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The caloric expenditure of 1,000 Kcal per week can be a meaningful intervention for controlling coronary artery disease risk factors in older female adults

Kee-Chan Joo†

Department of Clinical Exercise Physiology, Seowon University

<Abstract>

Objectives: We tried to confirm physical activity of 1,000 Kcal per week was a meaningful point in controlling coronary artery disease risks in female older adults. **Methods**: Participants were 66 female older adults recruited from senior welfare center. Participants were provided with accelerometer (e-step, Kenz, Japan) for measuring daily energy expenditure. Graded exercise test was done for measuring aerobic fitness. Blood glucose and lipid were analyzed. Framingham risk score was calculated based on blood glucose, blood lipid, and smoking. These variables were compared between the group expended more than 1,000 Kcal/week and the group with energy expenditure below 1,000 Kcal/week. **Results**: The group expended over 1,000kcal/week showed to be superior to the counterpart group in following variables; AC(Abdominal Circumference), %BF, HR_{rest}(resting heart rate), VO_{2peak}, FBG, LDL-C, TG, BDI-II, QOL, AR(Absolute Risk), RR(Relative Risk). **Conclusions**: The group expended over 1,000 Kcal/week was likely to have less probability in CAD than group expended less than 1,000 Kcal/week. The result of this study suggests the important role of active daily life that can be replaced with that of regular exercise especially for those who are not available to do structured exercise.

Key words: physical activity, CAD risk, older adult

Ⅰ. Introduction

The prevalence of CAD(coronary artery disease) in Korea has rapidly been increasing during the past decades as western industrialized countries had ever experienced. Moreover large population of older adult in Korea causes CAD prevalence higher and more accelerated. Even though onset of CAD is generally 10 years later in women due to estrogen effect, they catch up with their male counterpart in CAD incidence after menopause(Goldstein & Stampler, 2002). In this regard, preventing CAD should be emphasized and equally important for maintaining cardiovascular health in female older adults.

It is well known the terminology, risk factor originated from famous Framingham Heart Study(Dawber, 1980). It include both unmodifiable factors as age, gender and modifiable factors as smoking, hypertension, hyperlipidemia, obesity, diabetes, physical inactivity, psychologic status(Brubaker, Kaminsky, & Whaley, 2002). Even though risk factors do not directly cause CAD, these factors are strongly related to CAD prevalence if continuously exposed to them without appropriate intervention (Stamler, Wentworth, & Nelson, 1986). Therefore, it is not questionable that understanding and controlling these risk factors is the key to prevent CAD, especially in older adults.

Preventing coronary artery disease by controlling risk factors requires multifaceted endeavor including diet, exercise/physical activity, emotional control as well as medical treatment.

Corresponding author : Kee-Chan Joo
Department of Clinical Exercise Physiology, Seowon University, 377-3, Musimseo-ro, Seowon-gu Cheongju-si, Chungcheongbuk-do, 28674, Korea
주소: (28674) 충청북도 청주시 서원구 무심서로 377-3 서원대학교 임상건강운동학과
Tel: +82-43-299-8792, Fax: +82-43-299-8797, E-mail: kcjoogregory@gmail.com
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Among these interventions exercise has been long time considered as the cornerstone in that kind of approach(Blair, Kohl, Barlow, Paffenbarger, & Gibbons, 1995; Eriksson, 1999; Kokkinos & Papademetriou, 2000; Durstine & Thompson, 2001; Klein, Peters, Shangrow, & Wolfe, 1991). However, there are many people who are not able to do exercise on a regular basis because of many reasons as lack of time, long distance from exercising facility, and possibly low economic status.

Physical activity has emerged as an important lifestyle intervention to substitute with regular exercise(Fonong et al., 1996; Bouchard & Rankinen, 2001; Bouchard & Shephard, 1994; Eaton et al., 1995). It implies continuing cardiovascular health status or preventing CAD can be feasible by increasing caloric expenditure with active daily life. ACSM(American College of Sports Medicine) recommends a target volume over 500 to 1000 MET-min per week for most adults' optimal volume of exercise or physical activity for general health and it is approximately equal to 1,000 Kcal per week of moderate physical activity(Garber et al., 2011). It was also revealed in well-designed study that energy expenditure of CAD patients more than 2,000 Kcal per week caused regression of remaining atheroma, while energy expenditure below 1,000 Kcal led to progression of disease(Hambrecht et al., 1993). Thus it will be prudent for those who are not available in keeping systemic regular exercise to increase caloric expenditure by increasing daily physical activity.

