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Sociodemographic and Lifestyle Factors Are Associated with Diet Quality in Cardiometabolic Risk Subjects

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Abstract We investigated the association of social and lifestyle factors with diet quality in a cardiometabolic risk population. Cross-sectional data was from 265 subjects (aged 42 ± 16 years) attended at the Cardiovascular Health Care Program - PROCARDIO UFV (ReBEC identifier: RBR-5n4y2g). A 24-hour recall was applied and the Revised Healthy Eating Index (R-HEI) was calculated. Socioeconomic and lifestyle data were collected by chart analysis. Women (PR = 1.02, 95% CI: 1.01, 1.04), elderly (PR = 1.05, 95% CI: 1.02, 1.15), and those who eventually drink alcohol (PR = 1.02, 95% CI 1.01, 1.15) presented better diet quality (R-HEI> 70.8 points). Single subjects (PR = 0.89, 95% CI: 0.82, 0.98) and those with higher educational status (PR = 0.90, 95% CI 0.82, 0.98) presented lower score. Women had better scores on milk and dairy products, fruits and sodium. The elderly (> 60 years) presented better scores for total R-HEI, total vegetables and empty calories from solid fats, sugar and alcohol (GORD_AA) ($p<0.05$). Socioeconomic and lifestyle factors were associated to diet quality in cardiometabolic risk population, indicating the importance of identifying and considering in nutritional education strategies.

Keywords: *Healthy Eating Index, diet quality, educational status, lifestyle, sociodemographic factors*

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1. Introduction

The prevalence of noncommunicable diseases (NCD) has increased worldwide, mainly cardiovascular diseases (CVD) [1]. Among risk factor for NCD and CVD development, lifestyle is a relevant modifiable risk factor [2], so that 30% of deaths could be avoided only by dietary habits changes [3]. Both inadequate and excessive intakes of certain foods and nutrients are related with increased risk of cardiovascular risk and NCD [2,4]. Currently, the recommendation has been based on *in natura* foods, such as fruits and vegetables, which are associated with lower risk of CVD and premature mortality [2,5], while industrialized foods of high caloric density, rich in saturated fats, simple sugars and sodium must be avoided [4,6].

In this sense, Healthy Eating Index (HEI) was developed based on American Guidelines [7] and adapted by Brazilian researchers [8,9,10] in order to evaluate the diet quality and disease association [11,12,13]. In previous studies, the best HEI score has been associated to a better health profile [14]. However, dietary choices are complex and influenced by biological and sociodemographic factors, such as emotional state [15], age [16], sex [16,17], educational status [18] and social relations [19]. Studies indicate that women [17,20], elderly [20,21], regular exercise practitioners [22] and better income classes [20,23] and educational status [22,23] present better diet quality. However, few studies have investigated these factors as determinants of the diet quality in cardiometabolic risk adults [11,24].

Since social determinants may influence on food choices [25,26] and lifestyle is important factor in disease prevention and control, [27,28] this study investigated the potential association of social and lifestyle factors with diet quality in a cardiometabolic risk population

2. Materials and Methods

2.1. Subjects

In this cross-sectional study, participated 265 subjects (123 male, 172 female), mean age 42 ± 16 years, assisted by the Cardiovascular Health Care Program of the Universidade Federal de Viçosa (UFV) - PROCARDIO-UFV, state of Minas Gerais, Brazil. This program performs continuous nutritional intervention in the academic cardiovascular risk community. Subjects with filled medical records to studied variables between Mach 2012

and July 2017 were included. The data used in this study refer to the information collected during the first appointment, which means before the beginning of the nutritional intervention. The data collection methods have been previously described [29,30]. Briefly, the program adopts as inclusion criteria: age > 20 years old; cardiovascular disease diagnosis or some cardiometabolic risk factor such as overweight (body mass index ≥25 kg/m^2), hypertriglyceridemia (≥150 mg/dL), and hypercholesterolemia (≥200 mg/dL), low HDL (men <40 mg/dL and women <50 mg/dL), blood pressure ≥130/≥ 85mmHg or systemic arterial hypertension diagnosis (systolic blood pressure ≥140 and/or diastolic blood pressure ≥90 mmHg), fasting blood glucose ≥100 mg/dL or diagnosis of diabetes mellitus (fasting blood glucose ≥126 mg/dL), and/or medical referral.

