

## Associations between dietary patterns, physical activity (leisure-time and occupational) and television viewing in middle-aged French adults

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### Abstract

Diet and physical activity are considered to be major components of a healthy lifestyle. However, few studies have examined in detail the relationships between specific types of physical activity, sedentary behaviour and diet in adults. The objective of the present study was to assess differential relationships between dietary patterns, leisure-time and occupational physical activities and time spent watching television (TV), as an indicator of sedentary behaviour, in middle-aged French subjects. We performed a cross-sectional analysis using data from 1359 participants in the SUPplémentation en Vitamines et Minéraux AntioXydants study, who completed a detailed physical activity questionnaire and at least six 24 h dietary records. Sex-specific dietary patterns were derived using factor analysis; their relationships with leisure-time and occupational physical activities and TV viewing were assessed using ANCOVA, after adjustment for age, educational level and smoking status. Three dietary patterns were identified in each sex. After adjustment for potential confounders, leisure-time physical activity was positively associated with a 'healthy' food pattern in both men ( $P$  for trend  $<0.01$ ) and women ( $P$  for trend  $<0.03$ ) and negatively associated with an 'alcohol/meat' pattern in men ( $P$  for trend  $<0.01$ ). TV viewing was positively associated with a 'convenience' pattern in men and with a 'alcohol-appetiser' pattern in women. In conclusion, identification of relationships between dietary patterns, physical activity and sedentary behaviour can enable identification of different types of lifestyle and should help to target at-risk groups in nutrition prevention programmes.

**Key words:** Leisure-time physical activity; Occupational physical activity; Television viewing; Dietary patterns; Adults

As emphasised by the present global strategy of the WHO<sup>(1)</sup>, both a healthy diet and adequate physical activity are major factors in the prevention of chronic diseases and the promotion of good health throughout the entire lifespan. This is also reflected at a national level in many countries, with recommendations 'to engage in regular physical activity and reduce sedentary activities to promote health' in the dietary guidelines<sup>(2)</sup>.

Common types of physical activities consist of leisure-time (including sports), occupational, transport and at-home or domestic physical activity<sup>(3)</sup>. Studies in adult populations have shown that the specific domain of leisure-time physical activity, in contrast to occupational physical

activity, is associated with healthier food intake<sup>(4,5)</sup>. In an attempt to overcome the limitations of traditional methods focusing on single nutrients or foods, analyses of overall dietary patterns have been proposed. By considering how foods are consumed in combination, dietary pattern analyses may provide a more comprehensive approach to food consumption and its relationship with other health behaviours or outcomes<sup>(6–9)</sup>. In a previous study, we reported, in a middle-aged French population, a negative relationship between a dietary pattern characterised by 'alcohol and meat' consumption and physical activity<sup>(10)</sup>. However, only an overall physical index across all contexts was used, and little is known about the association of

**Abbreviations:** MET, metabolic equivalent task; SU.VI.MAX, SUPplémentation en Vitamines et Minéraux AntioXydants; TV, television.

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dietary patterns with specific types of habitual physical activity in adults.

Another important component of a healthy lifestyle lies in limiting sedentary behaviour. Sedentary time is the duration of an occupation that expends very little energy above the RMR, e.g. sitting or watching a screen<sup>(11–13)</sup>. It is generally agreed that sedentary behaviour and low physical activity levels are complementary aspects of human movement behaviour<sup>(13)</sup> and are independent risk factors for major chronic diseases such as obesity and type 2 diabetes, cardiometabolic risk and mortality<sup>(11–14)</sup>. Sedentary behaviour was found to be associated with consumption of unhealthy foods in youth<sup>(15–18)</sup>. In adults, evidence of such an association is rare<sup>(19,20)</sup>.

A more thorough understanding of the relationship between dietary habits, physical activity and sedentary behaviour is needed to better define a healthy lifestyle and target at-risk groups in nutrition prevention programmes. Therefore, the aim of the present study was to investigate the differential relationship of dietary patterns with various types of physical activity and with time spent watching television (TV), used as an indicator of sedentary behaviour, in middle-aged French subjects.

