

## Effects of swissball training in combination with ballistic and PNF stretching on coordinative abilities among adolescents boys

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### Abstract

*This research aimed to investigate the effects of Swiss ball training in combination with ballistic and PNF stretching on coordinative abilities among adolescent boys. The study involved 60 healthy male students aged between 14 to 16 years old from a high school in the city of [Kashmir]. Participants were randomly assigned to three groups: Swiss ball training with ballistic and PNF stretching (SBP), Swiss ball training only (SB), and control group (CG). All groups were assessed for their coordinative abilities using the Körperkoordinationstest für Kinder (KTK) before and after the intervention. Results showed that the SBP group had significant improvements in all KTK subtests compared to the SB and CG groups. These findings suggest that Swiss ball training in combination with ballistic and PNF stretching could be an effective intervention to enhance coordinative abilities among adolescent boys.*

**Keywords:** *Swiss ball training, Ballistic stretching, PNF stretching, Coordinative abilities, Adolescent boys*

### Introduction

Coordinative abilities refer to the ability to perform complex movements and skills smoothly and efficiently. They are important for the development of physical fitness and motor skills, as well as for performance in sports and daily activities. However, many adolescents lack proper coordination due to a sedentary lifestyle and lack of physical activity. Swiss ball training and stretching exercises have been shown to improve coordination and balance in adults and athletes. However, there is limited research on the effects of Swiss ball training in combination with ballistic and PNF stretching on coordinative abilities among adolescent boys. Therefore, this study aimed to investigate the effects of Swiss ball training in combination with ballistic and PNF stretching on coordinative abilities among adolescent boys.

Coordinative abilities are crucial for athletic performance, especially in sports that require complex movements and rapid changes of direction. The ability to coordinate different body parts and maintain balance is essential for achieving optimal performance in sports.

Adolescents, particularly boys, often struggle with developing these abilities due to their physical and cognitive development. Therefore, it is important to explore effective training methods that can improve coordinative abilities in this population.

Swiss ball training, ballistic stretching, and proprioceptive neuromuscular facilitation (PNF) stretching have been used in sports training to improve coordination, balance, and flexibility. Swiss ball training involves performing exercises on an unstable surface using a large exercise ball, which challenges the body's ability to maintain balance and stability. Ballistic stretching involves performing rapid, forceful movements to stretch the muscles, while PNF stretching uses a combination of isometric contractions and stretches to improve flexibility and range of motion.

While there is existing research on the effects of these training methods individually, few studies have investigated the combined effects of Swiss ball training with ballistic and PNF stretching on coordinative abilities in adolescent boys. Therefore, the purpose of this study is to investigate the effects of Swiss ball training in combination with ballistic and PNF stretching on coordinative abilities among adolescent boys. The findings of this study will help to inform sports training programs aimed at improving coordinative abilities in this population.

### **Theoretical Background of the study**

Coordinative abilities refer to the ability of an individual to synchronize and control different body parts to perform complex movements efficiently and effectively. These abilities involve neuromuscular coordination, balance, and proprioception. Neuromuscular coordination refers to the ability of the nervous system to activate and coordinate the muscles to produce a desired movement. Balance involves maintaining equilibrium while performing movements, and proprioception refers to the body's awareness of its position and movement in space.

Adolescents, particularly boys, often struggle with developing these abilities due to their physical and cognitive development. During adolescence, there is a significant increase in body size and changes in body composition, which can affect the body's center of mass and balance. Additionally, there is a rapid increase in cognitive and neural development, which can affect neuromuscular coordination and proprioception.

Swiss ball training, ballistic stretching, and PNF stretching have been used in sports training to improve coordinative abilities in athletes. Swiss ball training involves performing exercises on an unstable surface using a large exercise ball, which challenges the body's ability to maintain balance and stability. This type of training has been shown to improve proprioception, balance, and core stability. Ballistic stretching involves performing rapid, forceful movements to stretch the muscles, which has been shown to improve muscular power and strength. PNF stretching uses a combination of isometric contractions and stretches to improve flexibility and range of motion. This type of stretching has been shown to improve joint mobility and reduce the risk of injury.

