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Morphological Differences of Street Workout Athletes According to the Training Experience

Diferencias Morfológicas en Atletas de Street Workout según la Experiencia de Entrenamiento

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SUMMARY: In several sports, morphological differences exist when comparing training status. However, these are less known in novel urban sports such as Street Workout (SW). This study compares the morphological characteristics between untrained (novice) and trained (experienced) SW athletes. Thirty-seven male Street workout practitioners from Viña del Mar (Chile) participated. Anthropometric, body composition, and somatotype data were assessed and compared according to the training experience. We found that trained SW athletes had a higher flexed and tensed arm perimeter (+4.4 %, p=0.038), lower hips perimeter (-4.8 %, p=0.041), narrower biiliocristal breadth (-3.2 %, p=0.035), lesser sum of 6 skinfolds (-40.8 %, p<0.001), and a lower endomorphic component (p<0.001) than untrained SW athletes. The proportionality analysis revealed that trained athletes had significantly higher upper body perimeters and lower skinfolds than untrained athletes. In addition, trained participants had higher percentages of the whole-body (+6.5 %, p<0.001) and upper limb muscle mass (+1.1 %; <0.001), and lower fat mass percentage (-7.9 %, p<0.001) and fat mass (-6.9 kg, p<0.001). In conclusion, similar to other sports, morphological differences exist in SW according to the training status, suggesting that morphology is associated with training experience. Further studies using DEXA should corroborate our findings and, in turn, determine the relevance of morphology in SW performance.

KEY WORDS: Anthropometry; Body composition; Exercise; Gymnastics; Sports.

INTRODUCTION

In several sports, morphological and performance differences exist when comparing training status. For example, in Taw Kwon Do, experienced practitioners had lower body fat, higher strength, and better aerobic performance than novice practitioners (Toskovic *et al*., 2004). Also, elite female volley ballers had high muscle mass and bone mass compared to the amateur subgroup (Mielgo-Ayuso *et al*., 2017). In addition, a recent systematic review concluded that higher-level soccer players had a better body composition profile, higher cardiorespiratory fitness, and higher muscle strength and power compared to lower competitive level soccer players (Slimani & Nikolaidis, 2019). In this way, the training status and experience are linked to the morphological characteristics and performance, making the assessment of these variables and comparison between training status relevant.

Street Workout (SW) is a novel urban sport where athletes use their body weight as resistance, known as calisthenics exercises (Tomczykowska, 2013). Calisthenics exercises are used for strength, body composition, and posture improvements (Thomas *et al*., 2017; Kotarsky *et al*., 2018), for physical preparation of gymnasts and militaries (Harrison, 2010; Gist *et al*., 2015), and are commonly used in physical therapy and fitness (Tapley *et al*., 2015; Thompson, 2019). In SW, athletes execute isometric and isotonic calisthenic exercises on rings, bars, or the floor, as well, swings and combinations, called freestyle. Calisthenics exercises in SW are mainly performed in closed kinetic chain exercises (Harrison), are similar to gymnastics exercises and postures (e.g., pull up, front-lever, or straddle planche), and include variations to modify muscle recruitment and load (Ebben *et al*., 2011;

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Calatayud *et al*., 2017). About freestyle, it is similar to artistic gymnastics routines on high bars, parallel bars, and uneven bars.

The popularity of SW has led to the creation of international organizations such as the World Street Workout & Calisthenics Federation (WSWCF, 2011) or the Spanish Federation of Street Workout and Calisthenics (FESWC, 2017). However, despite the global popularity of bodyweight training (Kercher *et al*., 2021), few studies have investigated SW. For example, some authors researched the injury profile (Ngo *et al*., 2021), psychosocial profile (Taipe-Nasimba *et al*., 2019), and morphology (Sanchez-Martinez *et al*., 2017). Likewise, the morphology in SW was explored in competitive athletes. In that study, a balanced mesomorph somatotype was reported, with a high muscle mass and low levels of fat mass (Sanchez-Martinez *et al*.). In addition, they had small skinfolds values and high proportional girths in the upper limb and trunk, related to the predominance of upper body exercises in this discipline. Lastly, a recent study reported that adolescent SW athletes with higher training experience had a higher percentage of muscle mass and handgrip strength than the lower training level group (Podrihalo *et al*., 2021).

