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Effects of Resistance Training on Selected Health Related Physical Fitness Components

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Abstract

The main purpose of this study was to evaluate the effect of resistance training on selected health related physical fitness components of shishinda preparatory school male grade 12 students. To achieve the purpose of the study Simple random sampling techniques were used to select subjects as well as to assign subjects for control and experimental groups, while purposive sampling were used to select the sample sex and the study place, the data were analyzed 32 male sample was taken from a population of 114 male students by lottery sampling technique, all subjects had divided randomly into 2 equal groups (n=16) control group (CG) and (n=16) experimental group (EG) was implemented. Their age range was from 18-20 years. EG who performed in 3 days/week for 3-month resistance training program like as barbell lifting ,dumb bell, pull ups, pushups, sit up and parallel bar exercise on the other hand a CG did not perform this selected resistance training unless both groups undergone normal physical education class program. Both groups had taken pre and post-testing. PT of two groups of 16 subject's muscular strength was measured by 90 degree push up test. Flexibility was measured using sit and reach test, muscular endurance was measured through sit up test and body composition was measured by using BMI were recorded. Consequently, after three months, posttest measurement on the same parameters was taken, the difference between the tests were analyzed statistically, with paired sample "t" test at $P<0.05$ to determine the difference between initial and final mean for participant. Based on the analyzed data the mean difference value was boosted in 90 degree push up test performance by 7.19. In sit and reach test 1.56 mean differences was recorded. After 12 week resistances training in sit up test 1.38 increments and in body composition 0.61 were observed throughout the study period. The result obtained in this study indicated that there was significant improvement in muscular strength, flexibility, muscular endurance and body composition on EG. Based on this finding, it can be concluded that resistance training has positive effect on improvement of selected health related physical fitness components of male students on experimental group.

Key words- Health, physical fitness, Resistance training

1. INTRODUCTION

Physical fitness is considered an integrated measurement of all function (skeletomuscular, cardio-respiratory, circulatory, psycho-neurological and endocrine-metabolic) and structure involved in the performance of physical activity and /or exercise. Physical fitness is associated with person's ability to work effectively and efficiently, enjoy leisure time, be healthy, resist hypo kinetic disease or condition, and meet emergency situation (Ortega and Gutierrez, 2007).

Resistance training is a systematic program of exercises involving the exertion of force against a load with the goal of developing strength, endurance, and/or hypertrophy of the muscular system. It is commonly called strength or weight training. Resistance training is used for a wide variety of reasons, including to improve overall health, improve athletic performance, rehabilitate an injury, change ones physical appearance, or compete in power lifting or bodybuilding contests (Davies and Barnes, 1972).

Resistance training is presented by some type of equipment. The term resistance and strength training encompasses a wide range of training modalities, including plyometric and will refer only to normal resistance using free weight (barbell, dumbbells and kettle bells), weight machines, resistance band, and body weight (push up, pull up, squat, chin up and sit up), but from the different types of resistance training the researcher used barbells, dumbbells and body weight training. Resistance exercise leads to increased muscular strength, endurance, and power. Increased strength is the most obvious result of a resistance training program and the reason many individuals participate in resistance training. Strength gains following a resistance training program vary widely, owing largely to differences in initial strength and the training program. Resistance training at least twice a week improves muscle strength and endurance by approximately 25–100% (Haskell *et al*., 2007).

Resistance training programs are important for health, fitness and performance and are widely recommended by leading health organization. Resistance training results in increased collagen synthesis and strength of the connective tissue around the muscle. There is also evidence of increase tendon stiffness with resistance training (Folland and Williams, 2007).

Resistance training involves exercise in which the muscle exerts a force against an external load. It is most commonly referred to as weight training. It is perhaps the most common method of training to improve muscle strength and enhance muscle hypertrophy. Such a training program should be individualized be progressive, and attempt to be specific interims of the way the muscle are likely to be used in the chosen sport. The key points regarding resistance training for enhancement of strength. The weight should be greater than 85% of individual 1 repetition maximum (1RM), with between 6-8 repetitions in a set. Each session should employ 3-6 sets with recovery of about 2-5 minute between sets (Birchs, Lauren and George, 2005).

