Performance in sport

Isometric strength profile of the posterior chain in professional soccer players from the Colombian league

Perfil de la fuerza isométrica de la cadena posterior en jugadores profesionales de fútbol de la liga colombiana

Quiceno, Christian[1], Alfonso Mantilla, José Iván [2], Samudio, María Alejandra[2]

[1] Club deportivo la Equidad. Universidad de Antioquia.

[2] Universidad del Rosario. Club Deportivo la Equidad.

Contact Address: josealfonso25@hotmail.com
Jose Iván Alfonso Mantilla
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ABSTRACT

Introduction: it has been shown that in professional soccer players the use of tests and measurements for the analysis of neuromuscular strength and fatigue has significant effects in the identification of abnormalities as a risk factor for the onset of muscle injuries. In the literature it has been shown that the isometric strength test of the posterior chain (IPC-F) performed on force plates at 90° of the hip and knee has sensitivity indices in the peaks of relative strength, neuromuscular fatigue and effective recovery as an essential analysis element in high performance soccer players.
Methodology: descriptive study in 31 professional soccer players of the Colombian league (Age 19 ± 13 years; Height 170 ± 14 cm; weight 65 ± 12 kg) where strength measurement in Newton was performed with the IPC-F 90 ° test using the ForceDecks device from the company VALD Performance.
Results: statistical values were obtained for the total posterior chain IPC-F template on the left side, averaging 73N±16N with a range between 50N and 102N, and for the right side, averaging 76N±18N with a range between 45N and 124N with an asymmetry less than 10%.
Conclusions: the hamstring strength profile in professional soccer players allows the generation of statistical data related to biomechanical variables of movement involved in performance, such as force production rate, maximum peak force, velocity, and torque. The IPC-F test is a standardized test for the evaluation of isometric hamstring strength.

Keywords: hamstrings, isometric strength, soccer, injuries, force plates.

RESUMEN

Introducción: se ha demostrado que en jugadores profesionales de fútbol el uso de test y medidas para el análisis de fuerza y fatiga neuromuscular tiene efectos significativos en la identificación de anormalidades como factor de riesgo de aparición de lesiones musculares. En la literatura se ha demostrado que el test de fuerza isométrica de la cadena posterior (IPC-F) realizado en placas de fuerza a 90° de cadera y rodilla tiene índices de sensibilidad en los picos de fuerza relativa, fatiga neuromuscular y recuperación efectiva como un elemento de análisis esencial en el futbolista de alto rendimiento.
Metodología: estudio descriptivo en 31 jugadores profesionales de fútbol de la liga colombiana (Edad 19 ±13 años; Altura 170±14cm; peso 65±12kg) donde se realizó la medición de fuerza en Newton con la prueba IPC-F 90° mediante el dispositivo ForceDecks de la empresa VALD Performance.
Resultados: se obtuvieron valores estadísticos para el total de la plantilla de IPC-F de cadena posterior de lado izquierdo de media de 73N±16N con un rango entre 50N y 102N y para el lado derecho de media 76N±18N con un rango entre 45N y 124N con una asimetría menor al 10%.
Conclusiones: el perfil de fuerza de isquiotibiales en jugadores profesionales de fútbol permite generar datos estadísticos relacionados con variables biomecánicas del movimiento involucradas en el rendimiento tales como tasa de producción de fuerza, pico de fuerza máxima, velocidad, torque. El test IPC-F es una prueba estandarizada para la evaluación de la fuerza isométrica de isquiotibiales.

Palabras Clave: isquiotibiales, fuerza isométrica, fútbol, lesiones, placas de fuerza.

INTRODUCTION

Muscle injuries are the most common injuries in professional football with the highest prevalence in hamstrings, adductors, rectus femoris and gastrosoleus respectively (Opar et al., 2012; Opar et al., 2015; Robles-Palazón et al., 2022). There are different intrinsic and extrinsic factors that predispose the occurrence of muscle injuries such as previous injury, inadequate load adaptation and recovery, calendar congestion, low strength levels and muscle imbalances (Bourne et al., 2015; Timmins et al., 2016). All these factors create a complex paradigm in the analysis of muscle injuries (Opar et al., 2022; Opar et al., 2021).

The muscle injury paradigm stems from the analysis and relationship of loads between game variables such as change of direction, sprints, repetitive strain capacity, accelerations, decelerations, biomechanical demands on a specific muscle group (Bramah et al., 2024; Buchheit et al., 2010; Mendiguchia et al., 2022) in combination with mechanical factors such as isometric and eccentric peak forces, torque, angles of movement (Gabbett et al., 2017; Nedelec et al., 2014). This paradigm allows for relationship building and control of neuromuscular function, optimal load management, reduction of training-induced muscle damage and increased recovery periods, identification of abnormal fatigue periods allowing monitoring for decision making (Campbell et al., 2021; Claudino et al., 2021; Neupert et al., 2022).

The use of tests and measures for strength and neuromuscular fatigue analysis in professional football players has been shown to have significant effects in identifying abnormalities as a risk factor for muscle injury (McCall et al., 2015). The literature has shown that the isometric posterior chain strength test (IPC-F) performed on 90° hip and knee force plates has sensitivity indices for peak relative strength, neuromuscular fatigue and effective recovery (McCall et al., 2015).

