The Slippery Take-off Board: An Overlooked Safety Issue in the Long Jump

Nelio Alfano Moura, [1 2 3] **Tania Fernandes de Paula Moura,** [2 3] **Larissa de Paula Moura** [2 3]

[1]Esporte Clube Pinheiros
[2]Centro de Excelência Esportiva – SESP
[3]M&M Atletismo - Brasil

Long jump | Take-off board | Athlete safety | Shoe-surface friction

Headline

The long jump is one of the most longstanding events in athletics. Its origins can be traced to the ancient Olympic Games, where it formed part of the pentathlon, introduced in 708 BCE[1]. At that time, athletes took off from an area marked by an element known as the *báter* and landed in an excavated and prepared area of soil called the *skámma*[1,2]. The men's long jump has been included in the modern Olympic program since 1896. As athletics evolved, the use of a take-off board, traditionally made of wood and installed flush with the runway surface, became established practice. However, the transition from dirt or cinder runways to synthetic surfaces raises an important question: to what extent has the take-off board evolved alongside advances in runway technology, particularly regarding athlete safety?

According to the current World Athletics rules, "*the take-off board shall be rectangular, made of wood or other suitable rigid material in which the spikes of an athlete's shoe will grip and not skid and shall measure 1.22m ± 0.01m long, 0.20m ± 0.002m wide and not more than 0.10m deep. It shall be white. In order to ensure that the take-off line is clearly distinguishable and in contrast to the take-off board, the ground immediately beyond the take-off line or any blanking board shall be in a colour other than white*"[3]. Although the rules permit the use of any suitable rigid material, wood remains the material traditionally used to manufacture take-off boards. The rules require the material to provide grip for shoe spikes and prevent slipping, but do not specify quantitative criteria for evaluating this property, such as minimum slip-resistance values or coefficients of friction. The absence of quantitative criteria hinders objective assessment of take-off board safety under different conditions of use. Although such criteria are not specified for take-off boards, they are established for synthetic track and runway surfaces[4].

There is a factor that may expose athletes to risk, even when the take-off board complies with the technical rules. Athletes typically initiate take-off with brief initial ground contact by the heel, or rearfoot (Figure 1).

Shear forces reach their peak during heel strike and push-off, making these phases particularly susceptible to slipping. However, heel strike is especially critical, as a slip at this point may lead to a fall. Consequently, the magnitude of the forces generated at initial heel contact plays a key role in determining whether the friction available at the shoe–surface interface is adequate to prevent slipping.[5]

Because an elite athlete's shoe length (˜25–30 cm) exceeds the 20 cm board width, valid jumps where the toe approaches the foul line naturally place the heel on the synthetic runway behind the board, whereas contact with the board is made by the spike-bearing forefoot region of the shoe sole. However, foul attempts are common in international long jump competitions. World Athletics reported that approximately one-third of the jumps at the 2023 World Championships in Budapest were fouls (`https://www.flashscore.com/news/long-jump-trial-planned-to-eliminate-foul-jumps-after-record-foul-attempts-at-world-championships/EaaPriW1/`, accessed 23 October 2026), although this proportion may vary across competitions and athlete populations[6,7]. In some foul attempts, initial ground contact occurs directly on the board rather than on the runway, through the rearfoot region of the shoe, which generally has no spikes (Figure 2). Under these circumstances, grip may depend predominantly on friction between the shoe sole and the board surface, potentially increasing the risk of slipping, particularly under unfavorable conditions, such as when the board is dirty or wet. Thus, even a board that complies with the technical rules may not provide adequate grip under all conditions encountered in real life. Dowling et al. (2010)[8] demonstrated that differences in shoe–surface coefficients of friction affect movement kinematics, joint moments and movement strategies, while Vidal et al.[9] stated that friction between surfaces plays an important role for human motion pattern, safety and performance in running and walking. Although these studies did not specifically examine the long jump, their findings support the view that surface friction is an important safety consideration.

Athletes approach the take-off board at speeds exceeding 9 m/s in the women's long jump and potentially exceeding 11 m/s in the men's event[10–12]. During take-off, peak vertical ground reaction forces may reach up to 16.4 times body weight[13], within a ground contact phase lasting slightly more than one-tenth of a second[14]. Under these conditions, slipping may compromise support stability and the athlete's ability to control and transmit the forces involved in take-off, potentially increasing the risk of serious injury.

