International Journal of EXERCISE SCIENCE

Original Research

Assessing Physical Activity Levels and Motivation in an Urban Midwest Private Liberal Arts College

MICHAEL KANTOR[†1,2] and ANA B. FREIRE RIBEIRO[‡1]

[1]Department of Health, Physical Education, and Exercise Science, Augsburg University, Minneapolis, MN, USA; [2]Rocky Mountain University of Health Professions, Provo, UT, USA

[†]Denotes graduate student author, [‡]Denotes professional author

ABSTRACT

International Journal of Exercise Science 12(4): 1169-1178, 2019. Recent research indicates that over one third of U.S. adults are obese and 51.6% of adults meet the recommended 2008 physical activity (PA) guidelines. In this context, understanding what makes people engage or not in PA becomes of key importance when attempting to prevent obesity and its related comorbidities. The objective is to assess the PA and motivation levels of students, faculty, and staff in an urban Midwest Private College. Participants completed an anonymous online survey (n=119) on PA and Exercise Motivation. Fitness levels were tested and obtained from wellness assessments (n=74). Multiple regression statistical models were used to test age, body composition, and sex effects on motivation, PA engagement and fitness factors. Less than half of participants met the 2008 PA Guidelines. BMI was a significant predictor of overall fitness. Males were more motivated by competition and age was a significant predictor on 5 subscales of motivation. Males had greater muscle strength and endurance, while females were more flexible. PA and obesity prevalence didn't match national averages. Results suggest that age and sex are significant predictors of fitness and motivation to exercise.

KEY WORDS: Exercise Motivation Inventory, International Physical Activity Questionnaire, fitness assessment

INTRODUCTION

Obesity is defined as a body mass index (BMI) 30 or above and is considered a "disease state" by the American Medical Association (13). Recent research shows that over one third of U.S. adults are obese (20), which increases their chances of early mortality (21). In addition, obesity contributes to several major illnesses, including cardiovascular disease, diabetes, hypertension, and development of cancer (13, 23, 25). Obese adults in the U.S.A. have greater healthcare costs per capita; $1,429 more than those who are of normal weight (8). According to the Gallup-Healthways Well-Being Index, the obesity rate in American adults has increased from 25.5% in 2008 to 27.7% in 2014, with the highest occurrence in individuals 65 years of age or older, and the rates of normal weight and overweight adults have increased from 36.1% and 36.7%, to 35.1% to 35.2% respectfully (12).

Regionally, the obesity rates in the Midwest have increased about three percent since 2008 (12). Obesity prevalence was lower for male college graduates (22.1%) and higher for males with some college education (29.5%) and a high school diploma (29.1%) (1). For females, obesity was lowest among college graduates (17.9%) and highest for those with less than a college diploma (32.6%); therefore, college education seems to be negatively associated with obesity risk, independent of sex (1). In addition to the rising obesity rates in our country and state, physical inactivity is also prevalent and a growing problem. Only 51.6% of all U.S. adults meet the 2008 Physical Activity Guidelines (3) of at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity of aerobic training or activities every week (2).

Since participation in physical activity is one method to affect obesity, it can be used to improve overall health. People who are physically active tend to live longer and have lower risk for heart disease, stroke, type 2 diabetes, depression, and some cancers (3). In this context, understanding what makes people engage or not in physical activity becomes of key importance when attempting to prevent obesity and its related comorbidities.

Factors that are related to adult physical inactivity are: advancing age, low income, lack of time, low motivation, rural residency, perception of great effort needed for exercise, overweight or obese, perception of poor health, and having a disability (27). Sex also plays an important role in physical activity engagement, as motivation factors also seem to differ between males and females (9). Males were more motivated by performance and ego-orientated factors like, challenge, strength and endurance, competition, affiliation, and social recognition, while females were more motivated by weight management, appearance, nimbleness, positive health, and stress management (9). Increases in intrinsic and self-determined extrinsic motives are positively associated with more physical activity behavior in older adults (5). The Exercise Motivation Inventory-2 (EMI-2) is a validated and reliable questionnaire used for exercisers and non-exercisers to assess motivational factors (14 subscales) that are involved in participating in physical activity (17). The EMI-2 found that 8 had a statistically significant difference between traditional and nontraditional college students (10), 14 for age (22), and 12 for sex, race, and age (6).

