije ipd.), saj imajo globoke posledice v obdobju odraslosti. Predstavljenih bo več priporočil in napotkov, kako bi lahko prispevali k manjšemu tveganju za zdravje mladih. Predlogi so bili oblikovani na podlagi znanstvene literature in razpoložljivih informacij iz različnih baz podatkov Združenih držav Amerike, Centra za nadzor bolezni, državnih zdravstvenih inštitutov, Svetovne zdravstvene organizacije in številnih drugih preverjenih virov.

Predstavljeni podatki so za Slovenijo zelo pomembni, saj je dejstvo, da se dejavniki tveganja vse hitreje »zajedajo« v slovensko družbo. V prispevku predstavljam svoje ugotovitve z namenom večjega ozaveščanja o omenjeni problematiki in posledično aktivnejšega pristopa k reševanju omenjenih težav, in ne zgolj opazovanja upada splošne ravni zdravja, zlasti med mladimi, kar se bo nenazadnje odražalo tudi v hudi obremenitvi slovenskega finančnega proračuna za več let in desetletij.

***Ključne besede**: presnovni sindrom, otroška debelost, prehrana, telesna dejavnost, otroška sladkorna bolezen*

INTRODUCTION

Despite very large magnitude of empirical data generated by the health professionals in various fields, equipped with documented evidence that adult obesity among western industrialized nations is on an exponential increase, yet, it appears that we are not taking this awesome health risks and financially very costly health problem seriously. Although, much of the focus has been devoted to adult population, the origins and early signs can be tracked back to childhood. Child obesity has been on an increase for quite some time and has reached epidemic proportions. This short review and overview is based predominantly on the U.S. population; however, since most of Europe often copy American products, commercialization, technology, science, medicine, education and other products including life style, it is only a matter of time when Slovenia and other European countries will also develop symptoms and signs of unhealthy, risky and detrimental forms of life styles and decline in personal wellbeing.

Table 1: Potential risks with obesity

Glucose intolerance	Menstrual abnormalities
Insulin resistance	Impaired balance
Type 2 Diabetes	Orthopedic problems
Hypertension (HBP)	Low self-esteem
High cholesterol	Negative body image
Sleep apnea	Depression
Asthma	Social stigma
Skin conditions	Discrimination
Teasing & Bullying	

According to the U. S. Center for Disease Control and Prevention, obesity has been termed national health epidemic in the United States. They state that 1 in 3 children and teens in U.S. are overweight or obese and that 1 in 3 young people born in the year 2000 will develop Type 2 diabetes. These may be the first time in the history of the U.S. that current generation of children may live shorter lives than their parents.

Many of the factors that contribute to childhood, adolescent, and adult obesity can be found in multitude of behavioral, environmental, genetic, socioeconomic, technological, commercial, industrial, financial, and other factors.

Table 2: The statistics

10% of children ages 2 - 5 years are obese
15% children ages 6 - 19 years are overweight
54% increase in obese < 13 year olds from 1980s - 1990s
In teens, 39% increase from 1980s to 1990s, with 64% increase in morbidly obese

Numerous national and international organizations, including the World Health Organization have declared obesity a global epidemic that if not controlled will garner major health risks not only in early years but also in adulthood and beyond. In the United States the occurrence of children and adolescence being overweight and obese has been estimated to exceed 15%. That value has tripled since in the past four decades as reported by the US National Health and Nutrition Examination Survey (www.cdc.gov/nchs/nhanes.htm). The consequences of overweight and poetical and ensuing consequence of obesity may result in numerous serious health risks for diabetes mellitus, atherosclerosis, hypertension, insulin resistance, coronary heart disease, orthopedic problems that may inevitably lead to consequences of metabolic syndrome.

Measurement and estimation of overweight and obesity

There are numerous ways to estimate and measure a person's body composition; meaning, general distribution of muscle, fat, and bone tissue. Some of the methods are quite cumbersome but also significantly more accurate as in dual energy x-ray absorptiometry or DXA, tomography, magnetic resonance imagery; however, these are quite expensive and not very well suited or available to most individuals who need to estimate the person's body composition that is associated with little or no cost to them or their organization. Some of the methods used that are simple, easy to apply and yet provide a good estimate of persons body composition including percent of total body fat. These methods may include but are not limited to skinfold calipers, underwater weighing or hydrostatic weighing, and circumference measures. Perhaps the simplest form of estimating overweight or obesity is the use of body mass index (BMI) that relies on person's weight and height. These are not very accurate measures and provide only an indirect assessment of body composition; however, when collecting large samples of a cohort of individuals, the results may be quite useful and may provide some indication of individual overweightness or obesity when compared to standards and tables for BMI. The Center for Disease Control and Prevention in the US has numerous charts available for children of various ages and sex, ranging from infancy to adulthood with various norms (www.cdc.gov/growthcharts). The importance of using these charts is to identify the population one wishes to study or examine and to apply the appropriate formulae that will most accurately estimate the desired result.