Aim of the paper

This study aims to investigate potential mechanisms underlying slipping episodes on the long jump take-off board through an analysis of selected cases identified by the authors. The analysis seeks to identify factors that may contribute to these episodes and to propose measures to reduce the risk of slipping, thereby informing improvements to safety criteria for take-off boards.

Identified Cases of Slipping on the Long Jump Take-off Board

Table 1 presents selected episodes of slipping on the take-off board during the take-off phase of the long jump. This non-exhaustive list is limited to cases known to the authors and documented in photographs or videos that allow the circumstances of the slipping episodes to be examined. Analysis of these records aims to identify common features across the selected episodes, providing insight into potential underlying mechanisms and informing the development of preventive measures.

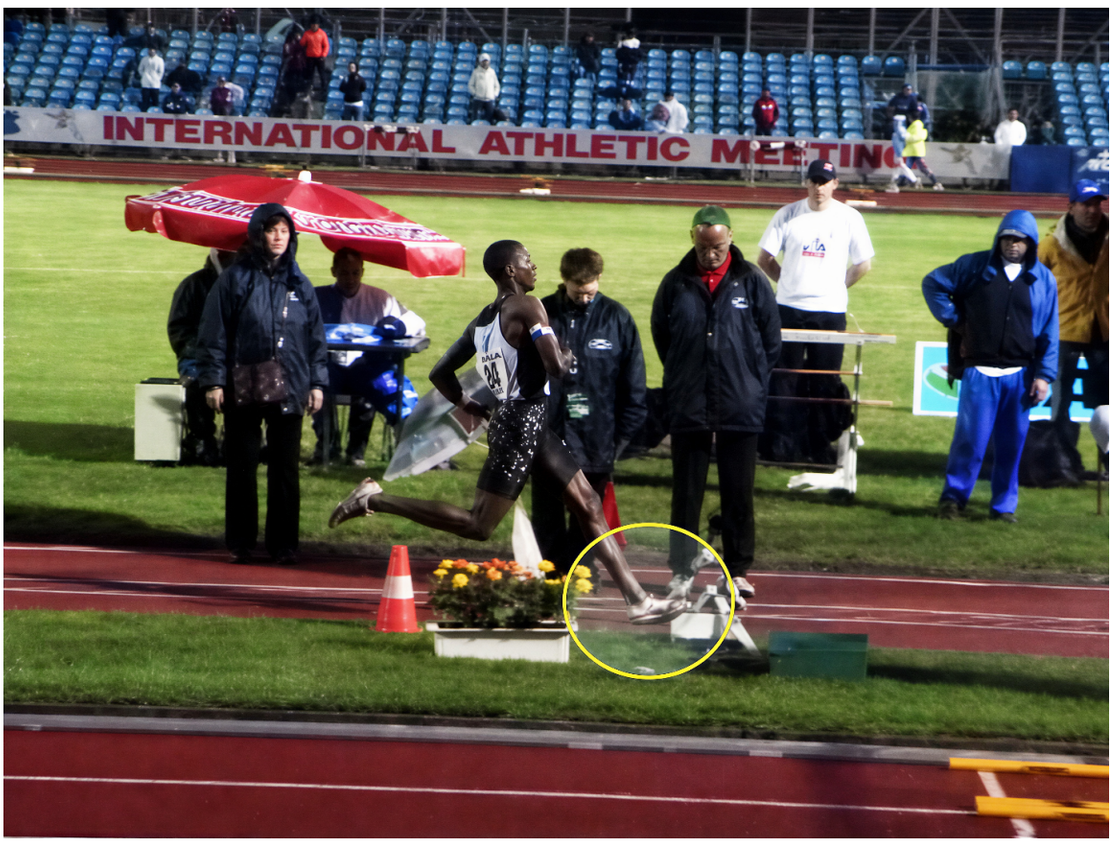


Fig. 1. **Initial rearfoot contact of the take-off foot with the runway behind the take-off board during a valid long jump attempt. The image was generated using artificial intelligence (Manus AI 1.6) based on video footage of an 8.45 m jump performed in rainy conditions in Zagreb in 2007.**



Fig. 2. **Rearfoot contact with the take-off board during a foul long jump attempt, immediately preceding a slipping episode. Image generated using artificial intelligence (ChatGPT) based on video footage of an actual jump (case #9 in Table 1).**

Table 1. Selected episodes of slipping on the take-off board during the take-off phase of the long jump.

