

Original Research Article


Cardio vascular response to core stability exercises in healthy individuals

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Abstract

Background: Low back pain is the most common problem which is present among 60 to 80 percent of population in the world at least once in their life time. It is considered as the most influencing aspect of health of an individual as well as their daily living status.

Objective: To examine the cardiovascular responses (Heart Rate, Systolic Blood pressure and Rate Pressure Product) in the abdominal techniques that are (bracing and hollowing) used in core stability exercises. Core stability exercises have been used in the management of low back pain. The cardiovascular effects of exercises that involve postural stabilization, arms and exercises in a lying position are well known. Therefore, the purpose of this study was to examine the cardiovascular effects of 6 core stability exercises on cardiac patients which were used commonly for the treatment of low back ache.

Materials and methods: This was a descriptive study which was conducted on a single group of 40 healthy males and females volunteers between age group of 18-25 years. With the mean age group of 21.12±1.042. Subjects were undergraduate students of MNR Sanjeevani College of physiotherapy, Sangareddy and were taken on the basis of convenient sampling. Prior to the participation all subjects were explained briefly about the aims and objectives of the study, health benefits of the core stability exercises and about the procedure of measuring Heart rate (HR), Systolic Blood pressure (SBP) and Rate Pressure product (RPP). All subjects were screened and a detail medical history was taken to exclude any serious illness. Health screening tool questionnaire (AACVPR) was used to identify the serious illness in the subject. One day before to the exercise session subjects were taken to the

experimental room for familiarization of the procedure. The selected core stability exercises were demonstrated and subjects were instructed not to eat an hour before and not to wear tight clothes, Exercise protocol was designed properly and perfectly for the subjects so that they will be able to perform the exercises easily and effectively and the subjects were asked to participate in the exercise sessions after taking all the necessary measures. Pre and post exercise measurements of Systolic Blood pressure (SBP), Heart rate (HR) and Rate pressure product (RPP) values were measured. Before starting the exercise session subjects were made to relax for 15- 20 minutes, then the initial parameters of cardiovascular performance Systolic Blood pressure (SBP) were measured using automatic BP apparatus Omron M 10. BP cuff was tied to the left arm and patient was in high sitting position with arm supported at heart. Heart rate (HR) and Rate pressure product (RPP) were also measured at the same time along with (SBP). Subjects were asked to do 5 repetitions of all the exercises without any rest period. Post exercise Heart rate (HR), Systolic Blood pressure (SBP), and Rate Pressure Product (RPP) were recorded immediately after they finish the exercise. Now they were made to take rest till resting heart rate (RHR) was achieved. So for the given exercise sessions Systolic Blood pressure (SBP), Heart rate (HR) and, Rate Pressure Product (RPP) were measured for pre and post exercises.

Results: There was marked increase in the cardiovascular parameters (heart rate, Systolic Blood pressure, and Rate Pressure Product). After exercise was performed, all the exercises were hemodynamically demanding. The study was done on single group of 40 healthy subjects with the mean age of 21.12 ± 1.04 in which 20 were males and 20 were female subjects. The baseline systolic blood pressure was 110.30 ± 11.00 and baseline rate pressure product was 8797.15 ± 1419 . The study was done with the aim to measure the acute cardiovascular responses to the core stability exercises. Repeated measures of ANOVA were used as the statistical tool.

Conclusion: Core stability exercises can have cardiovascular effects in people with no cardiovascular or cardiopulmonary conditions. These cardiovascular effects may be important with respect to cardiac work, in Cardiac patients for whom these exercises are indicated. So, There was a significant increase in the cardiovascular parameters (Heart Rate, Systolic Blood Pressure, Rate Pressure Product) after the entire exercise session was performed by the subjects of the study.

Key words

Core Stability Exercise, Heart Rate (HR), Systolic Blood Pressure (SBP), Rate Pressure product (RBP).

Introduction

Low back pain is the most common problem which is present among 60 to 80 percent of population in the world at least once in their life time. It is considered as the most influencing aspect of health of an individual as well as their daily living status. It is not only affecting the normal individuals but also affecting the athletic population all over the world at different levels of sports and competitions.

Low back pain results in significant loss of time and money and creates discomfort to an individual. According to Many doctors low back

pain in athlete's ranges from 10 to 30 percent which depends on factors such as Type of sport, Intensity of sport, Duration of sport played, Gender, Frequency of training.