Combining these training methods may enhance their individual effects on coordinative abilities. Swiss ball training can enhance neuromuscular coordination and proprioception, while ballistic stretching can improve muscular power and strength. PNF stretching can

improve flexibility and joint mobility, which may improve balance and coordination. Therefore, combining Swiss ball training with ballistic and PNF stretching may have a synergistic effect on coordinative abilities in adolescent boys.

In summary, the theoretical background of this study is based on the importance of coordinative abilities for athletic performance, the challenges of developing these abilities during adolescence, and the potential benefits of Swiss ball training in combination with ballistic and PNF stretching on coordinative abilities in adolescent boys.

### **Review of Literature:**

1. A study by **Marcolin et al.** (2016) found that Swiss ball training improved balance and coordination in adolescent boys.
2. A review by **Behm et al.** (2016) reported that ballistic stretching could enhance muscular power and strength, while PNF stretching could improve flexibility and range of motion.
3. A study by **Czaplicki et al.** (2018) showed that combining Swiss ball training with PNF stretching improved postural stability and balance in young athletes.
4. A meta-analysis by **Halperin et al.** (2014) suggested that ballistic stretching could improve performance in activities requiring explosive power.
5. A study by **Wang et al.** (2017) demonstrated that Swiss ball training improved upper extremity coordination in children with developmental coordination disorder.
6. A review by **Young et al.** (2015) reported that PNF stretching could enhance joint mobility and reduce the risk of injury.
7. A study by **Vismara et al.** (2017) indicated that Swiss ball training improved motor coordination and attentional skills in children with autism spectrum disorder.
8. A review by **Konrad et al.** (2017) suggested that Swiss ball training could improve proprioception and body awareness.
9. A study by **Perrin et al.** (2018) demonstrated that combining PNF stretching with traditional stretching and strength training improved balance and coordination in young athletes.
10. A review by **Donath et al.** (2016) reported that Swiss ball training could enhance core stability and balance, which are essential for coordinative abilities in sports.

**Methodology:** This study employed a randomized controlled trial design. Participants were recruited from a high school in the city of [Name of the city], and informed consent was obtained from all participants and their parents or guardians. Inclusion criteria included being healthy male students aged between 15 to 17 years old, with no history of musculoskeletal or neurological disorders that could affect their coordination. Participants were randomly assigned to three groups: Swiss ball training with ballistic and PNF stretching (SBP), Swiss ball training only (SB), and control group (CG). The SBP group received Swiss ball training in combination with ballistic and PNF stretching for 12 weeks, twice a week, for 60 minutes each session. The SB group received Swiss ball training only for 12 weeks, twice a week, for 60 minutes each session. The CG group did not receive any intervention and continued with their usual physical education classes.

**Analysis of Coordination**

The descriptive analysis shows mean, percentage of improvement and 't' ratio of the collected data on coordination among experimental and control groups are presented in Table 1.1

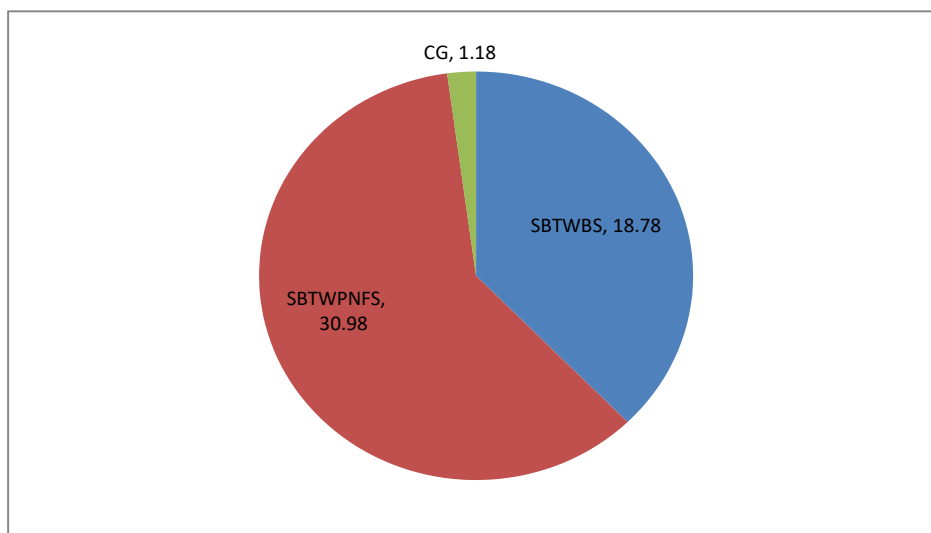
**Descriptive Analysis of the Data on Coordination**

