Anthropometry is the measurement of human morphology and is used in a wide range of applied and research contexts. In this volume, distinguished contributors including anthropologists, human biologists, physiologists, nutritionists and clinical scientists describe many of the ways in which anthropometry is used, and discuss problems associated with different methods of assessment. Topics include measurement error and statistical issues in anthropometry, and the construction and use of growth charts in growth monitoring. In addition, the use of anthropometry in assessments of body composition, physical performance and fitness is discussed.

This book will be of interest to graduates and researchers in human biology, anthropology, and nutrition. It will also be useful to workers in sports medicine, ergonomics, orthopaedics and paediatrics.
Cambridge Studies in Biological Anthropology 14

Anthropometry: the individual and the population
Cambridge Studies in Biological Anthropology

*Series Editors*

G.W. Lasker  
Department of Anatomy & Cell Biology,  
Wayne State University,  
Detroit, Michigan, USA

C.G.N. Mascie-Taylor  
Department of Biological Anthropology,  
University of Cambridge

D.F. Roberts  
Department of Human Genetics,  
University of Newcastle-upon-Tyne

R.A. Foley  
Department of Biological Anthropology,  
University of Cambridge

*Also in the series*

G.W. Lasker *Surnames and Genetic Structure*  
C.G.N. Mascie-Taylor and G.W. Lasker (editors) *Biological Aspects of Human Migration*  
Barry Bogin *Patterns of Human Growth*  
Julius A. Kieser *Human Adult Odontometrics – The study of variation in adult tooth size*  
J.E. Lindsay Carter and Barbara Honeyman Heath *Somatotyping – Development and applications*  
Roy J. Shephard *Body Composition in Biological Anthropology*  
Ashley H. Robins *Biological Perspectives on Human Pigmentation*  
C.G.N. Mascie-Taylor and G.W. Lasker (editors) *Applications of Biological Anthropology to Human Affairs*  
Alex F. Roche *Growth, Maturation, and Body Composition – The Fels Longitudinal Study 1929–1991*  
Eric J. Devor (editor) *Molecular Applications in Biological Anthropology*  
Kenneth M. Weiss *The Genetic Causes of Human Disease – Principles and evolutionary approaches*  
Duane Quaillt and Vernon Reynolds *Primate Behaviour – Information, social knowledge, and the evolution of culture*  
G.W. Lasker and C.G.N. Mascie-Taylor *Research Strategies in Biological Anthropology – Field and survey studies*
Anthropometry: 
the individual and 
the population

EDITED BY

S.J. ULIJASZEK
Lecturer in Biological Anthropology,
Department of Biological Anthropology,
University of Cambridge, Cambridge, UK

AND

C.G.N. MASCIE-TAYLOR
Reader in Biological Anthropology,
Department of Biological Anthropology,
University of Cambridge, Cambridge, UK
Contents

List of contributors ix
Preface xi
Acknowledgements xiii
1 The place of anthropometry in human biology 1
   G.W. LASKER
2 Asymmetry and growth 7
   PETER H. DANGERFIELD
3 Intra- and inter-observer error in anthropometric measurement 30
   STANLEY J. ULIJASZEK AND JOHN A. LOURIE
4 Statistical issues in anthropometry 56
   C.G. NICHOLAS MASＣIE-TAYLOR
5 Statistical constructs of human growth: new growth charts for old 78
   T.J. COLE
6 Growth monitoring and growth cyclicities in developed countries 99
   STANLEY J. ULIJASZEK
7 Growth monitoring, screening and surveillance in developing countries 108
   ANDREW TOMKINS
8 Variability in adult body size: uses in defining the limits of human survival 117
   C.J.K. HENRY
9 Anthropometry and body composition 130
   PETER S.W. DAVIES
10 Anthropometry and physical performance 141
    N.G. NORGAN

vii
### Contents

11 Anthropometry, strength and motor fitness  
ROBERT M. MALINA  
160

12 Anthropometry in the US armed forces  
CLAIRE C. GORDON AND KARL E. FRIEDL  
178

Index  
211
Contributors

Dr T.J. Cole
Dunn Nutritional Laboratory, Downhams Lane, Cambridge CB4 1XJ, UK

Dr P.H. Dangerfield
Departments of Human Anatomy and Cell Biology, and Orthopaedic Surgery, University of Liverpool, PO Box 147, Liverpool L69 3BX, UK

