PREVALENCE OF ANKLE INSTABILITY IN MALLAKHAMB PLAYERS IN PUNE: A CROSS-SECTIONAL STUDY

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Abstract : Background: Mallakhamb is a traditional Indian sport performed on a vertical pole or a hanging rope, and its repeated gripping, climbing and landing may load the ankle heavily. The prevalence of ankle instability in Mallakhamb players has not been reported. Objective: To estimate the prevalence of ankle instability among Mallakhamb players aged 12–20 years in Pune. Methods: In this cross-sectional study, 139 players (80 males, 59 females) with at least one year of training were recruited by convenience sampling from training centres in and around Pune after ethical clearance and written informed consent. Players with a fracture or surgery in the previous six months or a neurological deficit were excluded. The Cumberland Ankle Instability Tool (CAIT) was completed for each ankle, and a score below 24 in either ankle was classified as ankle instability. Prevalence is given with exact 95% confidence intervals; associations were examined with chi-square tests, Cramér's V and Fisher's exact odds ratios. Results: Mean age was 15.44 ± 2.63 years. Ankle instability was present in 79 of 139 players (56.83%; 95% CI 48.17–65.20), and in 32 players (23.02%) it was bilateral. A previous ankle sprain was reported by 71.22% of players, of whom only 21.21% had received physiotherapy. Instability was more frequent in players with a previous sprain (77.78%) than in those without (5.00%; OR 64.05, $p < .001$) and differed by Mallakhamb type ($p = .037$) but not by gender ($p = .595$). Conclusion: More than half of the players screened positive for ankle instability, and a previous sprain was the factor most strongly associated with it. Because the design is cross-sectional and the CAIT is self-reported, the findings indicate association rather than causation. Routine ankle screening, balance and neuromuscular training, safe landing practice and supervised rehabilitation after sprains are recommended in Mallakhamb academies.

IndexTerms - Ankle instability, Mallakhamb, Cumberland Ankle Instability Tool, prevalence, adolescent athletes, ankle sprain.

I. INTRODUCTION

Lateral ankle sprains are among the most frequent injuries in sport, especially in activities built around jumping, landing and abrupt changes of direction. A meta-analysis of prospective studies found a higher sprain risk in females, in younger individuals and in indoor and court sports [1], and a systematic review identified sprains as the commonest type of ankle injury across sports [2]. When a sprain is not rehabilitated adequately, residual symptoms such as repeated giving way, recurrent sprains and a lasting sense of instability may follow; together these are termed chronic ankle instability (CAI).

Functional instability can be present with or without mechanical laxity and is linked to deficits in neuromuscular control [3]. Current models describe CAI as the product of interacting mechanical, sensory-perceptual and motor-behavioural impairments rather than of ligament damage alone [4]. Proprioceptive information reaches every level of the central nervous system and is essential for activating the dynamic restraints that protect a joint [5], so injury to the receptors in the ankle ligaments can blunt this protective control. Rehabilitation frameworks for CAI therefore target the underlying impairments instead of focusing on tissue healing only [6].

Mallakhamb is a traditional Indian sport in which athletes carry out yogic postures, holds and aerial manoeuvres on a vertical wooden pole or a suspended rope. It demands strength, flexibility, balance and coordination, and it is usually practised barefoot, so the feet and toes grip the apparatus while the ankles control body position through transitions and dismounts. Gripping, twisting and landing may therefore expose the ankle to repeated loading, although this has not been measured in the sport. Players begin early and train through adolescence, a period of rising training volume.

Injuries are common among Indian athletes: one regional survey recorded an overall injury prevalence of 48.5%, with lower-limb injuries, including ankle sprains, predominating [7]. For Mallakhamb, a cross-sectional study of 60 rope players in Pune found strains and sprains to be the commonest injuries, mostly at the distal joints of the limbs [8]. We could not identify a study that reports the prevalence of ankle instability, measured with a validated instrument, in Mallakhamb players. International Ankle Consortium recommendations advise using validated self-report tools to identify CAI in research [9]; one such tool is the Cumberland Ankle Instability Tool (CAIT), a nine-item questionnaire scored from 0 to 30, with lower scores indicating greater perceived instability and with good reliability and validity [10]. In a study of 1,036 adolescent athletes aged 14–18 years, CAI was found in 20% and was associated with poorer ankle function and health-related quality of life [11].

