Association of pro-inflammatory diet with low-grade inflammation: results from the Moli-sani study

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Abstract

Objectives—The association of diet with inflammation is well documented. Yet, no evidence exists on the relationship between inflammatory potential of the diet and low-grade inflammation (LGI) as measured by a composite score of plasma and cellular biomarkers. The aim of the present study is to assess the association between Dietary Inflammatory Index (DII®) and LGI in a large population-based cohort.

Methods—Cross-sectional analyses were conducted on data from 20,823 subjects (age 35 years, 48% male) without acute inflammation, recruited within the general population of the Moli-sani study from 2005 to 2010. LGI was measured by using a composite score (INFLA-score) including platelet and leukocyte counts, the granulocyte to lymphocyte ratio and C-reactive protein. DII® scores were computed based on dietary intake assessed by the EPIC food frequency questionnaire.

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Multivariable linear regression models were fit to produce adjusted regression coefficients and 95% confidence intervals.

Results—Higher DII scores were associated with increased LGI (β=0.131; 95%CI 0.089 to 0.174 for the highest vs lowest quintile of DII) after adjusting for age, sex, lifestyle, prevalence of chronic diseases and health conditions. A higher DII score also was positively associated with each single biomarker of inflammation included in the INFLA-score, unhealthy behaviours (smoking, sedentary behaviour) and insulin.

Conclusions—Higher DII scores, indicating greater inflammatory potential of the diet, were directly associated with LGI, as measured by a composite score of plasma and cellular biomarkers of inflammation. These findings are consistent with the contributing role of diet-mediated inflammation in increasing risk of inflammation-related chronic diseases.

Graphical Abstract
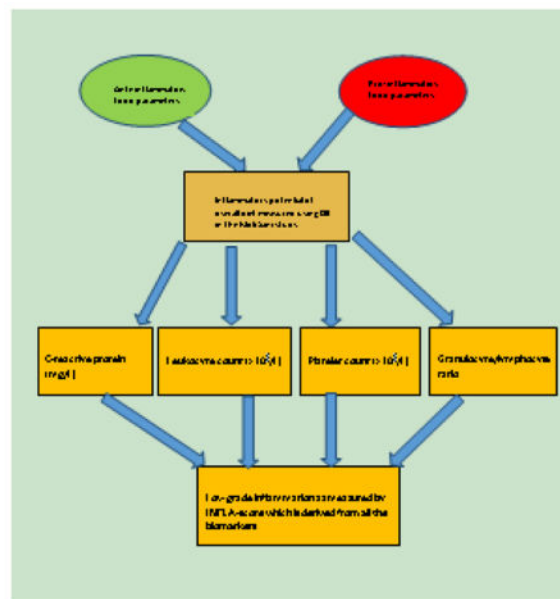
Keywords

dietary inflammatory index; low grade inflammation; Italy; FFQ; Moli-sani study

INTRODUCTION

Dietary components have been shown to be associated with a variety of chronic conditions ranging from cardiovascular diseases to cancer and mental disorders [1–4]. Acute inflammatory response is the process of body's natural reaction to injury or infection in order to heal wounds and promote tissue regeneration [5,6]. Chronic, low-grade (or subclinical) systemic inflammation is associated with numerous chronic conditions [7,8] and the ironic inability to mount a competent immune response to injury or infection [9]. A number of biomarkers, both circulating (i.e., C-reactive protein (CRP)) and cellular (i.e., leukocyte count) have been associated with the onset of major chronic diseases, such as

cardiovascular diseases [10,11]and cancer (8, 9) and, more recently, also with higher risk of death [12].

The Mediterranean dietary pattern, which is high in fruits, vegetables, olive oil, whole grains, and fish, and low in red meat and butter, with moderate alcohol intake, has been associated with lower levels of inflammation [13]. By contrast, the Western-type diet, which is high in red meat, high-f at dairy products, and refined grains, has been associated with higher levels of CRP, IL-6 and fibrinogen [14]. Specific nutrients also have consistently been associated with lower levels of inflammation. These include n-3 poly-unsaturated fatty acids (PUFA) [15], fibre [16], vitamin E [17]and β-carotene[18].

