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# Effect Of 4-Week Yoga Intervention on Selective Physical and Body Composition Variables in Indian Male Track and Field Athletes

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## Abstract

**Background:** Yoga is increasingly being incorporated into the training regimes of athletes. The aims of the present study were to understand the effects of practicing yoga for four weeks on selective physical and body composition variables on healthy young Indian male athletes participating in track and field events.

**Methods and materials:** Nineteen male (n=19) competitive track and field athletes belong to Sports Authority of India (SAI), New Delhi, with their mean age 20±3 years and minimum 2 years of training experiences were randomly assigned to either an experimental (n=10) or to a control group (n=9). Outcome measures were taken on day 1 and day 28 which included quantification of selective physical and body composition variables following standard protocols. The experimental group practised yogic asanas and pranayamas an hour daily (6 days/ week) in the evening (4- 5 PM) for a period of four weeks.

**Results:** There was a significant decrease in body weight (p=0.002), fat free mass (p= 0.043) and increase in back strength (p= 0.028), flexibility (p=0.001) and vertical jump height (p= 0.007) in experimental group in comparison to the control one in between group comparison test. Also, significant reduction in body weight (p=0.003) and increase in back strength (p=0.000), flexibility (p=0.000), vertical jump height (p=0.005), agility (p=0.02) and balance (p=0.003) were observed in the experimental group in within group comparison test.

**Conclusion:** This study would provide useful information that practising yoga for four weeks along with routine physical exercises regularly improved athlete's essential fitness components of sports performance.

**Keywords:** Asana; Agility balance; Athletes meditation; Flexibility; Pranayam

## Introduction

Yoga word is derived from sanskrit word 'Yuj' which means 'to join' and it says that "Union of the individual self with the universal/supreme self" [1]. The practice of yoga has a long history as an integrated lifestyle science. Those who have practiced yoga in its full form (including all eight traditional aspects: Yama= restraints, Niyama=observations, Asana=posture, Pranayam=breathing practices, pratyahara= withdrawing the senses, dharana=concentration, dhyana=meditation and Samadhi enlightenment) find that it touches almost every aspect of their inter- and intra-personal lives. Yoga is a form of mind-body fitness that involves a combination of muscular activity and an internally directed mindful focus on awareness of the self, the breath, and energy [2]. The practice of yoga produces a physiological state opposite to that of the flight-or-fight stress response and with that interruption in the stress response, a sense of balance and union between the mind and body can be achieved [3]. Yoga is practiced in sports for injury prevention [4] as well as to enhance the performance [5,6] through achieving the peak level of physical fitness. It has been documented through several researches that yoga intervention improves the athletic performance in different sports by enhancing their flexibility, muscle strength and endurance and cardiovascular performance [5,7-9], physiological health factors such as heart rate, diastolic blood pressure, immune function and muscle soreness [7,8,10-12] and mental fitness [13-15].Yoga increases flexibility and the effects are seen as early as six weeks, even if the participants are only training once a week [16-18]. Madanmohan et al. [19] stated that yoga training

for a short period of six weeks can produce significant (P=0.05) improvements in respiratory muscle strength and endurance in young healthy subjects' yoga training group (n=23, male=15, female=8) in comparison to the control non- yoga training group (n=23, male=15, female=8). Pargaonkar & Bera [20] concluded that yoga practices for six weeks (45 minutes/ day, 5 days/ week) may have positive effects in improving cardio- respiratory endurance, strength and endurance of abdominal muscles, and flexibility and significantly reducing body fat percentage in schoolgirls. Tran et al. [8] found positive effects of hath yoga practice for 8 weeks in ten healthy, untrained volunteers (nine females and one male), ranging in age from 18-27 years on the health-related aspects of physical fitness, including muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition, and pulmonary function. Short-term yoga intervention training (comprising of selected asana, pranayama's and meditation) for 6, 8 or 12 weeks can have a positive effect on health-related physical fitness components of healthy volunteers. However, a methodological study considering health related physical fitness components effects of a short term 4-week yoga training program on Indian young athletes participating in track and field events is still lacking. To fulfill the lacunae of the literature, the present study was undertaken with the aim to understand the effects of practicing yoga for 4 weeks (1 hour/day, 6 days/ week) on selective physical, body composition and endurance variables on healthy young Indian male athletes participating in track and field event.

