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Cross-sectional association between diet quality and cardiometabolic risk by education level in Mexican adults

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Abstract

Objective: Understanding the association between diet quality and cardiometabolic risk by education level is important for preventing increased cardiometabolic risk in the Mexican population, especially considering pre-existing disparities in diet quality. This study examined the cross-sectional association of overall diet quality with cardiometabolic risk, overall and by education level, among Mexican men and women.

Design: Cardiometabolic risk was defined by using biomarkers and diet quality by the Mexican Diet Quality Index. We computed sex-specific multivariable logistic regression models.

Setting: Mexico.

Participants: Mexican men (*n* 634) and women (*n* 875) participating in the Mexican National Health and Nutrition Survey 2012.

Results: We did not find associations of diet quality with cardiometabolic risk factors in the total sample or in men by education level. However, we observed that for each 10-unit increase in the dietary quality score, the odds of diabetes risk in women with no reading/writing skills was 0.48 (95%CI:0.26,0.87) relative to the odds in women with ≥10 years of school (referent). Similarly, for each 10-unit increase of the dietary quality score, the odds of having three versus no lipid biomarker level beyond the risk threshold in lower-educated women was 0.31 (95%CI:0.12,0.78) relative to the odds in higher-educated women.

Conclusion: Diet quality has a stronger protective association with some cardiometabolic disease risk factors for lower- than higher-educated Mexican women, but no association with cardiometabolic disease risk factors among men. Future research will be needed to understand what diet factors could be influencing the cardiometabolic disease risk disparities in this population.

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Conflict of interest: None

Ethical Standards Disclosure: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Ethics Committee of the Mexican National Institute of Public Health. Written informed consent was obtained from all subjects/patients under study.

Keywords

Diet quality; cardiometabolic risk; adults; Mexico

Introduction

Cardiometabolic diseases are a major public health concern in Mexico. In 2013, diabetes and ischemic heart disease were ranked as top causes of morbidity and mortality in Mexico[1]. Diets high in energy, saturated fat, sodium, refined cereals or added sugar, and low in fruits, vegetables or whole-grain products were within the top risk factors that accounted for the most disease in this country [1]. However, the focus on analyzing single nutrients or foods may not provide a realistic picture of the association between diet and health outcomes, since the combinations and quantities of foods and beverages consumed can have synergistic or antagonistic effects[2]. To address this concern, many studies have analyzed the role of overall diet quality in association with non-communicable diseases, including cardiometabolic diseases, using index-based dietary patterns that capture the complexity of the diet[3; 4; 5]. Results of randomized controlled trials show that improving diet quality can reduce the risk of cardiometabolic diseases, including type 2 diabetes and cardiovascular disease[6; 7; 8]. Some studies have also found that diet quality indices are associated with concentrations of different biomarkers, which themselves are strong predictors of cardiometabolic diseases. Specifically, better diet quality has been associated with lower levels of C-reactive protein and higher levels of high-density lipoprotein [9; 10], which are associated with cardiovascular risk[11; 12]. However, the association of overall diet quality with other biomarkers of cardiometabolic risk, including diabetes, atherogenic dyslipidemia, and chronic inflammation, has been scarcely studied, which is relevant given the burden of these conditions in Mexican population[1]. Furthermore, there is little understanding of whether the relationship between diet quality and cardiometabolic biomarkers varies by sex, despite previous evidence that women have more cardiometabolic risk than men because of inherent and lifestyle factors[13; 14].

Even less is known about whether the association between diet quality and cardiometabolic biomarkers varies by socioeconomic status (SES). This is relevant in countries like Mexico where there are pre-existing disparities in dietary intakes by SES. For example, in 2012, the intakes of fruits, vegetables, saturated fats, and added sugars were higher among Mexicans with high compared with low SES[15; 16]. In addition, the consumption of corn and corn-based foods and beans were associated with lower SES among Mexican adults[17]. A household-based assets index is typically used in Mexican national surveys as proxy of SES, especially as a proxy of income. Even though the assets index is a rapid and simple method for collecting SES data, it also has the main limitation that its interpretation may depend on the relationship of the individual to the household[18]. On the other hand, education level garners a high response rate and is measured at individual level, unlike other indicators of SES[19]. Moreover, education level has been associated with more financial resources, better social-psychological profiles, and healthier lifestyles (e.g., less smoking, more physical activity, better dietary patterns), and these may have synergistic effects[20; 21]. We would expect to find a stronger inverse association between diet and cardiometabolic risk among higher-compared to lower-educated groups, since better diet among the more highly educated might interact with other favorable health factors to produce larger improvements in cardiometabolic risk. An understanding of whether education modifies the association between diet quality and cardiometabolic risk will be important for developing food policies to prevent increased cardiometabolic risk in the Mexicans considering the potential differences by sex and education.

