Anthropometric profile, physical fitness and differences between performance level of Parkour practitioners

Oriol Abellán-Aynés[1], Fernando Alacid[2]

[1]International Chair of Sports Medicine. Faculty of Medicine. Catholic University San Antonio of Murcia (UCAM). Spain. [2]Department of Physical Activity and Sport Science. Faculty of Sport Sciences. Catholic University of Murcia, Murcia. Spain.

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Summary

Introduction: The aims of this study were to determinate the anthropometric profile and physical fitness of Parkour practitioners and to establish differences by performance level.
Method: Thirteen Parkour practitioners participated on this study. Agility, hamstring extensibility, horizontal jump distance, vertical jump height, vertical jump power, estimation of maximal oxygen consumption, body composition and somatotype were assessed with a battery of six tests. Also, a specific test which simulated a competition situation was performed in order to establish two groups (A: high performance; B: low performance) by the obtained score.
Results: Groups A and B obtained respectively 1.7-5.3-2.5 and 2.2-4.2-2.8 on somatotype; 7.50 ± 0.52 and 8.67 ± 2.13% on fat mass; 47.44 ± 2.03 and 45.91 ± 2.68% on skeletal muscle mass; 12.47 ± 0.70 and 12.53 ± 1.21% on bone mass; 72.80 ± 11.01 and 55.19 ± 6.06 ml•Kg^{-1}•min^{-1} on estimated oxygen consumption; 14.36 ± 0.47 and 15.29 ± 0.44 s on Illinois test (agility); 13.77 ± 5.20 and 7.86 ± 12.70 cm on sit and reach test; 50.09 ± 3.47 and 37.19 ± 4.82 cm on vertical jump height; 2820.84 ± 453.72 and 2105.84 ± 237.24 W on vertical jump power and 2.97 ± 0.71 and 2.60 ± 0.22 m on horizontal jump distance. Group A obtained significant lower values on ectomorphy and higher on mesomorphy, estimated oxygen consumption, agility, horizontal jump distance and vertical jump height and power.
Conclusions: After determining anthropometrical profile and physical fitness, we observe that vertical jump seems to be the most important parameter on Parkour performance, also other variables like estimated maximal oxygen consumption, agility, vertical jump power, horizontal jump distance, mesomorphy and ectomorphy appear as possibly determinant factors on Parkour performance.

Palabras clave:
Parkour. Performance. Anthropometry.

Perfil antropométrico, condición física y diferencias por nivel de rendimiento en practicantes de Parkour

Resumen

Introducción: Los objetivos del presente estudio fueron determinar el perfil antropométrico y condición física de los practicantes de Parkour y establecer diferencias en función del nivel de rendimiento.
Método: Trece practicantes de Parkour participaron en este estudio. Se valoró la agilidad, extensibilidad isquiosural, distancia de salto horizontal, altura de salto vertical, potencia de salto vertical, estimación del consumo de oxígeno máximo, composición corporal y somatotipo con un batería de seis test. Se llevó a cabo, además, un test específico que simulaba una situación de competición para establecer los dos grupos (A: mayor rendimiento; B: menor rendimiento) en función de los resultados obtenidos.
Resultados: Los grupos A y B obtuvieron, respectivamente, un somatotipo de 1,7-5,3-2,5 y 2,2-4,2-2,8; 7,50 ± 0,52 y 8,67 ± 2,13% en porcentaje de masa grasa; 47,44 ± 2,03 y 45,91 ± 2,68% en masa muscular esquelética; 12,47 ± 0,70 y 12,53 ± 1,21% en masa ósea; 72,80 ± 11,01 y 55,19 ± 6,06 ml•Kg^{-1}•min^{-1} en consumo máximo de oxígeno estimado; 14,36 ± 0,47 y 15,29 ± 0,44 s en el test de Illinois (agilidad); 13,77 ± 5,20 y 7,86 ± 12,70 cm en sit and reach; 50,09 ± 3,47 y 37,19 ± 4,82 cm en altura de salto vertical; 2.820,84 ± 453,72 y 2.105,84 ± 237,24 W en potencia de salto vertical y 2,97 ± 0,71 y 2,60 ± 0,22 m en distancia de salto horizontal. Comparando ambos grupos, el A obtuvo valores significativamente inferiores en ectomorfia y superiores en mesomorfia, estimación del consumo máximo de oxígeno, agilidad, distancia de salto horizontal, potencia y altura de salto vertical.
Conclusiones: Tras determinar el perfil antropométrico y condición física, observamos que el salto vertical se presentó como el parámetro más importante en el rendimiento en Parkour, además de otras variables como el consumo máximo de oxígeno, la potencia de salto vertical, la distancia de salto horizontal, la mesomorfia y la ectomorfia.

