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Association between the Dietary Inflammatory Index, Waist-to-Hip Ratio and Metabolic Syndrome

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Abstract

Inflammation due to poor diet may contribute to the development of metabolic syndrome (MetSyn). The Dietary Inflammatory Index (DII) was created to characterize diet on a scale from anti- to pro-inflammatory. Our hypothesis was that higher (i.e., more pro-inflammatory) DII scores are associated with an increased prevalence of MetSyn compared to those with lower (i.e., more anti-inflammatory) DII scores. Data from the Polish-Norwegian (PONS) Study were analyzed using logistic and linear regression procedures in SAS (version 9.4). Comparisons of interest were between the first and fourth DII quartiles; analyses were stratified by sex. Mean waist-to-hip ratio (WHR) and diastolic blood pressure were greater among those in DII quartile 4 compared to 1. No statistically significantly increased MetSyn risks were observed for DII quartile 4 among males or females. Males in DII quartile 4 had elevated odds of fulfilling the waist component of MetSyn (odds ratio = 1.65, 95% confidence interval = 1.01 to 2.69). Although this study benefited from the DII and large sample sizes for both males and females, its cross-sectional nature and use of self-reported data may limit interpretation of results. Further work must be done in longitudinal studies to understand whether pro-inflammatory diets are associated with an increased risk of MetSyn, its components or other metabolic-related conditions. Additionally, further examination of the DII in relation to body habitus will be needed to understand the role of pro-inflammatory diets on anthropometrics, as observed in this study.

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Keywords

Dietary Inflammatory Index; metabolic syndrome; inflammation; waist-to-hip ratio; diet; PONS

1. Introduction

Inflammation is a natural physiological response to injury [1]. However, prolonged exposure to chronic stressors (e.g., smoking, tobacco use, chronic infection, obesity) may lead to chronic inflammation, a risk factor for several chronic diseases including metabolic syndrome (MetSyn) [1, 2]. MetSyn is categorized by hypertension, obesity, elevated triglycerides, fasting glucose levels, and/or decreased high-density lipoprotein cholesterol (HDL) levels. Obesity is associated with inflammation and can serve as a precursor for metabolic disease [2]. Diet also has been shown to be a strong moderator of chronic, systemic inflammation [2]. Studies have shown that the Mediterranean diet (rich in fruits, olive oil, vitamins, and antioxidants) minimizes inflammation, while the ‘Western’ diet (with large quantities of fats and simple carbohydrates) increases inflammation [2]. These “unhealthy” dietary patterns, which are associated with increased inflammation, also are associated with MetSyn [3]. However, no other dietary index has been developed to specifically characterize dietary inflammatory potential, which may contribute to MetSyn risk or burden.

The Dietary Inflammatory Index (DII) was designed to evaluate individuals’ diet on an anti-to pro-inflammatory continuum [4]. Typically, more pro-inflammatory DII scores are observed among “unhealthy” diets high in fats, simple carbohydrates, and fast food [3]; the type of diets associated with MetSyn. Previously, the DII was associated with a range of outcomes including cancer, inflammation, cardiovascular disease, asthma, bone mineral density, telomere length, and overall mortality [5–14]. With respect to MetSyn, associations with the DII have been inconsistent. Some studies show no association with MetSyn, even though individual components of MetSyn were associated with the DII [5, 15, 16]. More pro-inflammatory diets, as indicated by higher DII scores, were associated with overall MetSyn in one study conducted in France [17]. This study utilized cross-sectional data from the Polish-Norwegian Study (PONS) to examine the effects of the DII on MetSyn. Specifically, we hypothesized that higher (i.e., more pro-inflammatory) DII scores would be associated with a higher prevalence of MetSyn and its components (i.e., waist circumference, hypertension, HDL cholesterol, triglycerides, and glucose intolerance), compared to those with more anti-inflammatory DII scores.

