ERS International Congress 2023: highlights from the Paediatrics Assembly

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Abstract

Respiratory health in children is essential for general wellbeing and healthy development in the short and long term. It is well known that many respiratory diseases in adulthood have their origins in early life, and therefore research on prevention of respiratory diseases and management of children with respiratory diseases will benefit patients during the full life course. Scientific and clinical advances in the field of respiratory health are moving at a fast pace. This article summarises some of the highlights in paediatric respiratory medicine presented at the hybrid European Respiratory Society (ERS) International Congress 2023 which took place in Milan (Italy). Selected sessions are summarised by Early Career Members of the Paediatrics Assembly (Assembly 7) under the supervision of senior ERS officers, and cover a wide range of research areas in children, including respiratory physiology and sleep, asthma and allergy, cystic fibrosis, respiratory infection and immunology, neonatology and intensive care, respiratory epidemiology and bronchology.

Introduction

Respiratory health in children is essential for general wellbeing and healthy development in the short and long term. *In utero* and early-life events influence the risk of many respiratory diseases in adulthood, including COPD, occupational asthma and lung cancer. Research on prevention of respiratory diseases and

management of children with respiratory diseases is therefore urgently needed to maximise lung health throughout the life course [1]. During the hybrid European Respiratory Society (ERS) International Congress 2023, the Paediatrics Assembly (Assembly 7) organised various outstanding sessions focusing on the latest insights into respiratory health in children. It included scientific symposia, clinical cases, a hot topics session on lung function trajectories and respiratory health from infancy to adulthood and a postgraduate course on cryotherapy in the paediatric airway. It resulted in an excellent programme of high interest to paediatricians as well as adult physicians and allied health professionals, stimulating the urgently needed collaboration between different healthcare professionals [1]. Assembly 7 Early Career Members and leading experts presented 315 abstracts in oral and poster sessions. Here, we present some of the major paediatric highlights from the 2023 ERS Congress. Senior officers from the Assembly selected sessions, which were summarised by Assembly 7 Early Career Members under their guidance.

Technical and epidemiological novelties in paediatric lung function and sleep

The oral presentation session "Technical and epidemiological novelties in paediatric lung function and sleep" addressed the latest insights on lung measurement parameters in diverse paediatric populations. Nicole Beydon (Paris, France) presented the new ERS technical standard statement for nasal nitric oxide (NO) measurement in children for the diagnosis of primary ciliary dyskinesia (PCD) [2]. The purpose of this ERS statement is to facilitate early diagnosis of PCD, to address both techniques used to measure NO in routine practice (chemiluminescence and electrochemical) and to standardise breathing manoeuvres (with and without velum close) and reporting forms. Although chemiluminescence can provide more reliable results, electrochemical methods are more widely used in Europe. A gradation method is proposed to report the reliability of results as well as considerations for nasal NO in different age groups (figure 1).

Carla Rebeca Da Silva Sena (Newcastle, Australia) provided new data on bronchiolitis risk factors in infants [3]. By utilising the data from the Australian cohort of children born to mothers with asthma in pregnancy, data for 385 infants with tidal breathing values and medical records were available. Of these, 19 were verified with a bronchiolitis hospitalisation after lung function measurements in the first year of life. Lower tidal breathing in infants at 6 weeks of age, along with higher maternal body mass index during pregnancy were found to be significantly associated with bronchiolitis hospitalisation in the first year of life.

Diana Gray (Cape Town, South Africa) presented data from the Drakenstein South African cohort [4], a cohort of children in whom lung function is measured annually using tidal breathing techniques (multiple-breath washout and oscillometry) from birth to 5 years of life. In total, 966 infants with more than 10 000 lung function measurements were available for analysis. Using these data, the authors were able to present how comprehensive lung function measurements change throughout the first years of life [5]. Additionally, lower respiratory tract infections at these ages were shown to be associated with higher airway resistance,

