

# The Relationship between Teaching Experience, Exercise Habit, Health Related Fitness, Bone Density and Arterial Stiffness of Korean Female Teachers

Su-In Yoon<sup>1</sup>, Sun-Ho Kim<sup>2\*</sup> and Young-Bok Yoon<sup>3</sup>

<sup>1</sup>Department of Early Childhood Education, Nambu University, Korea

<sup>2</sup>Department of Sports Leisure, Nambu University, Korea; sunho100@hanmail.net

<sup>3</sup>Department of Golf Industry, Chonnam Techno University, Korea

## Abstract

The purpose of this study was to investigate the relationship between teaching experience, regular exercise habit, health related fitness, bone density and arterial stiffness (PWV) by teaching experience of Korean female teachers. The subjects are 390 (age of  $46.48 \pm 7.2$ ) female teachers participating in teacher training programs. Teaching experience was divided into five categories (less than 10 years, less than 15 years, less than 25 years, over 25 years). Regular exercise habits were determined by how often they exercise regularly per week. Also, health related fitness (% fat, active physical fitness), arterial stiffness (PWV) and bone density (T-Score) were evaluated. Exercise habit, physical fitness awareness and health awareness were significantly higher in over 20 years compared to less than 10 years. Also, bone density was significantly higher in less than 10 years compared to over 20 years, whereas PWV was not different significantly in teaching experience. There were significant correlation between exercise habit and health related fitness as well as between exercise habit and bone density. Also, there were significant inverse correlation between exercise habit and arterial stiffness as between bone density and arterial stiffness. Therefore, it is necessary for teachers to take part in various health training courses or programs regularly for their health.

**Keywords:** Bone Density, Exercise Habit, Fitness, PWV, Teaching Experience

## 1. Introduction

According to the statistical data of Department of Education, total of 473.815 educators are teaching the future children in kindergartens, primary, middle and high schools all over the country. Among them, the ratio of women teacher has rapidly increased in 10 years from 59.8% in 2003 to 68.5% in 2013, which is almost 70%, and specially, portions of women teachers have been increasing that they made 77.9% in primary school, 67.5% in middle school and 45% in high school, in 2012<sup>1</sup>. Teachers take up high percentage among various influencing

factors on qualitative level of school education. Teachers not only affect growth and development of students as a most significant variable, but as they make great influence on local community, it is important to maintain their optimal health condition by creating correct lifestyle and habits<sup>1</sup>. However, they are suffering from a lot of stress as high educational zeal, poor educational environment, and excessive administrative work<sup>2,3</sup>. According to International Labor Organization, 25% of teachers in major developed countries are showing health problems due to serious stress, 1 out of 2 teachers over 40 years of age in Korea are suffering from various adult diseases<sup>4</sup>.

\*Author for correspondence

Specially, 70% of teachers are suffering from or experiencing occupational diseases, and they are suffering from general health problems and their quality of life is declining from health problems related to their occupation as hair loss related to mental stress, vocal fold nodule, and varicose vein by conducting classes standing up for long hours<sup>3,5</sup>.

The qualification for an ideal teacher may be recognized differently according to the point of view, but it is required to have ideal qualifications that are not only in professional field but also individual's field such as psychological health and physical health. Health related fitness that is closely related to physical health and lifestyle habit disease gets worse as the lack of exercise and stress increases and as the age increases, enhancement of health related fitness through regular exercise habits is effective in releasing stress and maintaining health<sup>6,7</sup>. Osteoporosis occurs as the bone atomic mass and density decrease due to aging, amenorrhea, malnutrition, menopause, decrease in physical activity, and therefore, regular exercise habit is recommended as a part to prevent osteoporosis<sup>8</sup>. Also, to keep the elasticity of blood vessels high and prevent arterial stiffness, it is important to regularly participate in exercise and as the age increase, regular participation in exercise is reported as the most effective method of preventing arterial stiffness<sup>9</sup>.