The aim of this study was to describe how active/healthy a Private Urban Midwest College students, faculty and staff are and what motivates them to maintain, start, and engage or not in physical activity. The following hypotheses are put forward: First, physical activity levels of students, faculty and staff are not expected to differ from national averages of 51.6%. Second, men will have greater muscular strength and endurance, lower body fat percentage, and will be motivated by challenge, strength and endurance, competition, affiliation, and social recognition, while females will be more flexible, and motivated by weight management, appearance, nimbleness, positive health, and stress management (4, 9, 28). Third, younger individuals will be more active, have lower body fat percentage, higher muscle strength and endurance, and higher $\dot{V}O_2$ max (4, 14). In addition, as age increases, we expect that students, faculty and staff will be more intrinsically motivated to exercise (e.g., challenge, enjoyment, positive health, revitalization, stress management, and weight management) regardless of affiliation (5). Fourth, lower BMI subjects will have higher $\dot{V}O_2$ max, lower blood pressure, lower resting heart rate, and lower body fat percentage (15, 24).

METHODS

Participants

The participants in this study were students, faculty, and staff members of an urban liberal arts' private college in the Midwest. A total of 119 subjects completed a survey and 74 subjects completed the fitness assessment. There were 34 students, 30 faculty, and 55 staff members who completed the online survey. This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science (18). The study was approved by University's Institutional Review Board (IRBNet#2015-68-03) and written consent was obtained from participants prior to data collection. Additional Fitness assessment data on faculty and staff were obtained from an existing fitness assessment database and were included in the analysis.

Protocol

Potential subjects were contacted via campus e-mail, flyers, and social media (Facebook). They were given a short description of the study and were asked to participate in an anonymous online survey that contains questions from the International Physical Activity Questionnaire (IPAQ) (11), and Exercise Motivation Inventory-2 (EMI-2) (17). The e-mails provided links to the online survey and to schedule an appointment to complete a fitness assessment which included height (SECA stadiometer), blood pressure and resting heart rate (Life source), body composition and weight (BodPod: COSMED), aerobic fitness level (YMCA Step Test), grip strength (dynamometer: JAMAR), flexibility (Sit and Reach Flex Tester Box: Novel Products Inc.) and muscle endurance (one minute each of push-ups, sit ups, and side-plank hold). On their visit participants completed consent forms and a physical activity readiness questionnaire (PAR-Q). Participants that had risk factors, as indicated on the PAR-Q were excluded from testing.

Statistical Analysis

Results from the questionnaires and additional question answers (Affiliation of either student, faculty or staff) were entered in multiple regression statistical models to determine which motivation factors were the most influential for different ages and sex. Separate multiple regression models were analyzed to find which variables are good predictors of current levels of participation in physical activity, including affiliation, age, and sex. Fitness assessment results from this study and existing fitness assessment database were analyzed in a multiple regression model to identify whether current fitness levels were related to age and sex. When the F ratio was significant ($p < 0.05$), pairwise comparisons between groups were performed using Tukey post hoc adjustment. All statistical analyzes were conducted using R Statistical Software (26).

RESULTS

A total of 119 Surveys and 74 fitness assessments were completed in the study. Age was significantly different between groups (student-staff: $p < 0.001$), (student-faculty: $p < 0.001$), and (staff-faculty: $p < 0.001$); therefore, it was controlled for in the regression models (faculty 50.1 ± 12.18 years, staff 40.07 ± 11.92 years, student 22.88 ± 6.86 years). Survey demographics are summarized in Table 1.

Table 1. Survey Demographics of Participants.

	Variable	n	%
Affiliation	Student	34	28.57
	Faculty	30	25.21
	Staff	55	46.22
Post-Secondary Education (years)	0-4	45	37.82
	5-8	45	37.82
	8-10	18	15.13
	11+	11	9.24
Race	Black/African/African American	3	2.52
	Asian/ Asian-American	3	2.52
	White/Caucasian	105	88.24
	Other	8	6.72
Students Athletes	Yes	16	47.05
	No	15	44.11
	Not Anymore	3	8.82

When analyzing the IPAQ-SF and EMI-2, after controlling for sex, the only significant (p>0.05) difference was between the motive to exercise for Challenge (Males: 2.24 ± 1.74, Adjusted Mean 2.02, SE: 0.289; Females: 1.31 ± 1.5, Adjusted Mean 1.405, SE: 0.397). All other Subscales (Challenge, Stress Management, Revitalization, Social Recognition, Affiliation, Health Pressure, Ill Health Pressures, Positive Health, Appearance, Weight Management, Strength and Endurance, Nimbleness, and Enjoyment) from the EMI-2 and all variables from the physical activity domains of the IPAQ-SF (Moderate, Vigorous, METs) were not statistically significant ($p > 0.05$).

