



UNIVERSIDAD DE LOS LAGOS



1er Encuentro Latinoamericano y del Caribe de Entrenadores de Atletismo 2025

Entrenamiento Atlético y Tecnología

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Vinculación con el Atletismo



FRANCISCO GALLARDO-FUENTES



- **PhD. en Investigación Transdisciplinar en Investigación Educativa**
- **MSc. en Educación**
- **Entrenador IAAF Nivel 3**
- **Entrenador de la Auslandstrainerschule Mainz, Alemania**
- **Actualmente Académico Titular de la Universidad de Los Lagos e Investigador de la Agencia Nacional de Investigación y Desarrollo (ANID)**

Momentos de la Sesión

1. Introducción:

Fundamentos del Entrenamiento Atlético.

2. Del entrenamiento intuitivo al basado en datos.

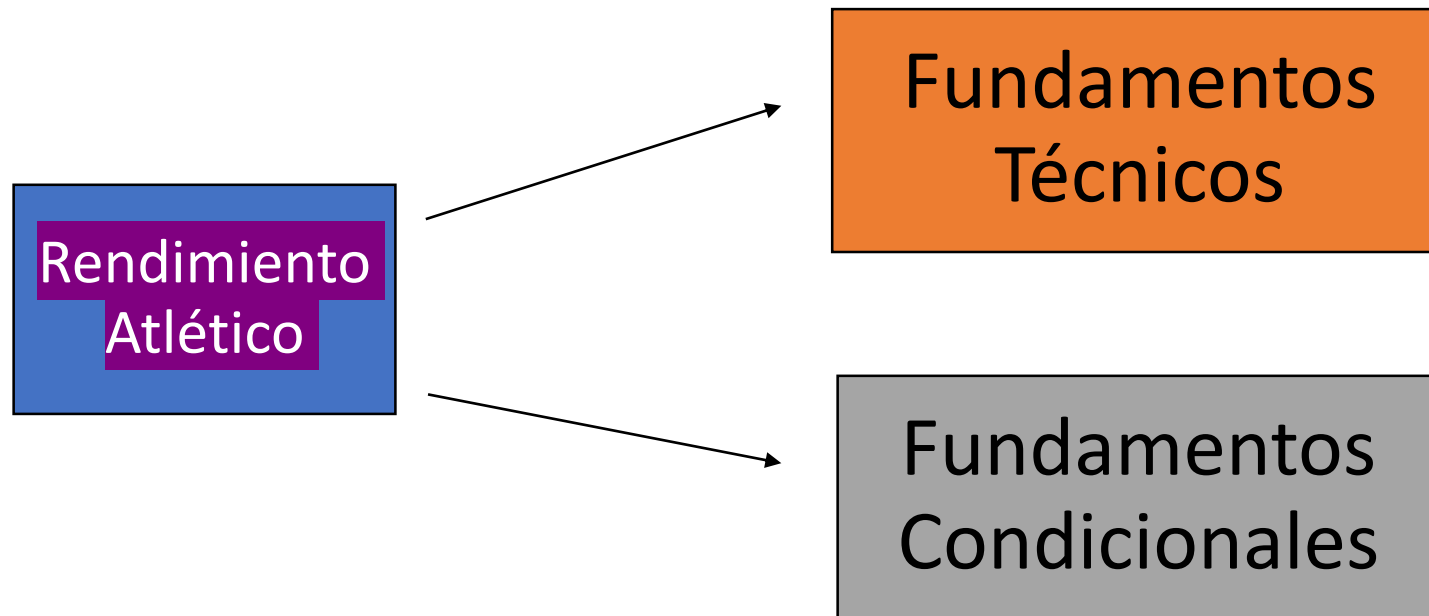
3. Tecnología al servicio del deporte.

