

**RESEARCH ARTICLE**

**Which is efficient in improving postural control among the novice runners?  
Isolated ankle strengthening or functional balance training programme: A  
randomized controlled trial**

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**ABSTRACT:**

**Background:** Functional balance is the integration of static and dynamic balance training to maintain or improve activities of daily living and quality of life. But, there is a lack of study examining effects of functional balance training programme (FTP) on novice runners. **Objective:** To compare the effects of isolated ankle strengthening exercise (IASE) and FTP in improving postural control among the novice runners. **Materials and methods:** A total of 30 novice runners were recruited by the simple random sampling (random number generator) to participate in this two group pretest-posttest, single blinded randomized controlled study. Recruited subjects were randomly divided into two groups, group A and group B. The novice runners in group A received, IASE. While in group B, the runners received FTP. Both the group performed the prescribed exercised for 4 weeks (5 days/week, a total of 20 sessions). Baseline and post exercise changes after 4 weeks were documented by star excursion balance test (SEBT) and foot and ankle ability measure (FAAM) and analyzed. **Results:** Group B demonstrated significance difference ( $p < 0.05$ ) in SEBT and FAAM when compared to group A. **Conclusion:** FTP is more beneficial in improving postural control and thereby could have the potential to reduce risk of injury when compared to IASE among the novice runners.

**KEYWORDS:** Exercise; foot; foot exercises; foot muscles; middle distance runners.

**INTRODUCTION:**

Functional balance is the integration of static and dynamic balance training to maintain or improve activities of daily living and quality of life. Static balance is the ability to maintain a position and dynamic balance is the ability to maintain stability during movements. Functional balance helps to improve both the stability and mobility.<sup>1</sup>

Novice recreational running is currently popular in order to maintain physical fitness, by participation in athletic activities.

Novice runners are those who are new to recreational running, with less than one year of running experience and who run at least twice a week for distance greater than five kilometers.<sup>2</sup> Novice runners are more prone for running related injuries like muscle strain, ligament sprain, illiotibial band syndrome, patello femoral pain syndrome, etc.<sup>3</sup> Novice recreational runners shows to have a higher incidence of running related injury when compared to elite athletes.<sup>4</sup>

Extrinsic foot muscle controls the foot during weight bearing activities and the extrinsic foot muscle are Tibialis Anterior, Tibialis Posterior, Extensor Hallucis Longus, Extensor Digitorum Longus, Peroneus Brevis, Peroneus Tertius. Extrinsic Foot Muscles helps in foot actions like dorsiflexion, plantar flexion, Inversion and Eversion.<sup>5</sup> Postural control is defined as the act of maintaining, achieving or restoring a state of balance during any activity. It involves postural orientation and postural equilibrium.<sup>6</sup> Postural orientation which helps to maintain the ability against gravity and postural equilibrium helps to maintain body balance during movement. Postural equilibrium involves co-ordination of movements to stabilize the centre of body mass during self initiated and externally triggered disturbance of stability.<sup>6</sup> The postural control has two main functions first to build up posture against gravity and ensure that the balance is maintained then it fixes the body segment thus stabilize it for performing voluntary movement. Postural control will be assessed as the balance deficit to predict of future ankle sprain.<sup>7,8</sup>

Running injuries are more common among recreational runners nearly 80% of runners sustain some type of injury each year.<sup>9</sup> Running injuries are caused mainly because of reduced muscle strength and excessive joint motion. Reduced muscular strength particularly at quadriceps and hamstring have increased possibilities of patellofemoral pain syndrome.<sup>10</sup> Increased hip abduction and knee internal rotation have high chances of development of iliotibial band syndrome in runners. Excessive abnormal movement at tibia and femur leads to patellar tracking.<sup>11</sup> Insufficient foot muscle strength is the reason for excessive foot loading during running.<sup>12</sup>