Key words:
Parkour. Rendimiento. Antropometría.

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Correspondence: Oriol Abellan-Aynés
E-mail: oabellan@ucam.edu

Introduction

Parkour has been defined as an extreme recreational activity in which a practitioner (traceur) reaches obstacles in the fastest and most efficient way possible, where it intervenes runs, jumps, vaults and climbing[1]. As Thibault & Roberts[2] indicate, there is a lot of controversy on Parkour definition. The word Parkour comes from the French word "parcours", which means route and it appeared in France in the 80's decade.

Research on Parkour is not as developed as other sportive activities. Previous studies have reported injuries produced on the practice[3-8]. Later, other studies with a sociological objective are focused on Parkour, studying how the -traceur- is involved on the environment, liberation of homogenization and globalization[9], the bad conception of this activity in society[10]. Other authors analysed the relationship of narcissist behavior and leadership among young people who practice risk sports, specially Parkour[11,12] and interviews for defining experiences[13].

Otherwise Leite *et al*.[14] determined physical fitness of Parkour practitioners in thirteen male traceurs, measuring performance variables such as aerobic capacity, vertical and horizontal jumps, hamstrings extensibility among others, concluding that Parkour improves upper limb more than lower limb and that its practice does not seem to need high values on physical fitness. Other authors have designed specific training sessions for this activity, focusing on the strenght-resistance development[15]. Grosprêtre & Lepers[16] compared Parkour practitioners with gymnast and power athletes, pointing out that traceurs have high plyometric abilities, great upper-to-lower limb coordination, high long jump, high vertical jump performance or knee extensors strenght. Puddle & Maulder[17] demonstrated that Parkour technique for landing gets lower ground reaction forces than traditional sports landing techniques.

Some authors also have treated the topic of incursion of Parkour in Physical Education classes[18], and Soto *et al*.[19] affirmed that children who practiced Parkour in Physical Education classes, avoided low motor coordination, which can carry to a lower adherence to sportiest practice, being Parkour an useful way to contribute to the improvement of coordination in childhood.

The aims of the present study were to determinate anthropometric profile and physical fitness of Parkour practitioners and to establish the differences between different performance groups in order to determine Parkour performance factors.

Material and method

Thirteen traceurs participated in this study. They were informed about the aims and procedures of the study and signed an informed consentient before starting the data collection. Inclusion criteria that traceurs had to achieve were: at least 3 years on Parkour practice, be older than 18 years old, not having any injury during data collection and not to practice any other kind of sport habitually (Table 1).

Measurements were done in three not consecutive days. Anthropometric data was collected on the first day, physical fitness test were done on the second day and the third day was for dividing the group by performance levels.

Table 1. General characteristics of the traceurs.

N	Age (years)	Stretch stature (cm)	Body mass (Kg)	Experience (years)
13	21.16 ± 2.52	177.25 ± 6.42	70.55 ± 9.06	5.57±2.34

Twenty anthropometric measurements were performed following the guidelines proposed by the *International Society for the Advancement of Kinanthropometry* (ISAK)[20].

Body mass and stretch stature were measured with a balance with stadiometer Seca 720 (Hamburg, Germany) with a precision of 100 g and 1mm. A total of 8 skinfolds (triceps, biceps, subscapular, iliac crest, Supraspinale, abdominal, front thigh and medial calf) with a Holtain® skinfold caliper (Holtain Ltd, Crymych, United Kingdom) with 0.2 mm of precision; 6 girths (arm relaxed, arm flexed and tensed, waist, gluteal, mid thigh and calf) with an anthropometric tape Cescorf® (Cescorf Ltda., Brasil) with a precision of 1 mm, and 4 breadths (biepicondylar humerus and femur, bistyloid and bimaleolar) with a modified Vernier caliper with 0.5 mm of precision.

All measures were taken twice and on the right side of the participants, the two measurements were compared with a tolerance of 5% for skinfolds and 1% for girths, breadths, body mass and height. In the case of a tolerance overcome, a third measurement was taken.

