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Association between leisure-time physical activity and hypertension status in Korean adults

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Abstract

Objective. To examine whether leisure-time physical activity (PA) is associated with hypertension status in Korean adults (men, 586; women, 1 135) who visited a public health promotion center for a medical checkup in Seoul from 2010 to 2011. **Materials and methods.** Multivariate logistic regression analysis adjusted for age, body mass index, sleep duration, mental stress, education level, economic status, and drinking and smoking frequencies was performed. **Results.** Odds ratios and 95% confidence intervals for having hypertension and performing PA compared to having hypertension and not performing PA were not significant for both sexes regardless of the PA frequency and intensity, except for moderate PA 3 times per week in women. **Conclusion.** We conclude that PA has no or little association with hypertension status in Korean adults.

Key words: Physical activity; hypertension; Korea

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Resumen

Objetivo. Examinaar si la actividad física en el tiempo libre (AF) se asocia con el estado de hipertensión en adultos (hombres, 586; mujeres, 1 135) que visitaron un centro de promoción de salud pública para una revisión médica en Seúl en 2010-2011. **Material y métodos.** Se realizó un análisis de regresión logística multivariado ajustado por edad, de índice de masa corporal, duración del sueño, estrés mental, nivel educativo, situación económica y consumo de alcohol y tabaco. **Resultados.** Las razones de momios y los intervalos de confianza del 95% para hipertensión y la realización de AF, en comparación con tener hipertensión y la no realización de AF, no fueron significativas en ambos sexos, independientemente de la frecuencia e intensidad de la AF, a excepción de AF moderada tres veces por semana en mujeres. **Conclusión.** Se concluye que la AF no tiene o tiene poca relación con el estado de hipertensión en adultos coreanos.

Palabras clave: actividad fisica; hipertensión; Corea

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The incidence of hypertension has recently been increasing in Korea, as the population is increasingly adopting Westernized eating habits including fast food consumption and a more sedentary lifestyle. The fifth Korea National Health and Nutrition Examination Survey V-1 (KNHANES V-1) in 2012 reports that the prevalence of hypertension in subjects aged >30 years was 30.1% in men and 27.7% in women and has been steadily increasing every year.[1] Male subjects aged 30-39, 40-49, 50-59, 60-69, and ≥70 years have hypertension rates of 12.6, 22.4, 41.0, 52.5, and 50.1%, respectively; female subjects in the corresponding age groups have rates of 1.6, 11.6, 33.7, 58.3, and 68.2%, respectively.[1]

High blood pressure, called primary hypertension or essential hypertension, is a significant risk factor for coronary heart disease, heart failure, stroke, and renal disease.[2] Moreover, hypertension is caused by genetic factors including age, body shape, and family history as well as lifestyle factors including alcohol consumption, smoking, consumption of high-salt or high-sugar foods, and sedentary lifestyle.[3] Physical activity (PA) level is significantly associated with hypertension;[4,5] epidemiological studies further corroborate this strong association.[6,7] Although PA is an important component in hypertension prevention and management, very few studies have examined the association between PA and hypertension status in Korea.[8] Furthermore, previous studies are limited by small sample sizes and their focus on hypertensive patients, and they have not analyzed the intensity (i.e., vigorous, moderate, or light) or frequency of PA. Therefore, this study examined whether PA intensity and frequency are related to hypertension status in a selected sample of Korean adults.

Materials and methods

Subjects

The subjects were 1 721 adults aged >20 years who visited the S-gu public health promotion center in Seoul, Korea, between November 1, 2010 and October 30, 2011. The subjects completed the three questions related to PA from the International Physical Activity Questionnaire (IPAQ)[9] and had their blood pressure measured. The subjects were physically and psychologically healthy. Subjects being treated for hypertension or those who had a family history of hypertension, stroke, heart failure, angina, myocardial infarction, or renal disease were excluded. All subjects provided written informed consent before participation, and all study procedures were approved by the Human Care and Use Committee of the S-gu Community Health Center. The characteristics of the subjects are shown in table I.