PROCARDIO-UFV is registered at Brazilian Clinical Trials Registry (ReBEC), identifier RBR-5n4y2g. This study was approved by the UFV Human Research Ethics Committee (protocol number 066/2012), in accordance to Resolution 466/2012 (National Health Council, Ministry of Health, Brazil). All participants read and signed the written free and informed consent, in accordance to Declaration of Helsinki principles.

2.2. Food Consumption and R-HEI Calculation

The current food intake was estimated based on the 24-hour recall (24HR) information applied at the first visit, considering previous 24 hours of food consumption. All interviewers received four-month-training and were supervised at the first interviews. In order to better estimate food consumption, the "multiple-pass" method was used [31] as well as a photographic album with images of food, preparations and standard utensils for home measurements.

The R-HEI was calculated according to proposed by Previdelli (2011) [10], the only one validated for the Brazilian adults population [32]. Foods reported in 24HR were tabulated in an Excel® spreadsheet in established groups according to the Brazilian Food Guide [33]. All preparations were dismantled and their ingredients included in the corresponding food group. Nutritional label information was used when some preparation was not contained in the tables. In addition, the salt and oil percentage of the preparations / foods were standardized [34,35] since these ingredients are reported with imprecision in 24HR.

The R-HEI maximum score is 100 points, which represents the best diet quality, so the higher the score, the better the diet adequacy. This also applies to their twelve components that have been individually punctuated. To R-HEI components considered unhealthy such as calories from solid fats, added sugar and alcohol (GORD_AA) and sodium, higher scores were computed when they were less consumed, and healthy components of index (e.g. fruits, cereals, meats and other food groups) received maximum score when intake reaches the recommendation values. Each R-HEI component score can range from zero to five, zero to ten or zero to twenty. The score was attributed according to consumption adequacy of the food portions ingested per 1000 kcal. For the item GORD_AA, the percentage calories adequacy in relation to the total energy value was evaluated. For sodium, the ingestion was evaluated in mg per 1000 kcal.

In the item GORD_AA, that evaluated the empty calorie intake, were included the calories from solid fats (butter, lard, hydrogenated vegetable fats, "hydrogenated" sauces), sugar and alcohol content (g) from alcoholic beverages, plus added sugar contained in industrialized or home prepared foods. For estimating the simple sugar in each food or preparation, the following tables were used: National Nutrient Database for Standard Reference - USDA release 28 [36]; Table for Food Consumption Evaluation in Domestic Measures [35] and food labels.

2.3. Sociodemographic and Lifestyle Factors

Sociodemographic and lifestyle variables were collected by interview and analysis of clinical records, such as age, sex, education status, family income (in minimum salaries), marital status (single, married, stable union, divorced or widowed), the UFV membership type (employee, student or relative), smoking (smokers, ex-smokers or non-smokers), sleep hours and regular physical activity practice (yes or no).

2.4. Statistical Analysis

The data normality was evaluated by Kolmogorov-Smirnov test. The R-HEI components were described as mean ± standard deviation. Student's t-test and one-way analysis of variance (ANOVA) with Tukey *post hoc* was used to compare R-HEI items scores by sex and age. For other analyses, R-HEI was categorized in two groups (lower or higher score), using the median (70.8 points) as the cutoff point. Other studies have already used this strategy [37,38] based on the premise of creating risk groups in epidemiological studies [39]. Associations between R-HEI (dependent variable) and sociodemographic and lifestyle variables were investigated using the Pearson chi-square or linear trend test, and Poisson regression using R-HEI scores as a reference (variable independent). The regression models were performed in the STATA software, version 13.0. The other analyses were performed in the Statistical Package for the Social Science (SPSS® 24.0, Chicago, IL, USA, 2016). A significance level of 5% was considered for all tests.

3. Results

The sample (n=295) was composed mainly by women (58.3%), adults aged between 30 and 60 years (49.5%), who had completed or in progress upper-level course (60.4%), employees or family members (60.0%), never smoked (68.0%), physical activity practitioner (52.9%) and eventually drinking (57.7%) (Table 1). This population had a mean of 69.4 ± 10.5 points (R-HEI) and low scores on total fruits (2.7), whole fruits (2.9), whole grains (0.4), milk and dairy products (5,2), sodium (4,7) and saturated fatty acids (SFA) (6,9) (Figure 1).

