www.jmscr.igmpublication.org

Impact Factor 3.79

ISSN (e)-2347-176x ISSN (p) 2455-0450

crossref DOI: http://dx.doi.org/10.18535/jmscr/v3i10.36

IGM Publication

Journal Of Medical Science And Clinical Research

An Official Publication Of IGM Publication

Effect of Treadmill Walking with Different Intensities on Coagulation Factors and Selected Cardiovascular Parameters in Mild Hypertensive Women

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ABSTRACT

Background: *No doubt that exercise plays an integral role in the protection against cardiovascular disorders, however decision for the proper exercise intensity may constitute the major challenging step in achieving that goal.*

Objective; *to compare between the effect of different treadmill exercise intensities on selected cardiovascular parameters including; blood pressure , maximum and resting heart rate in addition to coagulation factors including; bleeding time, clotting time, prothrombin time, prothrombin concentration, and platelets count*

Subjects & Methods: *Forty-five sedentary mild hypertensive women were recruited for the study their ages ranged from 30 to40 years old, subjects were divided into three study groups according to their exercise intensities: Group A (50%-65% of THR), B (65%-75% of THR) , and C (75% to 80% of THR) , they all participated in an exercise training program on treadmill for twenty minute three times per week for 12 successive weeks.*

Results: *significant decrease in bleeding time, clotting time, in group (C) with significant increase in platelets count in the same group compared to group (A)&(B). For selected cardiovascular parameters, result showed significant reduction of systolic and diastolic blood pressure in both groups (A&B) compared to group (C)*

Conclusion: *The walking exercises of low and moderate intensities have a positive effect on blood pressure with minimal impact in coagulation profile in mild hypertensive female.*

Keywords: *exercise intensities, hypertension ,coagulation and ,cardiovascular disorders*

INTRODUCTION

A strong and etiologically significant positive association is exist between blood pressures and cardiovascular-disease outcomes [1] Increasing evidence suggests that hypertension elicit a prothrombic state, characterized by abnormalities of endothelial function and platelet activation.[2] This dysfunction is conferred by isolated systolic hypertension as well as simultaneous systolic and diastolic hypertension.[3] Consequently, investigative interest has recently focused on endothelial and platelet activation as important mediators of hypertensive vascular injury.

In older hypertensive formation of an occlusive thrombus formation is dependent on the proper balance of the hemostatic system, the higher the rate of coagulation the more potential for thrombosis, thereby increasing the risk of an ischemic event this changes are even exaggerated with subject with elevated blood pressure . This hypercoagulable state is indicated by abnormally elevated levels of plasma coagulation markers [4].

Many factors may contribute to fluctuation in patients show considerable fluctuation in the levels of individual haemostatic factors among hypertensive female including; either physiological variability, (e.g. age, sex, racial origin, blood group or hormonal influence), or secondary to some environmental factors,(such as diet, physical inactivity and smoking habits).This must be taken into account when interpreting the results which obtained in patients being investigated for bleeding or thrombotic disorders.[5]

It has been reported that platelet activation in hypertension is one of the prominent pathogenesis of the thrombosis-related complications associated with hypertension and accordingly, it is the main mechanism promoting stroke and myocardial infarction.[6].

The importance of regular physical activity in essential hypertension has been extensively investigated over the last decades and has emerged as a major modifiable factor contributing to optimal blood pressure control. Aerobic exercise exerts its beneficial effects on the cardiovascular system by promoting traditional cardiovascular risk factor regulation, as well as by favorably regulating sympathetic nervous system (SNS) activity, molecular effects, cardiac, and vascular function. [7].