The purpose of this study was to show the difference of CAD risk factors between female older adult expending activity calory over 1,000 Kcal per week and those who expending below that caloric expenditure. With these results we tried to infer the feasibility of the physical activity over 1,000 Kcal per week for controlling coronary artery disease risks in female older adults.

Ⅱ. Method

1. Participants

The participants were sampled from the two largest Senior Centers in Cheongju, where totally more than 4,000 older adults were registered as a regular member. The sampling participants were performed during two months by randomly recruiting female older adults from every class they attended in the center. The older adults who had history of cardiovascular or metabolic disease were excluded from sampling. The participants of this study were initially eighty older female adults but sixty-six persons remained after omitting those who did not keep routine measurement of daily caloric expenditure. The most of participants had similar socio-economic and cultural background. They attended either exercise or non-exercise class and had same lunch provided from the Senior Center Monday to Friday. But daily energy expenditure level was thought to be dissimilar according to the classes they attended and depending on each one's physical activity at the weekend. This study was performed from March 2014 to October 2015 and reviewed by research ethics committee of Seowon University(IRB number 2014-01) before recruiting subjects.

<Table 1> Demographics

	Group A (n=32) PA≥1000Kcal/week (mean±SD)	Group B (n=34) PA<1000Kacl/week (mean±SD)
Age(years)	70.4±4.9	74.4±4.1
Height(cm)	152.1±3.9	150.6±4.9
Weight(kg)	55.4±8.1	56.1±7.5
PA Energy /week(Kcal)	1498.8±386.8	657.5±273.9

PA : Physical Activity

2. Procedure

1) Measurement of caloric expenditure

Participants were provided with accelerometer(e-step, Kenz, Japan) for measuring daily caloric expenditure. Participants were instructed to be familiar with using accelerometer(e-step) before starting measurement. The e-step was designed to safely continue turn-on state unless participant press off-button. The participants were simply hooked up with e-step on their waist belt from morning till they went to sleep and this measurement was done for one month. Sampled data of each participant's caloric expenditure was interfaced to PC software in every Monday, to analyze and to average to the caloric expenditure per week. Any operational problems could be troubleshooted at this time. In this process skipped data were also detected to notice it to the participants. As previously mentioned those who did not keep routine e-step measurement were excluded from this study. After finishing measurement and calculating average caloric expenditure per week participants were divided into two groups to compare the difference of CAD risks between them.; the group of those who expended caloric expenditure more than 1000 Kcal a week(Group A) and those who expended less than 1000 Kcal a week(Group B).

2) Exercise tolerance test

Symptom-limited maximal test by using BSU Bruce/Ramp treadmill protocol with little amount of increasing load every 20 second was preformed for identifying participant's functional capacity. Prior to the test questionnaire about medical and family history, recent sign/symptoms, CAD risk factor was obtained to screen whether the individual could be indicated to the exercise tolerance test. The criterion for exclusion was according to the absolute and relative contraindications to exercise test offered by American College of Sports Medicine(ACSM's Guidelines for Exercise Testing and Prescription, 9th edit, 2014). Resting ECG(electrocardiogram) and hemodynamics was measured before starting the test. During the test, ECG was continuously monitored with recording every 3 min. Systolic and diastolic blood pressure, ratings of perceived exertion were also obtained every 3 min. Expired gas analysis was performed by using metabolic cart (Moxus, USA) to obtain cardiorespiratory variables including VO_{2peak}(peak oxygen consumption) RER(Respiratory Exchange Ratio), and V_E(Minute Ventilation). Subjective ratings like angina, dyspnea, and claudication scale was asked every 3min and any moment as needed during the test. Terminating the test was according to the criteria suggested by American College of Sports Medicine, too(ACSM's Guidelines for Exercise Testing and Prescription, 9th edit, 2014). Immediately and 3 min after the termination, blood pressure was measured and ECG monitoring was continued till the participant recovered to the resting status. We did not find any other cardiovascular complications in every participant.