The American College of Sport Medicine is the largest sports medicine and exercise science organization in the world. The ACSM also make recommendation for resistance training frequency. For novice participants, ACSM recommendations to train the entire body two- three times per week, intermediate participants should train three days per week if doing whole body, or four days per week if doing an upper/lower split, and advanced participants should training four-six days per week, training each muscle group once to twice per week (Baechle and Earle, 2008).

The exercises are easily adaptable for all age and can be modified to accommodate individual fitness levels and physical limitations. To improve or maintain a desired level of physical fitness, there is a need to constantly administer an adequate training intensity while exercising. Conventional resistance training is one of the effective means to improve all rounded physical and cardiovascular fitness (Manikandan, 2014).

Resistance training is a systematic program of exercises involving the exertion of force against a load with the goal of developing strength, endurance, and/or hypertrophy of the muscular system. Resistance training important to improve sport performance and prevent injuries and enhance long- term health, Similar to other physical activity resistance training is a recommended component of a well-rounded fitness program for healthy children, adolescents, adults, and older adults and have a benefit effect on several measurable health indices, such as cardio vascular fitness, body composition bone mineral density, and blood lipid profile mental health (Davies and Barnes, 1972).

1. **H_1**: Resistance training has a significant effect on muscular strength
   H0: Resistance training has not a significant effect on muscular strength
2. **H1**: Resistance training has an effect on flexibility
   H0: Resistance training has not an effect on flexibility
3. **H1**: Resistance training has a significant effect on muscular endurance
   H0: Resistance training has not a significant effect on muscular endurance
4. **H1**:Resistance training has an effect on body composition
   H0: Resistance training has an effect on body composition
5. **H1**: Resistance training has a significant effect on muscular endurance
   H0: Resistance training has not a significant effect on muscular endurance
6. **H1**:Resistance training has an effect on body composition

H0: Resistance training has not an effect on body composition

2. Methods

A research design is a systematic plan to study scientific problem. For this regard stated that a research design is a plan, structure and strategy of investigation conceived as to obtain answer to research questions or problems (Kumar, 1996)

To investigate the effect of resistance training on selected health related physical fitness variables appropriate of the pre and post test data the experimental research approach was designed. This study were employed experimental design, since it helps to measure, assess, evaluate and analyze the effects of resistance training on selected health related physical fitness parameters such as muscular strength, flexibility, muscular endurance and Body composition were administered for the selected subjects. The selected participants were engaged in regular resistance training for twelve weeks (three month) such as, jogging, synchronized movements of hands, legs and arms, Bar bell lifting, Dumbbell lifting, push up, sit up, pull up, parallel bar exercise and stretching exercise or by doing (warming up, main part and cooling down) with low to high intensity for 3 non consecutive days per week (Monday, Wednesday and Friday) for 40-60 minutes per day for three consecutive months. The schedule for this study as follows.

Table1: Schedule for study design

Treatment	Resistance training
Frequency	3 days per week
Duration	3 month (12 weeks)
Intensity	low -high intensity
Duration of session	40-60 minutes
Exercise day	Monday, Wednesday and Friday
Time of training	Afternoon at 4:00-5:00pm(10:00-11:00 local time)

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The subject of this study were grade 12 male students from Shishinda Preparatory School who fulfill requirements for the study, age from 18-20 years old, free from any impairment or chronic disease and volunteer in response to the desired study. The total numbers of grade 12 students were 114. The sample of this study was 32 male participants from the total number of 114 grade 12th male students with age ranged between 18-20 years old. By using simple random sampling technique lottery method 32 students were selected from total population so as to give equal chance of the participants. The selected samples were assigned randomly in to two groups (experimental group=EG and Control group=CG) in random sampling technique**.** The data of this study was collected from the result of pre and post test resistance training program. Quantitative data was collected through appropriate health related physical fitness component test measures like, pushup test , sit and reach test, sit up test and Body Mass Index (BMI) calculation, after giving training for participants in resistance training for about 3 months in Shishinda preparatory school grade 12th male students. Before the subjects were going to resistance training program the pretest was given to both control and experimental groups and recorded by the researcher. Then after the intervention the post-test, was done and recorded at the end of three month. Stop watch, parallel and horizontal bars, adjustable free weight, adjustable dumbbells, cones, sit and reach box, whistles, bench, and mats were used in the training session and during tests.