Although it is well established that regular physical activity and increased cardio respiratory fitness are associated with reduced CVD risk, the intensity may play a key role in the modulation of coagulation profile in hypertensive patients. Improvement in coagulation profile may be a mechanism for training-induced CVD risk reduction. Several studies have investigated this relationship, and although the majority of cross-sectional studies have observed a significant inverse dose-response relationship with markers of coagulation at rest [8,9,10,11] such a relationship has not been entirely consistent . Therefore, the purpose of this study was to investigate the effect of different intensities (mild, moderate and severe) of exercise training program on blood coagulation and selected cardiovascular response including) in mild hypertensive women

MATERIAL AND METHODS

Subjects

Forty-five sedentary mild hypertensive females, Their age ranged from 30 to 40years old recruited from hypertension out clinic in El-Zahraa teaching hospital, all subjects were diagnosed clinically with mild hypertension by specialist (systolic blood pressure range 140-150 mmHg and diastolic blood pressure range 90-100 mmHg). diagnosed with recent onset up to five years. All participants were pre-menopause and use intra-uterine device only to prevent pregnancy to avoid any effects on results of the study. Their Body mass index ranged from (30 to 34.9),subjects were excluded from this study if diagnosed with diabetic neuropathy , smoker , chronic and acute musculoskeletal disorders and balance disturbance and subjects use oral contraceptive pills or injection to prevent pregnancy as they increase blood pressure that may affect results of the study. Subjects were divided randomly into three equal groups A,B and C according to their exercise intensities : Group A (50%-65% of THR), B (65%-75% of THR) , and C (75% to 80% of THR) each group consisted of 15 patients.

All procedures had been thoroughly explained and consent forms were signed by all participants. The study was approved by the Human Research Ethics Committee of the Faculty of Physical Therapy, and each participant signed written consent. The participants were recruited from AlZahra Hospital, Cairo, Egypt.

Procedures

I. Evaluative procedures

Exercise Testing and Blood Sampling:

venous blood samples were collected before exercise training program and the post blood sample was taking the 24 hours from the end of the last exercise session of the exercise training program (3 months) for determining blood coagulation markers (bleeding time, clotting time, prothrombin time as well as its concentration and platelets count using sysmex SF-3000 automated blood cell counter).

Exercise testing protocol, all subjects underwent Modified Bruce submaximal treadmill exercise test one week prior to their training . Exercise test was performed week before the training program for each subject , the parameters of resting blood pressure , resting heart rate and maximum heart rate were documented [12]

II. Exercise training program

Each woman in the three groups was participated at exercise training program for 3 months (3 times per week) each exercise session was hold for 30 minutes. Each woman was instructed not to eat for 2 hours before the exercise session.

The exercise training program was in the form of walking on treadmill, and asking each woman not to tightly grasp the rails because this action reduces the workload at any stage of exercise. To overcome this problem each woman was asked to remove their hands from rails, close their fists, and place one finger on the rails to maintain balance after they accustomed to walking on the treadmill.

The exercise session was started by five minutes warm up which involved walking with comfortable speed and no inclination at the walk way of the treadmill followed by twenty minutes of walking with 15 degrees inclination at the walk way of the treadmill and adjusted resistance to reach (50-65% THR) in group (A), (65-75% THR) in group (B), and (75-85% THR) in group (C).[13] The THR = [(maximal heart rate - resting heart rate)] + resting heart rate.[14] Maximum heart rate was detected according to Borg scale for rating perceived exertion. Then the session is ended by 5 minutes of cool down in which the intensity of the exercise was reduced to the level of the warm up.

III. Data analysis

For all the statistical testes done, the threshold of significance was fixed at the 5% level (P-value). P-value > 0.05 indicated non significant results. P-value < 0.05 indicated highly significant results. Using student t-test to compare intra subjects while, one way ANOVA to compare between subjects in the three groups.

RESULT

Table (1): Physical characteristics of the three groups

Variable	Group(A)	Group(B)	Group(C)	P-value
	X±SD	X±SD	X±SD	
Age (yrs)	42.2± 6.27	42.86±5.34	40.33±5.17	0.44
Weight (Kg)	87.86± 6.49	85.0±5.87	88.06±3.95	0.25
Height (cm)	166.6±4.3	164.53±5.39	163.13±4.67	0.15
BMI (Kg/m^2)	31.63±1.31	31.37±0.81	32.1±0.9	0.16
Duration of illness (yrs)	3.2±1.37	2.86±1.3	3±1.36	0.79

Table(2) Comparison of coagulation and cardiovascular parameters between subjects among study groups.