3) Assessment of CAD risk factor

To determine Framingham Risk the level of blood lipid and glucose as TC(Total Cholesterol), LDL-C(Low Density Lipoprotein), HDL-C(High Density Lipoprotein), TG(Triglyceride), and FBG(Fasting Blood Glucose) were measured. Blood was sampled from antecubital vein in the fasting state to be assayed with blood analyzer (Hitachi 736-20, Japan). The parameters to determine the Framingham risk score were age, LDL-C or TC, HDL-C, blood pressure, existence of diabetes, and smoking(Wilson et al., 1998). Depression and quality of life were tested via questionnaire of BDI-II(Beck Depression Index II) and WHO-QOL(World Health Organization-Quality of Life) respectively. Smoking history was obtained via questionnaire before exercise tolerance test. Body composition parameters including % body fat, BMI(Body Mass Index), and waist circumference were measured.

3. Statistical analyses

The Kolmogorov-Smirnov test was used to examine normal distribution in each variable. All the variables in this study were found to be normally distributed. Independent t-test was done to compare the difference of CAD risk factors and eventually the Framingham risk score between two groups. All the test values are presented by using mean and standard deviation in this paper. Probability below .05 was considered as statistically significant.

Ⅲ. Results

The most parameters of body composition was significantly different between two groups except hip circumference and BMI (Table 2). In terms of waist circumference, we could see the mean value of Group B was 84.8cm±6.2 meaning this value was stratified as one of metabolic syndrome risk according to Asian criteria proposed by Inoue et al(Kim, Kim, Choi, & Shin, 2004). while the waist conference in Group A was at the borderline. The mean value of % body fat in group A was 2.75% lower than that in group B. Moreover the mean value of % body fat in group B was “very poor” that laid in 1 to 15 percentile based on the Cooper Institute fitness categories for body fat(Cooper Institute, 2009).

We could see the significant differences in heart rate and VO_{2peak}. This difference may explain active daily life can elicits aerobic adaptations that regular exercise does. The systolic blood pressure and diastolic blood pressure at both rest and maximal end point as well as RPP at both situations were not different <Table 3>. However, maximal heart rate in group A was considerably higher than that in group B. Though it was not statistically different, it links to the fact that group A could end the test at higher metabolic rate. On the other hand VO_{2peak} representing aerobic functional capacity was definitely different between two groups with showing higher levels in group A. To stratify these values by using ACSM fitness categories for estimated VO_{2max}(maximal oxygen consumption) from YMCA submaximal test, the value of VO_{2max} in group A was rated as “average”laying in 45 to 50 percentile, while the group B was in the level of “poor” laying at lower 15 percentile(YMCA of the USA, 2000).

The value of glucose, LDL-C, and TG showed significant difference between two groups. Total cholesterol and HDL-C was not different between two groups <Table 4>. It is noticeable that the values of blood glucose, triglyceride in group B were stratified as higher than borderline of CAD risk based on a updated study(Roger et al., 2012).(e.g. >100mg/dL, >150mg/dL respectively).

The score of depression measured by using BDI – II was much higher in group B than in group A. QOL also showed statistical difference between two groups with higher score in group A <Table 5>. Both absolute and relative risk from Framingham score were higher in group B and showed statistical significant, even though the mean value of relative risk in group B was below the average risk in their same age group <Table 5>.

<Table 2> Comparison of body composition

	Group A PA≥1000Kcal/week (mean±SD)	Group B PA<1000Kacl/week (mean±SD)	Difference	t-value	Prob.
WC (cm)	80.1±9.9	84.8±6.2	-3.78	-1.858	.034†
AC (cm)	84.3±10.2	91.6±7.3	-7.27	-2.489	.009‡
HC (cm)	95.2±6.5	96.7±5.6	-1.51	-1.012	.157
WHR	.85±.06	.87±.04	-0.03	-2.018	.025†
BMI (kg/m^2)	23.9±3.4	24.9±2.8	-1.07	-1.411	.081
%BF	31.9±5.9	34.6±4.5	-2.75	-2.142	.0015‡

WC; waist circumference, AC; abdominal circumference, HC; hip circumference, WHR; waist-to-hip ratio, BMI; body mass index, †: <.05, ‡: <.01

