JUMORA: JURNAL MODERASI OLAHRAGA
E-ISSN: 2797-8761
Volume 2, No. 2, December 2022
DOI: 10.53863/mor.v2i2.426
Department of Sports Education, Universitas Ma'arif Nahdlatul Ulama Kebumen

Original Article Research

Effect of Skipping Rope Training on Resting Heart Rate and Cardiorespiratory Endurance Among Soccer Players

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Received: 06/04/2022 Revised: 4/11/2022 Accepted: 05/11/2022

Abstract

The main purpose of the present study was to investigate the effect of skipping rope training on resting heart rate and cardio-respiratory endurance among soccer players. A total of forty male soccer players (age 19 – 24 years) were selected from Manipur University, Imphal, Manipur (India) who participated in the national-level competition. The subjects were randomly assigned into two equal groups, the experimental group (n=20) and the control group (n=20). The groups were measured before the intervention with resting heart rate and cardio-respiratory endurance to find out the overall significant effect among soccer players. After the initial test, the subjects of the experimental group participated in a supervised skipping rope training program, where no special exercise was administered to the control group. Skipping rope training programs were carried out for a period of six weeks, five days of training (Monday to Friday), and 60 minutes for each session. The experimental group showed improved scores in resting heart rate and cardio-respiratory endurance compared to the control group ($p<0.05$). The mean of the resting heart rate for the pre-test and post-test of the experimental group were 58.60 and 56.45 respectively. The values of the cardio-respiratory endurance were 72.41 and 80.47 respectively. The significant improvement in skipping rope training of the experimental group might be due to the six weeks of the soccer players. Skipping rope trainprogramsgram significantly improved physiological variables such as resting heart rate and motor fitness variables such as cardio-respiratory endurance of the male soccer players.

Keywords: Skipping rope training, Resting heart rate, Cardio-respiratory endurance, Soccer players

How to cite:

Singh, L. S., L. Pungding, Singh, W. J., Bjelica, B., Burhaein, E., & Zelenovic, M. (2022). Effect of Skipping Rope Training on Resting Heart Rate and Cardiorespiratory Endurance Among Soccer Players. JUMORA: Jurnal Moderasi Olahraga, 2(2), 115-124. https://doi.org/10.53863/mor.v2i2.426

1. INTRODUCTION

The effects of exercise on the human body have been the subject of much research over the past few decades. Regular physical activity causes a decrease in resting heart rate and is positively associated with the cardiovascular system (Toosizadeh et al., 2021). Skipping rope is a cheap and portable material that is affordable to everyone and also needs only minimum space. It is a low-cost physical activity, thus its impact on physical fitness is being studied by various researchers Skipping rope exercise involves the muscles in the arms and legs, and it also improves cardiovascular function and metabolism (Partavi, 2013). The modern soccer game is very fast by its nature, the spectators and the players enjoy the game of football with a great amount of merriment. It is a game of constant action and requires continuous adaptation to changing situations by the team as a whole as well as by the individual players. With the constant demand for "high sports performance" the concept of football, to date, has changed. The concept of "Total soccer" applies skill development, tactical development, and development of all important motor components and physiological parameters which are closely associated and cwith ontribute to performance in soccer (Singh, 2020). A similar type of study was to compare the cardio-respiratory endurance of inter-university and inter-college footballers of the Don Bosco College affiliated with Goa University, Goa. A modified Harvard step test was employed to measure cardio-respiratory endurance (Singh, 2013). Cardio-respiratory endurance is the ability of the body to perform prolonged, large-muscle, dynamic exercise, at moderate to high levels of intensity such as walking, running, skipping rope, cycling, swimming, dancing, aerobics, etc. The cardiorespiratory system consists of the heart, blood vessels, and respiratory system (Singh, 2020). Aerobic activities are the best choice. The most commonly used activities are: running, swimming, cycling, skipping rope, walking, and in general all sports that require accelerated work of the cardiovascular and respiratory ssystems(Nadal, Ponz, & Margalida, 2018). Improving general fitness or maintaining endurance levels is the result of properly dosed training (Bjelica, Fulurija, & Ivanović, 2017).