## Methods

### Subjects

A total of nineteen male (n=19) competitive track and field athletes belong to Sports Authority of India (SAI), New Delhi, participated in the study. The athletes who were found clinically healthy with no cardio-respiratory problems, chronic injury, had no surgery in previous six months, currently training for competition and had not practiced yoga regularly over the past six months were included in the study. Dietary pattern of the athletes was similar in nature, calorie intake wise, supplied from a common mess. All of them were introduced briefly about the objective of study, parameters, procedure, health risks, benefits, and other important guidelines before participation. All experimental procedures were approved by the Institutional Ethics Committee. A written informed consent was obtained as per declaration of Helsinki from all the athletes above 18 years and for minors below the age of 18 years an informed consent was obtained from the parents or guardians.

### Yogic training

Initial testing was performed to determine baseline measures. The athletes were asked to refrain from eating, drinking or doing any kind of exhaustive physical work at least for 2 hour before the onset of experiments. The experimental group (n=10) practised Yogic asanas and pranayamas an hour daily (6 days/ week) in the evening (4- 5 PM) for a period of four weeks whereas the control group (n=9) did not perform asanas and pranayama's, instead they watch videos relevant to their athletic training (Figure 1). All athletes were instructed to maintain their current activity level throughout the training period and all of them were on pre- competitive training cycles. All yogic training sessions were taught by a certified (under Government of NCT of Delhi) yoga instructor. The aspects of yoga practiced in this study are the physical postures and breathing practices of Hatha yoga. The yoga instructor utilized the Iyengar style of Hatha yoga for the intervention in the present study. The Iyengar method of Hatha yoga is based on the teachings of the yoga master Iyengar et al. [1]. On the first day of the Yoga intervention, athletes were informed about proper yoga attire and safety consideration for performing the same. The safety precautions that apply to the practice of yoga are

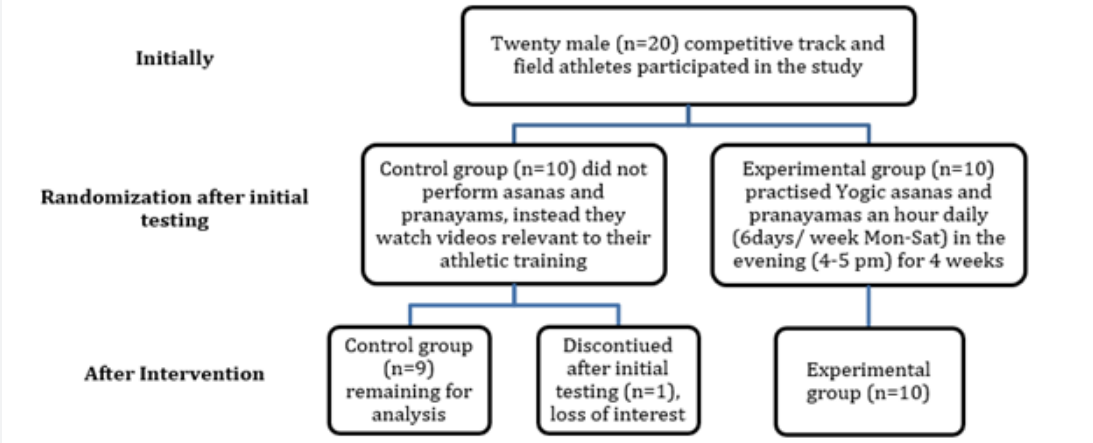


**Figure 1:** Flow chart of the research design.


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a) During Yoga, one should listen to his body and practice safely.

b) Follow the instructions exactly.

c) Should not compete with others.

d) Never force or strain to get into a specific position.

e) To practice leaving a gap between last meal and yoga.

f) Learn to distinguish between pain and sensation.

g) Before starting, educate yourself about various poses and techniques of practicing yoga by seeing relevant videos.