Constant physical activity habit in everyday life is important for teachers to maintain their health while coping with various stresses from work or home, but they are placed in a very difficult situation realistically to participate in various physical activities to resolve stress<sup>10</sup>. Specially, female teachers are participating in exercises at much lower frequency than male teachers<sup>3</sup>. Therefore, measures for this finding need to be prepared because low physical activity level of teachers is closely related with health risks as cardiovascular disease, obesity, high blood pressure, and chronic stress, and is reported to have high relevance with various diseases and the number of absences<sup>11</sup>. This study intended to provide basic data for the development of health improvement program of teachers in the future by analyzing exercise habits, health related fitness, and changes in bone density and artery stiffness on female teachers who are in dominant position in teaching profession according to the career level of education.

## 2. Materials and Methods

### 2.1 Subjects

The subjects of this study is 390 female teachers (the age of  $46.48 \pm 7.2$ ) who are kindergarten, elementary, junior high and high school teachers. 390 applicants who agreed to the intent and contents of the research among female kindergarten, elementary, middle, high school teachers from G Metropolitan City, J do, and C-do who participated in summer and winter faculty development program of N University for 2 weeks from 2004 to 2013 were selected as the subject of this study.

### 2.2 Methods

Teaching experience was divided into five categories (less than 10 years, less than 15 years, less than 20 years, less than 25 years, over 25 years). Regular exercise habit was determined by how often they exercise regularly per week<sup>12</sup>. Also, health related fitness were estimated by percentage of body fat, cardiovascular endurance, muscular strength, muscular endurance, flexibility, balance, agility, power, bone density was evaluated by T-Score, and arterial stiffness was tested by Pulse Wave Velocity (PWV). Survey questionnaires were used to gather the necessary data. For exercise habits, exercise habits scale developed jointly by Korea Institute of Sport Science and O<sub>2</sub> run was used.

Arterial stiffness was measured in the supine position using a non invasive device. Brachial-ankle Pulse Wave Velocity (ba-PWV) was measured according to the manufactures protocol using VP-1000 plus (O<sub>2</sub> run Healthcare CO., Ltd., Kyoto, Japan). In brief, electrocardiogram electrodes were placed on both wrists. Occlusion and cuffs were wrapped around both sides of the ankles and brachia. Volume waveforms for the brachium and ankle were stored, and the sampling time was 10 sec for automatic gain analysis.

### 2.3 Statistics

Measured value of this study is calculated by mean and standard deviation using SPSS Ver. 11.0. The differences of teaching experience are tested by Chi-Square and One-way ANOVA, the correlation among variables is tested by Pearson correlation analysis, and significance level is .05.

## 3. Result

For ratio of answering 'never participate in physical activity in a week,' it was in the order of less than 10 years, less than 15 years, less than 20 years, and less than 25 years of teaching experience ( $p < .05$ ). Specially, it was investigated that teachers with more than 20 years participate in exercise actively ( $p < .05$ ). Health awareness and physical fitness awareness were significantly high in over 25 years and less than 25 years of teaching experience, respectively ( $p < .05$ ). In addition, eating habits was significantly high in less than 25 years and over 25 years of teaching experience ( $p < .05$ ). Body fat percentage was significantly lower in less than 10 years compared to over 25 years ( $p < .05$ ).  $VO_2$  max was significantly higher in less than 10 years compared to over 20 years ( $p < .05$ ). In addition, active physical fitness such as grip, sit-ups, flexibility, agility, power and balance show highest level in less than 10 years but did not show significant difference according to the teaching experience. T-score was significantly high in less than 10 years ( $p < .05$ ). Also, arterial stiffness shows lowest level in less than 10 years but did not show significant difference according to the teaching experience. In the analysis of correlation, there are significant correlation between exercise habit and health related fitness as well as between exercise habit and bone density ( $p < .01$ ). Also, there are significant inverse correlation between exercise habit and arterial stiffness as well as between bone density and arterial stiffness ( $p < .01$ ).