Heart rate is measured in beats per minute (bpm) and trained soccer players often have a lower resting heart rate than others. The resting heart rate of the hockey players and the football players was assessed with the help of the Pulse Pulpatorymethod by counting the number of beats in 60 seconds (Singh, 2020).

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2. METHOD

2.1 Participants

For this study, forty male soccer players were selected from Manipur University, Canchipur, Imphal, Manipur (India) who participated in national-level competitions. The age of subjects ranged from 19-24 years.

2.2 Research Design

The subjects were randomly assigned into two equal groups, the experimental group (n=20) and the control group (n=20). The groups were measured before the intervention with an initial test of the palpatory method and a modified Harvard step was used to find out the significant effect among the mean of selected variables such as resting heart rate and cardio-respiratory endurance. After the initial test, the subjects of the experimental group participated in a supervised Skipping rope training program, where no special exercise was administered to the control group. The Skipping rope training program was carried out for a period of six weeks, five days of training (Monday to Friday), and 60 minutesfor each session. And this research proceeds from 23rd October to 23rd December 2021.

2.3 Instruments

The palpatory method was used to investigate the resting heart rate and the modified Harvard step was used to investigate the cardio-respiratory endurance to find out the significant effect of the skipping rope training program on male soccer players.

2.4 Procedures

The objects from this study have been trained followed by the Skipping rope training program. We have processed a total of 60 minutes of workout with a warm-up exercise for 10 min, the main exercise for 40 min, and wa arm-down exercise for 05 min. The exercise was applied for 6 weeks 5 times a weekIncreasingng the scale and number of exercise movements whichaincreasesntensity of exercise (Singh L. Santosh 2018). We have composed a routine that does not get out of the previously set maximum exercise intensity. And also when practicing each move, we focused on safety more than accuracy so we suggested a bit of changed movement in parts that were tough to follow. The specific contents are composed in table 1.

Table 1

Six weeks skipping rope training program for the exercise group

Weeks	Warm-Up	Skipping Rope Training	Sets	Rep.	Rest between Sets	WarmDown	Intensity (Minutes)
1	10 Minutes	Freestyle jump, Single & Double legs jump, Alternating foot jumps	2 Sets	8	1 Minute	5 Minutes	60 Minutes
2	10 Minutes	Freestyle jump, Single &	4 Sets	10	1 Minute	5 Minutes	60 Minutes

		Double legs jump, Alternating foot jumps					
3	10 Minutes	Freestyle jump, Single & Double legs jump, Alternating foot jumps	6 Sets	12	1 Minute	5 Minutes	60 Minutes
4	10 Minutes	Freestyle jump, Single & Double legs jump, Alternating foot jumps	8 Sets	16	1 Minute	5 Minutes	60 Minutes
5	10 Minutes	Freestyle jump, Single & Double legs jump, Alternating foot jumps	10 Sets	20	1 Minute	5 Minutes	60 Minutes
6	10 Minutes	Freestyle jump, Single & Double legs jump, Alternating foot jumps	12 Sets	24	1 Minute	5 Minutes	60 minutes

2.5 Data Analysis

The collected data were entered into an excel sheet and statistical analyses were conducted using the IBM SPSS software (version 22.0; SPSS Inc., Chicago, IL, USA). The normality of statistical distribution was tested by using ANCOVA and post-doc analysis was applied to examine differences among groups. The level of significance used in the statistical analyses was 0.05.

3. RESULTS

The result of the study showed that there was a significant improvement in the resting heart rate of male soccer players of selected subjects of the experimental group and control group. The analysis of co-variance for the pre-test and post-test of the experimental group and control group for resting heart rate was presented in table 2.

