RESEARCH PAPER

Association Between Chronic Ankle Instability and Y-Balance Test Among Recreational Athletes – An Observational Study

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ABSTRACT

Background: Chronic Ankle Instability (CAI) is a common condition among amateur athletes, often resulting from repeated ankle sprains that lead to mechanical and functional instability. It frequently occurs with injury of the lateral ligament complex, especially the anterior talofibular ligament, where the ligament injury does not fully heal following the initial sprain. CAI is associated with structural and functional changes at the ankle, resulting in increased injury risk. The Cumberland Ankle Instability Tool (CAIT) is a self-reported questionnaire used to determine the degree of functional ankle instability in athletes with a history of ankle sprains, and the Y Balance Test (YBT) is a valid tool used to assess dynamic balance. This study aims to assess whether the extent of perceived subjective chronic ankle instability and the degree of dynamic balance impairment are associated.

Objectives: To investigate the relationship between perceived subjective chronic ankle instability and dynamic balance performance among recreational athletes.

Methods: The study was a cross-sectional study that included recreational athletes aged 18–25 years with a history of ankle sprain. The athletes were asked to fill out the Cumberland Ankle Instability Tool to identify participants with CAI and its severity. The YBT was used to assess the dynamic balance during which participants balanced on the leg with perceived instability (CAIT < 24) while reaching with the other leg. Y balance parameters included maximum, normalized reach distance and composite score.

Results: A total of 31 recreational athletes participated in the study. The association between CAIT scores and YBT reach distances was analyzed using the Spearman correlation test, which identified that athletes with CAI performed poorly on the Y balance test, both in normalized reach distance and composite score; the scores were lower than previously reported normative cut-off values. We found no direct association between the degree of CAIT Score and YBT parameters (p value ranging from 0.194 to 0.878).

Keywords: Chronic ankle instability, Y-Balance test, Cumberland Ankle Instability Tool, recreational athletes.

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BACKGROUND

One of the most common musculoskeletal injuries is ankle sprain, which results from overstretching of ankle ligaments or an incomplete or full tear of the ligaments around the ankle joint, the estimated incidence rate of ankle sprain is 0.93/1000 for each athlete participating in 1 competition or practice.[1] Ankle ligaments can be divided into the lateral complex and the medial complex. The lateral complex is made up of the anterior talofibular ligament (ATFL), Calcaneofibular Ligament (CFL), and posterior talofibular ligament (PTFL), while the deltoid ligament makes up the medial complex, which prevents excessive motion and maintains joint integrity while

moving.[2] The lateral ligaments are more commonly involved in ankle sprain with an injury mechanism of inversion and plantarflexion, especially the anterior talofibular ligament. This usually occurs when landing awkwardly after the jump, changing the direction rapidly or landing on an uneven surface.[3]

Ankle sprains that occur repeatedly, usually involving the same ankle after an initial injury, are given the terminology repetitive ankle sprains or recurrent ankle sprains. It frequently happens when the lateral ligaments, especially the ATFL, do not fully heal following the initial sprain.[4] Athletes who have recurrent ankle sprains frequently complain of pain, swelling, and "giving-way" sensations, which result from structural issues such as laxity of ligaments and capsule and functional changes such as impaired balance and delayed peroneal reaction time.[5,6] If recurrent sprains are not adequately treated with rehabilitation that emphasises strength, balance, and proprioceptive training, they can result in progressive ligament laxity, joint capsule damage, and altered neuromuscular control, which can ultimately lead to chronic ankle instability (CAI).[6]

A study by Leah Tanen et al assessed the prevalence of CAI among high school and collegiate athletes and found it to be 23.4%.[7] Ankle sprain, associated with partial or total tearing of the ATFL and CFL may cause the talocrural and subtalar joints to become mechanically slack, increasing the chances of recurrent sprains which is associated with abnormal movement patterns, changes in the distribution of stress across the ankle complex, proprioceptive deficiencies, sensorimotor dysfunction, and delayed reflex activation of peroneus longus and brevis, resulting in instability. [8,9]