<Table 3> Comparison of cardiovascular function and maximal aerobic capacity

	Group A PA≥1000Kcal/week (mean±SD)	Group B PA<1000Kcal/week (mean±SD)	Difference	t-value	Prob.
HR_{rest} (bpm)	66.8±8.6	70.7±10.2	-3.98	-1.715	.045†
HR_{peak} (bpm)	134.8±19.2	127.8±19.2	7.02	1.483	.068
SBP_{rest} (mmHg)	125.8±17.8	128.7±17.9	-2.98	-.678	.25
DBP_{rest} (mmHg)	74.9±10.2	73.1±9.1	1.88	.788	.21
SBP_{peak} (mmHg)	189.9±27.2	182.5±24.6	7.42	1.163	.125
DBP_{peak} (mmHg)	85.6±12.2	87.2±13.4	-1.60	-0.508	.306
RPP_{rest}	84.3±15.8	90.6±17.4	-6.31	-1.542	.064
RPP_{peak}	256.6±63.7	234.4±55.3	22.25	1.515	.068
VO_{2peak} (ml/kg/min)	22.6±4.5	17.5±2.7	5.06	5.594	.000‡

HR_{rest}; heart rate at rest, HR_{peak}; heart rate value at maximal endpoint of the test, SBP_{rest}; SBP at rest, DBP_{rest}; DBP at rest, SBP_{peak}; SBP value at maximal endpoint of the test, DBP_{peak}; DBP value at maximal endpoint of the test, VO_{2peak}; peak value of oxygen consumption, RPP_{rest} : HR_{rest} x SBP_{rest}/100, RPP_{peak} : HR_{peak} x SBP_{peak}/100 † : <.05, ‡ : <.01

<Table 4> Comparison of blood lipid and glucose

	Group A PA≥1000Kcal/week (mean±SD)	Group B PA<1000Kacl/week (mean±SD)	Difference	t-value	Prob.
FBG (mg/dL)	92.9±16.9	107.9±22.6	-15.06	-3.053	.002‡
TC (mg/dL)	211.8±39	218.7±39.2	-6.89	-0.716	.231
LDL-C (mg/dL)	114.8±31.8	126.9±27	-12.07	-1.666	.050†
HDL-C (mg/dL)	56.5±12.6	51.9±13.0	4.65	1.471	.073
TG (mg/dL)	137.5±84.6	180.0±87.9	-42.56	-2.002	.025†

FBG; fasting blood glucose, TC; fasting total cholesterol, LDL-C; fasting low density lipoprotein cholesterol, HDL-C; fasting high density lipoprotein cholesterol, TG; triglyceride, † : <.05, ‡ : <.01

<Table 5> Comparison of psychological factor and framingham risk score

	Group A PA≥1000Kcal/week (mean±SD)	Group B PA<1000Kacl/week (mean±SD)	Difference	t-value	Prob.
BDI-II	5.43±5.1	11.63±7.7	-6.01	-2.735	.005‡
QOL	92.31±11.3	83.00±6.7	9.34	3.024	.002‡
AR(%)	7.8±5.5	10.9±5.6	-3.11	-2.271	.01‡
RR	.58±.41	.81±.40	-0.21	-2.096	.02†

BDI – II; Beck Depression Inventory – II, QOL; quality of life, † : <.05, ‡ : <.01
AR; absolute risk of CAD probability in 10 years , RR; relative risk of CAD probability in 10 years, † : <.05, ‡ : <.01

Ⅳ. Discussion

As previously mentioned, the importance of daily physical activity for health benefit is emerging. Because it can be replaced with structured exercise in maintaining cardiovascular health. From early 1950's to the late 1990's there have been numerous studies showed the evidence of physical activity to improve cardiovascular health status(Morris, Heady, Raffle, Roberts, & Parks, 1953; Paffenbarger, Laughlin, Gima, & Black, 1970; Physical Activity and Health: A Report of the Surgeon General, 1996). Furthermore decreases in physical activity as well as its low initial levels were considered as strong risk factors for all-cause mortality(Lissner, Bengtsson, Bjorkelund, & Wedel, 1995). The most reasonable way to rate the level of physical activity is to calculate daily or weekly energy expenditure. The volume of more than 500-1,000 MET-min/week that is equal to 1,000kcal/week is recommended as a reasonable target volume of physical activity for most adults(Garber et al., 2011). The study regarding to atherosclerotic prognosis reported that patients whose energy expenditure was less than 1,000Kcal/week showed progression of legion, while the patients who expended more than 2,200Kcal/week showed regression of plaque(Hambrecht et al., 1993). The aforementioned implied that energy expenditure of 1,000kcal per week might be a meaningful limit to influence controlling CAD risk factor for CAD patients as well as for the most adults.

