

# Evaluation of a Modified Italian European Prospective Investigation into Cancer and Nutrition Food Frequency Questionnaire for Individuals with Celiac Disease



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## ARTICLE INFORMATION

### Article history:

Submitted 26 May 2015

Accepted 20 April 2016

Available online 28 May 2016

### Keywords:

Individuals with celiac disease

Gluten-free diet

Validity

Dietary assessment

Food frequency questionnaire

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<http://dx.doi.org/10.1016/j.jand.2016.04.013>

## ABSTRACT

**Background** To date, it is unclear whether individuals with celiac disease following a gluten-free (GF) diet for several years have adequate intake of all recommended nutrients. Lack of a food frequency questionnaire (FFQ) for individuals with celiac disease could be partly responsible for this still-debated issue.

**Objective** The aim of the study is to evaluate the performance of a modified European Prospective Investigation into Cancer and Nutrition (EPIC) FFQ in estimating nutrient and food intake in a celiac population.

**Design** In a cross-sectional study, the dietary habits of individuals with celiac disease were reported using a modified Italian EPIC FFQ and were compared to a 7-day weighed food record as a reference method.

**Participants/setting** A total of 200 individuals with histologically confirmed celiac disease were enrolled in the study between October 2012 and August 2014 at the Center for Prevention and Diagnosis of Celiac Disease (Milan, Italy).

**Main outcome measures** Nutrient and food category intake were calculated by 7-day weighed food record using an Italian food database integrated with the nutrient composition of 60 GF foods and the modified EPIC FFQ, in which 24 foods were substituted with GF foods comparable for energy and carbohydrate content.

**Statistical analyses performed** An evaluation of the modified FFQ compared to 7-day weighed food record in assessing the reported intake of nutrient and food groups was conducted using Spearman's correlation coefficients and weighted  $\kappa$ .

**Results** One hundred individuals completed the study. The Spearman's correlation coefficients of FFQ and 7-day weighed food record ranged from .13 to .73 for nutrients and from .23 to .75 for food groups. A moderate agreement, which was defined as a weighted  $\kappa$  value of .40 to .60, was obtained for 30% of the analyzed nutrients, and 40% of the nutrients showed values between .30 and .40. The weighted  $\kappa$  exceeded .40 for 60% of the 15 analyzed food groups.

**Conclusions** The modified EPIC FFQ demonstrated moderate congruence with a weighed food record in ranking individuals by dietary intakes, particularly food groups. *J Acad Nutr Diet.* 2016;116:1810-1816.

**C**ELIAC DISEASE (CD) IS A CHRONIC IMMUNE-mediated disease. It begins with damage to the small bowel mucosa when genetically predisposed individuals with human leukocyte antigen haplotypes DQ2 or DQ8 ingest food containing gluten.<sup>1</sup> Damage to the small mucosa can be patchy and progressive, eventually leading to villous atrophy and malabsorption. This condition can be reversible upon elimination of foods containing gluten from the diet.<sup>2</sup>

The resulting gluten-free (GF) diet excludes many cereal-based staple foods, such as wheat, rye, or barley bread, flour, and pasta, which are important sources of

energy, protein, carbohydrate, iron, calcium, niacin, and thiamine.<sup>3</sup> Removing these staple foods and their derived products from the diet can impact the nutritional status of individuals with CD.<sup>3</sup> Although it is still difficult to draw a conclusion about the nutritional adequacy of a GF diet because of conflicting results reported in available studies, several studies have found that individuals with CD have a different intake of macro- and micronutrients compared with healthy control subjects.<sup>3-7</sup> For this reason, assessing the dietary intake of individuals with CD is important for dietary surveillance and treatment of these individuals.

Several dietary assessment methods are used to quantify both short- and long-term (habitual) dietary intake. They represent essential tools in the area of nutritional epidemiology for assessing the relationship between diet and health in both general living and clinical settings.<sup>8</sup> Food records, 24-hour recalls, and food frequency questionnaires (FFQ) are the three most common methods used to measure dietary intake.<sup>9</sup> The 7-day weighed food record, which involves weighing all foods and drinks consumed during a 7-day period, is widely used in validity studies<sup>10,11</sup> and has often been referenced as the “gold standard” against which less detailed and demanding methods can be compared.<sup>12,13</sup> However, the 7-day weighed food record is now recognized as having limitations, as it requires a high level of motivation and effort by both participants and researchers. As a consequence, its use is limited to recording dietary habits in individual patients or small groups of individuals. On the other hand, FFQs are retrospective assessment tools that require respondents to report the frequency of consumption of a predefined list of foods over a prolonged period of time, typically the previous 6 or 12 months.<sup>14</sup> FFQs are less expensive to process and can be self-administered electronically, making them suitable for online interviews. For these reasons, FFQs are most commonly used in large-scale epidemiologic and intervention studies to determine habitual food and nutrient intake.<sup>14</sup> Because they are less accurate than the 7-day weighed food record, FFQs need to be evaluated in the population where they will be applied and for the nutrient(s) of specific interest. This can be done by either measuring specific biological markers of exposure or, more commonly, comparing responses from the FFQ with those derived from a more accurate instrument, such as the weighed food record.<sup>14</sup>