Although the morphological differences between training status have been researched in several sports, novel urban sports such as SW are less known. For this reason, the objective of this study is to compare the morphological characteristics between untrained (novice) and trained (experienced) adult SW athletes.

MATERIAL AND METHOD

Participants. Thirty-seven male Street workout practitioners from Viña del Mar (Chile) voluntarily participated in this study between August and October 2015. Inclusion criteria were: i) healthy male above 18 years old; ii) current practice of Street Workout; iii) free of acute muscle-skeletal injuries. In addition, participants must sign an informed consent, which indicated the study protocol and objectives. Moreover, this research met the current Declaration of Helsinki criteria for human research.

Training experience categories. Participants were categorized by training status as Trained, defined as at least 1 year of resistance training experience or an athlete participating in a competitive sport at the high school, collegiate, or professional level; or Untrained, defined as less than 1 year of resistance training experience (Williams *et al*., 2017).

Anthropometric measurement. Anthropometric measurements met the protocol of the International Society for the Advancement of Kinanthropometry (ISAK) (Stewart *et al*., 2011). The protocol was composed of 25 measurements, including i) Basic data: weight (OMRON, HN-289-LA, Kyoto, Japan), height and sitting height (SECA, model 213, GmbH, Germany); ii) 6 breadths (Rosscraft anthropometer): biacromial, transverse chest, anteroposterior chest depth, biiliocristal, humerus, femur; iii) 10 girths (metal Lufkin tape): head, arm (relaxed), arm (flexed and tensed), forearm (maximum), chest (mesosternale), waist (minimum), hips (gluteal), thigh (1 cm gluteal), thigh (mid tro-tib-lat), and calf (maximum); and iv) 6 skinfolds (Slim Guide caliper): triceps, subscapular, supraspinale, abdominal, front thigh, and medial calf. Measurements were carried out by certified ISAK anthropometrists at the IRyS Laboratory of the Pontificia Universidad Católica de Valparaíso. The procedure was performed with as little clothing as possible to facilitate the marking and measurement in a proper evaluation room.

Data analysis. Body mass index (BMI) was calculated as body weight divided to height squared (kg/m^2) and categorized as underweight weight (below 18.5), normal weight (18.5-24.9), pre-obesity (25.0-29.9), obesity class I (30.0-34.9), obesity class II (35.0-39.9), or obesity class III (above 40), based on The World Health Organization (WHO) reference values. In addition, WHO cut-off points were considered for the interpretation of waist circumference for men (>94 cm represents a risk of metabolic complications) and waist-to-hip ratio (WHR) for men (≥0.90 denotes risk of metabolic complications). Waist to height ratio (WtHR), a predictor of cardiovascular risk and mortality, was classified using national cut-off points as low risk (<0.5), moderate risk (0.5-0.55), and high risk (>0.55) (Koch *et al*., 2008).

The somatotype of the subjects was determined by the Heath & Carter method (Carter & Heath, 1990). The somatotype quantifies the shape and composition of the body, about the relative fatness (endomorphy), relative musculoskeletal robustness (mesomorphy), and the relative linearity of the body (ectomorphy). For anthropometric proportionality, we used the Z-scores of the Phantom model (Ross & Wilson, 1974), which adjusts and scales anthropometric variables for comparisons between samples or populations. The whole-body composition was estimated using the pentacompartimental fractionation method (Kerr, 1988). Likewise, upper and lower muscle mass was estimated using validated equations for anthropometric data (Rodríguez-Rodríguez *et al*., 2010).

Statistical analysis. Data analysis was performed using IBM SPSS Statistics Version 25 for Mac (IBM Corp). Data are presented as mean and standard deviation (SD) or median and interquartile range (IQR). Likewise, data distribution was evaluated using the Shapiro Wilk test. Then, mean comparisons of independent samples were performed using t-test statistics for parametric and Mann-Whitney U for non-parametric data. The significance level was set at p<0.05.

