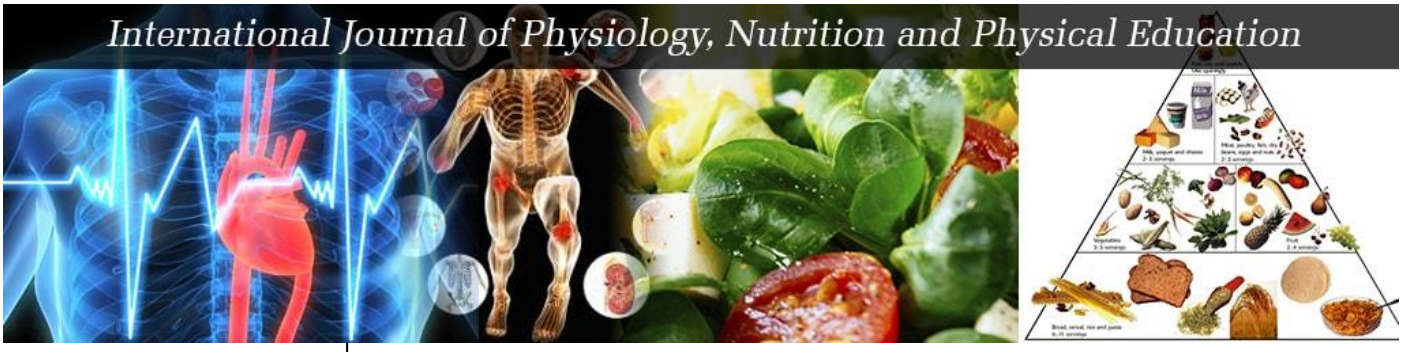

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Dr. Mukesh Kumar Mishra
Physical Education Teacher (PET), Govt. Boys Sr. Sec. School No.- 2, Avantika, Sector-1 Rohini, New Delhi, India

Dr. Vishan Singh Rathore
Professor & Head, Department of Physical Education, GGV Bilaspur, Chhattisgarh, India

Correspondence
Dr. Mukesh Kumar Mishra
Physical Education Teacher (PET), Govt. Boys Sr. Sec. School No.- 2, Avantika, Sector-1 Rohini, New Delhi, India

Comparative effect of static and dynamic core exercises on back and leg strength of male physical education students

Dr. Mukesh Kumar Mishra and Dr. Vishan Singh Rathore

Abstract
Purpose: The Purpose of the study was to find out the comparative effect of static and dynamic core exercise training on back and leg strength.
Selection of Subjects: For the present study 45 male students from Department of Physical Education, Guru Ghasidas Vishwavidyalaya, Bilaspur, 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 static and dynamic core exercise training as independent variable, back and leg strength as dependent variable.
Methodology: For the study pre-test – post-test randomized group design, which consists of control group (15 students) and two experimental group's i.e. static and dynamic core exercise group (30 students) were used. The data were collected through the pre-test, before training and post-test, after twelve weeks of static and dynamic core exercise training.
Statistical Technique: To find out the comparative effect of static and dynamic core exercise training on vital capacity of the subjects the pretest and post-test scores were analyzed by using Descriptive analysis, Analysis of Co-Variance (ANCOVA) and LSD 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 result of the study showed that there was significant difference between pre and post-test (experimental group) of back strength. Significant difference was found between adjusted means of dynamic core exercise training and control group ($p< 0.05$). There was insignificant difference between pre and post-test (experimental group) of Leg strength
Conclusion: It can be concluded that both the training methods were useful to develop back strength but the static core exercise training could be very much useful method.