3. Results and Discussion

To achieve the objective of the study 32 male students were randomly selected as subjects. They were assigned into two equal groups in number EG (n=16) and CG (n=16) their age was ranged from 18-20 years old. Resistance training was given for 12 consecutive weeks (three months October, November, and December). The training included three days per week; with duration of 40-60 minutes with low to vigorous intensity. The variables and tests selected for this study were: selected health related physical fitness variables (push up test for muscular strength, sit and reach test for flexibility, sit up test for muscular endurance and BMI for body composition). Pre and post tests were given for all 32

subjects on selected variables, data was recorded and the collected data was analyzed by paired sample t-test using SPSS version 20.The materials used for this study were: ruler, weight machines, sit and reach box, exercise mats, stopwatch, record sheets, paper, pen and whistle were used during training.

3.1. Characteristics of Study Participants and Physical Fitness Variables

Table2. Demographic Characteristics of the study participants

Group	N	Age		Height		Weight	
		Mean	S.D	Mean	S.D	Mean	S.D
EG	16	19.06	0.57	1.66	0.04	57.91	1.93
CG	16	19.12	0.50	1.65	0.03	53.72	

As shown from above Table2 Descriptive characteristics of 32 study participants from shishinda preparatory school of grade 12th male students mean of age (EG=19.06, CG=19.12) height (EG=1.66, CG=1.65) and weight (EG=57.91, CG= 53.72). Subjects were relatively had the same age, height and weight at the beginning of exercise.

Table 3.Dependent Variables and Tests

No	Variables	Methods/Test	Equipment	Unit of Measurement
1	Muscular Strength	90 degree Push up test	Ground, floor	Minute
2	Flexibility	Sit and reach test	Ruler, box, meter and mat	Centimeter
3	Muscular Endurance	Sit-up test	Sport field, Stopwatch, Whistle and Mat	Minute
4	Body Composition	BMI	Kilogram, Meter	Meter and kilogram

As it can be seen in above table 3 illustrated that the types of variables, methods, test items and its measurement units which designed to do this experimental research. The results of selected health related physical fitness variables of experimental and control group's pre and post-test data were analyzed. The results of each variable were presented in tables as discussed below.

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3.2. Effects of Resistance Training on Muscular Strength

Table 4.The mean and mean difference values of 90 degree push up test for EG and CG

Group	Test	PT(X±SD)	PoT (X±SD)	ΔX) PT and PoT
EG	Push up test	16.75±2.89	23.94±5.05	7.19
CG	Push up test	15.37±3.26	16.25±3.06	0.88

EG= experimental groups, CG=control groups, X=mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, PT=pretest result, PoT= post test results, p=significance level.

As shown from table 4 the average value of push up pretest score of EG (N=16) was 16.75 with a standard deviation of 2.89 and CG (N=16) was 15.37 with SD of 3.26. From this data we had seen that the scores in the pretest for both groups were close. The average post test score of push up test after 12 week resistance training of experimental group was 23.94 with SD of 5.05 and for control groups mean 16.25 with SD of 3.06 respectively. From this data we had seen that the scores in the posttest for both groups were very different. Hence, these data indicated that there was a significant difference and gradual improvement of push up between PT and PoT results of EG and there was deficient improvement between PT, and PoT test results of CG. This showed that due to the 12 week resistance training program the resistance training group (experimental group) showed better improvement. Therefore, participation in resistance training significantly improved the muscular strength of subjects.

