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RESEARCH ARTICLE

The Effect of Demographic and Lifestyle Factors on Mode of Travel in School-Aged Children in The UK: A cross-Sectional Study From Understanding Society

Sahar Fadl* and Omer Kheir

National Diabetes Prevention and Control Program, Ministry of Health, Riyadh, Saudi Arabia

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Abstract:

Background:

Increasing levels of physical inactivity is associated with growing trends of childhood obesity.

Objective:

We aim to study the effect of socio-demographic as well as lifestyle factors on mode of travel to and from school in children from 10 to 15-year-old.

Methods:

4,497 school-aged children from the first wave of Understanding Society database. A cross-sectional design was used to examine the relationship between active travel with demographic and lifestyle factors.

Results:

Multivariate analyses show that children ages 13 to 15 years were more likely to travel actively compared to younger peers (OR=1.92,95%CI:1.65-2.23). Those engaged in sporting activity 3 times or greater than per week were more likely to actively travel compared to those engaged in less than twice per week (OR = 1.21, 95% CI: 1.02 to 1.43) and those eating fast food once or less than per week were more likely to travel actively compared to unhealthy eaters.

Conclusion:

Sports activity 3 times or greater than per week and eating fast food once or less than per week are positively associated with children being active travellers.

Keywords: Physical activity, Socio-demographic, Cross-sectional, Lifestyle, School children, Mode of travel.

1. INTRODUCTION

"Eat well, move more, live longer" is an effective slogan for the public health campaign initiated and supported by the UK Department of Health, with the aim to encourage people to lead and live healthier lifestyles [1]. Eating healthy foods (five-a-day), as well as undertaking suitable physical exercise are the main key factors in reducing the risk of many chronic diseases [1]. According to World Health Organization (WHO) standards, the effinition of physical activity is any body movement produced by skeletal muscles that requires energy expenditure [2]. Exercise is a type of physical activity that can be described as planned and structured repetitive movements designed specifically to improve

* Address correspondence to this author at the Public Health Specialist at National Diabetes Prevention and Control Program, Ministry of Health, Riyadh, Saudi Arabia; Tel: +966 536 167597, +44 786 3928737 (UK); E-mail: sahar.fadl@gmail.com

fitness and health, other daily activities such as walking, cycling, climbing stairs, gardening, commuting, and recreational activities are various ways of achieving physical fitness [3]. In contrast to physical activeness, physical inactivity results from a sedentary lifestyle and insufficient participation of activities that require body movement. Thus, the individual will be engaged in activities that involve less body movement, which in turn leads to lack of physical fitness. Similarly, frequent use of "passive" approaches of transport is associated with declining physical activity levels [2]. Physical inactivity is recognized as the fourth most common risk factor in overall mortality globally, which is an estimated 3.2 million deaths. This accounts for 6% of the world's population [2], and high blood pressure (13%) is ranked first followed by tobacco smoking (9%), diabetes (6%), and then overweight or obesity (5%), which is fourth [2]. Physical inactivity poses as a major problem throughout the world, and organizations such as the WHO, Centre for disease Control and Prevention (CDC) and collaborating countries are therefore attempting to bring about changes in peoples' lifestyle and introducing policies to make people physically active by combatting inactivity.

Several countries have examined the relationship between physical activity and the contributing general risk factors of activity. A recent study in Brazil found that higher income, industrialization, urbanization, and globalization have led to considerable economic and social change. Consequently, a rise in unhealthy diets and physical inactivity has developed and thus the prevalence of overweight among the population increased dramatically within the last three decades from 18.6% in 1974 to 50.1% in 2008 [4].

In the mid-1980s, the mean distance travelled to school by 11–16-year-olds in the UK was just over two miles; by 2013 this had almost doubled, increasing to 3.7 miles [5]. In recent studies, it has been estimated that less than half of all school-age children in England now attend their nearest school [6]. The proportion of children using active methods of traveling to school has become less common in recent years, with a higher proportion of journeys being undertaken by car [7].

Twenty-three years ago, Armstrong described the physical activity level of over 300 British youths aged 11 to 15 years as "children are fit, but not active" [8]. Current evidence suggests that today's children are physically inactive and increasingly unfit [9]. Therefore, this study aimed to examine the contributing factors affecting the mode of travel to and from school for children in the UK through a cross-sectional study using a representative sample of youth population from the Understanding Society database.

