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PREVALENCE OF WEAK CORE IN RELATION WITH DYNAMIC BALANCE IN RECREATIONAL TREKKERS

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Abstract

Background: The most popular recreational activity in the world, mountaineering involves a variety of factors, including musculoskeletal, tactile, physiological, technical, mental, and physical elements. Various muscular strengths need to be on play in order to protect the trekker from injury. Almost every sport, including recreational trekking; special focus is always received by core. Core strength is in direct relation with both static and dynamic balance of the body.

Objectives: To find out whether there is correlation between dynamic balance and weak core in recreational trekkers.

Method: The mother article calculated the sample size and determined it to be 256. Both male and female subjects were sought out for the study with their informed consent, depending on the inclusion criteria. The sample was then subjected to various outcome measures like Double Leg lowering test, 60-Second Tall-Kneeling Test & Unilateral hip bridge endurance and the data was noted. This data was analyzed with statistical measures and correlation was found.

Result: For comparing the variable factor and the outcome measure and conclusion, a statistical analysis using the Student's t test was conducted. Varying results was achieved with different outcome measures and the compounding factor. Results was found to be significant for dynamic imbalance when assessed with 60-Second Tall-Kneeling Test with p value = 0.005* to 0.0001* for various compounding factor and with Unilateral hip bridge endurance with p value= 0.05*. The correlation between the dynamic balance and weak core among the subjects was examined using Pearson's correlation, and it was discovered that there was no significant result. However, a positive association was found.

Conclusion: The study concluded that the recreational trekking subjects do have weak core and the dynamic balance is affected in them significantly, but there was no correlation seen among the weak core and dynamic balance in the subjects.

Keywords: Prevalence, Weak Core, Dynamic Balance, Recreational Trekkers, Physiotherapy

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Introduction

Core and its parts: Core is described as muscular box comprised of four walls, anteriorly by the abdominal muscles mainly the rectus abdominis, laterally by transversus abdominis, posteriorly by back extensors, superiorly the diaphragm and inferiorly the pelvic floor [5]. There are about 29 pair of muscles that stabilizes the spine on pelvis during dynamic movements [1]. This system is known to be activated in both static as well as dynamic activities [9].

It has been studied by several authors that any one muscle weakness in the core can lead to dysfunction of the core. In all athletic activities, stabilization and force creation depend on the central core, according to a study by W. Ben Kibler, Joel Press, and Aaron Sciascia. “Core stability can be well-defined as the capacity to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion to the terminal segment in integrated athletic activities”. The authors concluded that it is hard to quantify the isolated individual component during dynamic activity, but its functions and dysfunction can be approximated [10].

There are 3 anatomical linking systems in the human body namely; muscular, facial and skeletal. Core is not only the part of the anterior and posterior parts of the body whereas it is connected to several muscles of both upper and lower extremities via muscular chain. Prof. Janda explained the three chain system in which he stated that weakness of one muscle can induce changes within the continued chain muscle. Among core “The transversus abdominis” receives a special attention for its stabilizing effects. Peculiar feature about transversus abdominis is the horizontal fiber orientation creating a belt around the abdomen. The hip musculature plays a vital role in all locomotory activities, and also assists in stabilizing the trunk and pelvis during dynamic activity like gait. It is been studied that reduced endurance and late activation of the hip extensors and abductor impose greater amount of load on the lumbar spine causing development of low back pain [2]. Being the weak flexor of the lumbar spine, the psoas has the ability to put a tremendous amount of compressive pressure on the lumbar discs. LBP can be brought on by psoas tightness by raising compressive loads [3]. Diaphragm being the roof of the core and an expiratory of the lung aids to spinal stability by increasing the intra-abdominal pressure on contraction. Contraction of the transversus abdominis occurs synchronously with recruitment of the pelvic floor muscles [6].

Balance is the perception of special orientation of human body which prevent from falling [18]. Core stability is important is maintaining spinal stability. Spinal stability directly influence both static and dynamic balance of human body. The neuromuscular control (neural elements), passive subsystem (osseous and ligamentous elements), and active subsystem (muscular elements) components of the spine stability system interact with one another [12].