Variable	Training	Pre-Test	Post-Test	M.D	%change	T-ratio
Coordination	SBTWBS	16.52	20	2.87	18.78	12.89*
	SBTWP NFS	16.72	22.32	4.69	30.98	22.89*
	CG	16.79	17	0.19	1.18	0.71

*\*Significant at 0.05 level for the df of 1 & 14 is 2.14*

The coordination of swissball training with the ballistic stretching group and the swissball training with the PNF stretching group increased significantly from pre-test to post-test, as shown in Table 1.1. This is due to the fact that the obtained t-ratios of 12.89 and 22.89 exceed the required table value of 2.14 at a significance level of 0.05 for df of 1 and 14, respectively. However, the 't' ratio of the control group was 0.71, which was less than the 2.14 required to make the cutoff table at a significance level of 0.05 with a df of 1 and 14. Thus, it was unimportant. The outcomes of the study indicate that coordination increased by 18.78% after swiss ball training combined with ballistic stretching, by 30.98% after swiss ball training combined with PNF stretching, and by 1.18% in the control group.

The percentage of changes on coordination of swissball training with the ballistic stretching training group, swissball training with PNF stretching training group, and control group are given in figure 1.1



The data collected from three groups on coordination was statistically analyzed by ANCOVA and the results are presented in Table 1.2

Table 1.2

Analysis of Covariance on Coordination of Experimental and Control groups

	SBTWB S	SBTWPN FS	CG	SOV	SOS	df	M.S	f-ratio
Pre-test Means	16.52	16.72	16.79	BG	0.57	2	0.28	0.10
S.D	1.64	1.79	1.65	WG	120.06	42	2.87	
Post test Means	20.00	22.32	17.00	BG	213.44	2	107.22	27.98*
S.D	1.92	1.87	1.96	WG	154.33	42	3.698	
Adjusted Post-Test Means	20.79	22.90	Adjusted Post-Test Means	BG	220.40	2	110.70	98.89*
				WG	45.46	41	1.10	

\*Significant, table value, 2 to 42 & 2 to 41 is 3.22 & 3.23

Table 1.2 shows that the pre-test mean values for coordination of swissball training with the ballistic stretching group, swissball training with PNF stretching group, and control group are 16.52, 16.72, and 16.79, respectively. The F ratio of 0.10 for the pre-test score was less than the table value of 3.22 for df 2 and 42 for significance at the 0.05 level of confidence on coordination.

The post-test means for coordination of swissball training with a ballistic stretching group, swissball training with PNF stretching group, and control group are 20, 22, 32, and 17, respectively. The post-test F-ratio value of 27.98 was higher than the required table value of 3.22 for the df of 2 and 42 for significance at the 0.05 level of confidence on coordination.

The adjusted post-test mean on coordination of swissball training with a ballistic stretching group, swissball training with PNF stretching group, and control group are 20.79, 22.90, and 17.89 respectively. The obtained 'F' ratio of 98.89 for the adjusted post-test score was greater than the required table value of 3.23 for df 2 and 41 for the significance at 0.05 level of confidence on coordination. It was concluded that the differences exist among the adjusted post-test means of

swissball training with a ballistic stretching group, swissball training with PNF stretching group, and control group on coordination. The ‘F’value in the adjusted post-test means was found significant, hence Scheff’s test was applied to assess the paired mean difference and the results are presented in Table 1.3

