ISOINERTIALEXERCISE DOES NOT CAUSE CLINICALLY SIGNIFICANT MUSCLE DAMAGE: A PILOT STUDY

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INTRODUCTION

Eccentric exercise has often been associated with skeletal muscles structural damage and athletes may experience signs and symptoms such as limited range of motion and muscle soreness of the muscles across the joint. The isoinertial modality provides additional eccentric load (1). To our knowledge, no previous study has investigated the effect of isoinertial exercise, which consists of both concentric and eccentric muscular actions, on exercise-induced muscle damage. Aim of the present study is to measure changes in exercise-induced muscle damage and soreness as result of one isoinertial concentric-eccentric maximal exercise session.

METHODS

Six healthy amateur football and gaelic football players (3 males, 3 females, age 21.7±0.7 years, mean±SD; height 173.6±8.6 cm;weight 70.3±11.2 kg;training volume 3.5±1.7 sessions/week) volunteered in this study. DOMS was assessed using a Graphic Pain Rating Scale, GRPS, (2). Serum Creatine Kinase (CK) was measured from blood samples using kits for Randox Daytona Analyzer (Randox Laboratories Ltd., Co. Antrim, UK). CK and Delayed Onset Muscle Soreness, (DOMS) were assessed at baseline, 24 hours, 48 hours and 72 hours after a training session consisting of 4 sets of 7 maximal repetitions of a standing-semisquat exercise using a flywheel equiment (Desmotec, Italy), starting with the knees flexed. The inertial mass of the flywheel was 1.8 kg and its radius 0.143 m.A similar training session performed 2/3 times a week for 5 weeks has improved strength and increased muscles's size (3).

RESULTS

Baseline CK levels ranged from 71 to 303 IU/l (n=6, 136±95.6 IU/l). Peak CK, i.e. the highest values measured in samples collected 24, 48 and 72hours after the training session, was 204.0±88.0 IU/l, significantly higher than baseline CK (p=0.029). Values as Mean ± Standard Deviation. All the participants did not experience DOMS ("no pain" in the GPRS scale) after the training session.

DISCUSSION

Isoinertial training does not cause a clinically significant muscle damage and athletes undergoing such a training do not experience DOMS. In conclusion, isoinertial training using a flywheel device is safe and it stimulates muscles in a way similar to other forms of training.

ACKNOWLEDGMENT

Javier Monedero and Paul O'Connor for helping with blood sample analyses.

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CARDIOPULMONARY RESPONSE DURING ONE SESSION OF MAXIMAL ISOINERTIAL TRAINING

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INTRODUCTION

The use of the flywheel resistance training has been shown to provide an increased eccentric muscle loading (1) and improve strength (2). Little research has been carried out on the effects the flywheel strength training session has on the cardiopulmonary system (3).The aim is to assess cardiopulmonary responses in amateur footballers undertaking isoinertial training.

METHODS

8 healthy male amateur footballers (age 19.5±2.3 years, weight 73.6±5.2 kg, height 180.4±5.2 cm) participated in this study. The inertial mass of the flywheel was 1.8 kg and its radius 0.143 m (Desmotec, Italy). The subjects performed 4 sets of 7 maximal repetitions, as per protocols shown to be effective to improving strength (2). After a familiarisation session, they were told to bend their knees down to 90 degrees flexion, stop the flywheel and extend at maximum speed, starting from a semi squat position. They were allowed to rest for 30 seconds between sets. Cardiopulmonary parameters were measured continuously throughout the test, oxygen uptake (VO_2) and carbon dioxide (CO_2) measured breath by breath by a portable gas analyser (Cosmed K4, Italy). The HR was measured by a heart rate monitor (Polar, Finland) throughout the test and blood lactate samples was taken from the earlobe at the end of the session and 3 and 5 minutes post completion of the four sets of exercise (LT-1710, Arkray, Japan). The highest value of lactate concentration was included in the present report.

