UNIVERSITY OF EXETER

PERCEIVED EXERTION RELATIONSHIPS IN ADULTS AND CHILDREN

Submitted by Danielle Lambrick to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Sport and Health Sciences (March, 2010)

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award a degree by this or any other University.

....

Acknowledgements

First of all I would like to express my sincere gratitude to my first supervisor, Professor Roger Eston, for his knowledge, dedication and unwavering support throughout my PhD. I am deeply grateful also to my second supervisor, Dr Ann Rowlands, for providing countless valuable suggestions and constructive advice in the course of this thesis. Both Roger and Ann have been instrumental in aiding my academic development, and it is my privilege to have worked alongside them these past few years.

I recognise that this thesis would not have been possible without the help of the volunteers who selflessly participated in each of my research studies. I am extremely grateful to each of you. I would like to thank the parents / guardians for their cooperation in this research to allow each child to participate. I would also like to extend my gratitude to Mrs Alison Turner (Headmistress of Exeter Junior School), Mr Dave Broad (Ladysmith Junior School) and Mrs Sheila Jefferies (Willowbrook Primary School) for their initial interest and support in conducting this research. Furthermore, I am also thankful to all the PhD students who kindly assisted me in data collection over the past 3 years, and to David Childs and Jamie Blackwell for their technical guidance and assistance when any problems arose.

Finally, I am forever indebted to my family and James for their endless love, patience, and understanding. Their encouragement in times of need ensured the successful completion of this thesis, and a relative level of sanity!

Abstract

The ratings of perceived exertion are commonly employed within both a clinical and exercise setting to quantify, monitor and evaluate an individual's exercise tolerance and level of exertion. Recent advances in the area of perceived exertion have led to novel applications in the use of the ratings of perceived exertion scale as a means of predicting an individual's maximal functional capacity ($\dot{V}O_2max$) for exercise (Eston, Lamb, Parfitt, & King, 2005; Eston, Faulkner, Mason, & Parfitt, 2006; Eston, Lambrick, Sheppard, & Parfitt, 2008; Faulkner, Parfitt, & Eston, 2007). Yet the utility of such procedures with low-fit individuals or children has received little or no research attention. As such, one aim of this thesis was to assess the efficacy of the ratings of perceived exertion in predicting the $\dot{V}O_2max$ of low-fit men and women, and healthy children. It is often presumed that like adults, a child's perception of exertion rises linearly with increases in exercise intensity, despite a limited amount research suggesting otherwise. Moreover, there is a lack of empirical evidence to suggest that children regulate their power output during a closed-loop exercise task in order to complete a given distance in the fastest time possible. Therefore, a further aim of this thesis was to explore the nature of the perceptual responses of young children across differing modes of exercise, and to examine whether children employ pacing strategies during running. In relation to this latter aim, it was of particular interest to explore pacing in relation to the ratings of perceived exertion during running, as the ratings of perceived exertion have been proposed as a key component of such a regulatory system during exercise (Tucker, 2009).

This thesis comprises a qualitative review of relevant literature, and six study chapters which were borne out of five empirical studies. The findings of studies 1 and 2 (chapters 3 & 4, respectively) support the utility of the ratings of perceived exertion to estimate $\dot{V}O_2max$ in low-fit men and women, during cycle ergometry exercise.

Importantly, this has been shown from a single exercise test at a low-moderate exercise intensity, during either a step-incremental (study 1) or ramp-incremental (study 2) protocol. Studies 3 and 4 (chapters 5 & 6, respectively) provide evidence to suggest that a child's perception of exertion may rise linearly or curvilinearly in relation to increasing work, during either cycle ergometry or treadmill exercise. These studies support the utility of a unique, curvilinear, paediatric ratings of perceived exertion scale in obtaining accurate exertional responses from young children, across differing modes of exercise. In contrast to studies 1 and 2, study 5 (chapter 7) suggests that the novel means of predicting maximal functional capacity from submaximal ratings of perceived exertion in adults is inaccurate with young children. This was particularly evident in the low intraclass correlation coefficients and wide limits of agreement obtained between measured- and predicted $\dot{V}O_2max$, for both cycle ergometry and treadmill exercise. Study 6 (chapter 8) demonstrated that young children employ pacing strategies during an 800 m run, similar to adults, and that this improves with trial familiarisation. Moreover, the presence of other competitors has a detrimental effect on performance, particularly for girls.

Thesis Content

List of Tables

List of Figures

Abbreviations

ACSM	American College of Sports Medicine
ANOVA	Analysis of Variance
b·min^{-1}	Beats per minute
BABE	Bug And Bag Effort scale
BIA	Bioelectrical Impedance Analysis
CALER	Cart And Load Effort Rating scale
CERT	Children's Effort Rating Table
CR-10	Category Ratio-10 scale
DBP	Diastolic Blood Pressure
E-P scale	Eston-Parfitt RPE scale
GET	Gaseous Exchange Threshold
GXT	Graded-exercise Test
HR	Heart Rate
% HRmax	Heart rate expressed as a percentage of maximal heart rate
ICC	Intraclass Correlation Coefficients
L·min^{-1}	Litres per minute
LoA	Limits of Agreement
m	Meters
min	Minutes
ml·kg^{-1}·min^{-1}	Millilitres per kilogram per minute
mmHg	Millimeters of mercury

n	Sample size
OMNI	Omnibus RPE scale
PCERT	Pictorial Children's Effort Rating Table
r	Pearson's correlation coefficient
R	Intraclass correlation coefficient
R^2	Coefficient of determination
rev·min^{-1}	Revolutions per minute
RPE	Ratings of Perceived Exertion
RR	Respiratory Rate
s	Seconds
SBP	Systolic Blood Pressure
SD	Standard Deviation
$\dot{V}CO_2$	Volume of Carbon Dioxide
$\dot{V}_E$	Ventilation
$\dot{V}O_2$	Volume of Oxygen Uptake
$\dot{V}O_2max$	Maximal Oxygen Uptake
$\dot{V}O_2peak$	Peak Oxygen Uptake
% $\dot{V}O_2max$	Oxygen uptake expressed as a percentage of maximal oxygen uptake
VT	Ventilatory Threshold
W	Watts
WR	Work Rate