In the literature, it has been demonstrated that the isometric posterior chain strength test (IPC-F), performed on force plates at 90° of hip and knee flexion, shows sensitivity indices in relative peak force, neuromuscular fatigue, and effective recovery. This makes it an essential analytical tool for high-performance football players (Wollin et al., 2017). For this reason, the objective of this article is to conduct a descriptive study on the IPC-F 90° profile in professional football players from the Colombian league.

METHOD

Population

31 professional football players from the Colombian league (age 19 ±13 years; height 170±14cm; weight 65±12kg) divided into the following positions: goalkeepers 4, central defenders 5, wingers 6, midfielders 8, forwards 4 and wingers 4. The assessment was carried out in January 2025.

Inclusion criteria

- Male professional football players with an active contract who could perform the tests.
- Players with no history of musculoskeletal injuries that may have occurred 2 months previously.
- Players who were free of pain in the last week.
- Players who were not prescribed any specific medication.

Exclusion criteria

- Players with injuries present and other health conditions that did not allow them to participate in the study.
- Players from other categories of the club.
- Players who have had an intense training session in the last two days.

Design

A descriptive study was conducted in professional male football players of the first division of Colombia where they were measured in Newton with the test IPC-F 90° (isometric strength test of the posterior chain) due to its high rate of validity and reliability in the evaluation of the neuromuscular component (Matinlauri et al., 2019; McCall et al., 2015), the Assessment was performed using the ForceDecks device of the company VALD Performance (Collings et al., 2024). The assessment was conducted on a voluntary basis where all participants were informed by informed consent. The measurement variable was defined as the force in newtons produced during the gesture.

The players performed a functional warm-up with dynamic muscle stretching of the rectus femoris, hamstrings, adductors and hip abductors. In the first instance, each participant was shown the gesture to be performed, which consisted of performing a supine decubitus position on a mat where it was assessed unilaterally, the heel of the limb to be tested was placed on a force plate supported on a base with a test angle established by goniometry and the limb that was not being tested was kept relaxed and extended. When each participant was clear of the position, the player performed a heel thrust on the test limb against the force plate keeping glutes, hips, hands and head on the mat where pressure

was applied to the contralateral limb avoiding offsets. The software took the results of 1 series of heel thrusts on the test limb against the force plate.
The software took the results of 1 set of 5 repetitions and for the present study the best result was taken. Image 1 shows the position of the execution and the devices used.

ForceDecks: is a validated and highly reliable device created by VALD Performance for the assessment of neuromuscular components in high performance sports (Collings et al., 2024). This device consists of platforms equipped with piezoelectric sensors or extensometers. These sensors measure the ground reaction force exerted by a person in different types of functional activities. The platform is composed of a top plate, circuit board and load cells which allow the measurement and generation of data and specific variables in strength, jumping and balance tests (Barker et al., 2018; Collings et al., 2024).

Image 1.
IPC-F 90°+ForceDecks

Note: own elaboration 2025

Ethical considerations
The study was conducted based on the Helsinki declaration of ethical principles in health research where participants were informed and signed an informed consent about their participation in the study.
Statistical analysis
Due to the quantitative Type of data recorded, descriptive values were analysed at the overall level and by game position as mean, median, maximum, minimum and standard deviation in the software (XLSTAT version 2020.5, XLSTAT by addinsoft).

RESULTS

Assessment was carried out on 31 Colombian football players to evaluate the Ability to produce force in newtons using the IPC-F and stratified by playing position. Table 1 shows the force in newton of the posterior chain at a general level, image 1 shows the Box Plot at a general level and table 2 shows the force in newton of the posterior chain by playing position.

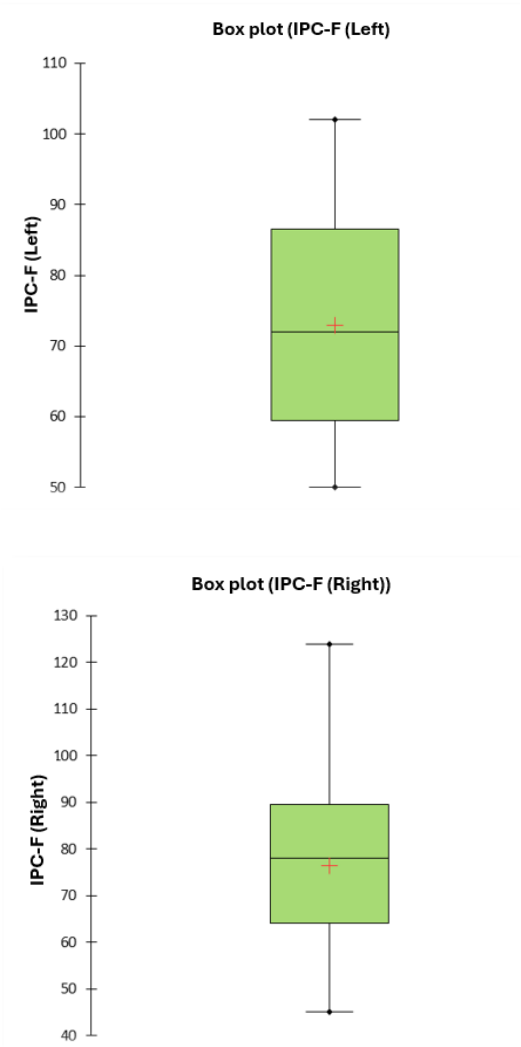
Table 1.
General IPC-F

Statistic	*IPC-F (Left) Newton*	*IPC-F (Right) Newton*
Mínimum	50	45
Maximum	102	124
Average	73	76
Standard Deviation (n-1)	16	18