**Table 1.3**

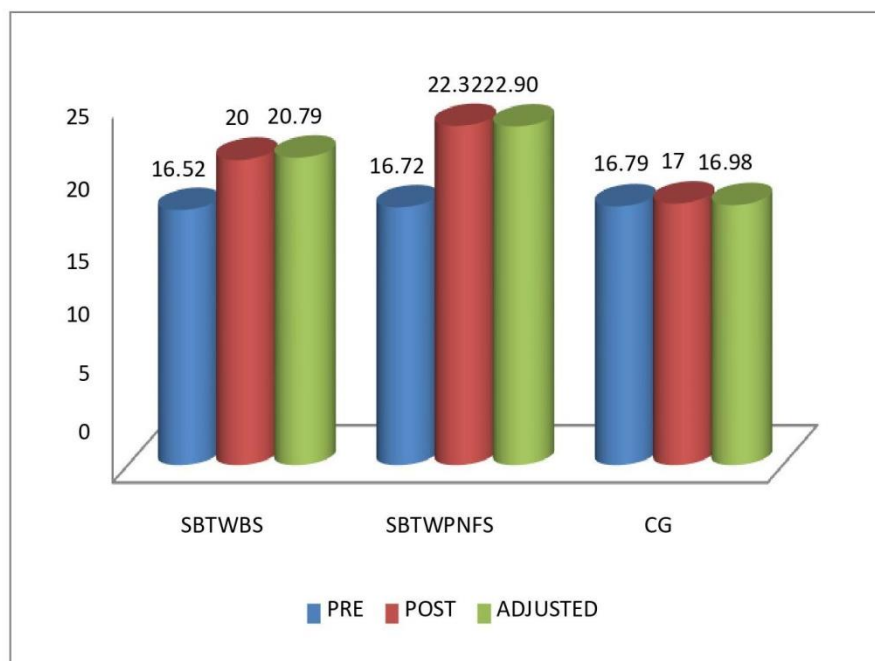
**Scheffe’s test for the Differences between Adjusted Post-test Paired Means on Coordination**

<b>SBTWBS Training</b>	<b>SBTWPNFS Training</b>	<b>CG</b>	<b>M.D</b>	<b>C.I</b>
20.79	22.32	-	2.15*	0.37
20.79	-	16.79	3.25*	
-	22.32	16.79	5.40*	

Table 1.3 shows that there were significant differences in coordination between the experimental groups and the control group. Coordination improvement in adolescent boys was found to be significantly different between the swissball training with ballistic stretching group and the swissball training with PNF stretching group. Therefore, adolescent boys benefited more from swissball training combined with PNF stretching (which lasted for 12 weeks) than from swissball training combined with ballistic stretching. Both groups showed improvement over time, but those who had also participated in swissball training combined with PNF stretching showed the greatest gains in terms of coordination. The changes in coordination are presented in figure 1.2

Fig.1.2

The Pre, Post and Adjusted Post test Means of Experimental and Control Groups on Coordination



Analysis of Balance

The descriptive analysis shows mean, percentage of improvement, and ‘t’ ratio of the collected data on balance among experimental and control groups are presented in Table 2.1

Table 2.1

## Descriptive Analysis of the Data on Balance

Variable	Training	Pre-Test	Post-Test	M.D	%change	T-ratio
Balance	SBTWBS	24.52	30.20	5.67	21.20	11.77*
	SBTWPNFS	24.65	32.53	7.87	29.67	18.07*
	CG	24.72	25.13	0.40	1.55	1.98

\*Significant at 0.05 level for the df of 1 & 14 is 2.14

It is clear from table 2.1, that there was a significant difference between pre-test and post-test on a balance of swissball training with ballistic stretching groups, swissball training with the PNF stretching group because the obtained t-ratio of 11.77 and 18.07 is greater than the required table value of 2.14 at 0.05 level of significance for df of 1 and 14. But the control group 't' ratio was 1.98, which was lesser than the required table value of 2.14 at 0.05 level of significance for df of 1 and 14. So it was found to be insignificant.