Active core, Stable spine and Good balance and postural control is a must in any static or dynamic activity. Absence of anyone will lead to increase in fall risk of that subject. One of the most well-liked leisure activities in the world is mountain trekking, which can range from a 15-day grueling expedition in high altitude mountains to a day-long hike up a hill. It is typically characterized by extended continuous low intensity exercise. It comprises of long distance, uphill-downhill walking across uneven terrains[17] Studies have demonstrated that, trekking involves increased risks of injuries like load-induced musculoskeletal injuries such as shin splint, ligament sprains, muscle strains, stress fractures along with overuse injuries[8].

Extensive research have statistically demonstrated that downhill walking increases the compressive pressures on the lower limbs, leading to greater eccentric loading, when compared to uphill and downhill hiking. One study found that repetitive eccentric contractions of the muscles in the lower extremities, which reduce muscle endurance, frequently result in iliotibial band syndrome, patellar tendinitis, and ankle sprains in trekkers. Since bearing an external load increases the vertical ground reaction forces, shear forces, and

patellar compressive stresses by 3–4 times compared to level walking, the risk of injury is higher when walking downhill than upwards[7]. According to Anderson LS J's research, improper usage of trekking poles, poorly shoes, uneven terrain, and the weight of the backpack are the main causes of falls and musculoskeletal injuries sustained when trekking [13]. When trekking, the weight of the backpack should be as light as possible because carrying a heavy burden over a long distance may increase the compressive pressure on the spine and lower extremities. According to a study by Schwameder H, downhill walking causes the external load's pressures to be amplified the most [14].
As already discussed core also plays vital role in maintaining both static and dynamic stability of the body. Studies have demonstrated that subjects with core weakness have poor static and dynamic balance. Thus, Core strength becomes important in trekking individuals to avoid falls. Studies have highlighted about the effect of the Eccentric contraction of muscle inducing the impact on the lower extremities especially the knee joint, heavy backpack, the trekking poles, the ground reaction forces and the increased compressive load on the spine. There can be many risk factors as described in previous studies for increased fall rate in recreational trekkers. Many studies have focused on lower extremity injuries and risk of fall due to overload on spine, but there is scarcity in the literature review related to strength of abdominals in relation with dynamic balance in recreational trekkers. Thus study is undertaken**.**

Material and Methodology
The current study is an observational cross sectional study with Sample size: 256. The study was started after obtaining institutional ethical letter. Written Consent was taken from every participant in the study thereafter the subjects were subjected to recruitment process. The study's participants were chosen based on the inclusion and exclusion criteria. Inclusion criteria: Trekking for more than span of 6 months, both male and female and Recreational trekkers, Age should be not less than 25 and not more than 40. Exclusion criteria: Novice backpackers, History of any surgical intervention of spine and lower extremities, Professional trekkers, History of any soft tissue injuries in past 0-3 months of spine/lower extremities. Participants were recruited from various trekking groups. 256 participants were assessed for the following outcome measures.

Double-Leg Lowering Test:
Under the subject's lumbar spine, a standard sphygmomanometer was inflated to 40 mm Hg and used to track the persistence of posterior pelvic tilting. A subject was made to lie supine on the plinth and was asked to flex both the hips for up to 90 degrees with knee in complete extension. Assistance was provided in lifting by the therapist. The subject was then told to lower both the legs down simultaneously maintaining the knee in extension and pelvis in posterior tilt. The degree was noted once the knee comes into flexion or there is loss of posterior tilting of the pelvis [11].

60-Second Tall-Kneeling Test:
Dynamic test performed actively to assess the eccentric strength of the iliopsoas and rectus femoris muscles. The subject is instructed to assume the standing, on both knees position with the arms crossed over the chest and the trunk aligned directly over the thighs as indicated in the illustration below. A normal goniometer was used to measure the subject's knee angle, which was instructed to lean rearward until it reached 70 degrees. The therapist's touch made a mark on the trunk's position. The test began with the patient being instructed to lean back until the therapist's hand while maintaining a neutral posture and avoiding any waist bending. The greatest level of tiredness was recorded together with the number of

successful repetitions completed each minute. If the subject's torso did not touch the tester's hand or if the subject did not maintain the neutral torso to thighs position throughout the trial, the repeat was deemed unsuccessful [11].