We aimed to determine whether higher overall diet quality was associated with lower cardiometabolic risk in Mexican adults by sex. Furthermore, we examined whether the association between overall diet quality and cardiometabolic risk was different across education levels.

Subjects and methods

Study design and population

The National Health and Nutrition Survey (ENSANUT, by its Spanish acronym *Encuesta Nacional de Salud y Nutrición*) is a probabilistic survey with health and sociodemographic information obtained from 96 031 individuals from 50 528 randomly selected households. Fasting blood samples and dietary intake data were obtained from a subsample of participants.

We included non-pregnant and non-lactating adults ages twenty to sixty-nine years with information of dietary intake and fasting blood samples ($n = 1\,921$). We excluded individuals that did not remember or answer if they were affiliated in a health insurance plan (n=3), with previous diagnosis of diabetes or hypertension ($n = 387$) and with potential implausible energy intakes, that is with a ratio of total energy intake to estimated energy requirement (in logarithmic scale) below −3 SD and above +3 SD ($n = 30$), as previously described[15]. A total of 324 individuals were excluded for one variable and 88 for two or more variables; therefore the analytic sample was composed of 1 509 adults (58% women).

Study measurements

Cardiometabolic biomarkers—Two fasting blood samples, whole-blood and serum samples, were obtained from an antecubital vein for each participant. Serum was separated by spinning down the blood sample in situ at 2 500 g in a portable centrifuge. Serum and whole blood aliquots were stored in cryovials placed in liquid nitrogen and transported to the National Institute of Public Health in Cuernavaca, Mexico. The serum concentrations of glucose, triglycerides (TG), total cholesterol, and high-density lipoprotein cholesterol (HDL-C) were measured in an automatic immunoassay analyzer (CI8200 Architect, Abbott Diagnostics, Wiesbaden, Germany). Glucose was measured using glucose oxidase, TG using a hydrolysis method, total cholesterol using an enzymatic digestion and oxidation method, and HDL-C by a direct enzymatic colorimetric method after removing chylomicrons. Low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation[22]. C-reactive protein (CRP) was assessed by nephelometry, using monoclonal ultrasensitive antibodies (Behring Nephelometer 100 Analyzer, Behring Laboratories, Messer Grisheim Gmbh, Frankfurt, Germany).

Definitions of diabetes, atherogenic dyslipidemia and inflammatory risk—We used nationally and internationally accepted definitions of cardiometabolic risk. For diabetes risk, we used high fasting glucose (≥100 mg/dl)[23]. We considered the following lipids biomarkers: high TG (>150 mg/dl), low HDL-C (<40 mg/dl for men, <50 mg/dl for women) and high LDL-C (>130 mg/dl)[23; 24], and defined atherogenic dyslipidemia risk as none, one, two or all lipid biomarkers beyond the risk threshold. Inflammatory risk for coronary heart disease was represented by CRP >3 mg/l but <10 mg/l[25].

Dietary intake—Details on dietary collection and assessment are described elsewhere, but in brief, dietary information was obtained from a random subsample of ENSANUT participants using the twenty-four-hour dietary recall developed by the United States Department of Agriculture (automated 5-step multiple-pass method), adapted to the Mexican context[26; 27]. A second twenty-four-hour dietary recall was conducted in a random subsample of ~9% of participants with the first twenty-four-hour dietary recall. We used information of the first twenty-four-hour recall only.

Mexican Diet Quality Index—We developed the Mexican Diet Quality Index (MxDQI) based on the Mexican Dietary Guidelines, which are focused on preventing overweight, obesity, and other non-communicable diseases, promoting healthy eating habits, preserving the food culture, and supporting sustainable food production[28]. We used the number of servings recommended for adults with a total energy intake requirement of 8 372 kJ (2 000 kcal) per day; (see Supplementary Table 1 for more details) to create 13 MxDQI components. The dietary components are shown in Table 1. Even though several components (e.g. whole fruit, whole- and refined-grain cereals, red and processed meat, sodium) for the MxDQI are similar to those reported in other dietary indices, such as the Healthy Eating Index, Alternate Healthy Eating Index, Dietary Approaches to Stop Hypertension score, and the Mediterranean diet score, the MxDQI includes specifications based on the Mexican context. For instance, we included in the Mexican Diet Quality Index a component related to 100% fruit juices given its relatively high consumption among Mexicans[29]. Likewise, we used cutoff points recommended by WHO, as well as recommendations of fat intake for Mexican population, to define minimum and maximum scores for polyunsaturated fat, saturated fat, and added sugars [30; 31; 32]. We defined scores between 0 (noncompliance) and 15 (intakes close to recommended) for each component. Specifically, we assigned a maximum score of 5 to those MxDQI components derived from the same food group (e.g., whole-grain and refined-grain cereals). We also assigned the added sugars and sodium components a maximum score of 15, given their high consumption in the Mexican population and therefore their potential impact on health[33; 34].