Keywords: Dynamic core exercise, static core exercise, strength, back strength, leg strength

Introduction
Core stabilization exercises are known to strengthen the deep muscles of the human body such the local spinal muscle group, the abdominal muscle group, the hip muscles, and the pelvic muscles (Brill, & Cozen, 2002) [6]. The trunk muscles such as the spinal, pelvic, and abdominal muscles are called the core muscles. These core muscles generate all the power and motility of the human body. Core muscle strength is an important prerequisite for several sport (e.g., track and field, climbing, soccer), and everyday activities (e.g., sitting, standing, walking in an upright position). No matter where motion starts, it ripples upward and downward to adjoining links of the chain. Thus, weak or inflexible core muscles can impair how well your arms and legs function. And that saps power from many of the moves you make. Properly building up your core cranks up the power. A strong core also enhances balance and stability. Thus, it can help prevent falls and injuries during sports or other activities.
Anatomically, the core can be described as a muscular box with the abdominals in the front, paraspinals and glutes in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom (Akuthota, Ferreiro, Moore, Fredericson, 2008) [2]. Functionally, the core can be thought of as the kinetic link that facilitates the transfer of torques and angular momentum between the lower and upper extremities that is of vital importance for sport-specific and everyday activities in different age groups (Kibler, Press, Sciascia, 2006) [10].

When these core muscles are in poor condition, additional stress is applied to the spine as it supports the body, and back injury or back pain is more likely.

Objectives of the Study

To find out the comparative effect of twelve weeks static and dynamic core exercises training on back strength and leg strength in physical education students of GGV Bilaspur.

Methodology

Selection of Subjects

Forty five (45) 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 three groups i.e. A- Static exercise group (SEG), B- Dynamic Exercise Group (DEG) and C- Control group (CG).

Table 1: Distribution of subjects

S. No.	Groups	N	Age (Years) [M ± SD]	Height (cm) [M ± SD]	Weight (kg) [M ± SD]
1.	SEG (A)	15	22.73 ± 1.53	166.13 ± 5.99	60.24 ± 6.35
2.	DEG (B)	15	22.13 ± 1.35	167.80 ± 4.31	61.40 ± 6.14
3.	CG (C)	15	22.53 ± 1.50	166.20 ± 6.54	61.61 ± 6.08
Total		45	22.46 ± 1.45	166.71 ± 5.62	61.08 ± 6.08

Selection of Variables

Keeping the feasibility criterion in mind, the researcher selected the following variables for the present study:

1. Independent variable - Static Exercise and Dynamic Exercise training
2. Dependent variables - Back strength and Leg strength

Criterion Measures

- Leg and back strength were measured with the help of dynamometer in kilograms.

Experimental Design

For the study, pre-test post-test randomized group design was used in which the pre-test was taken prior to the Static and Dynamic core exercises training and post-test was taken after twelve weeks Static and Dynamic core exercises training.

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

Group	Observation	Treatment	Observation
SEG	O_1	T	O_2
DEG	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 static and dynamic core exercise training, the pre-test data of back and leg strength were taken on both the experimental and control groups. After the completion of twelve weeks of static and dynamic core exercise 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 Sports Arena, Guru Ghasidas Vishwavidyalaya and were briefed on two types of training. The two experimental groups (SEG & DEG) were administered both the types of practices, Static core exercises training & Dynamic core exercises training and group control group (CG) did not participate in any kind of practice except the regular departmental programme. Both the 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 groups performed their respective training. Sufficient and required recovery was provided between the tests.

Table 3: Static core exercise training schedule for 1st & 12th weeks

S. No.	SEG	DEG (with gym ball)	Rep.	Holding Time per Weeks						Rest (Between the repetitions in Sec.)
				1&2	3&4	5&6	7&8	9&10	11&12	
1.	Elbow Plank	Basic crunch	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
2.	Raised Leg Plank	Supine leg curl on the ball	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
3.	Raised Arm Plank	Prone Jacknife	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
4.	Alternating Two-Point Plank	Press Up	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
5.	Superman Position	Pike position	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
6.	Hip Bridge	Leg Drop	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
7.	Supine Leg Lift	Core Ball Transfer	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
8.	Supine Bridge Elbow	Lateral Crunch	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
9.	Side Bridge on Elbow	Back Extension	3	30 sec.	45 sec.	60 sec.	75 sec.	90 sec.	105 sec.	30 sec.
10.	Extended Leg Side Bridge	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 statistical and Analysis of Co-Variance (ANCOVA). 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 table of the two experimental groups and control group in relation to Back Strength

