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Influence of core stability exercises on cardiovascular parameters in physically inactive individuals

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Abstract
Physically inactive individuals increase in India is due to modernization and it is rapidly increased in urban areas. Exercises are having a propensity to alter the blood vessel changes and it dilates the vessels and promotes more circulation to the part which was under exercises. There are various exercises which are prescribed for the patients with low back pain, among these exercises the core stability is recently added, although there are various benefits are found while applying core stability exercises for the low back pain, their effect on cardiovascular system is not identified and well studied. So this study identifies the effect of core stability exercises on cardiovascular parameters in physically inactive individuals. Experimental study design with 50 physically inactive individuals were recruited using the international physical activity questionnaire (short form), they all advised to do a set of core stability exercises, all the exercises were conducted for 4 times a week and the study organized for two weeks. The data were collected on the first visit of the patient and immediate post exercises, at the end of first week and end of second week. The data were collected through Sphygmomanometer for systolic and diastolic blood pressure and pulse oximetry for heart rate. The collected data was analyzed using SPSS 21.0. The result of the study identifies that the F value of Heart rate is 440.34, 47.29 and 72.82 for the Systolic and Diastolic Blood pressure respectively. There was a significant differences identified between the groups. This study concludes that there is a significant rise in the heart rate and blood pressure following exercises, but the elevation of these cardiac parameters will tend to reduce following regular exercises.

Keywords: core stability exercise, physically inactive, heart rate, blood pressure

1. Introduction

Inactivity is now becoming a major health concern in modern society. It has now becoming leading cause of death [1]. Inactive individual may be exposing themselves to a lot of chronic diseases and health conditions [2]. Sedentary lifestyle is considered to be one of the most important and modifiable risk factors for cardiovascular morbidity and mortality [3].

Physically inactive is rapidly increasing in India due to economic changes and increased mechanization [4]. It was more in urban areas than the rural [5]. Increase risk of cardiovascular problems in physically inactive individual is 90% if an individual spends 3.6 hours per day as inactive [6].

Exercises are the choice of modality for the rehabilitation of the patients with chronic low back pain. Core stability training has now become popular form of treatment and it has begun to be applied in rehabilitation programmes and in sports medicine as prophylactic care to sport injury preventions [7]. Core stability exercises have becomes the major focus in spinal rehabilitations [8].

During exercises there are lot of changes occurs to meet the demand placed by the muscles to carry out its functions with maximal efficiency. There will be oxygen demand occurs in the muscles while exercising. The speeding up of the metabolic process occurred with more nutrition used in the body which cause raise in body temperature [9].

Research demonstrates that dynamic exercises produce striking burden to the cardio respiratory systems. There is a linear relationship exists between oxygen consumption and exercise intensity up to the maximal amount of oxygen [10]. Dynamic exercises also provide modest effects on arterial blood pressures. There was increase in blood pressure observed during dynamic exercise is not the result of increased total peripheral resistance [10]. Sedentary lifestyle is one of the major risk factors for cardiovascular diseases. Regular exercise has a favorable effect on many of the established risk factors for cardiovascular disease. Various benefits of exercises seen in cardiovascular performances, vast evidences were found that exercise training improves the capacity of the blood vessels to dilate in response to exercise or hormones, consistent with better vascular wall function and an improved ability to provide oxygen to the muscles during exercise [11].

Physical exercises are identified to increase heart rate in the initial transition of exercises, and the adjustment of heart rate lowers when the exercises continue [12]. There are different mechanisms act to adjust heart rate during physical exercises [13]. The mechanism of increase of heart rate is due to activity of autonomic nervous system (ANS) through its sympathetic and parasympathetic branches on the sinus node of autorhthmicity, especially resting vagal activity, which is progressively inhibited when exercises started, and the sympathetic activity when exercises is further incremented [14].

It was hypothesized that exercise induced stress could unmask a latent tendency towards hypertension [15].There may be exaggerated BP response to exercise in normotensive subjects [16, 17]. During physical exertion there is an increase in cardiac output, a rise in systolic blood pressure is a natural consequence of dynamic exercises. Diastolic blood pressure remains unchanged or shows only a slight increase as a consequence of metabolic vasodilatation of the peripheral vessels [18].

