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Original Investigation

Concordance of a new IMU in different small-sided games and real game tasks in indoor sports

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Purpose: The purpose of this study was to analyze the concordance of a new Inertial Measurement Unit (IMU) device called OLIVER in different specific training tasks and real futsal game.
Methods: 10 elite futsal players competing in First National Division performed most of the typical futsal training tasks (game possession in 22×20m, 2vs2 in 20×20m, 3vs3, 4vs4 in 28×20m and 4vs4 in 40×20m). Players wore two tracking devices (OLIVER and WIMU Pro). Data were recorded with specific software systems to compare the concordance of data. After recording data, descriptive analysis was developed for each training task, as well as a one-way ANOVA to evaluate the concordance of OLIVER and WIMU devices.
Results: The results reported good agreement for most variables, such as total distance, distance covered in different partials, as well as meters of accelerations and decelerations at different intensities and maximum speed ($P > .05$). However, the distance covered in high-speed running 12.1-18 km/h (m) and the number of runs above 12 km/h reported statistical differences between OLIVER and WIMU ($P < .05$) in some of the training tasks.
Conclusion: The OLIVER system and WIMU system shows a high level of concordance in main variables of external load in different training tasks. OLIVER system is a valid and useful device to monitor external load in indoor sports, both small-sided games and real games.

Keywords: GPS; indoor; team sports; training and testing; validity.

Introduction

Futsal is considered a team sport played on an indoor court measuring 40×20 meters[1-5]. During the sport, two teams compete, each consisting of a maximum of five players on the court—four outfield players and one goalkeeper[1-5]. A match comprises two 20-minute halves, with unlimited substitutions allowed without stopping the clock. Players engage in a high-paced game characterized by short, high-intensity intermittent efforts, performing 13.7% of your total distance when running at high intensity and 8.9% of your total distance when running at maximum intensity[1,4,5].
Both in training and in matches, players run at different intensities. They also accelerate and decelerate[6,7]. These actions are physically demanding, making it crucial to assess these external load parameters[6]. Coaches must design training sessions considering these demands to adapt players to peak competitive requirements[1]. One of the most used methodologies for addressing these competitive demands in training is small-sided games. These tasks create higher player density and smaller playing areas to concentrate the frequency of desired tactical actions[8,9]. Recent futsal studies have developed tasks in spaces such as 30×15m[8,9], 20×10m[8], 20×20m[10], and 40×20m conditioned by the number of players or the division of the pitch into various zones[10]. Typically, fewer players participate in these small-sided games, ranging from 2vs2 to 4vs4[8-11].
In recent times, electronic devices designed to monitor external load have been implemented, such as global positioning systems (GPS), local position measurement (LPM), tracking devices, accelerometers, and video analysis systems[6]. In indoor sports, GPS accuracy declines because GPS signals require open spaces[6]. Indoor sports also feature more explosive, shorter actions than outdoor sports, making GPS data less precise for indoor use[6]. Thus, accelerometer is the best option for monitoring external load in indoor sports[12].
The aforementioned devices help us first understand competitive demands to define programs/tasks and control physical aspects[13]. In indoor team sports, Inertial Measurement Units (IMU) are the most used devices[6]. So far, some of the metrics recorded by these devices are total distance traveled, distance at different intensities, as well as accelerations and decelerations[7, 13, 14]. The use of IMU devices in team sports has facilitated to control over these parameters; however, data on their use in futsal are limited[1, 7, 15, 16].

For coaches and physical trainers, designing sessions related to competitive efforts and requirements is easier with the external load data provided by these devices. Acquiring this data to design sessions enhances performance and reduces injury risk[15-20].

Inertial Measurement Units (IMU) are essential tools for objectively monitoring and optimizing performance across various sports. However, ensuring the quality and validity of the data they provide is necessary[7]. Traditionally, these devices have been validated on athletic tracks with predefined distances like 200 or 20 meters or in specially designed circuits[16]. Most studies, however, limit validation to variables like maximum speed and total distance covered[16]. Despite this, some devices have been validated in more specific scenarios, such as futsal circuits that include particular movements like direction changes and decelerations. Yet, these too focus on speed and distance variables[6]. Recently, a study expanded validation in futsal, evaluating an IMU device in a 4v4 small-sided game on a 28×20 meters field[21]. This study validated more specific variables such as total distance (m), high intensity distance (12-18 km/h) (m), maximum intensity distance (>18.1 km/h) (m), high acceleration (m) (>2 m/s²), high deceleration (m) (> -2 m/s²), and maximum speed (km/h) [21]. Despite these advances, further validation studies under real game conditions are necessary. This is especially important in indoor sports, where the absence of GPS signals and reliance on accelerometer increase the complexity of obtaining accurate measurements. Additional studies will help determine the reliability of IMU in real and complex sports environments, providing more precise and relevant data for improving sports performance. Therefore, the objective of this study was to analyze the concordance of a new IMU device in different futsal-specific training tasks.