After 4 weeks of yoga training, all the athletes of both the groups undergo testing in the same order. Athletes were instructed to maintain similar dietary intake 24 hours before their session time as recorded during the pre- test condition and all participants executed their testing at the same time of day as during their pre- test. The protocol for each hour yoga class can be seen in Table 1. According to below mentioned yoga protocol, the athletes started their yoga session with warm up of 15 minutes and finished the session with cooling down for 10 minutes. The main asanas continued for 20 minutes followed by pranayama's for 15 minutes. Each main asana is required to be stretched/hold for 15-20 seconds for minimum two repetitions.

## Experimental procedure

All the athletes in both experimental (with yogic training) and control (without yogic training) groups participated in pre- post design study and every experiment war carried out to assess the effect of the said training. The standing body height was measured to the nearest 0.1 cm from sole of the feet to the vertex in erect body position, with the help of a digital stadiometer cum weighing machine by (Seca 284, Germany). Body weight (in kg) was measured with an empty bladder and stomach using same machine (Seca 284, Germany). Body mass index (BMI) was calculated as the ratio of weight to height squared. Hand grip strength (HGS) in kg was measured by using Hand Grip Dynamometer (Grip - D, TKK 5401, Takei, Tokyo, Japan), after adjusting grip size. Back muscle strength from the maximal isometric strength of the trunk muscles was measured in standing posture with 30°lumbar flexion using a digital back muscle strength meter (Back - D, TKK 5402; Takei, Tokyo, Japan) [21]. Explosive power of lower limbs i.e., the power of the legs in jumping vertically upwards was measured by using vertical jump tester (T.K.K. 5406, Jump M.D., Takei, Japan) following standard method of Sayers et al. [22]. Low back flexibility or flexibility of hip and trunk of participants was measured following modified sit-and-reach test [23] by using sit-and-reach box (Lafayette, Indiana, USA). The agility, speed and balance of the athletes were measured by using T-Test [24], 30m flying start [25] and standing stork tests [26] respectively.

**Table 1:** List of yoga practices.

| Practice | Duration |
|---|---|
| Regular physical training undertaken by both experimental and control Group | |
| Running and stretching exercises | |
| Anaerobic endurance and strength building exercises | |
| Sports specific skill development exercises | |
| **Practices specific to experimental group** | |
| Warm up (Tadasana, Dvikonasana, Trikonasana,Virbhadrasana, Surya – Namaskar | 15 mins |
| Asanas (Uttanasana- Urdhahastana, Natrajasana, Garudasana, Samkodasana, Meruvakrasana, Janu Sirsasana, Paschimottanasana, Gomukhasana, Ustrasana, Kandharasana, Bhujangasana, Adhomukh- svanasana, Salbhasana, Dhanurasana, Phalakasana) | 20 mins |
| Pranayamas (Nadi shodhan, Kumbhak, Kapalbhati, Bhastrika, Bhramari) | 15 mins |
| Cool down (Makarasana, Yoga mudra, Balasana, Savasana) | 10 mins |



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### Measurement of body fat and fat free mass

The athletes were instructed to remove all metal accessories, coins and mobile phones from their body before undergoing this test. Total fat free mass (%), body fat (%) and skeletal muscle mass (kg) of each subject was assessed using multi-frequency body composition analyzer (Model- mBCA 515, SECA, Hamburg, Germany) which is an eight-electrode segmental multi frequency bioelectric impedence analyzer (MFBIA) that measures impedance at 19 different frequencies ranging from 1 kHz to 1 MHz under uniform and controlled laboratory conditions. It is a 'stand-on' device where subjects put their feet on top of the electrodes in such a way so that their heel is placed central to the smaller posterior electrode and the forefoot is placed central to the larger 152 anterior electrode. Each side of the handrail has six electrodes; two are selected depending on the height of the subject with the angle about 30° between arms and the body. The hands touch the electrodes in such a way so that the electrode separator is located between the middle and ring finger. Each measurement in the multi frequency analyzer takes approximately 20 seconds. MFBIA values obtained at 5 and 50 kHz are applied in the predictive equations [27].