Dependent variables calculated using the anthropometric measurements were somatotype, using the Heath-Carter method[21], skeletal muscle mass through the Lee[22] formula, bone mass through Martin[23] formula and Yuhasz[24] formula for fat mass.

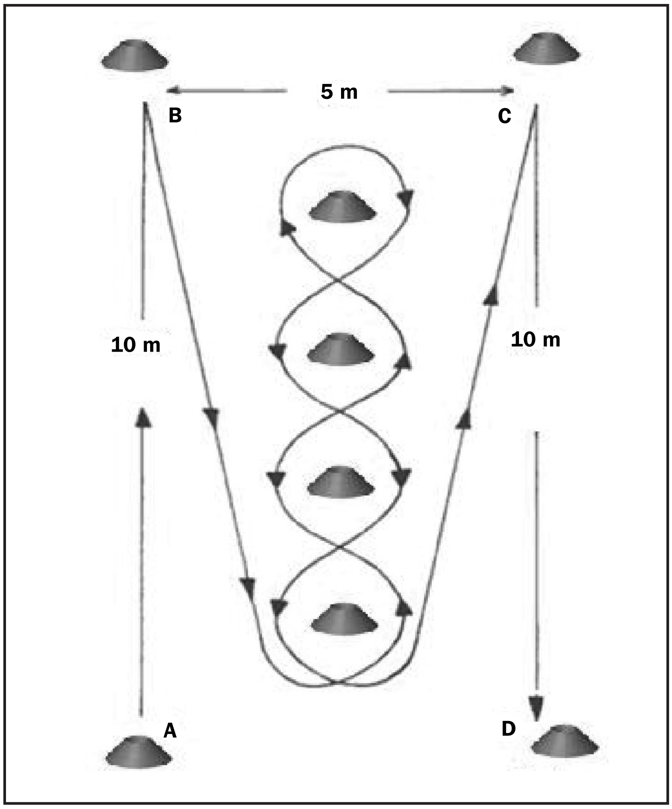
For the estimation of maximal oxygen consumption, it was used the 20 m shuttle run test[25].

Twenty meters shuttle run test consisted on running continuously between two point that were 20 m apart from side to side. These runs are synchronized with a pre-recorded audio tape. As the test proceeds, the athletes have to increase their speed over the course of the test until it is impossible to keep in sync with the recording. Initial speed is set on 8 $Km{\cdot}h^{-1}$, increasing to 9 $Km{\cdot}h^{-1}$ the first minute, then it increased a half kilometer per hour each minute. It was performed only one try per athlete.

For testing agility, we used the Illinois test, which consisted on running in a circuit with 10 x 5 m as area. Four cones in the corner and other four cones on the middle of the rectangle were used. The cone A marks the beginning of the test, B and C the turning points, and D as the end of the test. Athletes had to touch with one of their hands cones B and C, the end of the test was when they crossed the cone D. The circuit is presented in Figure 1. All athletes performed 2 attempts, saving the best score for each athlete.

Sit & reach test was used for the measurement of hamstring extensibility, having every athlete 3 attempts. They sat with their feet against the testing box and their knees extended. Then they placed the right hand over the left hand and reached forward as far as they were able. They were allowed to rest for one minutes among tries. The best score was the saved one.

Figure 1. Illinois test circuit.



Five countermovement jumps were performed by all athletes. Jump height was recorded using a contact platform Chronojump (Boscosystem® ltda., Spain). The best score for each athlete was saved and also used for calculating jump power using Samozino *et al*.,[26] equation.

All participants performed 3 horizontal jumps, starting on standing position with no previous run and parallel feet. The initial point was tiptoe, having the reference of calcaneus as the finish point.

The last test performed was a specific one, to determinate two groups as A: high Parkour performance; and B: low Parkour performance. The test consisted on a circuit designed by a Parkour expert. This test consisted on reaching seven obstacles where difficulty, execution and element concatenation were scored. Obstacles order were a length jump (3.125 m) with a 1.20 m ramp; a 1.10 m high rail vault using only their hands; two more identic rail vaults being allowed to do any element; a 2.15 m climb in a free way; other rail vault having to do, at least, a 360 degrees turn on the frontal or sagittal axis with no limit on longitudinal axis turns, being allowed to use only their feet; The sixth obstacle was a three elements concatenation where they had to do, at least, 360 degrees turn on frontal or sagittal axis and being allowed to use their hands on the ground; the last of them was another wall climb (2.6m height). On Parkour competitions, there are five judges to assess execution, difficulty, flow and creativity during a circuit. A Parkour expert took charge to define the execution, difficulty and flow punctuation to divide the sample in two groups due to it does not exist a published punctuation code yet, not being measured creativity.