Group	Test	N	Mean	SD	Std. Error	Min.	Max.	T	df	Sig.
CG	Pre	15	105.25	15.39985	3.97623	87.80	139.50	.879	14	.394
	Post	15	108.00	14.20739	3.66833	89.20	142.30			

SEG	Pre	15	102.80	13.67061	3.52974	79.50	128.50	7.250*	14	.000
	Post	15	120.25	8.97822	2.31817	95.60	129.30			
DEG	Pre	15	105.97	17.46779	4.51016	79.50	141.00	10.332*	14	.000
	Post	15	119.37	17.34296	4.47793	89.80	148.50			

*Significant at.05 level.

Table 4 shows that the pre-test means ± SD of CG, SEG and DEG were 105.25 ± 15.399, 102.80 ± 14.207 and 105.97 ± 17.467 respectively. The post-test means of CG, SEG and DEG were 108.00 ± 14.207, 120.25 ± 8.978 and 119.37 ± 17.342 respectively.

Table 4 also reveals that, the insignificant difference between the pre-test and post-test means of CG (t = 0.879, $p>0.05$) in relation to Back strength as obtained p-value is greater than 0.05 (p=0.394). Similarly there were significant differences between the pre-test and post-test means of SEG (t = 7.250, $p<0.05$) and DEG (t = 10.332, $p<0.05$), as obtained p-value is lesser than 0.05.

Table 5: Analysis of covariance of the means of the two experimental groups and control group in relation to Back Strength

Test	Groups			ANCOVA					
	CG	SEG	DEG	Source of variance	SS	df	MSS	F	Sig.
Pre -Mean	105.25	102.80	105.97	B	82.777	2	41.389	.170	.844
				W	10208.311	42	243.055		
Post - Mean	108.00	120.25	119.37	B	1399.782	2	699.891	3.600*	.036
				W	8165.311	42	194.412		
Adjusted Post- Mean	107.6	121.6	118.4	B	1618.414	2	809.207	11.707*	.000
				W	2833.952	41	69.121		

*Significant at.05 level.

From the table 5, analysis of co-variance (ANCOVA) indicate that the resultant F-ratio of Back strength (F=0.170) was insignificant in case of pre-test means. Hence, the random assignment of subjects to the experimental groups and control group were quite successful.

The post-test means of the entire three groups yielded an F-ratio 3.60 which was significant at.05 level of significance. Similarly, adjusted post-test means of the entire three groups i.e. CG, SEG and DEG in relation to back strength were 107.6, 121.6 and 118.4 respectively. The adjusted post-test means of experimental and control groups in relation to Back Strength (F= 11.707) was significant, as the p-value was lesser than.05 ($p<0.05$).

