



Original research article

Establishing energy-nutritional variety of boarding school daily menus as a result of regional differences using multivariate analysis



Jasenka Gajdoš Kljusurić^{*,1}, Vesna Bosanac, Katarina Šanko, Irena Colić Barić

University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia

ARTICLE INFO

Article history:

Received 17 September 2015
 Received in revised form 11 June 2016
 Accepted 21 June 2016
 Available online 22 June 2016

Chemical compounds studied in this article:

Cholesterol (PubChem CID: 5997)
 beta-carotene (PubChem CID: 5280489)
 Retinol (PubChem CID: 445354)
 alpha-Tocopherol (PubChem CID: 14985)
 vitamin B1 (PubChem CID: 6042)
 Riboflavin (PubChem CID: 493570)
 Niacin (PubChem CID: 938)
 vitamin B12 (PubChem CID: 5311498)
 Folate (PubChem CID: 6037)
 Pantothenic acid (PubChem CID: 6613)
 Biotin (PubChem CID: 171548)
 Vitamin C (PubChem CID: 54670067)

Keywords:

Food composition
 Menus
 Meals
 Food groups
 Food analysis
 Regional differences
 Boarding school
 Multivariate analysis

ABSTRACT

This study included food composition analysis of 14-day boarding school daily menus, in two seasons (spring/summer & autumn/winter), in five boarding schools in the Adriatic (coastal) region and four in the continental part of Croatia. The aim of the study was to investigate if there is a regional character in the variety of meals and menus, and whether the Mediterranean diet pattern was dominant in the coastal region. The food composition and number of servings of six food groups was analyzed for a 14-day menu rotation in two seasons and two regions. Content of energy, carbohydrates, fats and cholesterol was higher in continental menus, while the coastal school menus featured dishes with a lower energy intake and more diverse palette. Use of descriptive statistical tests in examining the regional menus found a significant difference only in sodium content ($p=0.026$). Therefore, a multivariate tool, principal component analysis, was used to identify significant differences in the regional menus. The results show that the regional character plays an important role and highlighted the coastal dietary pattern with a significantly higher intake of vegetables, fruits and dietary products ($p=0.0058$). A separate analysis of the breakfast, lunch and dinner menus resulted in regional clustering for dinners and loss of the regional character for breakfast menus.

© 2016 Elsevier Inc. All rights reserved.

1. Introduction

A balanced and varied diet that meets the recommendations for daily energy and nutritional intake is an important factor during the growth and development of children and adolescents (Stang and Story, 2005). In Croatia, adolescents (aged 14–18 years) are often accommodated in boarding schools during their education (accounting for about 7% of all secondary school students).

Boarding school menus should ensure the appropriate intake of macro- and micronutrients (Kurtanjek Ž. and Gajdoš Kljusurić, 2014), as adequate institutional nourishment of the young population is certainly a special public health interest.

The food service of each boarding school has an extremely important role in the practical education of adolescents and a unique possibility to promote a balanced and varied diet in line with the recommendations (IOM, 2011)—fundamental data for national recommendations (MHRC, 2013; Regulation 146/2012).

Croatia is regionally very different (with mountain, lowland and coastal sections) and the two main geographic regions, continental and coastal (Adriatic) are defined according to NUTS2 (National classification, 2012). Pucarín-Cvetković et al. (2010) studied the regional features of Croatian nutrition in relation to hypertension

* Corresponding author.

E-mail address: jasenka.gajdos@pbf.hr (J. Gajdoš Kljusurić).

¹ I acknowledge, as the corresponding author that the authors are familiar with the changes in the paper and I will continue to inform them of any changes related to this article.

by analysing dietary habits following the consumption of salt and sodium-rich foodstuffs typical of the traditional nutritional profile of the Croatian population. They stressed the need for continuous promotion of a healthy diet, healthy lifestyle and public education. These results prompted the need to study the similarities and differences in the nutritional supply of institutional menus in these regions, with an analysis of a significantly higher number of nutrients in the two regions (continental and coastal). In this study, regionalism was assumed to be trackable through the selection of food and dishes. The coastal part of Croatia focuses on the Mediterranean cuisine (as similar to the Spanish, Italian and Greek cuisines), while continental Croatia has the features of Austrian, German and Hungarian culinary traditions (Biluš et al., 2005). The Mediterranean diet (MD) is characterized by a high intake of monounsaturated fat, plant proteins, whole grains, moderately high intake of fish; moderate intake of alcohol, olive oil as the main fat; low consumption of milk and dairy products, mainly from yogurt and cheeses; and low consumption of red meat and eggs, refined grains, and sweets (Yannakoulia et al., 2012; Kenfield et al., 2014; Nordmann et al., 2011). Such a diet is followed particularly in southern European countries (Kenfield et al., 2014; Grosso et al., 2015; Sill, 2013).

Given the lack of information on the regional dietary intake of adolescents aged 14–18 years, the objective was to evaluate the overall energy and nutrition composition of boarding school menus with an emphasis on regional similarities and/or differences. Furthermore, we wanted to investigate which foods and/or food components are characteristic of the continental and coastal (Adriatic) region. We also investigated the applicability of multivariate analysis tools, particularly principal component analysis (PCA), in the classification of the regional menu offers.