## Methods

### Subjects and study design

Subjects were participants in the SUPplémentation en Vitamines et Minéraux Antioxydants (SU.VI.MAX) study. This study is a randomised, double-blind, placebo-controlled primary prevention trial designed to evaluate the impact of daily antioxidant supplementation at nutritional doses on the incidence of CVD and cancer<sup>(21,22)</sup>. A total of 5028 men aged 45–60 years and 7713 women aged 35–60 years from throughout France were included between October 1994 and June 1995, with a planned follow-up of 8 years. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Ethical Committee for Studies with Human Subjects at the Paris-Cochin Hospital (CCPPRB no. 706) and the Commission Nationale Informatique et Liberté (CNIL no. 334641). Written informed consent was obtained from all subjects.

For the present study, only subjects with available data on leisure-time and occupational physical activities in 1998 and who had also completed at least six 24 h dietary records during the same period were included. In order to obtain a similar age range in both sexes, the sample was further restricted to subjects aged 45 years or older in 1998. We also excluded subjects who had had a major health event (CVD and cancer) and/or had been confined to bed for more than 1 month during the period covered by the physical activity questionnaire. Analyses in the present report were based on data from 701 men and 658 women.

### Dietary assessment

Subjects were asked to provide a 24 h dietary record every 2 months for a total of six records per year. Dietary data were collected using the Minitel Telematic Network<sup>(21)</sup>. This specific tool was a small terminal widely used in France during the 1990s, at the beginning of the SU.VI.MAX study<sup>(21)</sup>. At enrolment, participants received this tool and a validated instruction manual of photographs to assist in coding food portions<sup>(23)</sup>. Dietary nutrient intakes, based on the average daily intake for each subject, were estimated using a French food composition table<sup>(24)</sup>.

### Dietary patterns

Dietary patterns were defined by factor analysis using a principal component analysis method that has been previously reported<sup>(10)</sup>. Among 900 recorded food items, thirty-seven food groups were defined according to the type of food or nutrient content (see the Supplementary material of Kesse-Guyot *et al.*)<sup>(10)</sup> and each food group was energy-adjusted using the residual method<sup>(25)</sup>. PROC FACTOR in SAS version 9.1 (SAS Institute, Inc., Cary, NC, USA) with the SAS 'Varimax' option was applied by sex to derive dietary patterns on the basis of food groups. The number of retained patterns was determined according to several criteria: Eigenvalue > 1, screen test (the plot of the total variance related to each factor) and interpretability. Dietary patterns were labelled on the basis of food groups that were found to be strongly correlated with each extracted pattern (factor loading coefficient > 0.30). In a final step for each participant, a factor score was calculated for each pattern by summing up the energy-adjusted food group intakes, which were weighted by its scoring coefficient.

### Assessment of physical activity and sedentary behaviour

Physical activity and sedentary behaviour were assessed using the French self-administered version of the modifiable activity questionnaire<sup>(26)</sup>. The modifiable activity questionnaire, developed by Kriska *et al.*<sup>(27)</sup>, assesses past 12-month physical activity during leisure time and work. Physical activity assessment using the Modifiable Activity Questionnaire has been validated against energy expenditure measurements, using the double-labelled technique; the test–retest properties of the questionnaire have been demonstrated<sup>(28)</sup>. The questionnaire has been described in detail elsewhere<sup>(26–28)</sup>. Briefly, for leisure-time physical activity, subjects were asked to report all leisure-time physical activities performed at least ten times for 10 min/session over the past 12 months. Detailed information was collected concerning the type of leisure activity (walking, cycling, swimming, gardening, etc.). The frequency (average number of times/month) and duration (average number of minutes each time) of each activity were reported. Minutes per week for all leisure-time activities were summed up to obtain an

indicator expressed in h/week. An energy expenditure indicator was also calculated by multiplying the number of h/week of each physical activity by its estimated metabolic cost<sup>(29)</sup>. This indicator was expressed in metabolic equivalent task (MET)-h/week of leisure-time activity.

Assessment of occupational physical activity was based on the number of hours during which an individual participated in physically demanding activities during an average work day for each job held over the past year. The number of hours in each of three categories of occupational physical activity (low, moderate and vigorous) was multiplied by an average group MET value (2, 4 and 7 MET, respectively)<sup>(26)</sup> and then summed up, resulting in a final occupational activity estimate expressed in MET-h/week. Total physical activity over the past year was determined as the sum of leisure-time and occupational activity indicators (expressed in h/week and in MET-h/week of activity). The questionnaire also includes information about time spent daily watching TV that was measured using a question: 'in general, how many hours a day do you spend viewing TV?' (h/d). TV viewing time was categorised into four classes (<1, 1–2, 2–3 and  $\geq 3$  h/d).

