ASSESSMENT OF THE INFLUENCE OF ROPE SKIPPING ON RESTING HEART RATE OF FEMALE ADOLESCENTS IN MAKURDI

SHACHIA TIMOTHY TERFA
Department of Human Kinetics and Health Education, Faculty of Education, Rev. Fr. Moses Orshio Adasu University, Makurdi, Nigeria.
Email: shachiaterfa@gmail.com

&

UEVER JONATHAN
Department of Human Kinetics and Health Education, Faculty of Education, Rev. Fr. Moses Orshio Adasu University, Makurdi, Nigeria.
Email: ueverjonathan@gmail.com

&

ADI DANIEL
Department of Physical and Health Education, Faculty of Education, Federal University, Wukari, Nigeria.
Email: adigracecollege1@gmail.com

Abstract
This study assessed the influence of rope skipping on resting heart rate (RHR) of female adolescents in Makurdi, Benue State. Pretest-posttest group research design was adopted for this study, Simple random sampling technique of deep and pick with replacement was used, for selecting, (27) participants who were randomly assigned to either experimental group (13) or control group (14). The experimental group underwent rope-skipping training three (3) times in a week for eight (8) weeks, while the control group did not. Before and after the training, resting heart rate (RHR), was measured using digital blood pressure apparatus and the data collected were recorded as pretest and posttest respectively. The data collected were analysed using descriptive statistics of mean and standard deviation to describe the physical characteristics of participants and hypothesis was tested using student's independent t-test at significant level of 0.05. through the statistical package for the social sciences (IBM SPSS®) for windows version 20. After the t test analysis, the result revealed that eight (8) weeks of rope-skipping

significantly reduced the RHR of female adolescents in Makurdi (P = 0.01). thus the hypothesis which states that, there is no significant influence of rope skipping on resting heart rate (RHR) of female adolescents in Makurdi was rejected. Rope skipping is a great exercise that can be used for the improvement of RHR which is an index of cardiovascular fitness. It was recommended that female adolescents should regularly engage in rope-skipping as an exercise to improve their RHR.

Keywords: *Adolescent, Female, Resting, Heart rate and students*

Introduction

Heart rate (HR) reflects the number of contractions of the ventricles per minute and fluctuates substantially with variations in systemic demand for oxygen. Resting heart rate (RHR) monitoring is a simple and non-invasive clinical method related to cardiovascular fitness prognoses. The RHR elevation in female adolescents is directly associated with indicators of cardiovascular diseases, such as overweight, obesity, increased blood pressure levels, elevated blood glucose, and high total cholesterol concentrations (Júnior et al., 2022).

Considering the evidence regarding the negative health effects associated with elevated RHR in female adolescence, it is relevant to consider the importance of RHR as health-related physical fitness component under cardiovascular fitness (Fernandes et al., 2019). Studies have shown that physically active female have lower odds of high resting heart rate, high blood pressure, hypercholesterolemia, and cardiovascular dysfunction (Lurbe et al., 2016). Thus, the investigation of the effect of exercises on cardiovascular parameters of participants will clarify whether the changes in rate of their heart function could be due to engagement in physical activities (rope skipping).

The health-related physical fitness components have biologically plausible links to changes in the heart (Fernandes et al., 2019). Higher or improved cardiovascular fitness is associated with more efficient myocardial function and lower RHR as an index of cardiovascular system (Silva, et al, 2018). Studies have repeatedly proven that sedentary life is associated with lower left ventricular mass, which affects lower resting systolic volume and higher RHR (Bellenger et al., 2016). In addition, the National Centre for Disease and Control (NCDC) (2025) reports that heart and blood disease also called blood diseases includes numerous problems which are related to a process called atherosclerosis, a condition that develops when a substance called plaque builds up in the walls of the arteries, narrowing the arteries, making it harder for blood to flow through, overworking the heart and increasing the resting heart rate (RHR) and blood pressure. This may subsequently form a blood clot and stop the blood flow resulting to a heart attack or stroke and subsequently death. Similarly, excess fat body built up due to sedentary life style is associated with the release of inflammatory adipokines into the bloodstream, which are associated with increased sympathetic nervous system activity that results in higher values of RHR thereby increasing the risk of cardiovascular diseases (Davy & Hall, 2014). There are cases of female adolescent consistently