RESULTS

Anthropometric characteristics. Anthropometric data of trained and untrained SW athletes are shown in Table I. Trained practitioners had a higher SW training experience than untrained participants (p<0.001), with a median difference of almost 2 years. About BMI, in the trained group, 10 out of 12 athletes had normal weight, and 2 had pre-obesity; while in the untrained group, 19 out of 25 were normal weight, 4 had pre-obesity, and 2 had obesity class I. All trained athletes were at low risk of metabolic complications regarding waist circumference, while 1 out of 25 of the untrained participants was at risk. About WHR, 2 out of 12 athletes in the trained group had a risk of metabolic complications, and all untrained athletes had a healthy WHR. Regarding WtHR, all trained athletes had a low risk of cardiovascular risk and mortality as well as 23 out of 25 untrained athletes, while 2 untrained participants had moderate risk. Based on mean values, both groups presented a healthy anthropometric profile on BMI (normal weight), waist circumference (low risk), WHR (low risk), and WtHR (low risk). No differences were found concerning age, weight, height, sitting height, and anthropometric indexes between groups.

Most of the breadths were similar between training status. However, untrained athletes had a wider biiliocristal diameter (+3.2 %, p=0.035) than trained SW participants. About girths, most of them were similar between training experience. Nevertheless, trained athletes had higher flexed and tensed arm girth (+4.4 %, p=0.038) and lower hips perimeter (-4.8 %, p=0.041) in comparison to untrained SW participants. Regarding skinfolds, the trained subgroup had lower values in all the measurements and 40.8 % less sum of 6 skinfolds than the untrained subgroup (p<0.001).

The somatotype of each participant and the subgroup means are illustrated in Figure 1. On the one hand, trained athletes had a balanced mesomorph profile (high musculoskeletal robustness and lower/balanced relative fatness and linearity). On the other hand, untrained athletes obtained an endomorphic mesomorph profile (the musculoskeletal component slightly dominates, followed by

Table I. Anthropometric characteristics of trained and untrained Street Workout athletes.

Variable	Trained	Untrained	p-value
n	12	25	
Age (y)	21.8 (6.54)	21.7 (4.14)	0.737
Experience (months)	24 (16.5)	2 (2.5)	**<0.001**
Weight (kg)	65.9 (11.5)	71.6 (10.7)	0.267
Height (cm)	169.7 ± 5.5	172.5 ± 6.1	0.197
Sitting height (cm)	90.3 ± 3.0	91.0 ± 3.0	0.501
BMI	23.06 (2.89)	23.40 (2.93)	0.491
WHR	0.86 ± 0.04	0.84 ± 0.03	0.090
WtHR	0.45 ± 0.02	0.46 ± 0.03	0.653
Breadths (cm)			
Biacromial	40.2 ± 1.8	40.1 ± 2.0	0.822
Transverse chest	28.0 (2.5)	28.2 (2.4)	0.689
Anteroposterior chest depth	19.1 (1.8)	18.8 (2.7)	0.620
Biiliocristal	27.0 (2.2)	27.9 (2.9)	**0.035**
Humerus	6.7 ± 0.3	6.9 ± 0.4	0.194
Femur	9.1 ± 0.3	9.1 ± 0.4	0.915
Girths (cm)			
Head	55.3 ± 0.9	56.3 ± 1.7	0.065
Arm (relaxed)	31.4 ± 1.3	30.4 ± 2.2	0.154
Arm (flexed and tensed)	34.4 ± 1.5	32.9 ± 2.2	**0.038**
Forearm	27.3 ± 1.1	26.6 ± 1.6	0.171
Chest	96.1 ± 4.0	95.4 ± 5.0	0.649
Waist	76.5 (6.1)	76.6 (7.7)	0.395
Hips	90.4 (4.6)	93.4 (7.2)	**0.041**
Thigh (1 cm gluteal)	53.7 (4.4)	55.0 (4.9)	0.102
Thigh (mid tro-tib-lat)	49.8 ± 2.9	51.3 ± 3.9	0.224
Calf	35.0 ± 2.3	36.0 ± 2.4	0.268
Skinfolds (mm)			
Triceps	6.0 (3.8)	12.0 (6.0)	**<0.001**
Subscapular	7.0 (4.8)	12.0 (8.0)	**<0.001**
Supraspinale	7.0 (3.4)	12.0 (12.5)	**0.002**
Abdominal	11.0 ± 3.7	21.4 ± 8.9	**<0.001**
Front thigh	9.0 (3.5)	14.0 (6.5)	**0.001**
Medial calf	5.0 (1.9)	8.0 (5.5)	**0.019**
Sum 6 skinfolds	45.0 (15.8)	76.0 (45.0)	**<0.001**
Somatotype			
Endomorph	2.1 ± 0.6	3.9 ± 1.3	**<0.001**
Mesomorph	5.4 ± 0.6	4.9 ± 1.0	0.099
Ectomorph	2.0 ± 0.7	2.0 ± 0.8	0.768