RESULTS

The average (± standard deviation) values recorded in our athletes during an isoinertial training session were as follows: Heart rate was 126.5 ± 18.4 beats per minute, VO_2 (mlO_2/min/kg) was 22.65 ± 2.60, respiratory quotient was 0.92 ± 0.08, blood lactate concentration was 2.53 ± 1.36

DISCUSSION

According to our preliminary data an isoinertial intermittent training session elicits cardiopulmonary responses within the aerobic range of metabolic intensities. Further research will focus on cardiopulmonary responses to different isoinertial masses and protocols.

REFERENCES

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ENHANCED POWER AFTER A 4-WEEK SUBMAXIMAL ISOINERTIAL TRAINING: A PILOT STUDY

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INTRODUCTION

The use of intermittent isoinertial maximal training has been shown to provide a form of eccentric overload exercise (1) and to improve strength (2) with minimal volume (4 sets of 7 maximal reps, 2-3 times a week for 5 weeks). Little research has been carried out on the effects of isoinertial training at submaximal intensity.

METHODS

Nine healthy male (n=8) and female (n=1) participants (age 35.4±8.4 years, weight 71.9±7.9 kg, height 173.9±6.4 cm, BMI 23.7±1.7 kg/m2) volunteered and signed an informed consent to take part to the study, which was carried out according to the Declaration of Helsinki. The inertial mass of the flywheel was 1.8 kg and its radius 0.143 m (D11, Desmotec, Italy). The exercise was a semisquat movement performed so that concentric and eccentric phases were coupled in a closed kinetic exercise. As participants were "harnessed" just above the hip joint, the muscles moving the ankle, knee and hip joints were loaded concentrically and eccentrically at each repetition. After testing at baseline (peak power, Wpeak, and average power, Wmax) in order to set training intensities, subjects were asked to train twice a week for 4 weeks. Each session consisted of 8 to 14 sets of 5 repetitions at progressively increasing fractions of the maximum power output: in week 1 70% of Wmax, 90% of Wmax in week 4. Participants were provided a visual feedback using D.Soft, the D11 dedicated software, so that they were allowed to see and adjust in real-time their power output during the training sessions. Participants were allowed to rest for 30 seconds between sets. Analysis was carried out using Prism 6 Statistical Software (paired T-test), significance was set at 0.05.

RESULTS

At baseline Wpeak was 737.1±423.9 W (mean ± standard deviation). After 8 sessions over 4 weeks of high intensity intermittent isoinertial training Wpeak significantly (p=0.0003) increased from 737.1±423.9 W to 1063.7±459.8 W, mean of differences 486.9 W, 95% CI 299.4 to 674.4 W) and Wmax significantly (p=0.0010) increased from 521.2±297.3 W to 861.3±383.3 W, mean of differences 448 W, 95% CI 244.3 to 651.7.

DISCUSSION

Our results show that a 4-week low-volume (twice a week) isoinertial training programme performed at submaximal intensities (80% Wmax) is useful to enhance power output. Further research is needed to clarify the mechanisms of adaptation.

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SVILUPPO DELLA PRESTAZIONE FISICA MEDIANTE ALLENAMENTO DI FORZA E CONDIZIONAMENTO

ISOINERTIAL EXERCISE DOES NOT CAUSE CLINICALLY SIGNIFICANT MUSCLE DAMAGE: A PILOT STUDY

*L'ESERCIZIO ISOINERZIALE NON CAUSA UN SIGNIFICATIVO DEGRADO MUSCOLARE: STUDIO PILOTA **

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INTRODUCTION

Eccentric exercise has often been associated with skeletal muscles structural damage and athletes may experience signs and symptoms such as limited range of motion and muscle soreness of the muscles across the joint.

The isoinertial modality provides additional eccentric load (1). To our knowledge, no previous study has investigated the effect of isoinertial exercise, which consists of both concentric and eccentric muscular actions, on exercise-induced muscle damage.

Aim of the present study is to measure changes in exercise-induced muscle damage and soreness as result of one isoinertial concentric-eccentric maximal exercise session.