Women presented better scores to intake of milk and dairy products, total fruits, whole fruits and sodium, and worse scores on oils and oilseeds ($p < 0.05$). In addition, subjects aged 30-60 years presented better R-HEI scores

and the components milk and dairy products, VeVeAL e GORD_AA compared to those aged <30 years. The elderly (> 60 years) presented better scores for total R-HEI, total vegetables and GORD_AA (p <0.05) (Table 2).

When analyzed the association of social and lifestyle factors with better diet quality we notice that female participants, elderly (> 60 years old), married or in stable union, with lower education level, employees and relatives, who drinking eventually had a higher prevalence of higher R-HEI score (> 70, 8 points), independent of confounding factors (Table 3).

Table 1. Socioeconomic and lifestyle aspects in cardiometabolic risk subjects, according to median Revised Healthy Eating Index (R-HEI) (70.83 points)

	Total		Lower R-HEI		Higher R-HEI	
	n	%	n	%	n	%
Sex						
Male	123.0	41.7	68.0	46.3	55.0	37.2
Female	172.0	58.3	79.0	53.7	93.0	62.8
Age (years)*						
< 30	108.0	36.6	69.0	46.9	39.0	26.4
30-60	146.0	49.5	63.0	42.9	83.0	56.1
>60	41.0	13.9	15.0	10.2	26.0	17.6
Marital status*						
Married / Stable Union	145.0	49.5	61.0	41.8	84.0	57.1
Single / Separated / Widowed	148.0	50.5	85.0	58.2	63.0	42.9
Education*						
Primary school (complete or incomplete)	58.0	20.9	21.0	15.4	37.0	26.1
Secondary (complete or incomplete)	52.0	18.7	21.0	15.4	31.0	21.8
College (complete or incomplete)	168.0	60.4	94.0	69.1	74.0	52.1
Income						
Until 2 Basic Salary	68.0	25.8	36.0	27.1	32.0	24.4
2 - 4 Basic Salary	110.0	41.7	57.0	42.9	53.0	40.5
> 4 Basic Salary	86.0	32.6	40.0	30.1	46.0	35.1
Employment at UFV*						
Employee or family member	176.2	59.7	150.5	51.0	202.1	68.5
Student	118.8	40.3	144.5	49.0	92.9	31.5
Smoking						
Never smoked	198.0	68.0	97.0	66.4	101.0	69.7
Smoker or Ex-smoker	93.0	32.0	49.0	33.6	44.0	30.3
Sleep Duration*						
< 8 hours/night	188.0	65.1	103.0	70.5	85.0	59.4
≥ 8 hours/night	101.0	34.9	43.0	29.5	58.0	40.6
Physical activity						
No	138.0	47.1	68.0	46.9	70.0	47.3
Yes	155.0	52.9	77.0	53.1	78.0	52.7
Alcohol intake*						
Do not drink/Never drunk	120.7	40.9	101.2	34.3	139.2	47.2
Drink eventually	174.3	59.1	193.8	65.7	155.8	52.8

UFV= Universidade Federal de Viçosa. *Pearson's chi-square test or chi square for linear trend (P<0.05).