Data shown as mean ± SD or median (IQR); BMI: body mass index; WHR: waist to hip ratio; WtHR: waist to height ratio. Significance shown in bold, p<0.05.

the fatness component). In addition, the trained group had a lower endomorphic component (p<0.001).

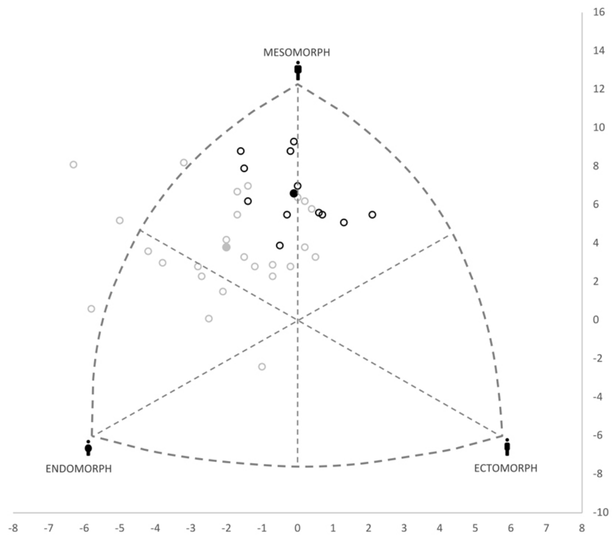

Fig. 1. Somatotype of trained (open black circles) and untrained (open gray circles) Street Workout athletes, and mean somatotype of the trained (black circle) and untrained (gray circle) subgroups.

Proportionality. The anthropometric proportionality comparison is illustrated in Figure 2. In general, both groups showed a similar anthropometric proportionality, with higher circumferences in the upper limb and trunk, smaller girths in the lower limb, and smaller skinfolds compared to the reference (Phantom, Z=0); however, some differences were found. Trained athletes had a larger relaxed arm (+47.4 %, p=0.029), flexed and tensed arm (+65.4 %, p=0.006), and forearm circumferences Z-scores (+101.3 %, p=0.006) in comparison to untrained SW athletes. No differences were found in other Z-score girths. Both groups had negative Z-scores in skinfolds, which means a lower proportionality component of subcutaneous adipose tissue. Nevertheless, trained athletes had smaller Z-score skinfolds (p<0.05) than untrained athletes.

Body composition. Data are summarized in Table II. No differences between groups were observed in the whole body, upper limb, and lower limb muscle mass. Nonetheless, trained athletes had a higher relative whole-body muscle mass (+6.5 %, p<0.001) and upper limb muscle mass percentage (+1.1 %; <0.001) than untrained SW participants. In addition, trained athletes presented smaller values of fat mass (-6.9 kg, p<0.001) and % fat mass (-7.9 %, p<0.001) in comparison to untrained participants. Finally, no differences were found in bone mass.

