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# Linkage of aerobic capacity and body fat percent: Effects of recreational activity on aerobic capacity, body composition, blood pressure and resting heart rate in University students

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## ABSTRACT

Objective of present study was to evaluate the effects of small-sided recreational basketball on maximum oxygen uptake, body composition, blood pressure and resting heart rate in untrained male and to examine relationship between maximal oxygen uptake and body fat percent. Two groups were formed; intervention and control with 12 participants in each. All participants were assessed at baseline and after 12 week. A supervised recreational basketball was offered to participants in intervention group for 12 weeks. All

games were played on half court and on 3 a side basis. Frequency of sessions was 2 times per week. Each session was of 30 minutes duration. Heart rates of all participants were measured during basketball sessions using polar heart rate monitors. Independent T test have shown mixed results with regard to physical parameters after twelve weeks of basketball. There was significant difference seen between two groups in body fat percent ($t_{20}$ = 2.417, $P$ = 0.026), $VO_2$max ($t_{20}$ = 2.144, $P$ = 0.046) and resting heart rate ($t_{20}$ = 2.183, $P$ = 0.043). No significant difference was seen in body mass ($t_{20}$ = 1.759, $P$ = 0.097), BMI ($t_{20}$ = 1.775, $P$ = 0.095), lean body mass ($t_{20}$ = 0.292, $P$ = 0.773), systolic blood pressure ($t_{20}$ = -1.389, $P$ = 0.180) and diastolic blood pressure ($t_{20}$ = -1.712, $P$ = 0.107). Significant relationship was seen between $VO_2$max and body fat percent intervention group (r = 0.049). Probably for the first time recreational basketball carried on half court (3 a side) on half hourly basis and only for two days in a week have shown significant improvement in $VO_2$max of untrained males along with reduction in body fat percent and resting heart rate.

**Keywords:** Aerobic Capacity, Body Fat Percent, Recreation Activity

## 1. INTRODUCTION

Recreational sports can play major role in promotion of health and fitness. Exercise can be performed as a recreational activity. Any exercise programme must be enjoyable so that it can be successfully incorporated into person's lifestyle (Ryan and Deci, 2000; Fatoba & Fatoba, 2017). Also there is evidence which suggest that adults like non-structured and social exercise settings than doing any exercise alone in a structured way (Burke et al., 2005). At present it is not clear if recreational sport can be considered as an effective tool in improvement of health and fitness (Brittany et al., 2013).

Benefits associated with traditional programs namely running or cycling is well documented and known (Goodpaster et al., 2003; Menshikova et al., 2005; Ross and Janssen, 2001; Tjonna et al., 2008). But the problem with such traditional and structured programmes is low adherence to such activities (Robison and Rogers, 1994). And the reason for such low adherence to endurance based activities is the lack of internal motivation for participation (Silva et al., 2008; Teixeira et al., 2006). Basketball is body contact game well known for efforts such as sprints, jumps and quick stops. It would be useful to know if recreational basketball without specialized physical fitness training will contribute in improving stated objectives of the study.

According to (Ainsworth et al., 2000) some of the games; basketball, ice hockey or soccer are generally considered to be of high intensity in nature (8.0–10.0 METs). If we look at basketball, it is even more intense form of activity comparing to other sports and it can help in building higher cardiovascular and other metabolic adaptations (Edgett et al., 2013). Participation in basketball training proved to be beneficial in prepubescent boys increasing their $VO_2$max (Vamvakoudis et al., 2007). Further there are number of studies which have stated that recreational football for 2-3 days/week, proved to be beneficial in increasing $VO_2$max and lower blood pressure (Bangsbo et al., 2010; Krustrup et al., 2009; Krustrup et al., 2010). It has been said that students of university are more inclined towards participation in activities that are more social and outside the ambit of structured settings (Bruke et al., 2005).

