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ORIGINAL

Effects of a circuit training including plyometric jumps on cardiorespiratory fitness of children and adolescents with Down syndrome

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Exercise;
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Abstract
Aim: To ascertain the effects of 21 weeks of circuit training, including plyometric jumps, on cardiorespiratory fitness of youths with Down's syndrome (DS).
Methods: Twenty-seven children and adolescent aged 10 to 19 years with DS participated in this study and were divided in two groups: exercise (EXE, n=14) and control (CON, n=13). Work time, peak values of oxygen consumption, respiratory exchange ratio, heart rate and minute ventilation of the participants were measured pre- and post-training with a graded exercise treadmill test.
Results: EXE group increased all their cardiorespiratory parameters compared to baseline after 21 weeks of training (all $P<.05$). Additionally, and despite having similar pre-training values, the EXE group showed higher values than the CON group in all cardiorespiratory parameters after training (all $P<.05$).
Conclusion: It may be concluded that youths with Down syndrome can achieve improvements in several cardiorespiratory parameters when performing 21 weeks of training including plyometric exercises.

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PALABRAS CLAVE:
Ejercicio;
Capacidad funcional;
Trisomía 21;
Tapiz rodante;
Salud

Efectos del entrenamiento pliométrico sobre la resistencia cardiorrespiratoria de niños y adolescentes con síndrome de Down

Resumen

Objetivo: Determinar los efectos de 21 semanas de entrenamiento en circuito, incluyendo saltos pliométricos sobre la resistencia cardiorrespiratoria de jóvenes con síndrome de Down (SD).

Método: Veintisiete jóvenes con SD de entre 10 y 19 años participaron en este estudio. Los participantes se dividieron en dos grupos: ejercicio (EJE; n = 14) y control (CON; n = 13). Antes y después de la realización del programa de entrenamiento se midieron los siguientes parámetros: tiempo de trabajo, valores máximos de consumo de oxígeno, cociente respiratorio, frecuencia cardíaca y ventilación minuto de los participantes mediante una prueba de esfuerzo progresiva en tapiz rodante.

Resultados: Los participantes del grupo EJE aumentaron todos los parámetros cardiovasculares en comparación con su valor basal, después del entrenamiento (todos $p < 0,05$). Además, a pesar de tener unos valores similares antes del entrenamiento, el grupo EJE mostró valores más elevados que el grupo CON después del entrenamiento (todos $p < 0,05$).

Conclusión: Se puede concluir que los jóvenes con síndrome de Down pueden conseguir mejoras en diversos parámetros cardiorrespiratorios tras la ejecución de 21 semanas de entrenamiento con ejercicios pliométricos.

Introduction

Down syndrome (DS) is a genetic condition characterised by the presence of intellectual impairment and more than 80 clinical characteristics[1], some of which are associated with exercise[2]. It has been reported that cardiorespiratory fitness (CF) is lower in individuals with DS compared with others without DS, with or without intellectual impairment[3,4]. This is important, since CF is an important heath indicator during childhood and adolescence, mainly due to its inverse relationship with abdominal and total adiposity, and its direct relationship with the reduction in cardiovascular risk factors, as well as with bone health[5]. Furthermore, it is also known that CF positively contributes to the freedom of the individual with special needs (such as those with DS) in their adult life[6], and favours the ability to carry out activities of daily living due to its close relationship with functional capacity[7].

Therefore, partly due to the increase in life expectancy of individuals with DS[8], and with the aim of increasing their independence and quality of life, CF could be a key factor to be investigated from childhood to adolescence in a population with DS.

It is well known that training programmes improve CF in children and adolescents, with or without special needs (such as type I diabetes, intellectual impairment or cerebral palsy[9-11]); however, it has not been investigated in detail whether these results can also be observed in children and adolescents with DS[4]. As has been reported in the scientific literature, using a systematic review, aerobic training is an effective strategy to improve CF in adults with DS[12]. Unfortunately, there are very few studies conducted exclusively on children and adolescents with DS[13-15], and the information that they provide is not conclusive as regards improvements in CF. Due to its intrinsically cyclic and rhythmic nature, aerobic training could not be particularly attractive for children with DS. Alternatively, circuit training is associated with play activities characterised by different exercises. Using low intensities and a high number of repetitions, it effectively combines the benefits of muscle strength training with the cardiovascular benefits of dynamic exercise. This type of training produces around 50% of the improvement in CF compared with cycling or continuous running in individuals with a disability[16], and it has been demonstrated that it improves body composition in adolescents with DS[17,18]. Significantly, plyometric training has also shown to produce increases in strength and power in the lower limbs, as well as improvements in the efficiency of the run and jump[19]. It has also been demonstrated that plyometric training is effective for increasing the maximal oxygen consumption (VO_{2max})[20].

Therefore, the aim of this study was to determine the effects of 21 weeks in a circuit training programme, including plyometrics (2 days a week, 25 minutes) on the CF of children and adolescents with DS.

Material and methods

Participants

A total of 27 children and adolescents with DS (12 girls and 15 boys), from 10 to 19 years when starting the study, took part. Fourteen of them (8 girls and 6 boys) were randomly assigned to the exercise group (EXE) and carried out the training programme, while the remaining 13 participants (CON group) did not increase their daily activities. A clinical record was completed, including the disease history and surgical interventions of each participant. The participants and their parents were informed of the aims of the study, possible risks and benefits. The study was conducted in accordance with the Helsinki Declaration of 1961(revised in