

Concordancia entre dos métodos de evaluación del salto contramovimiento de futbolistas juveniles en Barranquilla

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RESUMEN

El estudio aborda la concordancia entre dos métodos de evaluación del salto contramovimiento (CMJ) en futbolistas juveniles en Barranquilla, considerando que el fútbol genera altas demandas fisiológicas y biomecánicas, con acciones de alta intensidad como sprints, saltos, aceleraciones, desaceleraciones y cambios de dirección, que aumentan el riesgo de lesiones en jóvenes cuyo desarrollo estructural y hormonal está en proceso. Las lesiones más frecuentes incluyen meniscopatías, distensiones musculares, rupturas de isquiotibiales y lesiones ligamentarias, especialmente en la rodilla, con incidencia mayor durante la competencia. Se destacan estudios en Japón, Reino Unido, España, Brasil y reportes de la FIFA que evidencian el impacto de las lesiones deportivas y la necesidad de estrategias preventivas basadas en el seguimiento neuromuscular, control de cargas y uso de herramientas como el CMJ para identificar asimetrías, fatiga y descompensaciones.

El deporte y la actividad física representan pilares fundamentales de un estilo de vida saludable, con beneficios físicos, psicológicos y sociales. El fútbol es el deporte más practicado a nivel mundial, con millones de jugadores juveniles. Su evolución como tema de investigación ha permitido el desarrollo de métodos para evaluar condición física, fuerza, velocidad, potencia, resistencia y control neuromuscular. En futbolistas, la condición física es determinante para sostener demandas intermitentes de alta intensidad, y pruebas como el CMJ permiten evaluar rendimiento, potencia y eficiencia del ciclo estiramiento–acortamiento, siendo un indicador para el análisis funcional, la fatiga neuromuscular, las asimetrías y la readaptación.

El estado del arte resalta estudios sobre validez, confiabilidad y precisión de diferentes dispositivos para medir el CMJ, comparando plataformas de fuerza, acelerometría, aplicaciones móviles y sistemas fotoeléctricos. Se identifican niveles elevados de correlación, confiabilidad test-retest y sensibilidad para detectar cambios en el rendimiento. Sin embargo, se reconoce la necesidad de investigaciones en poblaciones específicas como futbolistas jóvenes en Colombia, lo que motivó este trabajo.

El estudio se desarrolló con un enfoque cuantitativo, observacional y transversal, con diseño correlacional-comparativo para analizar la concordancia entre un método de campo (Wheeler Jump) y uno de laboratorio (G-Sensor). Se realizó en dos instituciones deportivas entre junio y agosto de 2025, con 77 jugadores de 15 a 20 años pertenecientes a las categorías Sub-17 y Sub-20 de Barranquilla FC y Junior FC. Se utilizaron fuentes primarias y variables sociodemográficas, de composición corporal y de rendimiento neuromuscular. Se aplicaron fases de preparación, consentimiento informado, mediciones antropométricas y evaluación del CMJ con ambos dispositivos de manera simultánea, registrando altura, velocidad, potencia y fuerza en cada prueba.

Los resultados mostraron que la mayoría de jugadores tenían entre 15 y 17 años, residían en zona urbana y cursaban secundaria. El IMC promedio fue de 22,89 y el porcentaje de grasa de 15,79. El G-Sensor registró fuerza de impacto promedio, potencia concéntrica y velocidad de despegue con medias representativas del rendimiento juvenil. El Wheeler Jump mostró potencia promedio, fuerza relativa y potencia relativa dentro de rangos esperados para esta población. En la comparación, la altura media fue 37,903 cm en G-Sensor y 38,619 cm en Wheeler; la velocidad fue 2,967 m/s y 2,747 m/s respectivamente. El análisis de concordancia en altura presentó normalidad de residuos (Shapiro–Wilk $p=0,967$), pendiente de 0,96. Los gráficos de dispersión y Bland–Altman evidenciaron ausencia de sesgos y alta consistencia. Los ICC superaron 0,80 y los ICCk fueron superiores a 0,91, indicando excelente concordancia. Para la velocidad, aunque hubo relación significativa, los ICC variaron entre bajo y moderado (0,21–0,69), mostrando menor precisión interdispositivo.

En la discusión se relacionan los resultados con la literatura, destacando que los jugadores de mayor edad presentan mejor rendimiento por maduración y consolidación neuromuscular. Los valores de IMC y porcentaje de grasa son coherentes con estudios en futbolistas juveniles, y la variabilidad observada responde a diferencias biológicas y de entrenamiento. La altura de salto obtenida se ubica dentro del rango inferior reportado para futbolistas profesionales y juveniles, y las diferencias entre dispositivos concuerdan

con investigaciones previas sobre validez y confiabilidad del Wheeler Jump, OptoGait, Chronojump, My Jump 2 y sensores inerciales. Se resalta que la concordancia para la altura fue alta y metodológicamente aceptable, mientras que la velocidad presentó mayor variabilidad por diferencias en algoritmos y sensibilidad tecnológica.