2. Methods and Materials

Voluntary participants in the first wave of the PONS study were invited by public announcement in Poland’s Świętokrzyskie Province and in the city of Kielce (n=3,862). Participants were between 45 and 64 years of age and were recruited between September 2010 and March 2011 [18]. All data were gathered through interviews, blood samples, and clinical measurements. Questionnaire data included information on sociodemographic factors, personal health and family histories, and behavioral habits (e.g., sleep, smoking,

alcohol intake), among others. Fasting blood samples provided measurements of glucose, HDL cholesterol, and serum triglycerides. During the clinical examinations, measurements of hip and waist circumference, blood pressure, height, spirometry, and weight were obtained. This study was approved by the Ethics Committee of the Cancer Centre and Institute of Oncology (Warsaw, Poland). All participants provided informed written consent. More details on the PONS can be found elsewhere [19].

MetSyn components were considered “met” if the following criteria were observed: waist circumference of 102 cm for males or 88 for females; blood pressure >130 for systolic or >85 for diastolic; HDL cholesterol of <40mg/dL in men and <50 in women; triglycerides >149 mg/dL, and glucose >99 mg/dL. MetSyn was further defined as the presence of at least three of these components.

The DII attempts to quantify the role that diet plays in the development of inflammation and allows researchers to assess the inflammatory potential of diet through several means of data collection (e.g., food frequency questionnaire [FFQ], 24-hour dietary recalls [24HR]) [4]. For the PONS study, an FFQ consisting of approximately 55 questions measured food intake of the PONS study participants; frequencies and quantities consumed were converted into estimates of daily nutrient intake [19].

The DII was based on data reported in 1,943 research articles examining the relationship between various dietary constituents (referred to as food parameters) and inflammation to develop an article score for each food parameter. A “world” database (based on 11 populations from around the world including the United States, the United Kingdom, Bahrain, Mexico, Australia, South Korea, Taiwan, India, New Zealand, Japan, and Denmark) consisting of means and standard deviations for the food parameters was subtracted from an individual’s actual dietary intake and divided by its standard deviation, creating a z-score. These were expressed as percentiles and centered around 0 (i.e., -1 is most anti-inflammatory and +1 most pro-inflammatory). The centered scores were then multiplied by the inflammatory article score and summed across all parameters to create the overall DII score. DII scores were calculated per 1,000 calories consumed to account for the differences in energy intake between participants. The theoretical maximum range of DII values is from about -8 to about +9. For the analyses, DII values were converted to quartiles. The available DII food parameters in PONS included: carbohydrates; protein; fat; fiber; cholesterol; saturated, monounsaturated, and polyunsaturated fatty acids; niacin; thiamin; riboflavin; vitamins A, B6, B12, C, and E; iron; magnesium; zinc; selenium; folate; and beta-carotene.

2.1 Statistical Analyses

Analyses were performed using SAS® software (version 9.4, Cary, NC). Descriptive statistics are presented in Table 1. P-values represent differences between males and females using chi-square tests for categorical covariates and t-test or Wilcoxon rank sums test for continuous measures. The variable selection procedures started as a series of bivariate analyses (i.e., the DII + potential covariate). Covariates with a p-value ≤ 0.20 were added to a full model. Final model selection was based on a backward selection process for the MetSyn outcome. Unconditional multiple logistic regression was used to calculate odds ratios (OR) and 95% confidence intervals (95%CI) for dichotomous MetSyn outcomes. The

primary comparisons of interest were between DII quartiles 1 (least inflammatory) and 4 (most inflammatory). However, the DII also was analyzed as a continuous factor. Additionally, these analyses were stratified by sex. Least squares means also were obtained for each DII quartile for the continuous form of each MetSyn biomarker, as well as body mass index ($\text{BMI} = \text{kg/m}^2$) and waist-to-hip ratio (WHR), using generalized linear models.