2. METHODOLOGY

The data was obtained from the well-known Understanding Society survey that was conducted in England, Scotland, Wales, and Northern Ireland. The data include information about individuals' lives, experiences, behaviours, and beliefs. Wave one was conducted in 2009–2010 and it focused on the 10–15-year-old age group. Demographic data, as well as other lifestyle variables, were included. The outcome variable here is the mode of travel to and from school, whether it is active using bicycles or walking or non-active using cars.

This novel study jointly used demographic and lifestyle factors to examine the potential effects on the mode of travel to and from school. Demographic factors include age, sex, ethnic groups (*i.e.* white and non-white), and regions where the children live at the time of interview; other lifestyle factors such as the type of eating habits, sporting activity, smoking status, social/cultural differences, and socio-demographics may influence the choice of travel mode by children. In this study, the generic term "children" refers to children and youth in the age range from 10 to 15 years old, and the generic term "travel to school" refers to travel to and from school.

The data from the first Wave of cross-sectional data from the Understanding Society was analyzed in this study and descriptive statistics for the data used are presented. Data cleaning for categorical predictor variables were re-grouped. Missing data in the main outcome were removed from the dataset, and the data then were ready for descriptive analysis for the main outcome in relation to different predictors by obtaining the p-value. Univariate analysis for individual predictor variables of the outcome was conducted using logistic regression analysis. The last form of analysis conducted was multivariate logistic regression analysis, controlling for the confounding variables.

All analyses were performed using the STATA crop College Station TX, USA (version 10.0) and data management was performed in Microsoft Office Excel, Redmond, WA, USA (2007). (Table. **1**)

Table 1. Understanding Society data collection timeline.

Year	2009	2010	2011	2012	2013	2014
Data collection and prossessing allocation	Wave 1					
	Wave 2					
	Wave3					
	Wave4					
	Wave5					

3. RESULTS

3.1. Socio-Demographic Variables

The overall response rate to wave 1 of the Understanding Society survey (2009–2010) was 81.8%. Among the 4,899 respondents who completed the short self-completion youth questionnaire interview, 402 (8.21%) had missing values for the outcome variable (active vs. passive mode of transport to school) and they have been excluded from the analysis.

The sample was divided into two equal age groups, younger (10–12 years old) vs. older (13–15 years old). There was no statistically significant differences between the sexes according to age groups represented in the sample ($p>0.502$). There was also no statistically significant difference in ethnic groups for white participants compared with non-white participants (74.5% vs. 25.5%, respectively; $p>0.725$).

England had the highest proportion of participants (84.5%) including nine regions of which London had the largest sample distribution (17.4%), followed by the South East (12%), and the North West (10%). The North East region has the lowest proportion of participants (3.8%). Additionally, the differences between the countries were not statistically significant ($p>0.321$).

3.2. Active Travel to School

As shown in Table **2**, 26.8% of participants were using non-active transport (cars) for commuting to and from school, while approximately three-quarters (73.2%) were actively commuting. The active commuters were divided into those who walked (43.6% of all participants), those who used public transport (26.6% of all participants) or those who cycled (2.9% of all participants). Over 61% of respondents in the younger age group (10–12 years old) were commuting passively while 54% of older children (13–15 years old) were using active means of travel to and from school. There was a significant relationship between the mode of travel and the age groups ($P<0.001$). Seventy-three percent (73.2%) were active travellers, and walkers represented the majority (43.6%) followed by public transport users, representing 26.6%. Cycling was the least popular (2.9%). Differences between the age groups according to the mode of travel were statistically significant when comparing binary and categorical outcomes ($p<0.001$). Comparing the mode of travel between males and females cyclists, males account for the majority while females represent the minority (87% vs. 13%). Other modes of travel such as walking and using public transport have the same percentages for males and females, and the results were statistically significant ($p<0.001$).

Table 2. Frequencies and percentages of variables according to the age groups.