Obesity is defined abnormally excessive body fat linked with various kind of chronic disease. A quantity of researches noted that habitual exercise and/or active daily life play an important role of improving obesity-related parameters like body weight, %body fat, waist circumference, waist-to-hip ratio, and body mass index via negative energy balance. It is evident that obesity is inversely related to level of physical activity(Jakicic, 2002). A randomized trial confirmed same effect between structured exercise and lifestyle activity on obese women's health benefit(Anderson et al., 1999). In our study we could also see all the body composition variables except hip circumference and BMI are statistically lower in the group expending more than 1,000 Kcal per week. No difference in BMI with significant difference in %BF(% Body Fat), WC(Waist Circumference), and WHR(Waist-to-Hip ratio) implies BMI is not as good indicator as the other parameters in measuring body composition. It is worthy to note that waist circumference in the group expending less than 1,000Kcal per week (group B) were higher than borderline of metabolic syndrome, while the other group (group A) showed about average %body fat at their age.

It has been well known that hypertensive person could have a benefit in dropping blood pressure with habitual exercise or physical activity on the basis of several physiologic mechanisms. Studies revealed the level of daily physical activity, leisure time activity, and physical fitness is inversely related to hypertension risk(Ainsworth, Keenan, Strogatz, Garrett, & James, 1991; Blair, Goodyear, Gibbons, & Cooper, 1984; Reaven, Barett-Conner, & Edelstein, 1991). However, we could not see the difference of systolic and diastolic blood pressure between two groups in both at rest and at maximal endeavor. This might be caused from the fact that both groups were too old to be able to adapt in decreasing blood pressure with physical activity as their younger counterpart does. For the older adults hypertension is more likely to be accompanied by increase of peripheral vascular resistance(Dishman, Washburn, & Heath, 2004). Two third of hypertensive subjects in Harvard Alumni Study whose SBP(Systolic Blood Pressure) and DBP(Diastolic Blood Pressure) were more than 160mmHg and 90mmHg respectively expended physical activity energy less than 2,000kcal per week(Paffenbarger, Wing, Hyde, & Jung, 1983). In this regard the energy expenditure of 1,000kcal per week in this study might not be enough to decrease blood pressure. However it is noteworthy that group A showed near similar peak systolic blood pressure as group B at their higher maximum MET level, it could be regarded as cardiovascular adaptation during physical endeavor. If the systolic blood pressure in both groups had been compared at the same absolute submaximal intensity, group A should have shown significant lower values in blood pressure. By the same token, no statistical difference in peak RPP(Rate Pressure Product), the peak myocardial oxygen demand between two groups implies that group A should have shown lower RPP at the same absolute submaximal intensity. In addition the lower resting RPP in group A indicated the better cardiac efficiency than group B.

Fasting blood lipid profile showed significant difference between two groups except in HDL and TC. What we need to note is the mean value of TC, TG, and blood glucose in the group expending less than 1,000Kcal per week (group B) excessed the borderline of CAD risk, while most of values in group A were below the borderline. Even though we tried to recruit the subjects with same socioeconomic background, there might be a little difference in lifestyle. Therefore question about their similarity in diet habit still remained as a limitation in this study. Without considering the limitation above results indicated energy expenditure of more considering the 1,000Kcal per week (group A) was superior in improving blood glucose and lipids. However, as mentioned above, HDL-C was not different between two groups unlikely to the other lipid profiles. Some studies had agreement that only vigorous or high caloric expenditure-demanding physical activity and/or recreational exercise could result in positive change in HDL-C, HDL2, and Apolipoprotein A(Marrugat et al., 1996; O'Connor et al., 1995; Martin et al., 1999). This implies that energy expenditure of 1,000kcal per week may not be functioning for improving HDL-C.