Many studies have been done in past to study the effect of recreation football or recreation on healthy male and female subjects. Not many studies have been done on recreational basketball. Therefore, we need studies that may examine the effects of recreational basketball as an alternate towards improvement of aerobic capacity and fitness. Especially in this part of world where climate is a big challenge for outdoor activities, we would like to see if small sided games of recreation basketball can have a positive effect on health parameters. Therefore, primary aim of present study was to evaluate the effects of small sided recreational basketball on maximum oxygen uptake ($VO_2$max), body composition, blood pressure and resting heart rate (RHR) in untrained male. Another aim of the study was to examine relationship between maximal oxygen uptake and body fat percent (BFP).

## 2. MATERIALS AND METHODS

### Participants

Participants were 24 male undergraduate students selected randomly following exclusion criteria. Participants in study were fully informed about the risk involved and a written consent was obtained. Exclusion criteria; participants who were playing and doing physical activities regularly during last one year; who were playing regular basketball; those who were on prescribed medication; and those having cardiovascular diseases and obesity.

### Study Design and Intervention

Two groups were formed; intervention (IG) and control (CG) with 12 participants in each. All participants were assessed at baseline and after 12 week of intervention. Attendance was taken and recorded in each session. A supervised recreation basketball was

offered to participants in IG for 12 weeks and they were advised not to involve in any other physical activities during study period. All games were played on half court and on 3 a side basis. Frequency of sessions was 2 times per week. Each session of basketball was of 30 minutes duration. All the sessions were conducted under direct supervision of research team. Heart rates of all participants were measured during basketball sessions with the help of polar heart rate monitors.

**Measurements and Testing Protocols**

Age, body mass (BM), body mass index (BMI), body fat percent (BFP) was recorded at baseline. Body fat percent was recorded using Omron hbf-514c full-body sensor monitor. Hear rate during basketball was recorded with Polar FT7. Blood pressure and resting heart rate (RHR) were measured after resting for at least 20 minutes using Omron BP791IT 10 Series Monitor. $VO_{2max}$ was measured by single stage treadmill walking test, which is used to measure submaximal aerobic fitness test that estimates $VO_{2max}$. This test is appropriate for the people who are at lower risk, are normally healthy and not involved in athletic activities (Ebbeling et al., 1991).

**Statistical Analysis**

Collected data were shown as mean and standard deviation. All data were assessed for normality by Shapiro Wilks test. Baseline measurements were checked for any group differences using independent T Test. Between groups, differences in delta values (post minus pre values) were tested by independent T Test. Pearson correlation test was employed to examine relationship between $VO_{2max}$ and body fat percent. For statistical significance, P-value was set at 0.05.

## 3. RESULTS

General and baseline characteristics are reflected in (table 1and 2 respectively). Mean age was 19.63 ± 0.67 years in the IG and 19.9 ± 0.70 years in CG ($P$ = 0.49). No adverse complications occurred during the basketball sessions.

**Table 1** General Characteristics of Participants

| | Intervention Group | Control Group |
|---|---|---|
| Age (years) | 19.63 ± 0.67 | 19.90 ± 0.70 |
| Height (m) | 1.71 ± 0.04 | 1.73 ±0.03 |
| Weight (kg) | 72.26 ± 13.02 | 64.58 ± 10.41 |
| Average Hear Rate (b/m) | 167.82 ± 9.00 | |
| Maximum Heart Rate (b/m) | 191.87 ± 7.30 | |
| Playing Time (min) | 27.86 ± 3.15 | |
| Attendance | 91.66% | |