3. Results

The population was primarily female (67%) with an average age of 56 ± 5 years and BMI of $28.3 \pm 4.6 \text{ kg/m}^2$, lived mostly in urban areas (69%) and were married (81%). Overall, 50% of the population received only a high school diploma or less. Among all subjects, the prevalence of MetSyn and its components are as follows: MetSyn (30%), blood pressure component (67%); waist component (46%); HDL component (16%); triglycerides component (21%); and glucose component (36%). The average DII score was 0.93 ± 1.44 which was slightly pro-inflammatory.

No increased prevalence for MetSyn or its components were observed for DII quartile 4 compared to 1 (Table 2) among all subjects. The same was true for the continuous form of the DII (data not tabulated). Among males, those in DII quartile 4 experienced an increased prevalence of the waist component compared to those in quartile 1 (OR = 1.65; 95%CI = 1.01 to 2.69). Among females, more pro-inflammatory diets were associated with a decreased prevalence for overall MetSyn (OR = 0.63; 95%CI = 0.47 to 0.86), blood pressure component (OR = 0.76; 95%CI = 0.60 to 0.96), HDL component (OR = 0.70; 95%CI = 0.51 to 0.96), and the glucose component (OR = 0.74; 95%CI = 0.56 to 0.96) (Table 3).

Using general linear models, it was found that WHR was greater among those in DII quartile 4 compared to those in 1 (mean WHR: 0.90 vs. 0.87, $p < 0.01$), as was diastolic blood pressure (mean diastolic: 82.5 vs. 80.9, $p < 0.01$). No other differences were observed using general linear models (data not tabulated).

4. Discussion

Among males, those with more pro-inflammatory diets were found to have greater odds of meeting the waist component criteria. However, overall the hypothesis was rejected because no association was observed between overall MetSyn and DII scores among men. It also should be noted that decreased odds of meeting the blood pressure, HDL, and glucose components was observed for females with pro-inflammatory diets, as well as reduced odds of having MetSyn overall.

Previously, the glucose intolerance component of MetSyn was associated with more pro-inflammatory DII scores among Buffalo, New York police officers from the Buffalo Cardio-Metabolic Occupational Police Stress study (OR for DII quartile 4 compared to 1 = 2.03, 95%CI = 1.08 to 3.82). However, no association was observed for MetSyn (OR for DII quartile 4 compared to 1=0.87, 95%CI=0.46 to 1.63) [5]. No association between the DII and MetSyn was observed in a study from Luxembourg, nor was an association observed in a study from Spain [15, 16]. In the Luxembourg study, the DII was associated only with the dyslipidemic component of the MetSyn (OR for a 1-unit increase in the DII=1.46,

95%CI=1.00 to 2.13) [16]. It should be noted that both the BCOPS and the Luxembourg studies were cross-sectional; whereas the study from Spain was prospective. To date, the only study to show an association between the DII and overall MetSyn was from a prospective study conducted in France [17]. Specifically, the OR for MetSyn among DII quartile 4 compared to 1 was 1.39 (95%CI = 1.01 to 1.92). Additionally, more pro-inflammatory diets were associated with higher blood pressure and triglycerides and lower HDL-cholesterol [17]. However, caution is warranted when comparing the current results to these other studies, as the populations are located in different countries.

This analysis revealed decreased odds of MetSyn among females with more pro-inflammatory diets. While this is not what we would have expected, the cross-sectional nature of this study could have contributed to this finding because of, among others, reverse causation. Additionally, quartile 4 was not statistically significantly associated with MetSyn or its components as hypothesized. Perhaps the women meeting MetSyn criteria made lifestyle changes based on recommendations by healthcare providers before participating in this study. Although their original diets became healthier, there may not have been enough time to observe biological changes. It also should be noted that only 3 of the 5 components need to be met for MetSyn. Therefore, it is possible that women made healthy dietary changes and did experience healthy biological changes for some of the MetSyn components, but still met the overall diagnosis criteria. Other explanations for the lack of associations between the DII and MetSyn in this study may include: the very abbreviated nature of the FFQ (at 55 items it is the shortest yet used for calculating the DII), a lack of adjustment for unmeasured covariates or some other unaccounted-for bias, results could be random, or the DII simply may not be associated with MetSyn syndrome in this cross-sectional study.