### Measurement of maximum aerobic capacity

For the estimation of the maximum aerobic capacity, multi-stage Fitness Test (MSFT) or Bleep Test was used which involved continuous running between two lines 20 metres apart (distance is marked out with chalk) in time to recorded beeps. The kabaddi player was instructed to stand behind one of the lines facing the second line and begin running as per instructed by the beep. The player keeps on running between the two lines, turning when instructed by the recorded beeps. There is total 21- levels in the beep test and each level has a set number of stages/ shuttles to complete. Each level goes for one minute. After about one minute, a sound indicates an increase in beep tempo, and the beeps get closer together. If the player is not reached in time before the scheduled beep, he was asked to run to the line, turn and try to catch up with the pace within 2 more scheduled 'beeps. However, if the subject failed to reach the line for two consecutive beeps then the test was stopped. The subject's score i.e., the levels and number of shuttles reached before he was unable to maintain with the beep tempo was recorded. This level and shuttle score was then converted to a $VO_2$ maximum equivalent score using beep test standardized calculator [28].

### Statistical analysis

Data were analyzed using SPSS version 17.0 (SPSS Inc, Chicago, Ill). Descriptive statistics were used to assess normality and homogeneity. The sample size was estimated from a previous study conducted with an effect size (difference between mean values) of 2.93, standard deviation of 4.15, level of significance at 5%, the power of study at 80% and the estimated sample size of 8 per group. Considering the drop out, total 20 athletes were included in the study. Following normal distribution of the data, paired sample t- test was used to assess the within group changes, and analysis of covariance (ANCOVA) for between group changes were performed. Effect sizes for all variables are reported using partial eta2 ($\eta p2$). Effect size interpretation was based on the scale for effect size classification of Hopkins [29]. The scale for classification is as follows; <0.04 = trivial, 0.041 to 0.249 = small, 0.25 to 0.549 = medium, 0.55 to 0.799 = large, and >0.8 = very large. All the data were expressed as mean± SD. Criterion alpha level of $p \leq 0.05$ was used to determine statistical significances.

## Results

A total of twenty male (n=20) competitive track and field athletes belong to Sports Authority of India (SAI), New Delhi, with their mean age 20±3 years and minimum 2 years of training experiences initially participated in the study. After the initial testing, participants were randomly divided into the experimental (n=10) and control (n=9) groups based on a computerized random number generator and one athlete did not want to participate in post testing due to personal reasons (Figure 1). The comparison of various body compositions, physiological and physical parameters between experimental and control group is depicted in Table 2. It was revealed that paired t test done to assess within group changes show significant reduction in body weight by 1.77% (p=0.003) and increase in back strength by 33.1% (p=0.000), flexibility by 17.9% (p=0.000), vertical jump height by 42.1% (p=0.005), agility by 6.48% (p=0.02) and balance by 116.3% (p=0.003) in the experimental group post yoga intervention. Significant increase in back strength by 14.3% (p=0.023) in control group was also observed within group after 4 weeks of time without yoga intervention. Analysis of covariance (ANCOVA) on post intervention measures showed a significant decrease in body weight (p=0.002) by 4.5%, fat free mass (p= 0.043) by 2.5% and increase in back strength (p= 0.028) by 10.3%, flexibility (p=0.001) by 35.5% and vertical jump height (p= 0.007) by 26.3% in experimental group in comparison to the control one. Effect size for flexibility, body weight, back strength and vertical jump height is medium while for other parameters it is either small or trivial.

## Discussion

The findings of the study revealed that regular yoga practice, an ancient Indian culture and the mode of life, along with systematic training protocol helps to improve the physical fitness components in Indian male track and field athletes. Any athlete can reap the benefits of practicing yoga; it is especially valuable for preventing injuries in explosive sports (e.g., sprinting, tennis, basketball, baseball) [30]. Yoga's therapeutic effects are suggested