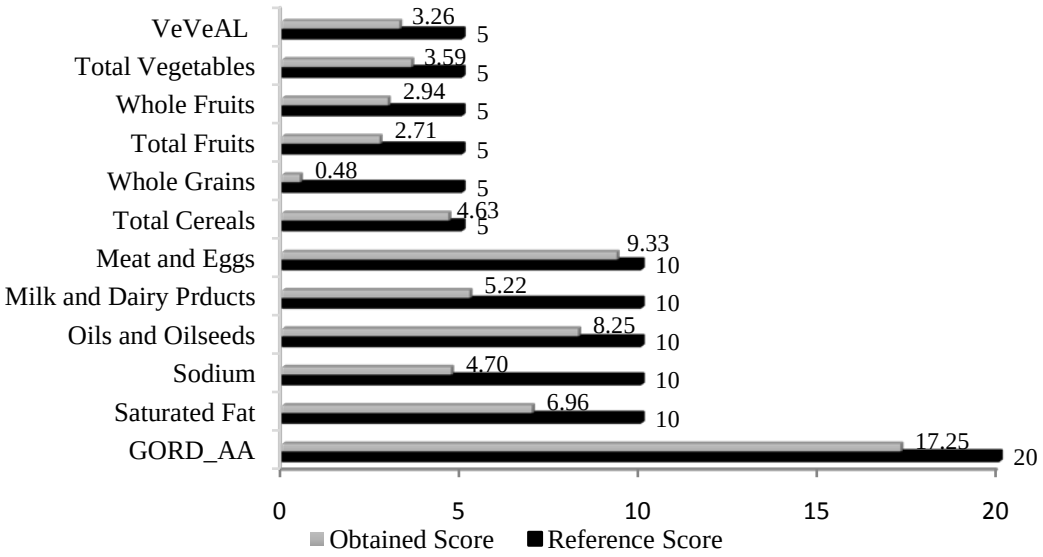

Figure 1. Average score obtained on each R-HEI component (in points) in relation to the respective reference values. in a cardiometabolic population. *VeVeAL = Dark green and orange vegetables and beans. GORD_AA = Calories from solid fat. alcohol and added sugar

Table 2. Scores of Revised Healthy Eating Index (R-HEI) components by sex and age in a cardiometabolic risk population

R-HEI Components	Total (n= 295)	Male (n = 123)	Female (n = 172)	< 30 years old (n = 108)	30-60 years old (n = 146)	> 60 years old (n = 41)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Total Cereals	4.63 ± 0.94	4.74 ± 0.79	4.56 ± 1.03	4.61 ± 0.99	4.70 ± 0.84	4.49 ± 1.11
Whole Grains	0.48 ± 1.19	0.38 ± 1.12	0.55 ± 1.24	0.45 ± 1.10	0.52 ± 1.27	0.40 ± 1.13
Milk and Dairy products	5.22 ± 3.57	4.18 ± 3.24[a]	5.97 ± 3.62[b]	6.14 ± 3.29[a]	4.42 ± 3.51[b]	5.65 ± 3.94
Total Fruits	2.71 ± 2.08	2.27 ± 2.09 [a]	3.02 ± 2.02 [b]	2.33 ± 2.08	2.88 ± 2.08	3.06 ± 1.99
Whole Fruits	2.94 ± 2.25	2.39 ± 2.28 [a]	3.33 ± 2.16 [b]	2.63 ± 2.26	3.08 ± 2.24	3.25 ± 2.24
Total Vegetables	3.59 ± 1.73	3.70 ± 1.67	3.50 ± 1.78	3.24 ± 1.73[a]	3.70 ± 1.77	4.11 ± 1.45[b]
VeVeAL	3.26 ± 2.18	3.31 ± 2.17	3.22 ± 2.18	2.80 ± 2.22[a]	3.48 ± 2.14 [b]	3.68 ± 2.03
Oils and oilseeds	8.25 ± 2.75	8.90 ± 2.17 [a]	7.79 ± 3.02 [b]	7.55 ± 3.11	8.65 ± 2.49	8.67 ± 2.30
Meat and eggs	9.33 ± 1.73	9.55 ± 1.56	9.17 ± 1.83	9.20 ± 1.92	9.27 ± 1.79	9.87 ± 0.50
Saturated fat	6.96 ± 3.35	7.51 ± 3.28 [a]	6.56 ± 3.36 [b]	6.34 ± 3.39	7.25 ± 3.32	7.55 ± 3.23
Sodium	4.70 ± 2.72	4.19 ± 2.64 [a]	5.07 ± 2.72 [b]	4.33 ± 2.85	4.89 ± 2.68	5.01 ± 2.39
GORD_AA	17.25 ± 4.55	17.7 ± 3.98	16.88 ± 4.90	15.99 ± 5.29[a]	17.80 ± 4.13[b]	18.58 ± 2.92[c]
R-HEI_TOTAL	64.40 ± 10.59	68.77 ± 10.29	69.86 ± 10.80	65.86 ± 9.85[a]	70.57 ± 10.78[b]	74.37 ± 9.72[c]

P-values from student's t-test and ANOVA (post hoc Tukey). Different letters indicate statistical difference (P <0.05). VeVeAL = Dark green and orange vegetables and beans; GORD_AA = Calories from solid fat, alcohol and added sugar.