Greater WHR values were associated with higher DII scores among all subjects. Similar findings were observed in a Mediterranean population. Men in DII quintile 5 in the PREDIMED study had a waist circumference that was 1.46 cm larger than those in quintile 1 ($p<0.01$). The difference in women was 1.67 cm ($p<0.01$) [20]. It is interesting to note that WHR is a measure of intra-abdominal adiposity; a factor strongly associated with inflammation [21]. It is possible that these individuals are not only increasing their systemic levels of inflammation, but also have naturally higher levels of pro-inflammatory cytokines due to increased abdominal adipose tissue. Therefore, individuals with elevated WHR or abdominal adipose tissue who also eat a pro-inflammatory diet may be putting themselves at even greater risk of a chronic inflammatory-related condition.

The primary strength of this analysis was the use of the DII which incorporates numerous macro and micronutrients and was developed based on diet and inflammation literature [4]. Another strength of this study is the large sample size for both males and females, which allows for a more accurate estimation of the association between the DII and MetSyn. A weakness of this study is that participants were only from Poland and these findings may not be generalizable to other populations. Another weakness pertains to the use of self-reported dietary data and the potential for misreporting, as well as the fact that the FFQ only ascertained information on 55 food items. As mentioned previously, because this study was cross-sectional, we are unable to discern whether there are causal associations between the

DII and MetSyn (i.e., whether individuals modified their diet given a diagnosis of MetSyn or a diagnosis of high or abnormal levels of one or two MetSyn components).

In conclusion, the results of this study suggest an association between the DII and some MetSyn components; however, this conclusion may be limited by the cross-sectional nature of the study, the use of self-reported data, participation of men and women from very specific geographic regions (Poland's Świętokrzyskie Province and the city of Kielce), and an abbreviated FFQ (inquiring about only 55 food items). Therefore, cohort studies with a larger, more multicultural population are needed to fully understand whether more inflammatory diets are associated with an increased risk of MetSyn or its components, as results associating the DII with MetSyn have been inconsistent to date. Additionally, other metabolic markers should be examined to help provide biological plausibility for the relationship between the DII and metabolic-related conditions. Given that the DII was associated with WHR in this study and anthropometrics in another [20], the DII may serve as a useful clinical tool in understanding which dietary sources of inflammation to reduce to ultimately decrease the risk of metabolic-related conditions, including MetSyn.

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Abbreviations

MetSyn	metabolic syndrome
HDL	high-density lipoprotein
DII	Dietary Inflammatory Index
PONS	Polish-Norwegian Study
FFQ	food frequency questionnaire
OR	odds ratio
95%CI	95% confidence interval
BMI	body mass index
WHR	waist-to-hip ratio

