South African Journal for Research in Sport, Physical Education and Recreation, 2016, 38(3): 27 - 35.
Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 2016, 38(3): 27 - 35.
ISBN: 0379-9069

COMBINED ASSOCIATIONS OF TELEVISION VIEWING AND PHYSICAL ACTIVITY WITH OVERWEIGHT/OBESITY IN TAIWANESE ELDERLY ADULTS

Shao-Hsi CHANG[1], I-Yao FANG[2], Ming-Chun HSUEH[2] & Yung LIAO[3]
[1] *Graduate Institute of Sport, Leisure and Hospitality Management, National Taiwan Normal University, Taipei, Taiwan*
[2] *Department of Physical Education, National Taiwan Normal University, Taipei, Taiwan*
[3] *Department of Health Promotion and Health Education, National Taiwan Normal University, Taipei, Taiwan*

ABSTRACT

This study investigated the combined association of TV viewing and physical activity (PA) with overweight/obesity in Taiwanese elderly adults. A telephone-based survey was conducted in 2013. Self-reported data (height, weight, TV viewing time, and PA time), were collected from a nationally representative sample of 1031 adults aged >55 years. Unadjusted and adjusted binary logistic regression models were used to calculate the odds ratios (ORs) of overweight/obesity (BMI≥25kg/m^2) according to four combined TV (2h/day) and PA (150min/week) categories. In total, 60.4% of the sample was overweight/obese. After adjustment for potential confounders, significantly higher ORs of overweight/obesity were observed in the high TV/sufficient PA (OR=1.96; 95% CI=1.31-2.95) and high TV/insufficient PA (OR=1.93; 95% CI=1.34-2.78), categories compared with the low TV/sufficient PA category. Consistent with those in high-income countries, Taiwanese elderly adults, who engage in more than two hours of TV viewing per day, are at a higher risk of being overweight/obese, regardless of whether they meet PA recommendations. Additional studies are required to identify at-risk populations and the associated correlates of prolonged TV viewing to design effective interventions.

***Key words*:** Physical activity; Sedentary behaviour; Body Mass Index; Obesity; Elderly.

INTRODUCTION

A high body mass index (BMI) has been linked to mortality worldwide and is a risk factor for non-communicable diseases, such as cardiovascular disease, Type 2 diabetes, and certain types of cancer (WHO, 2009). As observed in Western countries (Vasunilashorn *et al*., 2013), an increasing prevalence of overweight (including obesity) has been reported in nearly half (46.7%) of Taiwanese older adults (Health Promotion Administration, Ministry of Health and Welfare, 2008). Therefore, to develop overweight/obesity prevention initiatives, acquiring a clearer understanding of the modifiable behavioural risk factors of overweight/obesity in Taiwanese elderly adults is imperative.

Prolonged sedentary behaviour periods, such as television (TV) viewing and insufficient

physical activity (PA), are established independent behavioural risk factors for overweight (Martínez-González *et al*., 1999; Hu *et al*., 2003; Bowman, 2006; Cheriyath *et al*., 2010; Ekelund *et al*., 2011). The findings of recent studies are relevant to the examination of the combined effect of sedentary behaviour and PA on weight status because determining how increasing levels of sedentary time in combination with various PA levels may contribute to the risk of overweight is crucial (Eisenmann *et al*., 2008; Laurson *et al*., 2008; Sugiyama *et al*., 2008; Patel *et al*., 2010; Sisson *et al*., 2010; Liao *et al*., 2011; Inoue *et al*., 2012; Veerman *et al*., 2012; Chu & Moy, 2013; Maher *et al*., 2013).

These findings can be critical for determining target behaviours to treat and prevent the excess weight epidemic. For example, several studies have emphasised that both sedentary behaviour and PA time were critically associated with overweight (Eisenmann *et al*., 2008; Laurson *et al*., 2008; Sisson *et al*., 2010; Liao *et al*., 2011; Chu *et al*., 2013). Otherwise, sedentary behaviour might be as critical as PA for avoiding overweight/obesity (Sugiyama *et al*., 2008; Patel *et al*., 2010; Inoue *et al*., 2012), whereas PA has been identified as a stronger behavioural risk factor for overweight compared with sedentary behaviour (Maher *et al*., 2013). However, the evidence presented regarding the combined association of sedentary behaviour and PA with the risk of overweight/obesity is inconsistent. Moreover, most studies have focussed on youth and adult populations, with fewer studies focussing on older adults. Inoue *et al*. (2012) investigated Japanese older adults and revealed that watching TV for less than two hours was associated with a lower risk of overweight/obesity, regardless of the PA level (300 minutes/week). However, more information is required for understanding the association between health behaviour and overweight/obesity in older adults from various countries.