Figure 1: Graphical presentation of push up test result of both groups

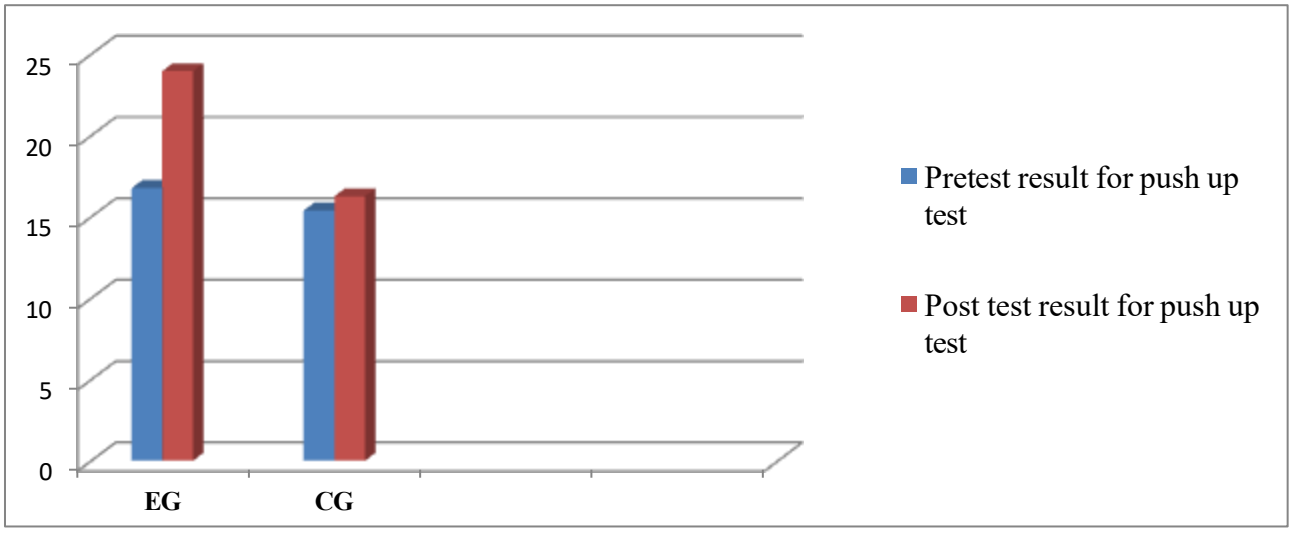


Fig1.As shown in the graph above the pre and posttest of the EG in push up test was a mean score of 16.75 and 23.94 and also the CG was 15.37 and 16.25 respectively. From this data the investigator compute a pre and post mean difference of EG and CG in which in case of the EG repetitions of push up test was significantly improved by a mean difference of 7.9 at P=.000 after three months resistance training. And also in case of the CG, in which repetition of push up test was poor improvement by a mean difference of 0.88 at P=0.048. Therefore resistance training had better improvement on push up test of EG students when compared with CGs. As a result the investigator testified and accepted alternate hypotheses one which said that there was a significant effect on improvement of muscular strength

after three month consecutive resistance training and the null hypothesis was rejected. But as the data shows there was very poor significant improvement in muscular strength of the CG who only has a single 40 minutes of physical education practical class. The result of this study was agreed with the findings of (Azeem and Amer, 2013) who studied effect of weight training program on body composition, muscular endurance and muscular strength of males. They reported significantly improved muscular strength of weight squat and bench press from 47.50 to 77.17 and from 30.96 to 54.00 at (p=0.05) respectively).

According to research conducted by (FLECK, S.J., and W.J. KRAEMER 1997) conclude the improvement of muscular strength through resistance training, Concerning the intensity of the resistance training, although higher relative loads (higher static component) should cause a greater increase in muscle strength even when fewer repetitions are completed, the protocol used in the present study (8 to 12 repetitions at 60% of peak strength) was effective to increase peak muscle strength.