Dependent variables

The subjects rested for at least 10 min in a sitting position before blood pressure measurements. Moreover, subject did not take caffeine or smoke before the evaluation. Systolic and diastolic blood pressures were measured at the right brachial artery by a nurse specialist using a mercury sphygmomanometer. Blood pressure was measured on three separate occasions at 2-min intervals. The nurse specialist determined the average blood pressure value. Blood pressure was measured according to the recommendations of Bates' Guide to Physical Examination and History Taking.[10] Normotension and hypertension were defined as blood pressure <140/90 and ≥140/90 mmHg, respectively. Hypertension was assessed by the same nurse specialist according to the criteria of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure-VII.[11]

Independent variables

To determine the PA intensity and frequency of each subject, three questions from the self-administered IPAQ[9] were used. The first, second, and third questions were about the frequencies of vigorous (e.g., aerobics, running, fast cycling, and fast swimming), moderate (e.g., cycling at a regular pace, swimming at a regular pace, and doubles tennis), and light (i.e., walking) PA, respectively, performed during leisure time for at least 10 min at a time during the past week; the possible responses for each category were no PA and 1, 2, 3, 4, and ≥5 times per week.

Covariates

The covariates were evaluated for each subject on the basis of responses to eight questions from the self-reported data. The questions and their responses are as follows:

1. Age: self-reported age was used without modification.
2. Body mass index: subjects had their height and weight measured, and body mass index (kg/m^2) was calculated.
3. Sleep duration: the four possible responses were: 1) <5 h, 2) 6 h, 3) 7 h, and 4) >8 h per night.
4. Mental stress: the four possible responses were: 1) very low mental stress, 2) low mental stress, 3) high mental stress, and 4) very high mental stress.
5. Education level: the four possible responses were: 1) elementary school or lower, 2) middle school, 3) high school, and 4) college or higher.

Table I
Characteristics of subjects who visited the S-gu public health promotion center in Seoul, Korea between November 1, 2010 and October 30, 2011

Variable		*Men (n = 586)*	*Women (n = 1 135)*	*Total (N = 1 721)*
Presence of hypertension	Yes	271 (46.2)	329 (29.0)	600 (34.9)
	No	315 (53.8)	806 (71.0)	1 121 (65.1)
Smoking frequency	Non-smoker	495 (84.4)	1,123 (98.9)	1 618 (94.0)
	Ex-smoker	52 (8.9)	3 (0.3)	55 (3.2)
	Current smoker	39 (6.7)	9 (0.8)	48 (2.8)
Drinking frequency	Non-drinker	490 (83.5)	976 (86.0)	1 466 (85.2)
	Once every month	22 (3.8)	105 (9.3)	127 (7.4)
	2–3 times every month	39 (6.7)	39 (3.4)	78 (4.5)
	≥4 times every month	35 (6.0)	15 (1.3)	50 (2.9)
Sleep duration	<5 h	13 (2.2)	51 (4.5)	64 (3.7)
	6 h	31 (5.3)	97 (8.5)	128 (7.4)
	7 h	22 (3.8)	80 (7.0)	102 (5.9)
	>8 h	520 (88.7)	907 (80.0)	1 427 (83.0)
Mental stress	Very low	502 (85.7)	870 (76.6)	1 372 (79.7)
	Low	31 (5.3)	75 (6.6)	106 (6.2)
	High	43 (7.3)	171 (15.1)	214 (12.4)
	Very high	10 (1.7)	19 (1.7)	29 (1.7)
Education level	Elementary school or lower	41 (7.0)	85 (7.5)	126 (7.3)
	Middle school	20 (3.4)	106 (9.3)	126 (7.3)
	High school	144 (24.6)	316 (27.8)	460 (26.7)
	College or higher	381 (65.0)	628 (55.4)	1 009 (58.7)
Economic status	Very poor	116 (19.8)	300 (26.4)	416 (24.2)
	Poor	66 (11.3)	137 (12.1)	203 (11.8)
	Rich	383 (65.3)	614 (54.1)	997 (57.9)
	Very rich	21 (3.6)	84 (7.4)	105 (6.1)

6. Economic status: the four possible responses were: 1) very poor, 2) poor, 3) rich, and 4) very rich.
7. Drinking frequency: the four possible responses were: 1) non-drinker, 2) once every month, 3) 2–3 times every month, and 4) ≥4 times every month.
8. Smoking frequency: the three possible responses were: 1) non-smoker, 2) ex-smoker, and 3) current smoker.