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Table 1

Population Characteristics by Sex

Characteristic	All Subjects (n= 3,862)	Males (n= 1,290)	Females (n= 2,572)	P-Value
Smoker				
Yes	653 (17%)	256 (20%)	397 (15%)	<0.01
No	3,209 (83%)	1,034 (80%)	2,175 (85%)	
Urban				
Yes	2,680 (69%)	894 (69%)	1,786 (69%)	0.93
No	1,182 (31%)	396 (31%)	786 (31%)	
Number of Kids				
Means $\pm$ SD	2.09 (1.10)	2.04 (0.99)	2.11 (1.15)	0.23
Siblings				
Yes	3,696 (96%)	1,228 (95%)	2,468 (96%)	0.27
No	166 (4%)	62 (5%)	104 (4%)	
Married				
Yes	3,113 (81%)	1,164 (90%)	1,949 (76%)	<0.01
No	743 (19%)	123 (10%)	620 (24%)	
Education				
Secondary or less	1,940 (50%)	544 (42%)	1,396 (54%)	<0.01
College	1,235 (32%)	423 (33%)	812 (32%)	
Vocational	687 (18%)	323 (25%)	364 (14%)	
DII				
Means $\pm$ SD	0.93 (1.44)	0.96 (1.40)	0.92 (1.46)	0.53
BMI				
Means $\pm$ SD	28.3 (4.6)	28.5 (3.8)	28.1 (5.0)	<0.01
Age				
Means $\pm$ SD	55.6 (5.3)	55.7 (5.4)	55.5 (5.3)	0.13
BP Component				<.01
Yes	2,590 (67%)	987 (77%)	1,603 (62%)	
No	1,266 (33%)	301 (23%)	965 (38%)	
Waist Component				<.01
Yes	1,759 (46%)	510 (40%)	1,249 (49%)	
No	2,099 (54%)	778 (60%)	1,321 (51%)	
HDL Component				<0.01
Yes	615 (16%)	167 (13%)	448 (17%)	
No	3,247 (84%)	1,123 (87%)	2,124 (83%)	
Trig Component				<0.01
Yes	815 (21%)	367 (29%)	448 (17%)	
No	3,044 (79%)	920 (71%)	2,124 (83%)	
Glucose Component				<0.01
Yes	1,402 (36%)	674 (52%)	728 (28%)	
No	2,457 (64%)	615 (48%)	1,842 (72%)	

Characteristic	All Subjects (n= 3,862)	Males (n= 1,290)	Females (n= 2,572)	P-Value
Metabolic Syndrome				<0.01
Yes	1,159 (30%)	473 (37%)	686 (27%)	
No	2,695 (70%)	811 (63%)	1,884 (73%)	

Column percentages may not equal 100% due to rounding. Stratum numbers may not equal column totals due to missing data. **All p-values represent differences between males and females.** All categorical variable p-values based on chi-square tests. Continuous variables were tested using t-tests or Wilcoxon ranks sums tests depending on normality. Waist Circumference of 102 cm for males or 88 for females. Blood pressure component of >130 is systolic or >85 is diastolic. High-density lipoprotein is <40mg/dL in men and <50 in women. Triglyceride component is >149 mg/dL. Glucose component is >99 mg/dL.

Table 2

Odds of Metabolic Syndrome by DII Quartiles

DII Quartile	Present	Absent	Crude OR (95%CI)	Adjusted OR (95%CI)
Metabolic Syndrome				
1	309 (27%)	654 (24%)	1.00 (referent)	1.00 (referent)
2	290 (25%)	672 (25%)	0.91 (0.75–1.11)	0.93 (0.74–1.16)
3	284 (25%)	624 (25%)	0.88 (0.73–1.07)	0.95 (0.77–1.19)
4	276 (24%)	607 (25%)	0.85 (0.70–1.03)	0.96 (0.77–1.19)
Waist Component				
1	462 (26%)	502 (24%)	1.00 (referent)	1.00 (referent)
2	446 (25%)	519 (25%)	0.93 (0.78–1.12)	0.78 (0.67–1.13)
3	441 (25%)	523 (25%)	0.92 (0.77–1.10)	0.95 (0.73–1.23)
4	410 (23%)	555 (26%)	0.80 (0.67–0.96)	0.79 (0.61–1.03)
Blood Pressure Component				
1	657 (25%)	307 (24%)	1.00 (referent)	1.00 (referent)
2	633 (24%)	329 (26%)	0.90 (0.74–1.09)	0.93 (0.76–1.13)
3	654 (25%)	311 (25%)	0.98 (0.81–1.19)	1.04 (0.85–1.27)
4	646 (25%)	319 (25%)	0.95 (0.78–1.15)	1.05 (0.86–1.28)
HDL Component				
1	184 (30%)	781 (24%)	1.00 (referent)	1.00 (referent)
2	168 (27%)	797 (25%)	0.90 (0.71–1.13)	0.91 (0.72–1.15)
3	145 (24%)	821 (25%)	0.75 (0.59–0.95)	0.78 (0.61–1.00)
4	118 (19%)	848 (26%)	0.59 (0.46–0.76)	0.62 (0.48–0.80)
Triglyceride Component				
1	209 (26%)	756 (25%)	1.00 (referent)	1.00 (referent)
2	198 (24%)	767 (25%)	0.93 (0.75–1.16)	0.94 (0.75–1.18)
3	200 (25%)	765 (25%)	0.95 (0.76–1.18)	0.99 (0.79–1.24)
4	208 (26%)	756 (25%)	1.00 (0.80–1.24)	1.04 (0.84–1.30)
Glucose Component				
1	361 (26%)	603 (25%)	1.00 (referent)	1.00 (referent)
2	341 (24%)	623 (25%)	0.91 (0.76–1.10)	0.94 (0.78–1.14)
3	341 (24%)	341 (24%)	0.91 (0.76–1.10)	0.97 (0.80–1.18)
4	359 (26%)	359 (26%)	0.99 (0.82–1.19)	1.11 (0.91–1.34)

