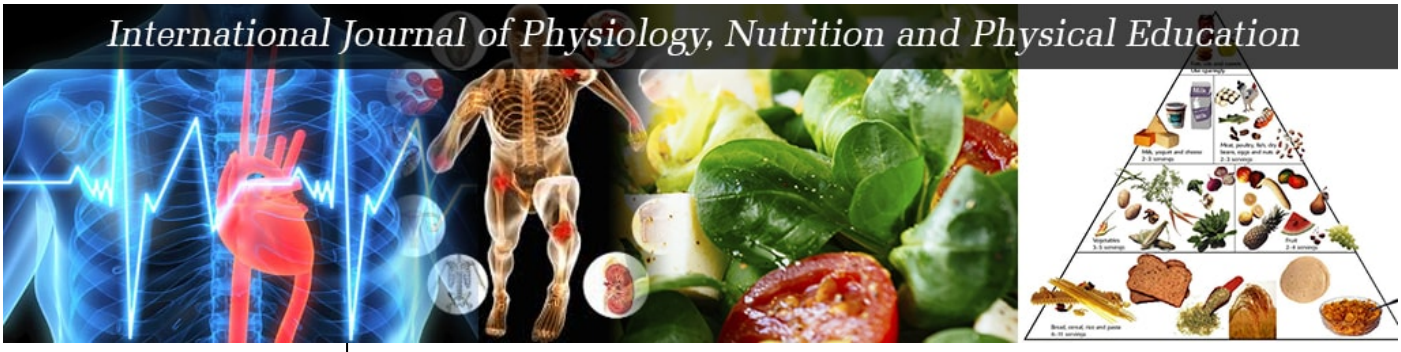


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# Effect of resistance training and stretching exercise on health related physical fitness variables of male higher secondary students

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**Abstract**
The specify of training principle predict that combining resistance and stretching exercise could interfere with the maximum development of strength that results from either type of training alone. The present study is to determine whether contracting and stretching exercise performed recurrently produces different performance and physiologic responses compared with each types of training alone. For the purpose of the study the researcher selected 60 untrained male higher secondary students and they were randomly assigned to one of three groups: asanas training (AT, N=20); resistance training (RT, N=20); and concurrent training (CT, N=20). The following measurements were taken from all the subjects before and after 8 weeks of training. Muscular strength, flexibility, muscular endurance, cardio-vascular endurance and percent body fat. Results of the study shows that the flexibility increased significantly in the AT, RT and CT groups ($P<0.05$), percent body fat significantly decreased in the RT and CT groups. Muscular strength, muscular endurance, and cardiovascular endurance significantly increased in the RT and CT groups, ($P<0.05$). CT group showed significantly superiority over AT and RT groups in increasing muscular strength, muscular endurance, cardiovascular endurance and decreasing percent body fat. From the result of the study it is concluded that concurrent training performed by adolescent healthy boys does not interfere with health-related physical fitness variables of muscular strength, muscular endurance, flexibility, cardiovascular endurance and percentage of body fat.

**Keywords:** concurrent training, muscular strength, muscular endurance, flexibility, cardiovascular endurance contracting and stretching exercise percent body fat.

## Introduction
Various authorities and agencies promoting physical development lay emphasis on different kinds of specific programmes as well as a combination of different methods of training for overall improvement of the body. In recent years contracting and stretching exercises have been given an immense boost as a significant means of improving performances in sports and games and fitness. Many research studies have been reported on the merits and outcomes of specific programme, however studies comparing different systems of training are hardly found reported in professional literature. The importance of weight training exercises (contracting Exercises) for developing various components of motor fitness is well established. So I the merits of Asanas in the form of slow stretching exercises for developing flexibility and stress management (relaxation) are also well documented. Though a number of reports have come out on the effects of Asanas and weight training exercises separately, the complementary and synergetic action of these two systems of exercise does not seem to have been investigated.

## Objectives
1. To find out the effects of stretching exercises on the health- related physical fitness variables of muscle strength, muscles endurance flexibility, cardiovascular endurance and percent body fat.
2. To find out the effects of contracting exercises (weight training) on the health related physical fitness variables of muscle strength, muscle endurance, flexibility, cardio-respiratory endurance and percentage of body fat.

3. To determine whether contracting and stretching exercises performed concurrently Produces different performance and physiologic responses in health -related physical fitness variables compared with each type of training alone.

