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Validity and reproducibility of a food frequency questionnaire focused on the Mediterranean diet for the Quebec population

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Abstract *Background and aims:* Validated dietary assessment methods specific to population and food habits are needed to conduct randomized clinical trials evaluating the efficacy of the Mediterranean diet in primary and secondary prevention of cardiovascular disease. Therefore, the aim of our study was to assess the reproducibility and the relative validity of a French language semi-quantitative food frequency questionnaire (FFQ) focused on the Mediterranean diet within the population of Quebec.
Methods and results: Fifty-three participants aged 19–86 years with and without coronary heart disease were recruited, and randomized in 3 groups in a crossover design where the sequence of administration of two FFQs and a dietary record (DR) differed in each group. The FFQ includes 157 food items and was designed to measure food intake over one month. It was administered twice 3–5 weeks apart to assess reproducibility and was compared to a 12-day DR to assess validity. For reproducibility ($n = 47$), intraclass correlation coefficients (ICCs) for energy and 33 nutrients ranged from 0.38 to 0.91 (mean 0.63). For validity, the Pearson's correlation coefficients between the DR and the FFQ pre-DR ranged from 0.26 to 0.84 (mean 0.55) and ICCs ranged from 0.25 to 0.84 (mean 0.54). As for the DR and the FFQ post-DR, the Pearson's correlation coefficients ranged from 0.36 to 0.83 (mean 0.55) and the ICCs ranged from 0.36 to 0.83 (mean 0.53).
Conclusion: This FFQ demonstrates good reproducibility and validity for most key nutrients of the Mediterranean diet for the Quebec population.

Introduction

Initially described by Keys et al. in the Seven Countries Study [1], the Mediterranean diet is characterized by high intakes of olive oil, grain products, legumes, vegetables and fruits, moderate intakes of dairy products, low intake of meat and meat products and moderate consumption of alcoholic beverages during meals [2,3]. This diet has been

Abbreviations: BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease; Centre EPIC, Montreal Heart Institute's Prevention and Physical Activity Center; DR, dietary record; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid; FFQ, food frequency questionnaire; ICC, intraclass correlation coefficient; SD, standard deviation.

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shown to reduce all-cause and cardiovascular mortality [4,5], and also plays a role in the primary [1,6] and secondary prevention of cardiovascular disease (CVD) [7]. Several mechanisms may explain the cardioprotective effects of the Mediterranean diet including beneficial effects on cardiometabolic parameters [8,9], endothelial function [10,11], vascular inflammation [10,12] and oxidative stress [13,14]. These mechanisms are possibly mediated by a combination of key nutrients found in greater amount in Mediterranean foods and foodstuffs as compared to those found in a Western-type diet, such as potassium, magnesium, calcium, vitamin E, vitamin C, dietary fiber, monounsaturated fat and omega-3 fatty acids, as well as polyphenols [3,15,16]. In the Quebec and Canadian populations, CVD is the second most common cause of death [17]. At the same time, few clinical trials have been conducted on the cardioprotective effects of the Mediterranean diet in the Canadian setting. In the context of our desire to conduct such studies, validated dietary assessment methods to measure food intake and especially nutrients characteristic of the Mediterranean diet are needed. While dietary records (DR) represent a "gold standard" method for capturing usual food intake, they result in high burden (time and cost) for patients and investigators alike [18]. Food frequency questionnaires (FFQs) are widely used in epidemiological studies. However, they may also be useful in clinical trials to capture changes in diet following a nutritional intervention [6,19]. The aim of our study was therefore to assess the reproducibility and relative validity of the Latour questionnaire, a FFQ developed at the Montreal Heart Institute's Prevention and Physical Activity Center (Centre EPIC) for the purpose of conducting clinical trials evaluating the efficacy of the Mediterranean diet for improving cardiovascular health.

Methods

Study population

Fifty-three participants, men and women, between the ages of 19 and 86 years were recruited. The sole inclusion criterion was age $\geq$18 years. Exclusion criteria were pregnancy, participation in a weight loss program including dietary modification and insufficient knowledge of the French language. Participants were primarily recruited at Centre EPIC. This study was approved by the ethics committee of the Montreal Heart Institute and written informed consent was obtained from all participants.

A minimal sample size of 47 participants was computed for reproducibility using the large sample normal approximation for an intraclass correlation coefficient (ICC) with an expected parametric ICC of 0.63 and a one-sided 95.0% confidence interval (CI) lower limit of 0.48. As for validity, a sample size of 31 participants was computed using the large sample normal approximation for a Pearson's correlation coefficient with an expected parametric Pearson's correlation coefficient of 0.55 and a one-sided 95.0% CI lower limit of 0.30.

Design

Participants completed two FFQs and one DR. Subjects were randomized in 3 groups in a crossover design where the sequence of administration of FFQs and DR differed in each group (Fig. 1). This design was chosen to minimize bias and verify the influence of the food record on the answers to the questionnaire. In order to lower bias related to within-person variability of food intake, participants were asked not to modify their diet for the duration of the study. To reduce the social desirability bias, it was emphasized to all participants that the aim of the study was to evaluate the FFQ as opposed to their food habits.

Measurements

Sociodemographic characteristics and medical history were obtained from participants' medical files when available and completed with the participants at their first visit. Anthropometric measures (weight, height, waist circumference, percentage body fat (segmental bioelectric impedance/Tanita BC-418)) were also taken at that time.

Reproducibility assessment

The FFQ was administered twice, 3–5 weeks apart, to assess reproducibility. This interval was chosen in order to reduce bias related to memory as well as real changes in food intake. All questionnaires were self-administered by the participants at Centre EPIC and reviewed by a registered dietitian (JC) for completeness. Food models and household measurements were used by the dietitian to assure adequacy of portion size reported by the participants. Additional questions were also asked by the dietitian to refine answers, such as proportions of vegetables eaten raw and cooked and proportions of types of nuts eaten.

Validity assessment

The FFQ was compared to a 12-day DR carried out over a one-month period to assess relative validity. Days were predetermined (8 week days and 4 week-end days) by the investigators and were non-consecutive. The DR was chosen over other dietary assessment methods to reduce correlated bias with the FFQ. The number of days chosen for the DR was established through a compromise between the number of days required to assess usual intake of the nutrients measured [20] and participant burden. All DRs were revised by the same registered dietitian with the participants.

Group 1	DR	FFQ1	FFQ2
Group 2	FFQ1	DR	FFQ2
Group 3	FFQ1	FFQ2	DR

Figure 1 Sequence of administration of FFQs and DR.