Statistical analysis was done with IBM statics SPSS 20 software. Saphiro-wilk test was used for testing normality of the data and t test for independent samples for determining if there were significant differences among groups.

Results

Anthropometric characteristics, somatotype and body composition are presented on Table 2.

No significant differences appear on skinfold variables, thus there are not significant differences on body fat. Although there are some girths that present significant differences, muscle mass does not appear as a variable with significant differences. Same as body fat, there are not differences between groups on bone mass, perhaps due to an absence of significant differences on breadths variables. It is on two somatotype components, mesomorphy and ectomorphy, where we can observe significant differences between groups.

On Figure 2 we can observe a somatochart for all sample, such as mean of both groups and individual somatotypes for all the athletes. We observe the difference between group A and B on mesomorphy.

Values for physical fitness of both groups are presented on Table 3.

Significant differences between performance groups on physical fitness were observed. Hamstrings extensibility has been presented as a not different variable among groups. The rest of variables measured are presented different between groups scores, thus they seem to be important factors on Parkour performance.

Discussion and conclusions

The main finding of this study were the high differences on mesomorphy, estimated maximal oxygen consumption, horizontal and vertical jump, jump power and agility between groups. So these variables

Figure 2. Somatochart of Parkour practitioners.

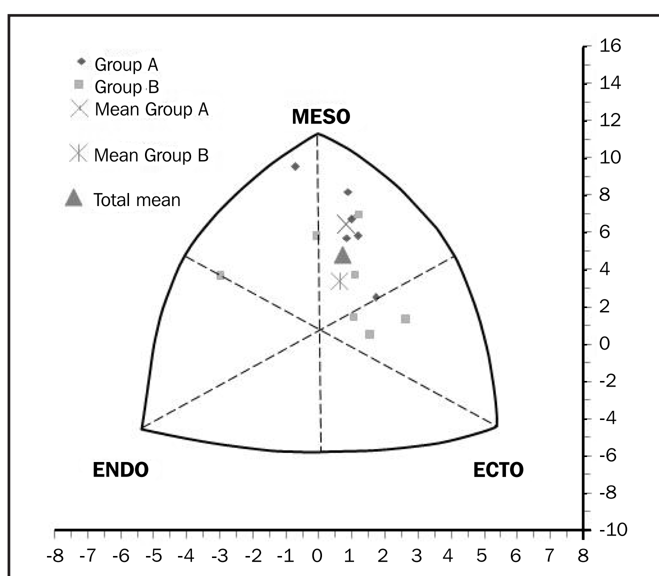


Table 2. Anthropometric characteristics and body composition (Mean ± SD).

