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Food sources of sodium, saturated fat and added sugar in the Spanish hypertensive and diabetic population

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ABSTRACT

Objectives: Previous research has shown that the diet of hypertensive and diabetic patients has a low accordance with the main nutritional recommendations, mostly due to the high intake of sodium, saturated fat and added sugars. This is the first study to identify the main food sources of these nutrients in these patients.
Methods: Cross-sectional study conducted in 2008–2010 in a representative sample of the Spanish adult population, including 2323 patients with hypertension and 635 with diabetes. The habitual diet was assessed using a validated diet history. The intake of sodium, saturated fat and added sugars was estimated with Spanish food composition tables.
Results: The hypertensive and diabetic population showed, respectively, an intake of 2.9 and 3.1 g/day of sodium, 26 and 26 g/day of saturated fat, and 33 and 24 g/day of added sugar. In hypertensive and diabetic patients, respectively, most sodium intake came from bread (35%, 34%), raw-cured sausages (15%, 15%), cooked sausages (6%, 7%), and soup (5%, 6%). The main sources of saturated fat were cured cheese (13%, 13%), bakery products (12%, 11%), red meat (10%, 11%), raw-cured sausages (8%, 9%) and whole milk (4%, 4%). The food groups that most contributed to added sugar intake were sugar directly added to coffee and other beverages (27%, 19%), bakery products (15%, 19%), sugary soft drinks (10%, 13%), and whole yogurt (9%, 12%). The main food sources of nutrients were similar in all sex and age groups.
Conclusions: In patients with hypertension and diabetes, the intake of sodium, saturated fat and added sugar can be substantially reduced by prioritizing low-salt varieties of bread, reducing the consumption of bakery products and sausages, replacing cured cheese and other whole dairy products by low-fat products, using non-sugary sweeteners, and substituting sugar-free soft drinks, or plain water, for sugary sodas.

1. Introduction

Hypertension and diabetes mellitus are two major public health problems due to their high frequency and their association with increased risk of cardiovascular disease, premature disability and death [1,2]. In Spain, a third of the adult population is hypertensive and less than 25% of these individuals have blood pressure controlled [3]. In addition, 12% of adults have diabetes [4], of which just over half reach the glycemic target [5]. This is important because poor control of blood pressure and glucose is associated with macrovascular complications in both groups of patients [6–8], and microvascular complications in diabetics [8].

Nutritional therapy is a key component of appropriate management of blood pressure and glucose levels in these patients [9–11]. However, a recent population-based study in Spain has shown that the diet of hypertensive and diabetic patients has a low accordance with the main nutritional recommendations, mostly due to the high intake of sodium, saturated fat and added sugars [12,13].

To our knowledge, no previous study has conducted a comprehensive analysis of the food sources of nutrients in a hypertensive or diabetic population in Europe. This work identifies the main food sources of sodium, saturated fat and added sugars in a representative sample of hypertensive and diabetic patients in Spain. This information may serve to implement changes in the diet of these

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patients to reduce inappropriate nutrient intake and, thus, improve blood pressure and glycemic control.

2. Methods

2.1. Study design and participants

The data were taken from the Study of Nutrition and Cardiovascular Risk in Spain (ENRICA), whose methods have been reported elsewhere [14]. This is a cross-sectional study conducted from June 2008 to October 2010 with 12,948 individuals representative of the non-institutionalized Spanish population aged 18 and over. Data were collected at the homes of study participants. Information was obtained by an interview on lifestyle, a physical exam to measure blood pressure and anthropometry, collection of blood and urine samples, and a dietary history to assess usual food consumption.

Study participants gave written informed consent. The study protocol was approved by the Clinical Research Ethics Committee of Hospital La Paz in Madrid and the Clínic Hospital in Barcelona.

2.2. Study variables

2.2.1. Hypertension

Blood pressure was measured, using standardized procedures, with validated automatic devices (model Omron M6) and cuffs of three sizes according to arm circumference [12]. Two sets of readings were made separated by 90 min. In each set, blood pressure was measured three times at 1–2 min intervals, after the individual had rested for at least 3–5 min in a seated position (or, if not possible, then lying face up). In the analyses, blood pressure was calculated as the mean of at least 3 out of the last 5 readings. Hypertension was defined as systolic pressure $\geq$140 mm Hg, diastolic pressure $\geq$90 mm Hg, or being treated with antihypertensive drugs. Because diet therapy is prescribed only to those with diagnosed hypertension, we restricted this analysis to individuals who answered affirmatively to the following question: "Have you ever been told by the doctor that you had hypertension, also called high blood pressure?"