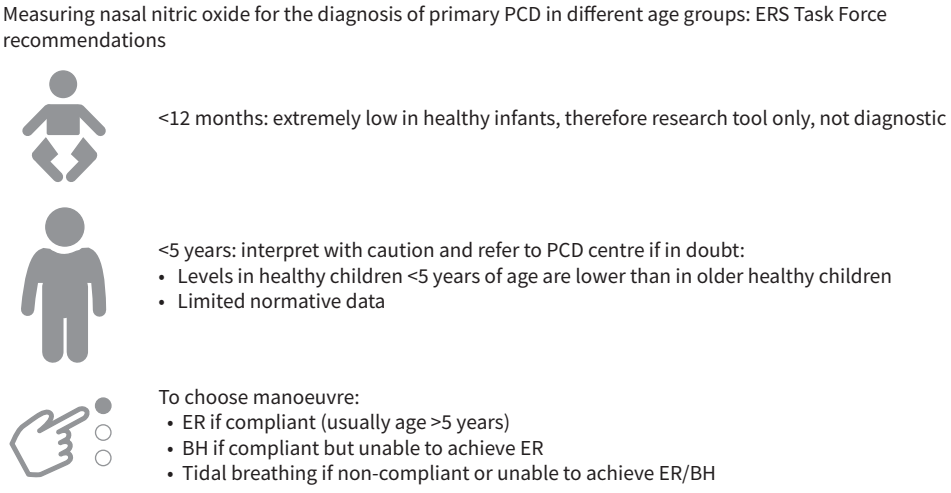

FIGURE 1 Considerations for nasal nitric oxide measurement in different age groups according to new European Respiratory Society (ERS) technical standard. PCD: primary ciliary dyskinesia; ER: exhalation against resistance; BH: breath-hold. Reproduced and modified from [2] with permission.

higher respiratory rate along with lower compliance. Respiratory syncytial virus (RSV) infections had higher impact on lung function than other respiratory viruses.

Jacob McCoy (Toronto, Canada) explored the differences between Global Lung Function Initiative (GLI) Global and GLI Caucasian equations regarding spirometry interpretation. He showed that the use of GLI Global led to a reduction of abnormal spirometry tests, particularly those suggestive of airway restriction [6]. Florian Wyler (Bern, Switzerland) presented data on the development of the lung clearance ratio, a novel ventilation inhomogeneity index that is less sensitive to the confounding effects of breathing patterns, dead space and end expiratory lung volume [7].

The presentations of Andrew Prayle (Nottingham, UK) and Maria Eleni Liagkaki (Athens, Greece) focused on paediatric sleep. Andrew Prayle presented the trajectories of sleep oximetry results in infants born with Pierre Robin sequence in the first 6 months of life [8], whereas Maria Eleni Liagkaki summarised nocturnal oximetry reference values in healthy term infants aged 1–6 months [9].

Take-home messages

- A new ERS statement on measuring nasal NO for the diagnosis of PCD is currently available.
- Early-life tidal breathing measurements significantly differ between children with and without respiratory diseases before school age.

Paediatric asthma and the rising obesity epidemic

Obesity is a rising issue in European children, often starting at an early age. The symposium "Lung consequences of the obesity epidemic from children to the elderly", included four outstanding presentations, by experts in this field.

Deepa Rastogi (Washington, DC, USA) focused on the link between the immune system and obesity-related asthma. There are many proposed mechanisms on pathobiology of asthma in patients with obesity such as the mechanical effect of fat load, inflammation and metabolic dysregulation [10–12]. Asthma in children with obesity is often associated with a non-atopic T-helper (Th)1-polarised systemic inflammation that correlates with pulmonary function deficits [13]. This inflammation has been associated with upregulation of the CDC42 (cell division cycle 42) pathway. CDC42 is a RhoGTPase that plays a role in Th cell physiology [14]. Yon *et al*. [15] investigated the mechanisms by which upregulation of CDC42 in T-cells is associated with airway smooth muscle biology and came to the conclusion that T-cells from asthmatic obese children have uninhibited chemotaxis and are more adherent to obese airway smooth muscle, which is associated with upregulation of genes and proteins associated with smooth muscle proliferation and reciprocal T-cell activation.