Parte 1. Fundamentos del Entrenamiento Atlético

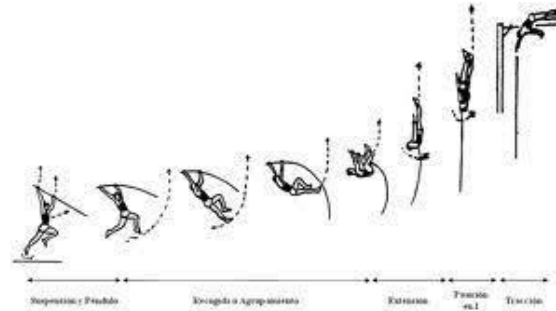
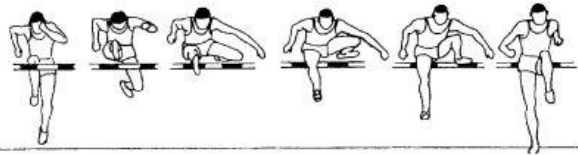
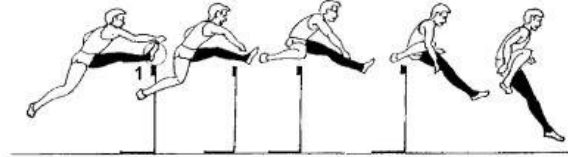
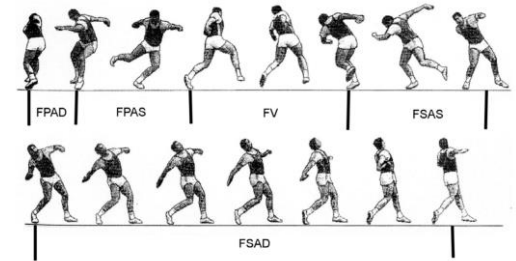
Etapas del Plan de Expectativa Individual

Edad	Participantes	Lugar
35 y + años	Etapa de Performance	Clubes Deportivos
19 – 34 años		Centro de Alto Rendimiento
14 – 18 años		Centro de Entrenamiento Regional
11 – 14 años	Etapa de Formación Básica	Escuelas Deportivas

Matveev, 1977



Fundamentos Técnicos.



Fundamentos Condicionales.

Condición Física estaría compuesta por:

1. Capacidades o cualidades físicas básicas o condicionales: Resistencia, Fuerza, Flexibilidad y velocidad



2. Cualidades motrices o coordinativas: Equilibrio, Coordinación percepción (espacio -tiempo, kinestésica).



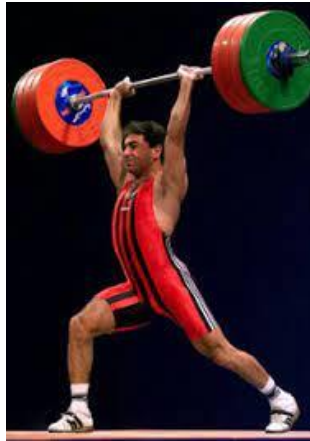
3. Cualidades derivadas: Potencia y Agilidad.



(Aguilar, Calahorro & Moral, 2009)

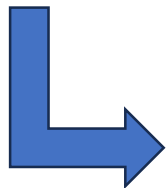
Condición Física estaría compuesta por:

3. Cualidades derivadas: Potencia y Agilidad.



(Aguilar, Calahorro & Moral, 2009)

Es en este escenario, donde históricamente los entrenadores día a día deben tomar decisiones



- Para equilibrar el rendimiento deportivo con la salud del atleta.”

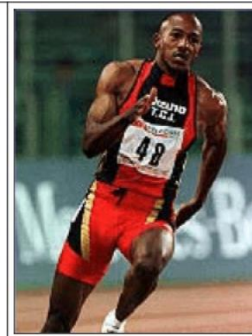
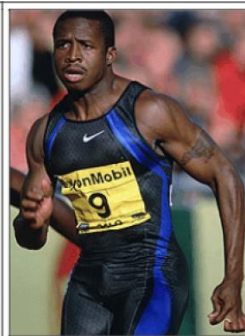
- Decidir la intensidad óptima ante el riesgo de sobrecarga o lesión.