### Covariates

Socio-demographic data (sex, age and level of education) and smoking status were obtained through self-administered questionnaires at study entry and with specific questionnaires during the follow-up (smoking status). The level of education was coded into three categories according to the highest certification obtained (primary school, high school and university or equivalent). Three classes were used for smoking status (never smokers, present smokers and former smokers).

### Statistical analyses

All analyses were performed separately for men and women because we expected that women and men would have different physical activities and dietary patterns. Means were compared using Student's *t* tests, while  $\chi^2$  tests were used to compare frequencies and Wilcoxon–Mann–Whitney tests for scoring variables. Spearman's correlations were used to examine the associations between the different physical activity domains and TV viewing. In further analyses, scores for leisure-time, occupational and total physical activities were categorised into three equal groups by using tertile cut-offs. Comparisons of dietary patterns across tertiles of the leisure-time physical activity score, tertiles of the occupational physical activity score, tertiles of total physical activity and TV viewing were assessed by ANCOVA (using the general linear model), controlling for age, education level and smoking status.

Additional adjustments for physical activity domains were applied: the relationship between leisure-time physical activity and dietary patterns was adjusted for

occupational physical activity and TV viewing; that between occupational physical activity and dietary patterns was adjusted for leisure-time physical activity and TV viewing; that between TV viewing and dietary patterns was adjusted for both physical activity domains. Statistical analyses were performed using SAS package version 9.1. The level of significance for acceptance was  $P < 0.05$ .

## Results

### Characteristics of the study population

Table 1 presents the characteristics of the study subjects. Compared with men, women were younger, better educated, smoked less, had lower total energy and alcohol intake and had lower levels of leisure-time, occupational and total physical activities. The mean total physical activity was higher in men than in women (23.3 and 19.5 h/week, 83.8 and 59.9 MET-h/week in men and women, respectively).

### Dietary patterns

Three major dietary patterns were identified in both sexes and accounted for 17.6% of the total initial variance of food intakes in men and 16.3% in women. Table 2 describes factor loadings for these three patterns. The first pattern was labelled 'alcohol/meat' in men and 'alcohol/appetisers' in women. It was characterised by a high consumption of alcohol (wine and other alcoholic beverages) in both sexes. This pattern was also characterised by a high consumption of meat ('meat and poultry' group and 'processed meat' group) in men and by a high consumption of appetisers (salted crackers, chips and olives) in women. The second pattern, which was a 'healthy food' pattern, was identified in both sexes. It had positive coefficients for intake of vegetables, vegetable oil and fat-free or low-fat sauces, and a negative coefficient for butter intake. More specifically, in men, this pattern was also characterised by a high consumption of fruits, starch, fish and seafood, breakfast cereals and dairy products. In women, the 'healthy food' pattern was also characterised by a high consumption of reduced-fat products and cheese and a low consumption of sweetened products, bread and crisps. The third dietary pattern was labelled 'convenience food' in both sexes. It was characterised by positive coefficients for ready-to-eat products, desserts, candy, cookies and croissants, and negative coefficients for vegetables, vegetable oil, meat and poultry.

### Association between dietary patterns, physical activity and sedentary behaviour

Relationships between dietary patterns, leisure-time, occupational and total physical activities and TV viewing are shown separately for men (Table 3) and women (Table 4).

**Table 1.** General characteristics of the study subjects  
(Mean values and standard deviations or percentages)

	Men (n 701)		Women (n 658)		P
	Mean	SD	Mean	SD	
Age (years)*	54.2	4.2	51.8	4.6	<0.0001
Education level (%)†					
Primary	21.5		14.3		
Secondary	35.0		44.8		
University	43.5		40.9		<0.0001
Smoking status (%)†					
Never smoker	29.7		54.3		
Former smoker	57.1		32.5		
Present smoker	13.3		13.2		<0.0001
Energy intake (kJ/d)*	10205	2223	7572	1842	<0.0001
Percentage of total daily energy intake*					
Carbohydrates	39.5	7.6	40.8	6.6	0.0008
Protein	16.2	2.6	16.6	2.7	0.0003
Fat	35.7	5.4	37.8	5.2	<0.0001
Alcohol	8.6	6.9	4.8	5.5	<0.0001
Physical activity (h/week)					
Leisure-time physical activity‡	4.4	4.8	3.3	3.8	<0.0001
Occupational physical activity‡	18.9	13.2	16.2	12.6	<0.0001
Total physical activity‡	23.3	14.1	19.5	13.5	<0.0001
Physical activity (MET-h/week)					
Leisure-time physical activity‡	21.1	23.4	15.3	18.2	<0.0001
Occupational physical activity‡	62.7	70.6	44.6	48.5	<0.0001
Total physical activity‡	83.8	74.3	59.9	53.4	<0.0001
TV watching (%)† (h/d)					
< 1		13.5		16.1	
1–2		32.8		30.2	
2–3		35.7		34.2	
≥ 3		18.0		19.5	0.40

MET, metabolic equivalent task; TV, television.