The effects of running injuries include both long term and short term includes pain and discomfort due to effect of immediate result of injury whereas the long term include reduction in the physical activity.<sup>13</sup> Biomechanically injury prevention is focused on adjusting both the external and internal loads of the body. Extrinsic foot muscle training strengthening not only increase the ability to tolerate the load but also reduce the internal loads at the joint to prevent injury.<sup>14</sup> Functional Balance Training (FVT) was used for ankle

injury rehabilitation patient who are suffering from chronic ankle instability and repeated ankle sprain.<sup>15,16</sup> But in recent days FBT protocol in improving muscle strength shows successful results which is followed in sports for healthy and physically active participants.(De Marche et al., 2011; Emery, Cassidy, Klassen, Rosychuk, and Rowe, 2005; Emery and Meeuwisse, 2010; Kaminski, Buckley, Powers, Hubbard, and Ortiz, 2003; Leetun, Ireland, Willson, Ballantyne, and Davis, 2004; McGuine et al., 2000; P O McKeon et al., 2009; Myer, Ford, McLean, and Hewett, 2006; Verhagen et al., 2004) To the best of the author’s knowledge, the benefits of FBT and isolated ankle strengthening exercise (IASE) in improving postural control among the novice runners have not been explored widely. Hence, we attempt to explore the same.

**MATERIALS AND METHODS:**

**Recruitment and allocation:**

The university research and ethics committee (ACS/2016/32) approved the study protocol and the study was done strictly in accordance with the guidelines of Helsinki declaration, revised 2013 adopted by World Medical Association.

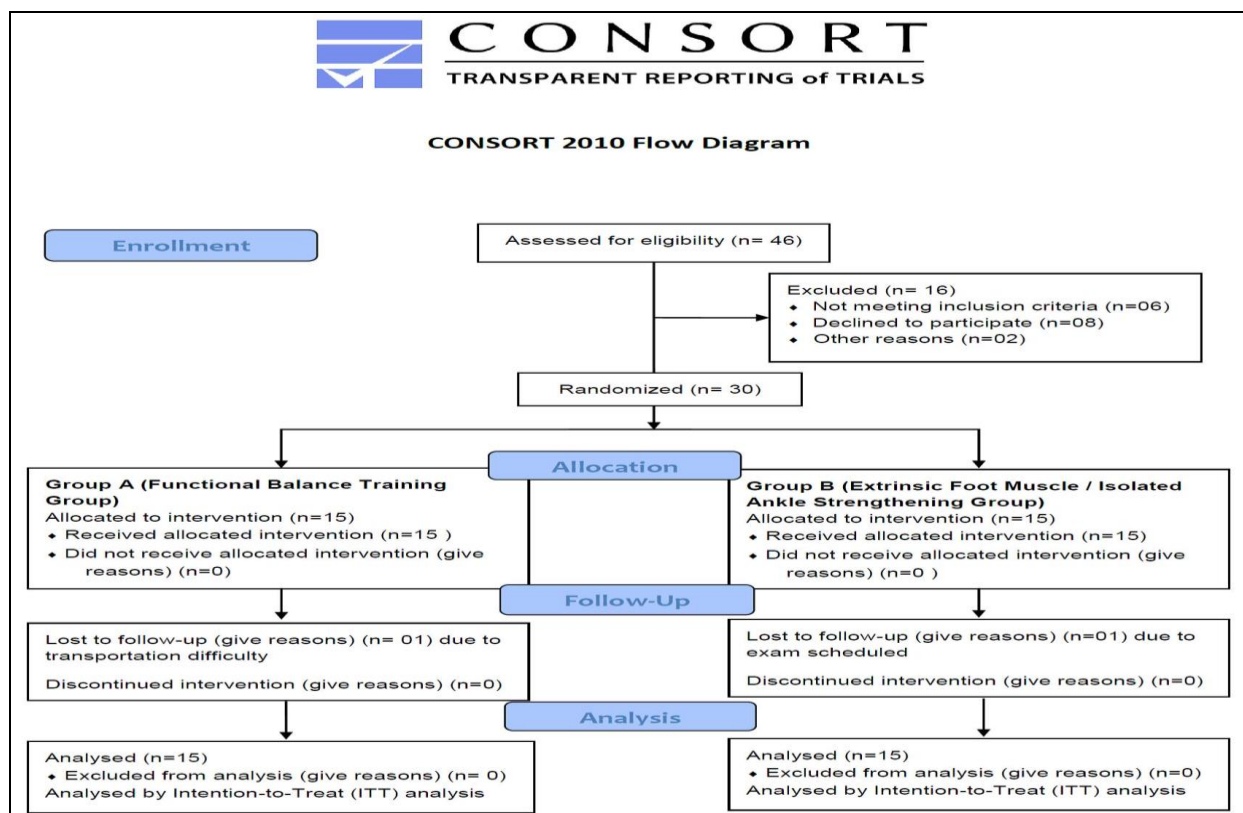
A total of 30 novice runners were recruited by the simple random sampling (random number generator) to participate in this two group pretest-posttest, single blinded randomized controlled study. Novice runners who had any history of lower limb fracture in the past six months or deformities were excluded from the study. After the demographics, recruited subjects were randomly allocated into two groups, group A and group B with 6 blocks by block randomization. The block matrix design is 5 X 6, five being the number of rows. Once the block was empty, next row block was opened. Thus, 15 numbers were allocated to each groups, maintaining equal number of samples during intervention. The subjects in group A received, IASE. While in group B, the subjects received FBT programme. The Consolidated Standards of Reporting Trials (CONSORT) flowchart of the study is displayed in Figure 1.