Unilateral Hip Bridge:
Initially, participants were asked to lift both the hips keeping the foot on the floor and after 5 seconds, participants were asked to lift one foot off the floor into a single-leg bridge position. The participants' ability to maintain the exercise's proper form for the allotted time was timed. Each session was videotaped, and the participants' pauses or breaks from form were noted.[19]

Result
The study was divided into male and female subjects with respect to the outcome measure and risk factors. The demographic data was analyzed for age, gender, body mass index, duration of trekking, distance of trekking (Table no. 1, 2, 3).

Table 1: Comparison of male and female subjects with duration of trekking by t test

Duration of Trekking	**Male**	**%**	**Female**	**%**	**Total**	**%**
6 months- 1 year	57	22.265	43	16.796	100	39.062
1 year or more	34	13.281	22	8.593	56	21.875
2 year or more	12	4.687	10	3.906	22	8.593
3 year or more r	20	7.812	8	3.125	28	10.937
4 year or more	18	7.031	15	5.859	33	12.890
5 year or more r	5	1.953	12	4.687	17	6.640
Chi-square= 1.2362 P = 0.5392						

Table 2: Distribution of respondents with respect to age and gender

Age in years	**Males**	**%**	**Females**	**%**	**Total**	**%**
25-30	**60**	**23.437**	**70**	**27.343**	**130**	**50.781**
30-35	**50**	**19.531**	**26**	**10.156**	**76**	**29.687**
35-40	**30**	**11.718**	**20**	**7.812**	**50**	**19.531**
Chi-square= 2.2362 p = 0.051*						
Mean ±SD Age	**29± 2.031**					

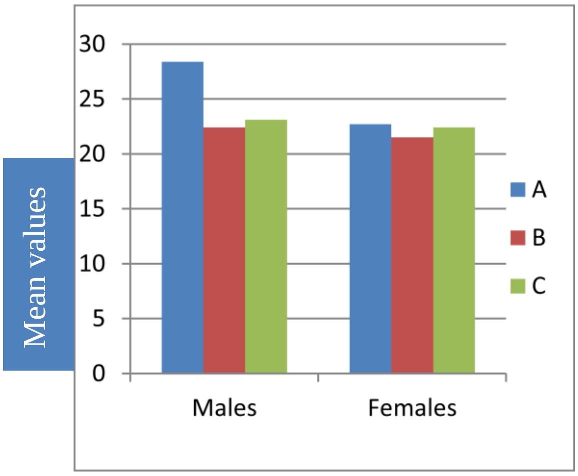
Table 3: Comparison of height, weight and BMI among the respondents with respect to gender

Variable	**Gender**	**Mean ±SD**	**P value**
Age	**Male**	**29.63± 2.12**	**0.0014***
	Female	**27.47±1.62**	
Height	**Male**	**163.10±7.35**	**0.3645**
	Female	**162.17±7.49**	
Weight	**Male**	**68.30±7.12**	**0.2272**
	Female	**57.45±6.18**	
BMI	**Male**	**21.80±2.97**	**0.1548**
	Female	**22.32±2.37**	

Descriptive statistics for continuous variables also included frequencies and percentages for nominal and discrete variables, as well as the mean, median, and standard deviation. The relationships between the outcome measures for continuous variables, the chi-squared test for count variables, and the logistic regression analysis were evaluated. P values are two-tailed, and the 5% level of significance was chosen; multiple testing was not taken into account.