However, not all children increase their weight due to large food sizes or obsessive overeating. Some may have underlying medical condition or genetic predisposition that needs to be treated by a health provider via pharmacological agents and other medical or surgical interventions. Healthy nutrition and physical activity are two key factors in counteracting child and adolescent obesity. Unfortunately, the choices of food and drinks, much of television time, computer games, marketing and advertising of fast-foods during commercials in television, sedentary life style and lack of vigorous physical activity all contribute to the obesity epidemic.

Table 3: Factors which contribute to child's obesity

High-calorie foods/beverages are high in sugar.
Fast foods
Baked goods
Vending machine snacks
Soft drinks
Candy & desserts

Excess percentage of body weight due to accumulated body fat, body mass index (BMI) calculated from a child's weight and height, serious medical condition, and childhood obesity leads to health problems once limited to adults (diabetes, high blood pressure and high cholesterol). All these factors contribute to childhood obesity.

Table 4: Definition of obesity (children and adults)

Energy intake > energy expenditure
Body mass index (BMI) = weight (kg) / (height in meters)2
BMI 20-23 is ideal for teens / adults
120% or more of ideal body weight or BMI > 95% defined as obese
BMI > 30 = obesity in teens and adults
BMI > 95% = obesity in younger children

If the obesity is reduced by 10%, these will result in significant positive changes in Blood pressure by 10 mmHg (on the average), decrease in triglycerides below 100 mg.dl-1 or by 200 (if genetic defect present), increase in HDL-C by 3-5 mg.dl-1 and decrease on LDL-C via diet/weight loss combined can lower LDL by 25-30% if elevated.

Various organizations have used different criteria for determination of metabolic syndrome mostly in adult population. The World Health Organization (WHO), International Diabetic Federation (IDF) and Association and National Education Panel/ Adult Treatment Panel III (NCEP/ATP III), all subscribe to slightly different categories to rank or identify individuals who are termed to have metabolic syndrome. Although they differ to some degree in their criteria; however, they mostly agree that there is a serious problem with metabolic syndrome and obesity in industrialized countries. The WHO require impaired glucose response and two other criteria, namely, the presence of microalbuminuria calculated as albumen/ creatinine ratio >30 mg.gm-1 creatinine. The IDF require central obesity plus two of the other abnormalities and the NCEP/ATP III require three or more of the five criteria for adults, namely, resistance to insulin-stimulated glucose uptake, Hyperinsulinemia, hypertension, glucose intolerance, increased VLDL-C triglyceride, and decreased HDL-C cholesterol.

The American Medical Association (AMA) requires three or more of the following criteria to designate a person as having metabolic syndrome as an adult. These categories are obesity (BMI >95th %), elevated blood pressure (systolic and/or diastolic >90th %), abnormal blood lipids (HDL-C< 40 mg.dl-1, and/or triglycerides >150mg. dl-1), impaired glucose tolerance (fasting glucose >100 mg.dl-1, 2h glucose >140, or any glucose >200 mg.dl-1).

Perhaps the most serious consequence of children and adolescence being overweight or obese is their predisposition to serious consequences for cardiovascular disease (CVD), coronary heart disease (CHD), heart failure (HF), cardiomyopathies, dyslipidemias and various other metabolic and cardiovascular diseases.

Heart disease is the major cause of mortality in industrialized countries. Despite reduction in mortality rates from heart disease over the past two decades, the CVD, CHD and HF continues to be the leading cause of death and public health problem. Heart disease is and continues to be responsible for more than 30% of all deaths, with ischemic heart disease representing 65% of this total. With improved mortality rates of coronary artery disease (CAD) has come greater understanding of how atherosclerosis arises and may be prevented. Assessment of the early onset of CVD in childhood is important to determine optimum preventive measures. Understanding of the early development of adult heart disease may help prevent or at least reduce cardiovascular heart disease since both the overweight and obesity in childhood and adolescence are frequent instigators of adult onset of metabolic syndrome and subsequently also responsible for heart disease.

The manifestation of metabolic syndrome according to almost all national and international organizations (WHO, IDF, NCEP/ATP III) identify excessive amount of lipids and lipoproteins (except HDL-C) as major risk factor as well as developing cardiovascular disease. When addressing the above normal values of lipids and lipoproteins in children, adolescents, or in adulthood, one cannot ignore the formation and development of atherosclerosis and tracking of lipids and lipoproteins from childhood into adulthood. There are a number of physiologic and pathologic events that underline the onset of CVD. The two major culprits in the process of developing cardiovascular disease are poor nutrition and sedentary life style or physical inactivity.