Case	Competition	Year	Season best (m)	Foul(Y/N)	Contact with the board	Rain(Y/N)	Continued competing (Y/N)	Notes *
#1 Female	IAAF World Championships Tokyo (JPN)	1991	7.32	Y	Rearfoot, simultaneous runway contact	N	Y	-
#2 Male	Diamond League Shanghai (CHN)	2018	8.43	Y	Rearfoot	Y	N	Multiple foot injuries; Surgery
#3 Male	GP Brasil São Paulo (BRA)	2023	8.10	Y	Rearfoot	N	N	Knee ligament sprain; Physiotherapy
#4 Female	World Athletics Championships Budapest (HUN)	2023	6.97	Y	Rearfoot	N	Y	-
#5 Male	World Athletics Championships Budapest (HUN)	2023	8.42	Y	Rearfoot	N	Y	-
#6 Male	World Athletics Championships Budapest (HUN)	2023	8.40	Y	Rearfoot	N	Y	-
#7 Male	Street Long Jump Piraeus (GRE)	2024	8.65	Y	Rearfoot	N	Y	-
#8 Male	FBK Games Hengelo (NED)	2025	8.07	Y	Rearfoot	N	N	-
#9 Female	Troféu Brasil São Paulo (BRA)	2026	6.75	Y	Rearfoot	N	N	Ankle ligament rupture; Surgery
#10 Female	Ultimate Championships Budapest (HUN)	2026	7.09	Y	Rearfoot	N	Y	-
#11 Male	Asian Games Nagoya (JPN)	2026	8.38	Y	Rearfoot	Y	N	Ankle ligament rupture; Surgery

Notes: Cases were selected based on the availability of audiovisual records, without systematic sampling. The list may therefore be subject to selection bias and does not permit estimation of incidence or relative risk.
** Clinical diagnoses (injuries, physiotherapy, and surgeries) were sourced from published athlete interviews or social media publications.*

Given the use of a convenience sample, these cases do not permit estimation of the incidence of slipping episodes or, on their own, establishment of causal relationships.

The athletes' season-best performances indicate that all competed at the international elite level. All identified slipping episodes occurred during foul attempts, 10 of them with initial ground contact made by the rearfoot directly on the take-off board. Moreover, 9 of the 11 incidents (81.8%) occurred under dry conditions, suggesting that loss of grip may be related to the sole–wood interface rather than exclusively to rain.

The authors identified no slipping episodes when rearfoot contact occurred only on the runway immediately behind the take-off board or when athletes took off entirely before the board after misjudging their approach. The available observations also do not indicate that taking off without contacting the board necessarily reduces the actual distance achieved. Case #9 provides an illustrative example. The athlete's best attempt that day was 6.62 m, with a 5 cm gap between the take-off point and the foul line. In another attempt, the athlete recorded 6.15 m after taking off 55 cm before the foul line, without contacting the board nor showing any signs of slipping. The actual distances of these two attempts, 6.67 m and 6.70 m, respectively, were similar, suggesting that board contact may not have influenced the outcome in this instance. The gaps between the take-off point and the foul line were estimated analyzing 120 fps video footage of the attempts with Kinovea®. However, this comparison is observational and does not account for other factors that may have differed between the two valid attempts and the attempt involving slipping, including approach speed, contact angle, force distribution and foot trajectory. Nevertheless, the comparison supports the need to investigate the interaction between the shoe, the runway and the take-off board surface.

Some of the listed episodes had no major consequences, and the athletes continued competing in subsequent attempts. In several cases, however, injuries of varying severity prevented further participation in the competition and, in some instances, required surgical intervention of varying complexity. The most severe case reported was case #2: the athlete returned to long jump competition only three years after the injury and required a further year to regain international elite-level performance (`https://worldathletics.org/athletes`, accessed 22 October 2026).

Discussion

Analysis of the identified cases suggests an association between slipping episodes in the long jump and rearfoot contact with the take-off board during foul attempts. Foul attempts and rearfoot contact on the board should not necessarily be interpreted as isolated technical errors; rather, they may represent foreseeable consequences of visual regulation of the approach run. As demonstrated by McCosker et al. (2021)[6], athletes continuously adjust their strides throughout the approach, but in some cases late corrections may be disproportionately concentrated within the final four steps before the board. These last-minute adjustments may be insufficient to achieve a valid attempt[7], potentially bringing the smooth rearfoot region of the shoe sole into contact with the wooden board.