TV viewing is a marker of an overall pattern of sedentary behaviour (Sugiyama *et al*., 2008), which constitutes a large proportion of the leisure time of older adults (Harvey *et al*., 2013). According to the 2010 Taiwan Social Change Survey, TV viewing is a major leisure-time activity. The Taiwan Social Change Survey (2010) and a study by Chang *et al*.(2015) reported that nearly half (47.4%) of Taiwanese elderly adults view TV for more than two hours per day. Furthermore, compared with Western countries, the Taiwanese population exhibited a higher prevalence of physical inactivity (Bauman *et al*., 2009). However, how different combinations of TV viewing and PA might influence the health of Taiwanese older adults remains unclear. Therefore, this article provides epidemiological evidence on the combined association of TV viewing and PA with the risk of overweight/obesity among Taiwanese elderly adults.

METHODOLOGY

The study protocol was approved by the Ethics Committee of the National Taiwan University before the survey was conducted (201309ES003). The telephone-based research service company did not offer any reward.

Participants

The cross-sectional survey data was derived from a random-digit-dialling telephone-based survey conducted from June to July 2013 by a telephone-based research service company in Taiwan. In December 2013, the population and land area of Taiwan was estimated at 23,373,517 and 36,192.8km^2, respectively. A total of 25.34% of the total Taiwanese population

aged 55 years and over (5,923,910 residents) were the target population for this study. The required sample size for this study was calculated to be 1,067 elderly adults, with a 95% confidence level and 3% confidence interval (CI), as derived in a previous survey (Hsueh *et al*., 2015). A stratified random sampling method was used to select respondents by gender, age (55–64 years and 65 years and older), and area of residence. Finally, among the 1,068 elderly adults who responded to the survey, 1,031 responses (55.7%) were considered valid for analysis after cleaning the data.

Measurements

The outcome variable was the BMI of the participants where the calculation was based on their self-reported height and weight. The BMI was dichotomised into normal ($<25 kg/m^2$) and overweight/obesity ($\geq 25 kg/m^2$) according to the international classification proposed by the World Health Organization (WHO, 2004).

The exposure variable was the length of TV viewing time, which was calculated as the amount of time spent watching TV on weekdays and on the weekend divided by 7, and the average TV viewing time per day (hours/day) over the 7 days immediately before the interview. This item was reported to demonstrate a high test-retest reliability (interclass correlation coefficient=0.76; Spearman ρ=0.78), according to the Older Adults' Sedentary Time questionnaire (Gardiner *et al*., 2011). The total TV viewing time was dichotomised into low TV viewing (<2 hours/day) and high TV viewing (≥2 hours/day) categories because this cut-off point has been reported as a health risk in previous studies (Grontved & Hu, 2011).

The Short Version of the International Physical Activity Questionnaire-Taiwan computer-assisted telephone interview (IPAQ-Taiwan CATI) (Liou, 2006), was administered to assess moderate-to-vigorous physical activity (MVPA) and walking, the test-retest reliability of the IPAQ-Taiwan CATI was 0.96. The intraclass correlation coefficients (ICCs) of the content validity indices were 0.82 for language similarity and 0.93 for semantic similarity between the English and Taiwanese versions of the IPAQ-Taiwan CATI. The concurrent validity for comparisons of the IPAQ self-administered short questionnaire and the IPAQ-Taiwan CATI was 0.84 (ICC) (Liou, 2006). PA time was calculated and dichotomised into sufficient PA (≥150 minutes/week) and insufficient PA (<150 minutes/week) categories based on public health guidelines (Haskell *et al*., 2007). According to the levels of TV viewing time and PA, participants were categorised into the following four groups: low TV/sufficient PA; low TV/insufficient PA; high TV/sufficient PA; and high TV/insufficient PA.

