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The Effects of Taekwondo Training on Cardiorespiratory Fitness and Flexibility Among Adolescent Fitness Trainees

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Abstract

Taekwondo is a dynamic unarmed combat style focused on self-defense, incorporating techniques such as punching, kicking, blocking, dodging, and parrying. This study aimed to explore the effects of taekwondo training on cardiorespiratory fitness and flexibility in adolescent fitness trainees. Using experimental research design, twenty-two male adolescents aged 10-18 years from Alex Fitness Training Center were randomly divided into two equal groups: the experimental group (EG, n = 11) and the control group (CG, n = 11). The EG underwent ten weeks of taekwondo training, participating in three sessions per week, each lasting 40 to 60 minutes. Their training included basic techniques, poomsae, sparring and self-defense. In contrast, the CG followed their regular fitness program. Both groups underwent pre- and post-testing, which assessed cardiorespiratory fitness via the Harvard step test and flexibility through static shoulder and wrist, trunk and neck tests, and the sit-and-reach test. The data were analyzed using SPSS version 25, employing descriptive statistics, paired t-tests, and independent t-tests at a significance level of $p < 0.05$. Cohen's d was used to evaluate effect sizes. Results indicated that taekwondo training significantly improved both cardiovascular fitness and flexibility ($p < 0.05$). The findings suggest a trivial effect size for cardiovascular fitness and a large effect size for flexibility. Consequently, taekwondo training is recommended for adolescents seeking to enhance their cardiorespiratory fitness and flexibility.

Keywords:-Adolescents, Martial arts, Taekwondo, Self- defense, cardiorespiratory fitness, Flexibility

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Background of the study

Martial arts are ancient combat techniques that have been modernized for sport and exercise (Demorest et al., 2016). The martial arts are a general term that includes a variety of styles and forms. Taekwondo, judo, soo bahk do, karate, kung fu, and Tai chi are among the most popular. Taekwondo is an unarmed combat style for self-defense that includes punching, jumping kicks, blocks, dodges, and parrying movements with the hands and feet. Taekwondo is a Korean martial art that evolved from multiple Korean martial arts systems to become its current form of self-defense (Singh, 2012). Taekwondo is now enjoyed as a sport for health promotion and self-discipline regardless of age and gender (Y. Kim et al., 2021). It is a traditional martial art from Korea that is practiced in more than 210 countries, including Ethiopia, and recognized as a global martial art and sport (Jeon et al., 2021 and Tadesse, 2015). Taekwondo training is also expected to improve physical fitness such as aerobic capacity, muscle strength, muscular endurance, flexibility, speed, and agility through physiological effects (Jeon et al., 2021). The effects of Taekwondo training on the same fitness factors varied widely across studies (Nam & Lim, 2019b). Taekwondo training, may provide physiological and physical benefits, such as improved flexibility and endurance, cardio respiratory fitness , body composition, reaction time, body balance, and bone mineral density in different populations(Huen,etal.,2014). According to Roh et,al.,(2018), body composition, cardiorespiratory fitness, strength, and flexibility did not change significantly after taekwondo trainings.

Adolescence is a stage of growth and development that occurs between childhood and maturity(Csikszentmihalyi, 2019).during this time, changes in health and health-related behaviors occur, including as smoking, substance misuse, bad eating habits, and lack of exercise, all of which can have a negative impact on health later in life (Salam et al., 2016). There is accumulating evidence that overweight and obesity are becoming more common among teenagers(Ogden et al., 2016). As adolescents gain weight, they are more likely to develop cardiovascular disease, metabolic syndrome, and die prematurely(Jung & Song, 2018). In adolescence, physical activity decreases and weight increases (Pietiläinen et al., 2008).

Adolescents have less physical activity and gain more weight(Pollock et al., 2011).

Most researchers have not validated or confirmed the physical benefits of taekwondo training, which include increased flexibility, muscular strength, aerobic and anaerobic fitness, and body composition. As a result, more research is needed before making claims that Taekwondo training improves health-related physical fitness (Huen et al., 2014). According to the review of (Fong & Ng, 2011) ,studies of Taekwondo training on physical fitness are still restricted, and there are very few studies on the health advantages of Taekwondo training .

Objective of the study

The objective of this study was to investigate the effects of taekwondo training on cardiorespiratory fitness and flexibility among adolescent fitness trainees.