**Hypothesis**

based on the specificity of the training principles and previous research, it is hypothesized that gains in muscle strength, muscles endurance, flexibility, cardio -vascular endurance and percent body fat would be less after concurrent training than respective gains after stretching or resistance training performed singularly.

**Methodology**

**Selection of subject**

The subjects were adolescent boys studying in the X standard of Government Higher Secondary School, Vattiyoorkavu, and Thiruvananthapuram. The subjects were randomly assigned to one of three groups, with the number of subjects completing the study as follows: asanas training (AT N=20): resistance training (RT, N=20); and concurrent training (CT, N=20). Subjects were informed of all possible risks involved in the study. All the subjects completed the study.

**Experimental design**

All subjects regardless of group assigned, were tested before and after training for each of the following dependent variables: muscle strength, muscle endurance, flexibility. Cardiovascular endurance, and body composition. All pre and post training testing procedures were completed with one week periods, spaced 8 weeks apart One day of rest and recovery was scheduled between each day of testing. Percent body fat and muscular strength was measured on the first testing day and muscular endurance and flexibility were conducted on second day. Cardiovascular endurance was completed on the third day of testing. Right grip and left grip were measured using grip dynamometer and back lift and leg lift were measured using back and leg dynamometer for muscular strength, muscular endurance measured using sit-up test, Flexibility was measured using sit and reach test, Cardiovascular endurance was measured using1.5 mile run, Percent body fat was estimated from body density by using the formula developed by Siri.

**Training programme**

Members of each group took part in the training programme that lasted 8 weeks. The RT group completed a series of standard resistance training exercises 3 days a week for 8 weeks. The resistance training programme consisted of individualized workout of one set of 8-12 repetition on 8 exercises designed to train all the major muscle groups of the body, and generally patterned after recommendations by American college of sports medicine (ACSM). The exercise included Leg Press, Leg Curl, Standing Calf Raise, Barbell Bench Press, Lat-pull Down, Barbell Military Press, Barbell Curl and Abdominal Crunch. A percentage of each subjects 1 RM for each exercise was used to determine the intensity for each week. The intensity and number of repetitions performed for each exercise were progressively changed by weekly and were adjusted for new IRM measured at the end of the weekly training.

The asanas group was trained by administrating selected asanas for 45 minutes three days per week on Mondays, Wednesdays and Fridays. A list of asanas was selected to give exercise to various major muscle groups. The following Asana were included: Bujangasana, Tadasana, Matchasana, Dhanurasana, Vakrsana, Badmasana, Virabhadrasana, Sethubantha Sarvangasana, Ustasana, Garudasana, Arthamatsendrasana, Yogamuthra, Viparita karani, Gomukasana, Chakrasana and Vajirasana. In every asana, the final position was held with no voluntary movement of the body starting with 30 seconds and progressively increased up to one minute. Each asana was repeated three times except Savasana. The number of repetitions gradually reduced from first week onwards and time isotonic and posture to purely postural aspect of asanas, In between exercise, the subjects relaxed for 10 to 15 seconds, The sessions were conducted by practicing Savasana for 5 minutes Concurrent training group was administered asanas of maintenance was increased. Thus there was progression for training followed by resistance training programme. The asanas groups assembled on Mondays, Wednesdays and, Fridays and practiced selected asanas as prescribed for asanas training group (AT) and adopted the same procedure. The resistance training exercises were done followed by asanas, using the same procedure prescribed for the resistance training group (RT).

**Analysis of Data**

Analysis of covariance was applied to determine whether the three training programmes produced significantly different improvements in selected variables after 8 weeks of training. Since the initial means were not matched, comparisons between actual means were not justified. Therefore before valid comparisons could be made, all means were adjusted by regression to a common initial mean. The significance of difference of pairs of adjusted final group means were tested for significance by applying Duncan's new multiple-range test. Among various post hoe test of significance, Duncan's new multiple range test is least conservative with respect to Type I error and as such most appropriate for this study, in which the effects of popular conditioning programmes are compared.

The group mean gains recorded by the various groups during the experimental period of 8 weeks in the criterion measures were tested for significance by applying students ‘1’ test. The accepted type 1 error rate was set at 5%.