Table 4: Relationship of risk factors and status of Double Leg lowering test (Abdomen strength)

Risk Factors		Mean ±SD	p value
Duration of trekking	**Male**	**28.4°±8.2°**	0.0001*
	Female	**22.7°±6.3°**	0.0001*
p value			0.05*
Distance of trekking	**Male**	**22.4°±11.3°**	**0.05***
	Female	**21.5°±11.1°**	**0.05***
p value			0.1273
Pre-trek preparation	**Male**	**23.1°±4.3°**	**0.05***
	Female	**22.4°±5.3°**	**0.05***
p value			**0.512**

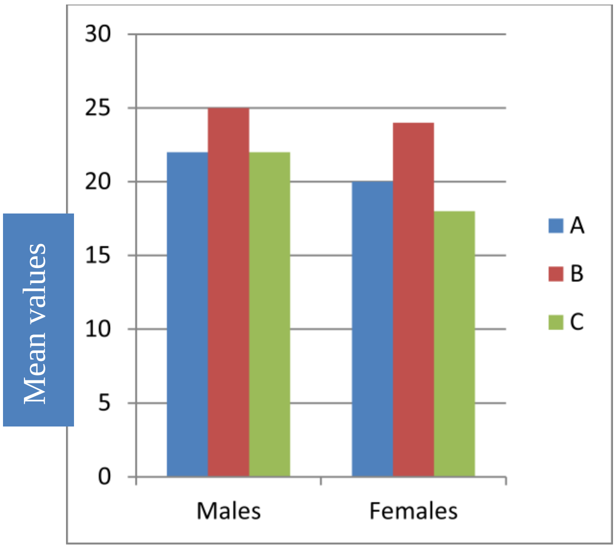


A: **Duration of trekking; B: Distance of trekking and C: Pre-trek preparation**

The above table suggests that, the outcome measures were statistically significant within males and females individually whereas the between group analysis showed only duration of trekking to be significant suggesting, between males and females the duration of trekking was alone significant. Double leg lowering test was statistically affected in Females more compared to Males with respect to Duration of trekking (**22.7°±6.3°**), Distance of trekking (**21.5°±11.1°**) and pre-trek preparation (**22.4°±5.3°**).Also the relationship between the gender was more significant with respect to duration of trekking and gender.

Table 5: Relationship of risk factors with 60-Second Tall-Kneeling Test (Dynamic stability)

Risk Factors		Repetitions / min	p value
Duration of trekking	**Male**	22±2	**0.0001***
	Female	20±1	**0.0001***
p value			**0.0001***
Distance of trekking	**Male**	25±2	**0.05***
	Female	24±4	**0.045***
p value			**0.05***
Pre-trek preparation	**Male**	22±1	**0.0001***
	Female	18±2	**0.00001***
p value			**0.0001***

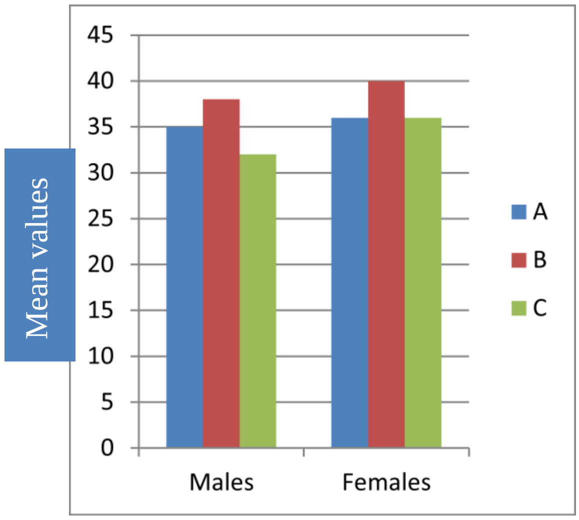


A: **Duration of trekking; B: Distance of trekking and C: Pre-trek preparation**

The above table suggests that, duration of trekking, distance of trekking and pre-trek preparation were significant within males and females with respect to 60-second Tall Kneeling Test for both within group and between group analysis, which means both males and females had lower score of 60-Second Tall Kneeling test suggestive of weak core stability. 60-Second Tall Kneeling Test was seen to be affected more in females than in males in all the risk factors, suggestive of low abdominal dynamic balance in females compared to males with increased duration of trekking, increased distance of trekking and pre-trek preparation not performed.