The dietary inflammatory index (DII$^®$) was developed by researchers at the University of South Carolina to estimate the overall inflammatory potential of the diet [19]. The DII is based upon an extensive literature search incorporating cell culture, laboratory animal, and epidemiologic studies of the effect of diet on inflammation. Previously, the DII has been shown to be associated with single markers of inflammation; specifically CRP, IL-6, TNF-α levels [20–28]. Specifically, in Italy, the DII has been shown to be associated with several cancers and myocardial infarction [29–36]. To date, no work has been conducted to validate the DII with low-grade inflammation as measured by a composite score of plasma and cellular biomarkers [12]. The objective of the current study is to conduct a cross-sectional analysis to examine the association between DII and low-grade inflammation in the general adult population of the Moli-sani study.

MATERIALS and METHODS

Study population

Data presented here are from the Moli-sani study, a large population-based cohort study that recruited 24,325 men and women aged   35 years from the general population of the Molise region, in central-southern Italy in 2005–2010[37].

For the purpose of the present analyses, we excluded individuals with implausible energy intakes (<800 kcal/day in men and <500 kcal/day in women or >4,000 kcal/day in men and >3,500 kcal/day in women; 3.2%), missing data on dietary habits (0.4%) or on markers of low-grade inflammation (3.3%), C-reactive protein levels   10 mg/L (4%), unreliable medical or dietary questionnaires (1% and 3.9%, respectively), missing data on main covariates (4.5%). The final sample consisted of 20,823 individuals. The Moli-sani study complies with the Declaration of Helsinki and was approved by the ethical committee of the Catholic University in Rome, Italy. All participants provided written informed consent.

Inflammatory biomarkers and INFLA-score

Blood samples were obtained from participants who had fasted overnight and had refrained from smoking for at least 6 h. A full description of biomarkers measurement is described elsewhere [38].

Low-grade inflammation was assessed by an INFLA-score, which has already been defined and used within the Moli-sani cohort [39] and includes C-reactive protein (CRP, mg/l),

leukocyte (WBC, $\times 10^9$/L) and platelet counts ($\times 10^9$/L) and the granulocyte to lymphocyte ratio (G/L ratio). For all four components, being in the highest deciles (7 to 10) was scored from +1 to +4; while being in the lowest deciles (1 to 4) was negatively scored from −4 to −1. The mid-deciles (5 or 6) were assigned a score of zero (0). The INFLA-score, which is sum of the four components, ranged between −16 and +16. Higher scores represented greater low-grade inflammation. For analytic purposes, the INFLA-score was rescaled to have a mean of zero and a standard deviation of one.

Assessment of risk factors

History of CVD included documented angina, myocardial infarction, revascularization procedures and cerebrovascular events. History of cancer included self-reported diagnosis of cancer. Hypertension was defined as systolic blood pressure 140 mm Hg or diastolic blood pressure 90 mm Hg or treatment for hypertension. Hypercholesterolemia was defined if total cholesterol 240 mg/dl or by use of specific medication. Diabetes was defined as fasting blood glucose 126 mg/dl, or on the basis of specific pharmacological treatment

Socioeconomic variables

Education was based on the highest qualification attained and was categorized as up to lower secondary school (8 years of study), up to higher secondary school (8–13 years of study) and post-graduate (>13 years of study). Household income, expressed as earned Euros per year, was a 5-level variable (<10,000; 10,000–25,000; 25,000–40,000; >40,000 with missing values collapsed into a non-respondent category). Occupational social class was based on the Registrar General's occupation based classification scheme but, differently from the original UK classification, the social class for women was obtained as done for men [40].

Dietary information

Food intake during the year before enrolment was assessed by the validated Italian EPIC food frequency questionnaire [41]. Adherence to the Mediterranean diet (MD) was defined according to the Mediterranean Diet Score [42], with scores ranging from 0 to 9.

Food antioxidant content (FAC) was appraised by a score determining the content in antioxidant vitamins and phytochemicals of each food group and ranged from −99 to 99 with higher values indicating increased consumption of foods rich in antioxidants [43]. The polyphenol content of diet was measured by a polyphenol antioxidant content (PAC)-score calculated as in Pounis et al [43].