2. Methods

This survey included analysis of 14-day boarding school daily menus, including weekends. Weekend and weekly menus were not different (no additional food is added). The range of 14 days was selected to obtain more accurate results of the central tendency and deviations in the observed data set. The diet composition analysis was conducted in the autumn/winter season (S1) and repeated in the spring/summer season (S2). Nine boarding schools were included, with four representing the continental region of Croatia and five representing the Adriatic region. Thus, 336 meals of the continental and 420 meals of the coastal boarding schools were statistically analyzed.

2.1. Menu offers analysis

The daily menu consisted of breakfast (B), lunch (L) and dinner (D). A typical continental daily menu was B: tea or milk, meat or cheese spread, bread; L: chicken or beef soup, roasted meat (chicken or pork), roasted potatoes or cooked rice, sauce, salad, fruit or cake; D: sandwich or goulash soup and fruit yoghurt. A typical coastal daily menu was B: tea or white coffee, butter, honey, bread or cereal based food, fruit; L: vegetable soup, grilled meat or fish; boiled or cooked vegetable and potatoes, seasonal salad, bread, fruit or compote; D: salad (boiled egg, feta cheese, kale and tomato) with bread or pasta. For all meals, recipes were collected with the masses of food used for cooking. Three samples of each meal were allocated by random sampling and weighed (e.g. for separately side dish; meat; salads; etc.). Using the recipes and food masses, 42 daily meal offers were calculated per boarding school, per season (14 days \times 3 meals). Students were interviewed if they consumed additional food(s). Less than 5% answered positively, and so this consumption was not taken in the overall calculation. The software PP2 (Bosanac and Gašparović, 2012) was used to

compute nutrient intake, based on the Croatian Food composition database. Loss and weight change factors during food preparation are integrated in the software to calculate the composition of meals by following 36 parameters of the energy and nutrition content (energy, total proteins, total carbohydrates, total fibre, total fats, saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), *trans*-fatty acids (TFA), cholesterol, sodium, potassium, calcium, magnesium, phosphorus, iron, copper, zinc, manganese, selenium, iodine, carotenes, beta-carotene, retinol, vitamin D, vitamin E, vitamin K, vitamin C, thiamine, riboflavin, niacin, vitamin B₆, vitamin B₁₂, pantothenic acid, folate and biotin). To evaluate consumption variety, the number of servings from six food groups was examined (cereals; vegetables; fruit; dairy; meat; fats & sugars). The numbers of servings of each food group was expressed as the average value per 14 days. The adequacy of the dietary offer at boarding schools was compared with the national recommended dietary intakes (Regulation 146/2012) and international guidelines (IOM, 2011; Shaw et al., 1998).

2.2. Statistical data analysis

The mean values and standard deviations (mean \pm SD) were calculated using descriptive statistics. The F-test was used to examine the equality of variances and the Two-tailed Student *t*-test (Samuels and Witmer, 2003) was used to compare differences between the means of observed variables. A significant difference was evaluated at the confidence level $P < 0.05$.

Multivariate analysis was used to classify boarding schools in different regions according to the nutritive offers and number of servings from different food groups. The matrix of input data consisted of 756 meals (14 days \times 9 boarding schools \times 3 meals \times 2 seasons) with 36 nutritional parameters and 6 parameters of the number of food group servings. Principle component analysis (PCA) was applied as a multivariate tool to identify patterns in the experimental data and to express the data based on their similarities and differences (Pripp, 2013) which were not detectable with the *t*-test and F-test (Kurtanjek Ž. and Gajdoš Kljusurić, 2014). All multivariate analyses were performed using the program Statistica v. 10 (StatSoft, 2011).

3. Results and discussion

3.1. Analysis of the menu and meal offers in boarding schools, by region

Table 1 presents the average number of servings (per year) with standard deviations of the number of food group servings offered regionally in boarding schools.

Significant differences were determined in the number of servings per day. On average, participation of *Cereals* was higher in the continental region (11 servings/day), while *Vegetables* (4.2 servings/day) and *Fruits* (1.3 servings/day) were more dominant in the coastal region. *P*-values were not significantly different for the offered servings of *Fats* ($p=0.289$), *Milk* ($p=0.075$) and *Meat* ($p=0.098$). A Mediterranean diet is characterized by a high intake of whole grains, vegetables, fruits, fish; and a low consumption of red meat, refined grains, and sweets (Nordmann et al., 2011). A multivariate analysis was applied to determine whether the Mediterranean dietary pattern is still present in Croatia (Kurtanjek Ž. and Gajdoš Kljusurić, 2014), and particularly to gain better insight into the distribution of these food groups in the two different regions. The PCA analysis showed a classification and separation of boarding school daily (menus based on season autumn/winter vs. spring/summer). The continental menus (C), regardless of season (S1 and S2) clustered together on the right sight of the chart together with the food groups *Cereals*, *Meat* and

Download English Version:

<https://daneshyari.com/en/article/7620154>

Download Persian Version:

<https://daneshyari.com/article/7620154>

[Daneshyari.com](https://daneshyari.com)