Blood pressure is usually measured using sphygmomanometer. It is a reliable device and is essential for healthcare facilities and research. The devices which register pressure using mercury column were the routine choice for many years and this is still the "gold standard" for blood pressure measurement. Sphygmomanometers are widely used for variety of conditions and types of patients.

Continuity of measurement standards is also vital for long term studies [19].

Exercises have been shown to protect against injury. Sedentary or Physical inactivity results in greater chance of cardiovascular compromises as well as more prone for musculoskeletal injuries. Exercises benefited on improvement of oxygenation to the tissues. Core stability exercises are form of isometric and isotonic exercises which are commonly used to prescribe for low back pain, but the influence of this exercises on cardiovascular parameters are not well studied. However there are studies which supports that exercises has positive influence on the cardiovascular system, there was poor research on the influence of core exercises on cardiovascular parameters. This study aims to identify the effect of core stability exercises on cardiovascular parameters in physically inactive individuals.

2. Method

This study was approved by institutional ethical committee, KG hospital. Study is a experimental design with 56 individuals were selected for the study, once the study organizes there were 6 individuals withdrawn from study because of personal reasons, so the study was completed with 50 participants. All the participants were selected from the college campus who fulfills the criteria of sedentary person. The international physical activity questionnaire (short form) was given to all the individuals who show interest in the study and those with low score were considered for the study. The age group of participants was 30—42 years, both gender was Included, individuals without history of back pain were recruited. Individuals without any neurological or musculoskeletal complain, without any history of high blood pressure or low blood pressure or any sort of cardiac diseases. A clear explanation about the study was instructed to all the participants. Participants are instructed to withdraw from the study at any time. Consent form was obtained from all the participants. A detailed explanation was presented to them through power point slides on the ill effects of sedentary lifestyle. All the participants were involved in six set of core stability exercises, which was the common exercises prescribed for patients with low back pain. Exercises includes a) supine abdominal drawing b) Exercises in Quadruped position c) Co-contraction of the Transversus Abdominis and Multifidus in upright position d) Exercises in dorsal decubitus in flexed knees e)Unilateral bridging and f) Sitting abdominal drawing with weights in the upper limb [36, 37, 38]. All participants underwent all these exercises for 3 repetitions, Prior to the beginning of exercises 10 mins bicycle ergometer was given to warm-up the participants, the exercise session is 4 days in a week, total of 8 sessions in two weeks. The data were collected on the first visit of the patient and immediate post exercises, at the end of first week and end of second week. The data were collected through Sphygmomanometer for systolic and diastolic blood pressure and pulse oximetry for heart rate. The collected data was analyzed using SPSS 21.0.

3. Result

Repeated measures ANOVA for heart rate, Systolic Blood pressure and Diastolic Blood Pressure (including pre exercise, post exercise, 1 week and 2 weeks) is shown in table 1, once the F statistics is significant post hoc test is used to compare the post test values at 0.05 level of significance.

Table 1

Variables	Heart Rate	Systolic Blood Pressure	Diastolic Blood Pressure	Level of significance
F Statistics	440.34	74.29	72.82.	0.005
Pre vs Imm Post	49.23	20.32	20.14	0.001
Pre vs 1st week	33.40	13.17	13.23	0.001
Pre vs 2nd week	19.49	7.43	7.67	0.001
Imm Post vs1st week	15.22	7.14	6.92	0.001
Imm Post vs 2nd week	29.73	12.88	12.47	0.001
1st week vs 2nd week	14.50	5.74	5.55	0.001

4. Discussion

The purpose of the study is to identify the effect of core stability exercises on cardiovascular parameters in physically inactive individuals. Studies identified that physically inactive cause reduction in the maximal oxygen capacity. The oxygen capacity will improve at once the individuals' initiates' workout within days. In physically inactive individuals the maximal cardiac output was reduced because of decreased stroke volume due to reduce venous return. Increased stroke volume appears to result from increased venous return during exercise and improved cardiac performances [10].

During moderate exercise intensity Chapman and Elliott found a significant increase in HR and SBP during DE, while DBP was highest during exercises [20]. During exercises the skeletal muscle blood flow increases nearly to 20 folds. However, the physiological mechanism which is responsible for the regulation of skeletal muscle blood flow during contraction remains relatively unknown [21]. Skeletal movements require activation and control of the musculoskeletal system, cardiovascular system and respiratory systems provide ability to sustain the movements for extended period of time. Bodily Adaptation to the exercises occurs upon training for several times in a week or frequent exercises [21].