Data shown as Means ± SD

**Table 2** Descriptive Statistics at Baseline and Post Intervention Comparison of Physical Parameters at Baseline between Intervention and Control Group (Independent t Test)

| Variable | Intervention Group (n = 11) | | Control Group (n = 11) | | P Value |
|---|---|---|---|---|---|
| | Baseline | 12 Week | Baseline | 12 Week | |
| Body Mass | 72.38 ± 12.94 | 71.86 ± 12.82 | 64.60 ± 10.41 | 64.90 ± 10.28 | 0.136 |
| Body Mass Index | 24.69 ± 4.60 | 24.51 ± 4.58 | 21.49 ± 3.24 | 21.59 ± 3.21 | 0.074 |
| Body Fat Percent | 17.90 ± 5.56 | 17.67 ± 5.58 | 14.13 ± 3.92 | 14.38 ± 3.96 | 0.083 |
| Lean Body Mass | 58.68 ± 7.06 | 58.61 ± 7.01 | 55.00 ± 6.26 | 55.07 ± 6.37 | 0.212 |
| Systolic Blood Pressure | 114.18 ± 7.18 | 114.81 ± 8.31 | 113.18 ± 11.80 | 110.90 ± 9.42 | 0.813 |
| Diastolic Blood Pressure | 71.72 ± 6.31 | 72.63 ± 7.69 | 69.27 ± 5.47 | 65.63 ± 2.94 | 0.342 |
| Resting Heart Rate | 77.54 ± 11.71 | 72.54 ± 11.52 | 76.81 ± 7.25 | 78.09 ± 6.51 | 0.863 |
| $VO_2$ Max | 34.54 ± 2.93 | 35.66 ± 3.06 | 37.10 ± 4.31 | 36.17 ± 3.54 | 0.121 |

Data shown as Means ± SD, *significant difference at .05

**Basketball Sessions**

All participants were able to complete intervention (small side basketball) during the study period. However, one participant each in IG and CG did not report for post measurements. All participants were able to play vigorous game of small sided basketball (mean average heart rate 167.82 ± 9.00 beats/ minute) for 30 minutes duration (mean duration of play 27.86 ± 3.15 minutes). Mean attendance in the IG during study period was 91.66% which shows the enthusiasm and interest of participants in recreational basketball.

**Relationship between Aerobic Capacity and Body Fat Percent**

There was significant relationship found between $VO_2$max and BFP in IG after 12 weeks of basketball training (r = 0.049), on the other hand we did not see any relationship between $VO_2$max and BFP (r = 0.643) in CG (table 3 and fig 1).

**Table 3** Relationship between $VO_2$Max and Body Fat Percent

| | $VO_2$Max | Body Fat Percent | Correlation |
|---|---|---|---|
| Intervention Group | 35.66± 3.06 | 17.67 ± 5.58 | 0.049* |
| Control Group | 36.17 ± 3.81 | 14.38 ± 3.54 | 0.643 |

Data shown as Means ± SD, *Correlation is significant at the 0.05 level (2-tailed)

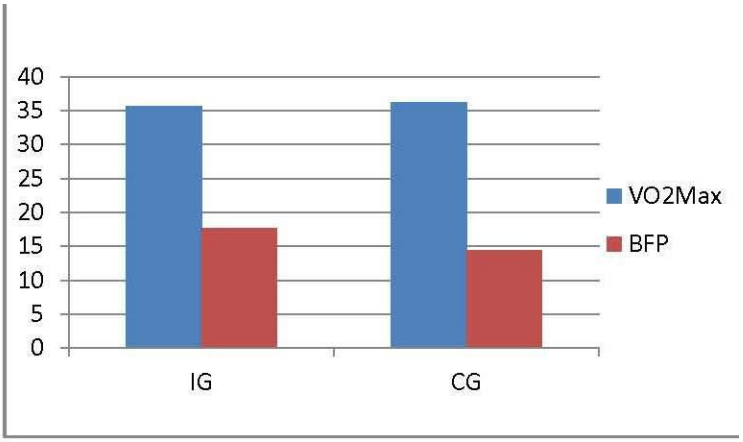


**Figure 1** Mean $VO_2$max and Body Fat Percent (BFP) after 12 weeks between IG and CG

**Body Composition**

We did baseline comparison of all variables between intervention and control group to check if difference exists between two groups. On analyzing independent T test, we could not find notable differences at baseline in both IG and CG (table 2 and fig 2).