Variety of fruit and vegetable intake was assessed by a Diet Diversity Score [44] derived from the total number of individual vegetable and fruit items eaten at least once in two weeks (range 0–37). FFQ-derived dietary information was used to calculate DII scores for all subjects, as described in detail elsewhere [19]. Briefly, the dietary data for each study participant were first linked to the regionally representative global database that provided a robust estimate of a mean and standard deviation for each of the food parameters (i.e., foods, nutrients, and other food components such as flavonoids) considered. A z-score was derived by subtracting the "standard global mean" from the amount reported and then dividing this value by the standard deviation. To minimize the effect of "right skewing" (a common

occurrence with dietary data), this value was then converted to a centered proportion, which was then multiplied by the respective food parameter inflammatory effect score (derived from a literature review and scoring of 1943 "qualified" articles) to obtain the subject's food parameter-specific DII score. All of the food parameter-specific DII scores were then summed to create the overall DII score for every subject in the study. For the current study, data were available for a total of 34 food parameters (carbohydrate, protein, total fat, alcohol, fibre, cholesterol, saturated fat, monounsaturated fat, polyunsaturated fat, omega-3, omega-6 fatty acid, niacin, thiamin, riboflavin, vitamin B12, vitamin B6, iron, magnesium, zinc, vitamin A, vitamin C, vitamin D, vitamin E, folic acid, β-carotene, anthocyanidins, flavan3ol, flavones, flavonols, flavonones, isoflavones, garlic, onion, tea). A description of validation work of the DII score, based on both dietary recalls and the 7-day dietary recall, a structured questionnaire similar in terms of its layout to an FFQ, is available elsewhere [23].

Risk factor assessment

Leisure-time physical activity (LTPA) was expressed as daily energy expenditure in metabolic equivalent task-hours (MET-h/d). Body mass index (BMI) was calculated as weight(kg)/height(m)^2 and then grouped into three categories as normal (25kg/m^2), overweight (>25 to <30 kg/m^2) or obese (30kg/m^2). Abdominal obesity was defined as waist-to-hip ratio 0.85 or 0.90 for women and men, respectively [45]. Subjects were classified as never-smokers, current smokers or ex-smokers (quitting from at least 1 year).

Statistical analysis

Characteristics of the study population were presented as numbers and percentages, or mean values and standard deviation for continuous variables. Differences in Tables 1 and 2 were calculated by using the analysis of variance (ANOVA) adjusted for age and sex (PROC GENMOD and PROC GLM in SAS for categorical and continuous variables, respectively). Beta-coefficients (±SE) with 95% confidence intervals (95%CI) from multivariable linear regression analysis were used to estimate the association of the INFLA-score or single inflammatory biomarkers (used as dependent variable) with DII, wither as quintiles or as a continuous variable (Tables 4,5). When quintiles are considered, beta-coefficients represent the change in INFLA-score (or single inflammatory biomarkers) for each quintile (2 to 5) in comparison with the lowest quintile (1). The regression models included age, sex, smoking, leisure-time PA, BMI (categorical), abdominal obesity, education, income, occupational class, CVD, cancer, diabetes, hypercholesterolemia and hypertension. Association with platelet count was further adjusted for haematocrit. A two-sided α=0.05 was phenomenal cutpoint for statistical significance. The data analysis was generated using SAS/STAT software, Version 9.4 of the SAS System for Windows$^©$2009. SAS Institute Inc. and SAS are registered trademarks of SAS Institute Inc., Cary, NC, USA.

RESULTS

Table 1 shows the characteristics of the participants across quintiles of DII. Changes were observed across quintiles for several characteristics. Participants in quintile 5 were younger, more likely to be males, smokers, have postgraduate education and income, be in a skilled occupation, have low physical activity, lower BMI, higher abdominal obesity, and lower

prevalence of CVD, cancer, hypertension, diabetes and hypercholesterolemia. Table 2 shows distribution of biomarkers of inflammation across quintiles of DII. Participants in quintile 5 had higher levels of most markers (INFLA-score, leukocyte count, platelet count, and granulocyte/lymphocyte ratio) compared to participants in quintile 1.