Vagal withdrawal and sympathetic augmentation observed during dynamic exercise, the increase in the overall heart rate and the blood pressure during static exercise suggest an increased activity of both autonomic branches [22]. During exercises there is an increase in arterial pressure, this occurs due to contraction of skeletal muscles which compresses the blood vessels throughout the body. This cause large quantity of blood from the peripheral vessels into the heart and lungs, which increase the cardiac output leads to increase in arterial pressure [23].

Increase of cardiac output is noted in the beginning of the exercises where as there is an increase in stroke volume and heart rate. Rise in the stroke volume cause increase venous return. Myocardium contractility is enhanced by the sympathetic nervous system which is activated by initiation of physical activity [24]. There is an increase in heart rate immediately after the exercises which result in parasympathetic withdrawal, as exercises continued there is further increase in heart rate due to activity of sympathetic nervous system [25].

Isometric exercises are responsible for elevated heart rate, it also cause increase in motor unit activation as well as stimulation of new motor unites which increases excitation of the central nervous system which possibly increases the sympathetic outflow and a decrease in the parasympathetic outflow which cause rise in blood pressure [26]. Efferent sympathetic fibers increase heart rate and the myocardial contractility. Muscle mass and the amount of work also differ with the raise in the heart rate [27]. This mechanism seems to demand a higher activation of motor units with a corresponding increase in central command to the cardiovascular centers that modulate heart rate control. Elevation of heart rate depends on the heart rate level rather than the type of exercises.

Systolic blood pressure (SBP) will rise in a pattern very similar to that of cardiac output. Peripheral resistance decreases owing to vasodilatation in the active muscles which was influenced by local chemical factors. Cardiac output increases because of reduction of resistance in vessel walls, mean arterial pressure increases slightly during dynamic exercises [26]. Long term moderate exercises produces rapid cardiac output in the initial stage of exercises then followed by the lowering of cardiac output. Initial increase in cardiac output is brought about by an increase in both stroke volume and heart rate. The increase in stroke volume results from an increased venous return, leading to the Frank-Starling mechanism, and increased contractility owing to sympathetic nerve [28].

Heart rate increases rapidly during the first 1 or 2 mins of exercises then the magnitude increases depending of the intensity. The rise in heart rate is by the parasympathetic withdrawal and activation of the sympathetic nervous system. The increase in heart rate is proportional to the decrease in stroke volume, so cardiac output is maintained during exercise [28]. The increase blood pressure during exercises is due to increase in peripheral vasoconstriction as well as rise in the stroke volume [29]. Metabolites accumulation following isometric muscle work is also one of the reasons for the rise in blood pressure during exercises [30]. Change in the central command which is mirrored by the increased effort by the individual might contributed to the elevation of blood pressure [31]. However, the muscle metaboreflex has been suggested to be the dominant mechanism responsible for the vasculature response (blood pressure increase), whereas the central command is supposed to be the main modulator of the cardiac response (heart rate increase) during exercise. [32, 33].

Study done by Vyas 2015 has shown that there were significant differences in the cardiovascular parameters such as blood pressure, heart rate and respiratory rate after the lumbar core stability exercises. [34]. Study done by Subramanian *et al*., 2014 has shown that there were significant differences exist in the cardiovascular parameters following application of core exercises using a Swiss ball. [35].

Post hoc results in the study have clearly shows a significant difference in heart rate, blood pressure values following the administration of cores stability exercise. The study identifies that there was a rapid raise of heart rate and blood pressure values following exercises, where as it is reduced following regular administration of exercises for one week and two weeks. This study makes clear that while prescribing the core stability exercises physical therapists should be aware of the rapid raise of cardiovascular functions and there should be some precautionary measures advised while prescribing exercises to the patient with any cardiovascular problems.

5. Conclusion

This study concludes that there is a significant rise in the heart rate and blood pressure following exercises, but the elevation of these cardiac parameters will tend to reduce following regular exercises. The study duration was very limited as well as the participants were, inclusion of many participants would have yielded many results in the long time duration.

6. References

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