Column percentages may not equal 100% due to rounding. Column percentages based on weighted frequencies. ORs represent the odds of a diagnosis among DII quartiles 2–4 compared to quartile 1. **DII Quartile Ranges** 1 = −4.56 to −2.62; 2 = −2.61 to −1.76; 3 = −1.75 to −0.77; 4 = −0.75 to 4.00. **Adjustments** All models adjusted for body mass index and age.

Abbreviations DII = Dietary Inflammatory Index. HDL = high-density lipoprotein, OR = odds ratio, CI = confidence interval.

Table 3

Odds of Metabolic Syndrome by DII Quartiles Stratified by Sex

DII Quartile	Males				Females			
	Present	Absent	Crude OR (95%CI)	Adjusted OR (95%CI)	Present	Absent	Crude OR (95%CI)	Adjusted OR (95%CI)
Metabolic Syndrome								
1	78 (16%)	134 (17%)	1.00 (referent)	1.00 (referent)	231 (34%)	520 (28%)	1.00 (referent)	1.00 (referent)
2	103 (22%)	166 (20%)	1.07 (0.74–1.55)	1.17 (0.76–1.80)	187 (27%)	506 (27%)	0.83 (0.66–1.04)	0.82 (0.63–1.06)
3	120 (25%)	227 (28%)	0.91 (0.64–1.30)	1.10 (0.73–1.66)	164 (24%)	454 (24%)	0.81 (0.64–1.03)	0.85 (0.65–1.11)
4	172 (36%)	284 (35%)	1.04 (0.74–1.46)	1.21 (0.82–1.80)	104 (15%)	404 (21%)	0.58 (0.44–0.76)	0.63 (0.47–0.86)
Waist Component								
1	82 (16%)	130 (17%)	1.00 (referent)	1.00 (referent)	380 (30%)	372 (28%)	1.00 (referent)	1.00 (referent)
2	110 (22%)	161 (21%)	1.08 (0.75–1.56)	1.22 (0.72–2.09)	336 (27%)	358 (27%)	0.92 (0.75–1.13)	0.86 (0.63–1.18)
3	129 (25%)	218 (28%)	0.94 (0.66–1.33)	1.40 (0.84–2.33)	312 (25%)	305 (23%)	1.00 (0.81–1.24)	1.13 (0.81–1.57)
4	189 (37%)	269 (34%)	1.11 (0.80–1.55)	1.65 (1.01–2.69)	221 (18%)	286 (22%)	0.76 (0.60–0.95)	0.88 (0.62–1.24)
Blood Pressure Component								
1	162 (16%)	51 (17%)	1.00 (referent)	1.00 (referent)	495 (31%)	256 (27%)	1.00 (referent)	1.00 (referent)
2	204 (21%)	65 (22%)	0.99 (0.65–1.50)	1.04 (0.68–1.61)	429 (27%)	264 (27%)	0.84 (0.68–1.04)	0.86 (0.69–1.08)
3	262 (27%)	86 (28%)	0.96 (0.64–1.43)	1.04 (0.69–1.56)	392 (24%)	225 (23%)	0.90 (0.72–1.13)	0.96 (0.76–1.21)
4	359 (36%)	99 (33%)	1.14 (0.78–1.68)	1.28 (0.86–1.91)	287 (18%)	220 (23%)	0.67 (0.53–0.85)	0.76 (0.60–0.96)
HDL Component								
1	39 (23%)	174 (15%)	1.00 (referent)	1.00 (referent)	145 (32%)	607 (28%)	1.00 (referent)	1.00 (referent)
2	43 (26%)	228 (20%)	0.84 (0.52–1.35)	0.86 (0.53–1.39)	125 (28%)	569 (27%)	0.92 (0.70–1.20)	0.92 (0.70–1.21)
3	35 (21%)	313 (28%)	0.50 (0.30–0.82)	0.51 (0.31–0.84)	110 (25%)	508 (24%)	0.91 (0.69–1.19)	0.95 (0.71–1.25)
4	50 (30%)	408 (36%)	0.55 (0.35–0.86)	0.56 (0.35–0.89)	68 (15%)	440 (21%)	0.65 (0.47–0.88)	0.70 (0.51–0.96)
Triglyceride Component								
1	62 (17%)	151 (16%)	1.00 (referent)	1.00 (referent)	147 (33%)	605 (28%)	1.00 (referent)	1.00 (referent)