Table 3 shows the distribution of dietary characteristics across DII quintiles, with participants in quintile 5 having higher energy intake and lower Mediterranean diet score, polyphenol content, antioxidant content and fruits and vegetables, compared to subjects in the lowest quintile.

Analysis of inflammatory markers

Analyses adjusting for covariates showed positive associations between DII and INFLA-score ($\beta_{DIIq5\ vs\ 1}$=0.13; 95%CI 0.09 to 0.17), CRP ($\beta_{DIIq5\ vs\ 1}$=0.05; 95%CI 0.01 to 0.09), leukocyte count ($\beta_{DIIq5\ vs\ 1}$=0.08; 95%CI 0.04 to 0.12), platelet count ($\beta_{DIIq5\ vs\ 1}$=0.07; 95%CI 0.03 to 0.12), granulocyte/lymphocyte ratio ($\beta_{DIIq5\ vs\ 1}$=0.10; 95%CI 0.05 to 0.14), (Table 4).

Subgroup analyses, as shown in Table 5, revealed a positive association between DII as continuous and: 1. INFLA-score among both men and women, those aged 50–65 years and among participants without CVD, cancer, diabetes, hypercholesterolemia and hypertension.; 2. CRP among men, those aged 50–64 years; 3. Leukocyte count among both men and women, those aged <50, 50–64 years, and healthy sample; 4. Platelet count among men, those aged <50, 50–64 years, and healthy sample; 5. Granulocyte/lymphocyte ration among women, those aged <50, 50–64 years, and healthy sample.

DISCUSSION

This is the first study in Italy to observe an association between inflammatory potential of diet, as measured by DII score, and low-grade inflammation assessed by a composite score including cellular and circulating biomarkers that have previously been found to be associated with increased risk of death [12]. The results also revealed a positive association between DII score and individual biomarkers of low-grade inflammation. These findings reinforce the idea that a diet rich in pro-inflammatory food parameters (sweets, butter and other animal fats, cholesterol, saturated fat), and relatively poor in anti-inflammatory food parameters (vegetables and fruits) contribute to low-grade, systemic inflammation among adults in the general Italian population. Overall, our study results are consistent with the hypothesis that diet modulates inflammation. The inference is that by modulating low-grade inflammation diet may exert an effect on chronic diseases such as several cancers and cardiovascular diseases. Higher scores also could result from low consumption of food items considered to be anti-inflammatory such as fruits and vegetables. Adherence to an anti-inflammatory dietary pattern, such as the Mediterranean diet, has been shown to reduce the risk of cardiovascular and cerebrovascular diseases [46,47]. All of these chronic health conditions are related to inflammation [48–50]. In subgroup analyses, the DII was associated with low-grade inflammation among most subgroups except those aged 65 years. The reason for this is not clear; therefore, further analyses should be carried out to investigate the

possibility of other factors such as infections or normal cellular senescence may play a major role in modulating inflammation among elderly [51].

We also observed that participants in DII quintile 5 had lower prevalence of CVD, cancer, hypertension, diabetes and hypercholesterolemia despite that these participants were more likely to smoke, be male, and have low physical activity. This can be explained by the fact that they were significantly younger than individuals in other quintiles (e.g., nearly 7 years younger than those in quintile 1). Another explanation is that older individuals, who are more likely to have had a diagnosed chronic disease are more likely to have adopted a healthier, anti-inflammatory diet. Of course, these explanations are not mutually exclusive.

In a previous study within the Moli-sani cohort, three dietary patterns were identified by principal factor analysis, the "Olive Oil and Vegetables" pattern, was associated with relatively lower values of CRP, the "Pasta and Meat" pattern, was positively associated with CRP and the "Eggs and Sweets" pattern, was associated with high values of CRP [52]. We also have reported previously an inverse association between INFLA-score and adherence to MD (56); while in another report polyphenol content of diet was negatively associated with low-grade inflammation as determined through INFLA-score [39]. As shown from the current analyses, higher DII scores are associated with lower Mediterranean diet score. The polyphenol and antioxidant content and lower fruit and vegetable consumption of the MD also are associated with lower DII scores.