For those who completed the Fitness Assessment ($n = 74$) the mean age was 35.65 ± 14.97 years, staff ($n = 34$, 38.5 ± 11.64 years), student ($n = 28$, 23.3 ± 7.62 years), and faculty ($n = 12$, 56.3 ± 7.88 years). Twenty-eight percent of participants had a BMI between 25 and 30 kg/m^2 (overweight), while 11% were found to have a BMI of over 30 kg/m^2 (obese). Twenty two percent were stage 2 hypertensive, while thirty four percent were stage 1 hypertensive according to the 2017 American Heart Association Blood Pressure Guidelines. Fitness assessment outcomes are presented in Table 2.

Table 2. Summary of fitness assessment outcomes for groups. Values are presented as unadjusted mean (SD) and age adjusted mean (SE).

Outcome Variable	Females (n=46)	Males (n=28)
Age (years)	39	30.1
(SD)	(15.36)	(12.69)
Body Fat %	24.19	16.69
(SD)	(8.82)	(7.17)
Adjusted mean	23.87	17.21 [a]
SE	(2.88)	(2.05)
$\dot{V}O_2$ max ($mL \cdot kg^{-1} \cdot min^{-1}$)	45.43	54.05
(SD)	(29.4)	(20.85)
Adjusted mean	46.87	50.78
SE	(9.01)	(6.57)
BMI (kg/m^2)	24.25	26.49
(SD)	(5.02)	(3.98)
Adjusted mean	24.25	26.51
SE	(1.65)	(1.17)
Endurance (Sit-ups/ min)	26.78	36.32
(SD)	(11.8)	(11.87)
Adjusted mean	27.99	34.35 [a]
SE	(3.77)	(2.69)
Endurance (Push Ups/ min)	26.54	37.75
(SD)	(11.97)	(14.07)
Adjusted mean	28.30	34.89 [a]
SE	(3.68)	(2.62)

Note: a = different than females after Tukey adjustment ($p < 0.05$)

Faculty participated on average in 47.03 ± 42.27 minutes of vigorous activity per week and 52.17 ± 49.47 minutes of moderate activity per week. Staff on average participated less in 46.27 ± 32.49 minutes of vigorous activity per week however staff on average participated in 156.82 ± 483.49 minutes of moderate activity. The students participated in the most on average of 91.18 ± 83.98 minutes of vigorous activity per week, while also participating in 155.15 ± 310.47 minutes of moderate activity in a week. When comparing different affiliations, students were significantly more vigorously active than faculty ($p = 0.011$) and staff ($p = 0.0015$), but faculty and staff did not differ in minutes of vigorous active per week ($p = 0.972$). Overall, 23% of the total survey respondents met the 2008 guidelines for vigorous activity and 13% met the guidelines for moderate activity, contradicting the first hypothesis of around 51% of the subjects were expected to meet the U.S.A. average of the 2008 guidelines for physical activity (3).

When controlling for age, competition was the only significant subscale ($p = 0.035$), where males scored significantly higher, partially confirming the second hypothesis. The fitness assessment, after controlling for age, males had significantly higher muscle endurance, as measured by push-ups ($p = 0.01$) and sit ups ($p = 0.002$), muscle strength ($p < 0.001$), lower body fat percentage ($p =$

0.002), and females had significantly greater flexibility, as measured by sit and reach ($p = 0.002$), confirming the second hypothesis.