#### 4. Discussion and Conclusion

Excellent education program and teachers are necessary to cultivate people of ability for Korean society of the future. Physical health cannot be excluded from various conditions to become excellent teachers. No matter how capable the teachers are, they cannot provide good education if they are not physically healthy, and health condition, regular life habit, and practice make great influence on students<sup>1</sup>. Regular life habit can decrease mortality related to chronic disease by 47% and can lengthen life expectancy by 9.3 years all around the world. In this context, developing healthy life habit will be the first step of disease prevention and health improvement<sup>13</sup>. In this research, the ratio of teachers participation in exercise over 3 times a week has been found to be 22.7%, which is quite low, and 32.2% did not participate in exercise at all, which shows that not a lot of time is spent on exercise just as the precedent researches have proven<sup>2,14-15</sup>.

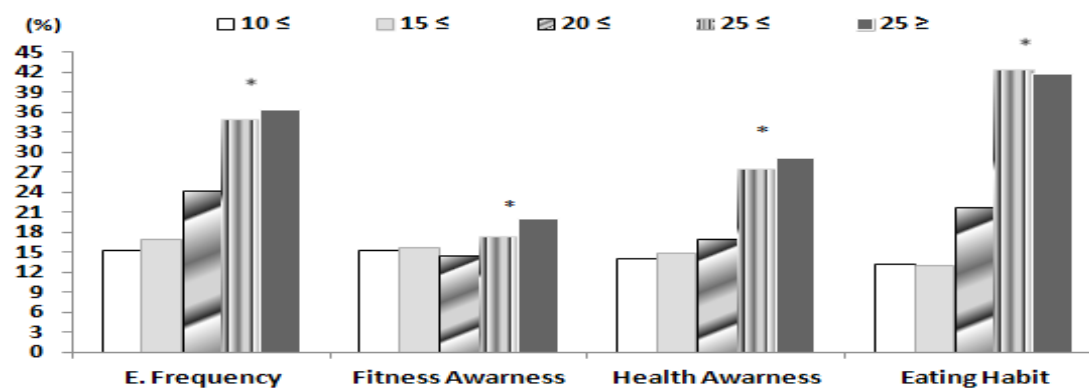
Especially, participation in exercise of teachers with experience of less than 10 years is shown to be the lowest (15.3%), and this phenomenon is considered to have happened because the teachers with less than 10 years of experience are in the age group of before and after 35 years old, who are in charge of various social roles that are in priorities with time including housewives, spouse, double-income and children fostering that they are not able to actively participate in physical activities. However, to maintain health, regular physical activity habits in daily lives are very important that it is necessary to provide systematic securities and various exercise programs that can be easily implemented at school field<sup>10</sup>.

Health related fitness can be said to be the ability to have energetic daily lives or to prevent diseases related to lack of physical activities in advance, and it includes body composition, cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, balance<sup>12</sup>. In this research, among the factors of health related fitness, % fat is found to be the lowest for teachers with experience of less than 10 years. The reason why the teachers with less than 10 years of experience have been shown to have lowest % fat despite the lowest rate of regular exercise participation rate, is considered to be because they are using other methods such as diet therapy other than exercise to manage body fat. Also, among the factors of health related fitness,  $VO_2$  max was very high in teachers with less than 10 years of experience and in other items (grip strength, sit-ups, sit-ups forward bend, side steps, standing high jump, one foot stand with eyes closed) were no differences shown according to teaching experience. These results show the united trend with precedent researches<sup>16-18</sup> that as the age increases, regular participation in exercise helps maintaining muscular strength, muscular endurance, balance, agility, and with high ratio of teachers with over 20 years of experience participating in exercise. It is considered that sustained motion load has caused appropriate stimulation for musculoskeletal, etc., creating positive reaction to the organs. Osteoporosis is a type of systemic disease in which sensibility of fracture increases due to the decrease in bone mass and disability in microstructure of bone structure and it is regulated to be the tenth disease that prevalence rate increases every year<sup>12,19</sup>. Especially, osteoporosis that frequently occur to women due to the physiological characteristics may cause serious side effects to health as it gets to fracture that special caution is needed<sup>20</sup>.