Nota: elaboración propia 2025

Statistical values were obtained for the total IPC-F template of the left side posterior chain with a mean of 73N±16N with a range between 50N and 102N and for the right side with a mean of 76N±18N with a range between 45N and 124N with a skewness of less than 10%.

Image 1.
Box Plot IPC-F at the general unilateral level.



Note: own elaboration 2025

Table 2.
IPC-F by playing position

Statistic	ARQ		DFC		DFL		VOL		DEL		EXT	
	IPC (Left)	IPC (Right)	IPC (Left)	IPC (Right)	IPC (Left)	IPC (Right)	IPC (Left)	IPC (Right)	IPC (Left)	IPC (Right)	IPC (Left)	IPC (Right)
Mínimum	55	78	59	46	50	53	50	45	51	52	54	61
Maximum	87	84	102	100	97	124	93	94	87	90	100	101
Average	74	80	80	81	67	75	74	74	68	73	75	78
DE	14	3	20	23	20	27	13	16	16	17	19	17

Note: own elaboration 2025. SD (Standard Deviation),. ARQ (Goalkeeper), DFC (Central Defender), DFL (Fullback), VOL(Flyer), DEL(Forward), EXT(wingers).

Within the results by position, statistical values of CPI-F were obtained for goalkeepers for the left side with a mean of 74N±14N with a range between 55N-87N and for the right side with a mean of 80N±3N with a range between 78N-84N; Centre fenders left side mean 80N±20N with a range between 59N-102N and for the right side mean 81N±23N with a range between 46N-100N; Side fenders left side mean 67N±20N with a range between 50N-97N and for the right side mean 75N±27N with a range between 53N-124N; Flyers left side mean 74N±13N with a range between 50N-93N and for the right side mean 74N±16N with a range between 45N-94N; Front left side mean 68N±16N with a range between 51N-87N and for the right side mean 73N±17N with a range between 52N-90N and finally front left side mean 75N±19N with a range between 54N-100N and for the right side mean 78N±17N with a range between 61N-101N with an asymmetry in all positions of less than 10%.

DISCUSSION

The IPC-F 90° strength assessment was performed where an initial strength profile was established for professional football players in Colombia. In the first instance, the literature establishes the need for the assessment of the neuromuscular profile in high-performance athletes with different types of technology that allow the generation of statistical data in relation to normal muscle strength indices, fatigue control, muscle recovery, control in rehabilitation and sports readaptation processes (Campbell et al., 2021; Eythorsdottir et al., 2024; Windt et al., 2020).

In the present study, the posterior chain force profile was established where the peak force becomes a fundamental unit of measurement of the total output per contraction time period of the hamstring musculature related to the specific angle in knee extension and hip flexion involved in eccentric activation, biomechanical deficits, stress on the muscle fibre at specific angulation and torque moments (Cohen et al., 2015; Matinlauri et al., 2019; Read et al., 2019). Having a force profile opens the door to the development and tracking of adaptive models by monitoring isometric force in combination with internal and external load measuring devices (Constantine et al., 2019; Morgans et al., 2018).

Finally, the present study opens up the possibility of generating a monitoring protocol by playing position allowing the development of methodologies based from load control by through the relationship of biomechanics, physiology and mechanical variables of movement adapted to game models with patterns of technical and tactical development generating muscle injury reduction, neuromuscular fatigue control, mechanical control, creation of predictive models and adapted to an innovative work scheme (Blanch & Gabbett, 2016; Collins et al., 2021; Gabbett, 2020).

Emphasis should continue to be placed on the need for research in the field of high performance sport with different population types and with a significant sample size that allows for cross-curricular cohort research generating statistical profiles that will develop future research for the application, creation and innovation of knowledge.

PRACTICAL APPLICATIONS

Within the technological development in high performance football, having a structural and functional profile guarantees a successful monitoring process in the control of the kinetic and kinematic variables of movement. By having specific measurement systems it is possible to generate Assessment protocols that develop an updated methodology to increase the physical performance of professional football players, statistical analysis in rehabilitation and sports readaptation processes.

CONCLUSIONS

In football, having a hamstring strength profile allows to generate statistical data related to biomechanical variables of movement involved in performance such as rate of force production, peak maximum force, speed, torque which provide information for monitoring processes and create strategies to reduce muscle injuries, load control, correlation matrices of variables focused on performance. In the present study an initial profile of the IPC-F of hamstring strength in Colombian professional football players was evidenced.

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