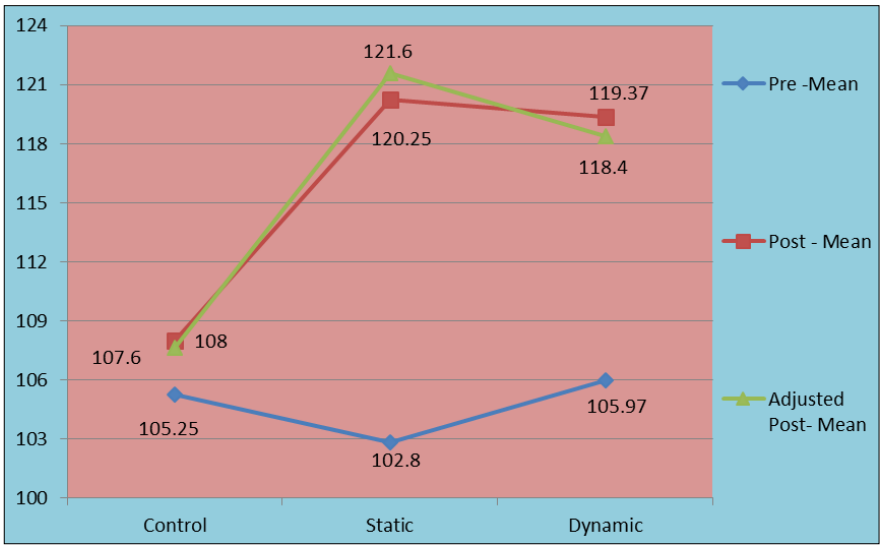


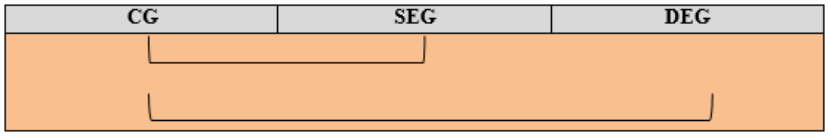
Fig 1: Graphical representation of means values of Pre-test, Post-test and Adjusted Post-test of experimental and control groups in relation to Back Strength

As the difference between the adjusted means for three groups were found significant. The Post Hoc Test (LSD) for adjusted means was applied to find out which of the difference between the paired adjusted final means were most significant. Differences between the paired adjusted final means were shown in table 6.

Table 6: Paired adjusted mean differences between the experimental groups and control group in relation to back strength

(I) training	(J) training	Mean Difference (I-J)	Std. Error	Sig.
CG	SEG	-14.020*	3.043	.000
	DEG	-10.851*	3.036	.001
SEG	CG	14.020*	3.043	.000
	DEG	3.168	3.047	.304

*Significant at.05 level.



"└──────┘" Shows significant difference.

Fig 2: Graphical representation of Paired adjusted means difference between different groups in relation to Back Strength

It is evident from Table 6 that significant difference was found between adjusted means of CG & SEG, CG & DEG, since the $p < 0.05$.

Table 7: Descriptive table of the two experimental groups and control group in relation to Leg Strength

Group	Test	N	Mean	SD	Std. Error	Min.	Max.	T	df	Sig.
CG	Pre	15	97.6133	18.00087	4.64780	67.00	131.50	.462	14	.651
	Post	15	98.9267	12.84821	3.31739	80.40	128.40			
SEG	Pre	15	99.3333	17.74287	4.58119	53.00	130.50	2.237*	14	.042
	Post	15	103.81	15.88651	4.10188	64.50	136.50			
DEG	Pre	15	98.0267	13.66792	3.52904	64.50	115.00	.396	14	.698
	Post	15	98.4733	13.29890	3.43376	70.00	116.50			

*Significant at.05 level.

Table 7 shows that the pre-test means ± SD of CG, SEG and DEG were 97.613 ± 18.00, 99.333 ± 17.742 and 98.026 ± 13.667 respectively. The post-test means of control CG, SEG and DEG were 98.926 ± 12.848, 103.81 ± 15.886 and 98.473 ± 13.298 respectively.

Table 7 also reveals that, the insignificant difference between the pre-test and post-test means of CG (t = 0.462, $p>0.05$) and DEG (t = 0.396, $p>0.05$) in relation to Leg strength as obtained p-value is greater than 0.05 level of significance. Similarly there were significant differences between the pre-test and post-test means of SEG (t = 2.237, $p<0.05$), as obtained p-value is lesser than 0.05.