2.2.2. Diabetes mellitus

Twelve-hour fasting blood glucose was measured using the oxidase glucose technique (ADVIS 2400 Chemistry System analyzer, Siemens). Diabetes mellitus was defined as glucose $\geq$126 mg/dl or use of antidiabetic medication. The analyses included only diabetic subjects who responded affirmatively to the question: "Have you ever been told by the doctor that you had diabetes or elevated blood sugar?" [13].

2.2.3. Diet

Usual food consumption in the previous year was ascertained with an electronic dietary history, developed from that used by the EPIC-Spain cohort study [15,16]. Specifically, we asked about food consumption in a standard week, and recorded all food eaten at least once every 15 days. The dietary history took into account seasonal and weekend food consumption.

Study participants reported the consumption of 880 different foods, which were classified into groups according to nutritional content. For the analyses of sodium intake, some sodium-rich foods like packaged fried tomato sauce, common salt added to food mixtures during cooking, and olives were analyzed separately. However, salt added at the table or that contained in water was not considered. For the analyses of the intake of added sugars, we considered only the 181 foods containing this nutrient, which were classified into groups of relatively homogeneous composition. Table 1 includes a detailed description of the food sources that contributed to at least 1% of the intake of the nutrients considered in this study.

Intake of sodium, saturated fat and added sugar was calculated using standard composition tables [17–21] and the information provided in some packaged food labels.

2.3. Statistical analysis

Among the 12,948 study participants, we excluded 873 who lacked blood pressure data and 221 without glucose data. Of these, we selected the 3995 individuals with hypertension and, among them, the 2367 who were aware of their condition. Likewise, we selected the 876 diabetics and, among them, the 696 diagnosed diabetics. Finally, we excluded the individuals whose diet was outside the valid range ($\leq$800 or $\geq$5000 kcal/day in men; $\leq$500 or $\geq$4000 kcal/day in women) and those with missing information on the remaining study variables. As a result, the analyses were performed with 2323 hypertensives and 635 diabetics.

The statistical analyses mostly used a descriptive approach. The population percentage of a given nutrient (sodium, saturated fat, or added sugar) that is contributed by any single food or food group was calculated as follows: [(target nutrient contributed by a specific food or food group for all individuals/target nutrient contributed by all foods for all individuals) $\times$ 100] [22]. We present data only for those foods/food groups that contributed at least 1% of the total nutrient intake.

The analyses were conducted with the total study sample, and separately by sex and three age groups. To assess group differences we used the chi square test, and statistical significance was set at 2-tailed $p < 0.05$. Individual observations were weighted to reconstruct the Spanish population. The analyses were performed with SAS (version 9.2, SAS Institute Inc, Cary, NC).

3. Results

Total energy intake was 2063 (SD 636) kcal/d among the hypertensives, and 2055 (SD 635) kcal/d among the diabetics. The hypertensive population showed an intake of 2.9 g/day of sodium, 26 g/day of saturated fat, and 33 g/day of added sugar (Table 2). As a result, only 10% met the recommended intake of sodium (<1.5 g/day), 8% of saturated fat (<7% of energy) and 9% of sugars (<10% of energy). Among the diabetics, the intake was 3.1 g/day for sodium, 26 g/day for saturated fat, and 24 g/day for added sugar. Corresponding figures for meeting the recommended nutrient intake were 9%, 8% and 11%, respectively. In both the hypertensives and the diabetics, the intake of sodium, saturated fat and added sugar was higher in men and in the youngest individuals (Table 3).

Fig. 1 shows that in both types of patients most sodium intake came from bread (about 35%) and raw-cured sausages (about 15%). Other important sources of sodium were cooked sausages (about 6%), soup (about 5%) and olives (about 4%). These foods were the main sodium sources regardless of sex and age (Table 3). It is of note that packaged foods (without considering olives and commercial fried tomato sauce) only contributed to 2.3% and 2.1% of total sodium intake in hypertensives and diabetics, respectively; the corresponding figures for precooked dishes were about 0.3% in both hypertensives and diabetics. No substantial differences were found in the sources of sodium between the hypertensive or diabetic individuals and those free of these diseases. (See Supplementary Table 1).

As regards saturated fat, the main sources were cured cheese, baked goods, pastries and cookies, red meat, raw-cured sausages and, to a lesser extent, whole milk. Together they contributed to 48% of saturated fat among both the hypertensives and the