METHODS

Six healthy amateur football and gaelic football players (3 males, 3 females) volunteered in this study.

Age: 21.7±0.7 years (mean±SD)

Height: 173.6±8.6 cm

Weight: 70.3±11.2 kg

Training volume: 3.5±1.7 sessions/week

DOMS was assessed using a Graphic Pain Rating Scale, GPRS, (2).

Serum Creatine Kinase (CK) was measured from blood samples using kits for Randox Daytona Analyzer (Randox Laboratories Ltd., Co. Antrim, UK).

CK and Delayed Onset Muscle Soreness, (DOMS) were assessed at baseline, 24 hours, 48 hours and 72 hours after a training session consisting of 4 sets of 7 maximal repetitions of a standing semisquat exercise using a flywheel equiment (Desmotec, Italy), starting with the knees flexed.

The inertial mass of the flywheel was 1.8 kg and its radius 0.143 m. A similar training session performed 2/3 times a week for 5 weeks has improved strength and increased muscles' size (3).

INTRODUZIONE

L'esercizio eccentrico è stato spesso associato al degrado tissutale dei muscoli scheletrici ed atleti potrebbero avvertirne i segni ed i sintomi quali limitata motilità e dolore muscolare a ridosso delle articolazioni. La modalità isoinerziale prevede un sovraccarico in fase di contrazione eccentrica (1).

Per quanto conosciamo non esistono studi pregressi, comprensivi di entrambe le fasi di contrazione (concentrica ed eccentrica), effettuati al fine di analizzare gli effetti dell'esercizio eccentrico ed il danno muscolare da esso indotto.

L'obiettivo del presente studio è misurare variazioni del danno muscolare e annessi sintomi dolorosi correlabili ad una sessione di esercizio eccentrico massimale.

METODI

Sei giocatori amatoriali di calcio classico e calcio gaelico in buona salute si sono prestati volontariamente per lo studio.

Più precisamente 3 maschi e 3 femmine.

Età: 21,7±0,7 anni (media±Dev.Std)

Altezza: 173,6±8,6 cm

Peso: 70,3±11,2 kg

Volume di esercizio: 3,5±1,7 sessioni/settimana

DOMS sono stati quantificati utilizzando una scala di valutazione grafica del dolore, GPRS, (2).

Sono stati misurati i livelli ematici di Creatina Kinasi Sierica (CK) mediante kit Randox Daytona Analyzer (di Randox Daytona Laboratories Ltd., Co. Antrim, UK).

CK e indolenzimento muscolare a insorgenza ritardata (DOMS) sono stati misurati a riposo, a 24 ore, 48 ore e 72 ore successive ad una sessione di allenamento di 4 serie da 7 ripetizioni massimali di mezzo squat eseguiti su una macchina a volano (Desmotec, Italy), partendo con le ginocchia flesse.

Massa inerziale del volano pari a 1,8kg ed raggio del disco di 143mm. Tale tipologia di allenamento intrapresa 2-3 volte a settimana per un periodo di 5 settimane ha restituito incrementi di forza ed ipertrofia muscolare (3).

(*) DESMOTEC declina ogni responsabilità per eventuali errori grammaticali o di contenuto presenti nella traduzione dei testi originali.

RESULTS

Baseline CK levels ranged from 71 to 303 IU/l (n=6, 136±95.6 IU/l).

Peak CK, i.e. the highest values measured in samples collected 24, 48 and 72hours after the training session, was 204.0±88.0 IU/l, significantly higher than baseline CK (p=0.029). Values as Mean ± Standard Deviation. All the participants did not experience DOMS ("no pain" in the GPRS scale) after the training session.

DISCUSSION

Isoinertial training does not cause a clinically significant muscle damage and athletes undergoing such a training do not experience DOMS.

In conclusion, isoinertial training using a flywheel device is safe and it stimulates muscles in a way similar to other forms of training.

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RISULTATI

Valori di CK misurati a riposo variavano da 71 a 303 IU/l (n=6, 136 ±95,6 IU/l).