	Group A (n=6)	Group B (n=7)	All (n=13)
Height (cm)	178.98 ± 6.55	175.77 ± 6.41	177.25 ± 6.42
Body mass (Kg)	75.47 ± 9.88	66.34 ± 6.16	70.55 ± 9.06
Triceps skinfold (mm)	5.08 ± 0.83	6.41 ± 3.03	5.80 ± 2.31
Subscapular skinfold (mm)	8.07 ± 0.76	9.26 ± 4.56	8.71 ± 3.32
Biceps skinfold (mm)	2.90 ± 0.33	3.31 ± 1.57	3.12 ±.15
Iliac crest skinfold (mm)	9.58 ± 2.04	14.07 ± 5.76	12.00 ± 4.88
Supraspinal skinfold (mm)	5.68 ± 0.73	7.61 ± 2.29	6.72 ± 1.96
Abdominal skinfold (mm)	7.45 ± 1.38	10.33 ± 4.80	9.00 ± 3.81
Front thigh skinfold (mm)	7.61 ± 2.16	11.01 ± 4.99	9.45 ± 4.18
Medial calf skinfold (mm)	5.93 ± 1.33	7.26 ± 3.77	6.65 ± 2.88
Sum of 8 skinfolds	54.63 ± 10.02	69.40 ± 30.70	61.45 ± 22.40
Sum of 6 skinfolds	40.56 ± 6.96	53.05 ± 23.33	46.32 ± 17.12
Arm relaxed girth (cm)	31.05 ± 2.39	28.32 ± 1.82 *	29.58 ± 2.46
Flexed and tensed arm girth (cm)	34.63 ± 2.59	31.07 ± 1.41**	32.71 ± 2.68
Waist girth (cm)	79.68 ± 3.60	74.71 ± 3.18 *	77.00 ± 4.14
Gluteal girth (cm)	94.79 ± 6.02	91.13 ± 5.75	92.82 ± 5.94
Calf girth (cm)	38.03 ± 2.20	35.07 ± 2.38 *	36.43 ± 2.68
Mid thigh Girth (cm)	54.68 ± 4.10	50.40 ± 5.75	52.38 ± 5.34
Humerus breadth (cm)	7.02 ± 0.33	6.63 ± 0.43	6.81 ± 0.42
Bistyloid breadth (cm)	5.66 ± 0.23	5.36 ± 0.28	5.50 ± 0.29
Femur breadth (cm)	9.56 ± 0.69	8.92 ± 0.66	9.22 ± 0.72
Bimaleolar breadth (cm)	7.35 ± 0.72	7.20 ± 0.31	7.27 ± 0.52
Endomorphy	1.7 ± 0.15	2.2 ± 1.01	2 ± 0.77
Mesomorphy	5.3 ± 0.89	4.2 ± 0.94**	4.7 ±1.04
Ectomorphy	2.5 ± 0.73	2.8 ± 0.92*	2.7 ± 0.82
Fat mass percentage	7.50 ± 0.52	8.67 ± 2.13	8.13 ± 1.66
Muscle mass percentage	47.44 ± 2.03	45.91 ± 2.68	46.61 ± 2.44
Bone mass percentage	12.47 ± 0.70	12.53 ± 1.21	12.50 ± 0.98

*p<0,05; ** p<0,01 respect group A

Table 3. Physical fitness (Mean ± SD).

	Group A (n=6)	Group B (n=7)	All (n=13)
Vo_2max (ml/kg/min)	72.80 ± 11.01	55.19 ± 6.06**	63.32 ± 12.35
Illinois test (s)	14.36 ± 0.47	15.29 ± 0.44**	14.86 ± 0.65
Sit & Reach (cm)	13.77 ± 5.20	7.86 ± 12.70	10.58 ± 10.06
Vertical jump height (cm)	50.09 ± 3.47	37.19 ± 4.82***	43.10 ± 7.88
Vertical jump power (W)	2820.84 ± 453.72	2105.84 ± 237.24 **	2435.84 ± 501.55
Horizontal jump (m)	2.97 ± 0.71	2.60 ± 0.22 **	2.77 ± 0.25

*p<0,05; ** p<0,01; *** p<0,001 respect group A.

seem to be determinant factors on Parkour performance. Lower values on ectomorphy also seem to be important on performance.

All components of body composition are presented as not important factors on Parkour performance because of the absence of statically differences among both groups, the same as happened to hamstrings extensibility and endomorphy.

Leite *et al.*[14] described some results on Parkour practitioners. On body mass index they found values of 21.21 ± 2.07, which were very similar to the values we described (22.46 ± 2.22). Their results on maximal oxygen consumption (44.21 ± 5.60 ml•kg^{-1}•min^{-1}) differs from the findings presented here (63.32 ± 12.35 ml•kg^{-1}•min^{-1}). On jumping variables, higher values for horizontal jump were described on the present study (2.77 ± 0.25 m) while they got values of 2.53 ± 0.21 m. Our results were lower on sit and reach (10.58 ± 10.08 cm) than Leite *et al.*, Subjects[14] (23.54 ± 8.32 cm). Warren *et al.*,[27] described results for fat mass of 7.26 ± 1.32% which were very similar to the values of the athletes from this study (7.50 ± 0.52%). Otherwise, in contrast to their study, we got results of 5100.58 ± 141.29 W for vertical jump power while they got 6234.32 ± 619.00 W, using the Sayers *et al*.,[28] cited in Carlock *et al*.,[29] equation for jump power.