Statistical analysis

All results are presented as mean ± standard deviation. Multivariate logistic regression analyses were conducted to determine whether PA was associated with hypertension after adjusting for age, body mass index, sleep duration, mental stress, education level, economic status, and frequencies of drinking and smoking. The level of statistical significance was set at $p< 0.05$, and all analyses were performed using SPSS v. 18.0.

Results

The results of multivariate logistic regression analyses for PA intensity and frequency according to hypertension status are shown in Table II. The prevalence of hypertension was 46.2% in men and 29.0% in women.

Table II

Multivariate logistic regression analysis for PA intensity and frequency according to hypertension status (N=1,721) of subjects who visited the S-gu public health promotion center in Seoul, Korea between November 1, 2010 and October 30, 2011

Hypertension vs. normotension		*Cases*	*β*	*SE*	*OR*	*95% CI*	*p-value*
Men (n = 586)							
Vigorous physical activity	No	407	Reference		1.000		
	Once per week	78	-0.367	0.280	0.693	0.400-1.200	0.190
	Twice per week	40	-0.052	0.380	0.949	0.451-1.997	0.891
	Thrice per week	35	-0.333	0.468	0.717	0.286-1.795	0.477
	4 times per week	13	-0.969	0.720	0.380	0.093-1.558	0.179
	≥5 times per week	13	-0.105	0.731	0.900	0.215-3.771	0.886
Moderate physical activity	No	398	Reference		1.000		
	Once per week	71	-0.420	0.290	0.657	0.372-1.159	0.147
	Twice per week	40	0.012	0.382	1.012	0.479-2.140	0.974
	Thrice per week	40	-0.457	0.412	0.633	0.283-1.418	0.267
	4 times per week	13	0.165	0.630	1.179	0.343-4.050	0.794
	≥5 times per week	24	-0.352	0.593	0.703	0.220-2.240	0.553
Light physical activity (walking)	No	375	Reference		1.000		
	Once per week	63	-0.288	0.296	0.749	0.419-1.340	0.331
	Twice per week	38	0.040	0.393	1.041	0.482-2.248	0.919
	Thrice per week	36	-0.661	0.463	0.517	0.208-1.280	0.154
	4 times per week	10	0.361	0.757	1.435	0.326-6.322	0.633
	≥5 times per week	64	-0.680	0.399	0.507	0.232-1.107	0.088
Women (n = 1,135)							
Vigorous physical activity	No	686	Reference		1.000		
	Once per week	134	-0.002	0.224	0.998	0.644-1.547	0.992
	Twice per week	77	0.305	0.283	1.357	0.780-2.363	0.280
	Thrice per week	77	-0.497	0.342	0.608	0.311-1.189	0.146
	4 times per week	44	-0.219	0.429	0.803	0.347-1.860	0.609
	≥5 times per week	38	-0.478	0.522	0.620	0.223-1.723	0.359
Moderate physical activity	No	650	Reference		1.000		
	Once per week	140	0.146	0.219	1.157	0.753-1.179	0.505
	Twice per week	76	0.198	0.296	1.219	0.682-2.178	0.504
	Thrice per week	88	-0.714	0.335	0.490	0.254-0.943	0.033*
	4 times per week	48	0.281	0.364	1.324	0.649-2.701	0.441
	≥5 times per week	54	-0.647	0.476	0.524	0.206-1.331	0.174
Light physical activity (walking)	No	751	Reference		1.000		
	Once per week	137	0.072	0.240	1.075	0.671-1.720	0.764
	Twice per week	81	0.070	0.327	1.072	0.565-2.034	0.831
	Thrice per week	82	-0.471	0.325	0.625	0.330-1.182	0.148
	4 times per week	46	-0.165	0.402	0.848	0.385-1.865	0.681
	≥5 times per week	38	0.154	0.274	1.167	0.682-1.994	0.573

SE, standard error; OR, odds ratio; CI, confidence interval

*$p < 0.05$; multivariate logistic regression analysis adjusted for age, body mass index, sleep duration, mental stress, education level, economic status, and frequencies of drinking and smoking.