Indra Narang (Toronto, Canada) addressed therapeutic considerations in obesity-related obstructive sleep apnoea (OSA). Drug-induced sleep endoscopy is a method performed *via* naso-endoscopy during "sleep" induced by pharmacological agents with the aim of identifying sites of obstruction for targeted surgical interventions. A study by Kirkham *et al*. [16] showed a significant reduction in the obstructive apnoea–hypopnoea index using this technique to identify surgical targets, and the reduction was even higher in the surgically naive group. Continuous positive airway pressure (CPAP) is a highly effective therapy for OSA but not very well tolerated, hence high flow nasal cannula therapy (HFNC) might be a more suitable alternative. A Canadian randomised control trial comparing HFNC to CPAP [17] showed that HFNC and CPAP had similar efficacy in treating OSA as determined by polysomnography. Therefore, HFNC seems like a promising therapy but more randomised controlled studies are needed to evaluate clinical outcomes. There are also pharmacological approaches such as weight management with GLP-1 agonists [18, 19] or repurposing drugs like atomoxetine and oxybutinin [20, 21] that might be effective in reducing weight and improving airway collapsibility.

With the question "Why (how) does childhood obesity cause (worsen) respiratory disease?" Erick Forno (Pittsburgh, PA, USA) summarised the current data on this topic (figure 2). He presented a study of six independent cohorts with/without asthma and airway dysanapsis [22, 23], which is defined by supernormal forced vital capacity (FVC), normal forced expiratory volume in 1 s (FEV_1) and low FEV_1/FVC ratio. Airway dysanapsis was more frequent in patients with overweight and obesity and was associated with an increased risk of severe asthma exacerbations and use of systemic steroids. He also presented data from the US National Health and Nutrition Examination Survey [24], where in a cohort of 1429 adolescents with metabolic syndrome, metabolic syndrome was associated with approximately 3% lower FEV_1/FVC in children without asthma, and up to 10% lower FEV_1/FVC in children with asthma.

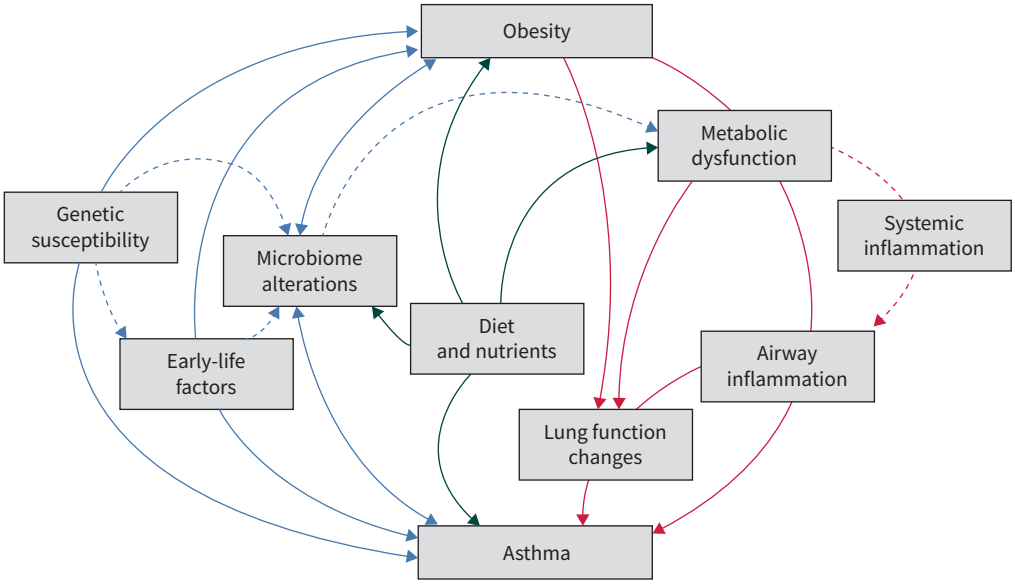

FIGURE 2 Obese asthma underlying pathways. Shown are general pathways and mechanisms involved in the obese asthma phenotype. Genetic susceptibility and early-life (including *in utero*) factors can predispose to both obesity and asthma. Microbiome changes can cause or be a consequence of either disease and can also contribute to metabolic dysregulation. Obesity can lead to metabolic dysfunction and systemic inflammation, both of which can increase airway inflammation, asthma risk, or asthma severity. Lung function changes can be the result of anatomical/developmental alterations in obesity and can also be influenced by metabolic dysregulation. Reproduced from [22] with permission.