Variable	Subgroup	Overall row Frequency	Overall row %	Freq. and (%) by age group		P-value[A]
				10-12 years	13-15 years	
Sex	**Male**	2,233	49.7	1,128(50.5)	1,105 (49.5)	0.502
	Female	2,264	50.3	1,121 (49.5)	1,143 (50.5)	
Ethnicity	**White**	2,969	74.5	1,467 (49.4)	1,502 (50.6)	0.725
	Non- white	1,015	25.5	508 (50.1)	507 (49.9)	
Country	**England**	3,798	84.5	1,920 (50.6)	1,878 (49.4)	0.321
	Wales	202	4.5	93 (46.0)	109 (53.9)	
	Northern Ireland	194	4.3	96 (49.5)	98 (50.5)	
	Scotland	303	6.7	140 (46.2)	163 (53.8)	
sporting activity	**Less than twice a week**	1,154	25.7	436(37.8)	718(62.2)	<0.001
	3 or more times a week	3,133	74.3	1,81(54.3)	1,52(45.7)	
Mode of travel: Binary	**Non-active**	1,21	26.8	741(61.4)	466(38.6)	<0.001
	Active	3,290	73.2	1,508(45.8)	1,782(54.2)	

(Table 2) contd.....

Variable	Subgroup	Overall row Frequency	Overall row %	Freq. and (%) by age group		P-value[A]
Categorical	**Car**	1,207	26.8	741(61.4)	466(38.6)	<0.001
	Walk	1,961	43.6	1,013(51.7)	948(48.3)	
	Bike	134		70(52.2)	64(47.8)	
	Public Transport	**1,195**	**26.6**	**425(35.6)**	**770(64.4)**	

A P value results from person's chi^2 test for the differences between subgroups

3.3. Sporting Activity

The overall sporting activity of children was 7%, and 74.3% of the whole sample was found to be physically active in sport (3 or more times a week) while those who practice less than three times a week were just 25.7%. The older age-group accounted for 62.2% of the less active group, while 54.3% of the younger group were more active. Differences in activity according to age groups were statistically significant ($p<0.001$).

3.4. Risky Behaviours

Overall, 6.4% were smokers, while 93.6% had never smoked. Additionally, 13.9% of children ate the recommended amount of fresh fruits and vegetables per day; 70.8% of children consumed crisps and fizzy drinks once a week or more; and 78.2% consumed fast food less than once a week, as shown in Table **3**. Differences between age groups related to all risky behaviour were statistically significant.

Table 3. Frequencies and percentages of risky variables.

Variable	Subgroup	Frequency	Percentage %	P-value[A]
Smokers	**Yes**	319	6. 4	<0.001
	No	4,545	93. 6	
Fresh fruit &Vegetable	**≥5 or more/day**	683	13.9	<0.001
	< 5 per day	4,175	86.1	
Fast food	**> once a week**	1,032	21.2	0.004
	≤ once a week	3,841	78.8	
Crisp and fizzy	**>once a week**	3,420	70.8	<0.001
	≤ once a week	**212**	**29.2**	

A P value results from person's chi^2 test for the differences between subgroups

3.5. Univariate Analysis

Results from the univariate logistic regression showed that 13–15 year olds were more likely to be active travellers compared with the 10–12 year olds (Odd ratio (OR) = 1.88, 95% CI: 1.64 to 2.15). There was no significant association between sex of the child and mode of travel to school. All areas of residence in the UK were associated with being less likely to use active transport, as shown by the lower OR compared with other countries, except for Scotland. This decrease was most significant for the following regions: North West, Yorkshire and Humber, West Midlands, South East, South West, and Northern Ireland; and the decrease was less significant for those living in North east, East Midlands, East of England, and Wales. We observed that non-smokers were less likely to use active transport to school compared with smokers (OR = 0.62, 95% CI 0.51 to 0.92). Those who ate fast food once a week or less were more likely to be active travellers to school than those who ate fast food more than once a week (OR = 1.18, 95% CI 1.01 to 1.38). Table **4** and **5**.

Table 4. Descriptive characteristics according to mode of transport to school.

Variable[A]	Sub groups	Passive commute		Active Commute		p-value[B]
		Frequency	%	Frequency	%	
Number		1,207	26.8	3,290	73.2	
Sex	Male	754	25.7	1659	74.3	0.088
	Female	633	28.0	1631	72.0	
Age	10-13	741	33.0	1,508	67.0	<0.001
	13-15	446	20.7	1,782	79.3	

(Table 4) contd.....