**Table 1.** Health related fitness, bone density and arterial stiffness according to teaching career M ± S.D

Variables	10years <sup>a</sup> (n=82)	15years <sup>b</sup> (n=84)	20years <sup>c</sup> (n=79)	25years <sup>d</sup> (n=70)	≥25years <sup>e</sup> (n=75)	F-value pr>F	post -hoc
%fat	25.09±3.86	26.68±5.05	27.37±4.97	28.60±3.99	28.97±4.68	4.341/.0371*	a<e
Cardiovascular endurance(ml/kg/min)	34.34±4.07	29.63±5.04	28.72±4.05	27.70±6.38	26.48±4.71	5.443/.0292*	a<e
Muscle Strength(kg)	26.13±2.84	24.83±6.17	24.60±5.59	24.24±5.72	23.18±4.25	1.902/.154	
Muscle endurance(beans)	25.42±3.06	21.27±3.25	20.55±3.86	20.13±3.14	18.75±2.71	.960/.387	
Flexibility(cm)	20.67±5.15	18.52±4.18	18.26±3.84	17.36±3.63	16.57±3.87	.142/.868	
Agility(beans)	29.08±4.73	27.23±6.17	26.79±7.19	25.62±6.87	22.11±6.71	.119/.888	
Power(cm)	30.15±5.46	29.05±6.13	28.50±7.24	26.57±8.35	25.52±7.03	1.930/.0916	
Balance(sec)	63.27±6.07	57.42±9.85	55.41±8.68	54.81±7.21	53.09±8.66	2.006/.140	
T-Score(score)	-1.18±0.52	-1.25±0.39	-1.48±0.51	-1.76±0.63	-1.83±0.48	5.139/.0287*	a<e
RHpww(ms)	339.04±24.68	362.17±34.10	366.83±29.16	375.59±37.79	380.64±42.68	2.629/.0935	
LHpww(ms)	343.87±32.75	356.37±31.70	360.26±42.13	365.43±30.62	377.41±28.58	1.329/.0696	
RFpww(ms)	378.94±35.62	388.74±38.86	403.01±30.72	415.37±32.61	419.96±37.22	0.398/1.939	
LFpww(ms)	380.65±40.13	392.39±28.79	405.19±32.87	407.45±30.54	415.29±39.28	1.635/1.024	

Values are means ± SEM.\* Significantly different from rest method (p<0.05). pww: pulse wave velocity, a: less than 10 years, b: less than 15 years, c: less than 20 years, d: less than 25 years, e: over 25 years.



**Figure 1.** Exercise frequency, fitness awareness, health awareness and eating habit according to teaching career Values are means ± SEM.\*Significantly different from teaching career (p<0.05). E. Frequency: 3days/week.

In ACSM<sup>12</sup>, bone mass of group of physical activities and athletes is higher than group of sedentary life that regular exercise is recommended as primary prevention plans. In this research, T-score, which is the index of bone density according to teaching experience, has been found to be higher in teachers with less than 10 years of experience but T-score is showing distribution that corresponds

to osteopenia that it is important to form habit of participating in exercise. Also, teachers with over 20 years of experience are showing the lowest T-score but this may be due to natural reduction of bone density following the aging and menopause and since their ratio of regular participation in exercise is high that the measure of osteoporosis is not found. These results show the united

**Table 2.** Correlation of exercise habit, health habit, bone density, arterial stiffness in teacher

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	1.00	-.237	.620**	.383*	.442*	.410*	.408*	.529*	.689*	.428*	-.426*	-.527*	-.419*	-.529*
B		1.00	-.095	.573*	-.057	-.125	-.143	-.459*	-.538*	.449*	.568*	.495*	.506*	
C			1.00	.018	.072	.131	.079	.036	.446	-.486*	-.471*	-.526*	-.588*	
D				1.00	.189	.170	.049	.411*	.380*	-.074	-.042	-.030	-.044	
E					1.00	.315*	.102	.223*	.325	-.107	-.068	-.030	-.105	
F						1.00	.104	.039	.139	.495	-.032	-.035	-.025	
G							1.00	.494*	.497*	.189	-.069	.008	-.030	
H								1.00	.094	.159	-.055	-.051	-.121	-.092
I									1.00	.307	-.123	.149	.059	.072
J										1.00	-.098	-.056	-.108	-.091
K											1.00	.907**	.908*	.879*
L												1.00	.791*	.807*
M													1.00	.887*
N														1.00

\* Significantly different among variables (p<0.05), \*\* Significantly different among variables (p<0.01).