The sociodemographic variables obtained from the research company included participant gender, age (55-64 or 65 ≥ years), residential area (rural or urban area), marital status (married or unmarried), job status (employed or unemployed), educational level (lower than high school or college graduate or postgraduate degree), and living status (alone or with others).

Data analysis

Data for 1,031 elderly adults who provided complete information for the study variables were analysed. A chi-squared test was performed to identify the sample characteristics among the four groups based on various combinations of TV viewing time and PA (TV/PA). Binary logistic regression was conducted to estimate the odds ratios (ORs) of overweight/obesity on

the basis of the TV/PA categories. Two regression models were tested: Model 1 (unadjusted) and Model 2 (all adjusted for gender, age, residential area, marital status, job, education level, and living status). Previous research identified these variables as potential confounders (Inoue *et al*., 2012). The low TV/sufficient PA category was the reference for the analysis, which was conducted using SPSS Version 24.0 with the level of significance set at $p<0.05$.

RESULTS

Table 1 shows the socio-demographic characteristics of the sample and category levels.

Table 1. **CHARACTERISTICS OF SAMPLE ACCORDING TO COMBINED TV VIEWING AND PHYSICAL ACTIVITY**

Groups	% of Total (N=1031)	% Low TV/ suffic. PA (n=226)	% Low TV/ insuffic. PA (n=316)	% High TV/ suffic. PA (n=180)	% High TV/ insuffic. PA (n=309)	p
Gender						0.79
Male	44.4	46.9	44.9	43.4	42.7	
Female	55.6	53.1	55.1	56.7	57.3	
Age (year)						0.58
55–64	54.6	55.3	55.7	57.2	51.5	
65≥	45.4	44.7	44.3	42.8	48.5	
Residential area						0.18
Rural	37.4	38.5	41.8	34.4	34.0	
Urban	62.6	61.5	58.2	65.6	66.0	
Marital status						<0.001**
Married	85.2	90.7	88.0	83.9	79.0	
Unmarried	14.8	9.3	12.0	16.1	21.0	
Job status						<0.001**
Unemployed	69.4	56.2	66.8	71.1	80.3	
Employed	30.6	43.8	33.2	28.3	19.7	
Education level						0.02*
Low education	76.3	77.0	70.3	78.9	80.6	
High education	23.7	23.0	29.7	21.1	19.4	
Living status						0.42
Alone	7.1	6.2	6.6	5.6	9.1	
With others	92.9	93.8	93.4	94.4	90.0	
BMI (kg/m^2)						<0.001**
Normal weight	56.0	63.3	62.7	47.8	48.5	
Overweight	44.0	36.7	37.3	52.2	51.5	
TV view. (hrs/day)						<0.001**
Low TV, <2	52.6	41.7	58.3	0.0	0.0	
High TV, ≥2	47.4	0.0	0.0	36.8	63.2	
PA (min/week)						<0.001**
Insufficient <150	60.6	0.0	50.6	0.0	49.4	
Sufficient 150≥	39.4	55.7	0.0	44.3	0.0	

BMI=Body Mass Index TV=Television PA=Physical activity
*p<0.05 **p<0.001

Overall, 44.4% of the respondents were males, 54.6% were aged 55-64 years, 37.4% lived in rural areas, 85.2% were married, 69.4% were unemployed, 76.3% had an education level of lower than high school, and 7.1% lived alone. In addition, 44.0% of the sample were overweight (including obese), 47.4% were engaged in high TV viewing, and 60.6% reported insufficient PA. A chi-squared test revealed proportional differences in marital status ($p<0.001$), job status ($p<0.001$), educational level ($p=0.02$), BMI status ($p<0.001$), TV viewing ($p<0.001$), and PA ($p<0.001$).

