

REVIEW ARTICLE

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Measurement of Physical Activity and Energy Expenditure in Wheelchair Users: Methods, Considerations and Future Directions

Tom E. Nightingale, Peter C. Rouse, Dylan Thompson and James L. J. Blazon*

Abstract

Accurately measuring physical activity and energy expenditure in persons with chronic physical disabilities who use wheelchairs is a considerable and ongoing challenge. Quantifying various free-living lifestyle behaviours in this group is at present restricted by our understanding of appropriate measurement tools and analytical techniques. This review provides a detailed evaluation of the currently available measurement tools used to predict physical activity and energy expenditure in persons who use wheelchairs. It also outlines numerous considerations specific to this population and suggests suitable future directions for the field. Of the existing three self-report methods utilised in this population, the 3-day Physical Activity Recall Assessment for People with Spinal Cord Injury (PARA-SCI) telephone interview demonstrates the best reliability and validity. However, the complexity of interview administration and potential for recall bias are notable limitations. Objective measurement tools, which overcome such considerations, have been validated using controlled laboratory protocols. These have consistently demonstrated the arm or wrist as the most suitable anatomical location to wear accelerometers. Yet, more complex data analysis methodologies may be necessary to further improve energy expenditure prediction for more intricate movements or behaviours. Multi-sensor devices that incorporate physiological signals and acceleration have recently been adapted for persons who use wheelchairs. Population specific algorithms offer considerable improvements in energy expenditure prediction accuracy. This review highlights the progress in the field and aims to encourage the wider scientific community to develop innovative solutions to accurately quantify physical activity in this population.

Key Points

- Predicting energy expenditure from physical activity is inherently more challenging in persons with chronic physical disabilities who use wheelchairs due to altered movement patterns and variations in metabolically active muscle mass.
- Recent studies have successfully attempted to utilise technological advancements (i.e. multi-sensor devices) to measure physical activity and predict energy expenditure (using population or activity-specific algorithms) in persons who use wheelchairs.
- Combining measurement methods (both self-report and objective) might provide greater contextual

information about the types and purpose of activities being performed by persons who use wheelchairs. This has implications to inform the wider public health agenda by promoting physical activity and reducing non-communicable diseases in persons with chronic physical disabilities.

Review

Introduction

Considerable evidence now exists to support the beneficial effects of physical activity (PA) for human health and wellbeing [1–3]. However, the majority of this evidence is from research in adults without disabilities. Our understanding of the impact and importance of PA for populations with chronic physical disabilities, particularly those who use wheelchairs, is therefore lacking.

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Measuring Physical Activity And Energy Expenditure

Henry Joseph Montoye



Measuring Physical Activity And Energy Expenditure:

Measuring Physical Activity and Energy Expenditure Henry Joseph Montoye, 1996-01 This manual of practical guidelines is written by internationally known experts in exercise physiology and exercise epidemiology It is the only book that covers all available methods for assessing energy expenditure and physical activity It includes comprehensive references on the topic and highlights promising areas for future research in measurement methodology And the extensive appendixes include a number of useful questionnaire and interview forms that represent the most widely used and adaptable resources available Measuring physical activity levels is a formidable task *Measuring Physical Activity and Energy Expenditure* smooths the way bringing together the diverse literature on the subject and providing state of the art scientific methods for assessing physical activity and energy expenditure

Physical Activity Assessments for Health-related Research Greg Welk, 2002 And examples References Construct validity in physical activity research Matthew T Mahar and David A Rowe Definitional stage Confirmatory stage Theory testing stage Summary References Physical activity data odd distributions yield strange answers Jerry R Thomas and Katherine T Thomas Overview of the general linear model and rank order procedures Determining whether data are normally distributed Application of rank order procedures Data distributions and correlation Extensions of GLM rank order statistical procedures Summary Endnote References Equating and linking of physical activity questionnaires Weimo Zhu What is scale equating Equating methods Practical issues of scale equating Remaining challenges and future research directions Summary References

