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Paediatric Lung Function

Edited by

U. Frey and P.J.F.M. Merkus



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Paediatric Lung Function

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Editor in Chief
K. Larsson

This book is one in a series of European Respiratory Monographs. Each individual issue provides a comprehensive overview of one specific clinical area of respiratory health, communicating information about the most advanced techniques and systems needed to investigate it. It provides factual and useful scientific detail, drawing on specific case studies and looking into the diagnosis and management of individual patients. Previously published titles in this series are listed at the back of this book with details of how they can be purchased.

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The Guest Editors



U. Frey



P.J.F.M. Merkus

U. Frey is Professor of Paediatric Pulmonology and Head of Department at the Division of Paediatric Respiratory Medicine, Dept of Paediatrics, at the University Hospital of Bern, Inselspital, Bern, Switzerland. After completing his MD degree in Bern, he achieved his PhD in Biomedical Engineering at the University of Leicester, UK. His current research interests are in infant physiology, with particular focus on physiology of wheezing disorders in the developing lung, early detection of bronchial asthma and inflammatory markers, the influence of genetic and environmental factors on lung growth in infants, and lung and airway growth in chronic lung disease of prematurity. He is interested in the complex analysis of fluctuation of physiological signals, the monitoring of asthma, the development of noninvasive infant lung function techniques for unsedated infants and the standardisation of infant lung function techniques and equipment. U. Frey is a member of the editorial board for the *European Respiratory Journal* and a member of the Swiss National Science Foundation board.

P.J.F.M. Merkus developed a special interest in paediatric lung physiology during his PhD studies in children with and without asthma. He published papers and a thesis on the growth of lungs and airways in children with asthma, at Leiden University, the Netherlands, in 1993. Thereafter, he specialised in paediatrics and paediatric pulmonology at the Sophia Children's Hospital, Rotterdam, the Netherlands. Subsequently, his research focus shifted to studies into the clinical application of infant lung function testing in children with chronic lung disease, cystic fibrosis and wheeze. At the same time, he initiated several multicentre trials into the off-label use of recombinant human DNase, which were conducted in the Netherlands. In 2007, P.J.F.M. Merkus became Associate Professor at the Dept of Paediatrics, Division of Respiratory Medicine at Radboud University Nijmegen Medical Centre, the Netherlands. His current research activities relate to new diagnostic techniques and treatment modalities of respiratory infections in asthma and cystic fibrosis, asthma management, and psychosocial aspects, adherence to treatment and quality of life in children with chronic lung disease. He has been collaborating with U. Frey for over 6 yrs and, until recently, they have chaired the European Respiratory Society scientific group 7.01, on Paediatric Respiratory Physiology.

Preface

It is a pleasure to present the fourth *European Respiratory Monograph (ERM)* devoted to respiratory medicine in children. In 1997, an issue entitled *New Diagnostic Techniques in Paediatric Respiratory Medicine* was published, and a substantial part of this *ERM* was focused on lung function assessment in children. A more broad approach was taken in the issue *Growing up with Lung Disease: the Lung in Transition to Adult Life*, which was published in 2002, and 4 yrs later, in 2006, the *ERM* entitled *Respiratory Diseases in Infants and Children* appeared as an issue covering most of the aspects of paediatric pulmonology. In the *Lung Function Testing* issue from 2005, one of the chapters took an interest in the specific aspects of assessment of lung function in infants and children. As the area is rapidly developing, the time has now come for an *ERM* entirely focused on paediatric aspects of lung function assessment, which seems appropriate considering that the paediatric assembly has become one of the largest within the European Respiratory Society.

There are specific issues concerning lung function measurement in children (and in the elderly for that matter), as normal values are difficult to define and instructions on how to perform the tests sometimes may be difficult to convey. In small children, techniques that do not require active involvement of the patients have to be developed. Furthermore, lung function assessment in adolescence has its own difficulties regarding predicted normal values, as two different teenagers may appear as children or adults at one and the same age.

From having been a concern mainly for the specialists, simple lung function testing is more and more becoming an integrated part of the daily clinical practice in adult and paediatric primary care in many countries. In parallel with the growing interest in lung function assessment in general, the technical development within the field is rapidly growing and more advanced methods are used. The publication of the current issue of the *ERM* is therefore felt to be timely and it is my conviction that it will be warmly welcomed by a large number of readers who are actively involved in lung function measurements in infants, children and adolescents. Apart from the pure paediatric clinical and technical aspects, this issue will also attract readers outside the paediatric guild, as there are chapters on developmental physiology, lung growth, environmental influences on lung development and function, *etc.* The editors, of whom one was also a guest editor for the *Respiratory Diseases in Infants and Children* issue, have succeeded in recruiting the most distinguished specialists as authors, which will make this *ERM* a milestone within the paediatric literature.

**Editor in Chief,
K. Larsson**

INTRODUCTION

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Paediatric lung function testing is an expanding field. Traditionally, tests developed for adults were adapted for use in primary schoolchildren; nowadays, we consider it relatively normal that efforts are made to assess lung function in sedated or unsedated (pre-mature) infants, in toddlers who do not cooperate actively, and preschool children who may perform active manoeuvres when rewarded with the right incentive.

The technical developments of the last decades are the major reason why it has been possible to improve equipment, enhance data sampling and refine data analyses. Especially in the children with the lowest "respiratory signals", it was crucial to reduce factors such as technical noise and equipment deadspace as much as possible. Although infant lung function testing is usually not a realistic option for diagnostic purposes in clinical care, further understanding of lung growth in health and disease, and of the relationships between structure and function, has been partly the result of studies in this field. This was and is especially the case when observations from infant lung function testing are combined with those of additional studies of structure (imaging, histology), inflammation and therapeutic interventions in young children, or from animal experiments.

The main progress in clinical research of functioning of the paediatric lung has been made through global collaboration of a large number of researchers and clinicians, many of whom also contributed to this *European Respiratory Monograph (ERM)*. Most of them were somehow related to or members of the scientific group Paediatric Respiratory Physiology (group 7.01) within the European Respiratory Society. They worked in teams, who have been creative, and were willing to spend a lot of time and effort upon details of the procedures and equipment, to improve their sensitivity and validity, and to reduce variability of these techniques between and within centres. Furthermore, much work has also been done in international standardisation and development of reliable reference ranges in healthy controls. More recently, studies and mathematical techniques have been employed to study biological variance in health and disease. This is a new way of looking at respiratory physiology as a complex and dynamic system that has an intrinsic tendency to vary, where the ability to alter rhythm and dimensions can be regarded as a way to adapt adequately to changes in the environment or as a manner to meet the changes in metabolic needs of the body in health and disease.

We think this *ERM* is a unique collection of reviews on paediatric lung function testing, providing an overview and update of a very active field within paediatric pulmonology. In general, the chapters have been limited in size because of the constraints of this *ERM* issue. If, however, you want to ask the authors for more background information, you are welcome to do so, and for that you can use the address information listed in each chapter of this volume. Additionally, if you have suggestions for future improvement of the *ERM*, on paediatric pulmonology in particular, please feel free to contact the editors. We hope this issue will contribute to enhanced knowledge and better treatment of children with respiratory disorders.