Variable[A]	Sub groups	Passive commute		Active Commute		p-value[B]
		Frequency	%	Frequency	%	
Ethnicity	White	810	27.2	2159	72.7	0.180
	Non-white	255	25.1	760	74.9	
Region* **	London	144	18.4	638	81.6	<0.001
	North east	50	29.2	121	70.8	
	North west	147	32.1	311	67.9	
	Yorkshire & hum	107	28.5	268	71.5	
	East midlands	90	24.8	273	75.2	
	West midlands	119	29.5	284	70.5	
	East of England	94	24.3	293	75.7	
	South east	181	34.1	349	65.9	
	South west	97	29.5	232	70.5	
	Wales	54	26.7	148	73.3	
	Scotland	53	17.5	250	82.5	
	Northern Ireland	71	36.6	123	63.4	
Sporting	<2 times a week	330	28.6	824	71.4	0.119
	≥3 times a week	874	26.2	2457	73.8	
**Smoking ** **	Yes	59	20.5	229	79.5	0.012
	No	1146	27.3	3051	72.7	
Fruit& vegetables	≥ 5 per day	167	26.8	455	73.2	0.981
	< 5 per day	1,033	26.8	2,821	73.2	
Fast food*	> once a week	281	29.5	673	70.5	0.042
	≤ once a week	673	26.2	2,607	73.8	
Crisp &fizzy	> once a week	844	26.7	2,322	73.3	0.642
	≤ once a week	357	27.3	949	72.7	

A variables with significant P value**s:***P<0.05; **P<0.01; ***P<0.001

B P-value results from person's chi^2 test for the differences between subgroups

Table 5. Univariate analysis according to the mode of travel.

Variables	OR[A] (95% CI)
Sex	
Male	1
Female	0.89 (0.78 - 1.02)
Age	
10-12	1
13-15	1.88***(1.64 - 2.15)
Ethnicity	
White	1
Non white	1.12 (0.95 - 1.32)
Region	
London	1
North east	0.55** (0.38 - 0.80)
North west	0.48*** (0.37 - 0.62)
Yorkshire & Humber	0.57*** (0.42 - 0.75)
East midlands	0.68** (0.51 - 0.92)
West midlands	0.54*** (0.41 - 0.71)
East of England	0.70** (0.52 - 0.94)
• South east	0.44*** (0.34 - 0.56)
• South west	0.54*** (0.40 - 0.73)
• Wales	0.62** (0.43 - 0.89)
• Scotland	1.06 (0.75 - 1.51)
• Northern Ireland	0.39*** (0.28 - 0.55)
Sporting Activity	

(Table 5) contd.....

Variables	OR[A] (95% CI)
< twice /week	1
≥ 3times/week	1.13 (0.97 - 1.31)
Smoking activity	
Smokers	1
Non Smokers	0.69** (0.51 - 0.92)
Fruit & vegetables	
≥ 5 portions/day	1
< 4portions/day	1.00 (0.83 -1.21)
Fast food	
> once /week	1
≤ once/week	1.18* (1.01-1.38)
Crisp& fizzy	
≥ once /week	1
<once/week	0.97 (0.84-1.12)

B *P<0.05; **P<0.01; ***P<0.001

We performed a univariate analysis of the following: ethnicity, sporting activity, consumption of fruits and vegetables and we found that fizzy drinks and crisps were non-significant predictors of active travelling in school children.

All variables that were associated with an active mode of travel to and from school in the univariate analysis were added sequentially into the multivariate regression model. Three models were chosen according to the variable categorization. Socio-demographic variables (model 1), overall activity (model 2), and risky behaviours (model 3) were added to the basic model. Comparisons between the three models are shown (Table **6**).

Table 6. Multivariate analysis according to the mode of travel.