Statistical analysis

We conducted all the analyses in Stata 15.0 (StataCorp, Stata Statistical Software, Release 15, 2017). We used survey commands to account for survey design and weighting to generate nationally representative results. Statistical tests were two-tailed and considered significant at $P<0.05$. We first descriptively examined characteristics of biomarkers and anthropometric measurements, total diet scores, and sociodemographic variables by education level and sex. We performed sex-specific binary logistic regression models for testing the association of total diet quality score with diabetes and inflammatory risk. We analyzed the association between total dietary quality score and atherogenic risk using sex-specific multinomial logistic regression models, using as reference the category of having no lipid biomarker beyond the risk threshold. We examined the associations between each 10-unit increase in total diet quality score and cardiometabolic risks. We adjusted the models for age (continuous, quadratic, or categorical term, depending on the lowest Akaike information criterion value identified for each model), total energy intake, number of servings of alcohol, parity (none, 1–2, 3–5 and ≥ 5 pregnancies), education level (no reading/writing skills, reading/writing skills or 3–9 y of school, and ≥10 years of school), tertiles of assets index (low/medium/high) –as a proxy of income–, health insurance/coverage (*Social*, linked to the formal labour market; *Popular*, funded with general taxes, and *Uninsured*), smoking status (current/former/none), region (North/Central/South) and area of residence (urban/rural). To test whether the associations differed by education level, we included models with interaction terms between total diet score and the three defined levels of education: 1) no reading/writing skills and 2) reading/writing skills or 3–9 years of school versus 3) ≥ 10 years of school. We used as reference the category of ≥ 10 years of school. We obtained the overall *P*-values for interaction through global Wald tests.

Sensitivity analyses

We did not include physical activity in the main analyses due to the poor validity of the International Physical Activity Questionnaire short form for assessing physical activity among Mexican adults[35]. However, physical activity could be an important confounder of the relationship between diet quality and cardiometabolic biomarkers. Thus, we conducted sensitivity analyses to test whether the inclusion of physical activity in models altered the associations between diet quality and cardiometabolic risk. We also conducted analyses in which corn tortillas were not considered as a whole-grain cereal, since it is uncertain whether all corn tortillas are made with whole grains.

Results

Sociodemographic, health, and lifestyle characteristics of Mexican adults by sex and education level are shown in Table 2. A higher percentage of adults with no reading/writing skills exceeded the threshold for diabetes risk in comparison with those with higher education. Likewise, higher percentage of men with lower education were categorized with atherogenic dyslipidemia risk (all lipid biomarkers beyond the risk threshold). The percentage of women categorized with atherogenic dyslipidemia and inflammatory risk was lower in those with lower-education level. Both lower-educated men and women had higher total dietary quality scores.

Association of diet quality score with diabetes, atherogenic dyslipidemia and inflammatory risk in men and women, overall and by education level

We did not find statistically significant associations of diet quality scores with diabetes, atherogenic dyslipidemia or inflammatory risk in the overall sample of men and women (Figure 1). Moreover, education level did not modify the association of dietary quality score with diabetes, atherogenic dyslipidemia or inflammatory risk in men (Figure 2). The education level in women modified the association between the diet quality score and diabetes risk (*P*-interaction = 0.04). For each increase of 10 units in the dietary quality score, the odds of diabetes risk in women with no reading/writing skills were around the half (OR: 0.47, 95%CI: 0.26, 0.85) of the odds of diabetes risk in women with ≥ 10 years of school. The association between the total dietary quality score and atherogenic dyslipidemia risk was also modified by education level (*P*-interaction <0.01). For each 10 units-increase in the dietary quality score, the odds of having one versus no lipid biomarker beyond the risk threshold in women with no reading/writing skills were 0.27 (95% CI: 0.12, 0.63) the odds in women with higher education. Likewise, for each increase of 10 units in the dietary quality score, the odds of having all versus no lipid biomarker beyond the risk threshold in women with no reading/writing skills were 0.33 (95% CI: 0.13, 0.84) the odds in women with ≥ 10 years of school. The association between total dietary quality score and inflammatory risk was not modified by education level.

Results of sensitivity analyses

Estimated odds of diabetes, atherogenic dyslipidemia, and inflammatory risk for each 10-unit increase in the total dietary quality score, in men and women, in overall sample and by education level, were similar to those observed when we further adjusted models for physical activity (Supplementary Tables 2–4). Likewise, estimations, were similar to those observed when we did not consider corn tortillas as whole-grain cereals, but the interaction between the dietary quality score and education level in women for diabetes risk was no longer statistically significant (Supplementary Tables 5–7).