Se concluye que existe una alta concordancia entre el G-Sensor y el Wheeler Jump para medir la altura y una concordancia moderada en la velocidad del CMJ. Se valida el uso de ambos dispositivos en contextos deportivos juveniles, especialmente el Wheeler Jump por ser portátil, accesible y de bajo costo. Los valores de rendimiento obtenidos reflejan un adecuado desarrollo de la fuerza explosiva, aunque cerca del límite inferior para futbolistas de élite. Se reconoce la heterogeneidad en la madurez física y preparación entre categorías.

Finalmente, las recomendaciones sugieren replicar el estudio en más poblaciones, incluir plataforma de fuerza como referencia, realizar evaluaciones periódicas durante una temporada para monitorear la condición física, integrar el G-Sensor al control de cargas y ampliar análisis hacia otras pruebas funcionales y programas de entrenamiento.

Palabras clave: Fútbol, rendimiento atlético, adolescente, salto con contramovimiento, pruebas de campo

ABSTRACT

This study examines the agreement between two methods for evaluating the countermovement jump (CMJ) in youth soccer players in Barranquilla, considering that soccer imposes high physiological and biomechanical demands, with high-intensity actions such as sprints, jumps, accelerations, decelerations, and changes of direction, which increase the risk of injuries in young athletes whose structural and hormonal development is still in progress. The most frequent injuries include meniscal injuries, muscle strains, hamstring tears, and ligament injuries, especially in the knee, with higher incidence during competition. Studies conducted in Japan, the United Kingdom, Spain, Brazil, and FIFA reports highlight the impact of sports injuries and the need for preventive strategies based on neuromuscular monitoring, load control, and the use of tools such as the CMJ to identify asymmetries, fatigue, and functional imbalances.

Sports and physical activity represent fundamental pillars of a healthy lifestyle, with physical, psychological, and social benefits. Soccer is the most widely practiced sport worldwide, with millions of youth players. Its evolution as a research topic has allowed the development of methods to assess physical fitness, strength, speed, power, endurance, and neuromuscular control. In soccer players, physical fitness is essential to sustain intermittent high-intensity demands, and tests such as the CMJ allow the evaluation of performance, power, and the efficiency of the stretch-shortening cycle, serving as indicators for functional analysis, neuromuscular fatigue, asymmetries, and rehabilitation. The state of the art highlights studies on the validity, reliability, and precision of different devices used to measure CMJ, comparing force platforms, accelerometry, mobile applications, and photoelectric systems. High levels of correlation, test-retest reliability, and sensitivity to detect changes in performance have been identified. However, the need for research in specific populations such as youth soccer players in Colombia is recognized, which motivated this study.

The study followed a quantitative, observational, and cross-sectional approach, with a correlational-comparative design to analyze agreement between a field method (Wheeler Jump) and a laboratory device (G-Sensor). It was conducted in two sports institutions between June and August 2025, involving 77 players aged 15 to 20 years from the Sub-17 and Sub-20 categories of Barranquilla FC and Junior FC. Primary data sources and sociodemographic, body composition, and neuromuscular performance variables were used. Preparation phases, informed consent, anthropometric measurements, and CMJ evaluation with both devices were applied simultaneously, recording height, velocity, power, and force in each test.

Results showed that most players were between 15 and 17 years old, lived in urban areas, and were enrolled in secondary education. Mean BMI was 22.89 and body fat percentage was 15.79. The G-Sensor recorded average impact force, concentric power, and take-off velocity with values representative of youth performance. The Wheeler Jump showed average power, relative force, and relative power within expected ranges. Mean height was 37.903 cm for the G-Sensor and 38.619 cm for the Wheeler; velocity values were 2.967 m/s and 2.747 m/s, respectively. The height concordance analysis showed normal residual distribution (Shapiro-Wilk $p = 0.967$) and a slope of 0.96. Scatter and Bland-Altman plots evidenced no systematic bias and high consistency. ICC values exceeded 0.80 and ICCk values were above 0.91, indicating excellent agreement. For velocity, although a significant relationship was found, ICC values ranged from low to moderate (0.21-0.69), showing lower inter-device precision.

The discussion relates the findings to the literature, highlighting that older players show better performance due to maturation and neuromuscular consolidation. BMI and body fat values align with studies on youth soccer players, and the variability observed reflects biological and training differences. The jump height obtained falls within the lower range reported for professional and youth soccer players, and differences between devices agree with previous research on the validity and reliability of Wheeler Jump, OptoGait, ChronoJump, My Jump 2, and inertial sensors. High concordance for height was observed, while velocity showed greater variability due to differences in algorithms and sensor sensitivity.

The study concludes that there is high agreement between the G-Sensor and Wheeler Jump for measuring height, and moderate agreement for CMJ velocity. The use of both devices in youth sports settings is validated, particularly Wheeler Jump, due to its portability, accessibility, and low cost. The performance values obtained reflect adequate development of explosive strength, although close to the lower limit for elite youth players. Heterogeneity in physical maturity and preparation between categories is recognized.

Finally, recommendations include replicating the study in more populations, incorporating a force platform as a reference, conducting periodic evaluations throughout a competitive season to monitor physical condition, integrating the G-Sensor into load monitoring, and expanding analyses to other functional tests and training programs.

Keywords: Soccer, athletic performance, adolescent, countermovement jump, field testing.

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