There are many researches to advocate the effect of structured exercise on improving blood glucose or diabetes mellitus. However active daily life also has negative association with insulin concentration, insulin resistance syndrome, and incidence of type 2 diabetes(Babyak et al., 2000; Motl, Birnbaum, Kubik, & Dishman, 2004; Young & Steinhardt, 1993). In our study fasting blood glucose in the group expended more than 1,000kcal per week (group A) was statistically lower than that in the less active counterpart (group B). Moreover the group B showed average fasting blood glucose over 100mg/dL, the borderline of prediabetes while the average FBG in the group A was below that level. This result was correspondent to the aforementioned studies with indicating the effectiveness of physical activity on preventing and controlling diabetes.

From early 1900's psychiatrist in US reported exercise effect on treating depression. Those treatment has been continued through 1960's with experimental studies to find the mechanism of exercise effect on improving emotional status(Dishman et al., 2004). More recently it has been well known that exercise treatment for major depression was as effective as medication therapy and the exercise had more significant therapeutic benefit if it was continued over time(Babyak et al., 2000). Another study reported the effect of physical activity on depressive symptoms in adolescence that more frequent leisure-time physical activity was inversely related to the depressive symptoms(Motl, Birnbaum, Kubik, & Dishman, 2004). In this study we could also observe that depression score from BDI-II was significantly lower in the group expended weekly activity energy of more than 1,000Kal(group A), while the score of QOL was significantly higher in the same group.

It has long been accepted aerobic fitness or aerobic functional capacity was strongly associated with prognosis after cardiac disease as well as it was inversely related to reduced coronary artery disease(Young & Steinhardt, 1993). Also it was reported strong relationship between physical fitness and coronary risk factors as well as between leisure-time physical activity and coronary risk factors(LØchen & Rasmussen, 1992). It is assumed there is serial interrelation between physical activity and/or exercise, physical fitness, and reducing coronary artery disease risks. In our study we could also observe the group expended more than 1,000Kcal per week (group A) showed significant higher VO_{2peak} as well as higher corresponding MET level. It was noticeable that the value of peakVO_2 in group B laid in the "poor" category at their age. This corresponding result to former researches emphasizes the active lifestyle has same effect on cardiorespiratory fitness as the regular structured exercise does.

By using CHD(Coronary Heart Disease) score sheet from Wilson et al(Wilson et al., 1998). we calculated and compared both absolute and relative risks of CAD between two groups.

Though relative risks in both groups are lower than average risk at their age, the group expended more than 1,000kcal per week (group A) showed lower probability of CAD in 10 years than the less active group B. It is no doubt this result was due to the fact that most variables to be used for determining Framingham score in group A had the ascendancy over the values in group B. The relative risk of CAD in group A was 0.58±.41. This indicates the probability of CAD in 10 years in group A is about a half of the mean value at their age. This result suggested active daily life with expending more than 1,000kcal per week could be considered to decrease the probability of coronary disease.

Ⅴ. Conclusion

The importance of active lifestyle has emerged in gaining health benefit and it can be considered as equally effective as the structured exercise for controlling chronic health problems. Former studies advocated energy expenditure of 1,000kcal per week as a cornerstone for eliciting health benefit. In our study we compared the difference in CAD risks between more active group (group A, PA>1,000kcal/week) and less active group (Group B, PA <1,000kcal/week), to obtain the results that the former group is likely to have less probability in CAD than the latter group. The result of this study suggests the important role of active daily life that can be replaced with that of regular exercise especially for those who are not available to do structured exercise.

References

Ainsworth, B. E., Keenan, N. L., Strogatz, D. S., Garrett, J. M., & James, S. A. (1991). Physical activity and hypertension in black adults: The Pitt County study. *American Journal of Public Health*, 81(11), 1477-1479.

Anderson, R. E., Wadden, T. A., Bartlett, S. J., Zemel, B., Verde, T. J., & Franckowiak, S. C. (1999). Effect of Lifestyle Activity vs Structured Activity in Obese Women; A Randomized Trial. *JAMA*, 281(4), 335-340.

Babyak, M., Blumenthal, J. A., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., Craighead, W. E., Baldewicz, T. T., & Krishnan, K. R. (2000). Exercise treatment for major depression: maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine*, 62(5), 633-638.

Blair, S. N., Goodyear, N. N., Gibbons, L. W., & Cooper, K. H. (1984). Physical fitness and incidence of hypertension in healthy normotensive men and women. *JAMA*, 252(4), 487-490.