Methods

Participants

Ten players (TIER 4)[22] from a First Division team in the Spanish futsal league (age 28.30±2.83 years, height 1.77±0.08 m, weight 72.07±6.46 kg) participated in this research. The team was conducting six sessions (7.50± 0.50 h) plus one match per week during data collection (the first half of the competitive period). Goalkeepers participated in the tasks, but their displacement data were not included in the study.

Design

A cross-sectional study was conducted to achieve the aforementioned objective. Four different small-sided game tasks characteristic of futsal were defined, in which players simultaneously wore the device to be validated (IMU OLIVER, Barcelona, Spain) and the already validated device (GPS WIMU PRO, RealTrack Systems, Almería, Spain). The study's objective and procedure were explained to all participating players, who then signed Informed consent was obtained in accordance with the Declaration of Helsinki. The study was approved by the local University Research Ethics Committee.

Methodology

At the beginning of training, all players simultaneously donned both devices. The WIMU device was placed on the back with a vest, and the OLIVER device was placed in the dominant leg's sock, at the gastrocnemius level. After training, players removed and turned off the devices, and their data were transferred to their respective software for extraction. Players participated with both devices simultaneously. Different specific futsal tasks were performed:

1) One series of possession games in a 22×20m area for 780 seconds.
2) 3 series of 2vs2 in a 20×20m area for 103 seconds each series.
3) 3 series of 3vs3 in a 28×20m area for 194 seconds each series.
4) 2 series of 4vs4 in a 28×20m area for 194 seconds each series.
5) 5 series of 4vs4 in a 40×20m area for 205 seconds each series.

Homogeneous participation was ensured with sufficient recovery (6'-9') to avoid fatigue affecting their performance[23].

The variables collected for both devices were: total distance (m), walking 0-6 km/h (m), jogging 6.1-12 km/h (m), high intensity distance 12.1-18 km/h (m), maximum intensity distance >18.1 km/h (m), high acc (m) at high intensity (>2 to 3m/s²) and maximum intensity (>3 to 10m/s²), high dec (m) at high intensity (> -2 to -3m/s²) and maximum intensity (> -3 to -10m/s²), number of accelerations at high intensity (>2 to 3m/s²) and maximum intensity (>3 to 10m/s²), number of decelerations at high intensity (> -2 to -3m/s²) and maximum intensity (> -3 to -10m/s²), number of high-intensity runs (>12 km/h) and maximum intensity runs (>18 km/h), and MAX Speed (km/h) as these are the typical actions in futsal[4, 6, 7].

Statistical analysis

Results are presented as mean ± standard deviation (SD). To analyze the concordance of the OLIVER device with WIMU, a one-way ANOVA was performed for each type of task[21] as all variables were normally distributed (Shapiro-Wilk test $P > .05$). Also, the effect size (ES) was calculated to assess statistical significance among both devices using Cohen's d, with the following ranges as >0.2 (small), >0.6 (moderate) and >1.2 (large). Statistical analysis was developed using JAMOVI 1.2.25 software (Sydney, Australia). The significance level was $P < .05$.

Results

Tables 1,2 and 3 show the one-way ANOVA results for the WIMU and Oliver devices in possession tasks on 22×20m, 2vs2 on 20×20m, 3vs3 on 28×20m, 4vs4 on 28×20m, and 4vs4 on 40×20m respectively. The average values of each variable from the two devices were analyzed. Significant differences were observed for the distance covered between 0-6 km/h (m) in the 2vs2 task on 20×20 ($P < .001$) and the 3vs3 task on 28×20m ($P < .001$). Also, in the distance covered between 12.1-18 km/h (m) in the possession task ($P = .002$) and the 3vs3 task on 28×20m ($P = .009$). Significant differences were also observed in the number of total accelerations (> 2 m/s²) (P< .001), in the number of total decelerations (> -2 m/s²) (P< .001), in the number of high intensity accelerations (2 to 3m/s²) (P< .001) and in the number of high intensity decelerations (-2 to -3m/s²) (P= .009) in the 2vs2 task on 20×20m. Furthermore, in the 4vs4 task at 28×20m, significant differences were observed in the total number of decelerations (> -2 m/s²) (P= .074). Lastly, significant differences were found in the number of high intensities runs (>12 km/h) in the possession task ($P < .001$), the 3vs3 task on 28×20m ($P < .001$), the 4vs4 task on 28×20m ($P < .001$), and the 4vs4 task on 40×20m ($P < .001$). Finally, significant differences were found in the maximum speed in the possession task ($P < .001$). For the rest of the variables in the different tasks, no significant differences were found ($P > .05$).