Finally, Miguel Angel Alejandre Alcazar (Cologne, Germany) showed metabolic determinants of asthma and COPD across ages, demonstrating that the trajectory of lung function is influenced by events early in life [25]. Risk factors and modifiers of chronic lung disease can also be found lay in the pre- and perinatal period [26], with factors such as premature birth, intrauterine growth restriction and maternal smoking determining lung diseases later in life. He presented recent data of the Avon Longitudinal Study of Parents and Children, a British longitudinal population-based birth cohort study of parents and children followed up to 24 years of age [27]. It showed a correlation of maternal body mass index and metabolism parameters early in life and lung function in adulthood. In addition, the work of Selle *et al.* [28] showed that perinatal obesity induces proliferation of bronchial and vascular smooth muscle cells *via* activating STAT3-FoxO1, causing bronchial obstruction and pulmonary hypertension later in life.

Take-home messages

- Asthma in children with obesity is often associated with a non-atopic Th1-polarised systemic inflammation.
- Obesity does not only influence asthma disease dynamics, but also may be the origin of chronic lung diseases.

Paediatric cystic fibrosis

The landscape in cystic fibrosis (CF) has changed dramatically after introduction of CF transmembrane conductance regulator (CFTR) modulator (CFTRm) therapies. The latest of these therapies is the triple combination of the two CFTR correctors elexacaftor (ELX) and tezacaftor (TEZ) with the CFTR potentiator ivacaftor (IVA). ELX/TEZ/IVA led to substantial improvements in several organ systems in CF in clinical studies, leading to approval for persons with CF (pwCF) with at least one *F508del* allele, aged 6 years and older (Europe, Australia), and/or at least one *CFTR* mutation of a list of other *in vitro* responding *CFTR* mutations, aged 2 years and older (USA). Unfortunately, the issue of reimbursement of this therapy remains unsolved in a high number of countries. Several abstracts from the 2023 ERS Congress dealt with this new treatment option and were presented in the poster session "Effects of CFTR modulator therapy in cystic fibrosis".

Results from a Turkish multi-centre study showed significant improvement in both FEV_1 and lung clearance index in pwCF who were on CFTRm for at least 3 months [29]. However, Pinar Ergenekon

(Istanbul, Turkey) underlined that these therapies are currently not reimbursed in Turkey and patients can only access these drugs by court decision. Due to the time between court decisions, many patients receive intermitted treatment. Positive treatment outcomes were also reported in a Spanish cohort of paediatric patients with CF that started ELX/TEZ/IVA. Jonathan Benito Patón (Valencia, Spain) reported a decrease in the colonisation by *Staphylococcus aureus* and *Pseudomonas aeruginosa* in these patients upon 6 months of treatment [30]. Rikke Mulvad Sandvik (Copenhagen, Denmark) showed that lateral decubitus chest computed tomography (CT) is a feasible and sensitive technique to detect and monitor structural lung abnormalities in newborn screened children with CF [31]. In this study, CFTRm therapy seemed to be associated with improvement in airway wall thickening.

Exercise tolerance is an important parameter of quality of life for pwCF. Ivan Bambir (Zagreb, Croatia) reported a significant improvement in exercise tolerance in 12 pwCF (range 12–18 years) using the 6 min walk test upon ⩾6 months of treatment with ELX/TEZ/IVA [32]. Molla Imaduddin Ahmed (Leicester, UK) analysed the impact of ELX/TEZ/IVA on exercise capacity by cardiopulmonary exercise testing at baseline and after 6–8 months without detecting changes in maximum oxygen consumption peak in a cohort of seven pwCF [33].

CFTRm are also associated with a positive long-term effect. Hadhud Mohamad (Jerusalem, Israel) studied the long-term effects of ELX/TEZ/IVA treatment on body mass index, pulmonary exacerbation rate, and increase in percentage predicted FEV_1 of 10% from baseline in FEV_1 after 18–24 months of ELX/TEZ/IVA treatment initiation. All patients had a long-term improvement and patients with worse baseline pulmonary disease were more likely to have sustained respiratory improvement [34]. Shahid Sheikh (Columbus, OH, USA) showed that 12 months of ELX/TEZ/IVA treatment significantly decreased chronic rhinosinusitis based on sinus CT in 64 pwCF [35]. Aleksandra Zver (Ljubljana, Slovenia) reported improved bone mineral density in 17 pwCF older than 12 years after 1 year of ELX/TEZ/IVA [36].

