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Effect of swiss ball exercises on muscular strength and endurance in male students

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Abstract
Purpose: The Purpose of the study was to find out the effect of swiss ball exercises on muscular endurance and strength of male students.
Selection of Subjects: For the present study 24 male students from Department of Physical Education, Guru Ghasidas Vishwavidyalaya, Bilaspur, and Chhattisgarh were selected randomly as the subjects for the study. The age of the subjects were ranged between 20-25 years.
Selection of Variables: The variables selected for the present study were swiss ball training (SBT) as independent variable, Muscular Endurance, Back Strength and Leg Strength as dependent variables.
Methodology: For the study pretest – posttest randomized group design, which consists of control group (CG, N=12) and experimental group (N=12) i.e. swiss ball training group (SBTG, N=12) were used. The data were collected through the pretest, before training and posttest, after twelve weeks of SBT.
Statistical Technique: To find out the effect of Swiss ball exercises on muscular endurance and strength of the subjects the pretest and post test scores were analyzed by using Descriptive analysis, and paired t-test were used, the data analyzed with the help of SPSS (21.0 version) software and the level of significance was set at 0.05 level of confidence.
Result: The t-value of SBTG and CG in relation to leg strength were found insignificant, as the p-value was higher than .05 ($p > 0.05$). For back strength the t-value of SBTG was found significant, as the p-value was lesser than .05 ($p < 0.05$). Another result was showed that the significant difference between pre and posttest of SBTG in relation to muscular endurance as the p-value was lesser than .05 ($p < 0.05$).
Conclusion: It can be concluded that the Swiss ball core exercises were effective for improvement in back strength and muscular endurance. Whereas Swiss ball core exercises were not effective for improvement in leg strength.

Keywords: Core exercise, training, swiss ball exercises, muscular strength, muscular endurance

Introduction
The swiss ball is an extremely popular apparatus used for core stability training in populations as varied as spinal disorders to elite athletes. The majority of the research involves abdominal muscle exercises comparing them to the traditional mat (stable surface) styles, however the benefits of swiss ball exercises appear to have been applied to whole body exercises equally. Performing strength exercises on swiss balls has been advocated that a labile surface will provide a greater challenge to the trunk musculature, increase the dynamic balance of the subject and possibly train subjects to stabilize their spines to prevent and treat injury.

Having a strong core will give more endurance in sports and other physical activities by improving our overall fitness. We would see improvements in golf, tennis, cycling, jogging and running, swimming, rowing, kayaking, baseball and volleyball, for example, in someone doing an abdominal strength-training program.

Muscle strength is the ability to exert force against resistance for a short period of time, and is necessary to complement and help improve endurance. Muscular strength improves the intensity of the performance, whereas muscular endurance improves the length.

Muscular endurance is the ability to perform an action over and over for a prolonged period of time. According to the American Council on Exercise, the benefits of muscle endurance include:
- Maintaining good posture
- Helping to carry out normal activities

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* Improving athletic performance

Objectives of the Study
To find out the effect of twelve weeks swiss ball exercises on muscular endurance and strength of male students of GGV Bilaspur.

Methodology
Selection of Subjects
Twenty four (24) male students from Department of Physical Education, GGV Bilaspur were randomly selected as subjects of the study. The age of the subjects ranged from 20-25 years. The subjects were divided into two group's i.e. Swiss ball training Group (SBTG) and Control group (CG).

Table 1: Distribution of subjects

Sr. No.	Groups	N	Age (Years) [M ± SD]	Height (cm) [M ± SD]	Weight (kg) [M ± SD]
1.	SBTG	12	22.25 ± 1.48	168.0± 4.59	61.52 ± 6.02
2.	CG	12	22.75 ± 1.48	165.67± 7.27	62.37 ± 6.49
Total		24	22.50 ± 1.47	166.83 ± 6.06	61.94 ± 6.14

Selection of Variables
Keeping the feasibility criterion in mind, the researcher selected the following variables for the present study:
1. Independent variable – Swiss Ball Training
2. Dependent variables – i) Strength and ii) Muscular Endurance

Criterion Measures
i) Strength
Back and leg strength were measured with the help of dynamometer and scores were recorded in kilogram.

ii) Muscular Endurance
Muscular strength of the selected subjects for this study was measured with the help of one minute sit-ups test (crunches) and scores were recorded in number of legal sit-ups

performed in one minute.

Experimental Design
For the study, pre-test post-test randomized group design was used in which the pre-test was taken prior to the Swiss Ball exercises training and posttest was taken after twelve weeks Swiss Ball exercises training.

Table 2: Pre-Test and Post Test Randomized Group Design

Group	Observation	Treatment	Observation
SBTG	O_1	T	O_2
CG	O_1	No training	O_2

Where O_1 is pre observation, O_2 is post observation and T is Treatment (training)

Collection of data
Before the administration of swiss ball exercises training, the pretest data of muscular endurance, back strength and leg strength were taken on both the experimental and control groups. After the completion of twelve weeks of swiss ball exercises training again the same tests were conducted to collect the post training data. Necessary instructions were given to the subjects before administration of the tests.