Dr P.S.W. Davies
Dunn Nutritional Laboratory, Downhams Lane, Cambridge CB4 1XJ, UK

Dr K.E. Friedl
US Army Research Institute of Environmental Medicine, Natick, Massachusetts 01760-5020, USA

Dr C.C. Gordon
Behavioral Sciences Division, US Army Natick Research, Development and Engineering Center, Natick, Massachusetts 01760-5020, USA

Dr C.J.K. Henry
School of Biological Sciences, Oxford Brookes University, Gipsy Lane, Headington, Oxford OX3 0BP, UK

Professor G.W. Lasker
Department of Anatomy and Cell Biology, Wayne State University, School of Medicine, 504 East Canfield Avenue, Detroit, Michigan 48201, USA
x Contributors

Professor J.A. Lourie
Department of Orthopaedic Surgery, Milton Keynes Hospital, Milton Keynes MK19 6EQ, UK

Professor R.M. Malina
Department of Kinesiology and Health Education, University of Texas, Austin, Texas 78712, USA

Dr C.G.N. Mascie-Taylor
Department of Biological Anthropology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK

Dr N.G. Norgan
Department of Human Sciences, Loughborough University, Loughborough, Leicestershire LE11 3TU, UK

Professor A.M. Tomkins
Centre for International Child Health, Institute of Child Health, 30 Guilford Street, London WC1N 1EH, UK

Dr S.J. Ulijaszek
Department of Biological Anthropology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK
Preface

This book examines the various ways in which anthropometric measurements are used and interpreted in a range of disciplines, including biological anthropology, human biology, clinical medicine, applied physiology, health sciences and ergonomics. Anthropometry can be used to define population characteristics or to assess individuals with respect to some physical parameter, and the dual nature of this methodology is addressed by many of the authors.

The introductory chapter by G.W. Lasker discusses the role that anthropometry plays in studies of human biology, and examines the history of anthropometric measurement. The use of anthropometry in discriminating the pathological from the normal is a theme which appears in the first chapter, and is developed further by P.H. Dangerfield, who considers asymmetry in human growth, and why it is important to define what is ‘normal’ asymmetry. Accurate measurement is important in any science, and S.J. Ulijaszek and J.A Lourie review what is known about measurement error in anthropometry and put forward references for maximum acceptable error. In the chapter which follows, C.G.N. Mascie-Taylor considers statistical issues and approaches when analysing cross-sectional anthropometric characters in groups or populations.

Growth charts are widely used for growth monitoring in both developed and developing countries, and the next three chapters consider different aspects of monitoring. In the first of these, T.J. Cole describes different types of growth chart and the principles underlying them, and elaborates on new types of conditional height charts which he has developed. In the subsequent chapter, S.J. Ulijaszek considers the importance of understanding human growth cyclicities in relation to accurate growth monitoring in Western nations, while in the third of these, A.M. Tomkins discusses the problems associated with growth monitoring, screening and surveillance in developing countries.

Anthropometry has been widely used in the assessment of nutritional status of children in developing countries. Only recently has it been considered for the assessment of undernutrition in adults. The chapter by C.J.K. Henry considers the use of body mass index (BMI) in such
Preface

assessment, and goes on to show that BMI can be used to define the limits of human survival. The BMI is a proxy for body size and, less directly, of body composition; anthropometry has been used to assess body composition in adults, but it has been little used for such assessment in children. The problems associated with this type of work are raised in the chapter by P.S.W. Davies. The following chapters by N.G. Norgan and R.M. Malina consider anthropometry and physical performance, and anthropometry and physical fitness, respectively. In an extensive review of the anthropometric concerns of scientists in the US Armed Forces, C.C. Gordon describes some approaches which may be of value to workers in other areas.

Collectively, this volume shows the many ways in which anthropometry is used. More specifically, authors address problems associated with the use and interpretation of this methodology in different areas of study.

Cambridge

Stanley J. Ulijaszek
C.G.N. Mascie-Taylor
Acknowledgements

We thank Kabi Pharmacia for their financial support of the one day anthropometry workshop held at the Department of Biological Anthropology, University of Cambridge, at which most of the chapters in this book were presented.