The strengths of our study include extensive information on diet, lifestyle and cardiovascular risk profile, the large size of the study population, and the sampling from the general population, with a high response rate (70%) [37]. As previously mentioned, this is the first study to investigate the association of biomarkers included in the INFLA-score with DII in a Mediterranean population. Previously, the DII has been shown to be associated with a variety of low grade inflammation-related outcomes in Italy both in prospective and case-control studies [29–35,53–56]. Another strength includes the large number of inflammation markers, measured in plasma and analysed centrally in the same laboratory and the large battery of lifestyle and anthropometric variables assessed according to standardized procedures is an important advantage of this study as it allows adjustment for several possibly confounding factors.

Several methodological limitations of the present study should be noted. The cross-sectional design of the study provided a picture of eating habits and other characteristics at a point in time, thus the possibility of inverse causation bias arises. Another limitation is the fact that DII scores were computed from self-reports via a food frequency questionnaire, which carried an inherent degree of recall bias and can lead to a potential misclassification of the exposure. Third, the DII was calculated using data on only 34 nutrients and food components derived from FFQ. In the DII validation study, sensitivity analysis was conducted comparing DII calculated from multiple (up to 15/person) 24HR (which provided data on 44 nutrients and food components) with DII calculated from 7-day dietary recalls (which provided data on 28 nutrients and food components) [23]. We found that the association with CRP was not attenuated when using the more limited list available with the 7-day dietary recalls. Still, the attenuation in the food parameter list could explain the

absence of an association between DII and CRP in this study. Despite the reduction in the number of parameters, we still could successfully observe associations with some of the inflammatory markers [23].

Conclusion

Results from this study suggest that consuming a pro-inflammatory diet high in food components such as sugar and saturated fat leads to a persistent state of low grade inflammation, which may increase the risk of a range of chronic diseases like cancers and cardiovascular diseases throughout life.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Highlights

- Dietary Inflammatory Index (DII) measures dietary inflammation potential.

- This study assessed the association between DII and low-grade inflammation.

- This is the first study to examine this association in an Italian population.

- Results showed that proinflammatory diet was associated with higher level of LGI.

Table 1

Characteristics of the study population by quintiles of dietary inflammation index, Moli-sani study, 2005–2010.

	Quintiles of dietary inflammation index (DII®) Score					
	1st	**2nd**	**3rd**	**4th**	**5th**	**P value**
Means, SD	−0.99 (0.81)	0.59 (0.31)	1.58 (0.27)-	2.53 (0.27)-	3.67 (0.60)	-
N, %	4164 (20.0)	4165 (20.0)	4165 (20.0)	4165 (20.0)	4164 (20.0)	
Age	58.1 (11.6)	57.0 (11.7)	55.8 (11.7)	54.5 (11.5)	51.2 (10.8)	<.0001
Sex (men, %)	36.6	44.6	51.5	51.4	52.6	<.0001
Education (%)						0.0002
Up to lower secondary school	52.7	54.1	52.9	52.8	47.3	
Up to higher secondary school	33.8	32.9	33.9	35.1	38.8	
Postgraduate	13.5	13.0	13.2	12.1	13.9	
Household income (%)						0.006
<10,000	6.8	5.3	5.9	5.5	4.0	
10,000–25,000	27.9	29.6	30.3	33.5	30.1	
25,000–40,000	19.8	19.7	20.6	20.7	22.5	
>40,000	11.9	12.1	11.8	10.9	12.7	
Non-respondents	33.5	33.3	31.4	29.5	30.7	
Occupational class (%)						<.0001
Professional/mangerial	22.3	20.4	21.0	19.8	20.1	
Skilled non-manual	36.5	36.2	34.4	35.3	39.3	
Skilled manual	14.6	17.2	19.9	19.2	18.6	
Semi-skilled/unskilled	18.6	19.5	18.7	20.6	16.7	
Unclassified	7.8	6.8	5.9	5.0	5.3	
Leisure-time PA (met-h/d)	4.0 (4.1)	3.7 (4.1)	3.6 (4.1)	3.3 (3.8)	3.0 (3.7)	<.0001
Smokers (%)	17.6	19.8	20.7	24.3	30.5	<.0001
BMI	28.1 (4.7)	28.1 (4.7)	27.7 (4.5)	27.8 (4.5)	27.7 (4.6)	<.0001
Abdominal obesity (%)	75.1	74.7	73.2	73.1	69.4	0.005
Cardiovascular disease (%)	6.8	5.5	5.4	4.6	2.8	0.002
History of cancer (%)	4.0	3.3	3.2	2.9	2.5	0.73

