South African Journal for Research in Sport, Physical Education and Recreation, 2015, 37(1): 165-171.
Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 2015, 37(1): 165-171.
ISBN: 0379-9069

ASSOCIATION BETWEEN LEISURE-TIME PHYSICAL ACTIVITIES AND OBESITY IN A SELECTED SAMPLE OF KOREAN ADULTS

Jin-Ho YOON[1] & Wi-Young SO [2]
[1] *Department of Sport and Leisure Studies, Far East University, Chungbuk, Republic of Korea*
[2] *Sports and Health Care, College of Humanities and Arts, Korea National University of Transportation, Chungju-si, Republic of Korea.*

ABSTRACT

The aim of this study was to determine whether leisure-time physical activities (PAs) affect obesity in Korean adults. The participants included 505 men and 1,061 women (>20 years) who visited a public health centre in Seoul during 2010-2011. They completed the International Physical Activity Questionnaire and their Body Mass Index was calculated. Obesity was defined according to the current World Health Organization criteria. The association was assessed using multivariate logistic regression analysis after adjustment for sex, age, smoking/drinking, sleep duration, mental stress, education and economic status. Odds ratios (95% confidence interval) for the association between obesity and vigorous, moderate, and light PA compared to those who do not participate in any PA were: 0.931 (p=0.691), 0.893 (p=0.531) and 0.815 (p=0.302) for once/week, respectively; 0.940 (p=0.789), 0.690 (p=0.129), and 0.787 (p=0.342) for twice/week, respectively; 1.031 (p=0.897), 1.375 (p=0.137) and 1.180 (p=0.473) for three times/week, respectively; 1.109 (p=0.759), 0.804 (p=0.491), and 0.907 (p=0.763) for four times/week, respectively; and 0.357 (p=0.006), 0.509 (p=0.034), and 0.641 (p=0.038) for >five times/week, respectively. Vigorous, moderate, and light PA >five times/week may reduce or prevent obesity in Korean adults.

Key words: Physical activity; Prevalence of obesity; Body Mass Index; Korea.

INTRODUCTION

According to the Fifth Korea National Health and Nutrition Examination Survey, the prevalence of obesity in people aged >19 years was 36.5% for men and 26.4% for women in Korea and has been increasing annually (Korea Centres for Disease Control and Prevention, 2012). The data indicate that obesity is already a serious social problem in Korea. Moreover, it is a major risk factor for many serious health conditions and chronic diseases (Yusuf *et al.*, 2005; Pischon *et al*., 2008; Luppino *et al*., 2010).

Excessive food energy intake is an independent risk factor for obesity (Thomas & Albert, 2002; Schröder *et al*., 2007). Physical inactivity and a sedentary lifestyle also contribute to the increasing prevalence of obesity (Hill & Wyatt, 2005; Hamilton *et al*., 2007; Chaput & Tremblay, 2009). For this reason, many obese people try to increase energy expenditure by increasing physical activity (PA) or exercise and reduce energy intake by controlling diet. Increasing PA is strongly recommended because it has associated health benefits such as better weight control, improved bone and muscle strength, and improved mental health and

mood (US Centres for Disease Control and Prevention, 2011). Additionally, PA is associated with increased ability to perform activities of daily living, a longer life span, and a reduced risk of cardiovascular diseases, Type 2 diabetes, metabolic syndrome and some forms of cancer. PA has also been shown to decrease the risk of falling (US Centres for Disease Control and Prevention, 2011).

Worldwide, many studies have previously reported that increased PA is associated with decreased obesity (Hill & Wyatt, 2005; Hamilton *et al*., 2007; Chaput & Tremblay, 2009; US Centres for Disease Control and Prevention, 2011). In Korea, although there are several studies that have examined the relationship between PA and obesity, previous studies were limited in that they did not analyse the details of PA, such as the vigorousness or frequency per week (Kim & Jeon, 2011; Kim & Han, 2012; Hwang & Kim, 2013).

RESEARCH PROBLEM

Since detailed PA patterns are an important component of physical education or exercise prescription, the purpose of the present study was to examine the association between participation in PA (physical activity) of various intensities and obesity in Korean adults.