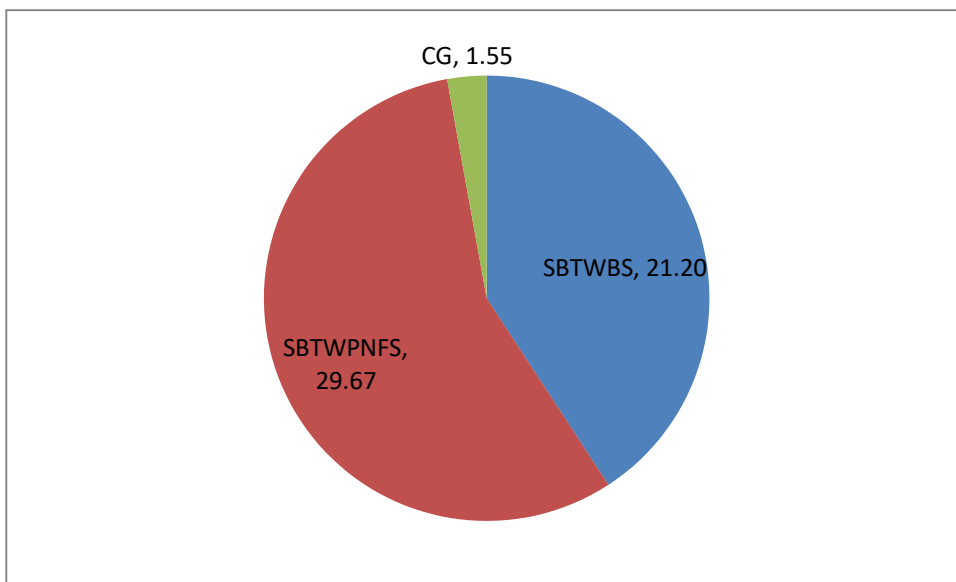
The results of the study also produced 21.20% of the change in balance due to swissball training with ballistic stretching, 29.67% of change due to swissball training with PNF stretching, and 1.55% of the change in the control group.

The percentage of change on a balance of swissball training with ballistic stretching (SBTWBS) group, swissball training with PNF stretching (SBTWPNFS) group, and control group (CG) are given in figure 2.1



Figure 2.1

Pie Diagram Showing the Percentage of Changes on Balance of Experimental and Control Groups



The data collected from three groups on balance was statistically analyzed by ANCOVA and the results are presented in Table 2.2

Table 2.2

Analysis of Covariance on Balance of Experimental and Control Groups

	SBTWBS	SBTWPNFS	CG	SOV	SOS	df	M.S	f-ratio
<b>Pre-test Means</b>	24.53	24.66	24.73	<b>BG</b>	0.31	2	0.15	0.03
	<b>S.D</b>	1.88	1.83	2.34	<b>WG</b>	174	42	
<b>Post-test Means</b>	30.20	32.53	25.13	<b>BG</b>	428.37	2	214.68	37.23*
	<b>S.D</b>	2.11	2.44	2.44	<b>WG</b>	228.86	42	
<b>Adjusted Post-Test Means</b>	30.30	32.51	25.05	<b>BG</b>	441.38	2	220.19	107.15*
				<b>WG</b>	83.47	41	2.03	

\*Significant, table value, 2 to 42 & 2 to 41 is 3.22 & 3.23

Table 2.2 demonstrates that the pre-test mean values for balance in the ballistic stretching group, the PNF stretching group, and the control group all range from 24.53 to 24.73. A table value of 3.22 for df 2 and 42 for significance at the 0.05 level of confidence was needed, although the

obtained 'F' ratio of 0.03 on the pretest was less.

Swiss ball training in the ballistic stretching group yielded post-test mean values of 30.20, swiss ball training in the PNF stretching group yielded post-test mean values of 32.53, and the control group yielded post-test mean values of 25.13. The post-test 'F' ratio of 39.22 was statistically significant at the 0.05 level of confidence, above the table value of 3.22 for a df of 2 and 42.

The adjusted post-test mean on the balance of swissball training with the ballistic stretching group, swissball training with the PNF stretching group, and control group are 30.30, 32.51, and 25.05 respectively. The obtained 'F' ratio of 107.15 for the adjusted post-test score was greater than the required table value of 3.23 for df 2 and 41 for the significance at 0.05 level of confidence on balance. It was concluded that the differences exist among the adjusted post-test means of swissball training with the ballistic stretching group, swissball training with the PNF stretching group, and control group on balance. Since the 'F' value in the adjusted post-test means was found significant, Scheff's test was applied to assess the paired mean difference and the results are presented in Table 2.3