Table 3. Prevalence ratio (PR) of higher diet quality (dependent variable)[1], according to socioeconomic variables and lifestyle factor in cardiometabolic risk subjects

Socioeconomic Variables	Prevalence (%)	Non-adjusted Model		Adjusted Model [2]	
		PR (CI 95%)	P-value	PR (CI 95%)	P-value
Sex					
Male	41.7	1		1	
Female	58.3	1.06 (1.02-1.10)	**0.014**	1.02 (1.01-1.04)	**0.010**
Age					
Adults (21-60 years old)	86.1	1		1	
Elderly (> 60 years old)	13.9	1.10 (1.05-1.21)	**0.001**	1.05 (1.02-1.15)	**0.025**
Marital status					
Married / Stable Union	49.5	1		1	
Single/Separated/Widowed	50.5	0.90 (0.83-0.97)	**0.008**	0.89 (0.82-0.97)	**0.004**
Education					
Primary school	20.9	1		1	
Secondary or College	79.1	0.96 (0.94-0.98)	**0.004**	0.90 (0.82-0.98)	**0.025**
Income					
Until 4 Basic Salary	67.4	1		1	
> 4 Basic Salary	32.6	1.00 (0.96-1.04)	0.731	1.02 (0.94-1.11)	0.607
Employment at UFV					
Student	40.3	1		1	
Employee or family member	59.7	1.13 (1.04-1.22)	**0.002**	1.10 (1.01-1.21)	**0.029**
Smoking					
Never smoked	68.0	1		1	
Smoker or Ex-smoker	32.0	0.97 (0.89-1.05)	0.558	0.96 (0.88-1.05)	0.462
Sleep Duration					
< 8 hours/night	70.5	1		1	
≥ 8 hours/night	34.9	0.99 (0.99-1.00)	0.516	0.99 (0.99-1.00)	0.289
Physical activity					
No	47.1	1		1	
Yes	52.9	0.99 (0.92-1.07)	0.945	1.00 (0.92-1.08)	0.929
Alcohol intake					
Do not drink/Never drank	40.9	1		1	
Drink eventually	59.1	1.09 (1.08-1.22)	**0.012**	1.02 (1.01-1.15)	**0.044**

CI = Confidence Interval.
[1] Higher diet quality = Revised Healthy Eating Index score (median 70.83 points).
[2] Model adjusted by waist circumference, diabetes mellitus and arterial hypertension diagnosis.

4. Discussion

The diet quality was classified as "need to improve" (69.4 ± 10.5 points), according to the criterion of Bowman (1998) [40]. Previous studies have identified even lower HEI scores in risk populations (values between 58.7 and 67.8) [41,42,43]. This is an expected result, since our sample can be considered as high cardiometabolic risk population. Female and older individuals (> 50 years) were more likely to have a higher R-HEI score. Women commonly present better diet quality when compared to men, [17,20] besides them more likely to engage in

healthy eating habits [16]. This food behavior is related to greater dissatisfaction with appearance, body weight [44] and greater health concern [17].

Regarding the association between age and diet quality, studies have described that younger people are more likely to have low R-HEI scores [17,20,21]. The higher meals eaten outside the home and the fast food preference (food consumption with high caloric density and low nutritional value) is commonly in young and adults when compared to elderly [45,46] This behavior is characteristic of contemporary life and contributing for obesity and cardiometabolic risk factors increase among young adults [47,48]. Thus, nutritional intervention is necessary in order to prevent the early mortality and improve quality of life, since these diseases evolution is silent and the manifestations may occur during life-course [49].

Marital status also influences eating habits, so that married or stable married individuals have better food adequacy compared to single ones [11,50]. In a cardiometabolic risk population living in New York, the married/living with a partner were more likely to have high diet quality (HEI score > 80) [51]. In another study, which adopted the Elderly Dietary Index to assess the diet quality of 4.252 older British men, diet quality had been most favorable in married men and those not living alone, showing that marital status and living arrangements can influence eating habits [50]. This is because meals made in a social environment motivate for preparing complete and elaborate meals. On the other hand, when this psycho-social engagement is absent, individuals tend to choose monotonous and easy-to-prepare meals [50]. In addition, the expense increase and the difficulty in handling the perishable foods purchase in small quantities lead to lower frequency to *in natura* food intake by those who live alone [19]. Among men, the lack of motivation for changing eating habits associated to the lack of familiarity cooking also contributing to worse diet quality [52].