Variable	Timing	Group (A) X±SD	Group (B) X±SD	Group (C) X±SD	P
Maximum Heart Rate (bpm)	Pre	143.26±10.31	145.40 ± 9.65	144.50±9.25	.471
	Post	155.46±11.44	150.66±10.64	147.13 ± 13.95	.014*
Resting Heart Rate (bpm)	Pre	85.50 ± 6.48	83.28 ± 5.52	83.5±5.15	.527
	Post	76.00 ± 0.36	76.14 ± 5.72	78.35±6.55	.528
SBP(mmHg))	Pre	145.66±4.57	144.66±4.8	146±4.3	.710
	Post	144.33±4.57	140.33±1.29	146±4.92	.0001*
DBP(mmHg)	Pre	95.33±3.99	95.0±3.77	94.66±3.99	0.89
	Post	91.66±5.23	83.33±5.23	95.33±4.41	0.001*

The result showed in table(2) significant reduction in both systolic and diastolic blood pressure in both mild and moderate intensities groups (SBP: P < 0.04 & P < 0.003),(DBP; P < 0.001& P < 0.001)respectively. Whereas, there was no significant differences for SBP&DBP in group C(P =0.68 & P = 0.16) respectively. Analysis of variance across the post measurements of three groups revealed significant reduction of systolic and diastolic blood pressure (F=10.8 P < 0.001) &(F=22.9 P < 0.001) respectively .Maximum heart rate was significantly increased for all study groups ,whereas resting heart rate were significantly reduced for all study groups but comparison between three groups revealed a non significant deference between groups (p=0.528).

Table(3) Comparison of coagulation and cardiovascular parameters between subjects among study groups.

Variable	Timing	Group (A) X±SD	Group (B) X±SD	Group (C) X±SD	P
Bleeding time (sec)	Pre	90.0±22.99	92.0±23.05	93.46±19.30	0.9
	Post	91.0±22.77	89.33±19.44	85.86±15.82	0.02*
Clotting time (sec)	Pre	401.66±51.02	406.33±97.18	406.66±59.12	0.94
	Post	395.0±51.02	387.0±63.3	379.0±60.71	0.001*
Prothrombin time (sec)	Pre	12.0±0.92	12.26±0.45	12.13±0.74	0.61
	Post	12.46±0.83	12.0±0.53	12.2 ±0.41	0.08
Prothrombin concentration %	Pre	81.0±4.62	80.66±2.96	82.33±5.23	0.13
	Post	82.0±6.03	81.33±1.75.6	82.33±4.95	0.09
Platelets count	Pre	244066.66±56683.91	258666.66±61396.44	259666.66±53867.12	0.7
	Post	244666.66±54197.61	243666.66±40420.4	285333.33±58446.14	0.001*

In respect to the coagulation parameters table (3) firstly, showed that bleeding time in group C who participated in the high intensity of exercise had a highly significant reduction in post training value ($P < 0.001$). While, there were a statistically non significant differences in the other groups (A & B) who participated in mild and moderate intensities ($P < 0.09$ & $P < 0.07$) respectively, while comparing between the three groups revealed a statistically significant differences across the post training measurements in all study groups ($F = 4.08$ & $P < 0.02$). For the clotting time, group C who trained with high intensity of exercise had a statistically significant increase post training value ($P < 0.03$). While, there were none significant differences in mild and moderate intensities of exercises ($P < 0.16$ & $P < 0.06$) respectively. Post training measurement were statistically different across all study groups ($F = 8.35$ & $P < 0.001$). for Prothrombin time and its concentration showed a statistically non significant differences among the three groups in both intra and between subjects ($F = 3.57$ & $P < 0.08$) & ($F = 3.38$ & $P < 0.09$) respectively. In platelet count showed a statistically highly significant increase ($P < 0.001$) in the severe exercise group), while, there were non significant differences in mild and moderate intensities ($P < 0.73$ & $P < 0.75$) respectively. At comparing between the three groups showed a statistically significant increase ($F = 9.93$ & $P < 0.001$).