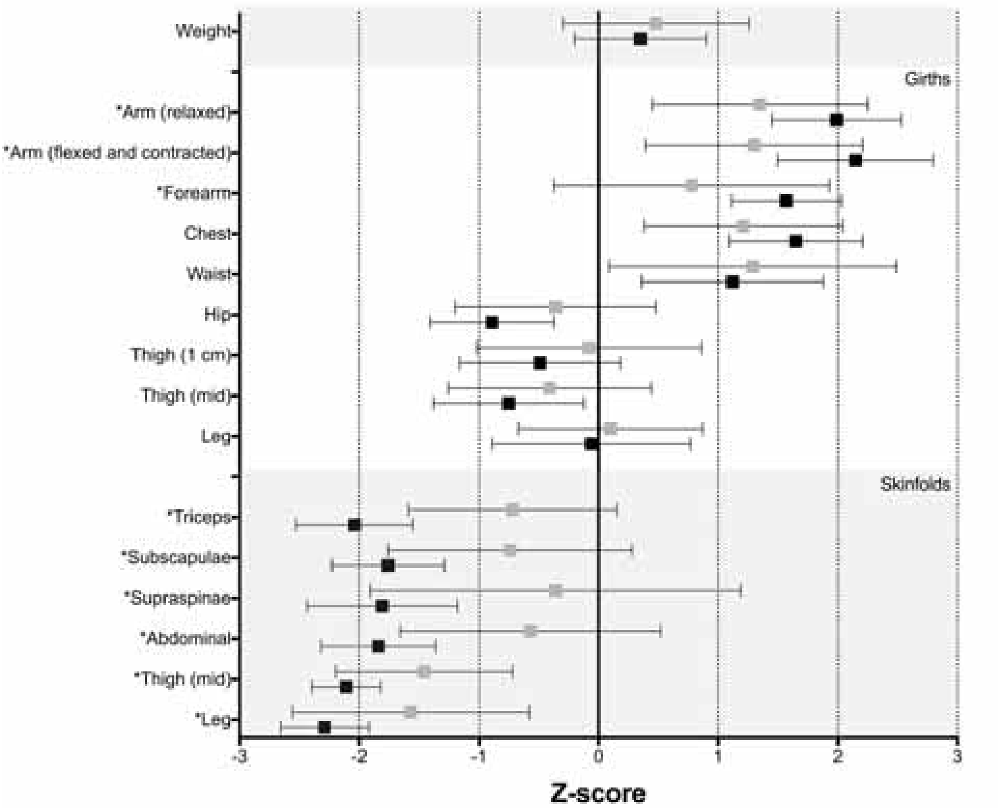

Fig. 2. Comparison of anthropometric proportionality between trained (black squares) and untrained (gray squares) Street Workout athletes. Data presented as mean and SD. *Significant difference between groups, p<0.05.

Table II. Body composition of trained and untrained Street Workout athletes.

Variable	Trained	Untrained	p-value
Muscle mass (kg)	34.7 ± 4.5	32.1 ± 4.0	0.084
Muscle mass (%)	51.5 ± 1.6	45.0 ± 4.1	**<0.001**
ULMM (kg)	7.1 ± 0.7	6.8 ± 1.1	0.323
ULMM (%)	10.6 ± 0.5	9.5 ± 0.9	**<0.001**
LLMM (kg)	14.1 ± 1.4	14.3 ± 1.6	0.715
LLMM (%)	21.0 ± 1.4	20.1 ± 2.2	0.190
Fat mass (kg)	13.5 (2.2)	19.3 (7.6)	**<0.001**
Fat mass (%)	20.3 ± 1.6	28.2 ± 5.1	**<0.001**
Bone mass (kg)	7. 6 (1.5)	7. 8 (1.4)	0.413
Bone mass (%)	11.4 ± 1.2	11.1 ± 1.2	0.465

Data shown as mean ± SD or median (IQR); LLMM: lower limb muscle mass; ULMM: upper limb muscle mass. Significance shown in bold, p<0.05.

DISCUSSION

This study aimed to compare the morphology between trained (experienced) and untrained (novice) SW athletes. We found that trained SW athletes had a higher flexed and tensed arm perimeter, lower hips perimeter, narrower biiliocristal breadth, lesser skinfolds, and a lower adipose component than untrained SW athletes. The proportionality analysis revealed that trained athletes had higher upper body perimeters and lower skinfolds than untrained athletes. In addition, trained participants had higher percentages of the whole body and upper limb muscle mass and lower fat mass.

Our findings are similar to a previous study that compared the body composition of adolescent SW athletes with different training levels (Podrihalo *et al*.). Both studies report differences in the percentage of muscle tissue concerning SW training experience; however, we additionally found differences in fat mass. Despite the similar results with the previous research, the comparison and interpretation should be cautioned due to the methodological differences to assess body composition, categorize training experience, and the age of participants.