Knowing how common ankle instability is among Mallakhamb players would help physiotherapists and coaches judge the size of the problem and plan screening, prevention and rehabilitation. The primary objective of this study was therefore to estimate the prevalence of CAIT-defined ankle instability in Mallakhamb players aged 12–20 years in Pune. As an exploratory secondary objective, we examined how prevalence varied with gender, Mallakhamb type and previous ankle sprain, to provide baseline data for prevention and rehabilitation programmes.

II. RESEARCH METHODOLOGY

2.1 Study design, setting and approvals

This was a cross-sectional observational study carried out at Mallakhamb training centres and clubs in and around Pune, Maharashtra, India. Permission was obtained from the parent institution and from the participating academies, ethical clearance was granted by the institutional ethics committee, and written informed consent was taken from every participant before data collection.

2.2 Participants and sample size

Players were recruited by convenience sampling. Mallakhamb players of either gender aged 12–20 years, with at least one year of training and willing to participate, were eligible. Players with a fracture or surgery in the preceding six months, or with a neurological deficit affecting the upper limbs, lower limbs or both, were excluded so that symptoms could be attributed to the ankle [9,12]. The sample size was calculated as $n = Z^2P(1 - P)/d^2$, where Z = 1.96 for 95% confidence, P is the expected prevalence and d the absolute precision. With P = 10% and d = 5%, the required sample was 139 players.

2.3 Data collection

After the study had been explained, each participant completed a data sheet covering age, gender, height, weight, body mass index (BMI) and dominant leg; Mallakhamb type (pole, rope or both), years of experience, weekly training frequency, session duration, level of participation, warm-up habits and use of ankle support or taping; and ankle injury history (previous sprain, side affected, number of sprains, swelling, medical treatment and physiotherapy). The CAIT was then completed separately for the left and right ankle.

2.4 Outcome measure and case definition

The CAIT has nine items, each answered for the left and the right ankle, and yields a total of 0–30 per ankle; lower scores mean greater self-reported instability. Its internal consistency (Cronbach's $\alpha = 0.83$) and test–retest reliability (0.96) have been reported as satisfactory [10]. A score below 24 in either ankle was classified as ankle instability. Players were further grouped as having left-only, right-only, bilateral or no instability.

2.5 Statistical analysis

Data were analysed with IBM SPSS Statistics for Windows, version 26.0. Continuous variables are summarised as mean (standard deviation, SD), median (interquartile range, IQR) and range, and categorical variables as frequencies and percentages. Normality was assessed with the Shapiro–Wilk test. The primary outcome, prevalence of CAIT-defined ankle instability, is expressed as a percentage with an exact (Clopper–Pearson) 95% confidence interval (CI) and was also calculated by gender, Mallakhamb type, participation level and previous sprain. Associations between instability and categorical characteristics were tested with Pearson's chi-square test, with Cramér's V as the effect size; unadjusted odds ratios (OR) with 95% CI and Fisher's exact p values were obtained for gender and previous sprain. Available observations were used for each analysis, without imputation or exclusion of outliers. The significance level was $p < .05$, and no correction for multiple comparisons was applied.

III. RESULTS

3.1 Participant characteristics

All 139 players had complete CAIT scores for both ankles and were included in the analysis. Males formed the majority (57.55%), and most players were right-leg dominant (74.82%). Players were mainly adolescents (mean age 15.44 years) with a mean of 3.94 years of Mallakhamb experience, training about four days a week for roughly two hours per session. Pole Mallakhamb was practised most often (51.08%), almost all players warmed up before training (99.28%), and ankle support or taping was uncommon (14.39%). Participation level ranged from recreational to national; 43 players (30.94%) competed at district level only and 42 (30.22%) were recreational only (Tables 1 and 2).

