Food Chemistry 238 (2018) 111–116

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Dietary nutritional profile and phenolic compounds consumption in school children of highlands of Argentine Northwest

M.C. Rossi, M.N. Bassett, N.C. Sammán *

Instituto Superior de Investigaciones Biológicas – Dpto. Bioquímica de la Nutrición, Facultad de Bioquímica, Química y Farmacia, UNT – CONICET, Chacabuco 461, San Miguel de Tucumán 4000, Argentina

ARTICLE INFO

Article history:
Received 1 April 2016
Received in revised form 22 November 2016
Accepted 20 December 2016
Available online 29 December 2016

Keywords:
Schoolchildren
Dietary pattern
Polyphenols intake

ABSTRACT

The objective of this work was to assess dietary patterns and consumption of phenolic compounds from fruits and vegetables byschoolchildren of high altitude regions from northwest of Argentina. A nutritional survey including food-frequency consumption, 24-h dietary recall and anthropometric measurements was applied to 241 children from 6 to 12 years old. The amounts of the different classes of phenolic compounds were established from Food Composition Tables available in phenol-explorer website. Statistics analyses were performed using IBM SPSS 20.0. Nutritional status assessment showed underweight (2.2%), low weight (12.7%), overweight (12.7%) and obesity (7.4%). Mean intake of phenolic compounds was 412 mg/day. Most consumed foods were infusions and sugar products, consumption of vegetables, fruits and dairy products were low compared to recommendations for this age. Considering that polyphenols have protective health effects, its low consumption could be a risk of development of chronic non communicable diseases.

Published by Elsevier Ltd.

1. Introduction

During childhood nutrition plays a key role in growth and development of children. It must provide the nutrients needed to maintain body structures and tissues, and energy for metabolism and physical activity. Also, adopting good eating habits in childhood is essential to achieve a healthy lifestyle in adulthood (Arimond & Ruel, 2004).

The prevalence of childhood overweight and obesity has increased worldwide in recent decades. Prevalence of obesity is higher in developed countries, but is significantly increasing in developing countries, coexisting with undernutrition. In Latin American countries, 5–15% of schoolchildren are overweight and obese. Obesity in childhood has short and long term consequences on health including increasing risk of neurological, pulmonary, gastroenterological, endocrine, hepatic disorders among others. Considering all above mentioned it is important to report dietary characteristics and to assess the nutritional status of the children population (Irizarry & Rivera, 2010).

Using food to provide health benefits beyond prevention of deficiencies is a reasonable change of traditional nutritional intervention. Some food components that are not considered nutrients in the traditional sense can provide health benefits. The exact mechanisms by which fruit and vegetables compounds reduce the risk of these chronic diseases are not precisely known (Rodriguez-Casado, 2016). A combination of antioxidants and phytochemicals found in fruit and vegetables might promote health by combating free radicals, which are linked with early phase development of some chronic diseases (Wang, Ouyang, Liu, & Zhao, 2014).

Number of studies report beneficial health effects of phenolic compounds. Many of the biological effects of polyphenols have been attributed to their high antioxidant potential, since these compounds can protect cell constituents from oxidative damage, limiting the risk of degenerative diseases associated with oxidative stress. However, it is now known that these compounds are more than just antioxidants and are involved in many mechanisms and molecular pathways involved in various physiological functions, resulting generally in a reduced risk of various diseases (Crozier, Jaganath, & Clifford, 2009; Hollman, 2016).

Evidence obtained from animal studies demonstrates association between ingestion of large amounts of polyphenols and diminution of dislypidemia, atherosclerosis and inflammatory process linked to cardiovascular diseases (Khurana, Venkataraman, Hollingsworth, Piche, & Tai, 2013). Polyphenols are secondary metabolites produced by plants, classified as phenolic acids, stilbenes, lignans, flavonoids and tannins. Phenolic compounds are widely distributed in plant foods (Wallace, Blumberg, Johnson, & Shao, 2015). Phenolic acids are structurally characterized by a phenol ring with a carboxylic substituent, resulting hydroxybenzoic, phenylacetic or phenylpropionic acids, in

* Corresponding author.
E-mail addresses: cotyrossi@hotmail.com (M.C. Rossi), natybassett@gmail.com (M.N. Bassett), nsamman@arnet.com.ar (N.C. Sammán).

http://dx.doi.org/10.1016/j.foodchem.2016.12.065
0308-8146/Published by Elsevier Ltd.

particular, hydroxycinnamic acids. Flavonoids can be divided into several subfamilies according to the degree of oxidation of the oxygenated heterocycle which forms part of its structure, being flavanols, flavanones, flavones, flavonols, isoflavones, and anthocyanidins (Kay, 2010).

Among stilbenes, resveratrol distinguishes for its anticarcinogenic properties. This kind of phenolic compound is not widely distributed in foods (Bertelli & Das, 2009).

