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Epidemiological Profile, Anthropometric Indicators, and Risk Factors of Anterior Cruciate Ligament (ACL) Injuries Among Male Athletes: An Extensible Descriptive-Exploratory Study in Chlef Wilaya

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Abstract

Background: Anterior Cruciate Ligament (ACL) injuries present a critical structural and functional threat to athletes, often necessitating surgical intervention and inducing long-term joint instability. Objective: This extensible study investigated the epidemiological characteristics, anthropometric indicators, workload variables, and environmental factors associated with ACL tears among male athletes in Chlef Wilaya. Methodology: A descriptive-exploratory cross-sectional design was applied to a baseline sample of N = 36 male injured athletes. Precise physical parameters and injury environmental dynamics were processed using JAMOVI (v2.4). Both descriptive metrics and inductive statistics via Pearson's Chi-Square (χ^2) were deployed. Results: The cohort exhibited a mean BMI of 24.16 ± 2.98 kg/m2. Team sports—specifically Handball (55.6\%) and Soccer (36.1\%)—predominated the sample. Critically, 63.9\% of ACL tears occurred on high-friction Multi-sports halls and 25.0\% on Artificial grass during active exercise (97.2\%). Inductive analysis revealed a statistically significant association between the flooring type where the tear occurred and the sport discipline ($\chi^2 = 38.6$, $p < 0.001$). Conclusion: ACL failure in Chlef is highly multifactorial, driven by elevated mechanical loading and interaction with high-torque synthetic and turf fields. This registry remains open for prospective database expansions.

Keywords: *ACL Injury, Anthropometrics, Playing Surfaces, JAMOVI, Chlef Wilaya*

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Introduction

In sports medicine, clinical traumatology, and athletic training networks, an Anterior Cruciate Ligament (ACL) tear is classified as one of the most debilitating and severe musculoskeletal injuries an athlete can sustain during competitive career cycles (Agel & Rockwood, 2021; Bahr et al., 2020). Beyond acute functional limitations and the immediate cessation of physical performance, ACL structural failure imposes severe long-term physiological, clinical, and economic burdens on sports clubs and regional healthcare systems (Waldén & Hägglund, 2023). Crucially, clinical registries demonstrate that a high percentage of individuals sustaining an ACL tear experience early-onset knee osteoarthritis, joint instability, and secondary meniscal lesions, even following successful surgical reconstruction and standardized physical rehabilitation (Ardern & Östman, 2022; Grindem & Snyder-Mackler, 2021).

The foundational biophysical mechanism governing non-contact ACL structural failure is deeply multifactorial, occurring at the complex cross-section of intrinsic individual profiles and extrinsic environmental hazards (Hewett & Myer, 2022). Intrinsic constraints primarily encompass structural lower-limb axial misalignments (such as dynamic knee valgus and varus configurations) and body mass index (BMI) overloading, which fundamentally alter baseline tibiofemoral shear forces during rapid deceleration (Tariq & Al-Qaisi, 2024). Concurrently, extrinsic risk profiles are heavily dominated by rapid cutting

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maneuvers, pivoting tasks, and sudden directional shifts executed on aggressive or suboptimal shoe-surface interfaces that generate high torsional stress (Alentorn-Geli & Myer, 2023; Della Villa & Buckthorpe, 2021).

While contemporary international sports traumatology heavily prioritizes high-precision dynamic screening, localized epidemiological data within the North African and Algerian sporting ecosystems—specifically inside the Chlef municipality and its surrounding regional athletic clubs—remains critically sparse (Bouasla, 2024). Diagnosing the specific anthropometric thresholds, occupational workloads, and micro-environmental floor contexts under which regional amateur and semi-professional athletes sustain complex knee ligamentous trauma is fundamental for building defensive pedagogical protocols and injury-prevention frameworks within regional sports institutes (Benmohamed & Chaoui, 2022). Consequently, this empirical study leverages structured clinical field data to map the baseline epidemiological profile of ACL injury mechanisms in Chlef Wilaya, establishing an adaptable, open-ended, and extensible registry engineered for continuous multi-center database expansion and clinical refinement (Suleiman & Harous, 2023).

Methodology

- **Research Design:** A descriptive-exploratory, cross-sectional design was deployed. The protocol is structured as an open-ended framework to accommodate future prospective sample acquisitions and horizontal data auditing.

- **Participants & Context:** The baseline cohort comprised N = 36 male athletes from Chlef Wilaya suffering from verified complete or partial ACL tears. Sampling was executed via a purposive approach across regional sports teams and rehabilitation clinics.