Table 1. One-way ANOVA (Welch) for WIMU and OLIVER Devices in small-sided games in 22×20m and 20×20m.

Variables	Possession on 22×20m							2vs2 on 20×20m						
	WIMU		OLIVER					WIMU		OLIVER				
	Mean	SD	Mean	SD	F	*P*	ES	Mean	SD	Mean	SD	F	*P*	ES
Total distance (m)	913.7	162.3	999.9	213.2	1.14	.299	.45	165.83	17.21	162.0	25.99	.5	.483	- .17
[0-6] km/h (m)	259.1	45.6	231.1	49.6	1.9	.184	-.59	53.15	8.14	42.28	12.54	17.46	< .001	-1.03
[6.1-12] km/h (m)	492.0	120.4	441.9	104.4	1.1	.309	-.45	88.81	16.70	91.47	20.20	.34	.561	.14
[12.1-18] km/h (m)	148.9	38.0	249.3	80.3	14.01	.002*	1.6	21.20	11.22	21.82	14.14	.04	.845	.05
[18.1-3600] km/h (m)	.0	.0	.9	2.8	.06	.06	.43	.0	.0	.0	.0	.06	.06	.0
High Acc quantity (>2m/s²)	37.1	7.8	41.2	11.1	.95	.343	.42	11.27	3.51	8.27	2.39	16.47	< .001*	- .99
High Dec quantity (> -2m/s²)	38.9	10.1	42.0	10.6	.49	.492	.29	12.06	2.93	9.45	2.11	17.28	< .001*	-1.02
High Acc (m) (>2m/s²)	144.3	35.2	161.8	46.2	.98	.334	.42	35.01	12.33	33.91	10.28	.16	.696	- .09
High Dec (m) (> -2m/s²)	136.1	40.7	154.1	40.1	1.09	.309	.45	33.39	8.70	34.32	7.66	.21	.645	.11
[2 3] m/s² (m)	107.9	31.6	117.9	31.3	.54	.470	.31	21.65	9.31	19.16	8.28	1.32	.255	- .28
[-3 -2] m/s² (m)	9.9	27.2	103.9	28.9	1.18	.291	.46	21.68	8.69	20.95	7.38	.13	.716	.18
[3 -10] m/s² (m)	36.4	16.1	43.9	25.8	.67	.424	.35	13.36	7.72	14.75	7.50	.55	.460	- .09
[-10 -3] m/s² (m)	45.2	15.1	5.2	18.2	.49	.494	.29	11.71	7.48	13.37	8.09	.75	.390	.21
[2- 3] m/s² quantity	27.2	6.5	31.5	7.9	1.84	.191	.58	7.24	2.59	5.09	2.01	14.26	< .001*	- .93
[3 -10] m/s² quantity	9.9	4.4	9.7	5.6	.01	.933	-.04	4.03	2.04	3.18	1.57	3.59	.063	- .47
[-3 -2] m/s² quantity	25.6	6.8	3.1	8.7	1.79	.197	.57	7.94	2.85	6.30	2.01	7.27	.009*	- .66
[-10 -3] m/s² quantity	13.2	3.8	11.9	3.9	.69	.415	-.35	4.12	2.33	3.15	1.89	3.45	.068	- .46
Number of maximum intensity runs (>18 km/h)	.0	.0	.1	.6	.06	.06	.43	.0	.0	.0	.0	.06	.06	.0
Number of high intensity runs (>12 km/h)	25.0	7.4	51.5	15.0	27.58	< .001*	2.24	4.00	2.06	3.09	1.72	3.78	.056	- .48
MAX Speed (km/h)	16.2	.8	18.3	1.2	22.8	< .001*	2.04	15.24	1.30	15.92	1.54	3.79	.056	.48

Note: *P: differences between Wimu and Oliver, $P < .05$. SD: Standard deviation. H_a μOLIVER ≠ μWIMU. [a] Significant Levene's test ($P < 0.05$) suggests that the variances are not equal. Effect Size (ES)

Table 2. One-way ANOVA (Welch) for WIMU and OLIVER Devices for small-sided games in 28×20m.