Table 1. Categorical characteristics of the participants (N = 139)

Characteristic	Category	n (%)
Gender	Male	80 (57.55)
	Female	59 (42.45)
Dominant leg	Right	104 (74.82)
	Left	35 (25.18)
Mallakhamb type	Pole	71 (51.08)
	Rope	40 (28.78)
	Both	28 (20.14)
Warm-up before training	Yes	138 (99.28)
	No	1 (0.72)
Ankle support or taping	Yes	20 (14.39)
	No	119 (85.61)

Table 2. Physical and training characteristics of the participants (N = 139)

Variable	Mean (SD)	Median (IQR)	Range
Age (years)	15.44 (2.63)	15.00 (5.00)	12–20
Height (cm)	150.68 (13.59)	150.00 (19.00)	113–178
Weight (kg)	47.35 (10.94)	46.00 (15.00)	27.9–72.0
BMI (kg/m²)	20.73 (3.23)	20.50 (4.25)	13.7–30.6
Playing experience (years)	3.94 (2.17)	3.00 (3.00)	1–14
Training frequency (days/week)	3.73 (1.16)	3.00 (1.00)	2–7
Session duration (hours)	1.84 (0.36)	2.00 (0.00)	1–3

SD, standard deviation; IQR, interquartile range; BMI, body mass index.

3.2 History of ankle injury

A previous ankle sprain was reported by 99 players (71.22%), who had a mean of 3.32 sprains each (SD 2.35; median 3.00; range 1–13). Among the 98 injured players for whom the side was recorded, the right ankle was involved most often (45.92%). Swelling followed the injury in 51.52%, whereas only 34.34% had received medical treatment and 21.21% physiotherapy (Table 3).

Table 3. History of ankle sprain

Characteristic	Category	n (%)
Previous ankle sprain (N = 139)	Yes	99 (71.22)
	No	40 (28.78)
Side affected (n = 98)	Right	45 (45.92)
	Left	27 (27.55)
	Both	26 (26.53)
Swelling after injury (n = 99)	Yes	51 (51.52)
	No	48 (48.48)
Medical treatment taken (n = 99)	Yes	34 (34.34)
	No	65 (65.66)
Physiotherapy taken (n = 99)	Yes	21 (21.21)
	No	78 (78.79)

Number of sprains per injured player (n = 99): mean 3.32 (SD 2.35), median 3.00 (IQR 2.50), range 1–13.

3.3 Normality and CAIT scores

Age (W = 0.911), playing experience (W = 0.880), left CAIT scores (W = 0.893) and right CAIT scores (W = 0.903) departed significantly from normality (all $p < .001$), whereas BMI did not (W = 0.990, $p = .434$); medians and IQRs are therefore reported alongside means. The mean CAIT score was numerically lower for the right ankle (23.30) than for the left (24.18), but the two sides were not compared statistically (Table 4).

Table 4. Cumberland Ankle Instability Tool (CAIT) scores (N = 139)

Outcome	Mean (SD)	Median (IQR)	Range
Left ankle CAIT	24.18 (5.62)	25.00 (9.00)	7–30
Right ankle CAIT	23.30 (6.20)	24.00 (10.00)	4–30
Lower of the two ankles	21.68 (6.25)	22.00 (10.50)	4–30

Higher scores indicate greater perceived stability; a score below 24 was classified as instability.

3.4 Prevalence of ankle instability

Seventy-nine of the 139 players (56.83%; 95% CI 48.17–65.20) met the criterion for ankle instability. Instability was identified in the left ankle of 52 players (37.41%) and in the right ankle of 59 (42.45%) (Table 5). By side of involvement, 20 players (14.39%) had left-only, 27 (19.42%) right-only and 32 (23.02%) bilateral instability, while 60 (43.17%) had none (Fig. 1). Among the 79 affected players, 40.51% were affected bilaterally, 34.18% on the right only and 25.32% on the left only.