Recreational athletes are those who routinely engage in sports and physical activities for fun, fitness, or social interaction at least 3 times a week.[10] They usually play sports like football, basketball, jogging, volleyball, or badminton and practice and compete at the amateur or non- professional conditioning or rehabilitation programs, putting recreational athletes at a high risk of musculoskeletal injuries, even though they may not receive the same volume or intensity of training as professional athletes.[11,12] Recreational athletes may also not receive the same preventive training or medical supervision as elite athletes, making them more susceptible to CAI.[13]

Cumberland Ankle Instability Tool (CAIT) is a standardised self-reported questionnaire that is used to evaluate the degree of functional ankle instability among athletes with ankle sprain history, with 82.9% sensitivity, 74.7% specificity and good test-retest reliability (ICC=0.96).[14] Nine questions make up the CAIT, which assesses symptoms like pain, instability, giving-way episodes, and the capacity to carry out daily and athletic tasks.[14]The total score goes from 0 to 30 points, with 30 denoting perfect ankle stability and lower scores denoting increased instability.[14]

The Y balance test (YBT) is a simplified and standardised variation of the Star excursion balance test (SEBT) and was developed to overcome some drawbacks, such as being time-consuming and requiring extensive assessor training.[15] It has been shown that the 3 reach directions used in YBT- anterior, posterolateral and posteromedial offer similar sensitivity and reliability to the eight original directions in SEBT.[15] The YBT exhibits high interrater reliability (ICC=0.99).[16]

CAI is typically associated with recurrent ankle sprains, resulting in functional limitations and poor balance control. Despite the high prevalence of CAI among recreational athletes, it is often not diagnosed and poorly managed. Assessing ankle instability using reliable tools such as CAIT and YBT can help identify functional deficits and balance impairments at an early stage. Although the theoretical link between balance deficits and CAI is well understood, few studies have directly investigated the association between subjectively reported instability (measured using CAIT) and objective balance performance (measured using YBT) among recreational athletes with recurrent ankle sprain. Understanding the relationship can enhance the screening process, help identify athletes at risk of recurrent injury and develop targeted rehabilitation programs aimed at restoring dynamic balance and preventing long-term disability.

OBJECTIVES

To investigate the association between perceived subjective chronic ankle instability and dynamic balance performance among recreational athletes.

METHODOLOGY AND PROCEDURE

Permission from the Central Ethical Committee (CEC), Sri Devaraj Urs Academy of Higher Education and Research (SDUAHER/R&D/CEC/RLJCOPT-UG/53/NF/2025-26) was taken for the cross-sectional study. Sample size for the study was calculated based on detecting a significant association between chronic ankle instability and the YBT. Assuming a moderate-to-strong correlation coefficient of r = 0.50, based on previous literature reporting similar relationships between dynamic balance measures and chronic ankle

instability,[17,18] with a two-tailed significance level of 0.05 and statistical power of 80%, the required sample size was calculated using Fisher's Z transformation formula for correlation studies. The minimum required sample size was calculated as 29 participants.

Recreational athletes with a known history of unilateral ankle sprain were identified from the university athletic teams from September 2025 to December 2025. The athletes were informed about the research, and a consent form was obtained. A total of 64 athletes were screened for inclusion and exclusion criteria. Inclusion criteria for the study were recreational athletes participating in sports at least 3 times a week[10] with a history of ankle sprain; both male and female athletes with a CAIT score indicating moderate to severe ankle instability (score less than 24).[19] Participants with acute ankle injuries and individuals with known neurological disorders affecting balance, recent history of any lower extremity injury (fractures and soft tissue injury). A total of 31 athletes matched the inclusion and exclusion criteria and were incorporated into the study.