Physical Activity and Health Audrey F. Manley, 1996-11 This report is the first report of the Surgeon General on physical activity and health For more than a century the Surgeon General of the Public Health Service has focused the nation's attention on important public health issues Reports from Surgeons General on the adverse health consequences of smoking triggered nationwide efforts to prevent tobacco use Reports on nutrition violence and HIV AIDS to name but a few have heightened America's awareness of important public health issues and have spawned major public health initiatives This new report which is a comprehensive review of the available scientific evidence about the relationship between physical activity and health status follows in this notable tradition Scientists and doctors have known for years that substantial benefits can be gained from regular physical activity The expanding and strengthening evidence on the relationship between physical activity and health necessitates the focus this report brings to this important public health challenge Although the science of physical activity is a complex and still developing field we have today strong evidence to indicate that regular physical activity will provide clear and substantial health gains In this sense the report is more than a summary of the science it is a national call to action

Physical Activity and Health, 1998 This is the first Surgeon General's report to address physical activity and health The main message of this report is that Americans can substantially improve their health and quality of life by including moderate amounts of physical activity in their daily lives Health benefits from physical activity are thus achievable for most Americans including those who may dislike vigorous exercise and those who

may have been previously discouraged by the difficulty of adhering to a program of vigorous exercise For those who are already achieving regular moderate amounts of activity additional benefits can be gained by further increases in activity level Extr introd 1996 *Measurement and Evaluation in Human Performance* James R. Morrow,Dale P. Mood,Weimo

Zhu,Minsoo Kang,2023 *Measurement and Evaluation in Human Performance* Sixth Edition With HKPropel Access teaches the fundamentals of collecting and analyzing human performance data by focusing on the concepts of reliability and validity It features practical applications in kinesiology physical education and more **Amsterdam Growth and Health**

Longitudinal Study (AGAHLS) Han C. G. Kemper,2004 A unique observational long term study In a long follow up period of 23 years about 600 teenagers were observed till their young adult age in order to investigate the longitudinal relationship between health and lifestyles considering physical activity diet smoking and alcohol consumption Longitudinal studies with a follow up lasting for a quarter of a century are very rare and the Amsterdam Growth and Health Longitudinal Study AGAHLS is indeed unique among them The focus is multidisciplinary and involves both physical and psychological determinants in relation to a wide range of health outcomes The multiple measurements were carefully standardized in nine waves of data collection thus producing a high quality data set which has been analyzed by the application of advanced statistical techniques The monograph provides not only an overview of 23 years of follow up it also summarizes over 200 scientific publications and 10 PhD theses This publication is especially recommended to investigators planning longitudinal research to health workers and to authorities who like to implement health promotional activities in their community **Sports**

Nutrition Judy A. Driskell,Ira Wolinsky,2007-09-14 Exercise by itself tears down the body To rebuild that body so that it expresses greater strength endurance and speed requires sound nutritional practices based on fact rather than fad Those practices must also recognize that specific needs vary greatly according to age gender and intensity of exercise Sports Nutrition Energy Metabo

Measurement for Evaluation in Kinesiology Ted A. Baumgartner,Andrew S. Jackson,Matthew T. Mahar,David A. Rowe,2015-02-13 Previous edition *Measurement for evaluation in physical education and exercise science* Ted A Baumgartner 8th ed 2007 **Measurement Theory and Practice in Kinesiology** Terry M.

Wood,Weimo Zhu,2006 Provides readers with an understanding of the basics of measurement techniques in physical activity by focusing on understanding the concept behind techniques Looking at measurement issues in the physical domain this book is useful for post graduate students researchers and professionals in sport and exercise science **Epidemiologic**

Methods in Physical Activity Studies I-Min Lee,2009 This book provides information regarding epidemiologic methods used in studies of physical activity It is intended for use by students and researchers in physical activity and in public health and by researchers and professionals using physical activity data e g exercise physiologists and health economists Additionally those interested in physical activity and health who want to understand and appropriately interpret the results of physical activity studies e g physicians and journalists may also find the book useful **BOOK JACKET** **Measurement**