Table 5. Prevalence of CAIT-defined ankle instability (N = 139)

Outcome	Instability, n	Prevalence (%)	95% CI (%)
Overall (either ankle)	79	56.83	48.17–65.20
Left ankle	52	37.41	29.36–46.01
Right ankle	59	42.45	34.11–51.11

CI, exact (Clopper–Pearson) confidence interval.

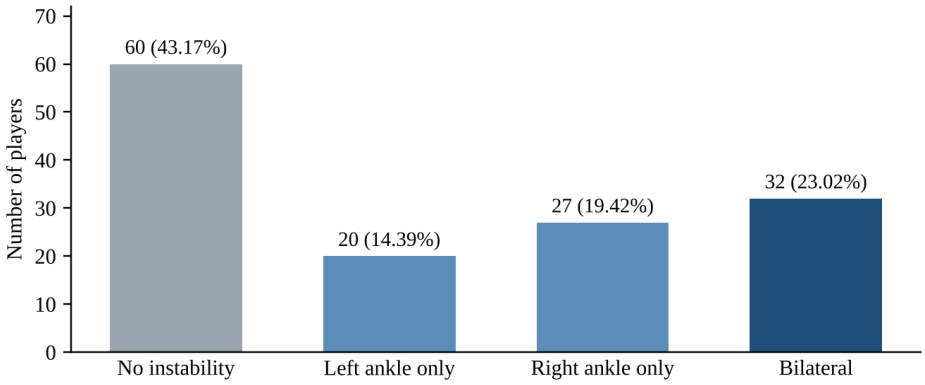

Fig. 1. Distribution of ankle instability by side of involvement (N = 139)

3.5 Prevalence by participant characteristics

Prevalence was 58.75% in males and 54.24% in females. By Mallakhamb type it was highest in rope players (65.00%), followed by pole players (60.56%) and players of both types (35.71%). The difference by previous sprain was large: 77.78% of players with a previous sprain screened positive, against 5.00% of those without (Table 6, Fig. 2).

Table 6. Prevalence of ankle instability by participant characteristics

Characteristic	Category	n/N	Prevalence (%)	95% CI (%)
Gender	Male	47/80	58.75	47.18–69.65
	Female	32/59	54.24	40.75–67.28
Mallakhamb type	Pole	43/71	60.56	48.25–71.97
	Rope	26/40	65.00	48.32–79.37
	Both	10/28	35.71	18.64–55.93
Previous ankle sprain	Yes	77/99	77.78	68.31–85.52
	No	2/40	5.00	0.61–16.92