YBT was assessed for all the participants; they were asked to stand barefoot at the centre of the YBT equipment with both their hands on the hip. Participants were then asked to balance on the limb with perceived ankle instability while reaching as far as possible with the opposite limb in three different directions - anterior, posterolateral, and posteromedial, without losing their balance. Before testing, participants' limb length was measured, and they were permitted a few practice runs. Each athlete performed three trials, and the highest score of the three trials was recorded for analysis. The normalised score and composite score were calculated using the formula).[18,20]

STATISTICAL ANALYSIS

Statistical software SPSS (Version 31) was used to analyse the data. The Shapiro–Wilk test was implemented to test the normal distribution of the data. Normality testing indicated that the YBT reach distance was not normally distributed. Hence, Spearman's correlation test was used for the analysis of the correlation between the YBT parameters and CAIT.

RESULT

Among 31 recreational athletes, 28 had instability on the left leg, and the rest had instability on the right side. The participants' average age was 21 years, and they participated in sports for a mean of 5 hours per week. The median score of CAIT was 19 with an interquartile range of 4.5 (graph 1), indicative of moderate ankle instability[14] among the participants (Table 1). The study results identified that athletes with CAI performed poorly on the YBT, both in normalised reach distance and composite score (Table 2) (graph 2). Statistical analysis showed no statistically significant correlation between the CAIT and YBT outcomes. The p-values ranged from 0.194 to 0.764 for maximum reach distance, 0.357 to 0.801 for normalised reach distance, and 0.878 for the composite score, indicating the absence of a meaningful association between perceived ankle instability and dynamic balance performance (Table 3,4,5).

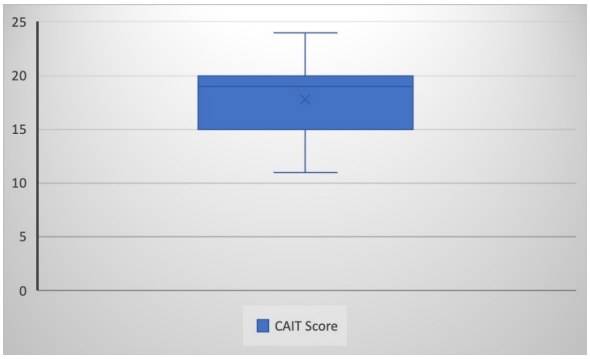
Table 1: Demographics data

Variables	Value
Age (years)	21
Gender	Male – 23 Female- 8
Side of instability	Left – 28 Right - 3
Duration of sports per week (hours)	5

Table 2: Y balance and CAIT scores

Components	Median (IQR)
YBT Anterior (cm)	55 (10.5)
YBT Posteromedial (cm)	63 (7.0)
YBT Posterolateral (cm)	65 (9.5)
YBT Anterior normalised score %	61.8 (13.0)
YBT Posteromedial normalised score %	73.0 (12.7)
YBT Posterolateral normalised score %	70.6 (16.13)
YBT Composite score %	68.6 (12.8)
CAIT	19 (4.50)

Graph 1: Cumberland Ankle Instability Tool Scores



Graph 2: Y Balance Test Parameters

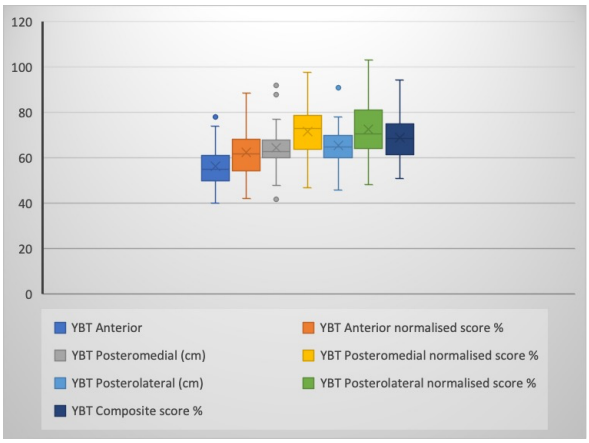


Table 3: Correlation matrix YBT reach distance and CAIT

Y Balance Test (Reach distance)	CAIT SCORE	
YBT - Anterior	Spearman's rho	0.056
	df	29
	p-value	0.764
YBT - Posteromedial	Spearman's rho	-0.240
	df	29
	p-value	0.194
YBT - Posterolateral	Spearman's rho	-0.033
	df	29
	p-value	0.860