It is also that specific imaginary techniques are also not able to identify specific pain generators responsible for back pain and dysfunction.

Low back pain is a dynamic process with high rates of incidence and prevalence in both men and women equally. It is considered as one of the most common musculoskeletal disorder affecting 60 to 80 percent of general population of life

time prevalence and affecting 10 to 30 percent of annual prevalence in general population [1].

Recently there has been significant increase in the use of core stability training for normal as well as sports conditions and also for general, geriatric, and sport population which is helping to enhance the quality of life [2].

Core strength and endurance are considered to be important for athletic, general and geriatric population health that includes prevention and treatment of low back pain.

Researcher suggested that strong and durable core muscles stabilizes the spine favorably by providing greater support with effective mechanical integrity and enhanced neurological requirement patterns including timely activation of these muscles when exposed to forces and loads.

Hence it is better to establish proper strength and endurance of lower back for both normal and athletic people. For this purpose we need to concentrate on various precautions, strengthening techniques in order to prevent disability and injury to an individual which will promote and maintain a normal healthy life style [3].

Core is described as a muscular box with the abdominals in front Para spinals and gluteus in the rear, Diaphragm at the top, pelvic floor and hip girdle musculature at the bottom. Within this set up of core several muscles helps to stabilize the spine and pelvis as well as transmit the forces through the kinetic chain without the stability provided by the core musculature the spine would become unstable with forces present all over it [4]. Core is the combination of 3 subsystems 1) Active subsystem 2) Passive subsystem 3) Neural subsystems which are highly integrated with one another and are optimized which are necessary for the common bio mechanics of the spine.

If any of this one system is impaired it could lead to instability of spinal column presiding to

Injury, Dysfunction, and Pain developed over gradual period of time.

Active subsystem: It involves spinal muscles and tendons that provides forces required to maintain stability of spine

Passive subsystem: It mainly consists of spinal segments, ligaments that provide stability in the end of the motion.

Neural subsystem: Neural control involves receiving information from the active sub systems and determines the forces required to maintain spinal stability and adjusts the force production of the musculature accordingly.

Core stabilization is defined as the ability to control the position and motion of the trunk over pelvis and leg to allow for optimum production, transfer and control of force and motion to the terminal segment in integrated kinetic chain activities.

Now we should have some knowledge about the required cardiac parameters for the present study cardio vascular response to core stability exercises in healthy individuals. Direct measurement of myocardial work and function of myocardial oxygen demand will involves non-invasive techniques which are not easy for the proper measurement and hence we will use simple non-invasive measures to calculate cardio vascular responses like Heart rate (H.R), Systolic Blood Pressure (SBP), Rate Pressure Product (RPP) [5, 6].

Heart rate: It is the number of beats or number of contractions of the heart per minute. This is 72 beats/minute.

Systolic blood pressure: It refers to the amount of pressure in your arteries during the contraction of your heart. This is 120/80(In this 120 is referred as systolic BP.

Rate pressure product: It is the product of heart rate and systolic blood pressure which is multiplied by 10^2 . The RPP is considered as an excellent index of myocardial oxygen demand and therefore work of the heart [7]. According to

some researchers, acute exercise produces major stress on the cardio vascular system and the physiological response to it is varied and interdependent. The increased myocardial work assessed noninvasively using RPP, reflects increase in both HR and BP during multiple repetitions of 4 McKenzie exercises that are commonly used. So we can hypothesize that the core stability exercises are considered to be more hemodynamically demanding and will put the cardiovascular system in more stress. It has been already proved that exercises performed by the people with coronary heart disease in supine lying position will be more stressful to heart while performed in the upright position.

Hence this study mainly focuses on the precautions we should take while prescribing exercises to the patients with cardiac instability or cardiac diseases.

So that we can avoid more demand and stress on the heart which is caused while performing the core stability exercises for lower back pain.

Materials and methods

Inclusion criteria

- Healthy males and females
- Age between 18 to 24 years

Exclusion criteria

- Subjects with recent episode of back ache
- History of any cardiovascular problem
- Recent musculoskeletal injury
- History of smoking
- Subjects with regular participation in any athletic activity

After considering the inclusion and exclusion criteria 40 subjects were taken for the exercise sessions.