DISCUSSION

Although it is well established that regular physical activity and increased cardiorespiratory fitness[15] are associated with reduced CVD risk, the mechanisms are not fully understood. Improvement in coagulation profile may be a mechanism for training-induced CVD risk reduction. Several studies have investigated this relationship, and although the majority of cross-sectional studies have observed a significant inverse dose-response relationship with markers of coagulation at rest [16,10], such a relationship has not been entirely consistent moreover doubts remain over the optimal volume (frequency, duration, & intensity) of exercises and the minimum volume for health benefits in particularly about intensity (e.g. moderate versus vigorous) on health status.

In this study, before and after exercise training with moderate and mild intensities resulted in non significant changes in coagulation factors where as the high intensity exercises showed a highly significant reduction in bleeding and clotting times ($P < 0.001$ & $P < 0.03$) respectively with significant increase in platelets counts($p< 0.001$) in coagulation parameters. For cardiovascular parameters ; result showed significant reduction of systolic blood pressure for both mild and moderate intensities($p< 0.04$& $p<0.003$) respectively and significant reduction in diastolic blood pressure for mild moderate intensities ($p < 0001$ & $p < 0001$)respectively compared to the non significant changes in systolic($p=0.86$) and diastolic blood pressure ($p=0.16$) high intensity exercise,. For maximum heart rate , significant increase of heart rate was shown for all study groups , similarly a significant reduction of resting heart rate was achieved across all study groups.

The great and significant reduction in blood pressure (systole and diastole), bleeding and clotting times was similar to that of Ikarugi et al'[17]. They found that high intensity exercise (75% THR) lead to insignificant increase in platelet count and moderate intensity cycling exercise for twenty minute at 71 % of maximal oxygen consumption twice per week for twelve weeks in sixty hypertensive male caused significant reduction in bleeding, blood pressure and clotting times. Also, EI-Sayed et al [4] found that high intensity exercise (80% THR) lead to insignificant increase in platelet count and moderate intensity exercise (70% THR) causes activation of coagulation, increases the coagulation factors specially factor VIII and great and significant reduction in bleeding time ,clotting times and blood pressure when exercised fifty hypertensive females on treadmill for ten minute twice a week for eight weeks.

The great and significant reduction in bleeding times was similar to that of Wang et al [18], they found that cycling exercise on a bicycle ergometer at about 75% of maximal oxygen consumption (high intensity exercise) for twenty-five minute per day, for five days per week for eight weeks in thirty moderate hypertensive male caused significant increase in platelet activity, aggregation, and adhesiveness as well as reduction in bleeding times.

In the current study there was no significant changes in Prothrombin time and Prothrombin concentration % In contrast to these findings, Andrew et al [19] studied the response of the haemostatic system (prothrombin time and concentration and platelet count) of ten hypertensive females after low intensity cycling exercise for twenty minute three times per week for eight weeks. They found that the major changes in the haemostatic system occurred with high intensity exercise (after 80% of maximal heart rate) while minor changes occurred with moderate intensity exercise (at 70-80% of maximal heart rate).This study were confirmed by Davis et al [20] who applied different intensities of cycle ergometer exercise for ten minute twice a week for twelve weeks to five hypertensive males and found that the activation of blood coagulation was intensity dependent. But the number of persons in both studies was too small decreasing the value and reliability of their study.

Similarly, the study of Gonzales, et al [21]showed great and significant increase in prothrombin concentration and consequently a great and significant reduction in prothrombin time cycle ergometer exercise (70% THR) for 35 min twice a week for fifteen weeks in forty-five healthy males. They stated that regardless the age, regular physical exercise diminishes the age negative effects on liver function and is effective in raising prothrombin substance.