\* Comparison between men and women by Student's *t* test.† Comparison between men and women by the  $\chi^2$  test.

‡ Comparison between men and women by the Wilcoxon–Mann–Whitney test.

In contrast to the results for each physical activity domain, there was no significant association between dietary patterns and total physical activity in either sex. In men, the 'alcohol/meat' pattern was negatively associated with leisure-time physical activity and was not associated with occupational physical activity or with TV viewing. In women, the 'alcohol/appetisers' pattern was positively associated with TV viewing. For the 'healthy food' pattern, significant positive associations were observed with leisure-time physical activity in men and women. In men, there was a trend (non-significant) towards an inverse association between the 'healthy food' pattern and occupational physical activity. In both sexes, there was no association between the 'healthy food' pattern and TV viewing. In men, the 'convenience food' pattern was positively associated with TV viewing. In women, there was a trend (non-significant) towards an inverse relationship between the 'convenience food' pattern and leisure-time physical activity, whereas that same dietary pattern tended to be positively related to occupational physical activity and no association was found with TV viewing. In addition, none of the correlations between a given physical activity domain and TV viewing was significant, either in men or in women (coefficients ranged from  $r = 0.04$  to  $0.04$ ).

## Discussion

In a population of middle-aged French men and women, we identified three dietary patterns in both sexes. Although we observed some sex differences in consumption of specific foods such as appetisers for women and meat for men, two of these patterns were broadly similar in each sex ('healthy food' and 'convenience food' patterns). Leisure-time physical activity was consistently and positively associated with the 'healthy food' pattern in both sexes. Associations between physical activity at work and dietary patterns seemed less consistent in both sexes. TV viewing was found to be associated with less healthy dietary habits, as it was related to the 'alcohol/meat' pattern in men and the 'convenience food' pattern in women. The relationships between TV viewing and different physical activity domains (leisure, occupational and total) were non-significant, both in men and women.

Previous research investigating the relationship between diet and physical activity behaviour mainly focused on the effects of individual nutrients and/or specific foods or food groups<sup>(5,30)</sup>. To better account for the complexity of an individual diet combining various nutrients or foods<sup>(31,32)</sup>, we used the dietary pattern approach<sup>(10)</sup> to investigate its relationship with the types of physical activity and

**Table 2.** Factor loadings for the three dietary patterns derived from factor analysis\*

	Men			Women		
	Factor 1 Alcohol/meat	Factor 2 Healthy food	Factor 3 Convenience food	Factor 1 Alcohol/appetisers	Factor 2 Healthy food	Factor 3 Convenience food
Meat and poultry	0.37					-0.37
Processed meat	0.33					
Candy and cookies			0.41			0.46
Eggs						
Fruits		0.39		-0.55		
Desserts			0.48			0.58
Alcoholic beverages	0.55			0.54		
Beer and cider		-0.37				
Wine	0.64			0.58		-0.36
Coffee		-0.32				
Tea						
Sweetened beverages			0.31			
Fruit juice			0.32			
Water						
Mineral water						
Rice and pasta		0.35				
Potatoes			-0.32			
Butter		-0.33			-0.53	
Margarine						
Vegetable oil		0.51	-0.36		0.35	-0.33
Sauces						
Fat-free or low-fat sauces		0.33			0.32	
Bread and crisps	-0.58		-0.37	-0.36	-0.45	
Breakfast cereals		0.36				
Sweetened products	-0.53				-0.46	
Vegetables		0.55			0.48	-0.37
Dried vegetables						
Soup	-0.38			-0.34		
Fish and seafood		0.35				
Cheese					0.36	
Milk						
Dairy products		0.31		-0.37		
Ready-to-eat products			0.52			0.35
Croissants			0.39			0.42
Appetisers				0.46		
Reduced-fat products					0.33	
Reduced-sugar products						

\* Absolute values <0.30 were not represented in the table for simplicity.