Regarding the fitness assessment results, $\dot{V}O_2$max ($p = 0.01$) and total METs per week ($p = 0.03$) significantly decreased with age, while body fat percentage ($p = 0.02$) significantly increased. After controlling for sex, age was a significant predictor of number of push-ups ($p < 0.001$). Sit-ups declined with age, regardless of sex ($p < 0.001$), suggesting that muscle endurance declines with advanced age. After controlling for sex, there were no age differences in muscle strength ($p = 0.13$), partially confirming the third hypothesis. For motivation, independent of sex, age was significantly negatively associated with challenge ($p = 0.003$), affiliation ($p = 0.048$), and positively associated with health pressures ($p = 0.025$), ill health pressures ($p < 0.001$), and nimbleness ($p < 0.001$). After controlling for age and sex, BMI was not a significant predictor of $\dot{V}O_2$max ($p = 0.19$) or resting heart rate ($p = 0.06$), contradicting our fourth hypothesis. After controlling for age, BMI was a significant predictor of systolic blood pressure ($p < 0.001$) and body fat percentage ($p < 0.001$), partially confirming our fourth hypothesis.

DISCUSSION

The present study findings that 23% of the total survey respondents met the 2008 physical activity guidelines for vigorous activity and 13% met the guidelines for moderate activity, are below the national average of 51.6% who participated in the recommended amounts of physical activity per week (2). We found that students were most active, when averaging minutes of moderate and vigorous physical activity using the IPAQ-SF, measuring vigorous activity, students had a highest mean participation of 91.18 ± 83.98 minutes. When comparing different affiliations, students were significantly more vigorously active than faculty ($p = 0.011$) and staff ($p = 0.0015$), but faculty and staff did not differ in minutes of vigorous active per week ($p = 0.972$). Our findings suggest that there is difference in physical activity participation based on age ($p > 0.001$). This reinforces the idea that working-age adults are at a greater risk of being obese. When calculating moderate activity using IPAQ-SF, this present study found that staff participated in the most moderate activity with a mean participation of 156.82 ± 483.49 minutes. This suggests that age should be considered when looking at physical activity levels of adults.

The findings in this study are supported by the literature, indicating that sex is statistically significant when comparing motivational factors to exercise and muscle strength and endurance, aerobic fitness and flexibility. Our findings are also in accordance with the literature (28) that females are significantly more flexible than males ($p = 0.002$). We also found that sex is a significant predictor of body fat percent, after controlling for age ($p = 0.002$). Our findings are supported by the literature (4) that males have significantly higher muscle endurance than females ($p = 0.01$), after controlling for age. In our model, age and sex explained approximately 44% of the variance in endurance, as measured by push-ups. Regarding muscle endurance, males performed significantly more sit ups ($p = 0.002$) than females, which is supported by the findings (4) that males have significantly higher muscle strength and endurance than females. Also, males have significantly higher muscle strength than females ($p < 0.001$), after controlling for age, as measured by grip strength ($p < 0.001$). Our model explained 60% of the variance in muscle strength. Understanding sex differences in physical fitness can help one design effective exercise prescriptions, to target sex specific strengths and weakness.

Motivation differed between sexes in only competition ($p = 0.0356$), in agreement with two other studies that men are more motivated by competition than females, partially confirming our second hypothesis (6, 22). Contradicting the literature, no other subscales were significant, in our study. This occurrence is likely because none of the compared studies tested on such a wide range of subjects, from young adults to old adults in a Midwest urban private liberal arts college. Understanding that motivation differs between sexes, can help more effectively promote physical activity to each sex more successfully.

The present study found that age is significantly negatively associated with challenge ($p = 0.003$) and affiliation ($p = 0.048$), and positively associated with health pressures ($p = 0.025$), ill health pressures ($p < 0.001$), and nimbleness ($p < 0.001$) which is partially supported by findings in the literature (6, 22). No differences were found in positive health ($p = 0.06$). The difference in findings might have occurred because their subjects were all from a fitness club (22), not individuals who are not highly active, such college students, faculty and staff. This suggests that older individuals resort to exercise as a way to improve/maintain health and to remain agile and that younger individuals are more motivated by challenge and social aspects/affiliation, which should be taken into account when trying to develop exercise interventions for individuals of different age ranges.

In addition, $\dot{V}O_2$ max ($p = 0.01$) and total METs per week ($p = 0.03$) significantly decreased with age, while body fat percentage ($p = 0.02$) significantly increased. This is supported by the findings in the literature that in adult men and women ages 20-90, $\dot{V}O_2$ max decreases with age and that people the age of 50 and over suffer from an 8% decline in $\dot{V}O_2$ max per decade in males and females (14).