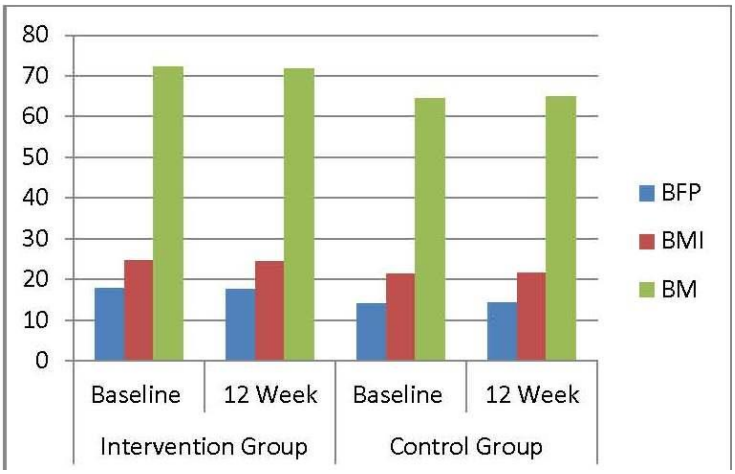


**Figure 2** Mean Body Fat Percent (BFP), Body Mass Index (BMI) and Body Mass (BM) at baseline and 12 weeks between IG and CG

Data analyses have shown mixed results with regard to physical parameters after twelve weeks of basketball table 4. There was significant difference seen in BFP ($t_{20}$ = 2.417, *P* = 0.026), with mean BFP 17.67 ± 5.58 and 14.38 ± 3.96 in IG and CG respectively. There was no difference (significant) seen in BM of participants in IG and CG groups post intervention ($t_{20}$ = 1.759, *P* = 0.097), where mean BM was 71.86 ± 12.82 and 64.90 ± 10.28 in IG and CG respectively. *T* Test did not reveled any significant difference in BMI ($t_{20}$ = 1.775, *P* = 0.095), with mean BMI of 24.51 ± 4.58 and 21.59 ± 3.21 in IG and CG respectively. In lean body mass (LBM) also there was no difference seen in both groups after intervention ($t_{20}$ = 0.292, *P* = 0.773), where mean LBM was58.61 ± 7.01 and 55.07 ± 6.37 in IG and CG respectively.

**Table 4** Comparison of Physical Parameters after 12 weeks (Difference between Post Test and Pre Test Scores, Independent t Test)

| Variable | Intervention Group (n = 11) | Control Group (n = 11) | P Value |
|---|---|---|---|
| Body Mass | 0.51 ± 1.32 | -0.30 ± 0.81 | 0.097 |
| Body Mass Index | 0.17 ± 0.44 | -0.10 ± 0.26 | 0.095 |
| Body Fat Percent | 0.23 ± 0.41 | -0.24 ± 0.51 | 0.026* |
| Lean Body Mass | 0.06 ± 0.96 | -0.06 ± 1.08 | 0.773 |
| Systolic Blood Pressure | -0.63 ± 4.78 | 2.2 ± 5.04 | 0.180 |
| Diastolic Blood Pressure | -0.90 ± 7.81 | 3.63 ± 4.05 | 0.107 |
| Resting Heart Rate | 5.00 ± 8.03 | -1.27 ± 5.12 | 0.043* |
| $VO_2$ Max | 1.11 ± 1.87 | -0.93 ± 2.56 | 0.046* |