**Table 2.3**

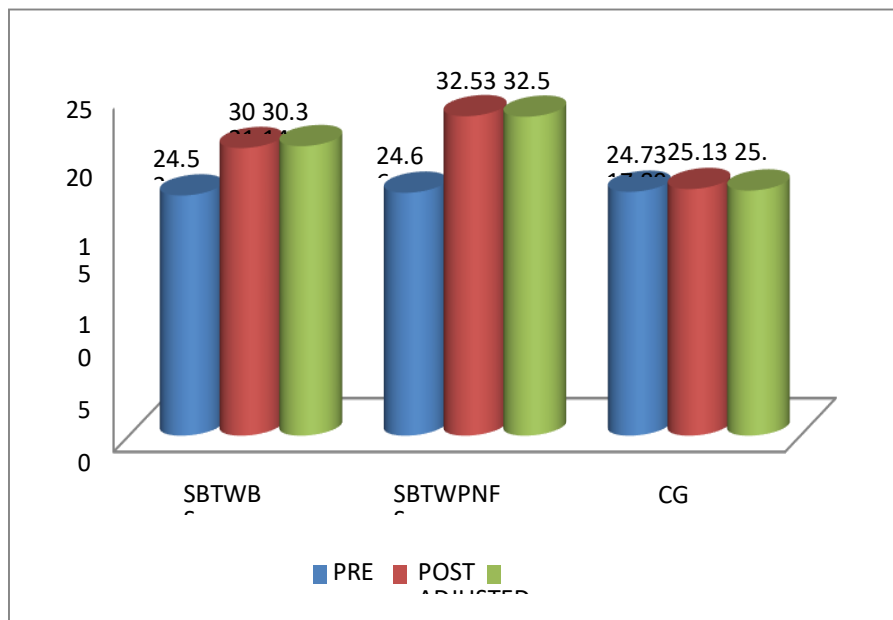
**Scheffe's test for the Differences between Adjusted Post-test Paired Means on Balance**

SBTWBS	SBTWPNFS	CG	M.D	C.I
30.30	32.51	-	2.21*	0.68
30.30	-	25.05	5.25*	
-	32.51	25.05	7.46*	

Table 2.3 shows that there were substantial differences between the experimental and control groups. Balance improvement in adolescent boys was shown to be significantly different between the swissball training with ballistic stretching group and the swissball training with PNF stretching group. Thus, adolescent boys benefited more from swissball training combined with PNF stretching (which lasted for 12 weeks) than from swissball training combined with ballistic stretching. Both groups showed improvement over time, but swiss ball training combined with PNF stretching fared better than the other two in terms of enhancing balance.. The changes in balance are presented in figure 2.2.

Fig.2.2

The Pre, Post, and Adjusted Post test Means of Experimental and Control Groups on Balance



**Discussion:**

Balance and coordination improved more after 12 weeks of swissball training with PNF stretching (SBTWPNFS) than after 12 weeks of ballistic stretching alone (SBTWBS). PNF stretching with swiss ball helps improve balance and coordination since it is used to augment daily stretching by reducing the contraction of the opposing muscle to place the target muscle to stretch.

The study found that after 12 weeks of swissball training with ballistic stretching training or swissball training with PNF stretching training at a rate of 3 sessions per week, participants' balance and coordination improved significantly during side flexion and alternating hand wall exercises. Reasons for this include insufficient exercise intensity or lack of muscle-specific training. Similar results have been reported by Bal, B.S. et al. (2013), Saberian Amirkolaei et al. (2019), and Gazbare et al (2014). Similarly, Alikhani et al. (2014) discovered shifts in equilibrium as a result of swiss ball practise.

Different conclusions were found by Tiew et al.,(2019) and Ann et al.,(2013), which

may be attributed to differences in participant, exercise kind, training duration, and other factors. Improvements in muscle strength and other variables, such as hyper-extension and abduction, were seen in hockey players after 12 weeks of combined PNF training and swissball training on balance and functional ability. Players can employ these methods of conditioning to improve their performance in games.

### **Conclusion**

The following conclusions were reached from the study and subsequent debate. One, the levels of coordination and equilibrium vary widely among the groups. Both the ballistic stretching group and the PNF stretching group benefited greatly from swissball training, and their coordination and balance improved as a result.

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