Variables	3vs3 on 28×20m							4vs4 on 28×20m						
	WIMU		OLIVER					WIMU		OLIVER				
	Mean	SD	Mean	SD	F	*P*	ES	Mean	SD	Mean	SD	F	*P*	ES
Total distance (m)	284.3	25.1	277.6	34.4	.82	.369	- .22	318.7	32.5	324.5	46.8	.22	.640	.14
[0-6] km/h (m)	103.2	10.6	90.3	13.9	18.06	< .001*	-1.05	101.5	11.7	104.2	11.4	.61	.438	.24
[6.1-12] km/h (m)	137.3	20.8	145.1	25.4	1.83	.182	.33	164.2	36.4	17.0	39.6	.26	.614	.15
[12.1-18] km/h (m)	39.3	12.8	30.6	13.8	7.17	.009*	- .66	47.8	18.4	39.4	28.9	1.33	.256	- .35
[18.1-3600] km/h (m)	.0	.0	.4	2.2	.06	.06	.25	.00	.0	.0	.0	.06	.06	.0
High Acc quantity (>2m/s²)	14.3	2.9	13.5	3.4	.92	.342	- .24	12.2	3.9	12.5	4.1	.04	.852	.06
High Dec quantity (> -2m/s²)	16.2	3.2	15.3	3.2	1.23	.271	- .27	15.9	3.8	13.8	3.6	3.36	.074*	- .55
High Acc (m) (>2m/s²)	48.1	10.7	53.4	13.2	3.12	.083	.43	44.8	15.6	49.2	17.8	.75	.391	.26
High Dec (m) (> -2m/s²)	48.9	11.3	53.9	11.4	3.16	.080	.48	50.6	14.4	49.6	15.3	.05	.827	- .07
[2 3] m/s² (m)	29.9	8.9	33.1	10.0	1.79	.186	.33	29.9	12.6	32.4	12.1	.45	.504	.20
[-3 -2] m/s² (m)	31.3	8.6	33.7	9.2	1.05	.308	.24	33.9	12.1	30.9	10.6	.77	.386	.21
[3 -10] m/s² (m)	18.2	7.9	20.3	9.3	.97	.328	.25	14.9	8.1	16.8	9.7	.48	.493	- .26
[-10 -3] m/s² (m)	17.5	8.7	20.3	8.8	1.589	.212	.31	16.6	6.8	18.6	10.3	.59	.447	.23
[2- 3] m/s² quantity	9.2	2.7	9.1	2.8	.03	.857	- .04	8.3	2.9	8.7	3.1	.16	.689	.12
[3 -10] m/s² quantity	5.1	2.1	4.5	2.1	1.51	.224	- .30	3.9	2.2	3.8	2.0	.05	.831	- .06
[-3 -2] m/s² quantity	10.1	2.9	10.4	2.8	.19	.669	.16	10.2	3.2	9.3	2.6	.95	.336	- .29
[-10 -3] m/s² quantity	6.2	2.6	4.9	2.2	3.95	.051	- .49	5.7	1.9	4.5	2.5	3.1	.086	- .53
Number of maximum intensity runs (>18 km/h)	.0	.0	.03	.2	.06	.06	.25	.0	.0	.0	.0	.06	.06	.0
Number of high intensity runs (>12 km/h)	4.5	1.9	7.0	2.4	22.47	< .001*	-1.17	4.5	2.6	8.2	2.8	2.39	< .001*	-1.36
MAX Speed (km/h)	16.1	.7	16.4	1.9	.67	.418	.20	16.0	1.3	15.9	.9	.07	.792	.08

Note: **P*: differences between Wimu and Oliver, $P < .05$. SD: Standard deviation. H_a μOLIVER ≠ μWIMU. [a] Significant Levene's test ($P < 0.05$) suggests that the variances are not equal. Effect size (ES).

Table 3. One-way ANOVA (Welch) for WIMU and OLIVER Devices in real 4vs4 play on 40×20m.