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to come from increasing vagal stimulation (parasympathetic) and turning off the hypothalamic-pituitary-adrenal axis and sympathetic nervous system response to stress [31]. Yoga is a highly structured activity that mimics critical aspects of athletic performance including balance, flexibility, muscular strength, muscle endurance, and movement efficiency (coordination) [32,33]. Continuous practice of yoga causes a gradual loosening of the muscles and connective tissues surrounding the bones and joints; this is thought to be one reason that yoga is associated with reduced aches and pains. The breathing techniques of Hatha yoga focus on conscious prolongation of inhalation, breathe retention and exhalation and it is through the association of the physical body, breath, and concentration while performing the postures and movements that interruptions in the energy channels of the body are cleaned and the body energy system becomes more balanced [34]. Pranayama, by continuous practice reduces the dead space ventilation and decreases the work of breathing. Entire lung is ventilated in contrast to the shallow breathing which only refreshes the base of the lung [35]. Hence the overall physical and mental health improves [36]. Some specific reasons that the athletic trainers might want to consider using yoga in their injury-prevention programs include increased core stability, increased flexibility and range of motion, and increased relaxation. It was observed from the result of the present study that yoga training for 4 weeks significantly reduces body weight and improves back muscle and leg strength in experimental group in both within and between group comparison tests. Godara et al. [37] investigated the effect of yoga training on 40 handball players with their age group of 12 to 15 years old and stated that the 10 weeks of yoga training improved back strength significantly in them. Kim Sojung et al. [38] conducted a study on 34 women with their average age group of 35 years to assess the effect of practising yogic exercises on their upper body strength and lower body strength for eight months and observed significant change in their leg strength. The possible mechanisms working in yoga therapy in reduction of weight are the calorie burning in physical activity as a combination of both isometric & isotonic exercises. On the other hand, experimental group exhibited 3.2% decrease in body fat percentage and 0.31% increase in fat free mass post intervention while the control group exhibited 7.47% increase in body fat% and 2.27% decrease in fat free mass without intervention, although changes were not found to be statistically significant. This might be due to improper optimization of the training load and/or short duration of the yoga training. Most of the long duration studies involving yoga intervention have found progressive and sustained reduction in body weight, body fat mass, body fat percentage, BMI [39-41]. On the contrary, some short-term studies have also shown positive results of yoga therapy [42-44]. Our results further indicated that yoga training, when added to the systematic training protocol, significantly enhances the measures of flexibility and agility in the experimental group post intervention in within group comparison test. In contrast, the control group had no significant improvement in their flexibility and agility. The impact of yoga was further demonstrated with significantly better balance for experimental group post intervention in within group comparison test. Researchers have shown that yoga increases participants' sit and reach scores in as little as six sessions over six weeks [17,18]. Polsgrove et al. [5] concluded that a 10 -week yoga intervention was linked with significant improvement in flexibility and balance in NCAA soccer and baseball players in comparison to the non -yogic group. Rayat [45] assessed the effect of yoga training on flexibility of 40 male college students with their age group of 18-24 years and concluded that they have found significantly improvement in flexibility after 12 weeks of training. Yoga practice also improved muscle torque and decreased lower back pain. Bi-weekly yoga practice for eight weeks was associated with increases in ankle flexibility (13%), knee extension (28%), shoulder elevation (155%), trunk extension (188%), and trunk flexion (14%) [6]. Asana practice increases core stability, which is essential for both sport performance and injury prevention [33]. Because yoga practice needs the movement of many major and minor muscle groups simultaneously and focuses on proper muscular and skeletal alignment, it tends to differ from other conditioning methods that emphasize active engagement of only certain areas of the body. A typical outcome of systematic asana practice is an increased overall sense of balance and strength for whole-body movements [30]. Yoga improves balance and joint range of motion, therefore, may enhance athletic performances that require these characteristics. On the contrary, the 4-week yoga intervention in our study did not show any significant improvement in VO2max in experimental group in comparison with the control one. The result is in contrast with the study by Lau et al. [46] which demonstrated significant improvement in $VO_2$max for apparently healthy adults assigned to a 12-week yoga training program and they postulated that the increased muscular endurance resulting from yoga practice may have achieved a better control of intercostal muscles that would consequently improve $VO_2$max in them. Our study had some limitations. The athletes were not in their peaking phase during either the pre- or post-testing which may have affected their body composition and endurance parameters. Although significant benefits were observed, multitude of yogic asanas makes it difficult to pinpoint the most effective component of yoga. Future research should continue to study what effects yoga has on an athlete's range of motion and force production. There was no comparable intervention for the control group. The sample size was small and lacked gender/ age diversity. The dosage of the yoga intervention was quite high and might not be replicable or realistic for others. An additional limitation of this study would be the lack of long term follow up. Another interesting area of research would be to find out what psychological influences yoga may play in athletes due to the meditation and centering that is part of the training, and if this would help or hinder their performance.