Data shown as Means ± SD, *significant difference at .05

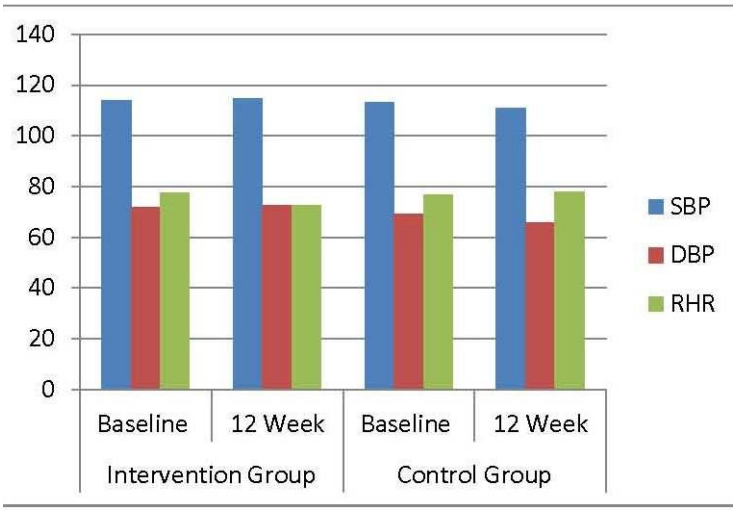


**Figure 3** Mean Resting Heart Rate (RHR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) at baseline and 12 weeks between IG and CG

### Aerobic Capacity

We have also observed significant difference in $VO_2$max ($t_{20}$ = 2.144, *P* = 0.046), with mean $VO_2$max 35.66 ± 3.06 and 36.17 ± 3.54 in IG and CG respectively.

### Resting Heart Rate

Furthermore, significant difference was also observed in RHR between two groups ($t_{20}$ = 2.183, *P* = 0.043), with mean RHR72.54 ± 11.52and 78.09 ± 6.51 in IG and CG respectively.

**Blood Pressure**

With regard to blood pressure, there was no significant difference in both control and intervention groups. Systolic blood pressure (SBP)($t_{20}$ = -1.389, *P* = 0.180), where mean SBP was 114.81 ± 8.31and 110.90 ± 9.42 in IG and CG respectively. Diastolic blood pressure (DBP) ($t_{20}$ = -1.712, *P* = 0.107), where mean DBP was 72.63 ± 7.69 and 65.63 ± 2.94 in IG and CG respectively Fig 3.

## 4. DISCUSSION

With regard to aerobic capacity, results indicate a significant improvement in aerobic capacity of intervention group. This is quite interesting as intervention was given only for two days a week. Although $VO_2$max of intervention group at baseline was less compare to control group. It was always difficult to carry out studies involving students with lot of academic pressure and commitments, and results must be interpreted with care considering limitation of study design. One of the strongest points was attendance of participants (91.66%), which shows enthusiasm and interest in small sided basketball game. This was also supported by other study, which stated that university students are more likely to appear and participate in physical activities, which are social in nature, and is not carried out in structured settings (Bruke et al., 2005). Our data and finding also suggest that recreational exercise or sports can give same or at least few of the beneficial effects as that of structured exercise, which is also reiterated by another study (Edgett et al., 2013).

Our results of $VO_2$max improvement were in line with another study where 3 a side basketball have shown significant improvement in $VO_2$max (Randers et al., 2018). There are few more similar studies which have shown improved aerobic fitness as a result of small side football in untrained subjects (Bangsbo et al., 2010; Krustrup et al., 2009; Krustrup et al., 2010). Small side games of football were effective in improving $VO_{2peak}$ in untrained participants with low initial $VO_{2peak}$ (Bangsbo et al., 2010). In our study also $VO_2$max was low at baseline in IG. There are several studies suggesting that competitive sport is not effective in improving $VO_{2peak}$ in relatively fit athletes (Hakkinen, 1993; Silvestre et al., 2006; Miller et al., 2007). This is an important and significant outcome, which suggests that untrained individual with lower initial fitness levels are more likely to achieve greater improvements in $VO_2$max through recreational sports in comparison to trained or fit individuals. It's interesting to note that in present study also aerobic capacity post intervention was increased (p = .046) by around 3% which is quite lower if compared to another study on badminton where $VO_2$max was increased by 16% (Patterson et al., 2017).