Discussion

The current study is the first to analyze the cross-sectional association of diet quality with cardiometabolic risk in Mexican adults, to our knowledge. In the overall sample, diet quality was not associated with diabetes, atherogenic dyslipidemia, or inflammatory risk. The Mexican Diet Quality Index may be a limited predictor of cardiometabolic risk in Mexican adults, a population undergoing the nutritional transition. Although the diet quality index was created to reflect current recommendations about dietary intake in Mexico, some food components and amounts of food components may not be the optimal for estimating diet quality as it relates to cardiometabolic disease risk in Mexican adults. For example, we did not categorize tortillas as cooked or fried, which could be relevant considering that both can be highly consumed in Mexican population, but their associations with cardiometabolic risk will vary significantly based on cooking method. Additional modifications of this dietary index may be needed to reflect the cardiometabolic risk in this population. Moreover, the Mexican Dietary Guidelines, which we used as reference to develop the Mexican Diet Quality Index, should be revised to assure they can prevent cardiometabolic diseases and other non-communicable diseases in Mexican population.

We found that education level modified the association of dietary quality score with diabetes and atherogenic risk in women, but not men. For women with the lowest education level, a higher dietary quality score was associated with lower likelihood of diabetes and atherogenic dyslipidemia risk, in comparison to higher-educated women. The reasons underlying these findings are unclear. Some studies suggest that women with low education level have more psychosocial risks than men with the same level of education[14; 36]. Increased psychosocial risk may be associated with higher cardiometabolic risk in lower-educated women, as observed in previous studies[37]. Thus, one possibility is that a better diet quality may offset the higher likelihood of cardiometabolic risk by psychological factors only in lower-educated women. Another possibility is that the observed results in women can be due to chance, resulting from the multiple testing analyses. However, descriptive results indicate that the percentage of women categorized with diabetes and atherogenic dyslipidemia risk as well as the total dietary score differed by education level. Therefore, education level may modify the association of diet quality with diabetes and atherogenic dyslipidemia risk in women. Under the assumption that our results are not chance findings, future research focused on identifying mechanisms responsible for sex differences in the relation between diet quality and cardiometabolic risk by education level would provide better knowledge of the potential pathways.

Several studies also indicate that low-educated women tend to have other risky lifestyle behaviors, such as smoking, low physical activity, sedentary activity, or poor sleep duration.[37; 38; 39]) High diet quality could counteract these factors and lead to reduced cardiometabolic risk. For higher educated women, who have fewer other risk factors, a high-quality diet may not be sufficient to further reduce their cardiometabolic risk. It is unlikely smoking could influence the results observed in the present study since models were adjusted for this factor. Moreover, although we included physical activity as covariate only in sensitivity analyses, results in women were similar to those observed in the main results. More research will be needed to understand whether other lifestyle factors, such as sleep duration and sedentary behaviors, modify the association between diet quality and cardiometabolic risk.

The observed inverse association of diet quality with risk of diabetes and atherogenic dyslipidemia in lower-versus higher-educated women may be also related to differential dietary misreporting. Dietary information was self-reported and therefore might be subject to social desirability[40], which appears to bias more the dietary data of women than men[41; 42], and seems to be more common in higher-educated women [43; 44]. If higher educated women were more prone to social desirability in this study, women who consumed more unhealthy foods may not have reported them, making it look like their diet was more similar to women who consumed more healthy food and thus obscuring the relationship between diet quality and cardiovascular disease risk.

The interaction between dietary quality score and education level in women for diabetes risk was statistically significant when we classified corn tortillas as whole-grain cereals, but not when we did not consider it as such. These results suggest that corn tortillas not only contributed substantially to the whole-grain cereals, but also to the total diet quality score. Although it is uncertain whether all corn tortillas are made with whole grains, corn tortillas are characterized by low-fat and low-sodium content, and have ~1.4 g of fiber for every 10 g of carbohydrates[45], which might contribute to reduce the risk of diabetes. However, what is not clear from the current study is why we only observed an association between the dietary quality score, considering tortillas as whole grain, and diabetes risk in lower-educated women. Flores et al. 2010 identified three major dietary patterns in Mexican adults. One of these patterns was *traditional*, where corn and corn-based foods accounted for almost 50% of energy intake and had the lowest contribution to total energy intake for most of the other food groups, except for beans and legumes, compared with the other dietary patterns. Furthermore, the traditional pattern was associated with lower SES and higher fiber intake[(46)]. Other studies conducted in 2006 and 2014 found that Mexican adults with the lowest SES had the highest diet quality or traditional dietary pattern[(47; 48)]. Moreover, the expenditure in traditional foods, such as corn tortilla, is still higher in populations with lower income[(49)]. It is possible that, in women with lower education, the consumption of corn tortillas reflects a healthier diet ─with more traditional foods and less processed packaged foods or Western fast food─ which in turn could reduce the risk of diabetes, whereas higher-educated women who consume less corn tortillas (and a less healthier diet) are shifting more rapidly away from the traditional Mexican dietary pattern, increasing their risk of diabetes. Moreover, the findings about dietary patterns from previous investigations together with those observed in the present study could indicate that Mexican lower-educated women might be viewed as being in an early stage of the nutrition transition. However, other studies have also found that the body mass index[(50)] and prevalence of diabetes[(51)] are higher in lower-educated adults (including our study), which suggest this population truly fit more in the non-communicable disease stage (an advanced stage) of the nutrition transition [(52)].

