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The Relationship Between Agility Score and Ankle Flexibility and the Risk of Ankle Injury Among Basketball Players at Giovanni Catholic Senior High School Kupang

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ABSTRACT:

Background: Ankle injuries are the most common type of injury experienced by basketball players, mainly due to pressure or rapid twisting forces upon landing after jumping. Agility scores and ankle flexibility are frequently associated with ankle injury risk, however research focused on high school students in Indonesia remains limited.

Objective: This study aimed to investigate the relationship between agility scores and ankle flexibility with ankle injury risk among basketball players at SMA Katolik Giovanni Kupang.

Methods: This analytical observational study used a cross-sectional design involving 43 active basketball players. Agility score was assessed using the Illinois Agility Run Test, ankle flexibility using the Weight Bearing Lunge Test (WBLT), and ankle injury risk using the Foot and Ankle Outcome Score (FAOS). Data were analyzed using Spearman Rank correlation.

Results: Most participants demonstrated poor agility scores (60.5%) and normal ankle flexibility ≥10 cm (88.4%). The mean FAOS was 80.03, indicating low injury risk. No significant relationship was found between agility score and ankle injury risk ($p = 0.954$; $r = 0.009$) or between ankle flexibility and injury risk ($p = 0.794$; $r = -0.041$).

Conclusion: Agility score and ankle flexibility were not associated with ankle injury risk in this population. Further research is recommended to assess proprioception and prior injury history.

KEYWORDS: Agility Score, Ankle Flexibility, Ankle Injury, Basketball, Students.

INTRODUCTION

Ankle injuries, commonly known as ankle sprains, represent the highest incidence of injuries among basketball players. Ankle injuries experienced by basketball players have been recorded at rates of 3.8 to 5.2 per 1,000 players. Particularly among NBA basketball players, who are renowned worldwide, the ankle joint is the most frequently injured, with an incidence exceeding 1,800 cases, accounting for 14.7% of all injuries in a single year.[1] Regarding prevalence, based on a systematic review by Andreoli et al. in 2018, the global number of injuries among basketball players reached 12,960 cases. The majority of these injuries occurred in the lower extremities (63.7%), including 2,832 ankle injuries (21.9%) and 2,305 knee injuries (17.8%). Injuries to the upper body accounted for approximately 12% to 14% of the total injuries.[3] In Indonesia, nearly all basketball players have experienced injuries while playing basketball.[4] Additionally, 77% of ankle injuries occur among soccer players, while 91% occur among basketball players.[5]

Ankle injuries pose a common issue among basketball players, primarily resulting from sudden pressure or rapid twisting forces, which lead to difficulties in maintaining body balance. This is associated with challenges in agility.[6] Furthermore, ankle injuries are also attributable to limited flexibility due to muscle and joint tension, which heightens the risk of injury from high-intensity repetitive movements, such as acceleration, deceleration, and landing after jumping.[7]

Previous studies have demonstrated a significant association between agility and flexibility with the risk of ankle injuries. A study by Sari et al. in 2023 on child-category soccer players indicated that low agility scores and ankle flexibility are associated

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with a higher risk of injury.[8] Another study by Anniza and Iskandar in 2022 revealed a relationship between agility and injury risk, where participants with excellent agility exhibited a low risk of injury, whereas those with poor agility tended to have a high risk of injury.[9]

Based on the gaps in prior research, studies examining the relationship between agility scores and ankle flexibility with the risk of ankle injuries among basketball players—particularly high school students in Indonesia—remain limited. Therefore, the researchers are interested in conducting a study on the relationship between agility scores and ankle flexibility with the risk of ankle injuries among basketball players at SMA Katolik Giovanni Kupang to address these gaps in the existing literature.

METHODS

This study employed a quantitative, observational analytic research design with a cross-sectional approach to examine the relationship between agility scores and ankle flexibility with the risk of ankle injuries among basketball players at SMA Katolik Giovanni Kupang. The temporal approach utilized in this study was cross-sectional. The research was conducted in September 2025 at the basketball court of SMA Katolik Giovanni Kupang. All active basketball players at SMA Katolik Giovanni Kupang were included in the study population, utilizing a total sampling approach to ensure comprehensive data collection. Exclusion criteria included students undergoing injury rehabilitation or having conditions that restricted physical movement, such as fractures or pain. Out of the total population of 45 students, two were excluded due to specific medical conditions, resulting in 43 eligible participants for the study.

The independent variables in this study were agility scores and ankle flexibility, while the dependent variable was the risk of ankle injuries. Agility scores were measured using the Illinois Agility Run Test. Ankle flexibility was assessed with the Weight-Bearing Lunge Test (WBLT). The risk of ankle injuries was evaluated using the Foot and Ankle Outcome Score (FAOS) questionnaire. Data analysis was conducted using univariate and bivariate analyses. Normality testing employed the Shapiro-Wilk test, given that the sample size was less than 50. Univariate analysis was used to present the data distribution for each variable, while bivariate analysis was employed to assess the relationships between the variables. Due to the presence of non-normally distributed variables and differences in data scales, the relationships between the variables were analyzed using Spearman's rank correlation test, with a significance level of $p < 0.05$.