Picchi di CK, ad esempio i massimi valori misurati a 24, 48 e 72 ore successive alla sessione di allenamento, si attestavano pari a 204,0±88,0 IU/l, significativamente più elevati rispetto ai relativi valori a riposo (p=0,029). Nessuno dei partecipanti ha sperimentato DOMS ("nessun dolore" nella scala GPRS) dopo la sessione di allenamento.

DISCUSSIONE

A livello clinico, l'allenamento isoinerziale non causa un significativo danno muscolare ed atleti che intraprendono tale regime di preparazione non sperimentano DOMS.

Infine, l'allenamento eccentrico mediante l'utilizzo di una macchina a volano è sicuro e stimola i muscoli in modo analogo a quello indotto da altre forme di allenamento.

RICONOSCIMENTI

Javier Monedero e Paul O'Connor per l'aiuto prestato nell'analizzare i campioni ematici.

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CARDIOPULMONARY RESPONSE DURING ONE SESSION OF MAXIMAL ISOINERTIAL TRAINING

*RISPOSTA CARDIORESPIRATORIA DURANTE UNA SESSIONE DI ALLENAMENTO ISOINERZIALE MASSIMALE **

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INTRODUCTION

The use of the flywheel resistance training has been shown to provide an increased eccentric muscle loading (1) and improve strength (2). Little research has been carried out on the effects the flywheel strength training session has on the cardiopulmonary system (3).

The aim is to assess cardiopulmonary responses in amateur footballers undertaking isoinertial training.

METHODS

8 healthy male amateur footballers participated in this study.
Age: 19.5±2.3 years (mean ± SD)
Weight: 73.6±5.2 kg
Height: 180.4±5.2 cm

The inertial mass of the flywheel was 1.8 kg and its radius 0.143 m (Desmotec, Italy). The subjects performed 4 sets of 7 maximal repetitions, as per protocols shown to be effective to improving strength (2). After a familiarisation session, they were told to bend their knees down to 90 degrees flexion, stop the flywheel and extend at maximum speed, starting from a semi squat position.

They were allowed to rest for 30 seconds between sets.

Cardiopulmonary parameters were measured continuously throughout the test, oxygen uptake (VO2) and carbon dioxide (CO2) measured breath by breath by a portable gas analyser (Cosmed K4, Italy).

The HR was measured by a heart rate monitor (Polar, Finland) throughout the test and blood lactate samples was taken from the earlobe at the end of the session and 3 and 5 minutes post completion of the four sets of exercise (LT-1710, Arkray, Japan).

The highest value of lactate concentration was included in the present report.

INTRODUZIONE

L'utilizzo della macchina a volano per un allenamento di tipo resistivo mostra di indurre un sovraccarico muscolare eccentrico (1) con conseguente incremento di forza (2). Pochi studi sono stati condotti al fine studiare gli effetti che una sessione di allenamento di forza con il volano esercita sul sistema cardiocircolatorio (3). L'obiettivo consiste nella determinazione delle risposte cardiocircolatorie in calciatori di livello amatoriale sottoposti ad allenamento isoinerziale.

METODI

8 calciatori amatoriali adulti di sesso maschile e in buona salute hanno partecipato a tale studio.
Caratteristiche (media± Dev.Std):
Età: 19,5±2,3 anni
Peso: 73,6±5,2 kg
Altezza: 180,4±5,2 cm)

Massa di inerzia del volano pari a 1,8 kg e raggio del disco pari a 143 mm (Desmotec, Italia). I soggetti hanno eseguito 4 serie da 7 ripetizioni, in base ai protocolli mostratisi efficaci per incrementare la forza (2).

Previo una sessione di familiarizzazione prelimare, è stato richiesto ai partecipanti di flettere le gambe sino al raggiungimento dei 90°, frenare il volano ed infine estendere le gambe con la massima potenza partendo dalla posizione di mezzo squat. È stato concesso un riposo di 30 secondi tra un set e quello successivo.