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Table 2

Pre-test and post-test means of the analysis of co-variance of resting heart rate

	Experimental Group	Control Group	Source of Variance	Sum of Squares	df	Mean Squares	Obtained F
Pre-test mean	56.45	60.25	Between	200.21	2	100.11	2.29
			Within	2406.65	38	42.97	
Post-test mean	62.40	61.75	Between	387.10	2	188.60	5.29*
			Within	1672.35	38	30.20	
Adjusted Post-test mean	60.35	61.30	Between	237.80	2	113.80	4.59*
			Within	1450.77	38	25.10	
Mean Diff.	-2.18	0.60					

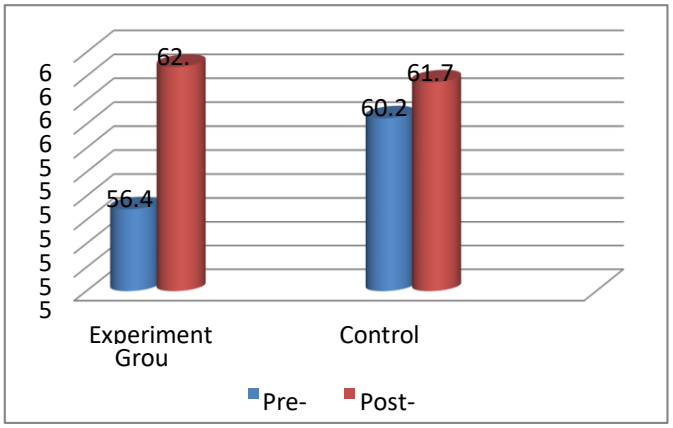
Information: Table F-ratio at 0.05 level of confidence for 2 and 38 (df) =3.16, *Significant

Table 2 reveals that the obtained means of the resting heart rate for the pre-test of the experimental and control group were 56.45 ± 60.25respectively. The obtained pre-test F-value was 2.29 and the required table F-value was 3.16, which proved that there was no significant difference among the initial scores of the subjects. The obtained means of the resting heart rate for the post-test of the experimental and control groups were 62.40 ± 61.75 respectively. The obtained pre-test F-value was 5.29 and the required table F-value was 3.16, which proved that there was a significant difference among the initial scores of the subjects.

Further, The pre-test means and post-test means adjusted post-test means were 60.35± 61.30 determined analysis of co-variance was done and the obtained F-value of 4.59 was greater than the required value of 3.16 and hence, it was accepted that there were significant differences among the treated groups. The mean score of resting heart rate for the experimental and control group were presented in figure 1.

Figure 1.

Pre-test and post-test means score of resting heart rate for experimental and control group



Source: Primary data

Since, significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table 3.

Table 3

Scheffe's Confidence Interval Test Scores on Resting Pulse Rate

Means			
Experimental Group	**Control Group**	**Mean Difference**	**Required CI**
60.35	61.30	5.00*	4.00

Information: * Significant

The post hoc analysis of obtained ordered adjusted means of the experimental group and control group were 60.35 ± 61.30 and the mean difference 5.00 respectively. It was proved that there was a significant difference between the experimental group and the control group.

The result of the study showed that there was a significant improvement in cardiorespiratory endurance of male soccer players of selected subjects of the experimental group and control group. The analysis of co-variance for pre-test and post-test of the experimental group and control group for cardio-respiratory endurance was presented in table 4.

Table 4.

Pre-test and post-test means of analysis of co-variance of cardio-respiratory endurance

	Experimental group	**Control Group**	**Source of Variance**	**Sum of Squares**	**df**	**Mean Squares**	**Obtained F**
Pre-Test Mean	71.40	72.72	Between	57.15	2	28.06	0.48
			Within	3216.16	38	58.90	
Post-Test Mean	81. 40	72.62	Between	539.20	2	234.68	4.51*
			Within	3006.34	38	51.74	
Adjusted Post- Test Mean	79.50	71.90	Between	712.25	2	349.13	10.61*
			Within	1720.05	38	31.80	
Mean Diff.	7.07	-0.08					

Information: Table F-ratio at 0.05 level of confidence for 2 and 57 (df) = 3.16, *Significant

Table 4 reveals that the obtained means of cardio-respiratory endurance for the pre-test of the experimental and control groups were 71.40 ± 72.72 respectively. The obtained pre-test F-value was 0.48 and the required table F-value was 3.16, which proved that there was no significant difference among the initial scores of the subjects. The obtained means of the cardio respiratory endurance for post-test of the experimental and control group were 81.40 ± 72.62 respectively. The obtained pre-test F-value was 4.51 and the required table F-value was 3.16, which proved that there was a significant difference among the initial scores of the subjects.