When comparing with other sports, such as gymnastics, we can observe the higher results on vertical jump (43.10 ± 7.88 cm) while other authors have found lower values like 37.22 ± 6.19[30], 38.50 ± 0.9[31], 40.10 ± 1.2 cm[32]. There are also big differences in somatotype, while we got values of 2.0-4.7-2.7, other studies present values of 2.4-4.7-2.8[33], 1.7-6.3-1.6[34] and 1.8-7.1-1.6[35]. Then we can observe our higher values on ectomorphy, but lower scores on mesomorphy. On the other hand we observe similar values in endomorphy. When comparing our 8.13 ± 1.75% of body fat value, the results in gymnastics were 7.13 ± 1.60[33] and 11.34 ± 1.6, so the body fat percentage appears lower on traceurs than gymnastics athletes.

Comparing the variables of horizontal jump and agility with other sport's athletes, it can be observed, also, the higher values for Parkour practitioners, even higher than other sports where the measured condition is the specific movement on the respective sport. Traceurs got scores of 14.86 ± 0.65 s on Illinois test, founding values of 16.28 ± 0.57 s on soccer players[36], 17.40 ± 0.90 s on Rugby players[37], 15.87 ± 0.47 s on squash players[38] and 16.88 ± 0.86 on hand ball players[39]. Our results have not previously been described. On horizontal jump, the traceurs of our study got values of 2.77 ± 0.25 m, while the results on soccer players are 2.39 ± 0.14[40], 2.72 ± 0.14 on sprinter and 2.72 ± 0.13 on long jump athletes[41].

This study set out to determine that the most important performance factors on Parkour practitioners are high values on mesomorphy, vertical jump height and power, horizontal jump, maximal oxygen consumption and agility and low values on ectomorphy. Parkour is also presented as an effective training method for development of high levels of horizontal and vertical jump and agility, getting higher scores even in horizontal jump than in long jump athletes