Table 4: Correlation matrix YBT normalised score and CAIT

Y Balance Test (Normalised reach distance)	CAIT SCORE	
YBT - Anterior Result	Spearman's rho	0.171
	df	29
	p-value	0.357
YBT - Posteromedial Result	Spearman's rho	-0.062
	df	29
	p-value	0.741
YBT - Posterolateral Result	Spearman's rho	0.047
	df	29
	p-value	0.801

Table 5: Correlation matrix YBT composite score and CAIT

Y balance Test	CAIT SCORE	
YBT Composite score	Spearman's rho	0.029
	df	29
	p-value	0.878

DISCUSSION

The objective of the current study was to assess the relationship between perceived CAI and dynamic balance among recreational athletes, as measured by the CIAT, and dynamic balance performance tested using the YBT among recreational athletes. The findings of the study indicated that although participants demonstrated impaired dynamic balance

performance on the YBT, no statistically significant correlation was identified between CAIT scores and YBT parameters.

The participants in this study exhibited a median CAIT score of 19, indicating moderate ankle instability, which is similar to previous literature by Hiller et al describing functional instability among athletes with recurrent ankle sprains and scores below 24 reflect functional deficits related to instability, pain, and episodes of giving way.[14] Despite this moderate level of perceived instability, the absence of a significant correlation indicates that subjective perception of ankle instability may not directly reflect objective dynamic balance performance.

The YBT findings of the recreational athletes with ankle instability demonstrated reduced normalised reach distances and composite scores in all three reach directions, indicating impaired dynamic balance. Previous studies have reported similar deficits in individuals with CIA, associating poor Y-Balance Test performance with altered ankle proprioception, delayed peroneal muscle reaction time, and structural changes at the ankle resulting from recurrent ankle sprain.

The lack of association between CAIT and YBT parameters aligns with previous studies suggesting that self-reported measures and performance-based tests identify different dimensions of ankle functions. While CAIT reflects an individual's perception of instability during daily functions and sporting activity, the YBT objectively assesses dynamic balance under controlled conditions. In our study, we observed that not all recreational athletes with low CAIT scores necessarily showed equivalent neuromuscular deficits during the balance test. Additionally, recreational athletes often continue participation in sports despite the symptoms of ankle instability, which may promote adaptive strategies that can mask balance deficits during standardised tests. The findings of this study contribute to the growing body of literature highlighting the multifactorial nature of CAI. The findings emphasise that perception of instability experienced by athletes may not always translate directly into measurable deficits during standardised balance assessments.

The findings of this study highlight the importance of using both subjective and objective assessment tools while evaluating individuals with CAI. Relying only on self-reported instability questionnaires or balance tests may fail to capture the true extent of instability among recreational athletes. A comprehensive assessment approach may improve early identification of neuromuscular deficits, guide individualised rehabilitation programs, and ultimately reduce the risk of recurrent ankle sprain and long-term functional impairment.

LIMITATIONS

The relatively low sample size may have reduced the statistical power to detect subtle associations between CAIT and dynamic balance assessment. Additional factors such as strength of lower limb, core strength, ankle range of motion and neuromuscular reaction time of peroneus muscles, that can influence balance, were not assessed.

FUTURE DIRECTIONS

Future studies can incorporate a larger sample size and additional components, such as lower limb strength and ankle range of motion, to better analyse the multifactorial nature of chronic ankle instability.

CONCLUSION

Recreational athletes with CAI demonstrate below normal dynamic balance performance on YBT. However, we found no significant association between perceived ankle instability (CAIT scores) and Y balance test parameters. These findings indicate that subjective perception of instability does not always correspond with objective dynamic balance assessment. The findings of this study indicate that a comprehensive assessment of CAI should include both self-reported questionnaires and objective performance-based tests to guide effective screening, planning appropriate rehabilitation and injury prevention strategies

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