3.3. Effect of Resistance Training on Flexibility

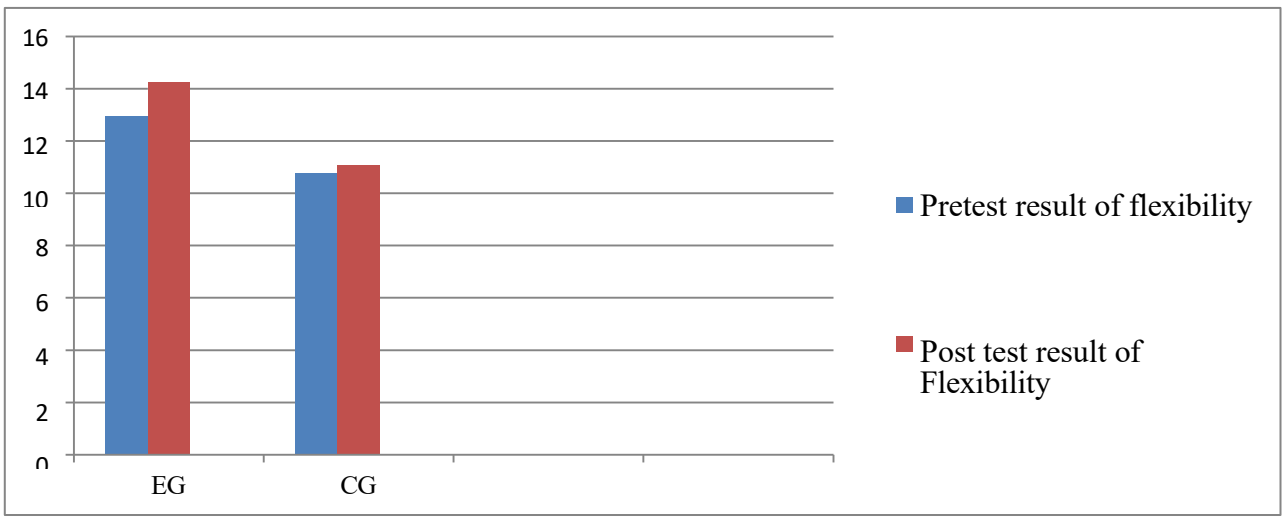
Table 5.The mean and mean difference values of sit and reach test for EG and CG

Group	Test	PT (X±SD)	PoT (X±SD)	ΔX) PT and PoT	P-value
EG	Sit and reach test	12.96±2.21	14.25±2.12	1.56	.001
CG	Sit and reach test	10.78±1.69	11.06±1.81	0.28	.419

EG= experimental groups, CG=control group X=mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, PT=pretest result, PoT= post test results p=significance level.

As shown from table 5 the mean value sit and reach pretest score of EG (N=16) was 12.96 with a SD of 2.21 and CG (N=16) was 10.78 with an SD of 1.69 respectively, from this data we have seen that the scores in the pretest for both groups were close. After 12 week resistance training of EG was found out 14.25 with SD of 2.12 and for CG mean 11.06 with SD of 1.81 from this data we have seen that the scores in the posttest for both groups were very different. One can pick up these numbers in pretest and posttests mean scores achievement levels are different. Hence, these data indicated that there was a significant difference and gradual improvement of sit and reach test between PT and PoT results of EG and there is no sufficient improvement of sit and reach test between PT, and PoT results in CG. Therefore, participation in 12 week resistance training program significantly improved the flexibility of participants.

Figure 2 Graphical presentation of Sit and reach test result of both groups



Mean **Groups**

Fig 2. As shown in the graph above the pre and posttest of the EG in sit and reach test was a mean score of 12.96 and 14.25 and also the CG was 10.78 and 11.06 respectively. From this data the investigator compute a pre and post mean difference of EG and CG. In which in case of the EG distance of sit and reach test was significantly improved by a mean difference of 1.56 at P=0.001 after three months resistance training. And also in case of the CG, the measured distance value of sit reach test was poor improvement by a mean difference 0.28 at P=0.419, There was an increase and a statistical significant improvement on sit and reach test for EG compared to sit and reach test scores of CG. Therefore the 12 week resistance training had a better improvement on flexibility of EG subjects when compared with CG. As a result the investigator testified and accepted alternate hypotheses two which is said that resistance training has a significant effect on improvement of flexibility after 12 week consecutive resistance training program and null hypothesis was rejected. But as the data shows there was very slight significant improvement in flexibility of the CG who only has a single 40 minutes of physical education practical class.