Since today's youth consume rather large quantities of fast foods, soda drinks, saturated fats and cholesterol rich meals, and therefore, it is not surprising that children and adolescents show elevated lipid levels and formation of atherosclerotic lesions. Although, all blood lipids and lipoproteins are important when assessing one's health, much attention has been focused on two main lipoproteins, namely, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C). Most studies investigating coronary heart disease relate elevated LDL-C and low levels of HDL-C. Many of these studies have demonstrated that adverse levels of CVD risk factors can be identified in childhood, although CHD do not usually occur until middle age.

Nicklas, von Duvillard and Berenson (2002) who tracked lipids and lipoproteins from childhood to dyslipidemias in adults as part of the Bogalusa Heart Study reported that lipids and lipoproteins measured in childhood were amplified profoundly also in the adulthood. They also reported that the percent of adult abnormality in obesity was significantly greater in participants who were at high childhood risk (39%) compared to children who were at acceptable risk for (24%) even after correcting for age. Participants in this study who were classified at high risk in childhood also had a significantly higher prevalence of hypertension (16%) compared to participants with low childhood risk (7%). Their data demonstrate that serum lipid and lipoprotein levels continue to track from childhood into young adulthood. The persistence of multiple CVD risk factors from childhood to adulthood and the impact of obesity in this regard point to the need for preventive measures aimed at developing healthy life style early in life.

As mentioned before, diabetes is an extremely potent risk factor for atherosclerosis. This increased risk is mediated through multiple mechanisms that include chemical modifications of the LDL particles (glycation) that makes these particles even more atherogenic. Similarly, hypertension that often accompanies obesity has created a secondary epidemic of insulin resistance and type 2 diabetes among children throughout the industrial western world.

Physical activity

Sedentary life style and profound decline in exercise have been linked repeatedly with multiple adverse health risks in both men and women. Belay, Belamarich and Racine (2004) reported that 50% of youth ages 12 to 21 years do not engage in regular vigorous exercise. They also found that American children who spend significant amount of time watching television is strongly linked to the risk of future obesity. Recommendation of the Center for Disease Control and Prevention (CDC) strongly suggest that both male and females benefit from physical activity. Furthermore they suggest the following:

- Physical activity need to be strenuous to be beneficial
- Moderate amount of daily physical activity are recommended for people of all ages. This amount can be obtained in longer sessions of moderately intense activities, such as brisk walking for 30 minutes, or shorter sessions of more intense activities, such as jogging or playing basketball for 15 to 20 minutes.
- Greater amounts of physical activity area even more beneficial, up to a point. Although excessive amounts of physical activity can lead to injuries, menstrual abnormalities, and bone weakening.

What can we do to help our children to be better citizens, to achieve maximal potential, prevent or reduce potential medical hazards and to reach respectable longevity? Here are some suggestions:

- Focus on strategies that increase physical activity, healthy eating and weight control behaviors, sources of social support, and issues of weight-related stigmatization and self-esteem
- Build exercise into family life/activities
- Help families make a few small, permanent changes at a time
- Set TV and videogame limits - and take out of the bedroom
- House Rules: no food in front of the TV/computer
- Change family patterns to incorporate exercise - bowling on Friday night instead of popcorn and a movie
- Family dinners!

It all starts with you, your schools, town or city, your community and your political leaders, etc. Do not take health for granted and help our children to become more ac-

tive, not just once but every day, stay engaged in their life while they are still children and adolescence because before you know it they will become young adults and establish their own families; however, if you planted the seed of healthy nutrition, active and vigorous activity, prevent smoking and other hazardous activities that too will pass those values to their children and you can and should be very proud of what you were able to achieve.

CONCLUSION

The occurrence and prevalence of childhood obesity and thus predisposition to metabolic syndrome has reached epidemic proportions. Medical professions and pharmaceutical industry alone cannot solve this health problem. The society, parents, schools, teachers, community leaders, state and federal government, and others will need to take significantly more active role in promoting appropriate and responsible nutrition and caloric intake and very proactively support and increase energy expenditure that should be strongly supported and implemented in all aspects of societal life. Advances in technology, social media, schools, academics, and other aspects of society should strongly encourage and promote physical activity, exercise, responsible and quality nutrition, changing attitudes about food choices, portion size and create environmental factors such as bike paths, green environments, walking and jogging opportunities, physical education and various other family activities that promote health and wellbeing. These are not only responsibility of community but they start with each individual, responsible parents, school board members, community leaders, state and federal government. This is not an easy task; however, we need to work together to reduce if not solve this epidemic obesity and metabolic syndrome of our children and youth.

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