Correspondence

Predicted values: how should we use them?

SIR,—The editorial by Drs MR Miller and AC Pincock (April 1988;**43**:265-7) makes the important point that, as the residual standard deviation (RSD) of lung function test results is relatively independent of age and height, the standardised residual (SR) can be used to determine where any given value falls on the standard normal curve.

They incorrectly determine the lower 95% confidence limit, however. The lower 95% confidence limit is the value for which only 5% of normal individuals will be lower. Thus a z value for one tail of the standard normal curve should be used, not the two tail value. Ninety five per cent of subjects will have an SR greater than $-1{\cdot}65$, not $-1{\cdot}96$ as reported. The lower 90% confidence limit has an SR of $-1{\cdot}28$, not $-1{\cdot}65$.

Their examples of lower 95% confidence limits as % predicted are really examples of the lower 97·5% confidence limit. The lower 95% confidence limits as % predicted are higher than they report. On the basis of the European Coal and Steel Community prediction equations[1] for a man of 50 years, 1·7 m in height, the lower 95% confidence limits for $FEV_1 \times 100/FVC$, forced vital capacity, residual volume (RV), and forced mid flow 25-75% (FMF) are 85%, 76%, 68%, and 56% of predicted. For FEV_1, the lower 95% confidence limit for a 31 year old man, 1·7 m in height, is 79% of predicted and for a 70 year old man is 70% predicted. For FMF the comparable figures are 63% and 43%.

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1 European Coal and Steel Community recommendations. *Bull Eur Physiopathol Respir* 1983;**19**(suppl 5):1-93.

AUTHORS' REPLY We disagree with Dr Johnson about his interpretation of a lower confidence limit, which we believe he is confusing with a percentile. Confidence limits are usually used for expressing the expected limits for a mean, whereas we have used the term to express the expected range within which an individual will fall. Between an upper confidence limit of mean + 2·0 × RSD and a lower of mean − 2·0 × RSD should lie 95% of a normal (that is, Gaussian) distribution. The term prediction limit may be more acceptable to some. Dr Johnson wishes to describe a limit above which a stated percentage of a normally distributed population will lie because, for lung function data, one is usually not interested in the supernormal subjects and only a lower cut off point needs to be defined. This is usually termed a percentile, and we have discussed this point with reference to lung function data elsewhere.[1] We agree with Dr Johnson that our stated lower 95% confidence limit would be the same as a percentile above which 97·5% of a normally distributed population will lie. We believe, however, that Dr Johnson is semantically incorrect and this difference between us has no bearing on our agreement about the use of standardised residuals rather than % predicted values.

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1 Miller MR, Grove DM, Pincock AC. Time domain spirogram indices: their variability and reference values in nonsmokers. *Am Rev Respir Dis* 1985;**132**:1041-8.

Breathing patterns during sleep in patients with nocturnal asthma

SIR,—With regard to the paper by Drs AD Morgan and NJ Douglas (1987;**42**:600–3) we would like to emphasise that breathing pattern during sleep is different in subjects with extrinsic and intrinsic asthma.

We studied three groups of subjects with their informed consent: nine patients (mean age 31 (range 17-41) years) with nocturnal asthma and allergic to *Dermatophagoides pteronissinus* (Rast and cutaneous prick test positive), nine patients (mean age 36 (range 26-48) years) with intrinsic asthma (history of recurrent respiratory tract infections and PRIST within the normal range), and seven healthy controls (mean age 32 (range 21-45) years). All subjects were studied according to conventional criteria on two consecutive nights in the sleep laboratory, the first night being for adaptation only. Each subject had been in a stable period of his or her disease for at least six weeks. The allergic patients showed no difference from the controls in either breathing frequency or expiratory time, but we found significant differences between subjects with intrinsic and extrinsic asthma (expiratory time 3·1 (SEM 0·3) seconds versus 2·3 (0·1) seconds, $p < 0{\cdot}01$, during non-REM sleep; 3 (0·1) *v* 2·1 (0·2) s, $p < 0{\cdot}01$, during REM sleep). Allergic subjects slept for longer than the other asthmatic subjects (335(18) *v* 295(15) min, $p < 0{\cdot}05$) and had more REM sleep (50(8) *v* 39(10), $p < 0{\cdot}05$).

None of the allergic patients showed significant paradoxical movements, whereas subjects with intrinsic asthma showed uncoordinated movements of the chest and abdomen during all stages of sleep. The abnormality of breathing pattern in patients with intrinsic asthma while they slept is not surprising as they have chronic respiratory disease with related consequences (Gianotti *et al*, Symposium on Control of Breathing During Sleep and Anaesthesia, Warsaw, 1987).

This is a further distinction as the subjects with extrinsic asthma who had nocturnal asthma did not show any abnormality of breathing pattern during sleep.

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