METHODS

Subjects

The subjects consisted of 505 men and 1,061 women, aged >20 years, who visited a public health promotion centre in Seoul, Korea during 2010-2011. All subjects signed a written consent form before participating in this study, and S-gu Community Health Centre approved all study procedures. The characteristics of the subjects are shown in Table 1.

TABLE 1. **CHARACTERISTICS OF SUBJECTS**

Variables	Categories	Men (n=505)	Women (n=1061)	Total Gr. (n=1566)
Body mass index	Healthy weight (<25)	288 (57.0)	820 (77.3)	1108 (70.8)
	Obese (≥25)	217 (43.0)	241 (22.7)	458 (29.2)
Age	20s	16 (3.2)	26 (2.5)	42 (2.7)
	30s	73 (14.5)	147 (13.9)	220 (14.0)
	40s	136 (26.9)	230 (21.7)	366 (23.4)
	50s	157 (31.1)	430 (40.5)	587 (37.5)
	Over 60s	123 (24.4)	228 (21.5)	351 (22.4)
Smoking frequency	Non-smoking	416 (82.4)	1049 (98.9)	1465 (93.6)
	Ex-smoking	51 (10.1)	3 (0.3)	54 (3.4)
	Current smoking	38 (7.5)	9 (0.8)	47 (3.0)

Data presented as: Frequency and (%)

continued

TABLE 1. **CHARACTERISTICS OF SUBJECTS *(cont.)***

Variables	Categories	Men (n=505)	Women (n=1061)	Total Gr. (n=1566)
Drinking frequency	Non-drinking	412 (81.6)	900 (84.8)	1312 (83.8)
	Once per month	21 (4.2)	106 (10.0)	127 (8.1)
	2–3 times per month	38 (7.5)	40 (3.8)	78 (5.0)
	Over 4 times per month	34 (6.7)	15 (1.4)	49 (3.1)
Sleep duration	Under 5 hours	13 (2.6)	50 (4.7)	63 (4.0)
	6 hours	30 (5.9)	97 (9.1)	127 (8.1)
	7 hours	22 (4.4)	82 (7.7)	104 (6.6)
	Over 8 hours	440 (87.1)	832 (78.4)	1272 (81.2)
Mental stress	Very low	422 (83.6)	794 (74.8)	1216 (77.7)
	Low	50 (9.9)	177 (16.7)	227 (14.5)
	High	31 (6.1)	77 (7.3)	108 (6.9)
	Very high	2 (0.4)	13 (1.2)	15 (1.0)
Level of education	Elem. school or lower	31 (6.1)	79 (7.4)	110 (7.0)
	Middle school	19 (3.8)	102 (9.6)	121 (7.7)
	High school	111 (22.0)	288 (27.1)	399 (25.5)
	College or higher	344 (68.1)	592 (55.8)	936 (59.8)
Economic status	Very poor	89 (17.6)	276 (26.0)	365 (23.3)
	Poor	58 (11.5)	133 (12.5)	191 (12.2)
	Rich	336 (66.5)	567 (53.4)	903 (57.7)
	Very rich	22 (4.4)	85 (8.0)	107 (6.8)

Data presented as: Frequency and (%)

Anthropometric measures

The subjects' height and weight were assessed using InBody 720 (Biospace, Seoul, Korea), and their Body Mass Index (BMI; kg/m^2) was calculated. According to the World Health Organization Asia-Pacific standard, people with a BMI of <25 were defined as healthy-weight, and people with a BMI of ≥25 were defined obese (WHO/IASO/IOTF, 2000).

Questionnaire

PA was evaluated for each participant based on the responses to 3 questions from the self-administered International Physical Activity Questionnaire (Craig *et al.,* 2003). The questions and their choice of responses are:

(Q1) "Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do *vigorous* physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?" Response options [1] no vigorous PA, [2] once, [3] twice, [4] 3 times, [5] 4 times and [6] over 5 times per week;

(Q2) "Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do *moderate* physical activities like bicycling at a regular (moderate) pace, swimming at a regular (moderate) pace, and doubles tennis in your leisure time?" Response options [1] no moderate PA, [2] once, [3] twice, [4] 3 times, [5] 4 times and [6] over 5 times; and

(Q3) "During the last 7 days, on how many days did you *walk* for at least 10 minutes at a time in your leisure time?" Response options [1] no walking, [2] once, [3] twice, [4] 3 times, [5] 4 times and [6] over 5 times.