Variables		Model1	Model 2	Model 3
		OR[A] (95% CI)	OR[A] (95% CI)	OR[A] (95% CI)
Age	10-12	1	1	**1**
	13-15	1.89***(1.64 - 12.19)	1.94***(1.68 - 2.25)	1.92***(1.65 - 2.23)
Sex	Male	1	1	1
	Female	0.81** (0.69 - 0.93)	0.82* (0.71 - 0.95)	0.79** (0.68 - 0.92)
Region	London	1	1	1
	North east	0.49** (0.32 - 0.76)	0.49** (0.32 - 0.75)	0.49** (0.32 - 0.76)
	North west	0.41***(0.31 - 0.56)	0.41***(0.30 - 0.56)	0.41***(0.30 - 0.56)
	York. & Hum.	0.54***(0.38 - 0.71)	0.52***(0.37 - 0.73)	0.54***(0.39 - 0.75)
	East midlands	0.62** (0.44 - 0.87)	0.62** (0.44 - 0.87)	0.61** (0.43 - 0.86)
	West midlands	0.52*** (0.38 - 0.71)	0.53***(0.38 - 0.73)	0.54***(0.39 - 0.75)
	East of England	0.61** (0.44 - 0.86)	0.61** (0.44 - 0.85)	0.60** (0.43 - 0.85)
	South east	0.39***(0.29 - 0.53)	0.39***(0.28 - 0.53)	0.37***(0.27 - 0.51)
	South west	0.46*** (0.32 - 0.65)	0.45***(0.31 - 0.64)	0.43***(0.30 - 0.62)
	Wales	0.50** (0.33 - 0.76)	0.50** (0.33 - 0.76)	0.51** (0.34 - 0.78)
	Scotland	0.89 (0.60 - 1.33)	0.89 (0.60 - 1.32)	0.87 (0.59 - 1.30)
	Northern Ireland	0.33***(0.22 - 0.49)	0.32***(0.22 - 0.48)	0.34***(0.23 - 0.51)
Ethnicity	White	1	1	1
	No white	0.83 (0.68 - 1.01)	0.84(0.69 - 1.02)	0.87 (0.71 - 1.07)
Sporting	< twice /week	-	1	1
	≥ 3times/week	-	1.22*(1.03 - 1.44)	1.21* (1.02 - 1.43)
Smoking	Smokers	-	-	1
	Non Smokers	-	-	0.79 (0.57-1.11)
Fruit &	≥5portions/day	-	-	1
Veg.	< 4portions/day	-	-	0.91 (0.73-1.12)
Fast food	> once /week	-	-	1
	≤ once /week	-	-	1.32** (1.10 - 1.58)
Crisp &	≥ once /week	-	-	1

(Table 6) contd.....

Variables		Model1	Model 2	Model 3
		OR[A] (95% CI)	**OR[A] (95% CI)**	**OR[A] (95% CI)**
Fizzy	< once/week	-	-	1.03 (0.87 - 1.21)
AIC[B]		4502.7	4489.132	4442.513
Pseudo R^{2} [C]		0.0331	0.0345	0.0365

A *P<0.05; **P<0.01; ***P<0.001 **C** Pseudo R^2 measures the best model fit (the higher the better fit)

When the above three models were compared, model 3 had the best Pseudo R2 reading (0.0365). Aikaike Information Criterion (AIC) showed the best finding with the lowest value, and when the same three models were compared, the lowest AIC value was found for model 3 (4442.513).All variables in the model were statistically significant: the older age group, females, living in all UK regions except Scotland, participating in sports three or more times a week, and consuming fast food less frequently. This indicates that demographic factors, sports, and eating fast food together influence the active mode of travel to and from school.

4. DISCUSSION

The active mode of travel was more prevalent in boys in the age group of 13–15 years old (see Tables **2** and **3**). The results are similar to findings from previous researches [**10** - **12**]. This could be explained because boys might be bolder and are free to choose their travel mode more so than girls. As children tend to mature and grow older, they want to assert their independence by travelling to school on their own. In the UK, age defines the level of child education. Primary school age children (7–10 years old) are accompanied by their parents most of the time, and their mode of travel will depend on their parents' attitude toward the way of commuting. This does not hold for secondary school children (11–16 years old) as they can pick the more convenient way of travel to their school. Additionally, parents may also wish to give their children some freedom or responsibility to travel to school on their own.

In a study by Davison, parents provided different forms of support including commuting to sporting activity venues, which was associated with a higher physical activity among girls who participated in organized sports, are more active than boys [13]. In children under the age of 5 years, being driven to school does not affect their overall physical activity [14]. In Glasgow, another study found that younger children are more likely to walk but also more likely to be driven than their older counterparts, while older children are more likely to take the bus than younger children [15].

The association between the active mode of travel and area of residence in our data show a statistically significant relationship. School children living in all regions within the UK except Scotland are less likely to travel actively compared to those living in London, and the observed inverse association is likely because of the discrepancy in the sample size between the respective areas and the reference region (London). Regions as a measure of active travel are not reflective at an individual level but rather at an ecologic level; therefore, this may explain our findings of a negative association with active travel modes. Additionally, our analysis does not account for distance or proximity between a participants' home and school, which may be a factor that can elucidate such a relationship. For example, a previous study found that the distance from home to school represents the major reason why youth are commuting inactively and that an increase of one mile in distance significantly decreased the odds of active commuting by 71% [16]. The type of residential setting may also differ between urban and rural areas—secondary schools in a rural setting in the UK can be far away from children's homes, which might explain why other regions in the UK use active travel less than in the London region. Additionally, the nature of this cross-sectional study examined the relationship between variables and resulting prevalence rates.