RESULTS

Table 1. Characteristics of Respondents

Variable	*Frequency*	*Precentage (%)*
Gender		
Male	20	46.5
Female	23	53.5
Age (Years)		
14	2	4.7
15	19	44.2
16	14	32.6
17	8	18.6
Training Frequency		
1-2 times/week	8	18.6
>2 times/week	35	81.4

As illustrated in Table 1, the sample comprised 20 males (46.5%) and 23 females (53.5%). Regarding age distribution, two participants (4.7%) were 14 years old, 19 (44.2%) were 15, 14 (32.6%) were 16, and eight (18.6%) were 17 years of age. In terms of training frequency, the majority of respondents engaged in basketball training more than twice per week, totaling 35 indiv iduals (81.4%), while the remaining 8 individuals (18.6%) engaged in basketball training 1-2 times per week.

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Table 2. Agility Scores Among Basketball Players at SMA Katolik Giovanni Kupang

Agility	*Frequency (n)*	*Precentage (%)*
Average	8	18.6
Fair	9	20.9
Poor	26	60.5
Total	4	100

Table 2 indicates the agility scores among 43 basketball player respondents. Eight individuals (18.6%) had agility scores in the average category, 9 individuals (20.9%) had agility scores in the fair category, and 26 individuals (60.5%) had agility scores in the poor category. These data demonstrate that the majority of respondents had agility scores in the poor category.

Table 3. Ankle Flexibility Among Basketball Players at SMA Katolik Giovanni Kupang_

Ankle Flexibility	*Frequency (n)*	*Precentage (%)*
≥10 cm	38	88.4
<10	cm5	11.6
Total	43	100

Table 3 indicates the ankle flexibility among 43 basketball player respondents is shown. Thirty-eight individuals (88.4%) had ankle flexibility values ≥10 cm, indicating normal ankle flexibility, whereas the remaining 5 individuals (11.6%) had ankle flexibility values < 10 cm.

Table 4. Statistical Values Based on Ankle Injury Risk Scores

Frequency (n)	*Mean*	*Median*	*Mode*	*SD*	*Min*	*Max*
43	80.03	79.76	81.55	10.43	53.57	98.81

Based on the data in Table 4, the mean ankle injury risk score is 80.03, with a median of 79.76 and a mode of 81.55. The minimum ankle injury risk score is 53.57, and the maximum is 98.81. The standard deviation of 10.43 indicates a moderate data spread, signifying sufficient variation among the ankle injury risk scores while the values generally cluster around the mean.

Table 5. Correlation Test Results of Agility Score and Ankle Flexibility on Ankle Injury Risk

Parameter	*Agility Score*		*Ankle Flexibility*		*N*
Ankle Injury Risk	ρ	r	ρ	r	43
	0.954	0.009	0.794	–0.041	

Correlation analysis presented in Table 6 shows no statistically significant relationship between ankle injury risk and either agility scores (r = 0.009; p = 0.954) or ankle flexibility (r = -0.041; p = 0.794). In both instances, the correlation coefficients indicate a very weak association based on standard strength criteria (r < 0.2).

DISCUSSION

The results of this study showed that the majority of respondents were classified in the *Poor* category for agility score (60.5%), despite the fact that most participants (81.4%) were active basketball players who trained more than twice per week. This finding indicates a discrepancy between training exposure and test performance, warranting further in-depth analysis. In this context, a low agility score does not necessarily reflect impaired motor capacity but may represent a form of protective neuromuscular inhibition triggered by the environmental conditions under which the test was conducted. The Illinois Agility Run requires high neuromuscular demands, as it involves activation of the stretch–shortening cycle (SSC) of the lower limb muscles to generate

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explosive power during rapid changes of direction.[9] The SSC is a mechanism in which a muscle undergoes a brief lengthening phase immediately prior to a forceful contraction, allowing greater force production during fast movements such as cutting and directional changes. When the test is performed on an outdoor concrete surface with a lower coefficient of friction compared to standard testing surfaces, the sensory input received by the central nervous system is altered. A more slippery surface stimulates mechanoreceptors in the plantar surface of the foot and proprioceptors in the talocrural joint, signaling potential instability of foot contact.