The covariate variables included: Sex (male/female); Age (self-reported); Smoking frequency: (non-smoking/ex-smoking/currently smoking); Drinking frequency (non-drinking/once per month/2–3 times per month/over 4 times per month); Sleep duration (under 5 hours/6 hours/7 hours/over 8 hours); Mental stress (very low mental stress/low mental stress/high mental stress/very high mental stress; Level of education (elementary/middle school/high school/college or higher; and Economic status (very poor/poor/rich/very rich.

Statistical analysis

All results are presented as mean±standard deviation. Multivariate logistic regression analyses were conducted to determine whether PA patterns and PA frequency per week were related to obesity after adjustment for sex, age, frequency of smoking or drinking, sleep duration, mental stress, education level and economic status. Statistical significance was set at $p<0.05$ and all analyses were performed using SPSS version 18.0 (SPSS, Chicago, IL, USA).

RESULTS

The results of multivariate logistic regression analyses of leisure-time PA for the healthy-weight and obesity groups of Korean adults are shown in Table 2. The odds ratios (ORs) and the 95% confidence interval (CI) are reported for the association between obesity and vigorous PA, moderate PA and light PA as compared to no vigorous PA, moderate PA and light PA. The ORs (CI) were:

For *once per week* the ORs (CI) were 0.931 (0.656-1.322, p=0.691), 0.893 (0.627-1.272, p=0.531) and 0.815 (0.553-1.201, p=0.302), respectively;

For *twice per week* the ORs (CI) were 0.940 (0.599-1.476, p=0.789), 0.690 (0.428-1.114, p=0.129), and 0.787 (0.481-1.289, p=0.342), respectively;

For *3 times per week* the ORs (CI) were 1.031 (0.645-1.649, p=0.897), 1.375 (0.903-2.093, p=0.137), and 1.180 (0.750-1.857, p=0.473), respectively;

For *4 times per week* the ORs (CI) were 1.109 (0.573-2.146, p=0.759), 0.804 (0.432-1.496, p=0.491); and 0.907 (0.482-1.707, p=0.763), respectively;

For over *5 times per week*, the ORs (CI) were 0.357 (0.171-0.747, p=0.006), 0.509 (0.273-0.950, p=0.034), and 0.641 (0.421-0.977, p=0.038), respectively.

TABLE 2. **MULTIVARIATE LOGISTIC REGRESSION ANALYSES: PATTERNS OF COMPLIANCE WITH PHYSICAL ACTIVITY ACCORDING TO OBESITY** (n=1566)

Intensity	Regularity	ß	SE	OR	95% CI	p
No PA				1.000		
Vigorous physical activity (PA)	1 x pw	-0.071	0.179	0.931	0.656-1.322	0.691
	2 x pw	-0.061	0.230	0.940	0.599-1.476	0.789
	3 x pw	0.031	0.239	1.031	0.645-1.649	0.897
	4 x pw	0.104	0.337	1.109	0.573-2.146	0.759
	5+ x pw	-1.029	0.376	0.357	0.171-0.747	0.006**
Moderate physical activity (PA)	1 x pw	-0.113	0.181	0.893	0.627-1.272	0.531
	2 x pw	-0.371	0.244	0.690	0.428-1.114	0.129
	3 x pw	0.319	0.214	1.375	0.903-2.093	0.137
	4 x pw	-0.218	0.317	0.804	0.432-1.496	0.491
	5+ x pw	-0.676	0.319	0.509	0.273-0.950	0.034*
Light physical activity (PA) [walking]	1 x pw	-0.204	0.198	0.815	0.553-1.201	0.302
	2 x pw	-0.239	0.251	0.787	0.481-1.289	0.342
	3 x pw	0.166	0.231	1.180	0.750-1.857	0.473
	4 x pw	-0.097	0.323	0.907	0.482-1.707	0.763
	5+ x pw	-0.444	0.215	0.641	0.421-0.977	0.038*