**Table 1: Warm-up session adopted by novice runners in both Group A and Group B**

S.No	Warm-up mode	Movement	Duration
1.	Aerobic	Side to Side Shuttle, Slow Running	1 Minute
2.	Static stretch	Iliopsoas, Hamstring, Quadriceps, calf	30 seconds x 5 times
3.	Dynamic stretch	Iliopsoas, Hamstring, Quadriceps	2 minutes for each muscle group
4.	Lateral Jump	Left to Right Right to left	10 repetition / side

**Table 2: Functional Balance training protocol adopted by novice runners Group B**

S.No	Functional balance training exercises	Exercise Protocol (1-2 weeks)	Exercise Protocol (3-4 weeks)	Sets and repetition
1.	Lunges	Forward and backward	Round the clock-	5 times per side
2.	Squat	Bipedal Squat, Box Touch	On wobble board	10 Repetitions
3.	Single leg stance	Eye Open and eye closed	Eye open and eye closed with variations in trunk and lowerlimb	5 Repetitions (30 seconds)
4.	Lateral Jump	Left to Right	Left to right	5 per side



**Fig 1**

**Isolated ankle strengthening exercise in group A:**

Novice runners in group A performed the prescribed warm-up, Table 1 for 5 minutes. After warm-up, IASE consisted of strength training for ankle dorsiflexors, plantar flexors, invertors and evertors with elastic band, The raband Level three and four (Red and Green Color Band) prescribed for 12 repetition x 3 sets / day for 4 weeks (5 days / week, a totaling 20 sessions).

**Functional balance training in group B:**

Novice runners in group B underwent FBT programme, as prescribed in Table 2 for 4 weeks (5 days/week, a total of 20 sessions). First two weeks of training consisted of basic training programme while later two weeks of advanced balance training programme. Before beginning FBT programme, five minutes warm-up session as described in Table 1 was incorporated.

**Outcome measures:**

Baseline and post-intervention training effects at 4<sup>th</sup> week to document postural control and activities of daily living changes were noted by star excursion balance test (SEBT)<sup>25,26</sup> and foot and ankle ability measure (FAAM)<sup>27</sup>. Measurement of SEBT was standardized after obtaining self-reported FAAM. Mean of three SEBT at each direction was used for analysis.

**Data analysis:**

The collected demographic and outcome measures were assessed for their normality using Shapiro-Wilk test. As the demographic data does not follow normal distribution, all the demographics were expressed in mean and range with 95% confidence interval. Mann-Whitney U test was used to demonstrate the significant difference between the groups. The outcome measures, SEBT and FAAM follow normal distribution. Hence, they were expressed in mean and ± standard deviation.