Table 6: Relationship of risk factors with unilateral hip bridge endurance (Hip endurance)

Risk Factors		**Mean ±SD**	**p value**
Duration of trekking	**Male**	**35±14**	**0.05***
	Female	**36±15**	**0.05***
p value			**0.05***
Distance of trekking	**Male**	**38±17**	**0.05***
	Female	**40±14**	**0.05***
p value			**0.05***
Pre-trek preparation	**Male**	**32±12**	**0.05***
	Female	**36±14**	**0.05***
p value			**0.05***

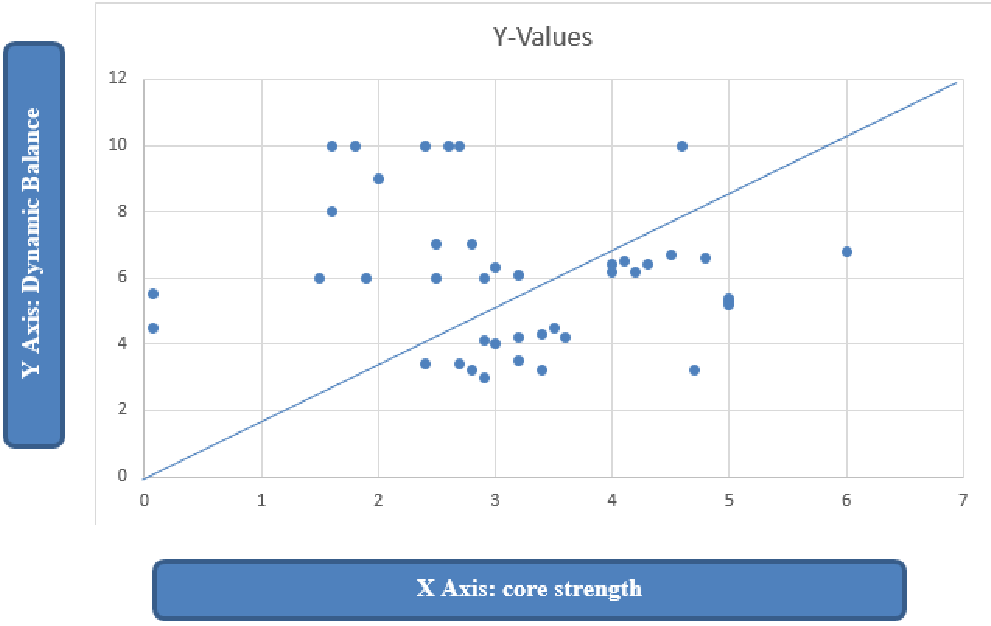


A: **Duration of trekking; B: Distance of trekking and C: Pre-trek preparation**

The above table suggests that, risk factors showed significant result both within and between group analyses. This suggests that Hip strength was statistically affected in both the groups of male and female with as the increased duration of trekking, increased distance of trekking and pre-trek preparation not performed. Variable scores were seen in the analysis of unilateral bridging outcome measure with respect to males and females, suggestive of variation in the hip strength with respect to gender and the risk factor.

Table 7: Correlation of Dynamic Balance and core strength

Using the Pearson correlation test, the mean of dynamic balance was associated with core strength. The P value was determined to be 0.571 ($p < 0.05$), which is not statistically significant. A positive relationship is seen in the dynamic balance and the core strength with a value of 0.05 suggesting stronger the core better the dynamic balance in recreational trekkers.



Discussion

The current study had recruited 256 sample and divided the sample into male and female groups. The table 1 showed that maximum participants were seen in 6months to 1 year duration of trek. And among all the group of duration of trek groups, males were maximum participants compared to females. On statistical analysis none of these measures were statistically significant no significant difference was seen among the groups suggestive of equal number of participants of both the genders with respect of duration of trekking. Also, the participants were categorized into age groups with respect to genders (Table 2) and it was seen that maximum participants among group were between 25-30 years among whom many were female trekkers with 70%. Among age range 31-35 years, males were the maximum participants with 50%.