- Decisiones que van más allá de lo físico, considerando lo emocional y lo social

Parte 2. Del entrenamiento intuitivo al basado en datos.

A pesar de que conocemos con precisión las especificaciones técnicas de cada prueba y las variables condicionales que las sustentan, estas se expresan en la individualidad de cada atleta, configurando un escenario dinámico y variable que el entrenador debe interpretar y comprender día a día.

Velocidad.



	M. Greene		D. Bailey		Montgomery		Fredericks	
	Tiempo Parcial	Velocidad m/s	Tiempo Parcial	Velocidad m/s	Tiempo Parcial	Velocidad m/s	Tiempo Parcial	Velocidadm/s
T. Reacción	0.134		0.145		0.134		0.129	
0-10m	1.71	5.847	1.77	5.649	1.73	5.780	1.73	5.780
10-20m	1.04	9.615	1.03	9.708	1.03	9.708	1.04	9.615
20-30m	0.92	10.869	0.91	10.989	0.93	10.752	0.93	10.752
30-40m	0.88	11.363	0.87	11.494	0.88	11.363	0.89	11.235
40-50m	0.87	11.494	0.85	11.764	0.86	11.627	0.87	11.494
50-60m	0.85	11.764	0.85	11.764	0.86	11.627	0.86	11.627
60-70m	0.85	11.764	0.85	11.764	0.86	11.627	0.86	11.627
70-80m	0.86	11.627	0.86	11.627	0.87	11.494	0.87	11.494
80-90m	0.87	11.494	0.87	11.494	0.88	11.363	0.88	11.363
90-100m	0.88	11.363	0.90	11.111	0.90	11.111	0.89	11.235
Promedio/T po final	9.86	10.14	9.91	10.09	9.94	10.06	9.95	10.05

Table 2. Berlin 2009 IAAF World Championships in Athletics Men's Triple Jump Phase Rates and Distances Analysis (Hommel, 2009; Bayraktar ve Çilli, 2017).

	Hop (m)	Step (m)	Jump (m)	Hop (%)	Step (%)	Jump (%)
Idowu P.	6.49	5.41	6.02	36	30	34
Evora N.	6.51	5.41	5.68	37	31	32
Copello A.	6.01	5.77	5.92	34	33	33
Sands L.	6.52	5.20	5.62	38	30	32
Girat A.	6.16	5.41	5.88	35	31	34
Li Y.	6.33	5.24	5.75	37	30	33
Spasovkhodskiy I.	6.47	4.80	5.69	38	28	34
Gregorio J.	6.33	5.10	5.72	37	30	33
Ort.	6.35	5.29	5.79	37	30	33

When Table 2 is examined, it is seen that male jumpers use the Middle East, that is, the vertical hop and jump technique (hop dominant) dominantly in the average phase ratios and distances.

Table 3. Berlin 2009 IAAF World Athletics Championships Women's Triple Jump Final Phase Rates and Distances Analysis (Hommel, 2009; Bayraktar ve Çilli, 2017).

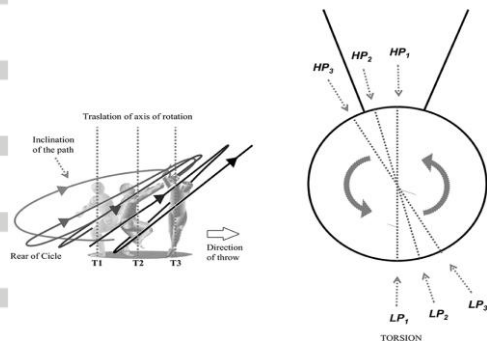
	Hop (m)	Step (m)	Jump (m)	Hop (%)	Step (%)	Jump (%)
Savigne Y.	6.49	5.41	6.02	36	30	34
Gay M.	6.51	5.41	5.68	37	31	32
Pyatykh A.	6.01	5.77	5.92	34	33	33
Topic B.	6.52	5.20	5.62	38	30	32
Smith T.	6.16	5.41	5.88	35	31	34
Lebedeva T.	6.33	5.24	5.75	37	30	33
Bujin C.	6.47	4.80	5.69	38	28	34
Veldakova D.	6.33	5.10	5.72	37	30	33
Ort.	5.38	4.20	5.04	37	29	34

When Table 3 is examined, it is seen that the Middle East technique is used dominantly in the average phase ratios and distances in female athletes as well as in male jumpers.