Contradictory to our results, other studies have identified that people with lower educational status are unlikely to have a higher quality diet [18,20,53]. It is necessary to consider that the majority of the sample has a higher schooling and spend more time away from home due to work, which predisposes the greater ingestion of practical and industrialized foods [45,46]. This context is common in several countries where increasing industrialization and working hours have accompanied the reduction in the time available for preparing food. In this sense, eating at least one meal a day in restaurants is related to a higher chance of having low HEI score [11] and the healthy lifestyle is not commonly prioritized in these populations [54,55].

Although other studies have identified a positive association between income and HEI score [18,20,53], we did not observe any association between income and diet quality. It should be noted that participants reported family income rather than *per capita* income, which may have contributed to non-association. However, we already know that the increase in years of study is related to better remuneration [56]. Data from the Family Budgets Survey - 2002-2003 describe that the Brazilian low-income population consumes more rice, beans, cereals and tubers, while higher-income classes consume more ready-made foods, industrialized mixtures and biscuits [57]. Low purchasing power and food access is related to higher food purchases from the basic food basket and lower fruits and vegetables intake [53,58], but also the lower intake of higher cost processed foods [57].

In relation to alcoholic beverages, those who drinks eventually presented a greater chance of having a better R-HEI score (> 70.8 points), independent of confounding factors. Other authors have observed that moderate alcohol consumption, characterized by the ingestion of few doses in social use, is associated to healthier dietary patterns [59,60,61]. Although alcohol intake contributes to the cardiometabolic alterations development [48,62], this association is mediated by the consumption quantity and frequency, factors that were not evaluated in this study.

Regardless of the sociodemographic and lifestyle aspects, the total sample presented low scores in the items whole grains, total fruits, whole fruits, milk and dairy products, SFA and sodium, a common result in cardiometabolic risk populations [13,42,63], and the whole grains group is the one that presenting greater inadequacy. For whole grains, the longer preparation time contributes to their low consumption, especially because the women insertion in the job market and less time for preparing food [54]. However, whole grains preserve more fiber, B vitamins and trace elements compared to refined grains, and should be associated to death risk reduction due to CVD [64].

The higher intake of fruits and vegetables characterizes healthier eating patterns and lower chronic diseases risk [59,65], because they provide micronutrients, fibers, anti-antioxidants and anti-inflammatory compounds with cardioprotective effect, leading to reduction of oxidative stress, subclinical inflammation and improving of glycemic and lipemia control [66,67,68]. Despite this, less than 38% of Brazilians consume fruit five times a week [69], so that the daily fruits [86 g/day) and vegetables (64 g/day) intake of this population [70] is so lower than the recommendation of 400 g/day [4,71]. Since 2.6 million deaths worldwide (30% of cardiovascular causes) could be avoided with adequate fruits and vegetables intake [72], altogether the data indicate the need for stimulating the consumption of these food-groups and providing conditions for accessing them to subsequently improving diet quality and reducing NCD.

As a limitation, only one R24 hour is used, according to Willett (1998), a single R24 hour may be sufficient to adequately estimate the mean intake of food and nutrients. In addition, the food consumption evaluated refers to the current and non-habitual intake. About results, the R-HEI is a useful tool in the diet quality determinants investigation and interventions targeting in risk and has been widely used in nutritional epidemiology [12] and in the investigation about sociodemographic and lifestyle factors [16,17].

5. Conclusion

The participants had low R-HEI (69.4 ± 10.5) and total fruit, whole fruits, whole grains, milk and dairy products, sodium and SFA scores. The best diet quality was observed among female subjects, older, less educated, married or in stable union, and who reported eventual

alcohol consumption, indicating the relevant role of social and lifestyle factors in adopting a healthy diet and controlling NCD.

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Statement of Competing Interests

The authors have no competing interests to declare.

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