Lung Function in Children from Sub-Saharan Africa and the Global Lung Initiative 2012 Reference Equations

Respiratory disease remains a leading cause of morbidity and mortality in African children (1, 2). Despite this high burden of respiratory disease, reference data for lung function in African children are not available. Reference to a population norm is essential for distinguishing health from disease; without this standard, it is not possible to fully define the burden of respiratory disease, diagnose respiratory disease accurately, or maximize management of chronic respiratory conditions. Hence, the article in this issue of the *Journal* by Arigliani and colleagues (pp. 229–236) addresses a significant lack of data in African pediatric respiratory health (3).

The study investigated the applicability of the Global Lung Initiative 2012 (GLI-2012) African American reference equations to spirometric data collected longitudinally on more than 1,000 children in public and private schools from three African countries: Angola (southwest Africa), Democratic Republic of Congo (central Africa), and Madagascar (southeast African island). This novel data set is the first multicountry prospectively collected pediatric sub-Saharan African data, and the first to assess the applicability of the GLI-2012 for spirometry in African children. Reassuringly, the study found that GLI-2012 reference values for African Americans are appropriate for use in well-nourished African children.

The GLI-2012 is the result of a large international collaboration providing an all-age spirometric reference equation for four ethnic groups, including African Americans, and confirms ethnic differences in lung function over and above the effect of height, weight, and sex (4). However, the GLI-2012 lacks data from African populations. It is not clear whether extrapolating from African American data is appropriate for African children, given the large heterogeneity in ethnic diversity and socioeconomic and environmental factors between African American and African populations. Hence, both assessing the relevance of these reference equations to African populations and collecting African data for inclusion in the GLI-2012 is needed.

The study has many strengths; namely, lung function collected in a standardized way by the same investigator, using the same equipment, and using internationally recommended equipment and standards, strengthening comparison between countries. The study includes lung function from 12 different schools, with more than 300 children from each country, a sample size adequate to test the GLI-2012 fit (5). Although lung function outcomes were different between the three countries, differences were minor and all countries performed well using the GLI-2012 equation [mean (SD) *z*-scores of −0.11 (0.83) for forced expiratory volume in 1 second (FEV_1), −0.08 (0.86) for forced vital capacity (FVC), and −0.07 (0.83) for FEV_1/FVC].

The study also investigated the effect of malnutrition on lung function, using *z*-score of body mass index (zBMI) as a measure of nutritional status, which is especially important in sub-Saharan Africa, where childhood malnutrition is highly prevalent. Anthropometry and lung function of African children were compared with those of African American children included in the NHANES (National Health and Nutrition Examination Survey) III study (http://www.cdc.gov/nchs/nhanes/nhanes3/data_files.htm). Despite being significantly younger and shorter than the African American children, African children with normal zBMI had similar lung function *z*-scores to their African American counterparts. Interestingly however, poorly nourished children (zBMI < 2) had significantly lower FEV_1 and FVC *z*-scores, but similar FEV_1/FVC, compared with well-nourished African children or with the African American cohort, leading to the conclusion that poor nutrition reduces lung growth, but not function. Data from birth cohort studies in high-income countries indicate that antenatal nutrition impairs not only somatic growth but also lung function, with low birthweight associated with later obstructive lung function and chronic obstructive lung disease (6). Further rapid weight gain in infancy has also been associated with lower lung function and asthma in later life (7, 8). The current study supports the fact that childhood nutrition is important for normal lung growth, an important message given the burden of undernutrition in Africa (9). A limitation of the study is that although it evaluated the effect of malnutrition, it excluded children who did not attend school, who are likely to be among the poorest, most nutritionally impaired children, and who may constitute a substantial proportion of the population in many African countries.

Although the article suggests that the socioeconomic status of African American children included in the NHANES and those included in this study differs greatly, no socioeconomic data were collected to confirm this. Public school attendance, thinness, or living in an African country were used as proxies for lower socioeconomic status; further, no data on the socioeconomic status of African American children were provided. However, it is likely that these two groups of children would have had very different environmental exposures, yet the GLI-2012 equation fitted the data well, an important and useful finding for child health specialists or researchers in Africa.

There is a need for further lung function data in healthy African populations across all ages, and from different African countries and socioeconomic settings. However, this article provides important novel data that are valuable, particularly given the challenges of collecting population specific reference data in low- and middle-income settings and the need for relevant lung function standards in respiratory health in countries with a high burden of respiratory disease. The fact that the GLI-2012 reference data may be useful despite the varying ethnicity, environmental, and socioeconomic exposures between countries is an important contribution to pediatric respiratory health research in Africa. ■

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