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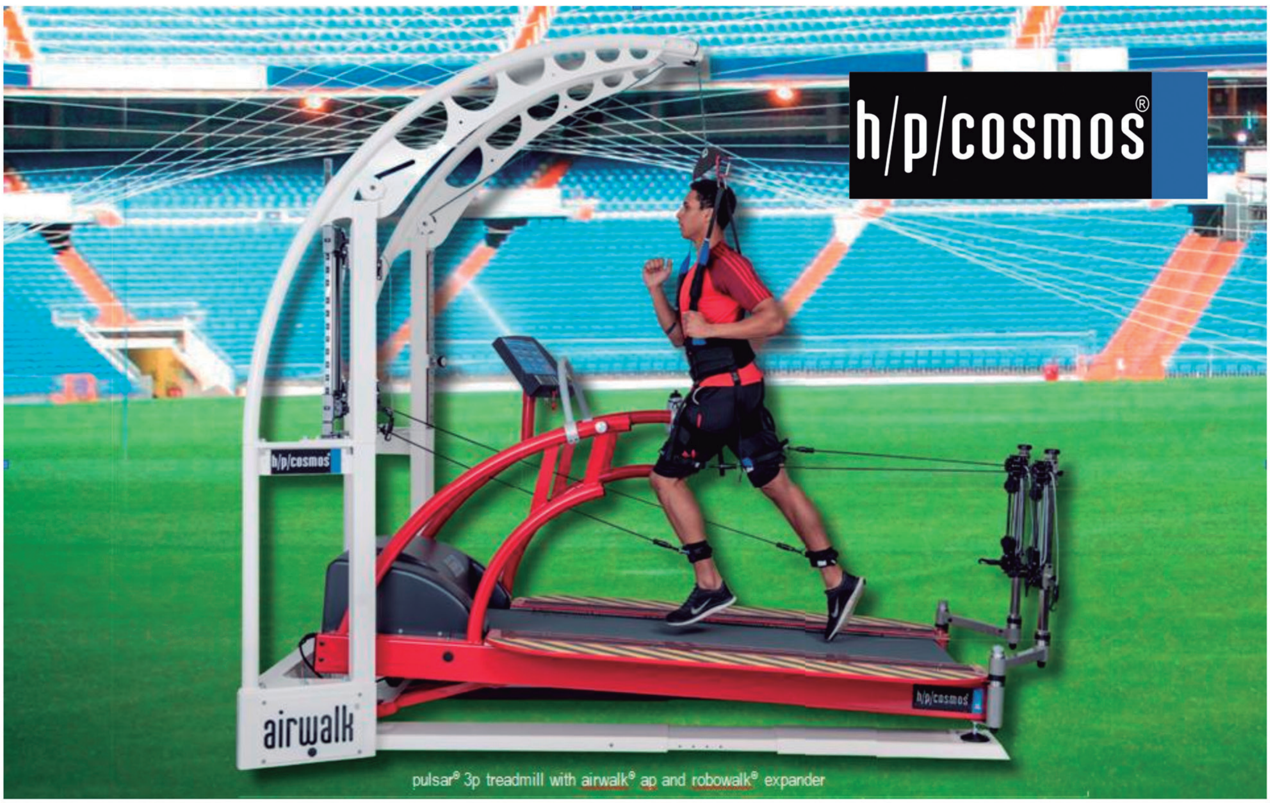
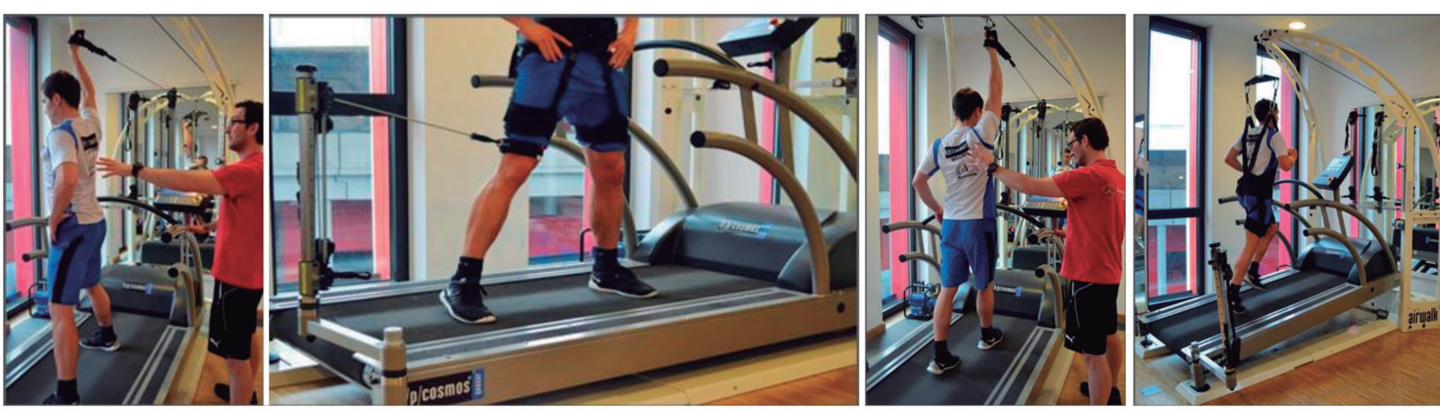
Entrenamiento y Rehabilitación

Utilizando los distintos componentes diseñados por **h/p/cosmos**, le ofrecemos una solución que nos permite disminuir el peso del paciente o deportista hasta un máximo de 120 Kg, para realizar tanto ejercicios de rehabilitación (de articulaciones, huesos o muscular) como de entrenamiento, ademas de aquellos casos de protección de sobrecarga anterior a una prueba deportiva, fascitis plantar, etc.

Ademas, puede utilizarlo también para otras aplicaciones como pruebas de esfuerzo, análisis de gases, estudios biomecánicos con análisis óptico, etc. Tanto en un tapiz rodante nuevo, como con el que ya disponga de la marca.



Ejemplos de ejercicios de musculación y carrera, con pendiente positiva o negativa



RehaRunning lo forma:

- Tapiz rodante, por ejemplo **Pulsar 3P** con una velocidad de hasta 40 Km/h
- Sistema antigravedad **Airwalk ap** con una descarga máxima de 80 o 120Kg (dos versiones) y altura max. del usuario de 220cm.
- Sistema de musculación mediante tensores delanteros y traseros **Robowalk expander** de aplicación simultanea a la carrera.

y pueden integrarse distintas soluciones para estudios biomecánicos y mejora de la carrera como:

- Plataforma de distribución para estudio de la pisada y paso, **Zebris FDM -T**
- Sistema **Optogait** con retro-información de la carrera en tiempo real
- Sistema de **análisis óptico** con 1 o 2 cámaras de alta velocidad

Mas información en www.aemedi.es/anti_gravitatorio.htm

AEMEDI

Telf: 934 585 201
www.aemedi.es
info@aemedi.es