We observed that diet quality was not associated with diabetes, atherogenic dyslipidemia, or inflammatory risk in the overall sample of men, which may indicate that a better diet alone is not enough to reduce the risk of cardiometabolic diseases in men. Some studies indicate that physical activity and diet may have synergistic effects or that physical activity may be necessary to unmask the potential benefits of healthy diets on cardiometabolic risk [(53; 54)]. A potential explanation of why the synergistic effects between diet and physical may be more likely in men than in women is that the former are more physically active. Unfortunately, we were unable to include physical activity in the main analyses due to the poor validity of the International Physical Activity Questionnaire short form in Mexican adults. Moreover, a larger sample size would be needed to assess the interaction between diet quality and physical activity. Future studies with larger sizes and more adequate measures of physical activity will be needed to evaluate whether physical activity modifies the association between diet quality and cardiometabolic risk in men.

Our analysis has several limitations that are important to acknowledge. First, it is not possible to establish a causal inference between diet quality and cardiometabolic risks given the cross-sectional nature of this study. Second, we estimated dietary quality scores based on a single twenty-four-hour recall, which may not represent the long-term dietary habits of the participants[(55)]. Third, the method we used to define atherogenic dyslipidemia risk assumes that having lipid levels beyond the risk threshold in any of the lipid biomarkers has the same atherogenic risk. However, this classification is consistent with those used to analyze the risk of metabolic syndrome[(23; 56)]. Last, we cannot rule out bias on the observed association between diet quality and atherogenic dyslipidemia risk in women, since the sample of women with no reading/writing skills and normal levels in all lipid biomarkers was small (n = 7). Some simulation studies indicate that a minimum of 5–10 observations per variable in logistic regression models may be enough to obtain reliable results[(57; 58)]. However, our results and interpretations need to be considered with caution until longitudinal studies with larger samples and detailed dietary data are conducted.

Despite the limitations, this study highlights the potential modifying effect of education on the association between diet quality and cardiometabolic risk in women, but not men, using a representative sample of Mexican men and women, with detailed diet data as well as information of several key cardiometabolic biomarkers and covariates. These results suggest that lower-educated women may benefit most from interventions and policies that improve their diet quality. Future research will be needed to understand which approaches work best for increasing diet quality and preventing cardiometabolic risk among lower-educated Mexican women. In addition, for higher-educated Mexican women and for Mexican men, for whom there was no relationship between diet quality and cardiometabolic disease risk, future research will be needed to identify what dietary and other factors will prevent cardiometabolic disease.