The finding of this study is in agreement with the finding of (Scott, 2002) who investigated that in strength training, it is important to ensure that all movements are carried through their full range of motion to satisfy the good thumb rule; stretch what you strengthen and strengthen what you stretch. (FLECK, S.J., and W.J. KRAEMER, 1997) also conducted that resistance training can modify muscular and tendentious physical characteristics as well as neuromuscular functional properties; because joint range of motion depends on the combination of muscular, tendentious and capsular characteristics, it is conceivable that resistance training has a potential effect on flexibility. This issue has direct practical implications, because a higher volume of flexibility training would have to be employed in the case of deleterious effects of resistance training on flexibility. On the other hand, no specific flexibility training would be necessary if resistance training itself could improve flexibility.

3.4. Effect of Resistance Training on Muscular Endurance

Table 6.The mean and mean difference values of sit up test for EG and CG

Group	Test	PT (X±SD)	PoT (X±SD)	ΔX) PT and PoT	P-value
EG	Sit-up	25.44±5.25	26.81±4.61	1.38	0.002
CG	Sit-up	23.06±3.51	23.81±3.93	0.75	0.151

EG= experimental groups, CG=control group X=mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, PT=pretest result, PoT= post test results p=significance level.

As indicated in table 6 the mean vale of sit up pretest score of EG (N=16) was 25.44 with a SD of 5.25 and CG (N=16) was 23.06 with an SD of 3.51 respectively, from this data we had seen that the scores in the pretest for both groups were close. After 12 week resistance training or PoT score of EG was found out 26.81 with SD of 4.61 and for CG mean 23.81 with SD of 3.93. From this data we had seen that the scores in the posttest for both groups were very different. Experimental group showed more significant improvement due the three month resistance training program in which they were engaged in. Therefore, participation in 12 week resistance training program significantly improved the muscular endurance of participants.

Figure 3 Graphical presentation of Sit up test result of both groups

Mean **Groups**

Fig 3. As shown in the above graph the pre and posttest result of the EG in sit up test had a mean score of 25.44 and 26.81 and also the CG was 23.06 and 23.81 respectively. From this data the investigator compute a pre and post mean difference of EG and CG, in case of the EG sit up test was significantly improved by a mean difference of 1.38 at P=0.002 and in case of the CG sit up test was poor improvement by a mean difference 0.75 at P=0.151

After three months resistance training, there was an increase and a statistical significant improvement of sit up test in EG compared to score in CG. Therefore resistance training had better improvement on muscular endurance of EG students when compared with CG. As a result the investigator testified and accepted alternate hypotheses three which said that resistance training has a significant effect on muscular endurance after 12 week consecutive resistance training and rejected the null hypothesis. But as the data shows there was very poor significant improvement in muscular endurance of the CG who only has a single 40 minutes of physical education practical class. The result of this study is consistent with the finding of (Shahidi *et al.,* 2012) who studied effect of two resistance training types on muscle fitness and anaerobic capacity in 16-18 years old male soccer players also reported that progressive resistance training had significant effect on the subjects lower body muscle endurance and abdominal muscle endurance.

3.5. Effect of Resistance Training on Body Composition

Table 7.The mean and mean difference values of BMI test for EG and CG

Group	Test	PT(X±SD)	PoT(X±SD)	ΔX)PT and PoT	P-value
EG	BMI	20.79±1.12	21.39±1.20	0.61	.004
CG	BMI	19.93±1.62	19.91±1.03	0.02	.941

EG= experimental groups, CG=control group X=mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, PT=pretest result, DT= during training result, PoT= post test results p=significance level.