The odds ratios and 95% confidence intervals for having hypertension and performing PA compared to having hypertension and not performing PA were not significant in both sexes regardless of frequency and intensity, except for moderate PA three times per week in women.

Discussion

This study examined the association between PA and hypertension status in a selected sample of Korean adults. The key finding of this study is that regardless of intensity, PA has little or no association with hypertension status in Korean adults in either sex.

Many previous studies demonstrate that PA is associated with hypertension.[12-14] In their cross-sectional study, Reaven *et al*.[15] reported that after adjusting for age, body mass index, and insulin level, there was an overall linear trend between lower blood pressure and higher levels of PA. Furthermore, Haapanen *et al*.[16] found that PA during spare time has a preventive effect against elevated blood pressure.

In contrast, Mkhonto *et al*.[17] recently reported that PA was not associated with hypertension in a sample of South African subjects. Furthermore, Marti *et al*.[18] and Manjoo *et al*.[19] also reported no association between blood pressure and PA measured on the basis of daily steps. Interestingly, in another Korean study, Yang *et al*.[8] reported that gender ($\beta = 0.09$, $p< 0.001$), medication ($\beta = -0.24$, $p< 0.001$), regular PA ($\beta = 0.06$, $p=0.02$), and comorbidity ($\beta = 0.14$, $p< 0.001$) are significantly associated with blood pressure. However, the results of that study show that regular PA has a weaker effect on blood pressure than gender, medication, and comorbidity.

Our study corroborates the findings of these more recent studies in that PA intensity and frequency have little or no association with hypertension status in Korean adults regardless of sex. This may be because the study subjects were required to be physically and psychologically healthy and hypertensive patients were excluded. Therefore, although PA may be a factor affecting the management of hypertensive patients, it may have no effect on healthy subjects. Yang *et al*.[8] show that PA has a weaker effect on blood pressure than other variables in Koreans. The present study supports the possibility that hypertension status is more closely associated with ethnicity as well as biological, behavioral, and environmental factors such as diet and cultural settings than PA in Koreans, even though PA is independently associated with hypertension. Moreover, these differences could be due to the quality of the measurements as discussed below.

This study has several limitations. First, although the self-administered IPAQ is valid and reliable,[9] this study did not directly measure or investigate exercise type, frequency, duration, or intensity. In addition, although the quality of the diet (including factors such as overeating and appetite) and types of food consumed are factors relevant to hypertension, this study did not investigate the influence of diet. Therefore, additional well-designed studies that determine PA with greater specificity should be performed. Second, due to its retrospective and cross-sectional design, the results of this study cannot elucidate any causal relationship between PA and hypertension status. Third, all covariate data (i.e., age, body mass index, sleep duration, mental stress, education level, economic status, and frequencies of drinking and smoking) were self-reported and therefore subject to the potential biases and inaccuracies inherent to self-reporting. However, the central limit theorem indicates study data are likely to have a normal distribution and be reliable if the number of subjects in each group is greater than 30.[20] Hence, because all experimental groups in this study had more than 30 subjects, the mental stress questionnaire results can be considered reliable. Fourth, because the subjects were recruited from a single health center, they are not necessarily representative of the entire Korean adult population. Nevertheless, the study is of substantial value due to the large number of subjects ($N = 1\,721$) and its focus on Korean adults.

Conclusion

PA—vigorous, moderate, or light—is not associated with hypertension status in Korean adults of either sex regardless of age, body mass index, sleep duration, mental stress, education level, economic status, or frequency of drinking or smoking.

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