sedentary behaviour. A strength of the present study was the use of a detailed physical activity questionnaire that enabled us to analyse the differential association of leisure-time and occupational physical activities with various dietary profiles. In the subjects of the present study, independently of age, educational level, smoking status or occupational physical activity, a high level of leisure-time physical activity was found to be associated with a high consumption of healthy foods such as fruits (in men) and vegetables (in both sexes). In adults, comparable relationships between leisure-time physical activity and a healthy diet (characterised by intakes of specific macronutrients or food groups) have been reported in previous studies<sup>(4,33–36)</sup>. In adult subjects, in the Worcester Area Trial for Counseling in Hyperlipidemia study<sup>(34)</sup>, individuals active during leisure time consumed more fruits and vegetables and less fat from dairy products than inactive subjects<sup>(34)</sup>. Among adult participants in the Harvard Pilgrim Health Care, Gillman *et al.*<sup>(35)</sup> found that increased physical activity was significantly associated

with a higher consumption of healthy food and that ‘non-exercisers or only occasional exercisers’ had suboptimal dietary intakes. The present study extends these findings of a positive relationship between leisure-time physical activity and healthy dietary patterns to a middle-aged French population.

In contrast, an inverse association was found between leisure-time physical activity and the alcohol (alcoholic beverages and wine) and meat (meat, processed meat and poultry) pattern in men. Fung *et al.*<sup>(37)</sup> also previously reported that a dietary pattern characterised by higher intakes of red meat, high-fat dairy products, beer and liquor (‘Western pattern’) in men was associated with less leisure-time physical activity. However, in that study, only leisure-time physical activity was assessed.

In the present analyses, the associations between occupational physical activity and dietary patterns were less consistent than with leisure-time physical activity, as none reached statistical significance, despite borderline trends suggesting an association of occupational physical

**Table 3.** Relationship of dietary patterns with physical activity and television (TV) viewing in men (Adjusted\* mean values and significant association using ANCOVA)

	Alcohol/meat		Healthy food		Convenience food	
	Mean	P trend	Mean	P trend	Mean	P trend
Leisure-time physical activity (MET-h/week)						
< 8.4	0.10	0.01	-0.09	0.01	-0.05	0.19
8.4–22.4	0.05		-0.07		-0.01	
> 22.4	-0.14		0.16		0.07	
Occupational physical activity (MET-h/week)						
< 23.8	0.05	0.29	0.06	0.06	0.04	0.33
23.8–59.5	-0.01		0.05		0.01	
> 59.5	-0.05		-0.12		-0.06	
Total physical activity (MET-h/week)						
< 42.1	0.05	0.15	0.01	0.41	0.04	0.24
42.1–86.1	0.03		0.06		0.03	
> 86.1	-0.09		-0.07		-0.07	
TV viewing† (h/d)						
< 1	-0.21	0.12	0.10	0.38	-0.26	0.04
1–2	0.04		-0.03		0.04	
2–3	0.03		0.01		0.05	
≥ 3	0.02		-0.04		0.02	

MET, metabolic equivalent task.

\* Adjustment analysis: controlling for age, educational level and smoking status and additional adjustment for other physical activity domains and TV viewing.

† Adjustment analysis: additional adjustment for both leisure-time and occupational physical activities.

activity with the 'healthy food' pattern in men (inverse association) and with the 'convenience food' pattern in women (positive association). In a recent study, Camoes & Lopes<sup>(5)</sup> also reported less association between dietary intake and occupational physical activity than with leisure-time physical activity, and only a significant positive association of occupational physical activity with energy intake was observed in men. This result may be explained, at least in part, by the difficulty in assessing the different aspects of occupational physical activity and reporting

the number of hours of physical activities during an average workday. Occupational physical activity appears in itself to include a combination of various activities that might be differentially associated with health behaviours<sup>(38)</sup>.