Table 2. **ADJUSTED ORs FOR OVERWEIGHT ACCORDING TO COMBINED TV VIEWING AND PHYSICAL ACTIVITY**

TV/PA categories	N (% Overw.)	**Model 1**		**Model 2**	
		OR (95% CI)	p-Value	OR (95% CI)	p-Value
Low TV/ Sufficient PA	226 (36.7)	1.00 (ref.)	–	1.00 (ref.)	–
Low TV/ Insufficient PA	316 (37.3)	1.03 (0.72–1.46)	0.880	1.09 (0.76–1.56)	0.660
High TV/ Sufficient PA	180 (52.2)	1.88 (1.26–2.81)	0.002*	1.96 (1.31–2.95)	0.001*
High TV/ Insufficient PA	309 (51.5)	1.83 (1.29–2.59)	<0.001**	1.93 (1.34–2.78)	<0.001**

TV=Television PA=Physical Activity Overw.=Overweight *p<0.05 **p<0.001 Model 1=Unadjusted Model 2=All adjusted (gender, age, residential area, marital status, job, education level, living status)

Table 2 shows the ORs for being overweight (including being obese) based on the TV/PA categories for the total sample. Compared with the low TV/sufficient PA category in Model 1, a significantly higher OR for being overweight/obese was observed between the high TV/sufficient PA (OR=1.88; 95% CI=1.26-2.81) and high TV/insufficient PA (OR=1.83; 95% CI=1.29-2.59) categories, but no significant association was observed in the low TV/insufficient PA category (OR=1.03; 95% CI=0.72-1.46). After adjustment for all of the socio-demographic variables in Model 2, most of the associations showed a higher likelihood of being overweight/obese in both the high TV/sufficient PA (OR=1.96; 95% CI=1.31-2.95) and high TV/insufficient PA (OR=1.93; 95% CI=1.34-2.78) categories, regardless of their PA status. No significant association was observed in the low TV/insufficient PA category (OR=1.09; 95% CI=0.76-1.56).

DISCUSSION

This study examined the combined association of TV viewing and PA with overweight/obesity among a sample comprising 1,031 Taiwanese elderly adults aged 55 years or older. The results reveal that excessive TV viewing time (≥2 hours/day) was associated with a greater likelihood of being overweight/obese, regardless of whether the participants had sufficient PA (≥150 minutes/week). The regression models revealed that Taiwanese elderly adults who watched TV for more than two hours per day were 1.93-1.96 times more likely to be overweight/obese, regardless of the time they spent engaging in PA. These results are consistent with the findings of previous studies involving adults in Australia and the United States, as well as older adults

in Japan (Sugiyama *et al*., 2008; Patel *et al*., 2010; Inoue *et al*., 2012). However, these findings differ from the evidence on children or young people in the United States (Eisenmann *et al*., 2008; Laurson *et al*., 2008; Sisson *et al*., 2010). Watching TV for more than two hours per day has been considered to have a negative impact on the health of older adults (Inoue *et al*., 2012; Veerman *et al*., 2012), which is crucial for developing strategies aimed at reducing the length of time spent watching TV to prevent elderly adults from gaining excess weight or becoming overweight/obese.

This study shows that older adults who engage in excessive TV viewing (≥2 hours/day), but sufficient PA (≥150 minutes/week), have similar or even slightly higher prevalence of being overweight/obese compared with those who engaged in excessive TV viewing and insufficient PA. A possible reason for this could be that PA does not play a protective role in the prevalence of being overweight/obese, which could be partially explained by the health benefit of low-intensity activity for elderly adults (Healy *et al*., 2007; Inoue *et al*., 2012). Although attaining the recommended level of PA is beneficial in protecting against weight gain, moderate-to-vigorous PA is difficult to perform with increasing age (Nelson *et al*., 2007). Another possible reason is that the fitness conditions of elderly adults, including muscle strength recession, cause decreased body flexibility or metabolic dysfunction with aging (Hamilton *et al*., 2007; Inoue *et al*., 2012; Stathokostas *et al*., 2013).

PRACTICAL APPLICATION

In an effort to reduce the TV viewing time in older adults, previous interventional studies have confirmed specific types of activity that may reduce the length of time spent watching TV while increasing the amount of PA for older adults, such as going outdoors daily or receiving individual consultation to reduce sedentary time (Jacobs *et al*., 2008; Fitzsimons *et al*., 2013). Future interventional studies could evaluate these strategies to lower the risks of older adults being overweight/obese, which might benefit their health benefit.