Body fat percent was significantly reduced in IG compare to control group following 12 weeks of recreational basketball. These results were also in line with another study on football where BFP was reduced significantly after 12 week of football (Randers et al., 2009). Results of present study were further supported by Randers et al; where BFP significantly decreased after 3 months of half-court basketball game (Randers et al., 2018). Body mass remain significantly unchanged post intervention and this was also supported by another study done on basketball (Randers et al., 2018).

Further significant change was observed in resting heart rate between IG and CG. In another study RHR also reduced10-15 beats per minute after 12 weeks of badminton training (Patterson et al., 2017). Our results were also similar to Randers et al; where RHR was significantly decreased after 3 months of small sided basketball (Randers et al., 2018). However, blood pressure in present study did not reduce significantly post intervention. Our results are contrary to study where blood pressure was reported to be lower after badminton training (Patterson et al., 2017). Our results were similar to a small sided basketball study that did not show any significant decrease in blood pressure (Randers et al., 2018).

**Intensity of Recreational Basketball**

Our programme was intense enough. Average intensity of our sessions was 88% of maximum heart rate (HRmax). Mean HRmax in our study was 191.87 bpm. There were studies which have previously examined intensities in sport among healthy adults and have shown an average heart rate of 82% ± 2 maximum heart rate (Krustrup et al., 2009), 89% ± 2 maximum heart rate (Magal et al., 2009), 83% maximum heart rate (Bangsbo et al., 2010), 82% ± 2 HRmax (Krustrup et al., 2010).All of them are largely similar with average heart rate recorded in our study and our intensity was greater than intensities mentioned in these studies. Another study on badminton reported intensity of 75% of HRmax (Patterson et al., 2017). Basketball represents more intense heart rate. As also indicated by another study that basketball is even more intense form of activity comparing to other sports and it can help build up higher cardiovascular and other metabolic adaptations (Edgett et al., 2013).

It was evident that there was definite relationship between BFP and $VO_2$maxin intervention group. $VO_2$max increased with reduction of body fat after 12 weeks of basketball. Whereas, (Pibris et al., 2010) in their study found negative relationship between $VO_2$max and BFP. $VO_2$max was generally adjusted employing ratio which leads to assumption that if $VO_2$max is divided with body mass; then any difference occur in $VO_2$max is due to body mass removed. There is negative relationship between body mass and

$VO_2$per unit of body mass (Vanderburgh and Katch, 1996; Nevill et al., 1992). There is misleading impression because of this relationship that more heavy persons possess relatively lower $VO_2$max (Vanderburgh and Katch, 1996). On contrary less heavy people have more chances to be placed in lower $VO_2$max levels (Heil, 1997).There are few take away points from the present study. Firstly, intervention was given only 2 days per week with gap of three days. Secondly, duration of basketball playing was only for 30 minutes in each session. Our results should be interpreted keeping in mind other studies done on recreational sports where training was imparted for 3 more days in a week and duration of session was also more than 30 minutes.

## 5. CONCLUSION

Probably for the first time recreational basketball carried on half court (3 a side) on half hourly basis and only for two days in a week have shown significant improvement in $VO_2$max of untrained males along with reduction in body fat percent and resting heart rate. However, no impact was seen on blood pressure, lean body mass and body mass which fairly remain constant. Despite mixed results obtained in present study, recreational basketball can be encouraged as an alternate activity for health improvement among untrained males. There is general consensus with regard to health benefits of physical activity but data regarding recreation activities and sports participation is limited. Current study may add to the existing knowledge but due to a peculiar educational setting in which data was collected, it won't be proper to generalize the results.

**Authors Contribution**

Rakesh Tomar - Principal Investigator
Varghese C Antony - Co-Investigator

**Conflict of Interest**

Authors hereby declare that they have no conflict of interest.

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