These sensory signals are processed by the central nervous system as a threat to postural stability. As a protective response, a reduction in motor unit recruitment occurs, causing basketball players to subconsciously decrease their movement speed, particularly when approaching turning zones. Consequently, a lower agility score more accurately reflects an adaptive strategy aimed at preserving joint integrity and preventing injury, rather than indicating pathological neuromuscular dysfunction or muscle weakness.[10] The findings further demonstrated that agility score was not associated with the risk of ankle injury ($p = 0.954$). This suggests that an athlete's ability to move quickly and change direction does not necessarily correspond to the likelihood of sustaining an ankle injury. This can be explained by the fact that agility and ankle injury originate from distinct physiological mechanisms. Agility primarily depends on coordination and movement speed, whereas ankle injuries—particularly involving the anterior talofibular ligament (ATFL)—typically occur during excessive and sudden ankle motions, such as improper landing mechanics.[11]

This explanation is consistent with the findings of Shenhar et al. (2025), who reported that joint position sense (proprioception) plays a more critical role in injury prevention than agility or speed. Shenhar et al. concluded that asymmet ry in agility performance cannot be considered a risk factor for ankle injury. Reduced proprioception is commonly observed in individuals with chronic ankle instability (CAI). Adequate proprioceptive function is essential for maintaining joint stability during dynamic activities, particularly when weight-bearing on uneven surfaces. Ankle sprains may damage proprioceptors located within periarticular ligaments and muscle spindles of the ankle, leading to impaired proprioceptive function.[10] In individuals with CAI, alterations in motor control following mechanoreceptor damage may compromise postural stability, reduce proprioceptive-related functional capacity, and impair the ability to respond effectively to unexpected perturbations, such as rapid and accurate changes of direction.[1] Ankle injuries can affect multiple tissue structures, including the capsuloligamentous complex, resulting in damage to mechanoreceptors. This damage may lead to proprioceptive deficits, such as impaired kinesthesia, reduced joint position sense, and degenerative changes within the joint. These conditions contribute to deficits in both mechanical and functional stability, thereby increasing the risk of recurrent injury. Repeated microtrauma and recurrent ankle sprains may subsequently limit daily activities and athletic performance.[13]

Furthermore, the Foot and Ankle Outcome Score (FAOS) used to assess ankle injury risk showed a mean value of 80.03, indicating that most respondents had good ankle function. This favorable baseline condition likely reduced the overall probability of ankle injury occurrence during the study period.

Players with lower agility scores may generate smaller torsional forces and momentum at the ankle joint. Slower movement speeds reduce joint loading, thereby decreasing the likelihood of excessive inversion torque that can precipitate injury.[11] This biomechanical consideration further explains why agility score was not associated with ankle injury risk in a population with relatively healthy ankle conditions. The study also found that ankle flexibility was not associated with ankle injury risk ($p = 0.794$). This finding aligns with the concept that joints function optimally when flexibility remains within a normal physiological range. In the present study, approximately 88.4% of respondents demonstrated normal ankle flexibility (≥10 cm), resulting in minimal variability that could influence injury risk. These findings are consistent with the study by Farley et al. (2020), which reported no significant association between flexibility and ankle sprain incidence.[11] Ankle stability is determined by both passive stabilizing structures, such as ligaments and joint capsules, and active stabilizers, including muscles responsible for dynamic control, such as the peroneus longus and peroneus brevis. Injuries are more likely to occur when a joint is either excessively stiff or overly lax. Because most respondents exhibited normal ankle flexibility, this variable did not serve as a distinguishing factor for injury risk. Shahi et al. (2020) also emphasized that flexibility alone is not a primary determinant of ankle sprain occurrence. Shahi et al. identified recurrent and acute ankle sprain history as the strongest predictors of ankle injury. Additionally, every 5-year increase in age and every 5-cm increase in height were found to significantly predict ankle sprain risk. Several studies within their analysis further confirmed that ankle dorsiflexion range of motion and overall ankle mobility do not reliably predict ankle sprain.[14]

A history of recurrent ankle sprains increases the risk of subsequent injuries due to repeated ligament stretching or tearing,

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which may result in prolonged ligamentous laxity and contribute to the development of CAI.[15] A systematic review by Wikstrom et al. (2021) explained that the risk of recurrent lateral ankle sprain (LAS) and the development of chronic ankle instability are influenced by multiple interrelated factors, many of which are direct consequences of the initial LAS or repeated prior injuries. For example, a history of LAS has been shown to reduce ligament structural integrity and impair sensorimotor function, potentially diminishing an individual's ability to avoid high-risk injury situations. Furthermore, evidence indicates that individuals with CAI exhibit altered sensory processing and impaired responses to fatigue, further limiting their capacity to mitigate injury risk.[16] Under these conditions, other factors—such as neuromuscular control and prior injury history—play a more substantial role in determining ankle injury risk. A history of ankle injury can weaken ligamentous structures, thereby increasing susceptibility to recurrent injury.

CONCLUSION

1. The results indicate that neither agility scores ($p = 0.954$) nor ankle flexibility ($p = 0.794$) are significantly correlated with the risk of ankle injury in this population.
2. The majority of basketball players at SMA Katolik Giovanni Kupang demonstrated poor agility, with 60.5% classified in the poor agility score category.
3. Most basketball players at SMA Katolik Giovanni Kupang exhibited normal ankle flexibility (≥10 cm), accounting for 88.4% of the participants.
4. Overall, the risk of ankle injury among basketball players at SMA Katolik Giovanni Kupang was low, with a mean Foot and Ankle Outcome Score (FAOS) of 80.03.

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