In order to better understand the mechanism of action of CFTRm on the metabolism of the lung, Emmanuelle Bardin (Paris, France) studied volatile organic compounds in the breath of 12 pwCF before and upon CFTRm treatment. Longitudinal analysis identified 12 volatile organic compounds in exhaled breath to be increased during the first month of treatment, and suggested that exhaled breath analysis could be a potential future tool for drug monitoring [37]. Another biomarker in exhaled breath is the fraction of exhaled NO. Isaac Martin (Toronto, Canada) reported that the use of ELX/TEZ/IVA increased the fraction of exhaled NO after 1–3 months of therapy, not indicating eosinophilic airway inflammation but rather restoration of fractional exhaled NO to a normal level [38].

In order to guide treatment, it is essential to identify responders to CFTRm at an early stage. Felix Ratjen (Toronto, Canada) evaluated 41 pwCF to predict the clinical benefit of CFTRm *via in vitro* assays using nasal epithelial culture. The findings showed that *in vitro* response to CFTRm correlates with clinical response, including change in weight, sweat chloride concentration and spirometry parameters in the same individuals [39].

Take-home messages

- CFTRm substantially improve the life of pwCF who are eligible for this new treatment.
- Reimbursement is an issue, and some pwCF receive off-label or intermittent treatment.

Paediatric respiratory infection and immunology

The hot topics session “The unfortunate relationship between respiratory disease and infection: challenges which need us to think outside the box” focused on understanding the molecular mechanisms underlying increased susceptibility to respiratory infections. In addition, this session emphasised the importance of preventive strategies, primarily vaccination.

The session started with the Sadoul Lecture (intended to honour senior scientists with a world-wide reputation) given by awardee Tobias Welte (Hannover, Germany). This lecture focused on discussing the impact of respiratory infections on lung health in general. Past and emerging evidence highlights that severe respiratory infections (*e.g.* community-acquired pneumonia and infectious exacerbations of COPD) are associated with a high risk for mortality [40, 41]. Apart from the short-term consequences, severe respiratory infections have an impact on long-term lung health. For example, severe respiratory infections impact lung function trajectories, development of chronic respiratory disease and risk of acute exacerbations in chronic lung diseases such as asthma or COPD [42]. The impact of early-life lung infection on lung trajectories was discussed further in the lecture by Erika von Mutius (Munich, Germany).

Cohort studies, including the Tasmanian cohort and the Oslo birth cohort, show that severe infections in early life, exposure to tobacco smoke, and co-existing allergies are the strongest determinants of impaired lung function trajectories up to adult years [43, 44]. The effects of exposure to risk factors might be different in boys and girls. Data from the Children's Health Study showed that upon *in utero* exposure to maternal smoking, boys with asthma had significantly larger deficits from *in utero* tobacco exposure in FVC and the ratio of FEV_1 to FVC, whilst girls with asthma had a higher decrease in FEV_1/FVC [45]. Delving into pathophysiological mechanisms underlying these associations will highlight possible preventive mechanisms for lung function decline in the future.

With regard to pathophysiological mechanisms underlying severe respiratory infections, Alberto Mantovani (Milan, Italy) discussed his group's work on identifying the role of innate immunity in response to respiratory viral pathogens. His group showed that the activation and polarisation of macrophages toward the M1 or M2 phenotypes play a crucial role in the early stages of inflammation, more specifically in the activation of proinflammatory and vascular endothelial mediators [46]. In addition, based on this and other groups' findings, we now know that innate immunity can be trained, and epigenetic modifications play a key role in training innate immune responses to microbial agents, cytokines and ultimately vaccines [47]. Epigenetic mechanisms may explain differences in mortality and long-term respiratory sequelae in response to severe respiratory infections [48]. Peter Openshaw (London, UK) presented research on the fast development of coronavirus disease vaccine as an example of drug target identification, development and testing in short timelines [49]. In contrast to the rapid development of coronavirus disease vaccines, prevention of RSV-related disease in adults and infants has been a long and difficult story. Prevention strategies are needed to prevent short- and long-term consequences of severe RSV-related disease [50]. Recent trials have shown that RSV vaccines provide good protection against lower respiratory tract infections in adults and maternal vaccination during pregnancy significantly decreases severe RSV disease in young infants [51]. Data regarding passive RSV immunisation show that a single injection of nirsevimab administered before the RSV season can protect healthy late-preterm and term infants from medically attended RSV-associated lower respiratory tract infection [52]. However, data around protection from long-term respiratory sequelae (*e.g.* asthma) are not available yet. Clinical trials on active vaccination in infants and children are still underway for protection in infants and children up to age 5 years when administered during pregnancy.