experiencing heartbeat of above 100 beats per minute (tachycardia) at rest, this is detrimental to life expectancy among adolescence. World Health Organisation also stressed that out of every 1000 female adolescent in Nigeria, about 100-200 are sedentary and experiencing either tachycardia or bradycardia. However, physical activities of moderate to high intensities which yields higher or improved muscle strength and flexibility levels are associated with neural and muscular adaptations, which result in greater parasympathetic nervous system activity that are reflected in healthy heart beat and proper RHR (Kruse & Scheuermann, 2017). In line with the tender of (Kruse & Scheuermann, 2017), several exercise are known to be efficient in burning excess body fat and resolving its accompanying complications, unfortunately, most of this evidence comes from studies with the adult population, which makes it uncertain whether these associations occur in female adolescents. It is in light of the above stated problems that the researchers were motivated to assess the influence of rope skipping on cardiovascular fitness of female adolescents in Makurdi.

Rope skipping exercises improves coordination, agility, and bone density while also serving as a meditative exercise. Despite its benefits, jumping rope can be hard on the joints. Skipping rope is a great cardiovascular workout. The participant's resting heart rate can drop by 5-10 beats per minute; it makes participants more resilient and less likely to get out of breath even in everyday life activities. In a move to encourage rope skipping participation and minimize injuries, Priya (2022) stated the precautions and tips to prevent rope skipping injuries, in his study, it was revealed that; the participants should not bend their knees too much. (A slight 2-5 degree bend is ok), the ankles should be close to each other, the participants be shoulders close to the body sides and maintain an upright posture and should concentrate on a point in their front. Poor-quality ropes, frayed ropes and incorrectly-sized ropes are recipes for disaster. Buying a premium-quality skipping rope will last longer and help prevent injuries and mishaps. Proper warm-up for at least 5 – 10 minutes before rope skipping is advised. Squats, lunges, push-ups, shoulder rotations, and ankle rolls are all great warm-up exercises for a rope skipping programme. A good pair of running shoes or cross-training shoes are good for rope skipping, when jumping rope ladies should always use their sports bras. Participants should stick to skipping on rubber mats, or wooden floors to ease the strain on muscles and ligaments. Carpets and concrete surfaces aren't such a good idea as the rope may bounce too much resulting in the participant jumping higher and high risk of injuries.

Furthermore, Priya (2022) emphasised that when it comes to exercise, there's good pain and bad pain. Good pain such as muscle soreness or a tight achy feeling is normal and goes away with stretching. It's a sign that your workout is effective as your body is being challenged. Bad pain could include intense shooting pain, chronic fatigue, noticeable swelling, etc. Participants should not push past this type of pain as that could lead to severe ligament, tendon, muscle injuries, etc. Recognise the signs and take rest whenever necessary. A 5-minute static stretch session after rope skipping exercise is needed to reduce your chances of injury. Incorporate a few exercises that stretch out your calves, hamstrings, lower back, quads, and glutes.

The purpose of this study was to assess the effect of rope skipping on resting heart rate (RHR) of female adolescents in Makurdi. To achieve this purpose, the researchers stated a null hypothesis that; there is no significant effect of rope skipping on resting heart rate of female adolescents in Makurdi.