DII Quartile	Males				Females			
	Present	Absent	Crude OR (95%CI)	Adjusted OR (95%CI)	Present	Absent	Crude OR (95%CI)	Adjusted OR (95%CI)
2	81 (22%)	190 (21%)	1.04 (0.70–1.54)	1.03 (0.68–1.55)	117 (26%)	577 (27%)	0.83 (0.64–1.09)	0.84 (0.64–1.11)
3	91 (25%)	256 (28%)	0.87 (0.59–1.27)	0.92 (0.62–1.37)	109 (24%)	509 (24%)	0.88 (0.67–1.16)	0.93 (0.70–1.23)
4	133 (36%)	323 (35%)	1.00 (0.70–1.43)	0.98 (0.68–1.43)	75 (17%)	433 (20%)	0.71 (0.53–0.97)	0.80 (0.58–1.09)
Glucose Component								
1	115 (17%)	98 (16%)	1.00 (referent)	1.00 (referent)	246 (34%)	505 (27%)	1.00 (referent)	1.00 (referent)
2	142 (21%)	129 (21%)	0.94 (0.65–1.34)	0.98 (0.68–1.43)	199 (27%)	494 (27%)	0.83 (0.66–1.03)	0.84 (0.66–1.06)
3	180 (27%)	167 (27%)	0.92 (0.65–1.29)	1.00 (0.70–1.42)	161 (22%)	457 (25%)	0.72 (0.57–0.91)	0.75 (0.58–0.96)
4	237 (35%)	221 (36%)	0.91 (0.66–1.27)	1.01 (0.72–1.42)	122 (17%)	386 (21%)	0.65 (0.50–0.84)	0.74 (0.56–0.96)

Column percentages may not equal 100% due to rounding. Column percentages based on weighted frequencies. ORs represent the odds of a diagnosis among DII quartiles 2–4 compared to quartile 1. **DII Quartile Ranges** 1 = –4.56 to –2.62; 2 = –2.61 to –1.76; 3 = –1.75 to –0.77; 4 = –0.75 to 4.00. **Adjustments** All models adjusted for body mass index and age.

Abbreviations DII = Dietary Inflammatory Index, HDL = high-density lipoprotein, OR = odds ratio, CI = confidence interval.