Take-home messages

- Severe infections in early life influence lung function trajectories into adulthood.
- Vaccine research remains important to reduce short- and long-term consequences of respiratory infection throughout all ages.

Respiratory disorders in neonatal and paediatric intensive care

The poster session "Respiratory monitoring and management in neonatal and paediatric intensive care" covered some of the challenging issues related to preterm birth, including the assessment of lung structure and function from birth to childhood, supportive treatment of neonatal airway disease, and the needs of affected individuals, their families and caretakers.

Finding adequate tools for respiratory monitoring in neonates is challenging due to the peculiar patient characteristics and the need for non-invasiveness. Concerning long-term monitoring of disease progression, Anne Hilgendorff (Munich, Germany) showed data of a longitudinal magnetic resonance imaging (MRI) study on functional and structural bronchopulmonary dysplasia (BPD) characteristics in preterm (<32 weeks of gestational age (GA)) infants near-term (n=88) and at preschool age (4–8 years; n=26) [53]. Structural and functional changes observed near-term persisted at 5 years with characteristic features depending on BPD severity and immaturity. Importantly, those structural changes were quantifiable [54].

Among the monitoring techniques applied in the neonatal intensive care unit, lung ultrasound and forced oscillation technique (FOT) have lately emerged [55, 56]. Emanuela Zannin (Monza, Italy) combined lung ultrasound and FOT to assess the response to systemic *versus* inhaled corticosteroids. 27 treatments (9 dexamethasone; 18 budesonide) in 20 infants born at 26.8±2.6 weeks GA were analysed. Both systemic and inhaled corticosteroids improved the airways (assessed by FOT) and the parenchymal compartment (assessed by lung ultrasound); however, treatment length was not standardised [57].

Petra Johanna Um-Bergström (Stockholm, Sweden) presented a comparison of two cohorts born in Sweden at 22–26 weeks between 2004–2007 (n=702) *versus* 2014–2016 (n=885). Survival at 36 weeks postmenstrual age (PMA) increased from 72% to 81% ($p<0.001$), as found elsewhere [58, 59]. The

increased survival was associated with a longer duration of respiratory support. Surprisingly, mechanical ventilation rose from 9 to 16 days for the 2014–2016 cohort (median; p<0.001). However, the incidence of severe BPD at 36 weeks PMA decreased from 26% to 21% [60].

Infants with severe BPD often require some form of respiratory support at discharge. Anna Lavizzari (Milan, Italy) investigated the long-term respiratory outcomes of 73 infants with severe BPD discharged home with nasal high flow therapy (NHFT, n=47) *versus* low-flow oxygen therapy (LFOT, n=26). The two groups presented similar baseline characteristics and severity of BPD. After applying a mixed-model correcting for several risk factors, the NHFT group showed a lower rate of wheezing (p 0.003), use of bronchodilators (p 0.024) and systemic steroids (p<0.001), and respiratory tract infections (p 0.031) within the first four years of life. Infants on NHFT were weaned at 8 *versus* 14.5 months (median), suggesting that NHFT may be a valid alternative to LFOT for infants with BPD requiring respiratory support after discharge [56].

Other than prematurity, growth restriction may play a significant role in altering lung development. Jip Anne Spekman (Leiden, The Netherlands) retrospectively analysed 39 pairs of discordant (⩾20% difference in weight at birth) monochorionic twins (GA 34.9 weeks). Spirometry, single-breath carbon monoxide diffusion and multiple-breath helium dilution were performed at a mean of 11 years (range 10–14). Although genetically identical, fetal growth-restricted twins presented a significant reduction in static lung volume z-scores and a decrease in dynamic lung function [61].