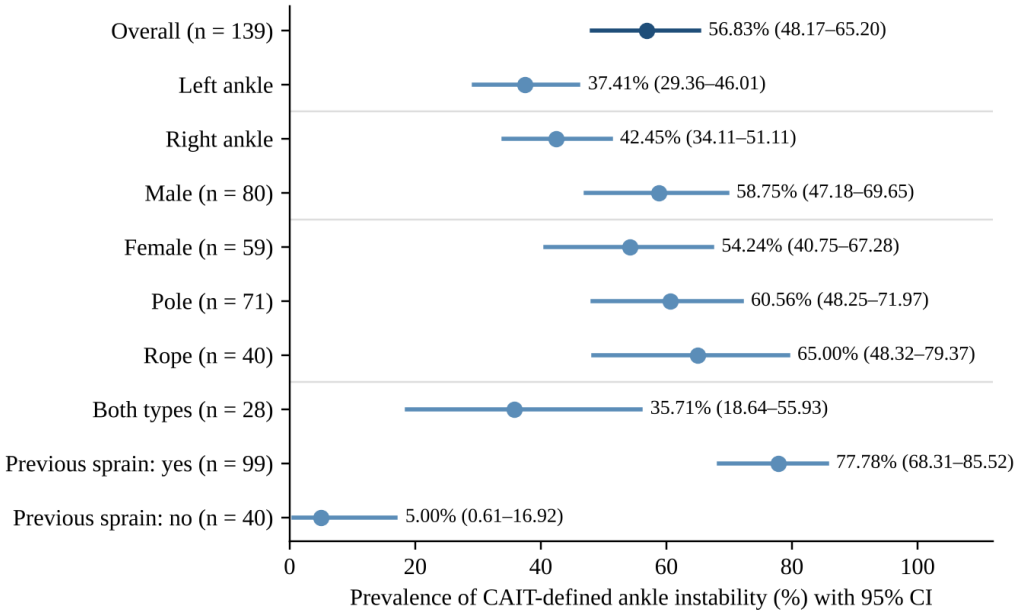

Fig. 2. Prevalence of ankle instability with 95% confidence intervals, overall and by subgroup

3.6 Associations with ankle instability

Ankle instability was significantly associated with Mallakhamb type, $\chi^2(2, N = 139) = 6.581$, $p = .037$, Cramér's $V = 0.218$, and with previous ankle sprain, $\chi^2(1, N = 139) = 61.508$, $p < .001$, $V = 0.665$; no association with gender was detected, $\chi^2(1, N = 139) = 0.282$, $p = .595$, $V = 0.045$. Players with a previous sprain had much higher odds of instability (OR 64.05, 95% CI 14.68–588.99, $p < .001$), although the very wide interval shows imprecision, because only two players without a previous sprain screened positive. The odds ratio for male versus female players was 1.20 (95% CI 0.58–2.50, $p = .608$) (Table 7).

Table 7. Association of participant characteristics with ankle instability

Variable	χ^2	df	p	Cramér's V	Unadjusted OR (95% CI)
Gender	0.282	1	.595	0.045	1.20 (0.58–2.50)*
Mallakhamb type	6.581	2	.037	0.218	—
Previous ankle sprain	61.508	1	< .001	0.665	64.05 (14.68–588.99)†

*Male versus female (reference: female), Fisher's exact p = .608. †Yes versus no (reference: no), Fisher's exact p < .001.

3.7 Age and training characteristics by instability status

Players with ankle instability were older on average (16.33 versus 14.26 years) and had slightly more playing experience (4.17 versus 3.64 years). Weekly training frequency was numerically lower in this group, and session duration was similar (Table 8). These comparisons are descriptive; no inferential tests were performed on them.

Table 8. Age and training characteristics by ankle instability status, mean (SD)

Variable	No instability (n = 60)	Instability (n = 79)
Age (years)	14.26 (2.20)	16.33 (2.60)
Playing experience (years)	3.64 (2.04)	4.17 (2.24)
Training frequency (days/week)	3.90 (1.36)	3.60 (0.97)
Session duration (hours)	1.81 (0.38)	1.87 (0.35)

IV. Discussion

This study set out to establish how common ankle instability is among Mallakhamb players aged 12–20 years. Using a CAIT score below 24 in either ankle, 56.83% of the 139 players (95% CI 48.17–65.20) screened positive, and almost one in four (23.02%) were affected in both ankles. To our knowledge, CAIT-based prevalence has not been described for this sport before; the nearest available evidence is a report of general musculoskeletal injuries in rope Mallakhamb, in which sprains and strains were common [8].

The estimate is much higher than the 20% CAI prevalence found in a large sample of adolescent athletes who played mainly basketball, football and volleyball [11]. The two figures cannot be compared directly. That study used a different questionnaire and case definition, whereas the present study applied a single CAIT cut-off to a convenience sample drawn from a limited number of training centres, which may over- or under-estimate the true prevalence. Even so, the result is in keeping with the high sprain burden reported for several court and team sports [1,2].

Features of the sport may help explain the finding, although none were measured here and they should be treated as hypotheses. In pole and rope Mallakhamb the feet and toes grip the apparatus, the player often works barefoot, and the foot may be twisted while body weight is carried. Dismounts require the ankle to absorb ground reaction forces, and a poorly controlled landing could overload the joint, particularly when an earlier sprain has not been fully rehabilitated. Because the sport relies on precise foot placement and rapid changes in body position, any lasting loss of proprioceptive and neuromuscular control [4,5] could make recurrent giving way more likely.