A; Exercise Habit, B; %fat, C; VO2max, D; Grip strength, E; Sit-Ups, F; Sit & Reach Test, G; Side Step, H; Eye Closed One Leg Stand, I; Vertical Jump, J; T-Score, K; Right hand pulse wave velocity, L Left Right hand pulse wave velocity, M Right foot pulse wave velocity, N; Left foot pulse wave velocity.

trend with precedent researches<sup>21-22</sup> that regular participation in exercise increases T-score, the mark of bone density. It is considered that repetitive and systematic physical activity played the role of the most important external factor for development and reformation of bone which is considered to be due to the increase in amount of muscle following the regular physical activities and change in bone mass<sup>23</sup>. Blood goes into blood vessel system of almost 100,000 kilometers after coming out from heart and artery takes the important role of delivering blood from the heart. This artery has the elasticity to expand to maintain the pressure inside the blood vessel and return to original condition and due to various factors such as lack of physical activities, hormones, metabolism materials, aging, etc., blood vessel is damaged and as fibrosis is progressed, elastic and buffering capability of artery is destroyed<sup>24</sup>. Especially, as women ages, damage of blood vessels and fibrosis is increased and arterial stiffness, which reduces elasticity capability, increases as well<sup>25</sup>. In this research, although teachers with over 20 years of experience who participate in exercise are very old, there are no attentive differences to arterial stiffness of right and left hand and feet, showing the united trend with the precedent researches<sup>26-28</sup> that continuous participation in exercise brings improvement in the function of blood vessels. These results are considered to have happened as the amount of blood flow in upper and lower limbs increased

and blood vessels expanded due to improvement in muscle abilities together with corporeal circulation after regular participation in exercise. Also, due to consistent stimulation, blood flow toward skeletal muscles increased and this increase not only expended the blood vessels but also positively affected the elasticity of blood vessels by activating sympathetic system<sup>29</sup>. Specially, even though regular exercise is considered importantly in preventing and managing chronic disease, many people do not participate in physical activities in leisure time and suffer from various diseases. Low health related physical fitness due to decreased physical activity can cause high death rate, and there is high probability of causing chronic disease by lowering cardiovascular system or musculoskeletal function<sup>30-31</sup>. In this research, exercise habits and health related fitness as well as between exercise habits and bone density showed positive correlation. Also, exercise habits and bone density as well as bone density and elasticity of blood vessels (right hand, left hand, right foot, left foot) showed inverse correlation. These results are caused by the positive effects in artery functions with improvement in health related strengths and function of blood vessels at the same time<sup>31-35</sup> and by change in amount of bone and expedition of osteoblast with lots of simulation to bones through regular physical activities<sup>20,36</sup>. As this study, teachers with over 20 years of teaching experience (less than 25 years) showed high exercise habit of exercising regularly for more than 3 days a week, physical fitness awareness,

and health awareness, and they showed regular eating habit as well. Among health related fitness, teachers with less than 10 years showed lower percentage of body fat (%fat) than teachers with over 20 years, and grip, sit-ups, sit and reach test, side step, vertical jump, and standing on one leg with eyes closed were higher for teachers with less than 10 years, but did not show significant difference. Teachers with less than 10 years showed higher bone density than teachers with over 20 years, but stiffness of artery did not show significant difference. Also, it was identified that exercise habit has positive correlation with health related fitness and bone density, and inverse correlation with artery stiffness.