Table 8: Analysis of covariance of the means of the two experimental groups and control group in relation to Leg Strength

Test	Groups			Ancova					
	CG	SEG	DEG	Source of variance	SS	df	MSS	F	Sig.
Pre -Mean	97.6133	99.3333	98.0267	B	24.183	2	12.092	.044	.957
				W	11559.140	42	275.218		
Post - Mean	98.9267	103.81	98.4733	B	263.003	2	131.502	.664	.520
				W	8320.456	42	198.106		
Adjusted Post- Mean	99.45	103.10	98.69	B	163.698	2	81.849	1.663	.202
				W	2018.516	41	49.232		

From the table 8, analysis of co-variance (ANCOVA) indicate that the resultant F-ratio of Leg Strength (F=0.044) was insignificant in case of pre-test means. Hence, the random assignment of subjects to the experimental groups and control group were quite successful.

The post-test means of the entire three groups yielded an F-ratio 0.664 which was insignificant at.05 level of significance.

Similarly, adjusted post-test means of the entire three groups i.e. CG, SEG and DEG in relation to Leg Strength were 99.45, 103.10 and 98.69 respectively. The adjusted post-test means of experimental and control groups in relation to Leg Strength (F= 1.663) was insignificant, as the p-value was greater than.05 ($p>0.05$).

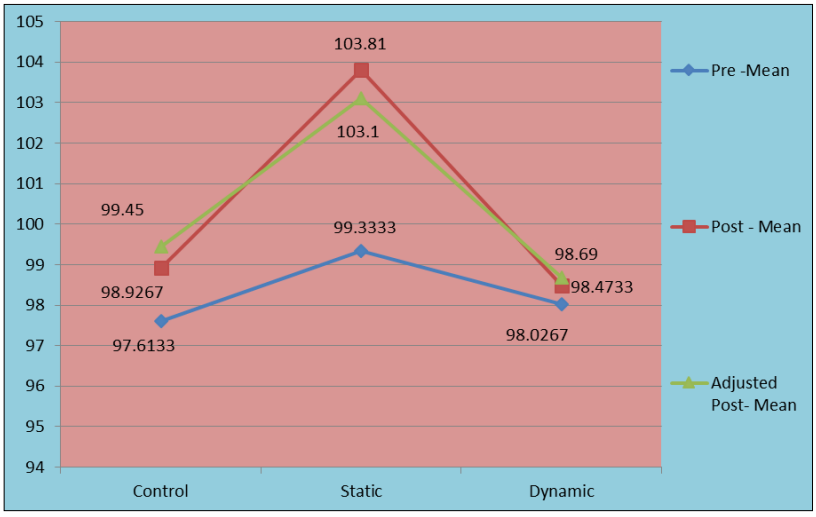


Fig 3: Graphical representation of means values of Pre-test, Post-test and Adjusted Post-test of experimental and control groups in relation to Leg Strength

Discussion of Findings

The findings on back strength showed that there is a significant increase on back strength in the experimental groups. Further it reveals that the strength has improved greater in Static core exercises training group than the Dynamic core exercises training group and control group. The above study shows that the core strength training improved the back strength. 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) [5] has suggested that regular training would improve the strength.

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

Several studies revealed that muscle strength is critical to health and well-being (Kraus & Hirschland, 1953; McDonangh & Davies, 1984; Astrand & Rodahl, 1986) [11, 13, 3] and is therefore considered to be a major component of fitness. Various factors, such as altitude (Ruff & Strughold, 1942) [14], diet (Keys et al., 1950) [9], age, sex (Mathiowetz et al., 1985) [12] influence the maximum force that can be exerted by a muscle (Berne & Levy, 1983) [4].

Conclusions

In Back Strength, F ratio for ANCOVA was significant at 0.05 level of significance. On further analysis through LSD test it was evident that dynamic core exercise group differ significantly from control group but there were no significant differences between static core exercise group and dynamic core exercise group. Thus it can be concluded that both static core exercise training and dynamic core exercise training are effective for improvement in Back Strength. However static core exercise training was more effective as the mean value was greater than dynamic core exercise training.

In Leg strength, F ratio for ANCOVA was insignificant at 0.05 level of significance. Thus it can be concluded that both trainings static core exercise and dynamic core exercise are not effective for improvement of leg strength.

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