Variables	WIMU		OLIVER				
	Mean	SD	Mean	SD	F	*P*	ES
Total distance (m)	313.4	23.5	317.7	44.3	.29	.593	.12
[0-6] km/h (m)	113.1	14.6	117.1	18.9	1.16	.286	.24
[6.1-12] km/h (m)	137.2	17.4	133.1	26.0	.69	.409	- .19
[12.1-18] km/h (m)	58.5	16.3	55.5	26.7	.38	.541	- .14
[18.1-3600] km/h (m)	.2	.7	1.5	4.9	3.04	.089	.39
High Acc quantity (>2m/s²)	13.8	4.0	12.7	3.3	1.69	.197	- .29
High Dec quantity (> -2m/s²)	15.5	4.0	14.3	4.0	1.78	.186	- .3
High Acc (m) (>2m/s²)	52.4	14.9	50.2	13.5	.46	.499	- .15
High Dec (m) (> -2m/s²)	51.3	13.5	51.8	13.8	.03	.873	.04
[2-3] m/s² (m)	34.1	13.1	31.1	9.9	1.33	.253	- .26
[-3 -2] m/s² (m)	33.9	12.1	30.8	12.0	1.32	.254	.08
[3 10] m/s² (m)	18.3	11.2	19.1	9.3	.13	.718	-.26
[-10 -3] m/s² (m)	17.4	8.8	21.0	8.7	3.35	.071	.41
[2 3] m/s² quantity	8.8	3.2	8.4	2.8	.31	.582	- .12
[3 10] m/s² quantity	4.9	2.8	4.2	1.9	1.68	.199	- .29
[-3 -2] m/s² quantity	9.6	2.9	9.4	3.5	.08	.782	- .06
[-10 -3] m/s² quantity	5.9	2.5	4.9	2.2	3.70	.058	- .43
Number of maximum intensity runs (>18 km/h)	.0	.2	.2	.6	1.56	.218	.28
Number of high intensity runs (>12 km/h)	8.1	2.3	5.9	2.2	19.4	< .001*	- .98
MAX Speed (km/h)	17.0	.8	17.4	2.8	.78	.380	.2

Note: * *P*: differences between Wimu and Oliver, $P < .05$. SD: Standard deviation. H_a µ OLIVER ≠ µ WIMU. [a] Significant Levene's test ($p < 0.05$) suggests that the variances are not equal. Effect Size (ES).

On the other hand, a statistical analysis was conducted to examine the intraclass correlation coefficient (ICC). For the possession task in 22×20m, the ICC for various variables ranged from - .43 to .99 (from poor to excellent). In the 2vs2 task in 20×20m, the ICC for various variables ranged from - .33 to .99 (from poor to excellent). In the 3vs3 task in 28×20m, the ICC for various variables ranged from - .13 to .99 (from poor to excellent). In the 4vs4 task in 28×20m, the ICC for various variables ranged from - .43 to .99 (from poor to excellent). In the 4vs4 task in 40×20m, the ICC for various variables ranged from - .29 to .55 (from poor to moderate).

Discussion

Previous studies have validated IMU and GPS devices in different types of circuits[7, 20, 24] but not in small-sided game tasks or real game. This study's novelty lies in including the comparison of several relevant variables in indoor sports. The objective was to analyze the concordance of a new IMU device in different futsal-specific training tasks. The main findings are: a) the device proves valid for monitoring external load in futsal during both small-sided games in training and real game; b) variables previously unvalidated in real game situations, such as distance covered at maximum intensity (>18.1 km/h), high accelerations (>2 m/s²), and high decelerations (> -2 m/s²), have been validated[6, 7, 20, 24].

Other research has examined the accuracy of GPS devices in team sports. Beato, Devereux, and Stiff[7] conducted three tests to measure device validity: a 400m test, a 1285m sport-specific circuit replicating team sports actions, and a 20m sprint, validating total distance and maximum speed variables. Similarly, Beato, et al.[20] conducted a sport-specific circuit and a 20m sprint, validating total distance and maximum speed variables. Moreover, Muñoz-López et al.[24] performed a 146-meter circuit designed around team sports activities, validating total distance and maximum speed variables. However, these variables are less relevant for futsal due to its small spaces and constant changes of pace, making measures like brief accelerations and decelerations more critical than maximum speed or total distance covered.