SE= standard error; OR= odds ratio; CI= confidence interval; **p<0.01 *p<0.05; pw= per week

DISCUSSION

The results from this study show that obesity was inversely associated with increased PA. Many previous studies have reported that PA is strongly associated with obesity (Hill & Wyatt, 2005; Wareham *et al*., 2005). The results of this study reveal that, in the case of Korean adults, only a high frequency of PA is associated with a reduction in obesity. Prevalence of obesity was decreased only when PA was performed over 5 times per week, regardless of intensity. All three types of PA (vigorous PA, moderate PA, and light PA) performed >5 times per week, were associated with a marked decrease in the prevalence of obesity. This risk was decreased by 64.3% with vigorous PA, 49.1% with moderate PA, and 35.9% with light PA in the group that performed PA over 5 times per week, compared with the groups that did no vigorous, moderate or light PA, respectively.

To prevent obesity, the American College of Sports Medicine's guidelines recommend over 3500kcal/week of energy expenditure with increased PA and a decreased sedentary lifestyle (American College of Sports Medicine, 2010). This figure of represents a high amount of energy expenditure, which may be most closely associated with frequency of PA more than five times per week, as reported in the this study. Thus, to prevent obesity, the authors strongly recommend that obese adults perform some type of PA at least five times per week.

LIMITATIONS

This study had several limitations. Firstly, it was a cross-sectional, retrospective study. Therefore, the authors could not confirm a causal relationship between PA and obesity. Secondly, even though the self-administered International Physical Activity Questionnaire is valid and reliable (Craig *et al*., 2003), lifestyle habits such as frequency of smoking and drinking were categorised based on self-reported data. Consequently, data regarding these measures may be limited. Thirdly, this study did not investigate and adjust for the amount, quality, and variety of food eaten, all of which affect obesity. Lastly, since the participants of this study were recruited from a public health promotion centre, the participants may not be a true representation of the Korean population. Therefore, in the future, further well-designed studies are needed to confirm the relationship between obesity and PA. Nevertheless, the large number of participants included in this study is one of its greatest strengths.

CONCLUSION

In conclusion, vigorous PA, moderate PA and light PA performed more than five times per week is associated with reduction or prevention of obesity in Korean adults, after adjusting for sex, age, frequency of smoking/drinking, sleep duration, mental stress, education level and economic status.

Acknowledgement

The authors declare that there was no conflict of interest.

REFERENCES

AMERICAN COLLEGE OF SPORTS MEDICINE (2010). *ACSM's resource manual for guidelines for exercise testing and prescription* (6th ed.). Baltimore, MD: Lippincott Williams & Wilkins.

CHAPUT, J.P. & TREMBLAY, A. (2009). Obesity and physical inactivity: The relevance of reconsidering the notion of sedentariness. *Obesity Facts*, 2(4): 249-254.

CRAIG, C.L.; MARSHALL, A.L.; SJÖSTRÖM, M.; BAUMAN, A.E.; BOOTH, M.L.; AINSWORTH, B.E.; PRATT, M.; EKELUND, U.; YNGVE, A.; SALLIS, J.F. & OJA, P. (2003). International physical activity questionnaire: 12-Country reliability and validity. *Medicine and Science in Sports and Exercise*, 35(8): 1381-1395.

HAMILTON, M.T.; HAMILTON, D.G. & ZDERIC, T.W. (2007). Role of low energy expenditure and sitting in obesity, metabolic syndrome, Type 2 diabetes and cardiovascular disease. *Diabetes*, 56(11): 2655-2667.

HILL, J.O. & WYATT, H.R. (2005). Role of physical activity in preventing and treating obesity. *Journal of Applied Physiology*, 99(2): 765-770.

HWANG, J. & KIM, Y.H. (2013). Physical activity and its related motivational attributes in adolescents with different BMI. *International Journal of Behavioral Medicine*, 20(1): 106-113.

KIM, J. & HAN, H.R. (2012). Physical activity, abdominal obesity and the risk of coronary heart disease: A Korean national sample study. *Public Health*, 126(5): 410-416.

KIM, O. & JEON, H.O. (2011). Relationship between obesity, alcohol consumption, and physical activity of male office workers in South Korea. *Nursing and Health Sciences*, 13(4): 457-462.

