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No significant independent relationships with cardiometabolic biomarkers were detected in the Observation of Cardiovascular Risk Factors in Luxembourg study population☆

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ABSTRACT

Recently, there has been an influx of research interest regarding the anti-inflammatory role that diet has in chronic and metabolic diseases. A literature-based dietary inflammatory index (DII) that can be used to characterize the inflammation-modulating capacity of individuals' diets has even been developed and validated in an American population. We hypothesized that the DII could predict levels of high-sensitivity C-reactive protein (CRP), which is an important inflammatory marker, as well as metabolic measures that include the metabolic syndrome and its components in European adults. This hypothesis was tested according to data from 1352 participants from the Observation of Cardiovascular Risk Factors in Luxembourg study, a nationwide, cross-sectional survey based in Luxembourg. Statistical methods consisted of descriptive and multivariable logistic regression analyses. The DII ranged from a minimum of −4.02 (most anti-inflammatory) to a maximum of 4.00 points, with a mean value of −0.41. Participants with higher DII score were significantly younger and had lower body mass index, waist circumferences, and systolic blood pressure levels. Other cardiovascular biomarkers including diastolic blood pressure, CRP, lipids, and glycemic biomarkers did not vary significantly across DII tertiles. Participants with proinflammatory (>1) DII scores had increased adjusted odds (odds ratio, 1.46; 95% confidence interval, 1.00-2.13) of having a low high-density lipoprotein cholesterol, compared with those with anti-inflammatory scores (DII ≤1). There were no significant relationships between high-sensitivity CRP and the DII. This study, which tested the

Abbreviations: BMI, body mass index; CI, confidence interval; CRP, C-reactive protein; DBP, diastolic blood pressure; DII, dietary inflammatory index; FFQ, Food Frequency Questionnaire; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; HOMA-IR, insulin resistance and sensitivity calculated according to homeostasis model assessment; hs-CRP, high-sensitivity C-reactive protein; MetS, metabolic syndrome; OR, odds ratio; ORISCAV-LUX, Observation of Cardiovascular risk Factors in Luxembourg; PUFA, polyunsaturated fatty acid; SBP, systolic blood pressure; SEASONS, Seasonal Variation in Blood Lipids Study; TG, triglycerides; WC, waist circumference.

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inflammatory capacity of the DII outside the United States, did not detect a significant independent relationship with cardiometabolic biomarkers, by using Food Frequency Questionnaire–collected data. These results are informative and representative of a relevant step in directing future research for nutrition and diet quality.

1. Introduction

Acute inflammation is the body's natural response to tissue injury and a necessary step in wound healing and tissue regeneration [1-4]. When acute inflammation is not controlled by normal processes of negative feedback, a chronic low-grade inflammatory state can occur [4]. Chronic inflammation is associated with metabolic syndrome (MetS) and its components [5] as well as type 2 diabetes [6], heart disease [6], and cancer [1], and diet plays an important role in the regulation of inflammation. A Western-type diet, which is typically high in red and processed meat, high-fat dairy products, and refined grains, is associated with higher levels of C-reactive protein (CRP) and interleukin 6 [7]. Alternatively, lower levels of inflammation are associated with the Mediterranean diet, which is characterized by a high intake of whole grains, fruit, green vegetables, and fish; moderate alcohol and olive oil consumption; and low intakes of red meat and butter [8,9]. Specific nutrients that are consistently associated with lower levels of inflammation include omega-3 polyunsaturated fatty acids (PUFAs) [10], fiber [11], vitamin E [12], vitamin C [13], β-carotene [14], and magnesium [15]. Diets high in fruits and vegetables are associated with lower levels of CRP and known to reduce the risk of MetS [16,17].

The dietary inflammatory index (DII) was developed to characterize the diets of individuals, according to their inflammatory potential [18,19]. The DII is based on an extensive review of literature and scoring of 1943 articles, published through 2010, which focused on the effects of diet on inflammation. Articles were scored according to whether each of 45 food parameters increased (+1), decreased (−1), or had no (0) effect on 6 inflammatory biomarkers (interleukins 1β, 4, 6, and 10; tumor necrosis factor α; and CRP) [18]. The parameters consisted of foods such as garlic, ginger, and onions; nutrients such as carbohydrates, fats, vitamins, and minerals; and other bioactive components such as flavonoids and resveratrol. This literature-based index, which focused on the inflammatory properties of the diets, aimed to facilitate research on diet-disease relationships and could even have potential implications for chronic disease prevention and patient counseling. The original index predicted interval changes in high-sensitivity CRP (hs-CRP) [19]. The updated version was recently validated using 2 different assessment methods of dietary intake (multiple days of 24-hour dietary recalls and a 7-day dietary recall) in each of 5 study periods from the Seasonal Variation in Blood Lipids Study (SEASONS). The results showed the capacity of the DII to predict hs-CRP greater than 3.0 mg/L (vs CRP $\leq$3.0 mg/L), using both assessment methods [20]. We also have observed that shift workers tended to have proinflammatory diets (higher DII scores), compared with their day-working counterparts [21]. Furthermore, higher DII scores were linked to asthma [22].

The authors hypothesized that the DII could predict inflammation-related outcomes in any population, using diverse dietary assessment tools. The current study aimed to test the DII's capacity to predict levels of an inflammatory marker (hs-CRP) and related health outcomes outside the United States. Therefore, we had 2 primary objectives. First, we aimed to examine the association between the DII and the MetS and its components, by using data from the "Observation of Cardiovascular Risk Factors in Luxembourg" (ORISCAV-LUX) study [23]. Second, we explored the inflammatory capacity of the DII, by using Food Frequency Questionnaire (FFQ)–derived data. This study constituted an opportunity to test the DII in a different setting, that is, in a sample representative of an adult European population who exercised different culinary and lifestyle habits as compared with the US population. Testing the performance of a novel dietary index is an important step to verify its future applicability in populations and could expand the scope of research in human nutrition and health.

2. Methods and materials

2.1. *ORISCAV-LUX study population*

Between November 2007 and January 2008, the ORISCAV-LUX study recruited a stratified random sample of 1432 subjects, between 18 and 69 years old. This nationwide, cross-sectional survey of healthy adults in Luxembourg aimed to establish baseline information on the prevalence of potentially modifiable and preventable cardiovascular risk factors, including obesity, hypertension, diabetes mellitus, lipid disorders, and smoking status. After the elimination of subjects with missing data on dietary intake, a total of 1352 individuals were available for the present analyses. A comprehensive description of the survey design, sample representativeness, and data collection is published elsewhere [23,24].

Demographic and socioeconomic variables, including age (in years), sex, education level (primary, secondary, or tertiary), marital status (live with partner or live alone), and economic status (below poverty threshold or above poverty threshold) were obtained. Further information about dieting practices, presence of chronic disease (diabetes, hypertension, or dyslipidemia), and use of medication were available for the analyses. Self-reporting of physical activity during the 7 days immediately before the interview was assessed using the International Physical Activity Questionnaire [25], which classifies subjects into active and inactive categories.

For all participants, anthropometric measurements of body weight (kilograms), height (centimeters), and waist circumference (WC) (centimeters) were collected according to standard operating procedures by using a digital column