Lago-Fuentes et al.[6] conducted a study to analyze the validity of an IMU for futsal through a circuit with sport-specific actions at different intensities: no activity (either standing or walking), and medium-low intensity at a speed <14 km/h, and high intensity at a speed >14 km/h. However, this study is the first to analyze the validity of various variables in small-sided games and real game tasks of high ecological validity, including variables such as jogging distance (6.1-12 km/h), maximum intensity distance (>18.1 km/h), high acc (m) (>2m/s²), high dec (m) (> -2m/s²), accelerations (2 to 3)m/s² (m), and high intensity decelerations (-3 to -2) m/s² (m), accelerations (3 to 10)m/s² (m), and maximum intensity decelerations (-10 to -3) m/s² (m), number of maximum intensity accelerations (3 to 10) m/s², and number of maximum intensity decelerations (-10 to -3)m/s², and number of maximum intensity runs (>18 km/h), specific to indoor sports, showing validity (*P*> .05) in both small-sided games and real game[18].

Several studies have analyzed the frequency emitted by GPS as fundamental to obtaining reliable measurements[7]. Beato et al.[7] used the STATSports Viper GPS with 10-Hz. The same author used the STATSports Apex GPS model with 10-Hz and another with 18-Hz in another study[20]. Muñoz-López et al.[24] used a WIMU GPS with 5-Hz. In another study, Lago-Fuentes et al.[6] used Overtraq, an IMU with a frequency of up to 200-Hz. The device under investigation in this study features a 10-Hz GPS for outdoor use and a 27-Hz IMU for indoor settings. Consequently, the frequency rates of the new IMU in this research are greater than those of the WIMU for outdoor applications and exceed those of the GPS. The Hz emitted by the device in this study provide secure data, as higher Hz improve the IMU signal, making the data more reliable, as noted by Beato et al.[7]

It's important to note that the subjects of this study were elite players from a premier division team in the Spanish league, adding significant perspective to validating an IMU device. Comparatively, other studies used less specialized samples: Beato et al.[7], and Beato et al.[20] involved 20 students; Muñoz-López et al.[24] involved two physically active males; and Lago-Fuentes et al.[6] included 11 junior futsal players. Using elite athletes in this study ensures greater relevance and reliability in the results, as these players perform movements and efforts that are inherently more representative of the competitive conditions the IMU devices face in high-performance situations.

Finally, this study examined and validated a variety of variables in multiple tasks, including total distance, jogging distance (6.1-12 km/h), maximum intensity distance (>18.1 km/h), high acc (m) (>2m/s²), high dec (m) (> -2m/s²), accelerations (2 to 3m/s²) (m), and high intensity decelerations (-3 to -2)m/s² (m), accelerations (3 to 10m/s²) (m), and maximum intensity decelerations (-10 to -3m/s²) (m), number of maximum intensity accelerations (3 to 10 m/s²), and number of maximum intensity decelerations (-10 to -3m/s²), number of maximum intensity runs (>18 km/h). It is interesting to note that placing the device in a sock at the calf level adds significant functionality. This location is advantageous as it corresponds to a garment player are already accustomed to using daily, unlike devices worn in vests, which could positively influence the device's acceptance and precision. Additionally, the comparison with another validated futsal device, OVERTRAQ, shows a limitation in the latter, as it lacks reference data for small-sided games and real game dimensions. Moreover, the variables validated by OVERTRAQ[6] are less related to key performance factors in futsal, highlighting the relevance of the approach and methodology used in this study in the context of sports performance in futsal.

Despite the results, this research is limited in its ability to cross-validate all variables since each franchise/device possesses unique proprietary variables. Nevertheless, this represents the second instance of validating a device across various small-sided games and actual play scenarios[21]. Future studies should analyze the external load in league matches and a micro-cycle in futsal. This study is not without limitations. The ICC is low (among poor to excellent depending on the task) because, being real situations, it is normal for the data to vary. Because these are situations in which the player is moving and in which they are changing positions among themselves. Notwithstanding, attending to the high levels of concordance among both devices, this study suggest that Oliver is a good tool for real game situations.

Practical Applications

This study validates the OLIVER system as an effective tool for recording and monitoring the external load of the main tasks and real game situations in different dimensions specific to indoor sports. These devices are essential for physical trainers in any sport, allowing individual external load control for each team player.

Conclusions

This study demonstrates the compatibility of the OLIVER system with various metrics in futsal. The new IMU device successfully tracked and documented the principal external load variables unique to futsal in diverse small-sided game and real game scenarios, recommending its application for monitoring training and competition loads.

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