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Reliability and accuracy of Cooper's test in male long distance runners

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ABSTRACT

Objective: Endurance capacity can be assessed by field test such as Cooper's test; however, reliability and accuracy are rarely reported in the literature. It was our aims to describe reliability and accuracy of Cooper's test in long distance runners.

Method: Fifteen male long distance runners performed twice all-out Cooper's test in a 400 m track. Total distance covered, maximum heart rate (HR) and rate of perceived exertion were recorded. Bias correction factor (Bc) was used to describe accuracy and the main dimensions of reliability were calculated by an intraclass correlation coefficient (ICC), effect size (ES) and agreement analysis.

Results: Accuracy for total distance and HR were relatively high (Cb = 0.994 and 0.956). Reliability for covered distance was as small as 1.7% (52.2 m) and ICC was 0.99; additionally, neither proportional nor systematic bias was detected in the agreement analysis.

Conclusions: All together, our results may confirm a good accuracy and reliability of Cooper's test in amateur long distance runners. Also, improvements or impairment lower than 52.2 m must not be associated with exercise training or retraining, since they are below the values of intra-subject reliability.

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Fiabilidad y precisión del test de Cooper en corredores varones de larga distancia

RESUMEN

Objetivo: La capacidad de resistencia puede ser evaluada por una prueba de campo como el test de Cooper, sin embargo, la precisión y fiabilidad son raramente divulgados en la literatura. Es nuestro objetivo describir la fiabilidad y la exactitud del test de Cooper en corredores de larga distancia.

Método: Quince varones fondistas realizaron pruebas de Cooper dos veces en una pista de 400 metros. La distancia recorrida, la frecuencia cardíaca máxima (FC) y la percepción de esfuerzo fueron registradas. El factor de corrección de sesgo fue utilizado para describir la exactitud y las dimensiones de la fiabilidad y se calcularon los coeficientes de correlación intraclase (CCI), el tamaño del efecto y un análisis de concordancia.

Resultados: La precisión de distancia total recorrida y de la frecuencia cardíaca fueron relativamente altas (Cb = 0.994 y 0.956). La confiabilidad para el recorrido era tan pequeña como el 1.7% (52.2 metros) y el CCI de 0.99, además no se detectó ni sesgo proporcional ni sistemático mediante el análisis de concordancia.

Conclusiones: Nuestros resultados pueden confirmar una buena exactitud y fiabilidad del test de Cooper en corredores de larga distancia aficionados. También, las variaciones inferiores a 52.2 metros no deben ser asociados con el ejercicio de entrenamiento o desentrenamiento, puesto que están por debajo de la fiabilidad intra-sujeto.

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Palabras clave:

Atletas Amateur

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Error técnico de medición

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Coefficiente de correlación intraclase

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Fiabilidade e precisão do teste de Cooper em corredores de longas distâncias do sexo masculino

R E S U M O

Palavras-chave:

Atletas amadores
Teste de campo resistência
Fator de correção de viés
Erro técnico de medição
Análise de concordância
Coeficiente de correlação intraclasse
Tamanho do efeito

Objetivo: A capacidade de resistência pode ser avaliada pelo teste de campo, tal como o teste de Cooper; no entanto, a fiabilidade e precisão são raramente relatados na literatura. O objetivo foi descrever a fiabilidade e precisão do teste de Cooper em corredores de longa distância.

Método: Quinze corredores de longa distância do sexo masculino realizaram teste de Cooper 2 vezes, numa faixa de 400 metros. Distância total percorrida, frequência cardíaca máxima (FC) e taxa de esforço percebido foram registadas. Fator de correção do viés (BC) foi usado para descrever a precisão e as principais dimensões de fiabilidade foram calculados por meio do coeficiente de correlação de intraclasse (ICC), tamanho do efeito (ES) e análise de concordância.

Resultados: A precisão da distância total e frequência cardíaca eram relativamente altas ($C_b = 0.994$ e 0.956). Fiabilidade para o curso era tão pequena quanto 1.7% (52.2 metros) e ICC de 0.99, além disso, uma vez que nem viés proporcional, nem sistemático foram detetados através da análise de jogo.