Lanzamientos.

Table 1. Kinematics parameters of male and female World Championship finalists - Berlin, Daegu, London [\[35,36,37\]](#)

	Male and Female throwers in WCh Berlin, 2009	Starting velocity (m/s)	Increase of velocity (m/s)				Release of velocity (m/s)	Angle of release (°)	Path of the hammer during turns (m)				Duration of turns (s)			
			Turn 1	Turn 2	Turn 3	Turn 4			Turn 1	Turn 2	Turn 3	Turn 4	Turn 1	Turn 2	Turn 3	Turn 4
1	Kozmus	16,8	2,9	2,6	1,4	4,6	28,2	41,6	10,8	11,1	10,4	12,2	0,62	0,52	0,44	0,48
2	Ziolkowski	16,7	3,2	2,1	1,7	4,1	27,7	40,8	10,7	10,5	10,7	13,3	0,62	0,50	0,46	0,52
3	Zagorny*	17,9	3,1	2,0	4,6	-	27,6	42,3	10,8	10,7	13,9	-	0,60	0,48	0,56	-
4	Pars	15,2	5,3	1,5	1,0	4,5	27,5	44,5	10,5	9,9	9,9	13,1	0,58	0,46	0,42	0,52
5	Litvinov	15,7	4,2	2,0	1,0	4,5	27,4	39,9	10,4	11,4	10,0	12,3	0,62	0,54	0,44	0,50
6	Esser	16,8	3,0	1,6	1,0	5,1	27,5	39,9	9,3	9,9	10,3	12,9	0,56	0,46	0,44	0,52
7	Haklitis	15,1	3,6	2,7	1,9	4,1	27,4	41,4	11,3	11,0	11,2	12,5	0,72	0,54	0,48	0,50
8	Kryvitski	15,3	3,3	2,5	1,6	4,6	27,3	40,2	10,2	10,4	10,9	12,4	0,64	0,52	0,48	0,50
1	Włodarczyk	15,3	4,7	2,3	1,1	4,4	27,8	41,8	10,5	11,5	9,9	12,2	0,60	0,54	0,42	0,48
2	Heidler	18,6	2,5	1,6	0,9	4,4	27,9	39,1	10,4	9,5	10,2	11,8	0,54	0,42	0,42	0,46
3	Hrasnova*	15,2	4,7	2,8	4,8	-	27,5	37,6	9,7	11,3	12,6	-	0,60	0,52	0,52	-
4	Klass	16,9	3,0	2,2	0,9	4,1	27,1	42,3	9,8	10,3	9,3	12,1	0,56	0,48	0,40	0,48
5	Zhang	15,7	4,8	1,8	0,9	3,7	26,8	39,8	10,9	10,9	10,9	11,5	0,60	0,50	0,46	0,46
6	Lysenko	14,5	4,7	2,6	1,4	3,4	26,6	41,6	10,2	10,6	10,9	12,6	0,64	0,52	0,48	0,52
7	Cosby*	17,5	3,2	1,7	4,4	-	26,7	38,6	9,8	9,7	13,8	-	0,56	0,44	0,56	-
8	Clarett	16,4	3,3	2,7	0,8	3,6	26,7	39,5	10,0	10,3	9,5	13,3	0,58	0,48	0,40	0,52



Evaluation of physical fitness in track and field throwing athletes across different competitive levels

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Abstract:

A comprehensive understanding of physical fitness across different competitive levels is essential in track and field athletics. Coaches of throwers typically develop training regimens tailored to either performance levels or the specific needs of individual athletes to maximize physical fitness and ultimately enhance competitive throwing performance. However, it remains uncertain whether the competitive level of athletes may require different training designs. Thus, this study aimed to assess and compare the physical fitness levels among throwers across varying competitive levels. Twenty-eight throwers (20 males, 8 females; age: 18.2 ± 2.7 years; body mass: 89.8 ± 15.1 kg; body height: 178.5 ± 9.9 cm) participated in the study. These athletes were categorized into three competitive experience groups: national level ($n = 10$), international level ($n = 7$), and international medallists ($n = 11$). During a summer training camp, comprehensive measurements were conducted, encompassing various aspects of physical fitness. These assessments comprised the following parameters: 20 m sprint time, countermovement jump (CMJ) height and power, standing long jump distance, handgrip isometric strength, and body composition analysis. Statistical analysis was performed utilizing one-way ANOVA. The results of the study revealed no significant differences for all variables between the three groups ($p > 0.05$). In addition, significant correlations were found between measures of physical fitness for both male and female athletes (i.e., body composition and physical fitness measurements). Therefore, in the early stage of throwers yearly preparation (i.e., summer training camp), physical fitness might be similar for throwers regardless of their competitive levels. From a practical perspective, coaches may design similar training programs for athletes especially in the beginning of the preparation phase in an attempt to enhance competitive performance among athletes with different competitive levels. Moreover, body composition may be a good predictor of physical fitness in both male and female thrower athletes.

Key Words: Track and field, athletic performance, skeletal muscle, shot put, hammer throw, javelin throw.

Introduction

Sport performance in track and field throwing events is influenced by several biomechanical (e.g., velocity, angle and height of release of the implement) and biological factors (e.g., lean mass, neural activation, muscle fibre type composition) (Bourdin et al., 2010; Brumitt et al., 2014; Leigh & Yu, 2007; Park et al., 2014; Zaras et al., 2021). Assessment of these factors may provide useful insights into the athletes training-induced adaptations and their preparedness for competitions (Zaras et al., 2016). Scientific literature emphasizes the significance of evaluating athletes' abilities at regular intervals since even the most experienced trainers may struggle to fully comprehend and quantify these variables (e.g., perceived effort, perceived fatigue, biochemical and hormonal analysis; diseases; injuries; technique and movement deviations; body composition; quality and duration of rest; psychology) that affect performance. Therefore, working with efficient and straightforward data is essential while maintaining scientific validity (Halson, 2014). Moreover, the availability of normative data

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Estudio en el contexto chileno

Parte 3. Tecnología al servicio del deporte.

La evaluación en el Deporte



- Es Fundamental y debe hacerse en un abanico holístico de variables (Capote-Lavadero et al., 2017)



- Con técnicas y herramientas fiables



- Con un profundo conocimiento que permita interpretar los resultados y Levantar datos de base

Tradicionalmente

Test de laboratorio



Instrumentos para monitoreo

- Pulsómetros
- Acelerómetros
- Software de análisis Biomecánico (Ej. Dartfish, Kinovea)
- Plataformas en la nube: seguimiento remoto



Aplicaciones Móviles



¿Que dice la Evidencia?



El “atleta aumentado” es aquel que integra **biotecnología, sensores y análisis digital** para extender sus capacidades físicas, con apoyo de la ciencia de datos y la inteligencia artificial.

¿Que dice la Evidencia?

