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From the authors:

We welcome the comments of J. Vandevorde and M. Swanney, who have been at the forefront of advocacy for the substitution of forced expiratory volume in six seconds (FEV₆) and its ratios for forced vital capacity (FVC) and its ratios. While we respect their findings, our study [1] concerned the use of spirometry to detect airway obstruction in a relatively healthy population, the third National Health and Nutrition Evaluation Survey (NHANES-III), rather than its clinical use in following patients with known disease.

We hope we agree that in following patients with known and significant airway obstruction or in assessing responsiveness to inhaled bronchodilators, the absolute values of FEV₁ or FEV₃ are optimal, and ratios such as FEV₁/FEV₆, FEV₁/FVC or mean forced expiratory flow between 25 and 75% of FVC (FEF_{25–75%}) are not. In following these patients, there is no need for repeated lengthy forced manoeuvres, such as FEV₆ or FVC. Unforced vital capacities not only suffice, but may be more informative and less stressful than repeated FEV₆ or FVC manoeuvres.

The question of selecting spirometric values to detect early airway obstruction, especially in primary-care settings, which was our focus, is more complex. For detecting obstruction, adding a measurement that focuses on the proportional increase in long time-constant lung units, *i.e.* the FEV₃/FVC (or 1–FEV₃/FVC), supplements the FEV₁/FVC well. J. Vandevorde and M. Swanney seem to object to us adding the FEV₃/FVC as a measure to detect obstruction in “healthy subjects”, yet the NHANES-III smokers clearly had greater increases of long time-constant lung units (1–FEV₃/FVC) than nonsmokers [1]. This increase may be undetected by the FEV₁/FEV₆ measurement, while the FEF_{25–75%}, using either the FEV₆ or FVC as a denominator, is certainly not sufficient to independently detect airway obstruction in a statistically valid way in a relatively healthy population [2].

One could question the clinical relevance of detecting borderline obstruction, except for epidemiological studies and for the purpose of the early detection of developing disease. In fact, another proponent of the FEV₆ measurement editorialises that the screening for chronic obstructive pulmonary disease by primary-care physicians has the potential to do more harm than good [3]. However, we think that early detection of

airway obstruction and identification of the cause have merit. Committee guidelines from authorities for detecting airway obstruction are useful [4], but not necessarily the last word, as evidenced by recent public correspondence [5, 6] and the conflicts over the Global Initiative for Chronic Obstructive Lung Disease standard of FEV₁/FVC <70% to define airway obstruction [4, 6].

In many, if not all, studies [2, 7–9], the coefficients of variation for the FEV₁/FVC and FEV₃/FVC are much lower than for FEV₁, FEV₃, FVC or FEF_{25–75%}. We contended that airway obstruction was likely to be present if either the FEV₁/FVC and/or FEV₃/FVC before bronchodilator administration were <95% confidence levels, even though the absolute FEV₁ may have been >80% mean predicted. Thus, in detecting, rather than quantifying obstruction, the spirometric curve after 1 s, and even after 6 s, may be important. Ignoring measurements that detect the increase in long time-constant airspaces lessens the ability to detect early disease. Therefore, in detecting airway obstruction, volume ratios such as FEV₁/FVC and FEV₃/FVC should both be useful. In contrast, absolute values, such as FEV₁ and FEV₃, are valuable in quantifying obstruction or assessing response to bronchodilators or to follow the progress of known disease.

Clinically, when spirometric values are borderline, clinical evaluation including a good history and physical examination, bronchodilator testing, and measurement of gas-transfer index may be necessary to diagnose or exclude lung disease. Neither ignoring airway obstruction nor over-diagnosis and over-treatment are desirable. However, let us acknowledge that spirometry has three major uses: 1) detection of airway obstruction; 2) assessment of disease progression; and 3) assessment of therapy. For the first, we showed that values of both the FEV₁/FVC and FEV₃/FVC separated NHANES-III current smokers from never-smokers by ~20 yrs by middle age [2]. We did not assess the similar effectiveness of the FEV₃/FEV₆, the progression of disease and therapy. However, for assessing disease progression or effect of therapy, we stress that the absolute values of FEV₁ and FEV₃ should be more sensitive than any ratios, including FEV₁/FEV₆, FEV₁/FVC or FEF_{25–75%}, because both numerator and denominator may increase or decrease together, thereby obscuring the absolute change in the fast time-constant lung units (those that contribute to the flow during the first second).