Quintiles of dietary inflammation index (DII®) Score

	1st	2nd	3rd	4th	5th	P value
Diabetes (%)	11.7	9.9	9.2	8.2	5.7	<.0001
Blood glucose (mg/dL)	103 (26)	101 (25)	101 (24)	100 (22)	100 (19)	0.005
Hypertension (%)	59.7	60.6	56.5	54.0	45.9	0.002
Systolic BP (mm Hg)	141 (22)	141 (20)	140 (20)	141 (21)	140 (19)	0.005
Diastolic BP (mm Hg)	82 (9)	83 (10)	82 (9)	82 (10)	82 (10)	0.41
Hypercholesterolemia (%)	35.6	33.0	29.9	29.6	26.7	<.0001
Total cholesterol (mg/dL)	213 (42)	213 (42)	212 (41)	213 (41)	213 (41)	0.13
HDL-cholesterol (mg/dL)	57 (15)	58 (15)	58 (15)	58 (15)	58 (15)	0.09
LDL-cholesterol (mg/dL)	131 (36)	130 (36)	129 (35)	131 (35)	131 (34)	0.34
Triglycerides (mg/dL)	125 (62)	125 (63)	124 (66)	124 (65)	123 (65)	0.11

Continuous variables are presented as means and standard deviation (SD).

Means and p values adjusted for age and sex.

Table 2

Dietary inflammation index and biomarkers of inflammation, Moli-sani study, 2005–2010.

	Quintiles of dietary inflammation index (DII®) Score					
	1st	2nd	3rd	4th	5th	P value
N, %	4164 (20.0)	4165 (20.0)	4165 (20.0)	4165 (20.0)	4164 (20.0)	-
INFLA-score	−0.07 (1.02)	−0.03 (0.99)	0.002 (1.00)	0.02 (0.98)	0.07 (1.00)	<.0001
C-reactive protein (mg/L)	2.03 (1.95)	2.01 (1.89)	2.05 (1.93)	2.02 (1.80)	2.08 (1.85)	0.43
Leukocyte count (×10⁹/L)	6.11 (1.97)	6.11 (1.55)	6.15 (1.62)	6.18 (1.57)	6.26 (1.65)	0.0002
Platelet count (×10⁹/L)	245 (66)	247 (64)	249 (63)	249 (63)	250 (62)	0.0052
Granulocyte/lymphocyte ratio	1.93 (0.74)	1.97 (0.75)	1.98 (0.78)	1.97 (0.73)	2.04 (1.29)	<.0001

Values are reported as means with standard deviation in brackets.

Mean and p values are adjusted for age and sex. Means for platelet count were further adjusted for haematocrit.

Table 3

Dietary inflammation index and dietary characteristics of the population, Moli-sani study, 2005–2010.

	Quintiles of dietary inflammation index (DII® Score)					
	1st	**2nd**	**3rd**	**4th**	**5th**	**P value**
N, %	4164 (20.0)	4165 (20.0)	4165 (20.0)	4165 (20.0)	4164 (20.0)	-
Energy intake (Kcal/d)	1883 (519)	2025 (519)	2105 (547)	2153 (567)	2256 (576)	<.0001
Mediterranean diet score	5.3 (1.4)	4.8 (1.5)	4.4 (1.5)	4.0 (1.5)	3.3 (1.5)	<.0001
Polyphenol content (PAC–score)	11.8 (10.8)	6.1 (10.7)	1.2 (10.8)	−4.4 (10.6)	−12.2 (9.9)	<.0001
Antioxidant content (FAC–score)	38 (42)	18 (42)	3 (41)	−14 (41)	−37 (39)	<.0001
Fruit and vegetable variety	16 (4)	15 (3)	14 (3)	13 (4)	11 (4)	<.0001

Continuous variables are presented as means and standard deviation (SD).