The present study also found that the number of sit-ups significantly declined with aging, regardless of sex ($p < 0.001$). Contradicting our hypothesis, there were no age differences in muscle strength ($p = 0.13$), independent of sex. Grip strength test was selected as a surrogate to overall muscle strength to agree with the College's wellness program assessment data and to allow for comparisons. It is possible that strength differences would be detected in other muscle groups. Our results suggest that it is essential to promote physical activity engagement for older individuals to potentially reduce the detrimental effects of aging on aerobic fitness and cardiovascular disease.

The literature partially supports our findings of BMI being correlated with fitness level. BMI was a significant predictor of $\dot{V}O_2$ max ($p = 0.01$), systolic blood pressure ($p < 0.001$) explaining approximately 31% of the variance in systolic blood pressure, and body fat percent ($p < 0.0001$) explaining approximately 31% of the variance in body fat percentage. This is in accordance with the literature (15), $\dot{V}O_2$ max will decrease as weight increases. High BMI was significantly associated with hypertension and diabetes in both males and females (23), but in the present study, systolic blood pressure was not found to be significantly predicted by BMI ($p = 0.06$). The present study found that 22% were stage 2 hypertensive, and 34% were stage 1 hypertensive, similar to study that found 29% of American adults that have high blood pressure while another one third are prehypertensive (19). Finally, resting heart rate was not found to be predicted by lower BMI (p = 0.06). The BMI results suggest that individuals who are obese should be considered to also have an increased risk to suffer from cardiovascular disease and diseases that are highly associated with obesity such as cancer, hypertension, and diabetes.

It is important to consider if additional factors could have explained this study's results such as demographics and selection of measurement tests; therefore, some potential limitations will be addressed below. The sample tested for this study was comprised mostly of one ethnicity (white/Caucasian), which limits the extrapolation of results to other ethnicities. Since this study was a cross-sectional study, recalling individuals' physical activity at one week in their lives, it is possible that it was a lower activity week, such as vacation or sick week, and not being an accurate representation of their participation in physical activity; thus, explaining the low participation in physical activity regardless of affiliation. This study used the YMCA Step Test to estimate $\dot{V}O_2$ max, since is a submaximal test, it is possible that scores from individuals who were highly active were overestimated, which is common with this test in highly active populations. The IPAQ-SF test is a cost-effective way to get cross-sectional data, since it is a recall of the last 7 days of physical activity, overestimation (16) and underestimation (7) are possible to happen, given that people may be unaware how to classify their physical activity.

This study provided insight on predictors of physical fitness, physical activity levels and motivation to exercise in an urban Midwest private liberal arts college students, faculty and staff. We found that age is a significant predictor in 3 areas of fitness (muscle strength and endurance, body fat percentage, and $\dot{V}O_2$ max), and that there are significant sex differences in muscle strength and endurance, body fat percentage, and flexibility. In addition, motivation to exercise was significantly higher for males in the subscale Competition, while age was significantly positively associated with 5 motivation subscales (Health Pressures, Ill Health Pressures, Nimbleness) and negatively associated with 2 subscales (Challenge, Affiliation). These findings offer a baseline for effective future physical activity interventions based on fitness level, sex, and age through appropriate motivation strategies by health and exercise professionals. Future studies should consider adding direct assessment of physical activity, other kinds of fitness level testing, and a more diverse population, to address some of the limitations in this study.

ACKNOWLEDGEMENTS

Northland American College of Sports Medicine Innovative Student Research Grant.
The Office of Undergraduate Research and Graduate Opportunity, Augsburg University.

REFERENCES

1. Centers for Disease Control. State-specific prevalence of obesity among adults--united states, 2007. MMWR 55: 985-988, 2006.

2. Centers for Disease Control. Adult participation in aerobic and muscle-strengthening physical activities--united states, 2011. MMWR 62(17): 326-330, 2013.

3. Committee PAGA. Physical activity guidelines advisory committee report, 2008. In. Washington, DC: U.S. Department of Health and Human Services; 2008.

4. Crow HC, Ship JA. Tongue strength and endurance in different aged individuals. J Gerontol A Biol Sci Med Sci 51(5): M247-250, 1996.

5. Dacey M. BA, Zaichkowsky L. Older adults' intrinsic and extrinsic motivation toward physical activity. Am J Health Behav 32(6): 570-582, 2008.

6. Egli T, Bland HW, Melton BF, Czech DR. Influence of age, sex, and race on college students' exercise motivation of physical activity. J Am Coll Health 59(5): 399-406, 2011.