Take-home messages

- MRI is a feasible tool to track disease progression and outcomes in former preterm infants.
- FOT and lung ultrasound help to discriminate between larger airways and lung parenchyma and may help to compare responses to different treatments.
- Survival of extremely premature infants rose to 81% at 36 weeks GA in Sweden, and the rate of severe BPD significantly decreased, although mechanical ventilation duration increased from 9 (2004–2007) to 16 days (2014–2016) in two large Swedish cohorts.
- NHFT is a valid alternative to LFOT as respiratory support after discharge for infants with BPD.
- *In utero* growth restriction has a significant impact on lung function in adolescence.

Paediatric respiratory epidemiology: lung function trajectories

The hot topics session on “Determinants of lung function trajectories and respiratory health from infancy to adulthood” included four presentations summarising the current evidence on lung function trajectories, their identification and possible interventions.

Shyamali Dharmage (Melbourne, Australia) presented “Lung function trajectories across the life-course: the looking forward/backward concept” explaining how the concept of lung function trajectories has changed our understanding of the pathogenesis of adult chronic diseases. COPD is no longer considered a single risk disease but has multiple risk factors with early onset and follows different lung function trajectories [62]. In the Tasmanian Longitudinal Health Study, authors identified six distinct lung function trajectories of which three gave rise to almost all COPD cases at age 53 years [43]. They also described lifetime spirometry patterns of obstruction and restriction associated with different risks of COPD [42, 63]. This concept of lung function trajectories has led to a looking forward (for paediatricians) and backward paradigm (for pulmonologists), which may allow to predict more accurately future lung function and inform clinical care and treatment response.

Niki Ubags (Lausanne, Switzerland) focused on “A mechanistic view into the early-life microenvironment and lung health” showing how early-life exposures can change immune maturation and prime the lung for disease [64]. She used the example of nutrition and explained how maternal malnutrition or obesity can alter nutrient sensing, endocrine signalling, and lipid metabolism leading to systemic inflammation and ultimately to chronic lung disease in the offspring [26]. Similarly, changes in maternal gut microbiota in pregnancy and during early life may lead to increased birth weight and gut dysbiosis, resulting in an increased risk of asthma [64]. She also highlighted the importance of inter-organ communication in the development and progression of respiratory diseases [65].

Erik Melén (Stockholm, Sweden) continued with “Looking forward: is the lung growth trajectory fixed or can we intervene?” highlighting the association of environmental factors with impaired lung function growth [66]. He presented two reviews summarising predictors of lung function growth such as air pollution, allergens, lower respiratory tract infections or asthma [67, 68]. In the BAMSE cohort, a Swedish

population-based birth cohort, although individual lung function was remarkably stable from 8 to 24 years, there was also plasticity of lung function, with lung function growth failure observed in 2.4%, and catch-up in 14.5% of children. The number of risk factors for poor lung function was associated with prevalence of impaired lung function growth [69]. He concluded that reducing factors associated with growth failure may give potential room for intervention to change lung function trajectories.

Finally, Rosa Faner Canet (Barcelona, Spain) gave an overview of "Novel biomarkers of impaired lung function in clinical practice" which may be candidates to identify disadvantageous lung function trajectories. She gave examples of current known biomarkers for COPD such as CC-16 which is associated with inflammation, low FEV_1 and accelerated lung function decline [70–72]. She also demonstrated a strong association between a genetic risk score for COPD derived in adults and airflow limitation in preschool children born preterm [73]. Difference in epigenetics were also shown to be associated with different lung function trajectories [74, 75]. These biomarkers could enable early detection of chronic respiratory diseases such as COPD.

Take-home messages

- Identifying early-life risk factors for adult-onset disease and potential lung function trajectories can inform clinical practice and support establishing effective preventive measures and interventions.
- Early-life exposures can alter immune response or microbiota and may set one on a trajectory for lung health or disease development.
- Clinical and biological biomarkers associated with low lung function could be used in the future to detect adverse lung function development.

Paediatric bronchology

The oral presentation session "Paediatric bronchology: next generation" included studies focusing on childhood interstitial lung diseases (ChILD), protracted bacterial bronchitis (PBB), pulmonary malformation and chronic aspiration.