Paired t test was adopted to find out the differences within Group- A and group-B for pre-post intervention changes. While independent t- test was used to compare the changes in mean values of SEBT and FAAM between Group- A and Group- B at baseline and end of 4 week intervention. The data was analysed using statistical software, statistical package for social science (SPSS), IBM SPSS version 20.0 (Armonk, NY: IBM Corp.). The p-value  $\leq 0.05$  was considered to be statistically significant.

**RESULTS:**

Thirty novice runners were recruited for the study. Among them 14 were male and remaining 16 were females. The demographic characteristic of the novice runners recruited were displayed in Table 3. There exists no significance difference between the two groups. Between the session and group comparison at baseline and end of 4 weeks training intervention for the outcome measures SEBT (Table 4 and Table 5) and FAAM (Figure 2) were displayed. Two drop-outs, (one in each group) were analysed by intention-to-treat analysis.<sup>28,29</sup> The cumulative mean of SEBT between the groups was displayed in Figure 3. In all the outcome measures, group B shows significant ( $p < 0.05$ ) improvement when compared to group A.

**Table 3: Demographic characteristics of the recruited novice runners between the groups**

Demographic characteristic	Experimental group	Control group	P- value
Age (Years)	22.8 (21.4 – 20.3)	21.2 (20.3-21.1)	0.08
Height (cm)	167.5 (163.03-171.9)	168.1 (163.4-170.9)	0.7
Weight (kg)	62.5 (58.2-66.7)	61.9 (54.6-69.2)	0.5
BMI (kg/cm <sup>2</sup> )	23.2 (21.4-24.9)	22.9 (20.4-25.3)	0.9

Abbreviations: cm – centimeter; kg – kilogram

**Table 4: Star Excursion Balance Test scores among the novice runners in group A**

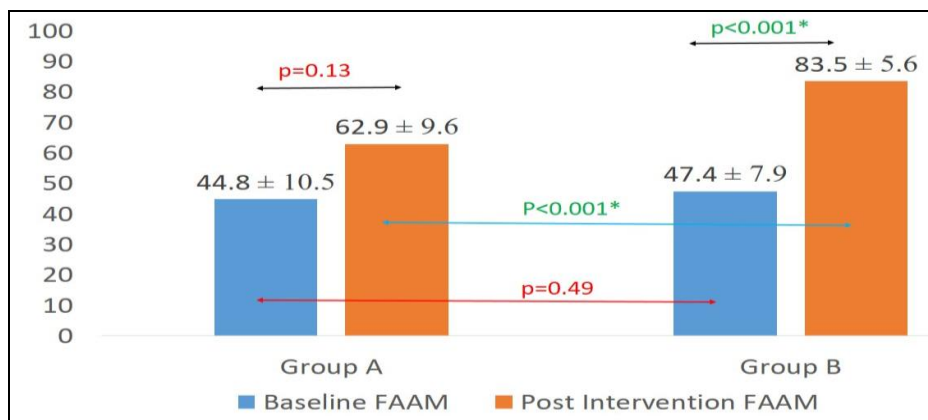
SEBT Reaching direction	Baseline	Post intervention	p- value
Anterior reach (cm)	69.3 ± 12.4	72.04 ± 10.9	0.09
Anteromedial reach (cm)	70 ± 13.2	71.4 ± 11.3	0.6
Medial reach (cm)	68.1 ± 12.9	70.4 ± 11.09	0.08
Posteromedial reach (cm)	64.7 ± 13.1	66.8 ± 12.04	0.06
Posterior reach (cm)	61.7 ± 14.4	64.5 ± 12.5	0.14
Posterolateral reach (cm)	60.2 ± 11.05	61.6 ± 11.2	0.41
Lateral reach (cm)	59.6 ± 10.1	63.7 ± 9.7	0.63
Anterolateral reach (cm)	68.7 ± 10.3	69.3 ± 11.3	0.7