KOREA CENTRES FOR DISEASE CONTROL AND PREVENTION (2012). *Korea Health Statistics 2010: Korea National Health and Nutrition Examination Survey (KNHANES V-1).* Seoul, Korea: Korea Centres for Disease Control and Prevention.

LUPPINO, F.S.; DE WIT, L.M.; BOUVY, P.F.; STIJNEN, T.; CUIJPERS, P.; PENNINX, B.W. & ZITMAN, F.G. (2010). Overweight, obesity, and depression: A systematic review and meta-analysis of longitudinal studies. *Archives of General Psychiatry,* 67(3): 220-229.

PISCHON, T.; BOEING, H.; HOFFMANN, K.; BERGMANN, M.; SCHULZE, M.B.; OVERVAD, K.; VAN DER SCHOUW, Y.T.; SPENCER, E.; MOONS, K.G.; TJØNNELAND, A.; HALKJAER, J.; JENSEN, M.K.; STEGGER, J.; CLAVEL-CHAPELON, F.; BOUTRON-RUAULT, M.C.; CHAJES, V.; LINSEISEN, J.; KAAKS, R.; TRICHOPOULOU, A.; TRICHOPOULOS, D.; BAMIA, C.; SIERI, S.; PALLI, D.; TUMINO, R.; VINEIS, P.; PANICO, S.; PEETERS, P.H.; MAY, A.M.; BUENO-DE-MESQUITA, H.B.; VAN DUIJNHOVEN, F.J.; HALLMANS, G.; WEINEHALL, L.; MANJER, J.; HEDBLAD, B.; LUND, E.; AGUDO, A.; ARRIOLA, L.; BARRICARTE, A.; NAVARRO, C.; MARTINEZ, C.; QUIRÓS, J.R.; KEY, T.; BINGHAM, S.; KHAW, K.T.; BOFFETTA, P.; JENAB, M.; FERRARI, P. & RIBOLI, E. (2008). General and abdominal adiposity and risk of death in Europe. *New England Journal of Medicine*, 359(20): 2105-2120.

SCHRÖDER, H.; FÏTO, M.; COVAS, M.I. & REGICOR INVESTIGATORS (2007). Association of fast food consumption with energy intake, diet quality, body mass index and the risk of obesity in a representative Mediterranean population. *British Journal of Nutrition*, 98(6): 1274-1280.

THOMAS, A.W. & ALBERT, J.S. (2002). *Handbook of obesity treatment* (3rd ed.). New York, NY: Guilford Press.

US CENTRES FOR DISEASE CONTROL AND PREVENTION (2011). "*Physical activity and health: The benefits of physical activity"*. Centres for Disease Control and Prevention. Online: [http://www.cdc.gov/physicalactivity/everyone/health/index.html]. Retrieved on 28 January 2014.

WAREHAM, N.J.; VAN SLUIJS, E.M.F. & EKELUND, U. (2005). Physical activity and obesity prevention: A review of the current evidence. *Proceedings of the Nutrition Society*, 64(2): 229-247.

WHO/IASO/IOTF (2000). *The Asia-Pacific perspective: Redefining obesity and its treatment.* Melbourne, Australia: Health Communications Australia.

YUSUF, S.; HAWKEN, S.; OUNPUU, S.; BAUTISTA, L.; FRANZOSI, M.G.; COMMERFORD, P.; LANG, C.C.; RUMBOLDT, Z.; ONEN, C.L.; LISHENG, L.; TANOMSUP, S.; WANGAI, P. (JR); RAZAK, F.; SHARMA, A.M.; ANAND, S.S. & INTERHEART STUDY INVESTIGATORS (2005). Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: A case-control study. *Lancet*, 366(9497): 1640-1649.

Prof Wi-Young SO: Sports and Health Care Major, College of Humanities and Arts, Korea National University of Transportation, 50 Daehak-ro, Chungju-si, Chungbuk 380-702, Republic of Korea. Tel.: 82-43-841-5993, Fax.: 82-43-841-5990, E-mail: wowso@ut.ac.kr

(Subject Editor: Dr Glynis Longhurst)