



UNIVERSIDADE TÉCNICA DE
LISBOA
FACULDADE DE MOTRICIDADE
HUMANA



PHYSIOLOGICAL RESPONSES AND LONG-TERM
ADAPTATIONS TO EXERCISE

EXERCISE TRAINING, FUNCTIONAL CAPACITY, BODY
COMPOSITION, MAXIMUM DYNAMIC STRENGTH,
EXERCISE ECONOMY, ELECTRODERMAL ACTIVITY,
ENERGY EXPENDITURE AND ANTHROPOMETRIC
MEASUREMENTS IN INDIVIDUALS WITH DOWN
SYNDROME.

Master in Physiotherapy Sciences Thesis

Advisor: PhD Fernando da Cruz Duarte Pereira

Committee:

Chairman:

PhD Jan Maria Cabri

Members:

PhD Bo Fernhall

PhD Pedro Jorge Moreira Parrot Morato

PhD Fernando Manuel da Cruz Duarte Pereira

Gonçalo Laima Vilhena de Mendonça

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ABSTRACT (PORTUGUESE)

PHYSIOLOGICAL RESPONSES AND LONG-TERM ADAPTATIONS TO EXERCISE

EXERCISE TRAINING, FUNCTIONAL CAPACITY, BODY
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MEASUREMENTS IN INDIVIDUALS WITH DOWN
SYNDROME.

Gonçalo Vilhena de Mendonça

OBJECTIVOS: Determinar os efeitos do exercício de carácter crónico na composição corporal, capacidade funcional e economia de esforço em indivíduos com Trissomia 21 (T21). Comparar a resposta galvânica da pele (RGP) perante um estímulo agudo de exercício em participantes com T21 e controlos saudáveis. Estudar a validade dos registos de dispêndio energético estimados a partir de um instrumento de multi-aquisição de dados fisiológicos por intermédio de uma validação cruzada com a espirometria de circuito aberto. Analisar a validade de uma equação antropométrica por intermédio de uma validação cruzada com a análise por bioimpedância espectral (BIA).

MÉTODOS: Os participantes com T21 foram distribuídos por um dos seguintes grupos. (1) programa de remo *indoor* – EG1; (2) programa combinado de condicionamento cardiorespiratório e força muscular dinâmica – EG2. Ambas as intervenções pelo exercício respeitaram uma duração absoluta de 28 semanas. Para as fases de pré e pós-treino, estabeleceram-se comparações dos dados de capacidade funcional e economia de esforço de ambos os grupos de T21 com um grupo de controlo (GC) devidamente emparelhado. Na fase de pré-treino, analisou-se RGP nos participantes com T21, tendo esta sido posteriormente comparada com os valores registados pelo GC. Analisaram-se os registos de dispêndio energético de repouso e de intensidade submáxima obtidos a partir a SenseWear Pro2 Armband™ (SWA) recorrendo-se a uma validação cruzada com os obtidos em simultâneo pela espirometria de circuito aberto. Nos grupos com T21, compararam-se as estimativas de massa gorda obtidas a partir equação antropométrica de Kelly e Rimmer, (1987) com as medições efectuadas por BIA.

RESULTADOS: Não se registaram diferenças entre o grupo EG1 e EG2 para as variáveis de capacidade funcional nas fases de pré e pós-treino. Ambos os grupos apresentaram valores inferiores aos registados no CG, antes e após a intervenção. Contudo, após o período de treino, tanto o grupo EG1 como EG2 expressaram aumentos de 40.98% e 23.73% para o consumo de oxigénio relativo, respectivamente. Adicionalmente verificou-se que, após o condicionamento físico, se esbateram as diferenças de economia cardiorespiratória registadas inicialmente

entre os grupos com T21 e o CG, tanto em repouso como em intensidades submáximas. Os grupos EG1 e EG2 mantiveram-se semelhantes para as variáveis de composição corporal pré e pós-treino. Contudo, o grupo EG1 expressou uma redução da massa gorda corporal de 5.02% e um acréscimo de 6.46% para a massa livre de gordura. O grupo EG2 apresentou incrementos significativos para a força muscular dinâmica de membros superiores e de membros inferiores. Os grupos com T21 expressaram valores semelhantes ao CG para a RGP perante um estímulo agudo de exercício. Embora as estimativas de dispêndio energético de repouso, obtidas pela SWA, tenham sido semelhantes para os grupos com T21 e o CG, as técnicas apresentaram coeficientes de correlação baixos. Não se registaram diferenças entre as análises de composição corporal a partir da equação de Kelly e Rimmer e da técnica de BIA.

CONCLUSÕES: Em ambos os grupos com T21, o estímulo crónico pelo exercício induziu um: (1) aumento da capacidade funcional, (2) efeito normalização na economia cardiorespiratória de repouso e submáxima. O programa de remo *indoor* contribuiu para a melhoria da composição corporal do grupo EG1. O grupo EG2 incrementou os níveis de força dos membros superiores e inferiores após a adesão à prescrição proposta. Aparentemente, não existem diferenças na RGP face ao exercício, entre indivíduos com T21 e controlos saudáveis. A SWA revelou-se um instrumento válido para a determinação do metabolismo de repouso de grupos de indivíduos saudáveis e com T21, contudo não está indicada para avaliações individuais. Finalmente, a equação de Kelly e Rimmer apresenta validade para a análise da composição corporal de adultos com T21.