Materials and methods

This study was conducted in Alex fitness training center in Hawassa city particularly in Tabor sub city, Sidama region, Ethiopia. The study design was experimental research design. The selection of study population was depending on their age, gender, health status, experience and interest of participants. Subjects who were interested, new entry, male, aged between 10-18 and who doesn't have health problem were included under the study. Informed consent was collected to ensure the willingness of participants. It was 10-weeks taekwondo training intervention of three days per week supervised taekwondo training. The study design was experimental research design. It was 10-weeks Taekwondo training intervention of three days per week supervised TKD training. From seventy total populations, twenty two male fitness trainees were selected as a sample by using purposive sampling technique. Simple random sampling was used to assign experimental and control group. Therefore, eleven subjects were experimental group and eleven subjects were control group. The Experimental group had taken TKD training for ten weeks with 3 sessions per week, each lasting 40 to 60 minutes. Both groups had taken pre and post-testing and all the subjects participated in physical fitness tests: cardio respiratory fitness was measured by using Harvard step test, and flexibility was measured by using static shoulder and wrist, static trunk and neck, sit and reach test and ankle. The training sessions included warming-up and cooling down exercises before and at the ends of each exercise days.

Training protocol

Table 1. Ten weeks Taekwondo training intervention program

	Low- high
	10 weeks
	40-60 min/day
	Monday. Wednesday and Friday

TKD involves Basics movements (kicking, stance ,strike and blocking), Forms ,Self-defense and Combat/sparring (Haddad, 2015).

Method of data analysis

The data that was collected through fitness tests were analyzed and interpreted in to a meaningful idea using computer. Descriptive statistics such as, means and standard deviation were used to describe the demographic characteristics of participants, Paired samples t-test was used to compare the difference of pre-test and post-test for control and experimental groups and independent t test to compare the mean value of the experimental and control groups. All data analyses were perform with in computer system using statistical package for social science (SPSS), version 25. P-values for statistical significance was set at<0.05.

Results

Table 2. Demographic characteristics of participant

	Age (in year)	**Height (in meter**	
	Mean ± SD	Mean ± SD	Mean ± SD
11	15.18±2.960	1.6064±.08686	55.36±8.041
11	15.00±2.236	1.6100±.11180	56.18±6.353

As table 2 above indicated, the average age of the experimental and control groups are 15.18 and 15.00 years, respectively. The average height and weight of the experimental and control groups are 1.6064, 1.61, and 55.36 and 56.18, respectively. It indicated that the control group participants are higher in height and weight than control group.

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Table 3. Paired t-test of Harvard step test for both control and experimental group.

Variable	Group	MD	SD	T	p-value
Cardiorespiratory fitness	E.G	4.7091	5.1122	3.055	0.012
	C.G	1.6545	2.2748	2.412	0.014

As table 3 above indicated, the significance values of the experimental group were 0.012. So Taekwondo training have significant effect over the cardiorespiratory fitness since ($p<0.05$). Similarly, the p value of CG was 0.014 .This value indicates that, statistically significant improvements were observed from pre to posttests results of Harvard step test in the CG as well $p<0.05$.

Table 4. Independent t- test between experimental and control group on cardiovascular fitness

Cardiorespiratory fitness	F	Sig.	T	Sig. (2-tailed)	Mean Difference	Cohen's d
	0.147	0.705	2.105	0.048	4.5818	0.17

As shown in table 4 above, the p value of EG were .017.This value indicates that, statistically significant improvements were observed in experimental group in posttest during Harvard step test hence $p<0.05$. The cohens'd showed that taekwondo training has very small size on cardiorespiratory fitness.

Table 5. Comparison of pretest and post-test of flexibility of control group and experimental group

Variable	Group	MD	SD	T	p-value
Shoulder & wrist	E.G	-0.90000	0.93173	-3.204	0.009
	C.G	-1.99273	2.86460	-2.307	0.044
Trunk & neck	E.G	1.22091	1.67979	2.411	0.007
	C.G	.63818	1.02107	2.073	0.065
Sit & reach	E.G	1.727	.786	7.286	0.000
	C.G	.545	.688	2.631	0.025
Ankle	E.G	1.73545	1.41091	4.080	0.002
	C.G	-.03545	.86250	-0.136	0.894

According to table 5 above indicated that, the significance values (P-value) of the experimental group were 0.007. So the Taekwondo training has significance effect on trunk and neck flexibility since ($p<0.05$). This implies that TKD training is useful to improve trunk and neck flexibility.

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Likewise, the significance values of the experimental group were .000. Therefore, taekwondo training has significance effect on flexibility during sit and reach since p<0.05). This implies that TKD can improve lower back and hamstring muscle flexibility.

Furthermore, the mean difference and standard deviation of E.G and CG were 1.73545, 1.41091, -.03545and .86250respectively. The significance values of the experimental group were .002 so the taekwondo training has significance effect over the dependent variable during ankle flexibility since, p<0.05).