Means and p values adjusted for age and sex.

Table 4

Association of dietary inflammation index with the INFLA-score and biomarkers of inflammation, Moli-sani study, 2005–2010.

	Quintiles of dietary inflammation index (DII®) Score					
	1st	2nd	3rd	4th	5th	Continuous
		Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)
INFLA-score	Ref	0.034 (−0.008 to 0.075)	0.086 (0.044 to 0.128)	0.092 (0.049 to 0.134)	0.131 (0.089 to 0.174)	0.029 (0.021 to 0.037)
C-reactive protein (mg/L)	Ref	−0.012 (−0.051 to 0.027)	0.028 (−0.010 to 0.068)	0.020 (−0.010 to 0.068)	0.054 (0.014 to 0.094)	0.012 (0.004 to 0.019)
Leukocyte count (×10^9/L)	Ref	0.012 (−0.028 to 0.052)	0.045 (0.005 to 0.085)	0.054 (0.013 to 0.094)	0.078 (0.037 to 0.120)	0.016 (0.009 to 0.024)
Platelet count (×10^9/L)	Ref	0.024 (−0.017 to 0.065)	0.065 (0.023 to 0.106)	0.067 (0.026 to 0.109)	0.074 (0.032 to 0.117)	0.016 (0.008 to 0.024)
Granulocyte/lymphocyte ratio	Ref	0.054 (0.011 to 0.096)	0.064 (0.021 to 0.107)	0.049 (0.006 to 0.092)	0.098 (0.054 to 0.142)	0.020 (0.012 to 0.028)

Regression coefficients (with 95% CI) obtained from a multivariable model adjusted for age, sex, smoking, leisure-time PA, BMI, abdominal obesity, education, income, occupational class, CVD, cancer, diabetes, hypercholesterolemia and hypertension. Association with platelet count was further adjusted for haematocrit.

Table 5

Sub-group analyses for the association of dietary inflammation index with the INFLA-score and biomarkers of inflammation, Moli-sani study, 2005–2010.

	Men (n=9,861)	Women (n=10,962)	Aged<50 y (n=7,870)	Aged 50–64 y (n=8,296)	Aged ≥65 y (n=4,657)	Healthy sample (n=6,385)[1]
	Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)	Regression coefficient (95%CI)
INFLA-score	0.027 (0.015 to 0.039)	0.031 (0.021 to 0.042)	0.025 (0.013 to 0.038)	0.034 (0.022 to 0.047)	0.014 (−0.003 to 0.032)	0.031 (0.017 to 0.045)
C-reactive protein (mg/L)	0.016 (0.004 to 0.027)	0.009 (−0.0007 to 0.019)	0.007 (−0.005 to 0.019)	0.022 (0.011 to 0.034)	−0.002 (−0.019 to 0.013)	0.012 (−0.001 to 0.026)
Leukocyte count (×10⁹/L)	0.015 (0.004 to 0.027)	0.018 (0.008 to 0.028)	0.019 (0.007 to 0.031)	0.014 (0.002 to 0.026)	0.011 (−0.007 to 0.028)	0.014 (0.0004 to 0.027)
Platelet count (×10⁹/L)	0.025 (0.014 to 0.037)	0.010 (−0.0002 to 0.021)	0.018 (0.006 to 0.031)	0.015 (0.002 to 0.027)	0.014 (−0.003 to 0.031)	0.023 (0.009 to 0.038)
Granulocyte/lymphocyte ratio	0.006 (−0.007 to 0.018)	0.032 (0.021 to 0.043)	0.017 (0.004 to 0.029)	0.021 (0.008 to 0.034)	0.012 (−0.007 to 0.031)	0.023 (0.009 to 0.037)

Regression coefficients (with 95% CI) obtained from a multivariable model adjusted for age, sex, smoking, leisure-time PA, BMI, abdominal obesity, education, income, occupational class, CVD, cancer, diabetes, hypercholesterolemia and hypertension. Association with platelet count was further adjusted for haematocrit.

[1]
Subjects free from CVD, cancer, diabetes, hypercholesterolemia and hypertension.