It is well known that ChILD are rare diseases and Halime Nayir Büyükşahin (Ankara, Turkey) presented data from the Turkey Registry, in which 416 patients have been enrolled from 19 centres [76]. The median age of the patients was 6.05 years and the most frequent diagnosis was neuro-endocrine cell hyperplasia of infancy. The patients were divided into two groups, the first including disorders of infancy, the other with disorders that can occur at all ages. The first group was characterised by the presence of tachypnoea, history of neonatal intensive care admission, lower weight and height and more than half of the patients had been diagnosed with surfactant disorders. The presence of cough characterised the second group together with low FEV_1 and most of the patients suffered from an interstitial lung disease related to exposures. Nagehan Emralioglu (Ankara, Turkey) presented data from the ChILD kids registry that includes 759 patients [77]. At baseline in children younger than 2 years of age, malnutrition was present in 44% of cases, this percentage halved at one year of follow-up. In children older than 2 years of age malnutrition was present in 37% of cases at baseline and in 25% of cases after 1 year of follow-up. Malnutrition was correlated to lower percent predicted FEV_1 and disease severity. The severity of some forms of ChILD requires a lung transplantation. Julia Carlens (Hannover, Germany) reported the data about the indications and outcomes of lung transplantation in 97 patients from her centre [78]. The most common indication was disorders of the immunocompromised host (*e.g.* severe bronchiolitis obliterans after stem cell transplantation), and after a median time of 4.65 years post-transplant 89% of patients were alive.

Regarding the possible risk factors and long-term sequelae of PBB, Anne Schlegtendal (Bochum, Germany) reported the data from a retrospective analysis including 200 children with PBB [79]. Patients with PBB had more frequently atopic dermatitis, recurrent wheezing and household tobacco smoke exposure compared to a control cohort. In the follow-up study including 63 out of the 200 children, a median of 8.5 years after the PBB diagnosis, cases were more frequently premature and had more respiratory symptoms, such as history of pneumonia, atopic disease and clinician-diagnosed asthma. Chronic wet cough was reported more frequently in the post-PBB children than in the controls (17.5% *versus* 9%, p=0.05). Lung function tests showed a significantly lower FEV_1 and FVC in post-PBB patients compared to controls. Respiratory symptoms and tobacco exposure were risk factors for long-term sequelae.

Oesophageal atresia (OA) and tracheo-oesophageal fistula (TOF) are congenital abnormalities that can affect 1:3500 live births. Katie Rose (Liverpool, UK) reported the data from 223 patients with a diagnosis of OA and TOF [80]. Almost half of them had been followed up and 49 patients (22%) had documented spirometry, with 13 (6%) having more detailed lung function. A total of 21/223 (9%) patients had FEV_1

<80% predicted, with a restrictive pattern at spirometry. 11 patients underwent CT scan of the chest, which demonstrated compression of the trachea by vasculature in two patients and reduced lung volume related to oesophageal replacement in two patients.

Paediatric dysphagia affects 1% of children but the prevalence is higher in children with neurological disorders. Nadine Freitag (Düsseldorf, Germany) reported data from a retrospective study analysing the bronchoalveolar lavage fluid for the presence of pathogens (either viruses, fungi, or bacteria) and immune cell population in a group of patients with dysphagia compared to a control group without swallowing disorders [81]. Children with dysphagia were more frequently colonised by pathogens such as *Enterobacterales* and *Pseudomonas aeruginosa* (54.3%) than controls (37.3%) (p=0.027). No differences in the composition of the immune cell population in the bronchoalveolar lavage were found between cases and controls.

Take-home messages

- ChILD are not only rare but also heterogeneous conditions that require a multidisciplinary approach including a careful nutritional evaluation.
- Lung transplantation can be an option in patients with severe forms of ChILD.
- Children with PBB can develop long-term sequelae, such as chronic wet cough and impaired lung function tests.
- Asthma and tobacco smoke exposure are risk factors for the development of long-term sequelae.
- Prematurity is a risk factor for PBB.
- In patients with OA/TOF reduced lung function may be present and could be due to a primary defect or to surgical procedure.
- Patients with dysphagia are more often colonised by respiratory pathogens.

Concluding remarks

The ERS International Congress 2023 showed that advances in paediatric respiratory medicine are rapidly advancing. In line with previous years [82, 83], we present a selection of the outstanding sessions on behalf of Assembly 7 (Paediatrics) in order to inform the reader of the latest developments and encourage participation in future ERS activities [84]. Overall, it has become evident that respiratory health in early life impacts respiratory health in childhood and adulthood, which underlines the need for collaboration among healthcare providers and researchers from different disciplines.

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