During the initial milliseconds of ground contact, the vertical ground reaction force is still rising[15]. When initial contact occurs through the rearfoot or heel directly on the wooden board, grip depends on friction between the shoe sole and the wood, rather than on spike engagement. Because the vertical force is relatively low at the onset of contact, the horizontal braking demand may exceed the available frictional resistance,

potentially triggering immediate slipping before peak vertical force is reached. This represents a plausible mechanism, rather than one confirmed by direct force or friction measurements in the present cases.

Reported foul-attempt rates in high-level international competitions range from 30% to 43.8%[6,7], while psychological factors, including anxiety and competitive stress, affect approach-run consistency[7]. These considerations highlight the importance of ensuring that the take-off board provides adequate friction during rearfoot contact, with the aim of protecting athletes even during foul attempts.

The modernization of athletics facilities has introduced a marked technological discontinuity within horizontal jump runways. World Athletics (2020)[4] specifies quantitative requirements for synthetic runway surfaces, including acceptable limits for shock absorption, vertical deformation, thickness and coefficient of friction. In contrast, Technical Rule 29.1[3] permits take-off boards made of wood or another suitable rigid material and specifies dimensions and a general requirement for shoe spikes to grip without skidding but provides no quantitative friction criteria. This abrupt transition between materials occurs at a point of high mechanical loading, potentially creating a gap in both regulatory requirements and surface grip during a critical phase of the jump.

The World Athletics Technical Rules should be revised to incorporate mandatory quantitative slip-resistance criteria for the take-off board surface. Validation of board materials or surface coatings should use standardized laboratory and field testing methods aligned with the requirements for synthetic track certification[4]. The regulatory objective should be to achieve static and dynamic coefficients of friction at the interface between spike-free regions of the shoe sole and the take-off surface comparable to those of the adjoining synthetic runway, while ensuring adequate grip during both spike engagement and unintended rearfoot contact.

Practical applications: Recommendations for improving athlete safety

In light of the identified episodes and the potential limitations of the current technical specifications, World Athletics should consider the following measures to reduce the risk of slipping on the take-off board:

- **Prioritize evaluation of the same synthetic material used on the runway for the take-off surface.** The feasibility of replacing the traditional board surface with the material used on the runway should be investigated, with the aim of improving grip for spike-free regions of the shoe sole. This option could be considered an interim risk-reduction measure for short-term implementation, provided that comparative testing and biomechanical assessments demonstrate adequate grip, spike engagement, durability and safety, without compromising take-off execution or application of the event rules.
- **Establish quantitative mechanical performance criteria and a testing and certification program.** Requirements should address slip resistance at the shoe–take-off surface interface, shoe engagement and grip throughout the contact area, including spike-free regions of the sole. Testing should encompass different shoe models, surface materials, environmental conditions and levels of wear. The findings should inform objective acceptance thresholds and certification requirements applicable regardless of the construction method or surface solution adopted.
- **Implement inspection, maintenance and incident-reporting procedures.** Protocols should be established to assess surface conditions before competitions and following rain or other potentially adverse conditions. These should include cleaning, identification of damage and criteria for withdrawing unsuitable equipment from use. In parallel, systematic recording of slipping episodes and accidents in the take-off area should be encouraged, documenting environmental conditions, the equipment involved, available audiovisual records and observed consequences. These data would support identification of factors associated with incidents and evaluation of the effectiveness of preventive measures.

Conclusion

The episodes presented in this paper highlight the need to investigate and reduce the risk of slipping on the long jump take-off board. Although the available records do not permit causal inference or estimation of the incidence of these events, they raise important questions about whether the current specifications provide adequate grip under all shoe–surface contact conditions encountered during take-off.

As a priority, World Athletics should evaluate the feasibility of using the same synthetic material as the runway on the take-off surface, particularly to improve grip when contact occurs through spike-free regions of the shoe sole. This option should undergo comparative testing and biomechanical assessment to verify its safety and compatibility with the technical requirements of the event. Particular attention should be given to how increased vertical deformation beneath the take-off foot might affect mechanical energy return, spike penetration mechanics, and take-off kinematics.

In parallel, quantitative performance criteria, standardized testing methods, and inspection and monitoring procedures should be established. The objective is not to alter the technical nature of the long jump, but to reduce potentially avoidable risks through practical solutions, verifiable requirements and evidence-based decisions. Given the severity of the consequences associated with some of the reported episodes, investigation of these alternatives should be treated as a safety priority in athletics.