Lignans are complex phenolic polymer molecules, known as phytoestrogens. Other polyphenols refers to compounds produced by the polymerization of flavonoids and phenolic acids. Finally, tannins have anti-nutritional properties (Santos-Buelga & Scalbert, 2000).

Despite the numerous studies reporting beneficial activities due to diets rich in polyphenols, caution should be taken when it comes to supplementation, since there are no recommendations or upper limits set. This work focuses on the beneficial effects of phenolic compounds, though it must be considered that negative effects cannot be completely disregarded (Fernández & Jiménez, 2012; Fraga, Galleano, Verstraeten, & Oteiza, 2010).

Knowledge of the contribution of nutrients and bioactive compound of the foods included in the diet is essential to develop food policies and campaigns on nutrition. This also helps to promote the consumption of these beneficial compounds and also for interventions in education and public health.

The objective of this work was to assess dietary patterns and daily consumption of phenolic compounds from fruits and vegetables by schoolchildren of high altitude regions from northwest of Argentina.

2. Material and methods

2.1. Sampling

The sample was composed by schoolchildren from high altitude zone of Tucuman and Jujuy. These provinces are located in Argentinean Northwest and include regions with altitudes between 1500 and 3700 metres above sea level (m.a.s.l). The population of this region is descendant of various ethnic groups including Diaguitas, Aymara, Atacamas. Populations of Jujuy and Tucuman are taken as representative since they have their own and different characteristics to each other, and that social and cultural factors have a big influence on what people eat, how they prepare their food, their food practices and food preferences.

To set the sample size, data of the target populations were taken from National census conducted in 2010 and calculated using a confidence level of 95%. The sample was composed of 241 children from four locations, two per province and represented 1.6% of the scholar population, which was considered to be a representative sample. For this study, it is considered that a valid option is capturing the population under study through educational institutions.

Once schools with the highest concentration of students were selected, a random selection of children from 6 to 12 years old was performed in each one. The inclusion criterion was having permission signed parental consent for each child.

Ethical clearance for the study was obtained from responsible academic of the respective educational institutions. Protocols work with children was properly approved by the scientific committee of CONICET Tucumán.

2.2. Survey

2.2.1. Nutritional survey

A nutritional survey including 48-h dietary recall and anthropometric measurements was conducted by previously trained staff. Younger children (6 to 9 years old) were requested to have a tutor or parent presence for carrying out the survey for reliable information. Photo food models were used as support material to standardize the types and amounts of the main food groups (Cereals, fruits, vegetables, sugar, drinks, spoons, cups, and plates).

2.3. Anthropometric measurements

Weight and height were measured with electronic scales (TEFAL CHARM, SC 2504 Rumilly, Francia; 200 g precision) and mobile rod (KAWE, 44444; Kirchner & Whilhelm GmbH, Asperg, Germany), respectively. Anthropometric measurements were performed according to the recommendation of the World Health Organization guidelines (WHO, 1995).

The nutritional status of schoolchildren was assessed with BMI-for-Age z-score and Height-for-Age z-score, calculated from the mean and standard deviation of the reference population. They were compared with reference standards child growth and reference standards of the World Health Organization (WHO, 2009).

2.4. . Phenolic compounds data analysis

The amounts of the different classes of phenolic compounds were established from Food Composition Tables in phenol-explorer website. It is the first comprehensive database on the polyphenol content in foods. It has more than 35,000 values of 500 different polyphenols contained in more than 400 foods. These data are derived from the systematic collection of more than 60,000 values polyphenol content from more than 13,000 publications critically evaluated before inclusion in the database Phenol-explorer.eu (Rothwell et al., 2013). In the case of regional foods that are not included in the basis above mentioned other published works were used (Anusic, 2012; Cattaneo et al., 2016; Di Paola Naranjo et al., 2016). It is noteworthy that the use of this database is due to the unavailability of regional databases of phenolic compounds.

2.5. Statistical analysis

Categorical variables (anthropometric measurements and physical activity level) were presented as percentages, while continuous variables (age, Energy intake and Basal Metabolism Rate) were expressed as means and standard deviations. Chi-squared test tests were used to evaluate associations between categorical variables, while Student's t-tests were used to compare group means by provinces with confidence level of 95% and the level of significance was set at $p < 0.05$. Statistics analyses were performed using IBM SPSS 20.0.

3. Results and discussion

3.1. Nutritional status and dietary patterns

Prevalence of underweight, overweight and obesity, as well as low height for age (stunting) are shown in Table 1. Anthropometric measurements showed coexistence of undernutrition and obesity. This phenomenon is characteristic of nutritional transition (Bassett, Gimenez, Romaguera, & Samman, 2013; Popkin, Adair, & Ng, 2012).

A particular characteristic of the nutritional transition in Argentina is the great heterogeneity in all the indicative variables between the provinces and regions.

Populations of high altitude areas in the process of nutritional transition are experiencing vulnerability and food insecurity; both could be attributed to limited access and consumption of food. It is