Table 7: showed that the mean value of pretest BMI score of EG (N=16) was 20.79 with a SD of

1.12 and CG (N=16) was 19.93 with an SD of 1.62 respectively, from this data we had seen that the scores in the pretest for both groups were close After 12 week resistance training (PoT score) of EG was found out 21.39 with SD of 1.20 and for CG mean 19.91 with SD of 1.03 from this data we had seen that the scores in the posttest for both groups were very different. One can pick up; these numbers in pretest and posttest mean scores achievement levels are different. Hence, these data indicated that there was a significant difference and gradual improvement of BMI between PT and PoT test results of EG and there was very poor significant improvement of BMI between PT, and PoT test results of CG.

Figure 4 Graphical presentation BMI test result of both groups

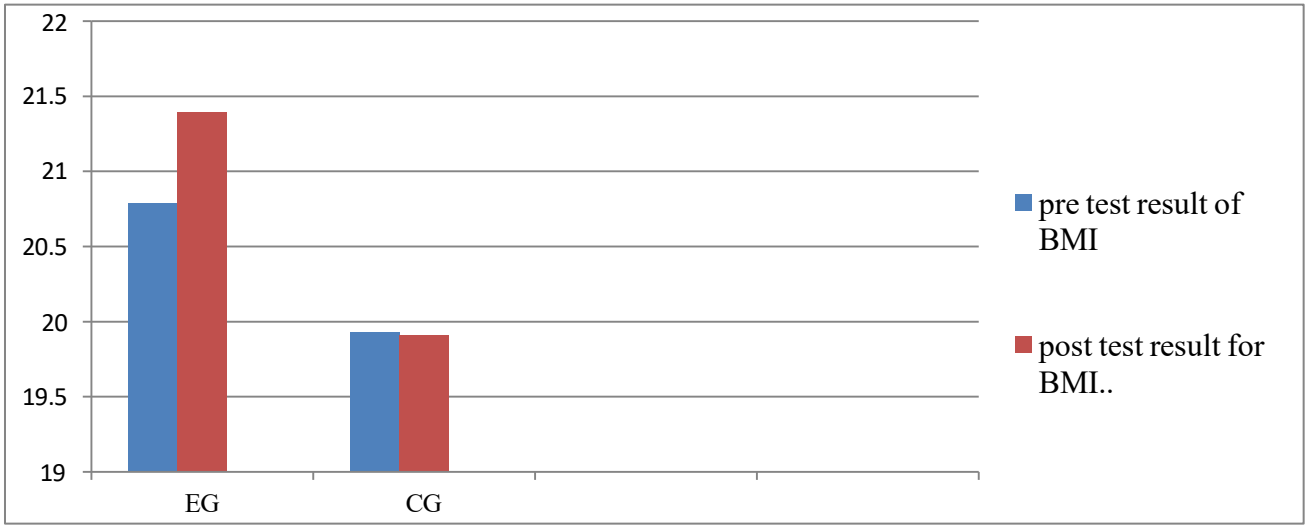


Fig 4. As shown in the above graph the pre and posttest of the EG in BMI test was a mean score of 20.79 and 21.39 and also the CG was 19.06 and 19.91 respectively. From this data the investigator compute a pre and post mean difference of EG and CG , in case of the EG BMI test was significantly improved by a mean difference of 0.61 at P=0.004

After 12 week resistance training, in case of the CG BMI test was very poor improvement by a mean difference 0.02 at P=0.942, There was a some significant improvement of EG compared to a constant score in CG. Therefore resistance training had some improvement on body composition of EG students when compared with CG. As a result the investigator testified and accepted alternate hypotheses four which said that 12 week resistance training has an effect on body composition and rejected the null hypothesis. The significant improvement of BMI was better in experimental group than the control group due to the increment of body weight. The result of this study is consistent with the finding of (Young and Steinhard, 1995) also concluded that resistance training programs can increase fat free mass and decrease the percentage of body fat. One of the outstanding benefits of resistance exercise, as it relates to weight loss, is the positive impact of increasing energy expenditure during the exercise session and somewhat during recovery, and on maintaining or increasing fat-free body mass while encouraging the loss of fat body weight .