Perspective

Ubiquitous Computing in Sports Trends and Developments

Arnold Baca ¹, Peter Dabnichki ², Che-Wei Hu ², Phi

¹ Centre for Sport Science and
² STEM College, RMIT University
* Correspondence: juliana.ase

Abstract: The use of small, pervasive computing for an itself but defines a way for it time. The demand for objects that evolve to fulfill the aims performance environments. ubiquitous computing in sports in wearable sensors, cloud a major change in the ways wearable technology, comput to the process of acquiring it conditions. We selected relevant of sports and physical activity and data processing practices to the data-driven informed. Finally, we hypothesize that lead to the development of unrestricted data access and sports training and performer

Keywords: pervasive computing; physical activity; performance



Citation: Baca, A., Dabnichki, P., Hu, C.-W., Kromdahl, P., Essl, J. Ubiquitous Computing in Sports and Physical Activity—Recent Trends and Developments. *Sensors* 2022, 22, 8370. <https://doi.org/10.3390/s22218370>

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1. Introduction

Pervasive or ubiquitous computing and communication to sports and exercise-related motion studies conducted recreational and health-co tactical analyses of association of a match, just to name a

In an earlier review by the authors concluded that development of intelligent devices and interventions". A become a reality by analyzing

We discuss the state of units (MEMS IMU) and c sports. The merging of the



Araştırma Makalesi <https://dergipark.org.tr/tip/>

DOI: 10.48133/ig

Yüklenme Tarihi: 13.11.2024 Kabul Tari:

Giyilebilir Spor Teknolojilerinin Spor

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¹ İnönü Üniversitesi, Şi
² Hakkari Üniversitesi, Şi
Ö.

Teknolojinin hızlı gelişimi, spor yönetimini köklü bir yönetime, bu yenilikleri yaygın sağlayarak is veri sporcuların performansını daha etkili bir şekilde izli ihtiyaçlara karşılık vererek daha akıllı ve etkili stı araştırmamızın amacı giyilebilir spor teknolojile incelenmesidir. Araştırmada, nitel araştırma metodolo edilmştir. Araştırma sürecinde, öncelikle giyilebilir şg akademik makaleler, tezler, dergiler, gazeteler ve k edilmştir. Elde edilen veriler detaylı bir şekilde incele kullanımı ve etkileri üzerine kapsamlı bir değerler sporcuların fiziksel durumlarını, performans veriler izlemeye olanak tanımaktadır. Bu veriler, antrenm risklerinin azaltılmasına ve iyileşme süreçlerinin hızla spor yöneticilerine ve antrenörlere, takım performar bilgiler sağladığı tespit edilmiştir. Bununla birlikte, v teknolojiye adaptasyon süreci gibi bazı zorluklar teknolojilerinin spor yönetiminde önemli bir rol oy görülmektedir. Gelecekte, teknolojik gelişmelerin de yönetiminde daha geniş bir kullanım alanı bulacağı olumlu etkiler yaratacağı öngörülmektedir.

Anahtar kelimeler: Spor Yönetimi, Teknolojik Geliş

Use and Effects of Wearable Sports 1

ABST

The rapid development of technology has radically t innovations and sports organizations and managers can it and monitor athletes' performance more effectively development of smarter and more effective strategies t is to examine the use and effects of wearable sports t the document analysis method was preferred by focus the research process, firstly, academic articles, these to wearable sports technologies and sports managem The obtained data was examined in detail and a compr of wearable sports technologies in sports managem monitor their physical condition, performance data a found to help personalize training programs, reduce it also been found to provide sports managers and coach performance and player health. However, some challenge device costs, and users' adaptation process to techn technologies play an important role in sports manag future, with the continuation of technological develop find a wider use in sports management and innovation of sports.

Keywords: Sports Management, Technological D Strategies

* Sorumlu Yazar: İhtiyaç sorularına yanıtını yalnızca kendisi verebilir.