Table 6. Independent Samples t- test between experimental and control group on flexibility

Variables	F	Sig.	T	Sig. (2-	MD	Cohens'd
Shoulder & Wrist	2.328	0.143	2.305	.032	2.76455	0.9
Trunk $ neck	3.408	0.080	2.345	.029	2.28455	0.2
Sit $reach	1.832	0.191	2.189	.041	3.909	0.73
Ankle	0.934	0.345	2.164	.043	2.62364	0.4

As table 6 above indicated that, the results of Levine's Test for Equality of Variances showed that there is unequal variance b/n EG and CG for shoulder and wrist, trunk and neck Sit and reach and ankle flexibility. The p-value of Levine's assumption of equal variance is .032, .029, .041 and.043 respectively. The small value of significance associated with levene's test indicates that the two groups have unequal variance. Therefore the variances of the two groups are significantly different in flexibility since p<0.05. The cohens'd for shoulder and wrist, trunk and neck Sit and reach and ankle 0.9, 0.2, 0.73, and 0.4 respectively. Therefore, Taekwondo training has a large effect size during shoulder and wrist since d> 0.8, medium during lower back and hamstring muscle flexibility hence d>0.5 And small effect size in trunk and neck and ankle flexibility since d>0.2. . However, no significant improvements were improved in control group.

Discussions

The findings of the study showed that both taekwondo training and regular fitness training were effective in improving cardiorespiratory fitness. More precisely, taekwondo trainees showed improvement in cardiovascular fitness with trival effect size. The previous studies supported the present study by showing that taekwondo training improved cardiorespiratory

endurance significantly (Nam & Lim, 2019a).However, a contradictory finding reveals that the effects of taekwondo training on cardiorespiratory fitness are not representatives of genuine effect of taekwondo training in the adolescent population(Fong et al., 2013a). In this context, (Melhim, 2001) found no significant difference in VO2max or resting HR before and after 8-weeks of taekwondo poomsae training program with male adolescents.Tekwondotraining improves aerobic fitness in the general population based on incon clusive evidence (Fong, 2014).

A specific taekwondotraining in adolescent fem ales was designed for beginners and consisted of basic taekwondo movements of poomsae (basic blocking, punching, and hand techniques), basic stepping and kicking drills, basic stepping and ta rget kicking drills, rest and some stretching drills). VO2max was not significantly increased as a r esult of the training program(H. B. Kim et al., 2011). In a recent study, Haddad et al., (2014) showed that typical taekwondo training with elite athletes was sufficient to enhance aerobic fitness.

The review of Fong & Ng, (2011) shows inconclusive evidence regarding the impact of taekwondo training on aerobic fitness. Regular training in martial arts at moderate to high intensity can increase cardiovascular health, increase metabolic rate, lead to improved fitness and improve physiological health in participants (Chaabène et al., 2015).

The findings of the study showed that Ten weeks taekwondo training shows improvement in shoulder and wrist, trunk and neck, sit and reach, and ankle flexibility. The effect size of taekwondo training on flexibility has a large during shoulder and wrist, medium during lower back and hamstring muscle, small size in trunk and neck and ankle flexibility. However no significant improvements were improved in control group.

According to (Brudnak et al., 2002) The flexibility of the lower back and hamstrings have increased for taekwondo practitioners who are elderly. Taekwondo training can benefit both young and old practitioners by developing lower body flexibility (Cromwell et al., 2007).

In order to perform high kicks and full range movements at high speeds, flexibility is essential for taekwondo athletes. Training in taekwondo may improve flexibility (Fong & Ng, 2011). According to (Roh et al.,2018) flexibility did not change significantly after taek wondo training While Taekwondo athletes kick strongly and directed without the ability to flex the joints of the body, shoulders, legs and hands, flexibility is needed to optimize the use of leg power, shoulders, abdominal muscles and waist rounding to kick (Mailapalli et al., 2015). Athletes must train and improve their flexibility, especially young ones (Kazemi et al., 2013). A child's muscles tend to be more flexible than an adult's. This will continue to be the case in teens

(school-age) (Casolino et al., 2012). The peak of their flexibility occurs when they reach adolescence (Ondello & Essitore, 2014).

Bending forward and backward repeatedly and sideways as well as widening the trunk require trunk flexibility, and jumping toward an opponent requires high flexibility in the lower extremities (Jafari & Hadavi, 2014). Taekwondo training can benefit both young and old practitioners by developing lower body flexibility (Cromwell et al., 2007). The effects of Taekwondo training on flexibility were greater than a medium effect, but they did not improve trunk forward flexion.

Children's flexibility improves as a result of repe ated activity in the warmup, cooldown, and majo r exercise phases. Unlike the sit and reach, it's i mpossible to pinpoint why trunk forward flexion flexibility did not improve (Nam & Lim, 2019a).

Depending on the findings taekwondo training has a significant improvement on cardiorespiratory fitness and flexibility. And it had a trivial effect size on cardiovascular fitness and a large effect size on flexibility. Consequently, taekwondo training is recommended for adolescents seeking to enhance their cardiorespiratory fitness and flexibility. Further studies should be conducted and needed including all health related physical fitness components, females, different age groups with large samples sizes to enhance the validity of evidences.

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