AI Use Statement

Artificial intelligence tools were used to assist with language editing and refinement (ChatGPT, MS Copilot, Gemini Notebook and Google Deep Review), as well as to enhance the visual presentation and clarity of Figure 1 (Manus AI) and Figure 2 (ChatGPT), without altering the athletes' positions. All AI-assisted text and figures were critically reviewed and verified by the authors. The authors retained full responsibility for the scientific content, methodological decisions, conduct and accuracy of the analyses, and interpretation of the findings. No AI tools were used to generate, fabricate, or manipulate any data.

Ethics Statement

This retrospective study was based on publicly available broadcast records of athletic competitions, with no direct interaction with participants, intervention, or collection of private or confidential information. As the analysis involved the examination of publicly accessible competition footage, formal ethical approval was considered not applicable. Nevertheless, the study was conducted in accordance with the principles of the Declaration of Helsinki, although complete anonymity could not be guaranteed, given the participants' characteristics.

References

1. Matthiesen, S. Q. & Freitas, F. P. R. de. *História Dos Saltos*. (Fontoura Editora Ltda., Várzea Paulista, 2017).

2. The Open University. *The Ancient Olympics: Bridging past and present.* https://www.open.edu/openlearn/history-the-arts/the-ancient-olympics-bridging-past-and-present. Accessed on November 14th 2026 (2016).

3. World Athletics. *Competition and Technical Rules 2026 Edition.* (World Athletics, Monaco Cedex, 2026).

4. World Athletics. *Certification System. Track and Runway Synthetic Surface Testing Specifications.* (World Athletics, Monaco Cedex, 2020).

5. Redfern, M. S. *et al.* Biomechanics of slips. *Ergonomics* **44**, 1138–1166 (2001).

6. McCosker, C., Renshaw, I., Polman, R., Greenwood, D. & Davids, K. Run-up strategies in competitive long jumping: How an ecological dynamics rationale can support coaches to design individualised practice tasks. *Hum. Mov. Sci.* **77**, 102800 (2021).

7. Moura, L. de P., Moura, N. A., Moura, T. F. de P., Moura, T. B. M. A. & Brandão, M. R. F. Jumping with Control: The Interplay Between Psychological Constructs and Run-Up Variability in Elite Jumpers. *Front. Psychol.* **15**, 1412910, 1–15 (2024). https://doi.org/10.3389/fpsyg.2024.1412910

8. Dowling, A. V., Corazza, S., Chaudhari, A. M. W. & Andriacchi, T. P. Shoe-Surface Friction Influences Movement Strategies during a Sidestep Cutting Task. *American Journal of Sports Medicine* **38**, 478–485 (2010).

9. Vidal, A. B., Monezi, L. A., Sarro, K. J. & Barros, R. M. L. De. Analysis of required coefficient of friction in running and walking. *Sports Biomech.* **20**, 768–780 (2021).

10. Crotty, J., Stanley, P., Akinsanya, F., Graham-Smith, P. & Jones, P. *2012 Olympic Games Report: Long Jump.* (England Athletics, 2012).

11. Koyama, H., Ae, M., Muraki, Y., Yoshihara, A. & Shibayama, K. Biomechanical analysis of the men's and women's long jump at the 11th IAAF World Championships in Athletics, OSAKA 2007: A brief report. *Bulletin of Studies in Athletics of JAAF* **5**, 107–118 (2009).

12. Moura, N. A., de Paula Moura, T. F. & Borin, J. P. Approach speed and performance in the horizontal jumps: What do Brazilian athletes do? *New Studies in Athletics* **20**, 43–48 (2005).

13. Hay, J. G. Citius, Altius, Longius (Faster, Higher, Longer): The Biomechanics of Jumping for Distance. *J. Biomech.* **26**, 7–21 (1993).

14. Mendoza, L. & Nixdorf, E. Biomechanical Analysis of the Horizontal Jumping Events at the 2009 IAAF World Championships in Athletics. *New Studies in Athletics* **26**, 25–60 (2011).

15. Seyfarth, A., Friedrichs, A., Wank, V. & Blickhan, R. Dynamics of the long jump. *J. Biomech.* **32**, 1259–67 (1999).

Copyright: The article published on Sport Performance and Science Reports are distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

HIIT SCIENCE
THE TRAINING SCIENCE PODCAST
ATHLETICA
óptimo
VALD