PALAVRAS-CHAVE: Trissomia 21; Exercício, Composição Corporal; Dispêndio Energético e Capacidade Funcional.

ABSTRACT (ENGLISH)

PHYSIOLOGICAL RESPONSES AND LONG-TERM ADAPTATIONS TO EXERCISE

EXERCISE TRAINING, FUNCTIONAL CAPACITY, BODY COMPOSITION, MAXIMUM DYNAMIC STRENGTH, EXERCISE ECONOMY, ELECTRODERMAL ACTIVITY, ENERGY EXPENDITURE AND ANTHROPOMETRIC MEASUREMENTS IN INDIVIDUALS WITH DOWN SYNDROME.

Gonçalo Vilhena de Mendonça

OBJECTIVES: Determine the chronic effects of exercise on body composition, functional capacity, exercise economy and dynamic muscle strength in adults with Down's syndrome (DS). Explore differences, in electrodermal response to an acute exercise bout, between DS participants and healthy controls. Crossvalidate an energy expenditure estimating device for both, the DS and control group (CG). Crossvalidate an anthropometric equation for assessing body composition in DS individuals.

METHODS: DS participants were assigned to one of the following groups: (1) indoor rowing aerobic program – EG1; (2) combined aerobic and dynamic strength conditioning program – EG2. Both exercise interventions had an absolute duration of 28 weeks. DS groups were compared with a paired CG before and after training for functional capacity and exercise economy. Body composition changes were determined by comparing the DS participants' baseline and post-training values. DS group electrodermal response to exercise was assessed prior to training and compared with the values attained by the controls. Resting and submaximal energy expenditure estimates computed by the SenseWear Pro2 Armband™ (SWA) were crossvalidated with open circuit spirometry, for both the DS and the CG. Kelly & Rimmer, (1987) anthropometric body composition analysis was crossvalidated with bioimpedance spectroscopy (BIA) for DS individuals.

RESULTS: EG1 and EG2 were similar for functional capacity before and after training, and these groups presented lower values than the CG at both assessment periods. However, after exercise intervention, relative peak oxygen consumption improved by 40.98% and by 23.73% for EG1 and EG2, respectively. At post-training period, both EG1 and EG2 presented similar resting and submaximal cardiorespiratory economy as healthy controls. There were no body composition group differences at pre and post-training assessments. However, EG1 showed positive body composition modifications of 5.02% fat mass decrease and 6.46% fat free mass increase. EG2 showed upper and lower body dynamic strength differences after intervention. Both the DS and control participants presented similar values for the electrodermal response to acute exercise. The resting SWA

energy expenditure estimates did not differ from the open circuit spirometry values, however they were poorly correlated. There were no differences between Kelly & Rimmer estimates and BIA assessments prior and after training.

CONCLUSIONS: Exercise training in both DS groups was effective in eliciting: (1) higher functional capacity, (2) normalization effect of resting and submaximal cardiorespiratory economy. The exercise program improved EG1 participants' body composition. EG2 increased upper and lower body strength after training. Apparently, DS individuals' electrodermal response to exercise is similar to that of healthy controls. The SWA is a valid tool for assessing resting energy expenditure of groups of DS or healthy individuals, but not on an individual basis; and finally, the Kelly & Rimmer equation is valid and reliable for body composition assessments in DS adults.

KEYWORDS: Down's syndrome; Exercise; Body composition; Energy Expenditure; Functional Capacity.

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SYMBOLS AND ABBREVIATIONS

1-RM	One maximum repetition
Ach	Acetylcholine
AGM	Anthropometric girth measurement
ATP	Adenosine triphosphate
BIA	Bioimpedance analysis
BMI	Body mass index
BP	Blood pressure
BRS	Baroreflex
BSA	Body surface area
CAT	Catalase
CG	Control group
CP	Chest press
CRI	Chronotropic response index
DS	Down's syndrome
EE	Energy expenditure
EG1	Experimental group 1
EG2	Experimental group 2
FFM	Fat free mass
FM	Fat mass
GSH-Px	Glutathione peroxidase
GSR	Galvanic skin response
GXT	Graded maximal exercise test
HDL	High density lipoprotein
HR	Heart rate
HRR	Heart rate reserve
IC	Indirect calorimetry
ID	Intellectual disabilities
LB	Low back
LE	Leg extension
LP	Leg press
MVC	Maximal voluntary contraction
RER	Respiratory exchange ratio
RMR	Resting metabolic rate
RR	Respiratory rate
SOD-1	Copper/zinc superoxide dismutase
SP	Shoulder press
SSR	Sympathetic skin response
SWA	SenseWear Pro2 armband
TP	Triceps press
TV	Tidal volume
V _E	Pulmonary minute ventilation
VO ₂	Volume of oxygen consumption
VT	Vertical traction