Several limitations encountered while conducting this study should be addressed. Firstly, this was a cross-sectional study; therefore, causality could not be inferred. Secondly, the main variables (PA, TV viewing time and BMI) were self-reported and might have contributed to recall bias (Haskell *et al*., 2007; Hallal *et al*., 2010). Thirdly, this study did not measure other variables, such as total time of sedentary behavior, light-intensity activity, smoking and unhealthy dietary behaviours, which might have confounded the results (Inoue *et al*., 2012). Despite these limitations, the strength of this research is that the study sample was extracted using a stratified random sampling technique by a telephone survey company. Therefore, the findings can be crucial and representative of Taiwan's elderly adult population.

CONCLUSIONS

The findings of this study support evidence that older adults who watch TV for more than two hours per day demonstrate a higher risk of being overweight/obese, regardless of whether they engage in sufficient PA. For obesity prevention, targeting older adults is critical for reducing the length of time they spend watching TV. Further study is necessary to identify at-risk populations and the associated correlates of prolonged TV viewing, thus allowing for the design of effective interventions for older adults.

Acknowledgments

This research was partially supported by the *Aim for the Top University Project* of National Taiwan Normal University (NTNU), sponsored by the Ministry of Education, Taiwan, R.O.C., and the *International Research-Intensive Center of Excellence Program* of NTNU and the Ministry of Science and Technology, Taiwan, R.O.C., under Grant no. MOST 104-2911-I-003-301.

REFERENCES

BAUMAN, A.; BULL, F.; CHEY, T.; CRAIG, C.L.; AINSWORTH, B.E.; SALLIS, J.F.; BOWLES, H.R.; HAGSTROMER, M.; SJOSTROM, M.; PRATT, M. & IPS GROUP. (2009). The international prevalence study on physical activity: Results from 20 countries. *International Journal of Behavioral Nutrition and Physical Activity*, 6(March): 21-32.

BOWMAN, S.A. (2006). Television-viewing characteristics of adults: Correlations to eating practices and overweight and health status. *Preventing Chronic Disease*, 3(2): A38.

CHANG, S.H.; FANG, I.Y.; HSUEH, M.C. & LIAO, Y. (2015). Gender differences in socio-demographic correlates with excessive television viewing time in Taiwanese older adults. *Iranian Journal of Public Health*, 44(6): 875-876.

CHERIYATH, P.; DUAN, Y.; QIAN, Z.; NAMBIAR, L. & LIAO, D. (2010). Physical activity in obesity and metabolic syndrome. *European Journal of Cardiovascular Prevention and Rehabilitation*, 17(3): 309-313.

CHU, A.H.Y. & MOY, F.M. (2013). Joint association of sitting time and physical activity with metabolic risk factors among middle-aged Malays in a developing country: A cross-sectional study. *PLoS ONE*, 8(4): e61723 (online).

EISENMANN, J.C.; BARTEE, R.T.; SMITH, D.T.; WELK, G.J. & FU, Q. (2008). Combined influence of physical activity and television viewing on the risk of overweight in US youth. *International Journal of Obesity*, 32(4): 613-618.

EKELUND, U.; BESSON, H.; LUAN, J.; MAY, A.M.; SHARP, S.J.; BRAGE, S.; TRAVIER, N.; AGUDO, A.; SLIMANI, N.; RINALDI, S.; JENAB, M.; NORAT, T.; MOUW, T.; ROHRMANN, S.; KAAKS, R.; BERGMANN, M.M.; BOEING, H.; CLAVEL-CHAPELON, F.; BOUTRON-RUAULT, M.C.; OVERVAD, K.; JAKOBSEN, M.U.; JOHNSEN, N.F.; HALKJAER, J.; GONZALEZ, C.A.; RODRIGUEZ, L.; SANCHEZ, M.J.; ARRIOLA; L.; BARRICARTE, A.; NAVARRO, C.; KEY, T.J.; SPENCER, E.A.; ORFANOS, P.; NASKA, A.; TRICHOPOULOU, A.; MANJER, J.; LUND, E.; PALLI, D.; PALA, V.; VINEIS, P.; MATTIELLO, A.; TUMINO, R.; BUENO-DE-MESQUITA, H.B.; VAN DEN BERG, S.W.; ODYSSEOS, A.D.; RIBOLI, E.; WAREHAM, N.J. & PEETERS, P.H. (2011). Physical activity and gain in abdominal adiposity and body weight: Prospective cohort study in 288,498 men and women. *American Journal of Clinical Nutrition*, 93(4): 826-835.