A history of sprain was the factor most strongly linked to instability: 77.78% of players with a previous sprain screened positive, compared with 5.00% of those without, and 71.22% of the whole sample reported at least one earlier sprain. Since CAI is by definition a sequel of an index sprain [9], a strong association is expected, and it supports models in which an initial injury leaves persistent sensory and motor impairments [3,4]. The confidence interval of the odds ratio is wide, so the magnitude of the association should be interpreted cautiously.

A further finding was the gap in care. Only 21.21% of players who had sprained an ankle had received physiotherapy, and 34.34% had received any medical treatment. This study cannot show that inadequate rehabilitation caused the instability, but the pattern suggests that injured players are often managed with rest and pain relief alone. Rehabilitation after a sprain should also restore range of movement, strength, balance and neuromuscular control before a return to sport [3,6].

The association with Mallakhamb type (p = .037) was small to moderate in size, and the lower prevalence in players practising both types (35.71%) may reflect differences in age, exposure or selection that were not examined; the subgroups were small and their confidence intervals wide. No association with gender was detected (58.75% in males, 54.24% in females), but the study was not designed to compare genders, and a higher sprain risk in females has been reported elsewhere [1]. Players with instability were on average two years older than those without, which may reflect accumulated exposure and injuries; because this difference was not tested or adjusted for, no conclusion can be drawn from it.

V. Conclusion

More than half of the Mallakhamb players aged 12–20 years in this Pune sample (56.83%) screened positive for ankle instability on the CAIT, and nearly a quarter had bilateral involvement. A previous ankle sprain was reported by most players and was the factor most strongly associated with instability, yet few of those players had received physiotherapy. Ankle instability is therefore an important concern in this population. Because the study is cross-sectional and relies on a self-reported questionnaire, the findings describe association and not causation, but they provide baseline data for future research and for injury-prevention planning in Mallakhamb training programmes.

VI. Clinical Implications

Screening and early identification. Academies could assess ankle stability with the CAIT at the start of a training cycle and after any ankle injury, and refer players scoring below 24 for a full clinical assessment [10]. Other lower-limb injuries and neurological problems should be identified at the same time so that symptoms are attributed correctly [12]. Repeating the questionnaire can also be used to follow progress.

Balance and neuromuscular training. Single-leg standing, work on foam or wobble boards and controlled landing drills may improve proprioception and postural control, with reactive and sport-specific tasks added as the player improves [5,6]. Strengthening of the ankle and intrinsic foot muscles (for example short-foot exercises, toe control and towel curls) should supplement, not replace, this work, because stability depends on several muscles and joints acting together.

Landing technique, support and surfaces. Coaches and physiotherapists can teach landing with adequate hip and knee flexion and good foot alignment, progressing from low-height tasks to sport-specific dismounts under supervision. Players with a history of sprains may benefit from taping or an external support after assessment by a sports physiotherapist, and academies should provide stable, shock-absorbing landing mats suited to the height and skill being practised.

VII. Limitations and Future Scope

Several limitations should be noted. The cross-sectional design assesses instability at one point in time and cannot establish cause and effect. Convenience sampling from selected academies in Pune limits generalisability to other regions. The CAIT is self-reported and subject to recall error and individual perception, and no objective measures of balance, strength, muscle activity or joint laxity were taken. Instability was defined by a single CAIT cut-off, without a confirmatory clinical examination. Differences in training methods, mat and floor conditions and strength programmes were not controlled, the analyses were unadjusted, and several subgroups were small, producing wide confidence intervals.

Future work could follow players prospectively to identify injury patterns and risk factors for CAI, use biomechanical analysis of landing forces, ankle motion and muscle activity during pole and rope dismounts, and test whether balance, strengthening and neuromuscular programmes improve ankle stability and prevent recurrent sprains. The influence of foot structure and joint hypermobility on instability in Mallakhamb players also deserves study, ideally in larger, multi-centre samples.

VIII. Acknowledgment

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