We hope that we can find common ground with J. Vandevorde and M. Swanney and their colleagues in recommending that spirometry to detect airway obstruction should be performed on good equipment by dedicated, trained and experienced technicians, under the supervision of physicians experienced and skilled in the interpretation of spirometry. We also believe that optimal spirometry measurements to detect early airway disease should include detection of an abnormal increase in proportion of longer time-constant (diseased) lung units. Conversely, absolute timed volumes, rather than ratios, are useful for following patients with known disease.

J. Hansen, X-G. Sun and K. Wasserman

Harbor-University of California, Medical Center, Torrance, CA, USA.

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Epidemiology and costs of COPD

To the Editors:

The lead article in the series “The global burden of chronic obstructive pulmonary disease”, on the epidemiology and costs of COPD, touched briefly on the subject of occupational factors in the section on “tobacco and other causes” of the disease [1]. One of the four citations noted in that discussion was in reference to a report on smoking, occupational and demographic characteristics in a population-based sample of >1,000 elderly Finns, carried out in 1990–1991 [2]. This study was cited to support the following statement: “It is likely that the interaction between occupational exposure and other risk factors determines whether an individual develops COPD.” [2]

Having served on the American Thoracic Society (ATS) task force that developed a recent statement on the occupational contribution to the burden of airway disease [3], which was also cited in the *European Respiratory Journal* article, we were intrigued by the Finnish study, since it had not come up in our task force’s review and appeared to be potentially relevant. We subsequently read the study closely. It does include descriptive data on smoking, social class and occupational dust exposure, but it presents no formal statistical testing of the association between occupational dust and chronic obstructive pulmonary disease (COPD).

As the tabular data in the published paper [2] allowed categorisation of all subjects with respect to airflow obstruction (forced expiratory volume in one second $\leq 65\%$ predicted, the study definition of COPD), sex, occupational dust exposure, social class (lowest *versus* middle and higher combined), and smoking status (ever *versus* never), we were able to recreate the data set (limited to these variables) for the purposes of risk modelling.

Occupational dust exposure and lower social class were inter-related ($p=0.02$). In a multiple logistic regression model adjusting for sex and smoking and including three dust-social class exposure variables (dust and low social class (25%), dust and higher social class (50%), and lower social class without dust (7%)), combined dust and lower social class was associated with a significantly increased risk of obstruction

(odds ratio 2.3; 95% confidence interval 1.1–4.8). Neither dust exposure among those of higher social class, nor lower social class without reported dust exposure was a statistically significant risk factor for airflow obstruction in the same model. Out of 82 cases among 1,191 observations, 28 (34%) fell into the lower class-work dust risk category, yielding a population-attributable risk percentage estimated to be 19.6%.

ISOAHO *et al.* [2] acknowledge that their definition of COPD subsumes asthma. Indeed, 20 of the 82 subjects defined in the study as having COPD on the basis of airflow obstruction also had clinical histories of asthma (two with work-related disease). Thus, the re-analysis we report may overestimate the risk of COPD due to dust, to the extent that asthma is even more strongly related to this factor than is COPD. The recent ATS estimate, however, suggests that the occupational burden of both COPD and asthma is similar among adults [3].

Regarding the reference to the Finnish study [2] in the *European Respiratory Journal*, this re-analysis could support the presence of an interaction between occupational dust exposure and social class, or the findings may simply reflect the differing types and amount of dust exposure inherent in job duties and occupations that are linked to categorisation by social class.

P.D. Blanc and J.R. Balmes

Division of Occupational and Environmental Medicine, Dept of Medicine, University of California, San Francisco, CA, USA.

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