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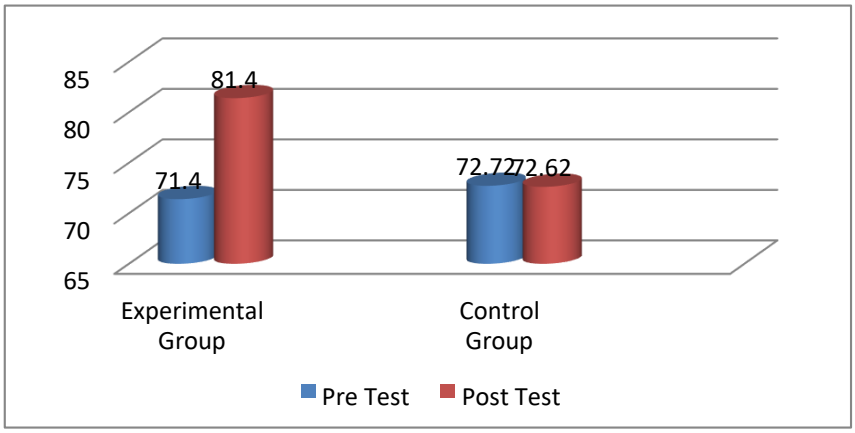
Further, The pre-test means and post-test means adjusted post-test means were 79.50 ± 71.90 determined and analysis of co-variance was done and the obtained F-value 10.61was greater than the required value of 3.16 and hence, it was accepted that there were significant differences among the treated groups. The means score of on Cardio-respiratory endurance for experimental and control group were presented in figure 2.

Figure 2.

Pre-test and post-test means score of cardio-respiratory endurance for experimental and control group



Source: Primary data

Since significant differences were recorded, the results were subjected to post hoc analysis using Scheffe's Confidence Interval test. The results were presented in Table 5.

Table 5

Scheffe's Confidence Interval Test Scores on Cardio-respiratory endurance

Means			
Experimental Group	**Control Group**	**Mean Difference**	**Required CI**
79.50	71.90	6.45*	4.62

Information: * Significant

The post hoc analysis of obtained ordered adjusted means of the experimental group and control group were 79.50 ± 71.90 and mean difference 6.45 respectively. It was proved that there was significant difference between experimental group and control group.

4. DISCUSSIONS

The effect of skipping rope training on resting heart rate was presented in Table 2, the analysis of co-variance proved that there was a significant difference between the experimental group and control group as the obtained F-value of 4.59 was greater than the required table F-value to be significant at 0.05 levels. The post hoc analysis of obtained ordered adjusted means of the experimental group and control group were 60.35 ± 61.30 and the mean difference 5.00 respectively. It was proved that there was a significant difference between the experimental group

and the control group. Thus, it was found that the skipping rope training program was significantly better than the control group in improving the resting heart rate of male soccer players.

The effect of the skipping rope training program on cardio-respiratory endurance was presented in Table 4. The analysis of covariance proved that there was a significant difference between the experimental group and control group as the obtained F-value of 10.61was greater than the required table F- value to be significant at 0.05 levels. Since a significant F-value was obtained, the results were further subjected to post hoc analysis, and the results presented in Table 5 proved that there was a significant difference between the experimental group and the control group. The post hoc analysis of obtained ordered adjusted means of the experimental group and control group were 79.50 ± 71.90 and the mean difference was 6.45 respectively. It was proved that there was a significant difference between the experimental group and the control group. Thus, it was found that the skipping rope training program was significantly better than the control group in improving the cardio-respiratory endurance of male soccer players.