Per tutta la durata del test i parametri cardiorespiratori di potenza aerobica (VO2) e anidride carbonica (CO2) sono stati misurati mediante un analizzatore di gas portatile (Cosmed K4, Italia) per tutta la durata del test.

La frequenza cardiaca è stata monitorata mediante cardiofrequenzimetro (Polar, Finlandia) per tutta la durata del test e campioni il lattato ematico sono stati prelevati dal lobo dell'orecchio (LT-1710, Arkray, Giappone) a 3 min e 5 min dal termine della sessione di 4 serie.

Il massimo valore di concentrazione di lattato è incluso nella presente relazione.

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RESULTS

The average (± standard deviation) values recorded in our athletes during an isoinertial training session were as follows.
Heart rate: 126.5 ± 18.4 beats per minute (mean ± SD)
VO (mlO2/min/kg): 22.65 ± 2.60
Respiratory Quotient: 0.92 ± 0.08
Blood lactate concentration: 2.53 ± 1.36

DISCUSSION

According to our preliminary data an isoinertial intermittent training session elicits cardiopulmonary responses within the aerobic range of metabolic intensities.
Further research will focus on cardiopulmonary responses to different isoinertial masses and protocols.

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RISULTATI

I valori medi registrati negli atleti durante la sessione di allenamento isoinerziale sono i seguenti:
Battito cardiaco: 126,5 ± 18,4 BPM (media ± Dev.Std)
VO2 (mlO2/min/kg): 22.65 ± 2,60
Quoziente respiratorio: 0,92 ±0,08
Lattato ematico: 2,53 ± 1,36

DISCUSSIONE

Aderendo ai nostri dati preliminari, sessioni di allenamento isoinerziale intermittenti sollecitano una intensità di risposta metabolica cardiorespiratoria compresa nel regime aerobico. Ulteriori ricerche saranno focalizzate sulle risposte cardiorespiratorie a differenti valori di massa inerziale e protocolli.

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ENHANCED POWER AFTER A 4-WEEK SUBMAXIMAL ISOINERTIAL TRAINING: A PILOT STUDY

*INCREMENTI DI POTENZA IN 4 SETTIMANE DI ALLENAMENTO ISOINERZIALE SUBMASSIMALE: STUDIO PILOTA **

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Little research has been carried out on the effects of isoinertial training at submaximal intensity.

METHODS

Nine healthy male (n=8) and female (n=1) participants volunteered and signed an informed consent to take part to the study, which was carried out according to the Declaration of Helsinki.
Age: 35.4±8.4 years
Weight: 71.9±7.9 kg
Height: 173.9±6.4 cm
BMI: 23.7±1.7 kg/m^2
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After testing at baseline (Peak Power - Wpeak, Average Power - Wmax) in order to set training intensities, subjects were asked to train twice a week for 4 weeks.
Each session consisted of 8 to 14 sets of 5 repetitions at progressively increasing fractions of the maximum power output:
in week 1 70% of Wmax
90% of Wmax in week 4.
Participants were provided a visual feedback using D.Soft, the D11 dedicated software, so that they were allowed to see and adjust in real-time their power output during the training sessions. Participants were allowed to rest for 30 seconds between sets.
Analysis was carried out using Prism 6 Statistical Software (paired T-test), significance was set at 0.05.

INTRODUZIONE

L'utilizzo della macchina a volano per un allenamento di tipo resistivo comporta un sovraccarico muscolare eccentrico (1) incrementando la forza (2) con un volume minimo di lavoro (4 serie da 7 ripetizioni, 2-3 volte a settimana per 5 settimane).
Pochi studi sono stati condotti al fine studiare gli effetti indotti da una sessione di allenamento isoinerziale ad intensità submassimale.