Blair, S. N., Kohl, H. W. III., Barlow, C. E., Paffenbarger, R. S. Jr., Gibbons, L. W., & Macera C. A. (1995). Changes in physical fitness and all-cause mortality. A prospective study of healthy and unhealthy men. *JAMA*, 273(14), 1093-1098.

Bouchard, C., & Rankinen, T. (2001). Individual differences in response to regular physical activity. *Medicine and Science in Sports and Exercise*, 33(6), S446-S451.

Bouchard, C., & Shephard, R. J. (1994). Physical activity, fitness, and health: International proceedings and consensus statement. Champaign, IL: *Human Kinetics*.

Brubaker, P., Kaminsky, L., & Whaley, M. (2002). Essencials of Prevention and Rehabilitation Programs. *Human Kinetics Publishers.*

Cooper Institute (2009). Physical Fitness Assessments and Norms for Adults and Law Enforcement : In ACSM's Guidelines for Exercise Testing and Prescription, 9th Edit. (2014). *Lippincott Williams and Wilkins*.

Dawber, T. R. (1980). The Framingham Study: The Epidemiology of Atherosclerotic Disease. *Cambridge: Harvard University Press.*

Dishman, R. K., Washburn, R. A., & Heath, G. W. (2004). Physical Activity Epidemiology. *Human Kinetics Publishers.*

Durstine, J. L., & Thompson, P. D. (2001). Exercise in the treatment of lipid disorders. *Cardiology Clininics*, 19(3), 471-484.

Eaton, C. B., Lapane, K. L., Graber, C. E., Assaf, A. R., Lasator, T. M., & Carleton, R. A. (1995). Physical activity, physical fitness, and coronary heart disease risk factors. *Medicine and Science in Sports and Exercise*, 27, 340-346.

Eriksson, J. G. (1999). Exercise and the treatment of type2 diabetes mellitus. *Sports Medicine*, 6, 381-391.

Fonong, T., Toth, M. J., Ades, P. A., Katzel, L. I., Calles, E. J., & Poehlman, E. T. (1996). Relationship between physical activity and HDL-cholesterol in healthy older men and women: a cross-sextional and exercise intervention study. *Atherosclerosis*, 127(2), 177-183

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., Nieman, D. C., & Swain, D. P. (2011). American College of Sports Medicine Position Stand. The quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine and Science in Sports and Exercise*, 43(7), 1334-59.

Goldstein, F., & Stampfer, M. (1995). The epidemiology of coronary heart disease and estrogen replacement in postmenopausal women. Progress in Cardiovascular Disease, 38(3), 199-210.

Hambrecht, R., Nibauer, J., Marburger, C., Grunze, M., Kälberer, B., Hauer, K., Schlierf, G., Kübler, W., & Schuler, G. (1993). various intensities of leisure time physical activity in patient with coronary artery disease: Effect on cardiorespiratory fitness and progression of coronary atherosclerotic lesions. *Journal of American College of Cardiology*, 22(2), 468-477.

Klein, S., Peters, E. J., Shangrow, R. E., & Wolfe, R. R. (1991). Lipolytic response to metabolic stress in critically ill patients. *Critical Care Medicine*, 19, 776-779.

Kokkinos, P. F., & Papademetriou, V. (2000). Exercise and Hypertension. *Coronary Artery Disease*, 11(2), 99-102

Jakicic, J. M. (2002). The Role of Physical Activity in Prevention and Treatment of Body Weight Gain in Adults. *J. Nutr*, 132(12), 3826S-3829S.

Kim, M. H., Kim, M. K., Choi, B. Y., & Shin, Y. J. (2004). Prevalence of the Metabolic Syndrome and Its association with cardiovascular disease in Korea. *Journal of Korean Med Sci*, 19(2), 195-201.

Lissner, L., Bengtsson, C., BjÖrkelund, C., & Wedel, H. (1995). Physical activity levels and changes in relation to Longevity. *American J Epid*, 143(1), 54-62.

LØchen, M. L., & Rasmussen, K. (1992). The Tromso study: physical fitness, self-reported physical activity, and their relationship to other coronary risk factors. *Journal of Epidemiology and Community Health*, 46(2), 103-107.

