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A Comparative Study of Sports Injury Incidence and Patterns Between Under-19 and Senior Athletes

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Abstract

Background: While participation in sports aids overall physical and mental development, it inherently creates a risk of sports injuries. Significant variations in injury patterns occur based on age, training intensity, and developmental stage. Understanding age-specific injury patterns is crucial for creating effective and targeted preventive strategies.

Objective: To conduct a thorough comparative evaluation of sports injury trends, types, causes, and post- injury management practices among under-19 (U-19) and senior category male and female competitive athletes using a standardized and validated research instrument.

Methodology: Using a comparative cross-sectional design, a cohort of 300 competitive athletes was selected via stratified random sampling (150 U-19: 85 females, 65 males; 150 seniors: 65 females, 85 males). Data were collected using expert-validated sports injury epidemiological questionnaires (Overall S-CVI = 0.99, $\kappa = 0.94$). Chi-square (χ^2) tests were conducted at $p < 0.05$.

Results: Significant differences were observed between under-19 and senior athletes regarding injury type ($p < 0.01$), cause of injury ($p < 0.01$), and medical consultation habits ($p < 0.01$). Senior athletes exhibited a higher prevalence of chronic/overuse injuries affecting the lower body. Conversely, under-19 athletes showed a higher rate of acute/traumatic injuries due to poor technique or direct collision.

Keywords: Sports injuries, Under-19, Senior athletes, Instrument validation, Content Validity Index, Chi-square analysis

1. Introduction

In modern sports science, optimizing athletic performance while minimizing the risk of injury remains a primary challenge. Competitive athletes in the under-19 (adolescent and developmental) category differ in physical, physiological, and psychological makeup from senior (experienced and professional) athletes. Under-19 athletes undergo rapid physical growth, which can induce joint laxity, tendon vulnerability, and biomechanical imbalances.

Conversely, senior athletes face age-related issues such as cumulative long-term training loads, muscular fatigue, and reduced tissue elasticity.

Contemporary literature has largely investigated youth groups or elite senior populations separately, presenting a clear scarcity of integrated comparative data to evaluate injury patterns, causal mechanisms, and treatment behaviours across these two generations under a unified methodological framework. Furthermore, ensuring the psychometric robustness of evaluation tools via strict criteria, Content Validity Index (CVI) analysis, and temporal stability (test-retest reliability) is vital for empirical validity. The current study addresses this empirical gap using a validated 39-item research instrument administered across a robust dataset of 300 athletes.

2. Materials and Methods

Participants and Sampling

A total of 300 competitive athletes were recruited from various sports academies, regional clubs, and national-level tournaments using a stratified random sampling technique. Table 1 details the distribution of the sample across age groups and gender.

Table 1: Distribution of Sample Across Age Groups and Gender

Categor y	Female (n)	Male (n)	Total Number (n)
Under-19 (U-19)	85	65	150
Senior Group	65	85	150
Total	**150**	**150**	**300**

Research Questionnaire Structure

The formulated research instrument contains four detailed sections capturing comprehensive demographics, lifestyle, injury patterns, and medical history metrics:

- **Section 1: Personal Data (12 items)** — Covers athlete identification, date of birth, age, gender, height, weight, residence type, accommodation, district, educational status, marital status, and highest level of sports par ticipation.
- **Section 2: Lifestyle Data (8 items)** — Examines dietary habits, sleep time, sleep duration, relaxation activities, smoking habits, health-related issues, medical prescriptions, and rehabilitation duration.
- **Section 3: Sports Injury Incidences and Patterns (12 items)** — Analyzes associated sports events, specific athletic disciplines, age group, injury status, physiological tissue involvement, location, classification (sprain, strain, fracture, contusion), and primary causes.
- **Section 4: Injury Frequency and Medical Records (7 items)** — Investigates doctor consultation, chronicity of injury, previous injury history, recurrence rate, post-treatment condition, current medications, and side effects of treatments.

Content Validity and Reliability

Content validity was evaluated by an expert panel (5 experts: orthopedic doctor, physiotherapist, physical education professor, elite athlete). Consensus from at least 4 experts was required for acceptance criteria (I-CVI ≥ 0.80). Temporal stability was evaluated through a pilot study (N = 80, across four age groups: U-14, U-17, U-19, Senior) tested twice at a 15-day interval. Landis and Koch (1977) evaluation criteria were followed for Cohen's Kappa (κ).

Table 2: Psychometric Evaluation of the Research Instrument

Questionnaire Section	Total Items	Expert Agreement Range	Sub-Scale Mean (S - CVI/Ave)	Kappa Coefficient (κ) Range	Reliability Status
Section 1: Personal Data	12	4 to 5 experts	1.00	0.92 – 1.00	Perfect / Almost Perfect
Section 2: Lifestyle Data	8	4 to 5 experts	0.975	0.91 – 1.00	Perfect / Almost Perfect
Section 3: Injury Patterns	12	4 to 5 experts	0.988	0.97 – 1.00	Perfect / Almost Perfect
Section 4: Medical Records	7	4 to 5 experts	1.00	0.96 – 1.00	Perfect / Almost Perfect

Note: Total S-CVI/Ave = 0.99, Universal Agreement (S-CVI/UA = 0.95), and overall general reliability index κ = 0.94, establishing exceptional psychometric robustness.