Administration of Training Programme
All the subjects were assembled at the University Basketball court, Guru Ghasidas Vishwavidyalaya and were briefed about the swiss ball training. The one experimental group (SBTG) was administered with the swiss ball exercises training and control group (CG) did not participate in any kind of practice except the regular departmental programme. Experimental group also participated in regular departmental programme. The training was carried out for a period of twelve weeks, six days a week. The scholar demonstrated the exercises for each group and explained all the related objectives. Each subject of the experimental group performed their respective training. Sufficient and required recovery was provided between the tests.

Table 3: Swiss ball exercise training schedule for 1st & 12th weeks

Sr. No.	Swiss ball exercises	Rep.	Holding/Performing Time per Repetition						Rest (Between the repetitions in Sec.)
			1to 2 Weeks	3 to 4 Weeks	5 to 6 Weeks	7 to 8 Weeks	9 to 10 Weeks	11 to12 Weeks	
1.	Basic crunch	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
2.	Supine leg curl on the ball	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
3.	Prone Jacknife	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
4.	Press Up	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
5.	Pike position	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
6.	Leg Drop	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
7.	Core Ball Transfer	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
8.	Lateral Crunch	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
9.	Back Extension	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
10.	Leg Raises	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.

Statistical Procedure
The data were analyzed by applying descriptive statistics and paired t-test. The data analyzed with the help of SPSS (21.0 version) software and the level of significance was set at 0.05

level of confidence.

Result and findings of the study

Table 4: Descriptive and comparative table of the experimental and control groups in relation to Leg Strength

Group	Test	N	Mean	SD	Std. Error	t	Df	Sig.
CG	Pre	12	98.10	20.042	5.78568	.334	11	.744
	Post	12	99.26	14.448	4.17092			
SBTG	Pre	12	99.37	14.940	4.31309	.085	11	.934
	Post	12	99.25	14.784	4.26793			

Table 4 shows that the pretest means ± SD of CG and SBTG were 98.10 ± 20.042 and 99.37 ± 14.940 respectively. The posttest means of CG and SBTG were 98.26 ± 14.448 and 99.25 ± 14.784 respectively.

Table 4 also reveals that, the insignificant difference between the pretest and posttest means of control group (t = 0.334, *p*>0.05) in relation to Leg strength as obtained p-value is greater than 0.05 (p=0.744). Similarly there were insignificant difference between the pretest and posttest means of Experimental group (t = 0.085, *p*>0.05), as obtained p-value is greater than 0.05.

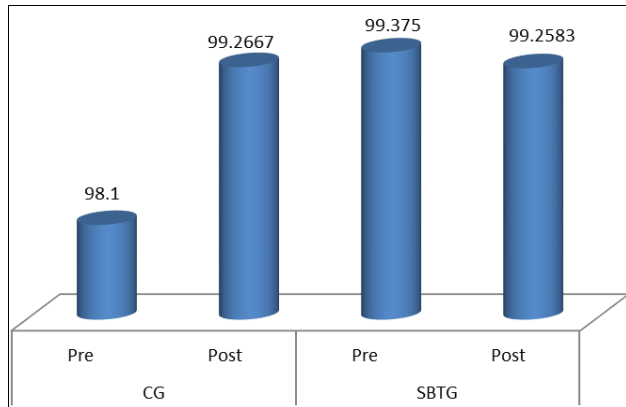**Fig 1:** Graphical representation of mean values of Pretest and Posttest of experimental and control groups in relation to Leg Strength

Table 5: Descriptive and comparative table of the experimental and control groups in relation to Back Strength

Group	Test	N	Mean	SD	Std. Error	t	df	Sig.
CG	Pre	12	106.51	15.198	4.38730	.146	11	.887
	Post	12	106.12	15.290	4.41413			
SBTG	Pre	12	105.29	17.826	5.14614	8.669*	11	.000
	Post	12	118.92	18.268	5.27365			

*Significant at .05 level.

Table 5 shows that the pretest means ± SD of CG and SBTG were 106.51 ± 15.198 and 105.29 ± 17.826 respectively. The posttest means of c CG and SBTG were 106.12 ± 15.290 and 118.92 ± 18.268 respectively.