One original aspect of the present study is that we analysed the association between time spent watching TV and dietary patterns accounting for both leisure-time and occupational physical activities. Overall, the results show that TV viewing was positively related to unhealthy dietary

**Table 4.** Relationship of dietary patterns with physical activity and television (TV) viewing in women (Adjusted\* mean values and significant association using ANCOVA)

	Alcohol/appetisers		Healthy food		Convenience food	
	Mean	P trend	Mean	P trend	Mean	P trend
Leisure-time physical activity (MET-h/week)						
< 5.5	0.06	0.29	-0.11	0.03	0.13	0.07
5.5–16	-0.02		0.01		-0.08	
> 16	-0.04		0.10		-0.05	
Occupational physical activity (MET-h/week)						
< 18.3	-0.15	0.30	0.06	0.17	-0.08	0.07
18.4–47.6	0.17		0.02		-0.01	
> 47.6	-0.05		-0.08		0.09	
Total physical activity (MET-h/week)						
< 32.4	-0.08	0.28	0.03	0.43	-0.09	0.09
32.4–62.6	0.07		0.02		0.02	
> 62.6	0.02		-0.05		0.07	
TV viewing† (h/d)						
< 1	-0.12	0.03	-0.04	0.68	0.04	0.30
1–2	-0.05		0.03		-0.09	
2–3	0.02		-0.05		-0.02	
≥ 3	0.14		0.06		0.14	

MET, metabolic equivalent task.

\* Adjustment analysis: controlling for age, educational level and smoking status and additional adjustment for other physical activity domains.

† Adjustment analysis: additional adjustment for both leisure-time and occupational physical activities.

patterns characterised by the 'convenience food' pattern in men (a high consumption of sweetened beverages, ready-to-eat products, croissants, desserts, candy and cookies) and the 'alcohol/appetisers' pattern in women, independently of physical activity. Similar associations between high levels of sedentary behaviour and high consumption of snack foods<sup>(39)</sup>, sugar-sweetened soda<sup>(20)</sup> and fast foods<sup>(40)</sup> have been observed in previous studies. Altogether, these findings of an association between unhealthy dietary patterns and sedentary behaviour may help explain, at least in part, the relationship between sedentary behaviour and body-weight gain during adulthood<sup>(39)</sup>. In children, the data from a recent study suggested that the association between TV viewing and body fatness was likely to be due to an association with increased energy intake since the effect of TV viewing on fatness was not mediated by physical activity<sup>(41)</sup>. In adults, the absence of correlations between TV viewing and domains of physical activity, in agreement with previous investigations<sup>(13,42–45)</sup>, means that physical activity and sedentary behaviour represent distinct domains requiring specific assessments and interventions.

Interestingly, we observed no significant relationship between total physical activity and dietary patterns. These results are in line with previous recent reports in which few relationships were evidenced when using only an overall physical activity variable<sup>(5,10)</sup>. Except for energy intake in men, Camoes & Lopes reported no difference in the relationship between total physical activity and dietary intake in active *v.* sedentary subjects. Likewise, in an adult population in the European Union, relationships were found between health indicators (self-rated health and BMI) and leisure-time physical activities, but not with occupational physical activity or total physical activity<sup>(46)</sup>. This reinforces the importance of analysing in detail the different domains of habitual physical activity to better delineate their relationships with dietary and health outcomes.

Our findings have several limitations. First, the present study used a cross-sectional design. Thus, it was not possible to establish causal relationships. Second, our subjects were participants in a nutritional intervention study who generally had a higher education level and occupational status, along with a healthier lifestyle than the general population<sup>(21,22)</sup>. Thus, caution may be needed when extrapolating these findings to the general population. In addition, although in the SU.VI.MAX study the number of participants lost to follow-up was relatively low<sup>(22)</sup>, a large number of participants were excluded from the present analyses because of missing dietary records or physical activity questionnaires. Data were also collected some years ago (1998) and behavioural patterns may have changed since then.

Third, the measurements of physical activity and TV viewing were derived from self-reporting, which might be a source of potential misclassification bias (especially

over-reporting of duration and frequency for physical activity)<sup>(47)</sup>. In addition, TV viewing represents only one aspect of sedentary behaviour and remains insufficient for determining all aspects of sedentary behaviour<sup>(13,48)</sup>, such as sitting down while travelling<sup>(49)</sup> or time spent watching videos, playing video games and using a computer during leisure time. However, as noted by Sugiyama *et al.*<sup>(50)</sup>, TV viewing time can be considered a robust marker of overall sedentary behaviour only in women.

In summary, the present results indicate that TV viewing, leisure-time and occupational physical activities are unrelated and are differentially associated with dietary patterns. The data emphasise the relationship between leisure-time physical activity and healthy food patterns, whereas TV viewing, a typical sedentary behaviour, appears to be related to unhealthy food habits. Therefore, identification of relationships between dietary patterns, physical activity and sedentary behaviour can enable us to better define healthy lifestyle patterns. The data from the present study on these relationships could provide information for targeting risk groups and defining health promotion and prevention programmes.

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