Marrugat, J., Elosau, R., Covas, M. I., Molina, L., Prat, J. R., & the MARATHOM Investigators.(1996). Amount and intensity of physical activity physical fitness, and serum lipids in men. *American J Epidemiology*, 143(6), 562-569.

Martin, S., Elosua, R., Covas, M. I., Pavesi, M., Vila, J., & Marruga, J. (1999). Relationship of lipoprotein (a) levels to physical activity and family history of coronary heart disease. *American J Public Health*, 89(3), 383-385.

Morris, J. N., Heady, J. A., Raffle, P. A., Roberts, C. G., & Parks, J. W. (1953). Coronary heart disease and physical activity of work. *Lancet*, 265(6795), 1053-1057.

Motl, R. W., Birnbaum, A. S., Kubik, M. Y., & Dishman, R. K. (2004). Naturally occurring changes in physical activity are inversely related to depressive symptoms during early adolescence. *Psychosomatic Medicine*, 66(3), 336-342.

O'Connor, G. T., Hennekens, C. H., Willett, W. C., Goldhaber, S. Z., Paffenbarger, R. S. Jr., Breslow, J. L., Lee, I. M., & Buring, J. E. (1995). Physical exercise and reduced risk of nonfatal myocardial infarction. *American J Epidemiology*, 142(11): 1147-1156.

Paffenbarger, R. S. Jr., Laughlin, M. E., Gima, A. S., & Black, R. A. (1970). Work activity of longshoremen is related to death from coronary heart disease and stroke. *N Engl J Med*, 282(20), 1109-1114.

Paffenbarger, R. S. Jr., Wing, A. L., Hyde, R. T., & Jung, D. L. (1983). Physical activity and incidence of hypertension in college alumni. *American Journal of Epidemiology*, 117(3), 245-257.

Physical Activity and Health: A Report of the Surgeon General. (1996) US Department of Health and Human Services Centers for Disease control and Prevention.

Physical Fitness Assessments and Norms for Adults and Law Enforcement, Cooper Institute: In ACSM's Guidelines for Exercise Testing and Prescription, 9th Edit.(2014). *Lippincott Williams and Wilkins*.

Reaven, P. D., Barett, C. E., & Edelstein, S. (1991). Relation between leisure time physical activity and blood pressure in older women. *Circulation*, 83(2):559-565.

Roger, V. L., Go, A. S., Lloyd-Jones, D. M., Benjamin, E. J., Berry, J. D., Borden, W. B., Bravata, D. M., Dai, S., Ford, E. S., Fox, C. S., Fullerton, H. J., Gillespie, C., Hailpern, S. M., Heit, J. A., Howard, V. J., Kissela, B. M., Kittner, S. J., Lackland, D. T., Lichtman, J. H., Lisabeth, L. D., Makuc, D. M., Marcus, G. M., Marelli, A., Matchar, D. B., Moy, C. S., Mozaffarian, D., Mussolino, M. E., Nichol, G., Paynter, N. P., Soliman, E. Z., Sorlie, P. D., Sotoodehnia, N., Turan, T. N., Virani, S. S., Wong, N. D., Woo, D., & Turner, M. B. (2012). Heart Disease and Stroke Statistics-2012 updated: a report from American Heart Association. *Circulation*, 125(1), e2-220.

Stamler, J., Wentworth, D., & Nelson, D. (1986). Is the relationship between serum cholesterol and risk of premature death from coronary heart disease continuous and graded? Findings in 356,222 primary screenees of the Multiple Risk Factor Intervention Trial (MRFIT). *JAMA*, 256, 2823-2828.

Wilson, P. W., D'Agostino, R. B., Levy, D., Belanger, A. M., Silbershatz, H., & Kannel, W. B. (1998). Prediction of coronary heart disease, *Circulation*, 97, 1837-1847.

YMCA of the USA (2000). Golding LA. YMCA Fitness Testing and Assessment Manual 4th Edit : In ACSM's Guidelines for Exercise Testing and Prescription, 9th Edit. (2014). *Lippincott Williams and Wilkins*.

Young, D. R., & Steinhardt, M. A. (1993). The importance of physical fitness versus physical activity for coronary artery disease risk factors: A cross-sectional analysis. *Research Quarterly for Exercise and Sport*, 64(4), 377-384.