APPLICATION OF MOBILE TECHNOLOGY IN SI ENGAGEMENT AND AI

Kostić Dark

Faculty of Technical Sciences, University of Pri

PROFESSIONAL ARTICLE
DOI: 10.5937/ATAVPA25321K

Abstract: The integration of mobile applications in sports ha industry, including athlete performance, fan engagement and various applications of mobile technology in sports and its signific continues to advance, the role of mobile apps in the world of sports opportunities and challenges. The focus will be on how mobile ap the sports experience. This paper serves as an overview of the cu importance of the application of mobile technology in shaping th Key words: mobile technologies, sport, physical activity, applica

INTRODUCTION

The widespread use of mobile technology has revolution solutions to improve athlete performance, engage fans a address a wide range of needs, from personalized traini shaping the future of sports. Mobile technology has not on their performance but has also changed how fans expe performance analysis platforms, and interactive fan app and accessible. At the same time, apps facilitate sports org development in mobile technology enables not only bett and real-time analysis.

MOBILE APPLICATIONS FOR MONITORING THE PERFI

Training and Fitness Apps:

Mobile applications play a very important role in the exercise plans, nutrition guidelines and real-time perform Club) and FitOn empower athletes to optimize their p advancement of artificial intelligence and machine l sophisticated algorithms to provide personalized training and Strava use data collected through wearable device condition, fatigue, and injury potential. Additionally, spor coaches to track video analysis and improve their strateg



Picture 1 NTC

Performance Analysis:
Sports analytics applications allow coaches and ath

JMIR MHEALTH AND UHEALTH

Shaw et al

Original Paper

Smartphone and Tablet Software Apps to Collect Data in Sport and Exercise Settings: Cross-sectional International Survey

Matthew Peter Shaw^{1*}, MSc; Liam Paul Satchell², PhD; Steve Thompson³, PhD; Ed Thomas Harper⁴, MSc; Carlos Balsalobre-Fernández⁵, PhD; Daniel James Pear⁶, PhD

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Abstract

Background: Advances in smartphone technology have facilitated an increase in the number of commercially available smartphone and tablet apps that enable the collection of physiological and biomechanical variables typically monitored in sport and exercise settings. Currently, it is not fully understood whether individuals collect data using mobile devices and tablets, independent of additional hardware, in their practice.

Objective: This study aims to explore the use of smartphone and tablet software apps to collect data by individuals working in various sport and exercise settings, such as sports coaching, strength and conditioning, and personal training.

Methods: A total of 335 practitioners completed an electronic questionnaire that surveyed their current training practices, with a focus on 2 areas: type of data collection and perceptions of reliability and validity regarding app use. An 18-item questionnaire, using a 5-point Likert scale, evaluated the perception of app use.

Results: A total of 204 respondents reported using apps to directly collect data, with most of them (196/335, 58.5%) collecting biomechanical data, and 41.2% (138/335) respondents reported using at least one evidence-based app. A binomial general linear model determined that evidence accessibility ($p=35$, 95% CI 0.04–0.67; $p=.03$) was significantly related to evidence-based app use. Age ($p=.03$, 95% CI –0.06 to 0.00; $p=.03$) had a significant negative effect on evidence-based app use.

Conclusions: This study demonstrates that practitioners show a greater preference for using smartphones and tablet devices to collect biomechanical data such as sprint velocity and jump performance variables. When it is easier to access information on the quality of apps, practitioners are more likely to use evidence-based apps. App developers should seek independent research to validate their apps. In addition, app developers should seek to provide clear signposting to the scientific support of their software in alternative ways.

(JMIR Mhealth Uhealth 2021;9(5):e21763) doi: [10.19196/21763](https://doi.org/10.19196/21763)

KEYWORDS

mobile apps; sports; smartphone; mobile phone; questionnaire; survey

<https://mhealth.jmir.org/2021/5/e21763/>

JMIR Mhealth Uhealth 2021 | vol. 9 | iss. 5 | e21763 | p. 1
(page number not for citation purposes)

Parte 4. Algunos ejemplos donde la Evidencia puede contribuir a mejorar el entrenamiento Deportivo.