Many authors have listed various risk factors of rate of fall in recreational trekkers like Chopda et al. The author studied about the Practice of Pre-trek training and it's Awareness among Trekkers. It was a survey-based study with 251 participants. The authors came to the conclusion that participants' knowledge of the value of warm-up, cool-down, and balance training as a part of pre-trek physical training is lacking. On analysis the authors found that most of the participants were aware about the other domains of the pre-trek physical training that is aerobic and resistance training. [20]
Authors Timothy B Gardner [5], David R Hill studied about the risk factors causing illness and musculoskeletal injuries in long distance trekkers. The authors concluded that pre-hike training is one of the important domain which is skipped by many trekkers leading to the faults during trek causing injuries. The reason stated by the authors were the importance of core muscle strength and endurance. Core comprises of back extensors, transversus abdominis and abdominal flexors. Weakness of core will lead to major accidents and musculoskeletal injuries during trekking. Awareness of pre-trek physical training and Prevalence musculoskeletal injuries were analyzed [8]. The current studies analyses the relationship of the enlisted risk factors and the abdomen strength and dynamic stability which is important in trekkers. The current study found that pre-trek preparation or the physical training will enhance the abdomen strength and dynamic stability. As the study conducted on

participants had less knowledge about pre-trek training had, low abdomen strength and hip muscle endurance along with reduced dynamic stability.

The current study listed three commonly encountered risk factors and was analyzed statistically. Authors like Chopda et al [20] and Timothy B Gardner , David R Hill [8] studied the importance of pre-trek physical activity and stated the importance of it in their study also they listed the physical activity to be performed by the trekking individuals before the actual trek. The exercises mentioned were cycling, brisk walking, running, jogging, swimming, weight training, hiking, biking, alpine skiing, boot conditioning and health care visits.

A study by Keisuke Kobayashi, Koji Kaneoka, Hideki Takagi, Yasuo Sengoku and Masahiro Takemura on the lumbar alignment and trunk muscle activity during swimming on 22 college participants concluded that internal oblique/transversus abdominis muscle activities were more active during swimming and were responsible for magnitude of alteration in the lumbar lordosis during swimming thus maintaining the alignment of the lumbar spine.[16] Another study by S.-J. Nam et al demonstrated the activity of abdominals and erector spinae during brisk walking showed that greater the speed of walking higher activity of abdominals on dominant side whereas the erector spinae was activate regardless of speed of walking on dominant and non-dominant side.[15] Both the study showed importance of abdomen during the physical training involved in pre-trek preparation. In the present study it was seen that increased duration and distance of walking led to weak abdomen strength measured by double leg lowering test which was statistically significant. This is in similar theories to the other studies as abdomen plays an important role in maintaining the stability of lumbar spine and to generate the speed during activity as was stated by Keisuke Kobayashi in the study of swimming and S.-J. Nam et al in the study of walking respectively. The authors stated the reason that transversus abdominis acts as a binder between the anterior abdominal wall and posterior abdominal wall, weakness of which will cause the instability of the trunk and higher chances of fall.

The psoas (a part of the lumbar spine) activity peaked at 14% MVC during the upstroke phase of regular cycling and approached 60% during sprinting, according to research by Daniel Juker, Stuart McGill, and Peter Kropf on the quantitative assessment of the muscle activity of the abdominal wall and psoas major during cycling activity. Erector spinae exhibited very low that 5% MVC throughout cycling until standing and sprinting methods were used. The abdominals likewise showed low MVC when compared with standing and sprinting. However, the current study discovered that inadequate hip muscle endurance resulted in decreased dynamic stability when trekking for longer periods of time, farther distances, or with little to no pre-trek preparation.

Limitation of the Study

1) Only recreational trekkers were recruited in the study

2) Only dynamic balance was correlated in the study, but; sexes, age trekking frequency, trekking distance and duration can be correlated.

Future recommendation:

Correlation of various compounding factors can be analysed and the effect of training protocol for core strengthening can be analysed on the dynamic balance of the recreational trekkers.

Conclusion

This study concludes that though there is positive correlation between the dynamic balance and the core strength it was not statistically significant. This study also concludes that there was definite weakness in abdomen strength and weak core stability in recreational trekkers.

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Conflict of Interest

Conflict of interest declared none.

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