Methodology

The researchers adopted an experimental research design, of a pre-test-post-test control group in this study. The population size was 306, Purposive sampling technique was used to select only female adolescent students, whose body mass index (BMI) ranged between 22.00 kg/m^2 and 27.00 kg/m^2 ($85^{th} \leq 95^{th}$) percentile and 13-19 years old. Simple random sampling technique of deep and pick with replacement was used, for selecting, (27) participants who were randomly assigned to either experimental group (13) or control group (14). The experimental group underwent rope-skipping training three (3) times in a week for eight (8) weeks, while the control group did not. After assigning the participants to either experimental group (13) or control group (14), Physical characteristics of age and body mass index (BMI) were measured, the data collected were analysed using descriptive statistics of mean and standard deviation to describe the homogeneity in characteristics of participant. Before and after the training, resting heart rate (RHR), was measured using digital blood pressure apparatus. The data collected were analysed using student's independent *t*-test to test hypothesis at significant level of 0.05.

Rope Skipping Training Programme

The participants performed the rope skipping in singles, the pace and exercise intensity was controlled and guided by the use of the talk test. The talk test is rated as follows:

If participants could easily talk in full complete sentences and even sang simple songs while simultaneously performing the exercise, then such performance was of low intensity exercise.

If the participants could speak in-complete sentences fairly easy, but could not sing simple songs while simultaneously performing the exercise, then such performance was of moderate intensity. If the participants could only mutter a few words or simple sentences while simultaneously performing the exercise, such performance was of high or vigorous intensity (Carter *et al.,* 2019). For this study, the exercise was of moderate to high intensity.

Table 1. Training schedule for the participants.

Week	Warm-Up	Training Intensity	Training Duration	RPE	Cool down
1st-2nd	5 minutes	50% - 55%	20 minutes	6 - 8	5 minutes
3rd-4th	5 minutes	60% - 65%	25 minutes	9-10	5 minutes
5th-6th	5 minutes	70% - 75%	30 minutes	11 -12	5 minutes
7th-8th	5 minutes	80% - 85%	35 minutes	12-13	5 minutes

Adapted from (Jahromi & Gholami, 2017)

Table 1. shows the schedule for the rope skipping programme that, during the 1st-2nd week of training, participants began the programme with 5 minutes warm-up, after which they skipped the rope for 20 minutes at 50-55% intensity (HR max) and cooled down for 5 minutes. During the 3rd-4th week, the participants began the programme with 5 minutes of warm-up, after which they performed the rope-skipping for 25 minutes at 60-65% intensity (HR max) and cooled down for 5 minutes. During the 5th-6th week, the participants began the programme with 5 minutes of warm-up, after which they performed the rope-skipping for 30 minutes at 70-75% intensity (HR max) and cooled down for 5 minutes. In the last session of (7th-8th week), the participants began the programme with 5 minutes warm-up. Thereafter, they performed the rope skipping for 35 minutes at 80-85% intensity (HR max) and cooled down for 5 minutes. The exercise intensity was controlled via the talk test.

Consequently, all post-training programme measurements were taken at 8th week. As the body adapt to the rope skipping exercise, progressively increasing the intensity of the training subjected the body to more load which continued to modification on the body of participants.

Results

Table 2. Physical characteristics of participants

Table 2: The physical characteristics of the participants before commencement of the training in the experimental and control groups.

Control Group (n = 14)			Experimental Group (n =13)	
Variables	**Mean**	**SD**	**Mean**	**SD**
Age (years)	16.64	1.08	16.30	0.94
BMI (kg/m^2)	24.93	1.55	24.85	1.30

Table 2. shows that before the commencement of the training, the mean age, of the control group was 16.64 ± 1.08 years and the mean BMI was 24.93 ± 1.55 kg/m^2. The

mean age of the experimental group was 16.30 ± 0.94 years and the mean BMI was 24.85 ± 1.30 kg/m^2 indicating the means of the cores in the two groups were homogeneous.

Tests of Hypothesis

There is no significant effect of rope-skipping exercise on RHR of female adolescents in Makurdi, Nigeria.