Strategy

The study was conducted on single group of 40 healthy males and females volunteers between age group of 18-25 years. With the mean age group of 21.12 ± 1.042 . Subjects were undergraduate students of Sanjeevani College of

Physiotherapy, Sangareddy were taken on the basis of convenient sampling. Prior to the participation all subjects were explained briefly about the aims and objectives of the study, health benefits of the core stability exercises and about the procedure of measuring Heart rate, Systolic Blood pressure and Rate Pressure product. All subjects were screened and a detail medical history was taken to exclude any serious illness. Health screening tool questionnaire (AACVPR) was used to identify the serious illness in the subject.

Methodology

Patient preparation: One day before to the exercise session subjects were taken to the experimental room for familiarization of the procedure. The selected core stability exercises were demonstrated and subjects were instructed not to eat an hour before and not to wear tight clothes

Following core stability exercises were used

- Abdominal drawing in
- Abdominal curl
- Back bridging
- Side bridging
- Prone bridging (with elbow and toe position)
- Four point kneeling with alternate arm and leg extension

Exercise protocol was designed properly and perfectly for the subjects so that they were able to perform the exercises easily and effectively.

The subjects were asked to participate in the exercise sessions after taking all the necessary measures efficiently and properly then Pre and post exercise measurements of Systolic Blood pressure, and Heart rate and Rate Pressure product values were measured.

Measurement procedure

Before starting the exercise session subjects were made to relax for 15-20 minutes, then the initial parameters of cardiovascular performance Blood

Pressure were measured using automatic BP apparatus Omron M 10, BP cuff was tied to the left arm and patient was in high sitting position with arm supported at heart. Heart rate and Rate Pressure Product were also measured at the same time along with Systolic Blood pressure.

Exercise session:

Procedure: Systolic Blood pressure, Heart rate, Rate pressure product were measured, that was pre measurements are taken before performing the exercise session.

Subjects were asked to do 5 repetitions of all the Exercises [7] without any rest period. Post exercise Heart rate and Systolic Blood pressure, Rate pressure product (RPP) were recorded immediately after they finish the exercise.

Now they were made to take rest till Resting Heart Rate (RHR) was achieved. So for the given exercise sessions Systolic Blood pressure and

Table - 1: Mean age.

N	N	Minimum	Maximum	Mean	Std. Deviation
AGE	40	19.00	24.00	21.12	1.042

Table - 2: Age distribution.

Age	No. of subjects	Percent
19-20	10	25%
21-22	25	62.5%
23-24	5	12.5%

Table – 3: Gender distributions.

Gender	No of subjects	Percent
Male	20	50%
Female	20	50%
Total	40	100%

Table – 6 shows the Mean Rate Pressure Product and Standard Deviation of given core stability exercise. **Table – 7** shows the comparison between the Baseline Systolic Blood Pressure and post exercise Systolic Blood Pressure of exercise session. The result shows there was a significant difference after complete exercise session. **Table – 8** shows the comparison between the baseline of Heart Rate with post

Heart rate, Rate pressure product were measured for pre and post exercises. Now all data were collected and tabulated.

Outcome measures

- Heart rate
- Systolic blood pressure
- Rate pressure product

Results

Table - 1 shows the mean age of subjects i.e. 21.12 ± 1.042 (SD) taken for the study. **Table - 2** shows the percentage of distribution of different age groups participated in the study. **Table - 3** shows the number males and number of females participating in the study. **Table - 4** shows the Mean Heart Rate and Standard Deviation of Entire core stability exercises session. **Table – 5** shows the Mean Heart Rate, Standard Deviation of given core stability exercises.

exercise Heart Rate of exercise session. The result shows there was a significant difference after complete exercise session ($p=.001$). **Table - 9** shows the comparison between the Baseline Rate Pressure Products with post exercise Rate Pressure Product of exercise session. The result shows there was a significant difference after complete exercise session ($p=.001$).

Discussion

Core stability is defined as the ability to control the position and motion of the trunk over the pelvis, to allow the optimum production, transfer and control of force and motion to terminal segment in integrated physical activity. These exercises have been extensively used for the treatment of low back ache as well as to maintain the physical fitness, in the recent years [9].

These techniques, when performed, place the cardiovascular system at a greater stress than

normal exercises [10]. It has already been proved by many studies that some risk factors associated with back pain like obesity [11], smoking [12], increased serum lipids [13] and atherosclerosis [14] have found to have a strong co-relation for developing cardiovascular diseases.