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**Table 2:** Comparison of body compositions, physiological and physical parameters between two groups.

| | Control Group (n=9) | | | Experimental Group (n=10) | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameters | Pre-Test | Post-Test | t value (sig 2 tailed) | Pre-Test | Post-Test | t value (sig 2 tailed) | F value (sig) | Partial eta squared |
| Height (cm) | 168.89±6.00 | 169.22±5.84 | -2 | 169.3±7.29 | 169.6±7.38 | -1.964 .081 | 0.018.894 | 0.001 |
| Weight (kg) | 58.52±11.05 | 59.25±11.48 | -1.795 | 57.58±5.09 | 56.56±5.10 | 4.111.003* | 13.451.002# | 0.457 |
| Body fat (%) | 10.7±5.60 | 11.5±6.92 | -1.5 | 14.01±9.66 | 13.55±9.30 | 1.246.244 | 4.050.061 | 0.202 |
| Fat free mass (%) | 90.56±6.44 | 88.5±6.92 | 2.279 | 85.99±9.66 | 86.26±9.27 | -0.808.440 | 4.844.043# | 0.232 |
| Muscle mass (Kg) | 19.28±7.95 | 19.9±6.24 | -0.324 | 22.3±3.38 | 22.82±3.36 | -1.221.253 | 0.999.332 | 0.059 |
| Right hand grip strength (kg) | 35.58±6.38 | 36.75±7.14 | -1.386 | 36.92±9.39 | 39.16±7.41 | -1.973 .080 | 0.931.055 | 0.055 |
| Left hand grip strength (kg) | 37.28±7.21 | 37.53±4.94 | -0.182 | 38.45±8.16 | 39.26±7.58 | -0.547 .598 | 0.271.610 | 0.017 |
| Back strength (kg) | 78.76±23.52 | 90.09±17.91 | -2.805* | 74.68±17.44 | 99.4±14.85 | -5.746.000* | 5.280.028# | 0.267 |
| Flexibility (cm) | 28.56±7.52 | 29.78±6.44 | -1.148 | 34.2±5.61 | 40.35±5.50 | -6.066.000* | 16.546.001# | 0.508 |
| Vertical jump height (cm) | 33.56±4.39 | 36.33±3.20 | -2.156 | 32.3±8.52 | 45.9±8.84 | -3.724.005* | 9.427007# | 0.371 |
| Speed (secs) | 5.26±0.39 | 5.54±1.33 | -0.658 | 5.23±0.32 | 5.10±0.28 | 2.210 .054 | 0.940.347 | 0.055 |
| Agility (secs) | 12.66±0.43 | 12.49±0.65 | 0.777 | 3.24±0.19 | 3.45±0.17 | -2.835.020* | 2.283.150 | 0.125 |
| Balance (secs) | 6.62±3.84 | 9.11±6.38 | -1.01 | 7.22±5.71 | 15.62±9.92 | -3.932.003* | 3.129.096 | 0.164 |
| Max aerobic capacity ( $VO_2$ max) (ml/kg/min) | 50.90±13.05 | 53.68±12.73 | -1.632 | 49.02±7.47 | 50.17±10.76 | -0.410.691 | 0.290.597 | 0.018 |

*p<0.05 for within group changes using paired t test (t value).

#p<0.05 for between group changes using analysis of covariance (F value).

## Conclusion

The results of the study showed that practising yoga for four weeks (1 hour/day, 6 days/ week) along with routine physical exercises regularly improved athlete's fitness parameters like muscular strength, flexibility and decrease body weight. Thus, the practice of yoga may provide an additional training option for the track and field athletes to enhance sports performance. Further investigation with longer follow-up (e.g., 6 months) should be considered, which would offer insights as to the long-term benefits of yoga.

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