Ozer, Duzgun, Baltaci, Karacan, & Colakoglu (2016) assessed the effects of a 12-week skipping rope training program on functional parameters including multi-joint coordination and proprioception, strength, and endurance in adolescent female volleyball players. They demonstrated significant improvement in physical fitness variables. On the other hand, these findings are in accordance with (Chao-Chien & Yi-Chun, 2012) demonstrated that 12-week jumping rope training significantly affects on cardiorespiratory endurance, flexibility, muscular strength, heart rate, and endurance in students with intellectual impairment.

Baker (2015) compared skipping rope exercise with jogging and finally concluded that 10 minutes of skipping rope exercise is more beneficial than 30 minutes of jogging where both interventions were used to improve cardiovascular efficiency. These studies were that a daily 10min. program of rope skipping will significantly improve (p = .05) cardiovascular efficiency as measured by the Harvard step test, that a daily 30-min. program of jogging will significantly improve (p = .05) cardiovascular efficiency as measured by the Harvard step test, and that a 10min. daily program of rope skipping is as efficient as a particular 30-min. daily program of jogging for improving cardiovascular efficiency as measured by the Harvard step test.

Orhan (2013) pointed out that many researchers suggested that physical activities including skipping rope would give better results in physical fitness. During the initiation of this skipping rope, arms rotate the rope and both legs would perform repeated jumping, at the same time it aims to maintain constant vertical take-off and landing phases, and the body also needs to control the balance and force through a coordinated action of upper and lower body muscle groups. The role of skipping rope exercises within training programs has been proven that it gives positive effects on the physiological parameters of the cardiovascular and respiratory systems. (Baker, 1986) separated 92 students into 2 groups and applied 10 minutes of rope-jump training to the first group, and 30 minutes of jogging training to the second group. After 6 weeks, when Harvard test results were evaluated, it was determined that the rope group improved as much as the running group in cardio-respiratory endurance, coordination ability, and heart rate.

(Chao-Chien & Yi-Chun, 2012) added that heart rate is a main physiological indicator that can be used to monitor the effect of exercises training and helps in directing training programs Variable Group Pre-test Post-test Resting heart rate Rope jump training 81.12±4.3 72.31±1.8 (b/min) Control 80.05±7.2 80.26±5.6 Leg strength Rope jump training 13.54±±1.55 15.01±1.61

muscles(kg) Control 14.08±1.91 13.95±1.87, rope jumping training was significantly improved of heart rate improved. Further, (Mekić, Nikšić, Beganović, Merdan, & Ramić, 2022). pointed out that practicing exercise regularly leads to decreasing heart rate during rest because of the effect of exercise on increasing the heart muscle volume and muscle adduction ability and the response of indefinite nerve that helps in slowing the heart rate. Similar types of the study were found that designed to investigate the effect of Plyometric Training on Muscular Endurance for Football Players. From the result, it was obtained that there was a significant effect of plyometric Training on the Muscular Endurance of Football Players ((Patir, Singh, Singh, & Meetei, 2021, Susanto, Afandi, & Irmawati, 2022) It was informed in the literature that skipping rope has positive effects on cardio-respiratory endurance and resting heart rate and it is a significant implementation in developing and maintaining muscle strength and cardiovascular system, and it improves foot movements as a support for the preparation for sports branch. It was indicated that resting heart rate values are expected to be lower in well-trained soccer players.

5. CONCLUSIONS

It was concluded that the skipping rope training program significantly improved physiological variables such as the resting heart rate of male soccer players. It was found that there was a significant difference between the experimental groups and the control group. Further, concluded that the skipping rope training program significantly improved motor fitness variables such as cardio-respiratory endurance of the male soccer players. It was found that there was a significant difference between the experimental groups and the control group.

The findings of this study proved that the skipping rope training program significantly improved motor fitness variables of the male soccer players. Hence, it was recommended that the protocols suggested in this study may be followed by soccer players for their training. The benefits of the skipping rope training program may be popularized among male soccer players. The findings of this study proved that the skipping rope training program improved motor fitness variables, and cardio-respiratory endurance, the findings may be extended to similar other players. Similar research may be conducted among women soccer players.

Acknowledgment

The authors would like to thank you very much to the co-authors for kind help and the final formation of the manuscript and also, thanks to the soccer players of Manipur University for their positive contribution, help, and cooperation.

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