In conclusion, to the best of our knowledge, ours is the first study to assess the association between diet quality and cardiometabolic risk in Mexican adults, overall and by education level. There was no association between diet quality and cardiometabolic disease risk in Mexican adults. However, education level modified the association of diet quality with diabetes and atherogenic dyslipidemia risk in Mexican women, but not in men. A higher diet quality was associated with lower diabetes and atherogenic dyslipidemia risk in lower- but not higher-educated women. Our findings suggest that Mexican women with low SES could be targeted for interventions focused on improving their quality of the diet and, in turn, reduce the likelihood of diabetes and atherogenic dyslipidemia risk. More research using larger sample sizes and longitudinal data is needed to confirm and add evidence or insights about the nature of these associations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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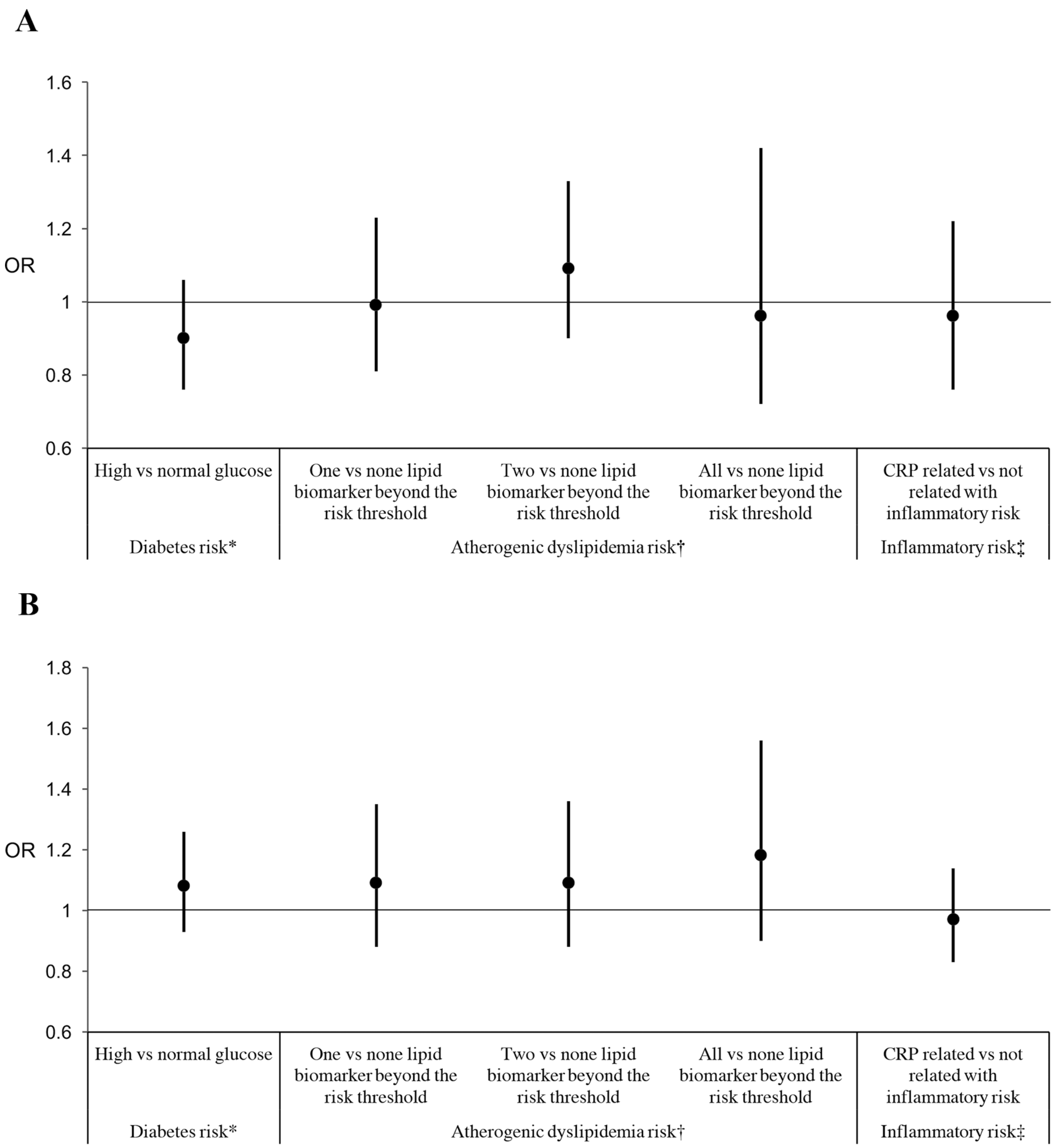

Fig. 1.

Multivariale logistic regression models of the association between the dietary quality score (10-unit increment) and cardiometabolic risks in Mexican men (A) and women (B) (*n* 1 509). CRP, C-reactive protein. *High glucose: ≥100 mg/dl. †Lipid biomarkers: high triglycerides (>150 mg/dl), low high-density lipoprotein cholesterol levels (<40 mg/dl for men, <50 mg/dl for women) and high low-density lipoprotein cholesterol levels (>130 mg/dl). ‡ CRP levels related with inflammatory risk: >3 mg/l but <10 mg/l.