In the case of individuals with CD, dietary intake has been assessed through the use of either the weighed food record<sup>3-7,15-17</sup> or FFQs<sup>16,18</sup> in several studies. However, the principal limitations of these studies are, in the case of weighed food records, the small number of individuals with CD investigated and, in the case of FFQs, the use of instruments that have not been evaluated in the celiac population. Therefore, the aim of the present study was to evaluate a specific FFQ, the modified Italian EPIC FFQ, completed in a large number of individuals with CD using the 7-day weighed food record as a reference method.

## MATERIALS AND METHODS

### Participants and Study Design

Participants were recruited from among the patients referred to the Center of Prevention and Diagnosis of Celiac Disease at the IRCCS Cà Granda Foundation, Policlinico Hospital, Milan. The exclusion criteria were diagnosis of CD <2 years before, age younger than 18 years or older than 70 years, metabolic or chronic disease (eg, diabetes mellitus, Crohn's disease, cardiovascular and neurovascular diseases, cancer, neurodegenerative diseases, and rheumatoid arthritis), pregnancy or lactation, or being vegetarian. All individuals were recruited between October 2012 and August 2014 and the data were collected during the same period. In that time period, during their annual medical examination, patients were first screened for the adherence to the GF diet and 1,800 of the approximately 2,500 patients referred to the Center adhered to a GF diet for at

least 2 years. Of those 1,800 patients, 400 were eligible for the study and they were invited to participate. Two hundred individuals with histologically confirmed CD, all adhering to a strict GF diet as confirmed by a negative CD serology (ie, anti-transglutaminase IgA antibodies), signed a written informed consent and were enrolled in the study. At the end of their annual medical examination, study participants were interviewed about their usual nutritional intake consumed during the previous year using the modified Italian EPIC FFQ. They also received a 7-day weighed food record. Additional data on age, duration of disease, date of birth, and self-reported anthropometric measures (weight, height) were collected.

The local Ethical Committee for Human Research of the City of Milan approved the protocol. The study was registered at [ClinicalTrials.gov](http://ClinicalTrials.gov) (ID NCT01975155).

### Dietary Records

Total food and beverage consumption was assessed by means of a food diary filled out daily for a total of 7 days, as described previously.<sup>4</sup> The food diary was a booklet that included columns for the food description, the amount consumed, and the preparation method and recipes. A dietitian trained the participants on how to record all of the food consumed. Participants were asked to weigh all food and drink consumed and to provide a detailed description of each food, including methods of preparation and recipes used, whenever possible. In the case of GF foods, participants were asked to precisely note the name of the manufacturer or to provide the food label. Participants were asked to send their completed 7-day weighed food record to the Department of Food Science of the University of Parma. A dietitian reviewed the diaries and when the dietitian had concerns regarding possible errors or omissions, the participants were contacted by phone to clarify the issues.

Nutrient intake was calculated using the Microsoft Access application (version 2003, Microsoft Corp) linked to the European Institute of Oncology's food database, covering the nutrient composition of >900 Italian foods,<sup>19</sup> integrated with the nutrient composition of 60 GF foods present in the Italian market.<sup>20</sup> When a food recorded in the 7-day weighed food record was not in the database, an appropriate alternative food was chosen based on similarities in energy and nutrient composition. The output consisted of the mean daily intake of macro- and micronutrients and food items for each subject. Food items consumed were grouped into the following food categories: pasta; breads (including crackers and salty snacks); other cereals (including corn, quinoa, buckwheat, and rice); fruit; vegetables and legumes; meat and preserved meats; dairy products (including milk, yogurt, cream, and cheese); eggs; fish; oils and fats; sweets (including biscuits, sweet snacks, breakfast cereals, ice cream, candies, and chocolate); soft drinks; juices; coffee and tea; and alcoholic beverages. For each subject, the mean daily intake of each food category was then calculated.

### FFQ and Evaluation

The electronic version of the EPIC FFQ developed for North-Central Italy and specifically adapted for the celiac population, which included 188 food items, was used to determine the usual intake of foods and beverages consumed during the previous year.<sup>21</sup> The FFQ does not ask about the frequency of

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