Abbreviations: cm – centimeter

**Table 5: Star Excursion Balance Test scores among the novice runners in group B**

SEBT Reaching direction	Baseline	Post Intervention	p- value
Anterior reach (cm)	72.5 ± 10.4	77.3 ± 9.84	0.04
Anteromedial reach (cm)	70.7 ± 11.1	76.1 ± 10.6	0.04
Medial reach (cm)	71.8 ± 11.3	77.4 ± 12.3	0.03
Posteromedial reach (cm)	64.1 ± 9.0	68.2 ± 9.5	0.05
Posterior reach (cm)	64 ± 10.1	68.5 ± 10.9	0.02
Posterolateral reach (cm)	59.2 ± 8.8	63.3 ± 9.5	0.03
Lateral reach (cm)	56.9 ± 9.5	60.1 ± 9.3	0.04
Anterolateral reach (cm)	72.6 ± 10.6	76.9 ± 11.06	0.02

Abbreviations: cm – centimeter



**Figure 2**

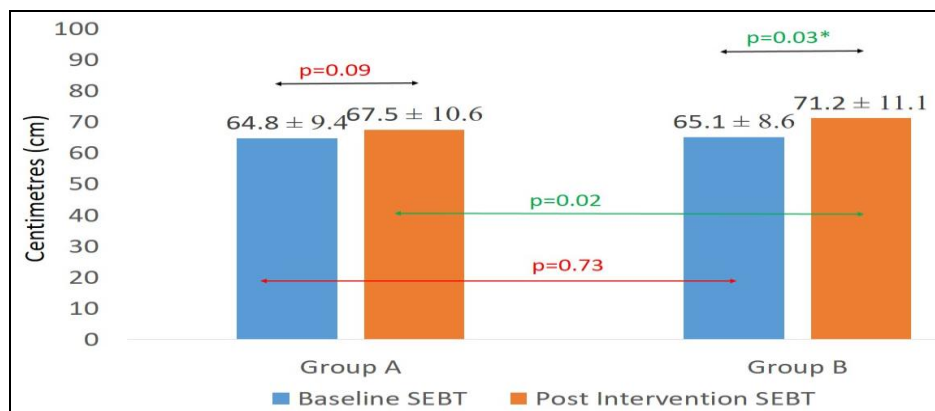


Figure 3

**DISCUSSION:**

The importance of FBT programme is highlighted through this randomized controlled study. This provide ample information to the novice runners about the benefits of FBT programme and their role in improving postural control. With the increasing awareness of the benefits of physical activity, a more health conscious general population expressed interest in exercise. Recreational running, with its accessibility and low monetary cost, has grown increasingly popular among the general population as a primary form of exercise. However, the increase in popularity of running has also led to an increase in running-related injuries. Previous running injury studies have found the yearly injury incidence proportion to range from 26-85%.<sup>30</sup> The effects of running injuries include short-term and long term pain and discomfort. Short-term pain and discomfort would be due to the immediate effects of the injury.<sup>2</sup> This highlights the impetus for further investigation into running injury prevention, as this is a growing concern for the general population not only from a running injury perspective, but also from a health standpoint.

A variety of intrinsic risk factors that are inherent to the runner have been identified for running injury. Some of the most commonly studied intrinsic variables include muscle strength and joint kinematics and kinetics during running. It has been found that weak plantar flexor strength is associated with an increased incidence of Achilles tendinopathy,<sup>31</sup> one of the most common overuse running injuries. Furthermore, decreased muscular strength, particularly at the quadriceps and hamstrings, has been associated with increased incidence of patellofemoral pain syndrome, another common overuse running injury.<sup>32,33</sup>

The results from this study is highly relevant for the field of health and wellness. This study provides valuable information regarding the efficacy of four

weeks IASE or four weeks FBT program to reduce intrinsic risk factors for novice runners. The higher total score in SEBT and FAAM among group B novice runners suggest, that the applied FBT programme improves the quality of postural control, foot ability and thus might have a potential to reduce the risk of injury in novice runners.

**CONCLUSION:**

There is a sufficient evidence to demonstrate that functional training programme among the novice runners improve postural stability and thereby might have a potential to decrease risk of injury.

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