Spirometry in Biracial Children: How Adequate Are Race-Based Reference Equations?

Spirometric reference equations are typically stratified by race because of racial differences in lung function, particularly between black and white individuals, at least in part because of black individuals having a smaller thorax to leg length ratio, and thus smaller lung volumes for a given height, than white individuals. Use of race-based pulmonary function equations is especially problematic in biracial/multiracial individuals, who compose an increasing portion of the US population, as lung physiology may not simply be an average of their composite races; use of race in pulmonary function testing has recently been questioned. To our knowledge, no spirometric reference equations exist for biracial or multiracial individuals.

We assessed pulmonary function in biracial (black and white) children and compared spirometric data when children were classified as being black vs white.

**Methods.** We recruited biracial (black and white) children aged 8 to 19 years without lung disease. Racial/ethnic background was determined by parental or self-report. The study was approved by the University of North Carolina investigational review board; informed consent was obtained.

Spirometry was performed according to American Thoracic Society guidelines. Forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV₁) were recorded as absolute and percentage of predicted values (by National Health and Nutrition Examination Survey III criteria) with subjects classified as being white and black. Paired t-testing was used to compare mean spirometric percentage of predicted values by racial classification (significant P < .05).

**Results.** Seventeen children (9 male, 8 female) were enrolled at mean (SD) age 12.2 (3.6) years. When classified as being black, mean FVC and FEV₁ were 111% and 110% of predicted, respectively. With reclassification as being white, FVC and FEV₁ were 94% and 95% of predicted, a mean difference of 16.5 percentage points for FVC and 15.5 for FEV₁ (95% confidence interval, 12.5-20.7; P < .001) and 10.4-20.6; P < .001) (Figure). No subjects met American Thoracic Society/European Respiratory Society criteria for obstructive disease (FEV₁ < 80% of predicted) when classified as being black; 2 subjects (11.7%) met obstructive criteria with white classification.

**Comment.** Our data illustrate the potential inadequacy of current race-based spirometric reference equations for biracial (black and white) children, with a mean difference in the percentage of predicted values of more than 15 points for FVC and FEV₁.

Our study had several limitations. Small sample size has the potential to bias results toward or away from the null. However, the consistency of our findings makes it unlikely that they are due to chance alone; our results are also consistent with previous studies. Allowing subject self-identification of race may also introduce potential bias. However, this method of racial identification is consistent with the majority of studies using race as a variable, including those studies used to generate spirometric reference equations.

Racial classification can thus have a clinically significant effect on lung function assessment and can lead to inaccurate assignment of disease. While all factors involved in racial/ethnic differences in pulmonary function (by height) have yet to be identified, the thorax to leg length ratio has been shown to be a significant contributor. Use of more direct measures of thorax length, such as sitting height, may be important in the future to create more accurate, more broadly applicable, spirometric reference equations. The "true" percentage of predicted values for biracial and multiracial children cannot be determined at this time. Interpreting the percentage of predicted value as the midpoint of white and black values may diminish the likelihood of inaccurate disease assessment; however, this does not address potential physiologic and anatomical differences that may exist. Most important is to maintain consistency in racial assignment when performing repeated
evolutions, because change in racial classification on pulmonary function testing could lead to a change in percentage of predicted values without change in absolute values and might influence management or diagnosis of disease.

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COMMENT

Sometimes Zero Risk Is Not an Option

I read with interest the Christakis editorial “Predictably Unhelpful: Why Clinicians Do Not Use Prediction Rules.”1 I agree with much of the editorial. However, I disagree that once a physician is concerned about a condition the degree of risk is not important. A risk of 0.001% of a serious bacterial infection corresponds to a risk of 1 in 100 000. The risks associated with evaluating and treating 99 999 infants who do not have a serious bacterial infection to avoid missing the one who does are not negligible. There would be 99 999 well babies who would receive unnecessary venipuncture and likely unnecessary bladder catheterization, lumbar puncture, intravenous antibiotic administration, and hospitalization as well. The risk of adverse effects from any of these common procedures and medications is certainly very low, but each carries a risk that is likely higher than 1 in 100 000.2-8 The combined risk is even higher.

I strongly agree with Christakis that much more attention should be paid to how clinical prediction rules will be implemented prior to their development. I believe the negative predictive value that end users think would make a clinical prediction rule useful for a given condition is one of the important issues to consider during such implementation research.

Perhaps one way to improve clinical prediction rules would be to require public registration for rules in development, similar to the registration required for randomized controlled trials. Registration would facilitate public comment and could be used for clinical practice guidelines as well as prediction rules. Authors could also be required to demonstrate that potential users of rules were consulted prior to rule development.

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