The particularities of the SW training may justify the morphological differences found between training statuses. Firstly, upper body exercises predominate in SW, so a higher muscle development due to training adaptation could explain the differences in the arm perimeter between training status. In this way, higher percentages of whole-body muscle mass and upper limb were found in trained athletes. Similar differences between training levels have been found in sports that use bodyweight exercises and resistance training. For example, the higher the training level in CrossFit, the higher the fat-free mass (Mangine *et al*., 2020). In addition, a higher volume of high-intensity functional training (HIFT) increased lean body mass compared to lower HIFT volumes (Cavedon *et al*., 2020). Secondly, the smaller hips perimeter detected in trained athletes could be because lower body exercises are less performed in SW. In addition, negative Z-scores in the lower limb, compared to the positive upper limb scores, could interpret the use and disuse of musculature in SW.

Thirdly, it is known that full-body resistance training reduces the fat mass content (Wewege *et al*., 2022). Trained participants had lower skinfolds and fat mass than untrained athletes, differences that may be related to the resistance training experience. These findings are comparable to sports with the dominant use of high-intensity bodyweight training. For example, a study in CrossFit athletes found that the higher the training level, the lower the fat percentage (Mangine *et al*.). In addition, a high volume of HIFT training reduced the fat mass content, in contrast to lower HIFT volumes (Cavedon *et al*.).

Regarding somatotype, both groups had high musculoskeletal robustness; however, untrained athletes had higher relative fatness. Trained athletes had a balanced mesomorph profile, same as senior male gymnasts (Sterkowicz-Przybycien´ *et al*., 2019) and competitive Street Workout athletes (Sanchez-Martinez *et al*.). Athletes of sports with a predominant use of upper body limbs, such as mountain climbers and boulderers, had a high mesomorphic component; however, they presented higher ectomorphic levels than trained SW athletes (Barbieri *et al*., 2012; Ozimek *et al*., 2017). The same somatotype between SW and gymnastics could be due to similar biomechanical demands and exercise executions.

The present study has some limitations. Firstly, the number of participants may not be a representative sample of the SW population in Chile. However, the total quantity of practitioners in this country is unknown. Secondly, the prediction of body composition using doubly indirect methods (anthropometry) may increase the variability of the results. Therefore, future studies may compare the body composition of SW athletes using a reference standard for body composition assessment such as dual-energy x-ray absorptiometry (DEXA). Lastly, further studies may evaluate the association of morphological characteristics and performance (aerobic capacity or strength) to better understand performance predictors and their differences according to the training status in SW.

CONCLUSION

Similar to other sports, morphological differences exist in SW according to the training experience. Trained

SW athletes have a higher development of upper body, higher muscle mass, and lesser fat mass and skinfolds than untrained athletes, suggesting that morphology is associated with training experience. Further studies using DEXA should corroborate our findings and, in turn, determine the relevance of morphology in SW performance.

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RESUMEN: En diversos deportes, existen diferencias morfológicas según la experiencia de entrenamiento. Sin embargo, en nuevos deportes urbanos como el Street Workout (SW) las diferencias son menos conocidas. El objetivo de este estudio es comparar las características morfológicas entre atletas de SW desentrenados (novatos) y entrenados (experimentados). Participaron treinta y siete hombres practicantes de SW en Viña del Mar (Chile). Se recolectaron datos antropométricos, de composición corporal y somatotipo, los cuales se compararon según la experiencia de entrenamiento. Encontramos que los atletas entrenados de SW tienen mayor perímetro de brazo flexionado y contraído (+4,4 %, p=0,038), menor perímetro de caderas (-4,8 %, p=0,041), diámetro biiliocrestideo (-3,2 %, p=0,035), menor suma de 6 pliegues cutáneos (-40,8 %, p<0,001), y menor componente endomórfico (p<0,001), en comparación a los atletas desentrenados. El análisis de proporcionalidad reveló que los entrenados tienen perímetros de miembro superior más grandes y menores pliegues que los atletas desentrenados. Además, los entrenados tienen porcentajes mayores de masa muscular total (+6,5 %, p<0,001) y miembro superior (+1,1 %; <0,001), mientras que menor porcentaje de masa grasa (-7,9 %, p<0,001) y masa grasa (-6,9 kg, p<0,001). En conclusión, existen diferencias morfológicas en el SW según el nivel de entrenamiento, sugiriendo que la morfología está asociada a la experiencia de entrenamiento. Futuros estudios deberían corroborar nuestros hallazgos utilizando DEXA y, a la vez, determinar la relevancia de la morfología en el rendimiento en el SW.