7. Ekelund U, Sepp H, Brage S, Becker W, Jakes R, Hennings M, Wareham NJ. Criterion-related validity of the last 7-day, short form of the international physical activity questionnaire in swedish adults. Public Health Nutr 9(2): 258-265, 2006.

8. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: Payer-and service-specific estimates. Health Aff (Millwood) 28(5): w822-831, 2009.

9. Pauline JS. Physical activity behaviors, motivation, and self-efficacy among college students. Coll Stud J 47(1): 64-74, 2013.

10. Kulavic K, Hultquist CN, McLester JR. A comparison of motivational factors and barriers to physical activity among traditional versus nontraditional college students. J Am Coll Health 61(2): 60-66, 2013.

11. Lee PH, Macfarlane DJ, Lam TH, Stewart SM. Validity of the international physical activity questionnaire short form (ipaq-sf): A systematic review. Int J Behav Nutr Phys Act 8: 115, 2011.

12. Levy J. U.S. Obesity rate inches up to 27.7% in 2014. In: Gallup; 2015.

13. Ligibel J. A. ACM, Courneya K. S., Demark-Wahnefried W., Burger R. A., Chlebowski R. T., Fabian C. J., Gucalp A., Hershman D.A., Hudson M.M., Jones L. W., Kakarala M., Ness K.K., Merrill J.K., Wollins D.S., Hudis C.A. American society of clinical oncology position statement on obesity and cancer. J Clin Oncol 32(31): 3568-3574, 2014.

14. Loe H, Rognmo O, Saltin B, Wisloff U. Aerobic capacity reference data in 3816 healthy men and women 20-90 years. PLoS One 8(5): e64319, 2013.

15. Maciejczyk M, Wiecek M, Szymura J, Szygula Z, Wiecha S, Cempla J. The influence of increased body fat or lean body mass on aerobic performance. PLoS One 9(4): e95797, 2014.

16. Mader U, Martin BW, Schutz Y, Marti B. Validity of four short physical activity questionnaires in middle-aged persons. Med Sci Sports Exerc 38(7): 1255-1266, 2006.

17. Markland D, Ingledew, D. K. The measurement of exercise motives: Factorial validity and invariance across gender of a revised exercise motivations inventory. Br J Health Psychol 2: 361-376, 1997.

18. Navalta JW, Stone, W.J., Lyons, T.S. Ethical issues relating to scientific discovery in exercise science. Int J Exerc Sci 12(1): 1-8, 2019.

19. Nwankwo T, Yoon SS, Burt V, Gu Q. Hypertension among adults in the united states: National health and nutrition examination survey, 2011-2012. NCHS Data Brief (133): 1-8, 2013.

20. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the united states, 2011-2012. JAMA 311(8): 806-814, 2014.

21. Peeters A, Barendregt JJ, Willekens F, Mackenbach JP, Al Mamun A, Bonneux L. Obesity in adulthood and its consequences for life expectancy: A life-table analysis. Ann Intern Med 138(1): 24-32, 2003.

22. Quindry JC, Yount D, O'Bryant H, Rudisill ME. Exercise engagement is differentially motivated by age-dependent factors. Am J Health Behav 35(3): 334-345, 2011.

23. Gothankar JS. Prevalence of obesity and its associated co morbidities amongst adults. Indian J Community Med 2(2): 221-224, 2011.

24. Shook RP, Gribben NC, Hand GA, Paluch AE, Welk GJ, Jakicic JM, Hutto B, Burgess S, Blair SN. Subjective estimation of physical activity using the international physical activity questionnaire varies by fitness level. J Phys Act Health 13(1): 79-86, 2016.

25. Shukla A, Kumar K, Singh A. Association between obesity and selected morbidities: A study of brics countries. PLoS One 9(4): e94433, 2014.

26. Team RC. R: A language and environment for statistical computing. In. Vienna, Austria: R Foundation for Statistical Computing; 2013.

27. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: Review and update. Med Sci Sports Exerc 34(12): 1996-2001, 2002.

28. Youdas JW, Krause DA, Hollman JH, Harmsen WS, Laskowski E. The influence of gender and age on hamstring muscle length in healthy adults. J Orthop Sports Phys Ther 35(4): 246-252, 2005.