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Association between dietary offerings and nutritional status of adolescents as a factor of geographic region

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ABSTRACT

An analysis was performed of 14-day menu rotations in nine student dormitories in two different regions in Croatia – Coastal and Continental – during two seasons. Subjects were adolescents aged 15–22 years (n = 978); the anthropometric measured outcomes were body mass index, body fat and waist-hip ratio. In the Coastal region, vegetable and fruit groups were present in the menus in significantly greater proportions as characteristic elements of the Mediterranean diet. Since diet reflects nutritional status, significant differences were established depending on regional affiliation. In both regions, calories and the share of macronutrients in the menus exceeded international standards for a healthy diet. Almost 17% of male students and 13% of female students were overweight or obese. Body weight was significantly lower for female students in the Coastal region, though BMI was not significantly different between the genders in the two regions. However, the percentage of body fat and WHR revealed that the share of the overweight adolescent population is lower in the Coastal region in comparison to the Continental region (8.3% vs. 11.1%), which might be the result of higher energy and fat levels offered on the menu at dormitories. The data set of nutritional vs. anthropometric values confirmed that regional affiliation is an important factor in the diet quality and the nutritional status of adolescents.

1. Introduction

It is extremely important for people of all ages to maintain a balanced diet that covers their nutritional needs. Adolescence in particular is a complex and vulnerable period of life, with intensive (phenomenal) growth that has an increased demand for energy and nutrients (Stang and Story, 2005). Therefore, optimal nutrition is a requisite for achieving full growth potential and is essential in preventing adult diet-related chronic diseases, such as cardiovascular disease, cancer, and osteoporosis (Nola et al., 2010). Schools, student dormitories and universities play an important role in promoting good eating habits, regular physical activity and a *healthy* overall lifestyle, especially if the menus offered are not the selective type. Adequate institutional nourishment of youth is a matter of special public health concern, and the Croatian Ministry of Health has established standards and nutritional guidelines for organized meal planning in kindergartens (Vučemilović and Vujić Šisler, 2007), and primary and secondary schools (Regulation 146/2012; MHRC, 2013).

In order to ensure the appropriate amounts of macro- and micronutrients necessary for mental and physical growth and development, it is important for adolescents to incorporate the

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recommended amounts of all food groups into their daily diet (vegetable; fruit; grain; meat, fish, eggs, and legumes/beans; dairy; fats). However, teaching youth about *healthy* eating habits is not always an easy task, as they sometimes turn to various fad diets, skip meals, restrict energy intake and eliminate certain foods or entire food group(s) from their diet (Astrup et al., 2004). Elimination of certain foods or food groups deprives youth of macro- and micronutrients, which could ultimately result in nutrient deficiencies and health risks during adolescence and in later life.

Studies have shown that 18.4% of children aged 12–19 years in the USA are obese (USDA, 2011). In Croatia, the values range from 10 to 13%, but these percentages are expected to rise in future (CNIPH, 2013). Inactivity, coupled with excess energy intake, has been cited as a contributor to the high obesity rate (USDA, 2011).

The dietary habits of Croatian primary and secondary school students are characterized by high levels of total and saturated fats and cholesterol. Also, their consumption of vegetables and fruits is low, yet they consume sweets and soft drinks in excess (Krešić et al., 2008; Gajdoš Kljusurić and Colić Barić, 2004). Furthermore, dairy consumption and calcium intake are below the recommendations for the population in Croatia, as reported by several authors (Krešić et al., 2008; Rumora et al., 2009).

In Croatia, the two main geographic regions are defined as Coastal (Adriatic) and Continental according to NUTS2 (National classification, 2012). These geographic regions also influence differences in the dietary habits of their inhabitants (Gajdoš Kljusurić et al., 2015). The Coastal region has a typically Mediterranean cuisine (similar to the Spanish, Italian and Greek cuisines), while the Continental region features elements of the Austrian, German and Hungarian culinary traditions.

Insufficient data have been collected on the similarities and differences of the nutritional status of adolescents from different regions of the country and about the Mediterranean diet in Croatia.

Due to the paucity of national data on the dietary intake of adolescents and in view of the above, the first goal of this study was to evaluate the overall energy and nutrition offered on the menu in student dormitories, with an emphasis on the similarities and/or differences between regions. The hypothesis to be tested was, "Does the quality of menus at student dormitories differ based on geographic region?" The second objective was to investigate whether there was a relationship between menus of the regions and the anthropometric data of the students accommodated within them.

