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The Effect of Nutrition and Sleep Habits on Predisposition for Metabolic Syndrome in Greek Children

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ABSTRACT

Purpose: To investigate the effect of lifestyle habits in childhood Metabolic Syndrome (MTS).
Design and Methods: Descriptive correlation study with 480 participants (5–12 years old) using a specially designed questionnaire was conducted. Anthropometric and biochemical analyses were performed.
Results: Fifteen percent of children exhibited predisposition for MTS. Regarding sleep habits, logistic regression analysis (LRA) showed that hour of sleep -before 22:00- was associated with decreased waist circumference (WC%) ($p = .026$). Midday siesta was negatively correlated with systolic (SBP) ($p = .001$) and diastolic blood pressure (DBP) ($p = .046$). In children without MTS, lack of sleep and night time sleep was positively correlated with DBP ($p = .044$) and fasting blood glucose (FBG) ($p = .005$). Regarding nutrition habits, fast food consumption was positively correlated with SBP ($p = .006$) and meat consumption was positively correlated with both Body Mass Index% (BMI%) ($p = .038$) and WC% ($p = .023$). LRA showed that fruit ($p = .001$) and legume ($p = .040$) consumption was associated with decreased FBG; fish consumption with decreased Low Density Lipoprotein (LDL) cholesterol ($p = .031$), vegetable ($p = .054$) and cereal consumption ($p = .012$) with decreased DBP. In children with MTS, fruits were associated with increased FBG ($p = .034$). In children without MTS, meat consumption was associated with increased LDL ($p = .024$), cereal with increased WC% ($p = .002$) and olive products with increased High Density Lipoprotein (HDL) cholesterol and BMI% ($p = .037$).
Conclusions: The adoption of both balanced diet and sleep habits seemed to be crucial for the prevention of MTS.
Practice Implications: Clinical health nurses could develop and implement preventive intervention programs in order to avoid metabolic complications in adulthood.

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Introduction

The prevalence of childhood obesity, with the consequences which this entails, has dramatically increased worldwide over the last 30 years (Lobstein et al., 2015). Metabolic Syndrome (MTS) is defined as a group of disorders including glucose intolerance, insulin resistance, central obesity, dyslipidemia and hypertension (Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004). These disorders constitute risk factors for developing cardiovascular disease, type 2 diabetes mellitus (T2DM) and chronic pro-inflammatory states (Hanson, Imperatore, Bennett, & Knowler, 2002; Lee, Gurka, & DeBoer, 2017). Central obesity, along with the dietary and lifestyle factors contributing to its development, is the major predisposing factor for MTS. Free fatty acids are released from adipose tissue into the hepatic portal vein and influence FBG and LDL levels. Additionally, adipokines such as Interleukin-1, Interleukin-6, resistin and adiponectin, which are secreted by the visceral adipose tissue, play a crucial role in the promotion of insulin resistance and the creation of a chronic inflammatory environment (Bergman et al., 2006).

Metabolic disorders are influenced by the individual's lifestyle. Nutrition and eating habits can positively or negatively influence the prevention or treatment of metabolic disorders like obesity, T2DM and hypertension. For instance, fruits, vegetables, whole grain products and unsaturated fats are positively correlated with reduced prevalence of MTS. The Mediterranean dietary pattern is not only positively correlated with the reduction of visceral fat deposition, but also seems to be a protective factor against MTS (Giugliano & Esposito, 2008; Godos et al.,

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2017). Sleep habits also play an essential role in the prevention of metabolic disorders, as sleep is directly related to maintaining a normal BMI (Leibel, 2002). The metabolism of carbohydrates and lipids is regulated by hormones which are secreted following the circadian rhythm (Cummings & Foster, 2003).

Risk factors for metabolic disturbances in childhood are most likely to continue in adult life, rendering primary prevention strategies necessary (Kim, Lee, & Lim, 2017). It is important to highlight that the correlation of lifestyle habits with MTS has not been sufficiently studied in Greek children. In research conducted among Cretan primary school students, it was found that the Healthy Eating Index score was negatively correlated with the parameters of MTS. The Healthy Eating Index is a quality measure of nutrition that includes data collected through a 24-hour recall about the consumption of different food groups (fruits, vegetables, grain, sodium, fat, cholesterol, dairy, meat) (Linardakis, Bertsias, Sarri, Papadaki, & Kafatos, 2008).

The aim of the current survey was to study the prevalence of MTS in healthy children, aged 5 to 12 years old, living in Sparta, Greece. Following the gaps in current literature, it also aimed to associate dietary and sleep habits with the biochemical and anthropometric markers which indicate predisposition for MTS. It is important to mention that the role of lifestyle habits was studied in children who either are or are not already predisposed for MTS.