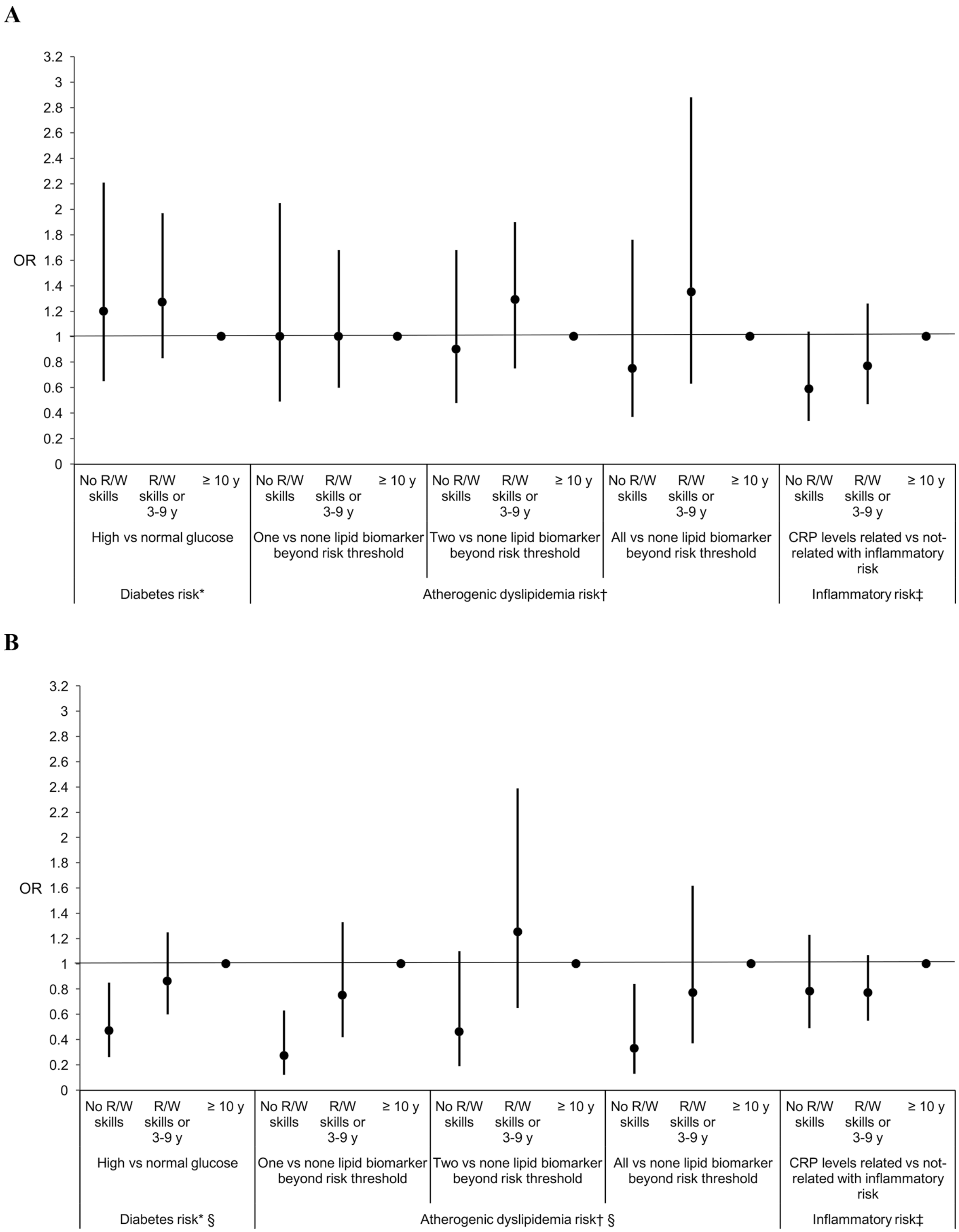

Fig. 2.

Multivariable logistic regression models of the associaton between diet quality (for each 10-unit increase) and cardiometabolic risks in Mexican men (A) and women (B) by education level (*n* 1 509). CRP, C-reactive protein; R/W, reading/writing.*High glucose: ≥100 mg/dl. †Lipid biomarkers: high triglycerides (>150 mg/dl), low high-density lipoprotein cholesterol levels (<40 mg/dl for men, <50 mg/dl for women) and high low-density lipoprotein cholesterol levels (>130 mg/dl). ‡ CRP levels related with inflammatory risk: >3 mg/l but <10 mg/l. § P for interaction < 0.05.

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Table 1

Mexican Diet Quality Index. Components and criteria for scoring

Food component	Maximum points	Criteria for minimum score (0)	Criteria for maximum score
Adequacy			
Vegetables	10	0 servings	≥ 3 servings per 2,000 kcal
Whole fruit	10	0 servings	≥ 3 servings per 2,000 kcal
Whole-grain cereals			
Women Men	5	0 servings	≥ 3 servings per 2,000 kcal
Legumes	10	0 servings	≥ 2 servings per 2,000 kcal
Seafood, poultry or eggs	5	< 1 serving per 2,000 kcal	≥ 2 servings per 2,000 kcal
Low-fat dairy	5	0 servings	≥ 3.5 servings per 2,000 kcal
Polyunsaturated fat	5	< 6% of total energy intake	> 10% of total energy intake
Moderation			
100% fruit juices	5	> 250 mL per 2,000 kcal	≤ 125 mL per 2,000 kcal
Refined grains	5	> 3 servings per 2,000 kcal	≤ 1 serving per 2,000 kcal
Red and processed meat	5	> 1.5 servings per 2,000 kcal	≤ 0.5 serving per 2,000 kcal
Added sugars	15	> 10% of total energy intake	< 5% of total energy intake
Sodium	15	> 2 g per 2,000 kcal	≤ 1.5 g per 2,000 kcal
Saturated fat	5	> 10 % of total energy intake	< 7% of total energy intake
Total	100	0	100

Table 2

Characteristics of Mexican men and women by education level. ENSANUT 2012 (*n* 1 509)