2. Methods

2.1. Participants

The survey was conducted upon the written approval of the *Croatian Ministry of Science, Education and Sport*. Nine student dormitories from the two main regions of the country were included in the study: four in the Continental region, and five in the Coastal region (see Supplementary data, Fig. S1 for map). The dormitories accommodated a total of 2907 students of middle and late adolescence (Bosanac, 2012), of which 978 students voluntarily participated in this study (33.6%). Dormitory residents were selected with the aim of evaluating the effects of the menus offered on the anthropometric parameters and appearance of weight-related problems. Anonymity was guaranteed (anthropometric measures were confidential and accessible only to subjects and the measurer) and all were offered individual consultations with the nutritionist. At the time of taking measurements, students were also asked, "What is an average number of meals you consume in the dormitory?" The total set of participants included 38% female (Continental = 190; Coastal = 201) and 62% male adolescents (Continental = 285; Coastal = 302). The age of participants ranged from 15 to 22 years, with an average of 17.2 ± 2.2 years.

Anthropometric parameters were taken: body mass (BM), body height (BH), and also waist and hip circumferences (WC; HC). Body mass index (BMI) and waist-to-hip ratio (WHR) were calculated from these data. All measurements were conducted according the study of Roseman et al. (2007). The WHO recommendations were used as the cut-off points for identifying underweight, overweight and obese persons and the percentage of body fat (% BF) was measured in order to acquire a detailed overview of the nutritional status of the examined adolescents.

2.2. Dietary offerings at student dormitories

Menus at each dormitory were collected for the dietary assessment during 14 consecutive days in two seasons (autumn/winter – S_1; spring/summer – S_2). Each daily menu consisted of breakfast, lunch and dinner, with nationally defined serving sizes (Regulation 146/2012). Only one choice per meal is offered, with no set of choices, except beverage offerings for breakfast and dinner (milk or tea). In total, 252 daily menus were analysed, with 112 from Continental dormitories and 140 from Coastal dormitories. Meals were randomly sampled and weighed (individually as food item, side dish or meal). The recipes gave known masses of components used in preparing meals. This allowed for calculation of the average intake. The software *PP2* (Bosanac, 2012) was used to analyse energy, macro- and micro-nutrient content of each daily menu (Table 1). Average values for each daily menu during 14 days in two different seasons (spring/summer and autumn/winter) were calculated for each dormitory. Also, the number of servings of various food groups was evaluated (vegetable; fruit; grain; meat, fish, eggs, and legumes/beans; dairy; fats), by season and geographic region, on the basis of the Food Guide Pyramid (USDA, 2005) and using the previously mentioned software. The adequacy of the dietary offering at dormitories was compared with the national recommended dietary intakes (Regulation 146/2012) and international guidelines (CNIPH, 2013). For more details concerning the actual menus, see Supplementary data, Table S1.

2.3. Statistical analysis

The mean values and standard deviations (mean ± SD) were calculated using descriptive statistics. The F-test and Two-tailed Student *t*-test were used to compare differences between the means of parametric continuous variables. Statistical significance for categorical variables was calculated using the Pearson χ^2 test. Analysis of variance (ANOVA) was used to confirm or disprove the null hypothesis (H_0) of the nutritional uniformity of dormitory menus based on geographic region. A significant difference was evaluated at $P < 0.05$. The Spearman rank correlation coefficient was calculated between variables by using a 2-tailed significance test for variables with non-Gaussian distribution.

Additional analysis to distinguish and classify dormitories with excessive or insufficient offerings of certain nutrients is a multivariate issue, and therefore principal components analysis was applied, as a powerful multivariate analysis tool. The matrix of the input data, i.e. 252 menus with 36 nutritional parameters and 6 parameters of the numbers of servings, was used in the analysis of the average daily offering and average offerings of meals, as well as the average number of servings of various food groups.

Principal components analysis (PCA) was applied to identify patterns in the experimental data and to express the data based on similarities and differences not detectable using descriptive statistical tools (Kurtanjek and Gajdoš Kljusurić, 2014). All analyses were performed using the program StatSoft, Inc. (2011) STATISTICA (data analysis software system), version *10*.