Therefore, it would be necessary for teachers to participate in various exercise programs periodically and regularly to maintain their health.

## 5. References

1. KEDI. Education Basic Statistics of 2013. Korean Educational Statistics Service, Korean Educational Development Institute; 2013. Available from: <http://kess.kedi.re.kr/stats/school>.
2. Lee EY, Cho BY, Sohn AR, Ahn DH. School teacher's health behaviors and health status in Seoul and Gyeonggi-do. *Korean Journal of Health Education and Promotion*. 2009; 26(4):49–62.
3. Jeon NM, Yoon JH, Kim CH, Kim CK, Kim HS. The study of Seoul teacher's satisfaction with and needs for health examination and health promotion programs. *The Journal of Korean Community Nursing*. 2012; 23(1):154–64.
4. Cho HJ, Jeon BU, Oh SH. A study on special school teachers working condition, perceived health status and health promoting lifestyle practice. *Korean Journal of Physical and Multiple Disabilities*. 2009; 52(2):59–74.
5. KFTA. Research on Occupational Disease of the Teacher's for 2013. The Korean Federation of Teacher's Associations; 2013. Available from: <http://www.kfta.or.kr/>.
6. Sangrajrang S, Chaiwerrawattana A, Ploysawang P, Nooklang K, Jamsri P, Somharnwong S. Obesity, diet and physical inactivity and risk of breast cancer in Thai women. *APJCP*. 2013; 14(11):7023–7.
7. Mosallanezhad Z, Salavati M, Sotoudeh GR, Nilsson WL, Frandin K. Walking habits and health-related factors in 75-year-old Iranian women and men. *Archives Gerontology and Geriatrics*. 2014; 58(3):320–6.
8. Heyward VH. Advanced fitness assessment and exercise prescription. 6th, Human Kinetic Pub; 2011.
9. Michaelides AP, Souli D, Antoniadis AS, Miliou A, Ioakeimidis N, Chatzistamatiou E, Bakogiannis C. Exercise duration as a determinant of vascular function and antioxidant balance in patients with coronary artery disease. *Heart*. 2011; 97:832–7.
10. Brach JS, Simonsick EM, Kritchevsky S, Yaffe K, Newman AB. The association between physical function and lifestyle activity and exercise in the health, aging and body composition study. *J Am Geriatr Soc*. 2004; 52(4):502–9.
11. Eaton DK, Marx E, Bowie SE. Faculty and staff health promotion, results from the school health policies and programs study. *J Sch Health*. 2007; 77(8):557–66.
12. ACSM. ACSM'S guidelines for exercise testing and prescription. 7th, Lippincott Williams & Wilkins; 2006.
13. WHO. Global recommendation on physical activity for health; 2010. Available from: <http://www.who.int/entity/dietphysicalactivity/publications/9789241599979/en/-28k/>
14. Kim GS, Kim BJ, Park JY. The effects of health behavior practices and related factors among married women teachers. *Journal of Korean public health nursing*. 2008; 22(2):186–99.
15. Park HR, Song JM, Lee HJ. Middle school teacher's knowledge of physical activity recommendations. *Journal of Korean Physical Education Association for Girls and Women*. 2006; 20(4):85–98.
16. Akune TI, Muraki S, Oka H, Tanaka S, Kawaguchi H, Nakamura K. Exercise habits during middle age are associated with lower prevalence of sarcopenia. *Osteoporosis International*. 2014; 25(3):1081–8.
17. Ceaser TG, Fitzhugh EC, Thompson DL, Bassett DR. Association of physical activity, fitness, and race: NHANES 1999–2004. *Medicine and Science in Sports and Exercise*. 2013; 45(2):286–93.
18. Siddiqui N, Nessa A, Hossain MA. Regular physical exercise; way to healthy life. *Mymensingh Medical Journal*. 2010; 19(1):154–8.
19. WHO. Prevention and management of osteoporosis; 2003. Available from: <http://www.who.int/iris/handle/10665/42841-19k>.
20. Pollycore R, Simon JA. Osteoporosis; Screening and treatment in women. *Clinical Obstetrics and Gynecology*. 2012; 55(3):681–91.
21. Kanis JA, Oden A, Johnell O, Jonsson B, de Laet C, Dawson A. The burden of osteoporotic fractures: a method for setting intervention thresholds. *Osteoporosis International*. 2001; 12(5):417–27.
22. Blanshet C, Giguere Y, Prud'homme D, Dumont M, Rousseau F, Dodin S. Association of physical activity and bone: influence of vitamin D receptor genotype. *Med Sci Sports Exerc*. 2002; 34(1):24–31.
23. Lui PP, Qin L, Chan KM. Tai Chi Chuan exercise in enhancing bone mineral density in active seniors. *Clin Sports Med*. 2008; 27:75–86.
24. Kawasaki T, Sullivan CV, Ozoe N, Higaki H, Kawasaki JA. Long-term, comprehensive exercise program that incorporates a variety of physical activities improved the blood pressure, lipid and glucose metabolism, arterial stiffness, and balance of middle-aged and elderly Japanese. *Hypertens Res*. 2001; 34(9):1059–66.