Issues in Aging and Physical Activity Weimo Zhu, Wojtek J. Chodzko-Zajko, 2006 Based on the 10th Measurement and Evaluation Symposium Measurement Issues and Challenges in Aging Research Measurement Issues in Aging and Physical Activity considers research from experts around the world relating to the latest questions challenges and techniques in aging and measurement The reference addresses a range of topics in aging research including issues from the fields of kinesiology biology physiology technology urban planning measurement and statistics Measurement Issues in Aging and Physical Activity breaks new ground with a discussion of multicultural factors related to physical activity promotion and intervention Ideas include using culture as a catalyst for active living and using culture based physical activity as an alternative approach to promotion of active living The reference further examines multicultural issues with a look at alternative medicine including an account of a demonstration of qi gong a traditional Chinese exercise from the symposium In addition a new term kinesmetrics is introduced for the field of measurement and evaluation Kinesmetrics is defined as a discipline for developing and applying measurement theory statistics and mathematical analysis to the field of kinesiology The groundbreaking Measurement Issues in Aging and Physical Activity explores subjects in a range of research topics For both veterans and newcomers to the field this reference will be a comprehensive guide to the latest research on aging in measurement and physical activity Publisher description *Routledge Handbook of Physical Activity Policy and Practice* Joe Piggin, Louise Mansfield, Mike Weed, 2017-12-22 Physical activity inactivity and their relationship to health are serious concerns for governments around the world This is the first book to critically examine the policy and practice of physical activity from a multi disciplinary social scientific perspective Moving beyond the usual biophysical and epidemiological approaches it defines and explores the key themes that are shaping the global physical activity debate Unrivalled in its scale and scope it presents the latest data on physical activity from around the world including case studies from Europe North and South America Africa and Asia Drawing on social economic and behavioural sciences it covers contexts from the global to the local and introduces the dominant ideas which inform the study of physical activity Its 41 chapters examine the use of different forms of evidence in policymaking the role of organisations in advocating physical activity and the practical realities of public health interventions The Routledge Handbook of Physical Activity Policy and Practice is a landmark publication for all students academics policymakers and practitioners interested in the social scientific study of sport exercise physical activity and public health Measurement and Evaluation in Physical Activity Applications Ronald L. Snarr, Will Peveler, Phillip Bishop, 2025-11-10 Measurement and Evaluation in Physical Activity Applications Exercise Science Physical Education Coaching Athletic Training and Health offers an accessible student friendly introduction to the principles and practice of measurement and evaluation Spanning applications in exercise science sports performance physical education coaching athletic training health and physical occupational therapy the book includes chapters on the key principles underlying good measurement practice validity reliability and objectivity as well as an introduction to using statistics and qualitative

measurement This textbook is intended to help students overcome their fear of scientific research and statistics Fully revised and updated the third edition provides a clear guide to the obstacles of good measurement how to apply the principles of good measurement an introduction to statistical analyses and the eventual application communication of measurement outcomes Structured for use in both single and double semester classes and involving readers at every stage through its rich pedagogy and accessibility this book is a crucial resource for introducing students to the principles of best practices in measurement and evaluation This book is the ideal learning aid for students studying measurement evaluation or assessment in kinesiology exercise science sports coaching physical education athletic training and health and fitness

Kinanthropometry and Exercise Physiology Laboratory Manual: Tests, Procedures and Data Roger