Table 5 also reveals that, the insignificant difference between the pretest and posttest means of control group (t = 0.146, *p*>0.05) in relation to Back strength as obtained p-value is greater than 0.05 (p=0.887), and there were a significant differences between the pretest and posttest means of SBTG (t = 8.669, *p*<0.05), as obtained p-value is lesser than 0.05.
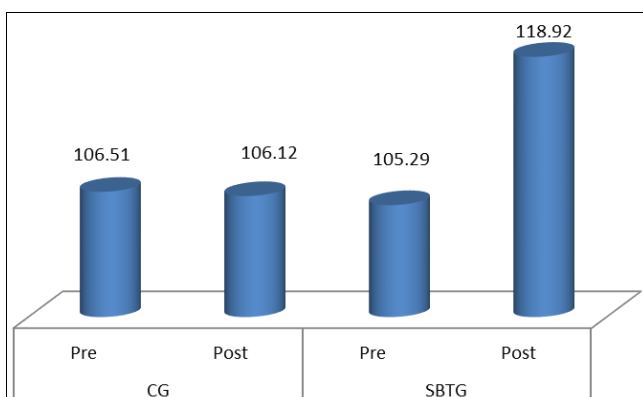

Fig 2: Graphical representation of mean values of Pretest and Posttest of experimental and control groups in relation to Back Strength

Table 6: Descriptive and comparative table of the experimental and control groups in relation to Muscular Endurance

Group	Test	N	Mean	SD	Std. Error	t	df	Sig.
CG	Pre	12	32.83	9.646	2.78479	.649	11	.530
	Post	12	33.58	10.413	3.00620			
SBTG	Pre	12	32.75	10.190	2.94167	4.436*	11	.001
	Post	12	40.16	11.400	3.29102			

*Significant at .05 level

Table 6 shows that the pretest means ± SD of CG and SBTG were 32.83 ± 9.646 and 32.75 ± 10.190 respectively. The posttest means of c CG and SBTG were 33.58 ± 10.413 and 40.16 ± 11.400 respectively.

Table 6 also reveals that, the insignificant difference between the pretest and posttest means of CG (t = 0.649, p>0.05) in relation to Muscular Endurance as obtained p-value is greater than 0.05 (p=0.530). In other hand there was a significant differences between the pretest and posttest means of SBTG (t = 4.436, *p*<0.05) as obtained p-value is lesser than 0.05.
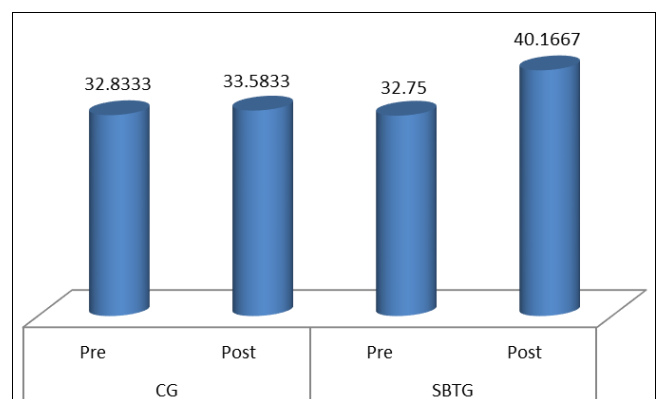

Fig 3: Graphical representation of mean values of Pretest and Posttest of experimental and control groups in relation to Muscular Endurance

Discussion of Findings
The findings on back strength showed that there is a significant increase on back strength in the experimental group. Further it reveals that the strength has improved greater in swiss ball training group than control group. Back strength is directly related to the development of core muscles. More the development of core muscles more will be the back strength. In the applied training schedule subjects were engaged in rigorous core muscles development programme so the back strength has been significantly improved. The finding of this study is in conformation with the findings of Brentano, *et al*., (2008) and Ahamed; Gnanachellam (2018) [1] has suggested that regular training would improve the strength.

In training schedule incorporated for leg strength no significant difference was observed. No any exercise for leg strengthening and therefore no any increase in leg strength are bound to happen; hence the result sows insignificant difference.

The findings on muscular endurance showed that there is a significant increase on muscular endurance test in the experimental group. The above study shows that the core strength training improved the flexibility in physical education students. The muscular endurance has been measured by 1 min. sit up test and as we know that applied training protocol is concerned mainly with core development exercises of moderate to high intensity throughout 12 weeks therefore we can say that there is high possibility of increased

core muscle endurance and hence the significant increase in muscular endurance.

Conclusions

It was evident that the insignificant difference between pre and posttest of Swiss ball exercise group (t = 0.085, $p > 0.05$) and control group (t = 0.334, $p > 0.05$) in relation to leg strength. Thus it can be concluded that the Swiss ball exercises are not effective for improvement in leg strength. On other hand the significant deference was found between pre and posttest of Swiss ball exercise group (t = 8.669, $p < 0.05$) in relation to back strength. So it can be concluded that the Swiss ball exercises are effective for improvement in back strength.

Another result of the study shows that there was a significant difference between pre and posttest of Swiss ball exercise group (t = 4.436, $p < 0.05$) in relation to Muscular Endurance. Thus it can be concluded that the swiss ball exercise training are effective for improvement in Muscular Endurance of male students.

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