INTERSESSION AND INTRASESSION RELIABILITY AND VALIDITY OF THE *MY JUMP* APP FOR MEASURING DIFFERENT JUMP ACTIONS IN TRAINED MALE AND FEMALE ATHLETES

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ABSTRACT

Gallardo-Fuentes, F., Gallardo-Fuentes, J., Ramírez-Campillo, R., Balsalobre-Fernández, C., Martínez, C., Caniqueo, A., Cañas, R., Banzer, W., Loturco, I., Nakamura, F.Y., and Izquierdo, M. Inter-session and intrasession reliability and validity of the *My Jump* app for measuring different jump actions in trained male and female athletes. *J Strength Cond Res* 30(7): 2049–2056, 2016. The purpose of this study was to analyze the concurrent validity and reliability of the iPhone app named *My Jump* for measuring jump height in 40-cm drop jumps (DJs), counter-movement jumps (CMJs), and squat jumps (SJJs). To do this, 21 male and female athletes (age, 22.1 ± 3.6 years) completed 5 maximal DJs, CMJs, and SJJs on 2 separate days, which were evaluated using a contact platform and the app *My Jump*, developed to calculate jump height from flight time using the high-speed video recording facility on the iPhone. A total of 630 jumps were compared using the intraclass correlation coefficient (ICC), Bland-Altman plots, Pearson's product moment correlation coefficient (r), Cronbach's alpha (α), and coefficient of variation (CV). There was almost perfect agreement between the measurement instruments for all jump height values (ICC = 0.97–0.99), with no differences between the instruments ($p > 0.05$; mean difference of 0.2 cm). Almost

perfect correlation was observed between the measurement instruments for SJs, CMJs, and DJs ($r = 0.96$ – 0.99). *My Jump* showed very good within-subject reliability ($\alpha = 0.94$ – 0.99 ; CV = 3.8–7.6) and interday reliability ($r = 0.86$ – 0.95) for SJs, CMJs, and DJs in all subjects. Therefore, the iPhone app named *My Jump* provides reliable inter-session and intrasession data, as well as valid measurements for maximal jump height during fast (i.e., DJs) and slow (i.e., CMJs) stretch-shortening cycle muscle actions, and during concentric-only explosive muscle actions (i.e., SJs), in both male and female athletes in comparison with a professional contact platform.

KEY WORDS biomechanics, fitness, physical performance, strength

INTRODUCTION

Jump performance (i.e., explosive strength) has a key role in anaerobic-dominant (4,13), aerobic-dominant (39), and mixed aerobic-anaerobic athletic disciplines (20). Jump performance has been related with athletes' competition success (5) and may differentiate athletes from distinct technical levels (2,23). In addition, jump measures can predict injury risks (47), serve as talent identification (23), and replicate explosive competitive activities of athletes (27). Furthermore, the performance in vertical jumping can be associated with muscle power (44), neuromuscular fatigue (26,42), metabolic markers of exercise performance such as lactate, ammonia (42), and cortisol (7), and with psychobiological indices of perceived effort (7). Thus, it is not surprising that the vertical jump tests

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¿Porque son importantes este tipo de estudios?

- **Un aumento de la altura máxima de salto vertical suele ir acompañado con un mejor desempeño competitivo en atletas de Endurance Masc. y Fem.** (Ramirez-Campillo, Alvarez, Henriquez-Olguin, Baez, Martinez, Andrade & Izquierdo, 2014)
- **Es creciente la utilización del rendimiento del salto vertical (usado como un indicador de la fatiga neuromuscular) en una variedad de deportes de resistencia** (Boullosa, Tuimil, Alegre, Iglesias & Lusquinos, 2011; Del Coso, Salinero, Abian-Vicen, Gonzalez-Millan, Garde, Vega & Perez-Gonzalez, 2013; Petersen, Hansen, Aagaard & Madsen, Muscle, 2007)

La App. My Jump puede ser muy adecuada para evaluar a los atletas que participan en eventos de tipo explosivo, así como también para los atletas que compiten en eventos de resistencia.

Ante todo lo visto hasta acá, solo queda dialogar sobre:

¿Cuáles son las tecnologías que usan ustedes en sus procesos de entrenamiento?

Gracias