25. Braith RW, Beck DT. Resistance exercise; training adaptations and developing a safe exercise prescription. *Heart Fail Rev.* 2008; 13(1):69–79.
26. Figueroa A, Park SY, Seo DY, Sanchez-Gonzalez MA, Baek YH. Combined resistance and endurance exercise training improves arterial stiffness, blood pressure, and muscle strength in postmenopausal women. *Menopause.* 2013; 18(9):980–4.
27. Madhura M, Sandhya TA. Effect of short duration aerobic exercise training on reflection index, stiffness index and pulse wave velocity. *Indian J Physiol Pharmacol.* 2012; 56(1):15–20.
28. Yoshizawa M, Maeda S, Miyaki A, Misono M, Saito Y, Tanabe K, Ajisaka R. Effect of 12 weeks of moderate intensity resistance training on arterial stiffness: a randomised controlled trial in women aged 32-59 years. *Br J Sports Med.* 2009; 43(8):615–8.
29. Tordi N, Colin E, Mourot L, Bouhaddi M, Regnard J, Laurant P. Effects of resuming endurance training on arterial stiffness and nitric oxide production during exercise in elite cyclists. *Applied Physiology Nutrition and Metabolism.* 2006; 31(3):244–49.
30. Blair SN, Sloanm RA, Sawada SS, Martin CK, Church T. Associations between cardiorespiratory fitness and health-related quality of life. *Health Qual Life Outcome.* 2009; 28(7):47–53.
31. Yang SJ, Hong HC, Choi HY, Yoo HJ, Cho GJ, Hwang TG. Effects of a three month combined exercise program on fibroblast growth factor 21 and fetuin - A levels and arterial stiffness in obese women. *Clin Endocrinol.* 2011 Oct; 75(4):464–9. doi: 10.1111/j.1365-2265.2011.04078.x
32. Boreham CA, Ferreira I, Twisk JW, Gallagher AM, Savage MJ, Murray LJ. Cardiorespiratory fitness, physical activity, and arterial stiffness: the Northern Ireland Young Hearts Project. *Hypertension.* 2004; 44(5):721–6.
33. Okamoto T, Masuhara M, Ikuta K. Effect of low-intensity resistance training on arterial function. *Eur J Appl Physiol.* 2011; 111(5):743–8.
34. Miura H, Takahashi Y, Kitabatake Y. Influence of group training on pulse wave velocity in elderly women. *Nippon Koshu Eisei Zasshi.* 2010; 57(4):271–8.
35. Baykara M, Ozturk C, Elbuken F. The relationship between bone mineral density and arterial stiffness in women. *Diagnostic Interventional Radiology.* 2012; 18(5): 441–5.
36. Kadoglou NP, Iliadis F, Liapis CD. Exercise and carotid atherosclerosis. *Eur J Vasc Endovasc Surg.* 2008; 35(3):264–72.