Conclusões: Os nossos resultados podem confirmar uma boa precisão e fiabilidade do teste de Cooper em corredores de longa distância amadores. Além disso, melhorias ou prejuízo menor do que 52.2 metros não devem ser associados a treinamento físico ou destreinamento, uma vez que estão abaixo dos valores de fiabilidade intrassujeitos.

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Introduction

Maximum oxygen uptake (VO_{2max}), lactate thresholds and running economy have been widely used to assess endurance and aerobic capacity in middle and long distance runners, and all related to athletic performance.¹ However, these variables are time consuming and expensive in field settings still; indirect tests can be utilized to substitute these latter assessments. The utility of a test depends on its validity, accuracy and reliability (reproducibility). Validity can be assumed if a test represents accurately those features of the phenomena, which are aimed to describe, explain or theorise.²

Regarding accuracy, this is the degree of a test to measure the true value. Finally, reliability informs about reproducibility of a test and a procedure of repeated measures is used in order to calculate repeatability; so we can consider reliability as the degree to which an assessment tool produces stable and consistent results (also known as test-retest reliability). Both low reliability and accuracy may limit applicability and utility of field performance tests.

However, utility of field tests has commonly relied on construct validity, usually associated with the capacity of the test to estimate or be associated with laboratorial variables or clinical tests.³ In this sense, one of the most studied physiological constructs is VO_{2max} , which determines the maximum aerobic capacity and should be related with endurance and long-term performance.⁴ Thus, several field tests have been created in order to obtain a valid and reliable estimation of VO_{2max} . One of the first tests developed to estimate VO_{2max} was Cooper's test, which is a simple time limit single-stage test, where athletes need to cover as many meters as possible during a 12-min all-out test.⁵ The VO_{2max} estimated from Cooper and a multistage shuttle run tests has been strongly correlated in young healthy adults, which may confer a good concurrence at least for this population. The same study showed a good reliability (Φ : 0.96) and acceptable systematic error of 4.3% for maximal oxygen uptake prediction.⁶ However, the Cooper's test accuracy has not been still reported to date. Also, there are a lack of data of reliability and accuracy data in athletes.

Since, there is a lack of knowledge about the reproducibility (test-retest reliability) characteristics of field tests to estimate endurance capacity such us Cooper's test in long distance runners, it was our aim to analyze the reliability and accuracy of Cooper's

test on amateur long distance runners over two repeated measures (test-retest).

Method

Subjects

Fifteen adult male amateur athletes (34.5 ± 1.9 years, and 3.7 ± 4.6 years of training) volunteered to participate in the study. All athletes were informed of the study characteristics, procedures and risks; afterwards a signed informed consent was obtained from those who decided to be enrolled. The Ethical Review Institutional Board (IRB) at the University of Malaga approved the research protocol.

Experimental procedures

Test-retest approach was used by repeating Cooper's test twice in a period of 48 h. Reliability analysis was carried out in all variables obtained from the Cooper test such as distance, heart rate (HR) at the end of the test and the rate of perceived exertion (RPE). Two Cooper's tests split by 48 h were carried out in a synthetic track of 400 m, and under similar meteorological conditions. Every day athletes followed thoroughly the same protocol: firstly, a 15-min running warm-up was performed at between 50 and 70% of the theoretical maximal HR ($220 - \text{Age}$). Then, the original Cooper's test was executed; briefly, athletes were asked to run all-out during 12-min along the inner lane of the track; immediately afterwards a member of research team recorded the distance in meters by placing a mark exactly in the point where every athlete stood still. Also, the HR at the end of test was recorded by using a HR monitor Polar RS300X (Polar Electro, Finland), and the RPE using the 0-10 Borg scale was individually asked to each participant.⁷

Statistical analysis

The accuracy of total distance in Cooper's test, maximal HR and RPE were calculated by bias correction factor (C_b) from concordance correlation coefficient analysis. Absolute reliability was reported as the mean differences, coefficient of variation (CV),

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