**Results**

**Muscular strength**

In the AT group the average changes in each of the static strength measures of right grip (+3.19%), left grip (+3.3%), back lift (+.77%), leg lift (+.90%), and dynamic strength (military press) (+1.73%), after training was not significant. In contrast, in RT group the average change in each of the static strength measures of right grip (+15.46%), left grip (+12.73%), back lift (+5.73%), leg lift (+6.15), and dynamic strength (military press) (+3.13%) significantly elevated above pre training level at the post training time point. Static strength measures of right grip (+25.68%), left grip (+22.01%), back lift (+8.83%), leg lift (+9.11%), and dynamic strength (military press) (+26.16%), increased significantly from pre to post training in the CT group. Between groups analyses showed that the change in static and dynamic strength in the CT group was significantly greater than the resistance training and asanas training groups. The changes in static and dynamic strength in the RT group was significantly greater than that of the AT subjects in each of the static strength measures of right grip, left grip, back lift and leg lift.

**Muscular endurance**

In the AT group the average change in muscular endurance was not significant (+5.53%). In contrast, the mean muscular

endurance in the RT and CT groups was significantly increased from pre to post training (+18.32%, +26.33% respectively) Between group analysis showed that the change in muscular endurance in the CT group (+26.33%) was significantly different than the muscular endurance in the AT (+5.53%) and RT (+18.32%) groups. The RT group (18.32%) was significantly different than the muscular endurance in the AT group (+5.53%) RT (+18.32%) groups. The RT group (18.32%was significantly different than the muscular endurance in the AT group (+5.53%).

**Flexibility**

The AT, RT and CT groups flexibility was significantly increased from pre to post training (+14.13, +11.79 and +27.71%, repectively). The average increases in flexibility from pre to post training in the CT group (+27.91%) was significantly greater than the RT and AT groups (+ 11.79and+ 14.13%repectively). The change in flexibility for the R T and AT subjects did not differ significantly.

**Cardiovascular Endurance**

In the AT group the average change in cardiovascular endurance was not significant (-0.47%). In contrast, the mean cardio- vascular endurance in the RT and CT groups were significantly elevated above Pre training levels at the post training (-3.90% and 6.37% respectively). Between group analysis showed that the change in cardiovascular endurance in the CT group (-6.37%) was significantly different than the cardiovascular endurance in the AT (-0.47%) and RT (-6.30%) groups. The RT group (-3.90) was significantly different than the AT group (0.47%).

**Body composition**

With respect to body composition, a significant decrease in per cent body fat was found from pre to post training in the RT and CT groups. (- 12.20% and -11.85% respectively). No significant change in percent body fat was found in the AT group - (2.02%) Between group comparisons showed that the change in percent body fat in the CT (-11.85% and RT (-12.20%) groups were significantly different than the percent body fat in the AT (2.02%) group. The change in per cent body fat for the RT and C subjects did not differ significantly. (12.20% and 11.857o respectively)

**Table 1:** Health related physical fitness variables results

| Variable | Group | Pretest | Post test | |
|---|---|---|---|---|
| **Static muscle strength** | | | | |
| Right grip(kg) | AT | 17.20 ± 1.69 | 17.75 ± 2.07 | NS |
| | RT | 18.10 ± 1.76 | 20.90 ± 2.92 | S* |
| | CT | 18.30 ± 2.26 | 23.00 ± 3.44 | S ss |
| Left grip(kg) | AT | 15.05 ± 1.66 | 15.55 ± 2.01 | NS |
| | RT | 16.10 ± 2.30 | 18.15 ± 3.21 | S* |
| | CT | 15.90 ± 1.73 | 19.50 ± 2.82 | S ss |
| Back lift(kg) | AT | 64.25 ± 2.70 | 64.75 ± 3.16 | NS |
| | RT | 66.30 ± 3.28 | 70.10 ± 4.05 | S* |
| | CT | 65.10 ± 3.26 | 70.85 ± 4.83 | S ss |
| Leg lift(kg) | AT | 66.60 ± 3.22 | 67.20 ± 3.60 | NS |
| | RT | 69.10 ± 4.04 | 73.35 ± 4.99 | S* |
| | CT | 68.00 ± 4.24 | 74.20 ± 5.96 | S ss |
| Military press(kg) | AT | 15.95 ± 2.27 | 16.45 ± 2.67 | NS |
| | RT | 16.45 ±2.30 | 18.60 ± 3.25 | S* |
| | CT | 16.05 ±2.27 | 2025 ± 3.52 | S ss |
| Muscular endurance(no) | AT | 11.75 ±2.59 | 12.40 ± 3.65 | NS |
| | RT | 12.55 ±2.65 | 14.85 ± 3.40 | S* |
| | CT | 12.15 ±2.63 | 15.35 ± 3.50 | S ss |
| Flexibility (Cms) | AT | 23.00 ± 3.66 | 26.25 ± 4.29 | S |
| | RT | 22.90 ± 3.43 | 25.60 ± 4.16 | S |
| | CT | 22.80 ± 3.72 | 29.05 ± 4.49 | S ss |
| Cardiovascular Endurance(Sec) | AT | 855.05 ± 61.14 | 851.00 ± 60.16 | NS |
| | RT | 854.50 ± 53.01 | 821.15 ± 45.91 | S* |
| | CT | 852.95 ± 63.53 | 798.5 ± 45.91 | S ss |
| Percent body fat (%) | AT | 8.40 ±1.23 | 8.23 ± 1.21 | NS |
| | RT | 8.36 ±1.25 | 7.34 ± 1.13 | S* |
| | CT | 8.35 ±1.27 | 7.36 ± 1.30 | S* |