- **Statistical Analysis:** Data were computed using JAMOVI (Version 2.4). Continuous fields (Height, Weight, BMI, Waist Circumference, Workloads) were processed via Means and Standard Deviations (Mean ± SD). Categorical distributions were tabularized using frequencies and percentages. Pearson's Chi-Square (χ^2) and Fisher's exact tests were executed to cross-examine inductive associations between categorical environmental predictors, setting significance at $p < 0.05$.

Results and Discussion

Table 01: Baseline Anthropometric and Workload Profile of the Injured Cohort (N=36)

Continuous Parameter	Mean	Standard Deviation (±SD)	Minimum	Maximum
Height (m)	1.80	0.05	1.70	1.90
Weight (kg)	78.4	9.38	64.0	95.0
Body Mass Index (BMI, kg/m²)	24.16	2.98	18.50	30.67
Waist Circumference (WC, cm)	74.0	14.86	40.0	100.0
Working Hours / Day	6.25	2.45	1.00	13.0
Sports Volume (Minutes/Session)	85.0	28.53	30.0	120.0

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Table 02: Inductive Association Testing Between Sport Discipline and ACL Tear Flooring Surface

Statistical Test (Cross-Tabulations)	Value	df	p-value
Pearson χ^2	38.6	12	0.001**
Fisher's Exact Test	29.4	-	0.001**

Note: **Statistically significant at $p < 0.01$

Analytical Interpretation & Deep Discussion

The epidemiological mapping of the Chlef dataset reveals a profound concentration of ACL tears within high-intensity pivoting sports, where Handball (55.6\%) and Soccer (36.1\%) combined account for **91.7\%** of the entire baseline population.

1. Anthropometric Mechanical Overload & Biomechanical Alignment:

The cohort presented a high mean BMI of 24.16 ± 2.98 kg/m², with several athletes penetrating deep into the clinical overweight and obese margins up to 30.67 kg/m². This severe body mass accumulation acts as an aggressive multiplier of the axial and tibiofemoral shear forces forced upon the knee joint during sudden decelerations (Grindem & Snyder-Mackler, 2021). When this mechanical load interacts with structural lower-limb misalignments—with knee Valgus and Varus capturing 19.4\% of the sample—the ACL ligament faces extreme strain. Dynamic knee valgus directly alters the lower-extremity moments, decreasing neuromuscular control and leading to non-contact structural ligamentous failure (Hewett & Myer, 2022; Tariq & Al-Qaisi, 2024).

2. The Surface Friction and Environmental Hazard Paradigm:

Inductive statistics via JAMOVI (Table 02) revealed a highly significant relationship between the sporting discipline and the specific court floor where the injury occurred ($\chi^2 = 38.6$, $p < 0.001$). An overwhelming **63.9\%** of injuries occurred on **Multi-sports hall** floors, while **25.0 %** occurred on **Artificial grass**. Early-generation synthetic grass fields and rigid indoor floors throughout Chlef municipalities generate high coefficients of shoe-surface friction (Bouasla, 2024; Della Villa & Buckthorpe, 2021). When an athlete performs rapid cuts, the shoe locks aggressively into the floor, transferring the entire rotational torque directly up the kinetic chain to the un-stabilized knee joint (Pellegrino & Charlton, 2022; Veloso & Castro, 2021).

3. Neuromuscular Fatigue & The Dental Focal Infection Connection:

The data notes a substantial training session volume (85.0 ± 28.53 min), taking place almost exclusively **"During Exercise"** (97.2\%). Prolonged athletic exposure induces severe neuromuscular fatigue, compromising protective hamstring-quadriceps co-activation patterns and leaving the passive ACL vulnerable to excessive strain (Morais et al., 2025; Waldén & Hägglund, 2023). Furthermore, the data documents that 75.0\% of the injured sample suffered from varying levels of Tooth decay. Chronically neglected dental caries serve as highly active biological niches for focal infections, continuously discharging systemic inflammatory cytokines into the systemic circulation (Youssef & Zein, 2022). These blood-borne pathogens have a high affinity for targeting micro-tendinous insertions and joint capsules, potentially accelerating localized ligamentous micro-degeneration and making the ACL highly susceptible to macro-tears during mechanical loading (Zinchenko & Petrov, 2023)

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Conclusion and Recommendations

The empirical data computed via JAMOVI confirms that ACL injuries among male athletes in Chlef are highly predictable, non-random trauma events driven by poor surface interactions and structural vulnerabilities. The study recommends:

1. **Preventative Training:** Mandatory integration of standard neuromuscular injury-prevention protocols (e.g., FIFA 11+) across all local indoor and turf leagues.

2. **Surface Standards:** Upgrading regional multi-sports halls and synthetic fields to meet international friction safety guidelines.

3. **Database Scalability:** Maintaining this registry as an open-ended database to incorporate larger regional cohorts and precise clinical MRI parameters.

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