	Men						Women					
	No reading/writing skills (*n* 75)		Reading / writing skills or 3–9y of school (*n* 422)		≥10y of school (*n* 137)		No reading/writing skills (*n* 92)		Reading / writing skills or 3–9y of school (*n* 588)		≥10 y of school (*n* 195)	
	Mean or %	SE	Mean or %	SE	Mean or %	SE	Mean or %	SE	Mean or %	SE	Mean or %	SE
Sociodemographic												
Age (years)	48	2.3	41	1.0	35	1.6	50	1.7	40	0.7	35	1.1
Area												
Urban	46	7.5	66	3.1	82	3.7	54	7.9	70	2.2	79	3.6
Rural	54	7.5	34	3.1	18	3.7	46	7.9	30	2.2	21	3.6
Region												
North	15	5.1	20	2.3	23	4.2	7	3.1	19	1.7	17	2.6
Central	35	7.4	43	3.7	43	5.8	38	9.2	50	2.6	54	4.2
South	51	7.5	37	3.2	34	5.1	55	8.7	31	2.2	29	3.6
Tertiles of assets index												
Low	60	7.9	39	3.1	17	3.9	61	8.9	33	2.7	11	2.5
Medium	26	7.3	32	3.4	32	5.6	21	6.6	34	2.8	22	3.7
High	14	5.8	29	3.7	51	5.8	18	9.2	33	3.2	67	4.2
Health insurance/coverage												
Social	21	6	26	3.4	44	5.7	34	9.3	32	2.8	51	4.8
Popular	58	7.5	49	3.5	33	5.7	51	8.5	46	2.9	25	4.1
Uninsured	21	6.4	25	2.8	23	4.8	15	4.9	23	2.8	24	3.9
Health												
Glucose (mg/dL)	96	3.7	97	1.4	92	1.2	110	9.3	99	1.6	95	1.8
Diabetes risk (glucose > 100 mg/dL)	29	6.4	25	3.1	17	3.7	36	8.1	33	2.8	25	4.2
TG (mg/dL)	203	23.4	204	9.0	191	13.2	165	16.1	164	5.4	158	9.9
HDL-C (mg/dL)	38	1.3	37	0.6	36	0.8	41	1.0	41	0.6	42	0.8
LDL-C (mg/dL)	105	6.3	109	2.4	108	3.3	107	4.5	107	2.4	103	4.1
Atherogenic dyslipidemia risk (number of lipid biomarkers above the cut-off point)												

	Men						Women					
	No reading/writing skills (*n* 75)		Reading / writing skills or 3–9y of school (*n* 422)		≥10y of school (*n* 137)		No reading/writing skills (*n* 92)		Reading / writing skills or 3–9y of school (*n* 588)		≥10 y of school (*n* 195)	
	Mean or %	**SE**	**Mean or %**	**SE**	**Mean or %**	**SE**	**Mean or %**	**SE**	**Mean or %**	**SE**	**Mean or %**	**SE**
None	15	4.8	17	2.6	18	3.8	6	3	12	2.1	12	3
One	32	7.8	29	3.4	27	5.3	48	8.4	38	2.9	44	4.9
Two	34	7.2	42	3.4	43	5.9	40	8	38	3.2	31	4.6
Three	19	5.1	12	2.3	12	3.7	6	2.3	11	1.9	13	3.2
CRP (mg/L)	2	0.5	3	0.4	3	0.5	4	0.8	4	0.3	3	0.5
Inflammatory risk (CRP > 3 mg/L but < 10 mg/L)	14	3.8	16	2.7	23	5.5	22	5.7	30	2.9	27	4.3
Lifestyle												
Total diet quality score	48	2.1	42	1.1	37	1.6	49	2.6	40	0.8	37	1.2
Smoking status												
Never	53	7.8	47	3.4	59	5.8	97	2.1	85	2.5	74	4.4
Former	24	6.2	29	3	20	4.3	0	0	12	2.4	13	3.1
Current	24	6.3	24	3.1	21	5.2	3	2.1	4	1	13	3.7
Physical activity												
Inactive	7	4	9	2.2	18	4.3	15	5.4	19	2.5	14	2.8
Moderately active	15	6	10	2.7	11	3.7	10	5.9	13	1.9	7	2.5
Active	78	6.7	81	3.8	70	5.2	75	7.4	69	2.9	79	3.6
Parity categories												
None	-	-	-		.		53	8.2	32	2.9	39	4.8
1–2	-	-	-				7	5.7	27	2.9	39	4.5
3–4	-	-	-		-	-	10	4	18	2.2	16	3.2
≥5	-	-	-	-	-	-	29	6.9	23	2.2	7	2.2

CRP, C-reactive protein; ENSANUT, Mexican National Health and Nutrition Survey; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.