Values are given as means ± SO, AT, asanas trained; RT resistance trained; CT, concurrent trained; pre, pre training; post, post training: for within group mean difference NS indicates not significantly different, S indicates significant difference from pre to post training ($P$>0.05). For between groups changes, calculated as the post training minus the pre training values. Ss Indicates significant difference from the CT changes value. Indicates significant difference from the change value of the other two group ($P$<0.05).

**Discussion**

The study was designed to test the specificity of training principle as applied to two types of exercise modalities commonly recommended to promote the health and physical fitness of healthy adolescent boys. The aim was to characterize the physiologic and performance adaptations which result from stretching and contracting exercises training performed singularly and concurrently. Based on the specificity of training principle and published research it is hypothesized that stretching and contracting exercise training performed singularly would produce greater gains in Health-Related Physical Fitness variables of muscle strength, muscle endurance, cardiovascular endurance, flexibility and per cent body fat than the concurrent training of stretching and contracting exercises.

Contrary to our hypothesis the subjects in the CT group made

significantly greater gains in each of the static muscle strength measures of right grip, leg grip, back lift, and leg lift and dynamic muscle endurance measured in sit-ups, cardiovascular endurance measured in 1.5 miles, (muscle strength seen in the RM military press) and percent body fat estimated from body density.

The findings are in general agreement with those of MC Carthy etal. Z, who reported no interference in strength gains and comparable improvements in IRM squat performance between their resistance (contracting) and concurrent trained subjects.

The specificity of training principle would not predict an increase in strength with contracting exercise training equivalent to that obtained with stretching exercise training alone. The data generally support this principle, while the subjects in the study showed a substantial increase in average in each of the static muscle strength measures of right grip (+15.46%) left grip(+12.73%) back lift (+5.73%) leg lift (+6.15%) and dynamic strength (+3.13%), this was significantly less than the gains realized by the AT group subjects in each of the static strength measures of right grip (+3.19%), left grip(+3.36%) back lift (+0.77%) leg lift (+0.90%) and dynamic strength (+1.73%).

As noted previously, the principle of training specificity predict that contracting exercise training alone should produce a greater increase in muscle strength than stretching exercise training. The data supports the principle showing significant increase in muscle static and dynamic strength with contracting exercise training but not with stretching exercise training.

The principle of training specificity would predict no, or at best minimal improvement in muscle strength, muscle endurance, cardiovascular endurance with traditional stretching exercise training. The data confirm this principle in that no increase in muscle strength, muscle endurance, and cardiovascular endurance was found in our AT group.

## Conclusion

The study was conducted to determine the effect and to prescribe stretching exercise, contracting exercise, and concurrent exercise consistent with the recommendations of the ACSM to improve health and fitness. The findings do not support the existence of an "interference phenomenon" between concurrent stretching exercise training and contracting exercise training with respect to health related physical fitness variables gains. When young healthy adolescent boys perform either of contracting exercise training only or of concurrent stretching exercise training, similar gains in health -related physical fitness variables of muscle strength, muscle endurance, flexibility cardiovascular endurance, and percent body fat can be expected. Finally the data shows that effects of concurrent training on the development of health related physical fitness variables is superior to stretching exercise or contracting exercise training alone. These findings have important implications for professionals designing exercise programmes to improve health and fitness in the young adolescent children.

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