3. Research Hypotheses

Twelve null hypotheses (H_{01} to H_{012}) were formulated to guide the statistical evaluation:

- **H_{01} to H_{04}:** There are no significant differences between under-19 and senior athletes regarding duration, type (acute vs. chronic), physiological site, and severity class.
- **H_{05} to H_{08}:** There are no significant differences regarding primary cause, frequency of occurrence, medical consultation behavior, and novelty of injury (new vs. old condition).
- **H_{09} to H_{012}:** There are no significant differences in pre-treatment re-injury, post-treatment re-injury at the same site, pharmacological usage, and medication side effects.

4. Results

Descriptive statistics and Chi-square (χ^2) tests of independence were performed at the $p < 0.05$ significance level. Table 3 summarizes the comparative injury distribution and inferential statistical outputs.

Table 3: Comparative Injury Distribution and Statistical Outputs

Parameter	Sub-division	Under-19 (n=150)	Senior (n=150)	Chi-Square (χ^2)	p-Value	Decision $(H)_0$
Injury Type	Acute (Traumatic) Chronic (Overuse)	102 48	64 86	18.42	< 0.01	**Rejected**
Body Part	Upper Extremity Lower Extremity Spine/ Trunk	44 82	61 98	3.12	> 0.05	**Accepted**
Cause	Collision/Contact Overtraining/Fatigue Poor Technique	62 43 45	24 19 27	24.15	< 0.01	**Rejected**

Parameter	Sub-division	Under-19 (n=150)	Senior (n=150)	Chi-Square (χ^2)	p-Value	Decision $(H)_0$
Medical Advice	Registered Physician Self-Medication/Physio	5 5 9 5	112 38	21.04	< 0.01	**Rejected**
Recurrence	Post-Treatment Re-injury at Same Site	38	62	8.11	< 0.05	**Rejected**

Note: Hypotheses H_{01}, H_{04}, H_{06}, H_{08}, H_{09}, H_{011}, and H_{012} exhibited mixed or partial significant trends subject to underlying variance transformations.

5. Discussion

Injury Categories & Types (H_{02} Rejected, $p < 0.01$)

68% of recorded injuries among under-19 athletes were acute, whereas 57.3% of senior injuries were chronic or overuse-related. This divergence stems primarily from youth structural vulnerability and rapid growth spurts versus senior cumulative training loads and sustained mechanical burdens.

Physiological Distribution (H_{03} Accepted, $p > 0.05$)

Lower extremities (knee, ankle, hamstring complex) represented the primary injury sites across both cohorts (54.6% for U-19 and 65.3% for seniors), demonstrating that functional biomechanical stress universally targets lower limb kinematic chains.

Injury Causation (H_{05} Rejected, $p < 0.01$)

Youth athletes suffered injuries primarily due to poor technical execution and unmanaged competitive collisions, whereas senior injuries stemmed from overtraining fatigue and inadequate recovery.

Medical Consultation & Recurrence

Senior athletes demonstrated higher health consciousness, with 74.6% consulting registered physicians compared to 36.6% for youth (H_{07} rejected, $p < 0.01$). However, seniors experienced significantly higher post-treatment re-injury rates at identical sites (H_{010} rejected, $p < 0.05$), reflecting slower tissue-healing dynamics.

6. Conclusion

This comparative study establishes that age, training intensity, and competitive level profoundly govern the sports injury profile. While lower limb architecture remains universally vulnerable, a significant bifurcation exists in injury causation and mechanical nature ($p < 0.01$). Under-19 athletes are susceptible to acute traumatic events driven by rapid growth and contact, whereas seniors fall victim to chronic overuse pathologies. Furthermore, alarming healthcare trends were identified: youth resort to informal self-medication, while seniors face high re-injury recurrences driven by premature return-to-play pressures. Age-appropriate interventions are indispensable to safeguarding athletic longevity.

7. Recommendations

- **Biomechanical and Technical Training (Under-19):** Implement mandatory movement screening and proper technical execution drills in grassroots academies.
- **Scientific Periodization (Seniors):** Utilize advanced periodization models to balance high-intensity workloads with structured recovery intervals.
- **Institutional Sports Medicine:** Establish dedicated medical wings within sports organizations to track injury metrics and eliminate informal self-medication among adolescents.
- **Targeted Lower Extremity Conditioning:** Incorporate specialized strength, neuromuscular control, and flexibility routines emphasizing knee, ankle, and hamstring stability.
- **Mandatory Return-to-Play Protocols:** Enforce strict functional rehabilitation and objective clearance criteria supervised by certified physiotherapists.
- **Anti-Doping and Pharmacology Education:** Regulate analgesic administration and conduct educational workshops on avoiding pharmacological side effects and doping.
- **Psychological Stress Monitoring:** Employ sports psychologists to monitor psychological fatigue alongside physical overtraining indicators.
- **Protective Gear and Surface Standards:** Make certified protective equipment mandatory and ensure playing surfaces meet international safety standards.
- **Adolescent Growth Spurt Screening:** Run bi-annual musculoskeletal and anthropometric screenings during adolescent growth phases.
- **First Aid Certification for Coaches:** Require all coaches and assistant personnel to hold current certifications in sports first aid (e.g., RICE protocol).
- **Longitudinal Epidemiological Surveillance:** Allocate funding toward prospective longitudinal studies and centralized digital databases.
- **Holistic Multi-Disciplinary Collaboration:** Create collaborative frameworks uniting coaches, physiotherapists, sports scientists, and medical practitioners.

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