Table 3: Independent *t*-test analysis on the influence of rope-skipping exercise on resting heart rate of female adolescents

Variable	Group	N	Mean (bpm)	SD	df	*t*	p
	Control	14	84.00	5.68			
RHR:					25	2.63	0.01
	Experiment	13	78.07	6.00			

(t-critical = 1.96, $p < 0.05$)

Table 4.3.1. shows the result of the *t*-test analysis of the influence of rope-skipping exercise on RHR of female adolescents in Makurdi, Nigeria. The result revealed that 8 weeks of rope-skipping exercise significantly ($p < 0.05$) reduced the RHR of female adolescents in Makurdi. Therefore, the null hypothesis which states that there is no significant effect of rope skipping exercise on RHR of female adolescents in Makurdi, Nigeria was rejected. Meaning that rope-skipping exercise significantly reduced the RHR of female adolescents in Makurdi.

Discussion of Findings

The result of this study revealed that eight (8) weeks of rope-skipping-exercise had a significant ($p < 0.05$) decrease on the RHR of female adolescents in Makurdi.

This finding also confirmed the findings of Davy and Hall (2021), who assessed the effect of rope-skipping programme on cardiovascular fitness of overweight female adolescents. In the study, a sample size of 30 participants was used, the mean age of the participants was 18.27 (SD = 0.61), the mean height was 158.2 (SD = 19.6) and the mean weight was 72.12 (SD = 38.09). RHR was measured before and after 8 weeks of rope-skipping programme. A pre-test and post-test analyses was done and findings of the study revealed that the 8-weeks rope-skipping programme significantly ($p < 0.05$) reduced the RHR of the participants. Similar findings were obtained by Tan *et al.* (2019), who also explored the effect of rope skipping exercise on anthropometric indices, cardiovascular function, and physical fitness of overweight female adolescents. During the study, 28 participants were randomly assigned into either exercise group or control group. Cardiovascular parameters of RHR and RBP, and anthropometric indices of WHR, BMI as well as physical fitness were measured, at 4th week, at 8th week and at the end of the 12 weeks rope-skipping training. The exercise group participated in the 12 weeks of rope-skipping training, while the control group did not participate in the rope-skipping exercise. The data were analysed and the result revealed that rope-skipping exercise significantly ($p < 0.05$) decreased RHR at the 8th week of the training. The study also

revealed a significant ($p < 0.05$) decrease in resting systolic and diastolic blood pressure after 12 weeks of rope-skipping exercise. Specifically, the p difference was first observed after the 8th week session of the rope skipping exercise, which is similar to the result of the current study.

The findings of Williams & Morton (2020), who conducted a study on the effects of 8 weeks of rope-skipping exercise on RHR, RSBP and RDBP of overweight adolescent girls in selected post-primary schools in Ewekoro, Ogun State, Nigeria also found a significant ($p < 0.05$) reduction in the RHR of participants after 8 weeks of rope skipping programme in a pre-test post-test analyses.

Eler and Acar (2019) in their study on the effects of training on heart and lungs performance sampled 30 overweight adolescent girls using a per-test post-test research design, RHR and VO_2max were measured before and after 8 weeks of rope-skipping training. The result revealed a significant ($p < 0.05$) decrease between the pre-test and post-test measurements of RHR and VO_2max, which are similar to the findings of the present study. The results of the studies indicate that rope-skipping exercise is an effective training of reducing RHR in female adolescents. These studies all adopted the similar methodology which led to the similarities in the findings of the present study. the empirical studies enshrined in our study, reported a similar result, this could be as a result of the systematic process of training duration and research methodology adopted by the researchers and dedication of the participants.

Conclusion

Based on the results of this study, it was concluded that, eight weeks of rope skipping had a significant reduction on the RHR of Female adolescent in Makurdi.

Recommendation

On the basis of the findings, the researcher recommends that, female adolescents should regularly engage in rope skipping exercise to modify their resting heart rate.

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