Physical activity acts as an essential vehicle for play and exercise, and the ability to learn physical and social skills, develop creative intelligence, and stimulate growth and fitness. However, there is a relatively small amount of evidence linking physical inactivity in children with childhood health outcomes compared with adults. Normal markers of morbidity and mortality related to lifestyle cannot be used as evidence by researchers. However, in children and adolescents with elevated levels of a variety of risk factors for diseases such as obesity, elevated blood pressure, adverse lipid profiles, or low bone mineral density, which can be used as evidence. Cardiovascular disease, type 2 diabetes, and cancer require long incubation periods. Because of early and repeated exposure to risk factors during childhood and adolescence and throughout life, diseases related to lifestyle such as clinical hypertension (high blood pressure), diabetes, osteoporosis, or cardiovascular disease, rarely occur in children and adolescents. Additionally, measuring physical activity in children is more challenging compared with adults, and this produces weaker relationships [17].

The prevalence of active travellers corresponds to more than two-thirds of respondents in our study sample, among whom the prevalence of cycling is low (2.9%). Netherlands had reported the highest cycling prevalence (26%) followed

by Denmark with 19% cyclists [18], while fewer than 1% of respondents were cyclists in the US overall in 2003

The present study showed that smoking was associated with active travel while another study found that active travel was inversely associated with smoking in boys but not girls in a small study of German 14-year-olds [19]. While two studies from Canada showed that smoking was inversely related to active travel in the larger [20], but not in the smaller study [21]. The most probable explanation is that older age group who travel actively in the UK try to experiment challenging behaviours with their peers.

Our study suggested that participating in a sporting activity more than 3 times a week is positively associated with active mode of travel. However, cycling was found to be associated with increased levels of physical activity among boys only, but physical activity was reduced among those who travelled to school by motor vehicle [22]. Similar findings were shown that a person who is actively commuting to school is more physically active than those who travel by motorized ways of transport [23].

This data is nationally representative source of information about UK population,, and it contains accurate data on participation in other types of physical activity.. The potential relationships between the active mode of travel and both socio-demographic characteristics and lifestyle factors have been established in this cross-sectional study. The analysis of youth data were adjusted by removing the confounding variables for demographic factors such as age, ethnicity, and region as well as lifestyle factors such as smoking status and eating habits.

However, respective regions were lower than for the reference group (*i.e.* London), due to lack of statistical power. Our results suggest that 13 to 15 year-olds are more likely to be active travellers, due to exposition either directly or inadvertently to many activities that encourage a healthy lifestyle and active travel. Sporting activity can act as important predictor for active school travel. Policy should help young children to discover a particular sporting activity of their interest.

Additionally, physical education can be promoted during Parent Teaching Association meetings through launching campaigns to spread the message for parents directly and to inform them of the importance of their child being physically active through sports participation, physical education and promotion of active travel to school.. Another implication of this study suggests that healthy eating habits such as consuming fast food once or less than per week are a predictor for active travel. The school curriculum should include the benefits of eating healthier food, which promote the physical and mental health, and the risk of eating fast food.

CONCLUSION

In conclusion, active travel to and from school was found to be influenced by demographic characteristics such as age and region; and lifestyle factors such as sporting activity and eating habits.

LIST OF ABBREVIATIONS

AIC	=	Aikaike Information Criterion
BHPS	=	British Household Panel Survey
BMI	=	Body Mass Index
CDC	=	Centre for Disease Control
CHD	=	Coronary Heart Disease
CI	=	Confidence Interval
CMO	=	Chief Medical Officer
ESRC	=	Economic and Social Research Council
HSE	=	Health Survey of England
ISER	=	Institute for Social and Economic Research
NERS	=	National Exercise Referral Scheme
NHS	=	National Health Services
OR	=	Odds Ratio
PTA	=	Parent Teaching Association
TfL	=	Transport for London
EFIC	=	European Food Information Council

WHO = World Health Organization

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Human Ethics Committee Review Board following the Declaration of Helsinki in 1995 at the Faculty of Associated Medical Sciences, Chiang Mai University, Thailand and fifty healthy sedentary males as revised in 2008 (http://www.wma.net/en/20activities/10ethics/10helsinki/).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the *Helsinki Declaration* of 1975, as revised in 2008 (http://www.wma.net/en/20activities/10ethics/10helsinki/).

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

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