3.6. Comparison of Four Tests (Push Up, Sit and Reach, Sit Up and BMI) Results of EG

Table 8.Changes of 12 week resistance Training in the selected health related physical fitness components (muscular strength, flexibility, muscular endurance and body composition)

Type of test	PT(X±SD)	PoT(X±SD)	(ΔX) PT and POT	P-value
Muscular strength (90 Degree Push Up)	16.75±2.89	23.94±5.05	7.19	0.000
Flexibility (sit and reach test)	12.96±2.21	14.25±2.12	1.56	0.001
Muscular endurance (sit up test)	25.44±5.25	26.81±4.61	1.38	0.002
Body composition (BMI)	20.79±1.12	21.39±1.20	0.61	0.004

X=mean value of each tests, SD= Standard deviation, ΔX= (MD) mean difference, PT=pretest result, PoT= post test results p=significance level.

The above table showed that EG there was significance difference in between the pre to post test score of (push up test, sit and reach test, sit up test and BMI) results due to twelve week resistance training in the selected health related physical fitness components (muscular strength, flexibility, muscular endurance and body composition).All test had changes due to resistance training in which they were engaged in.

The mean score value of muscular strength pretest before training result was (16.75) and posttest after 12 week resistance training mean score values was (23.94) The mean difference score of pretest with mean difference score of posttest mean difference value increased by (7.19). As indicated in the above table, the PT mean value of sit and reach test was 12.96 increased to 14.25on posttest. Sit and reach test score of pretest to posttest mean difference value of EG was increased by 1.56. The PT mean value of sit up test was 25.44 and PoT mean value of sit up test was increased to 26.81 after 12 week resistance training. Sit up test score of pretest mean to posttest mean difference value of EG increased by 1.38. As indicated in the above tables mean value of BMI test was from pretest 20.79 increased to 21.39 post tests. BMI test score from pretest to posttest mean difference value of EG increased to 0.61. When we compare the pretest and posttest mean difference value scores in each test of 12 weeks resistance training intervention experimental groups. Change was observed on muscular strength (90 degree push up test),flexibility (sit and reach test) , muscular endurance (sit up test) and body composition (BMI).The improvement rate of this data was one indicator of the great resistance training effect on some selected health related physical fitness components. Therefore, resistance training was important for increment of muscular strength, flexibility, muscular endurance and body composition according to the result on this study.

Limitation

Among the main limitations, the wide heterogeneity of the sample stands out and should be acknowledged. Previous experience with resistance training ranged from 6 months to 1 years, and the participants' training status was not clearly described in most studies. Furthermore, some studies did not report whether the training sessions were managed by experienced professionals in the field, nor whether food intake was controlled during the experimental protocols. These methodological gaps hinder the comparison of results. Another relevant point concerns the nomenclature used to describe the training method. Some studies have adopted the terms supersets, paired sets, or bi-sets as interchangeable, without clear standardization, especially regarding the resistance training on selected health related physical fitness exercises. Future studies should aim for greater uniformity in the description of participants, control of intervening variables, and the terminology used. This measure would allow for better comparability, interpretability and replication of the findings.

5. Conclusions

The purpose of this study was to evaluate the associations between Resistance training with selected Health related physical fitness components in grade 12 male students in case of Kaffa Zone Shisho Inde Wereda Shishinda preparatory school. Data was drawn from a pre and posttest after 12 weeks of resistance training within selected physical fitness tests i.e. 90 degree push up test to assess muscular strength ,sit and reach test to assess flexibility ,sit up test to assess muscular endurance and BMI test to body composition administered to selected sample male subjects (N=32). As a result, the following conclusion was made. This study indicated that resistance training has its own advantage on improving students selected health related physical fitness components particularly muscular strength, flexibility, muscular endurance and body composition on the resistance training in experimental groups showed a significant difference ($p<0.05$) on the above components compared with control group . Depending on the major findings of this study the researcher conclude that, the 12 week resistance training brings a significant improvement on selected physical fitness components (muscular strength, flexibility, muscular endurance and body composition).

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