Material and Methods

Subjects and Ethics

This study was conducted under the educational program "Prevention of childhood obesity and type 2 diabetes" in Sparta, Greece; approved by the Hellenic Ministry of Education, Department of Healthcare and Environmental Education. Overall, 949 children aged 5 to 12 years were enrolled to participate in the program and 480 children finally agreed to participate in the procedure of biochemical analysis (50.58% participation rate). The children were selected randomly from eight primary schools and kindergartens among the eighteen schools of the region. A multistage stratified sampling was conducted. Parents and/or guardians gave their informed consent for both questionnaire and biochemical analysis. The anonymity of the school, parents and children was assured. Parents or guardians helped children to answer the survey's questions, when it was necessary (in case of younger participants). The study was in accordance with the Declaration of Helsinki (1964). All children were interviewed using a standardized questionnaire. The sample size was sufficient to evaluate standardized differences between the investigated parameters >0.5, achieving statistical power >0.80 at $p < .05$.

To study the correlation of the biochemical markers and lifestyle factors to MTS, children were divided in two groups: children with ($n = 72$) and without ($n = 308$) predisposition for MTS.

Lifestyle Questionnaire

For the needs of the study, a dietary and sleep habits standardized questionnaire was constructed. The questionnaire consisted of two parts, regarding children's both eating and sleeping habits. In detail, the first part of the questionnaire included 16 questions about children's eating habits. Children were asked about the frequency of consumption of the following food categories on a weekly basis (with a score from never (0) to 7 times a week (Cummings & Foster, 2003)): fast food, red meat/chicken, fish, fruits and vegetables, grains, legumes/pulses, dairy products and olive oil/olives. The second part of the questionnaire intended to screen individuals' sleep habits through four questions concerning the hours of both midday (siesta) and night sleep.

The initial edition of the questionnaire was reviewed by four experts (a pediatrician, a nutritionist, a psychologist and a primary school teacher) in order to evaluate the clarity and appropriateness of the questions or recommend exclusions of any questions from the questionnaire. Moreover, the clarity and suitableness of the questions were assessed by 10 adults and 10 children of the general population. Specifically, they were asked to check whether the general structure format of the questionnaire was readable and understandable, whether the questions were ambiguous, to suggest changes and specify what our questions meant to them. All suggestions were taken into consideration and were incorporated in the final version of our questionnaire. The analysis showed that the results were consistent, stable and the internal consistency and reliability of the questionnaire was acceptable (Chronbach's alpha = 0.78).

The children's diet score was also calculated in order to assess the adherence to a Mediterranean diet pattern in accordance with previous research conducted by Panagiotakos, Pitsavos, and Stefanadis (2006).

Demographics and Anthropometric Characteristics

Demographic characteristics were also included in the questionnaire. Antropometric measurements collected were children's height, weight, WC and Hip Circumference (HC)·The BMI (kg/m^2) and WC/HC ratio were also calculated. BMI and WC were coupled/studied according to the child's age and gender (McCarthy, Jarrett, & Crawley, 2011). Blood pressure was measured twice for each child with a 10-minute interval between the measurements. The final value representing blood pressure used for further analysis was the mean of the two measurements.

Laboratory Measures, Blood Samples and Serum Assays

Peripheral blood samples were collected from 110 fasting participants for subsequent analysis. Complete biochemical tests were performed. More specifically, blood lipid profile, FBG, markers of liver function and the acute inflammation marker C-Reactive Protein (CRP) were measured with the use of a biochemical analyzer (Olympus AU600). All serum analyses were conducted at the same lab following the same procedure. Capillary blood samples were taken from 380 fasting participants for FBG and cholesterol measurements (Accutrend Plus System, Roche Hellas).

Diagnostic Criteria for MTS Predisposition

There are two categories of diagnostic criteria regarding MTS in children: the International Diabetes Federation (IDF) criteria of children aged 6 to 18 years old (Zimmet et al., 2007) and National Cholesterol Education Program (NCEP) criteria of adolescents aged 12 to 19 years old (Goodman, Daniels, Morrison, Huang, & Dolan, 2004). In this study, the IDF criteria were used because of the age of the population studied, to which additional parameters were added: BMI% (≤90%), fasting LDL-cholesterol (≤100 mg/dL), and total cholesterol (≤200 mg/dL). Consequently, in this research, a child was characterized as predisposed for MTS when three or more factors coexisted, when choosing among WC%, FBG, fasting triglycerides, fasting HDL cholesterol, blood pressure, BMI%, fasting LDL cholesterol, and total cholesterol.

Statistical Analysis

Continuous variables are presented as mean (±SD). To evaluate the effect of independent variables on dependent variables, the parametric *t*-test for two independent samples and the analysis of variance (ANOVA) were used. In case of non-normality, the Mann-Whitney and the Kruskal-Wallis tests were used. Pearson's correlation was used to evaluate the relation between quantitative variables, while odds ratios were calculated to measure the association between categorical variables. The statistical analysis was performed using IBM SPSS Statistics 22 (SPSS, Chicago, IL, USA), while the significance level was set at 5%.

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