PALABRAS CLAVE: Antropometría; Composición corporal; Ejercicio; Gimnasia; Deportes.

REFERENCES

Barbieri, D.; Zaccagni L.; Cogo, A. & Gualdi-Russo, E. Body composition and somatotype of experienced mountain climbers. *High Alt. Med. Biol., 13(1)*:46-50, 2012.

Calatayud, J.; Casaña, J.; Martín, F.; Jakobsen, M. D.; Colado, J. C.; Gargallo, P.; Juesas, A.; Muñoz, V. & Andersen, L. L. Trunk muscle activity during different variations of the supine plank exercise. *Musculoskelet. Sci. Pract., 28*:54-8, 2017.

Carter, J. L. & Heath, B. H. *Somatotyping: Development and Applications*. Cambridge, Cambridge University Press, 1990.

Cavedon, V.; Milanese, C.; Marchi, A. & Zancanaro, C. Different amount of training affects body composition and performance in High-Intensity Functional Training participants. *Plos On., 15(8)*:e0237887, 2020.

Ebben, W. P.; Wurm, B.; VanderZanden, T. L.; Spadavecchia, M. L.; Durocher, J. J.; Bickham, C. T. & Petushek, E. J. Kinetic analysis of several variations of push-ups. *J. Strength Cond. Res., 25(10)*:2891-4, 2011.

Gist, N. H.; Freese, E. C.; Ryan, T. E. & Cureton, K. J. Effects of low-volume, high-intensity whole-body calisthenics on army ROTC cadets. *Mil. Med., 180(5)*:492-8, 2015.

Harrison, J. S. Bodyweight training: A return to basics. *Strength Cond. J., 32(2)*:52-5, 2010.

Kercher, V. M.; Kercher, K.; Bennion, T.; Yates, B. A.; Feito, Y.; Alexander, C.; Amaral P. C.; Soares, W.; Li, Y.; Han, J.; *et al*. Fitness trends from around the globe. *ACSM Health Fit. J., 25(1)*:20-31, 2021.

Kerr, D. A. *An Anthropometric Method for Fractionation of Skin, Adipose, Bone, Muscle and Residual Masses in Males and Females Age 6 to 77 years.* M.Sci. Kinesiology Thesis. British Columbia, Simon Fraser University, 1988.

Koch, E.; Romero, T.; Manríquez, L.; Taylor, A.; Román, C.; Paredes, M.; Díaz, C. & Kirschbaum, A. Razón cintura-estatura: Un mejor predictor antropométrico de riesgo cardiovascular y mortalidad en adultos chilenos. Nomograma diagnóstico utilizado en el Proyecto San Francisco. *Rev. Chil. Cardiol., 27(1)*:23-35, 2008.

Kotarsky, C. J.; Christensen, B. K.; Miller, J. S. & Hackney, K. J. Effect of progressive calisthenic push-up training on muscle strength and thickness. *J. Strength Cond. Res., 32(3)*:651-9, 2018.

Mangine, G. T.; Stratton, M. T.; Almeda, C. G.; Roberts, M. D.; Esmat, T. A.; VanDusseldorp, T. A. & Feito, Y. Physiological differences between advanced CrossFit athletes, recreational CrossFit participants, and physically-active adults. *Plos One, 15(4)*:e0223548. 2020.

Mielgo-Ayuso, J.; Urdampilleta, A.; Martínez Sanz, J. M.; Calleja-González, J. & Seco, J. Relationship of sport competitive level on dietary intake, body composition and somatotype between elite and amateur female volleyballers. *Ann. Women Health, 1(2)*:1006, 2017.