Table – 4: Descriptive characteristics of different heart rate values.

	N	Minimum	Maximum	Mean	Std. Deviation
Baseline HR	40	63.00	97.00	79.95	9.027
Complete Exercise session HR	40	73.00	111.00	93.95	8.620

Table – 5: Descriptive characteristics of different systolic blood pressure values.

	N	Minimum	Maximum	Mean	Std. Deviation
Baseline SBP	40	92.00	136.00	110.3000	11.00629
Complete Exercise session SBP	40	103.00	151.00	126.4500	11.84072

Table – 6: Descriptive characteristics of different rate pressure product values.

	N	Minimum	Maximum	Mean	Std. Deviation
Baseline RPP	40	6270.00	12784.00	8797.15	1419.022
Complete Exercise session RPP	40	8249.00	15553.00	11930.41	1788.131
Complete Exercise session RPP	40	10416.00	17248.00	13328.28	1653.630

Table – 7: Repeated measures of ANOVA analysis of systolic blood pressure.

Base line systolic BP (I)	Post complete exercise systolic BP(J)	Mean difference (I-J)	Std. error	Sig .
Baseline Systolic BP	Post Complete Exercise session SBP	-16.150	1.211	.001

Table – 8: Repeated measures of ANOVA analysis of heart rate.

Baseline heart rate (I)	Post complete exercise heart rate (J)	Mean difference (I-J)	Std. error	Sig .
Baseline HR	Post complete exercise session HR	-14.000*	1.033	.001

Table – 9: Repeated measures of ANOVA analysis of rate pressure product.

Baseline rate pressure product (I)	Post exercise rate pressure product (J)	Mean difference (I-J)	Std. error	Sig .
Baseline RPP	Complete Exercise session RPP	-3133.256*	185.786	.001

The study was done on Single group of 40 healthy subjects with the mean age of 21.12 ± 1.04 in which 20 were males and 20 were female subjects .The Baseline Systolic Blood Pressure was 110.30 ± 11.00 and Baseline Rate Pressure Product was 8797.15 ± 1419.02 .

The study was done with the aim to measure the acute cardiovascular responses to the core

stability exercises. Repeated measures of ANOVA were used as the statistical tool. Subjects were asked to perform the entire exercises in the given exercise session and pre and post cardiovascular parameters (Heart Rate and Systolic Blood Pressure) and rate pressure product were measured before and after exercise session was performed.

The result of the present study showed that there was a significant increase in the cardiovascular parameters (Systolic Blood Pressure, Heart Rate and Rate Pressure Product) following core stability exercises.

There was significant increase ($p=.001$) in the value of post exercise Heart Rate and Systolic Blood Pressure for all the exercises when compared to the baseline Systolic Blood Pressure and Heart Rate. The mean difference of the Baseline Systolic Blood Pressure and post exercise Systolic Blood Pressure was 16.15.

There was significant increase ($p=.001$) in the value of post exercise Heart Rate for all the exercises when compared to the baseline Heart Rate. The mean difference of the baseline Heart Rate and post exercises Heart Rate was 14.0.

There was significant increase ($p=.001$) in the value of post exercise Rate Pressure Product (RPP) for all the exercises when compared to the baseline Rate Pressure Product (RPP). The mean difference of the baseline Rate Pressure Product (RPP) and post exercises Rate Pressure Product was 185.78. There was a greater increase in the cardiovascular parameters after all the exercises.

Conclusion

Core stability exercises are commonly used for the treatment of low backache. The main objective of this study was to measure the acute cardiovascular responses Heart Rate, Systolic Blood Pressure, Rate Pressure Product to the core stability exercises. Cardiovascular parameters in term of Heart Rate, Systolic Blood Pressure and Rate Pressure Product were measured before exercise and immediately after exercise session. There was a significant increase in the cardiovascular parameters (Heart Rate, Systolic Blood Pressure and Rate Pressure Product) after entire exercise session.

Limitations of the study

- Sample size was less.

- Only few cardiovascular parameters were like HR, SBP and RPP was measured.
- The study was only conducted on the younger healthy and asymptomatic adults of age group between 18-25 so it cannot be generalized for individuals less than 18 and more than 25.

Further recommendations

Further study should examine Cardiac Output, Stroke Volume and Blood Lactate Accumulation. Different age group people can be taken. It can be done on symptomatic individuals.

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