METODI

Nove partecipanti in buona salute, 8 di sesso maschile e una di sesso femminile hanno partecipato previo firma di consenso allo studio, portato avanti in accordo con la dichiarazione di Helsinki.
Età: 35,4 ± 8,4 anni (media± Dev.Std)
Peso: 71,9 ± 7,9 kg
Altezza: 173,9 ± 6,4 cm
BMI (ICM): 23.7±1.7 kg/m^2
Massa di inerzia del volano pari a 1,8 kg e raggio del disco di 143 mm (Desmotec, Italia). L'esercizio considerato consisteva in un movimento di mezzo squat a fasi concentrica ed eccentrica accoppiate in catena cinetica chiusa. I partecipanti sono stati vincolati mediante un'imbragatura lombare poco al di sopra dell'anca; i muscoli motori di caviglia, ginocchio e di anca sono stati caricati in fase concentrica ed eccentrica ad ciascuna ripetizione. In seguito ad un test preliminare per individuare un' intensità individuale di lavoro (potenza massima (Wpeak) e potenza massima media (Wmax)), ai soggetti è stata richiesta una sessione di allenamento bisettimanale da 8 a 14 serie di 5 ripetizioni per un periodo di 4 settimane, a carico di potenza incrementale.
Settimana 1: 70% di Wmax
Settimana 4: 90% di Wmax
Ai partecipanti è stato fornito il software di feedback visivo (D.Soft, Desmotec, Italia) presente sulla D11, permettendo loro di monitorare e affinare la potenza del proprio gesto durante le sessioni di allenamento.
Ai partecipanti è stato concesso un riposo di 30 secondi tra una serie e quella successiva. L'analisi dei dati ottenuti è stata effettuata mediante l'utilizzo di Prism 6 Statistical Software (T-test accoppiato) e significatività impostata a 0,05.

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RESULTS

At baseline Wpeak was 737.1±423.9 W (mean ± standard deviation).

After 8 sessions over 4 weeks of high intensity intermittent isoinertial training Wpeak significantly (p=0.0003) increased from 737.1 ± 423.9 W to 1063.7 ± 459.8 W, mean of differences 486.9 W, 95% CI 299.4 to 674.4 W) and Wmax significantly (p=0.0010) increased from 521.2 ± 297.3 W to 861.3 ± 383.3 W, mean of differences 448 W, 95% CI 244.3 to 651.7.

DISCUSSION

Our results show that a 4-week low-volume (twice a week) isoinertial training programme performed at submaximal intensities (80% Wmax) is useful to enhance power output. Further research is needed to clarify the mechanisms of adaptation.

REFERENCES

1. Norrbrand, L., Pozzo, M. & Tesch, P. A., 2010.
Flywheel resistance training calls for greater eccentric muscle activation than weight training.
European Journal of Applied Physiology, Volume 110, pp. 997-1005.

2. Tesch, P. A., Ekberg, A., Lindquist, D. M. & Trieschmann, J. T., 2004.
Muscle hypertrophy following 5-week resistance training using a non-gravity dependent exercise system.
Scandinavian Physiol Soc., Vol.180, pp. 89-98.

RISULTATI

Per gli atleti la massima potenza di riferimento era pari a 737,1 ± 423,9 W (media ± dev.std).

Dopo 8 sessioni di allenamento isoinerziale intermittente ad alta intensità distribuite su 4 settimane Wpeak è incrementata significativamente (p=0,0003) da 737,1 ± 423,9 W a 1063,7 ± 459,8 W con media delle degli scostamenti pari a 486,9 W al 95% dell'intervallo di confidenza da 299,4 a 674,4. Wmax presenta un aumento da 521,2 ± 297,3 W a 861,3±383,3 W con media delle degli scostamenti pari a 448 W al 95% dell'intervallo di confidenza da 244,3 a 651,7 W.

DISCUSSIONE

I nostri risultati mostrano come un allenamento isoinerziale a ridotto volume di carico protratto per 4 settimane (due volte a settimana) ad intensità submassimali (80%Wmax) è utile a sviluppare incrementi i potenza muscolare. Occorre ulteriore ricerca al fine di chiarire i meccanismi di adattamento.

RIFERIMENTI

1. Norrbrand, L., Pozzo, M. & Tesch, P. A., 2010.
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