Ngo, J. K.; Solis-Urra, P. & Sanchez-Martinez, J. Injury profile among street workout practitioners. *Orthop. J. Sports Med., 9(6)*:2325967121990926, 2021.

Ozimek, M.; Krawczyk, M.; Zadarko, E.; Barabasz, Z.; Ambroz˙y, T.; Stanula, A.; Mucha, D. K.; Jurczak, A. & Mucha, D. Somatic profile of the elite boulderers in Poland. *J. Strength Cond. Res., 31(4)*:963-70, 2017.

Podrihalo, O.; Podrigalo, L.; Iermakov, S.; Sotnikova-Meleshkina, Z.; Sokol, K.; Podavalenko, O.; Halashko, O. & Yermakova, T. Comparative analysis of morphological indicators of street workout athletes with different training experience. *Teori. Metod. Fìz. Vihov., 21(4)*:343-9, 2021.

Rodríguez-Rodríguez, F.; Almagià, A. & Berral, F. Muscle mass estimation of appendicular limb, for dual energy X ray absorciometry (DEXA). *Int. J. Morphol., 28(4)*:1205-10, 2010.

Ross, W. D. & Wilson, N. C. A stratagem for proportional growth assessment. *Acta Paediatr. Belg., 28 suppl*:169-82, 1974.

Sanchez-Martinez, J.; Plaza, P.; Araneda, A.; Sánchez, P. & Almagià, A. Morphological characteristics of street workout practitioners. *Nutr. Hosp., 34(1)*:122-7, 2017.

Slimani, M. & Nikolaidis, P. T. Anthropometric and physiological characteristics of male soccer players according to their competitive level, playing position and age group: a systematic review. *J. Sports Med. Phys. Fit.., 59(1)*:141-63, 2019.

Sterkowicz-Przybycien, K.; Sterkowicz, S.; Biskup, L.; Zarów, R.; Kryst. & Ozimek M. Somatotype, body composition, and physical fitness in artistic gymnasts depending on age and preferred event. *Plos One, 14(2)*:e0211533, 2019.

Stewart, A.; Marfell-Jones, M.; Olds, T. & De Ridder, J. *International Standards for Anthropometric Assessment*. Vol. 137. Potchefstroom, ISAK. 2011.

Taipe-Nasimba, N.; Peris-Delcampo, D. & Canton, E. Motivos de la práctica deportiva, bienestar psicológico e inmigración, en practicantes de Street Workout. *Rev. Psicol. Deporte, 28(2)*:135-42, 2019.

Tapley, H.; Dotson, M.; Hallila, D.; McCrory, H.; Moss, K.; Neelon, K.; Santos, B., Turner, A. & Turner, L. Participation in strength training activities among US physical therapists: A nationwide survey. *Int. J. Ther. Rehabil., 22(2)*:79-85, 2015.

Thomas, E.; Bianco, A.; Mancuso, E. P.; Patti, A.; Tabacchi, G.; Paoli, A.; Messina, G. & Palma, A. The effects of a calisthenics training intervention on posture, strength and body composition. *Isokinet Exerc. Sci., 25*:215-22, 2017.

Thompson, W. R. Worldwide survey of fitness trends for 2020. *ACSM Health Fit. J., 23*:10-8, 2019.

Tomczykowska, P. The modern face of calisthenics. Street Workout as a new discipline of sport. *J. Health Sci., 3(11)*, 2013.

Toskovic, N. N.; Blessing, D. & Williford, H. N. Physiologic profile of recreational male and female novice and experienced Tae Kwon Do practitioners. *J. Sports Med. Phys. Fit., 44(2)*:164-72, 2004.

Wewege, M. A.; Desai, I.; Honey, C.; Coorie, B.; Jones, M. D.; Clifford, B. K.; Leake, H. B. & Hagstrom, A. D. The effect of resistance training in healthy adults on body fat percentage, fat mass and visceral fat: a systematic review and meta-analysis. *Sports Med., 52(2)*:287-300, 2022.

Williams, T. D.; Tolusso, D. V.; Fedewa, M. V. & Esco, M. R. Comparison of periodized and non-periodized resistance training on maximal strength: a meta-analysis. *Sports Med., 47(10)*:2083-100, 2017.

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