In the current study the blood platelet count was significantly increased with exercise in exercise group with high intensity which was similar to that of Rock et al [22] and Mckenzie et al [23], they reported that, blood platelet count increased with high intensities of cycle ergometer exercise (75% THR) for twenty minute four times a week for twenty weeks in fifty healthy male. The increase in platelet count in response to exercise may be due to the mechanical action of the circulation on blood platelets, washing them into the circulating pool.

This is in contrast to both Bartsch et al [24], who found no change in platelet count immediately after marathon race for 100 Km (high intensity exercise) in nineteen well trained male runners, and Rcker et al [25]. who found no change in platelet count after high intensity isometric exercise (80% THR) to the dominant arm for fifteen minute three times a week for ten weeks in forty healthy females.

The significant elevation of platelet count with high intensity exercise group in this study was most probably due to increase blood pressure with high intensity exercise that increase shearing force on platelet that lead to increase micro particle and total count of platelet that induced activation of the haemostatic system.

In the current study the high intensity exercise induced reduction in bleeding and clotting times which are considered as the most important indicators of platelet function. This was confirmed by Banfi et al [26] who studied the platelet function in athletes after a race of 30 Km. in high altitude (6700 m. ascents and descents), they found that the bleeding and clotting times were greatly and significantly decrease.

Ware et al [27] exercised eighteen hypertensive women on treadmill for thirty minutes per day five days per week for two months at 50% of maximum oxygen consumption (low exercise intensity), they recorded minimal and significant depression of blood pressure (systole and diastole) and platelet count after exercise but when exercise deconditioning program was continued for 3 months all changes returned to the base line.

Ibboston et al [28] studied the effect of low intensity exercise (60% THR) on bicycle ergometer for fifteen minute three times per week

for three months on the haemostatic system of sixteen newly diagnosed hypertensive males without vascular complications and nine healthy volunteers. They found that the response of the two groups was apparently different. They recorded activation of coagulation variables (bleeding time and platelet count) in healthy persons, such response was found in hypertensive patients but with a lesser degree.

In the current study result showed significant reduction of resting heart rate across all measurement for the three study groups with no significant differences when comparing all post measurement for the three groups , the result was in agreement of Juliano et al [29] who reported that there were no significant changes in the autonomic indicators of neural activity that were observed after different type of exercise intensities and duration Compared with the pre-exercise values, they found that there were no significant changes in the heart rate , Low frequency (LF)R-R and high frequency (HF) R-R after the intense short session, the moderate short session, the light long session and the control session or in the LF/HF after any of the sessions . There was a significant increase in the LF_{R-R}^{nu} and HF_{R-R}^{nu} between zero and five minutes post-exercise for the moderate long session.

The result of our study is contrasted with that of Forjaz et al, [30]. they reported that Stroke volume (SV) increased and heart rate (HR) decreased following control and exercise at 30% of VO2peak whereas SV decreased and HR increased after exercise at 50% and 75% of VO2peak. The differences of result may be attributed to selection of exercise intensity for the three exercise groups.

In the current study , mild and moderate intensities of walking exercise positively affect the blood pressure without adversely affect process of blood coagulation and improve the function and responsiveness of blood platelets so hypertensive subjects and those suspected to suffer from thrombus formation are advised to perform moderate intensity walking exercise to help in reduction of blood pressure. Additionally; mild and moderate intensities have beneficial effect on resting heart rate and maximum heart rate.

CONCLUSION

Therefore, it was concluded that exercise with different intensities may elicit significant improvement in cardio vascular parameters including ; maximum and resting heart rat , where as exercise with mild and moderate intensities exercise may have a significant effect in reducing systolic and diastolic blood pressure compared to high intensity exercise in mild hypertensive , it is also concluded that high intensity exercise may be associated with significant increase in coagulation profile including bleeding time, clotting time and platelets count compared to mild and moderate intensity exercise

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