Eston,2009-06-02 Kinanthropometry is the study of human body size shape and form and how those characteristics relate to human movement and sporting performance In this fully updated and revised edition of the classic guide to kinanthropometric theory and practice leading international sport and exercise scientists offer a clear and comprehensive introduction to essential principles and techniques Each chapter guides the reader through the planning and conduct of practical and laboratory sessions and includes a survey of current theory and contemporary literature relating to that topic The book is fully illustrated and includes worked examples exercises research data chapter summaries and guides to further reading throughout Volume One Anthropometry covers key topics such as body composition proportion and growth evaluating posture flexibility and range of motion children s physiology maturation and sport performance field work statistical methods for kinesiology and sport accurate scaling of data for sport and exercise sciences The Kinanthropometry and Exercise Physiology Laboratory Manual is essential reading for all serious students and researchers working in sport and exercise science kinesiology and human movement Roger Eston is Professor of Human Physiology and Head of the School of Sport and Health Sciences at the University of Exeter Thomas Reilly is Professor of Sports Science and Director of the Research Institute for Sport and Exercise Sciences at Liverpool John Moores University *Measurement of Physical Activity and Energy Expenditure Using Heart Rate, Motion Sensors and Questionnaires* Scott J. Strath,2001 *Nutrition in the Prevention and Treatment of Disease* Ann M. Coulston,Carol J. Boushey,Mario Ferruzzi,2013 This comprehensive clinical nutrition textbook uniquely focuses on the clinical applications and disease prevention of nutrition clearly linking the contributions of basic science to applied nutrition research and in turn to research based patient care guidelines *Public Health* Jacek Czepiel,Alicja Domagała,Mariusz Duplaga,Tomasz Grodzicki,Janusz Hałuszka,Grażyna Jasieńska,Justyna Klingemann,Iwona Kowalska-Bobko,Andrzej Ryś,Monika Ścibor,Marzena Tambor,Beata Tobiasz-Adamczyk,Piotr Tyszkowski,2024-06-17 In Poland for almost three decades education in the field of public health has been provided in medical universities with the aim of creating an expert workforce to ensure appropriate action in this area The book draws on the experience and knowledge of teachers associated with the School of Public Health of the Jagiellonian University undoubtedly

a leading institution in the country in this area but experts from other centres also were invited in order to provide content of an appropriately high quality The textbook on public health edited by professor Stanis awa Golinowska is highly recommended not only to medical university students but also to all persons involved in health protection activities in Poland For all interested in public health this is must read Prof Zbigniew Gaciong MD Medical University of Warsaw This textbook perfectly addresses the health challenges of the contemporary stage of civilization development in which public health is becoming an extremely complex and at the same time dynamically evolving field The scope of the textbook is clearly defined and its division into chapters and within them into sections dedicated to specific issues facilitates the search for the required content The textbook also provides a wholesome understanding of public health which covers the theoretical foundations an overview of problems and challenges as well as a description of the tools used both in research and in public policy at multiple levels global European national and local Prof Andrzej M Fal Wroc aw Medical University President of the Polish Society of Public Health

Bioinformatics in Human Health and Heredity ,2012-12-31 The field of statistics not only affects all areas of scientific activity but also many other matters such as public policy It is branching rapidly into so many different subjects that a series of handbooks is the only way of comprehensively presenting the various aspects of statistical methodology applications and recent developments The Handbook of Statistics a series of self contained reference books Each volume is devoted to a particular topic in statistics with Volume 28 dealing with bioinformatics Every chapter is written by prominent workers in the area to which the volume is devoted The series is addressed to the entire community of statisticians and scientists in various disciplines who use statistical methodology in their work At the same time special emphasis is placed on applications oriented techniques with the applied statistician in mind as the primary audience Comprehensively presents the various aspects of statistical methodology Discusses a wide variety of diverse applications and recent developments Contributors are internationally renowned experts in their respective areas [ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription](#) David P. Swain,ACSM,Clinton A. Brawner,2012-12-26 ACSM s Resource Manual for Guidelines for Exercise Testing and Prescription was created as a complement to ACSM s Guidelines for Exercise Testing and Prescription and elaborates on all major aspects of preventative rehabilitation and fitness programs and the major position stands of the ACSM The 7th edition provides information necessary to address the knowledge skills and abilities set forth in the new edition of Guidelines and explains the science behind the exercise testing and prescription ACSM s Resource Manual is a comprehensive resource for those working in the fitness and clinical exercise fields as well as those in academic training

Research Methods in Physical Education and Youth Sport Kathleen Armour,Doune Macdonald,2012-03-15 This is the first research methods book to focus entirely on physical education and youth sport It guides the reader through the whole research process from the first steps to completion of a dissertation or practice based project and introduces key topics such as formulating a research question qualitative approaches quantitative approaches

mixed method research literature review case studies survey interviews and focus groups data analysis writing the dissertation Each chapter includes a full range of useful pedagogical features including chapter summaries practical activities case studies dialogues with active researchers and guidance on further reading and resources With contributions from some of the world s best known researchers in the field this book is indispensable reading for all students and professionals working in physical education youth sport sports coaching and related subjects

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