FITZSIMONS, C.F.; KIRK, A.; BAKER, G.; MICHIE, F.; KANE, C. & MUTRIE, N. (2013). Using an individualised consultation and activPAL™ feedback to reduce sedentary time in older Scottish adults: Results of a feasibility and pilot study. *Preventive Medicine*, 57(5): 718-720.

GARDINER, P.A.; CLARK, B.K. & HEALY, G.N. (2011). Measuring older adults' sedentary time: Reliability, validity, and responsiveness. *Medicine and Science in Sports and Exercise*, 43(11): 2127-2133.

GRONTVED, A. & HU, F.B. (2011). Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: A meta-analysis. *JAMA* (*Journal of the American Medical Association*), 305(23): 2448-2455.

HALLAL, P.C.; GOMEZ, L.F.; PARRA, D.C.; LOBELO, F.; MOSQUERA, J.; FLORINDO, A.A.; REIS, R.S.; PRATT, M. & SARMIENTO, O.L. (2010). Lessons learned after 10 years of IPAQ use in Brazil and Colombia. *Journal of Physical Activity and Health*, 7(Supplement July): S259-S264.

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.

HARVEY, J.A.; CHASTIN, S.F. & SKELTON, D.A. (2013). Prevalence of sedentary behavior in older adults: A systematic review. *International Journal of Environmental Research and Public Health*, 10(12): 6645-6661.

HASKELL, W.L.; LEE, I.M.; PATE, R.R.; POWELL, K.E.; BLAIR, S.N.; FRANKLIN, B.A.; MACERA, C.A.; HEATH, G.W.; THOMPSON, P.D. & BAUMAN, A. (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, 39(8):1423-1434.

HEALTH PROMOTION ADMINISTRATION, MINISTRY OF HEALTH AND WELFARE (2008). "Percentage distribution of Body Mass Index (BMI)". Hyperlink: [http://health99.hpa.gov.tw/OnlinkHealth/Onlink_BMI.aspx]. Retrieved on 1 December 2014.

HEALY, G.N.; DUNSTAN, D.W.; SALMON, J.; CERIN, E.; SHAW, J.E.; ZIMMET, P.Z. & OWEN, N. (2007). Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose. *Diabetes Care*, 30(6): 1384-1389.

HSUEH, M.C.; YUNG, L. & CHANG, S.H. (2015). Are total and domain-specific sedentary time associated with overweight in older Taiwanese adults? *International Journal of Environmental Research and Public Health*, 12(10): 12697-12705.

HU, F.B.; LI, T.Y.; COLDITZ, G.A.; WILLETT, W.C. & MANSON, J.E. (2003). Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *JAMA* (*Journal of the American Medical Association*), 289(14): 1785-1791.

INOUE, S.; SUGIYAMA, T.; TAKAMIYA, T.; OKA, K.; OWEN, N. & SHIMOMITSU, T. (2012). Television viewing time is associated with overweight/obesity among older adults, independent of meeting physical activity and health guidelines. *Journal of Epidemiology*, 22(1): 50-56.

JACOBS, J.M.; COHEN, A.; HAMMERMAN-ROZENBERG, R.; AZOULAY, D.; MAARAVI, Y. & STESSMAN, J. (2008). Going outdoors daily predicts long-term functional and health benefits among ambulatory older people. *Journal of Aging and Health*, 20(3): 259-272.

LAURSON, K.R.; EISENMANN, J.C.; WELK, G.J.; WICKEL, E.E.; GENTILE, D.A. & WALSH, D.A. (2008). Combined influence of physical activity and screen time recommendations on childhood overweight. *Journal of Pediatrics*, 153(2): 209-214.

LIAO, Y.; HARADA, K.; SHIBATA, A.; ISHII, K.; OKA, K.; NAKAMURA, Y.; NAKAMURA, Y.; SUGIYAMA, T.; INOUE, S. & SHIMOMITSU, T. (2011). Joint associations of physical activity and screen time with overweight among Japanese adults. *International Journal of Behavioral Nutrition and Physical Activity*, 8(November): 131. (online)

LIOU, Y.M. (2006). The manual of the short-telephone version of international physical activity questionnaires by a computer assisted telephone interviewing (CATI) system. Taipei, Taiwan, R.O.C.: The Bureau of Health Promotion, Department of Health.

MAHER, C.A.; MIRE, E.; HARRINGTON, D.M.; STAIANO, A.E. & KATZMARZYK, P.T. (2013). The independent and combined: Associations of physical activity and sedentary behaviour with obesity in adults: NHANES 2003-2006. *Obesity*, 21(12): E730-E737.

MARTÍNEZ-GONZÁLEZ, M.A.; MARTÍNEZ, J.A.; HU, F.B.; GIBNEY, M.J. & KEARNEY, J. (1999). Physical inactivity, sedentary lifestyle and obesity in the European Union. *International Journal of Obesity and Related Metabolic Disorders*, 23(11): 1192-1201.

NELSON, M.E.; REJESKI, W.J.; BLAIR, S.N.; DUNCAN, P.W.; JUDGE, J.O.; KING, A.C.; MACERA, C.A. & CASTANEDA-SCEPPA, C. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, 39(8): 1435-1445.

PATEL, A.V.; BERNSTEIN, L.; DEKA, A.; FEIGELSON, H.S.; CAMPBELL, P.T.; GAPSTUR, S.M.; COLDITZ, G.A. & THUN, M.J. (2010). Leisure time spent sitting in relation to total mortality in a prospective cohort of US adults. *American Journal of Epidemiology*, 172(4): 419-429.

SISSON, S.B.; BROYLES, S.T.; BAKER, B.L. & KATZMARZYK, P.T. (2010). Screen time, physical activity, and overweight in U.S. youth: National survey of children's health 2003. *Journal of Adolescent Health*, 47(3): 309-311.

STATHOKOSTAS, L.; MCDONALD, M.W.; LITTLE, R.M. & PATERSON, D.H. (2013). Flexibility of older adults aged 55-86 years and the influence of physical activity. *Journal of Aging Research*, 2013(June): ID 743843 (8 pp.) (online).

SUGIYAMA, T.; HEALY, G.N.; DUNSTAN, D.W.; SALMON, J. & OWEN, N. (2008). Joint associations of multiple leisure-time sedentary behaviours and physical activity with obesity in Australian adults. *International Journal of Behavioral Nutrition and Physical Activity*, 5(July): 35.

TAIWAN SOCIAL CHANGE SURVEY (2010). "Taiwan Social Change Survey 2010, Phase 6, Wave 1". Hyperlink: [http://www.ios.sinica.edu.tw/sc/cht/scDownload2.php#sixth]. Retrieved on 1 December 2013.

VASUNILASHORN, S.; KIM, J.K. & CRIMMINS, E.M. (2013). International differences in the links between obesity and physiological dysregulation: The United States, England, and Taiwan. *Journal of Obesity*, 2013(April): ID 618056 (13pp.) (online).

VEERMAN, J.L.; HEALY, G.N.; COBIAC, L.J.; VOS, T.; WINKLER, E.A.; OWEN, N. & DUNSTAN D.W. (2012). Television viewing time and reduced life expectancy: A life table analysis. *British Journal of Sports Medicine*, 46(13): 927-930.

WHO (WORLD HEALTH ORGANIZATION) (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, 363(January): 157-163.

WHO (WORLD HEALTH ORGANIZATION) (2009). "Global health risks: mortality and burden of disease attributable to selected major risks". Hyperlink: [http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf]. Retrieved on 1 December 2013.

Dr Candidate Ming Chun HSUEH: Research Fellow of Department of Physical Education, National Taiwan Normal University, 162, Heping East Road Section 1, Taipei, Taiwan. Tel.: +886277343222, Email: boxeo19912016@gmail.com

(Subject Editor: Dr Glynis Longhurst)