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AN EVALUATION OF THE ASSESS PEAK FLOW METER ON HUMAN VOLUNTEERS

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Abstract: The Assess peak flow meter was tested by comparing PEF values obtained on it for 49 normal subjects, with the values obtained for the same subjects on the Wright and mini-Wright meters. Its reproducibility was tested by comparing its coefficient of variation with that of the other 2 instruments. PEF values on the Assess were 5% lower in lower ranges and 9% higher in higher ranges tested as compared with those on the Wright. Values from the mini-Wright and Wright paralleled each other with the former values 3-5% higher. Variabilities on the Assess were 20-50% higher than those of the other 2 meters. Further, PEF values >670 L/min could not be read by the Assess. Although the Assess fulfils necessary criteria for accuracy and reproducibility, it appears to be less reliable than the other 2 instruments, and its range limits and utility.

Key words: peak flow meters, lung function, assess peak flow meter, peak flow rates

INTRODUCTION

Peak expiratory flow rate (PEF) is a simple index of pulmonary function often used in clinical and epidemiological studies for the assessment of ventilatory capacity. It is effort-dependent and reflects the status of the large airways. Thus it is insensitive to early obstructive changes which are known to occur in the small airways (1). However, it has gained popularity, because of the simplicity of the manoeuvre needed and the low cost and portable nature of the equipment. It is especially useful in situations where repeated testing or home monitoring are needed. It provides a good objective index to confirm diagnosis, start treatment, control medication and monitor response to treatment. These cannot be decided on a patient's subjective assessment of his condition (2-5). The peak flow meters which have been universally accepted for use are the standard Wright and the mini-Wright peak flow meters. Recently, a handy, inexpensive meter, the Assess peak flow meter, has been marketed for asthmatic patients to monitor their own response to treatment. We sought to test this instrument with regard to accuracy and reproducibility in a population with widely differing but stable PEF values.

METHODS

Agreement of PEF values recorded on the instrument, with those recorded on a mini-Wright and a standard Wright peak flow meter, was taken to indicate its accuracy. The reproducibility of the instrument was also tested, by comparing its variability with the variabilities of the other two instrument. Only one instrument of each type was used for the entire study.

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Instrument code :

A=Assess peak flow meter (Health Scan Products Inc, Cedar Grove, NJ, USA : Range 70-670 L/min, design patent No. 254443).

B=mini Wright peak flow meter (Clement Clarke International, Harlow, England : Range 50-800 L/min).

C-standard Wright peak flow meter (Airmed Limited, Harlow, England : Range 60-1000 L/min).

Sixty healthy medical students, 30 men and 30 women, took part in the study. The subjects had a mean age of 18.65 ± .89 years, a mean standing height of 162.13 ± 9.53 cm and a mean weight of 52.52 ± 7.65 kg. An equal number of men and women were chosen, so as to obtain a well-distributed range of PEF values. Since repeated PEF manoeuvres may cause changes in values either due to fatigue or improvement in technique (6), the students were divided into three batches of 20 each (10 men and 10 women)-designated ABC, BCA and CAB, each batch using the instruments in that particular sequence.

PEF was measured for all subjects at the same time of day, in one sitting. Each subject was required to stand and blow into the instrument using the right technique (i.e., with maximal force after full inspiration) five times, and the PEF value was computed as the mean of the highest three values (7, 8). The technique was personally supervised, and the readings taken, by one of the investigators (EAV).

The data was analysed on the computer with SPSS software using the Analysis of variance (ANOVA) test (9). Further group comparisons were made using the paired t-test. For comparison of the accuracy of the instruments, the mean of the three highest recordings in each instrument was used; the coefficient of variation (c.v.-%) of these three values was taken as a measure of the variability of the instrument where;

c.v.% = standard deviation /mean of these 3 values x 100.

RESULTS

The Assess peak flow meter records a maximum value of 670 litres per minute. For 11 of the 30 men it was found that the pointer hit the top of the instrument, and we were not sure whether the value was 670 or more, hence for all the calculations the PEF values of these 11 persons have been omitted.

For the purpose of studying the performance of the instrument in different ranges of PEF, the values from the 49 subjects were divided into 3 groups based on the average PEF value obtained from all three instruments.

Group I : (n=16) mean peak flow = 256-369 L/min "low".

Group II: (n=17) mean peak flow = 370-488 L/min "intermediate".

Group III : (n = 16) mean peak flow = 489-605 L/min "high".

Table I summarises the PEF values of these three groups, determined by the three instruments. In group I, values obtained by A were lower than those obtained by B and C, whereas in Group III, values obtained by A were significantly higher than those obtained by the other two instruments (Fig. 1 and 2).

Table II summarises the variabilities of the three instruments. A had significantly higher variability than the other two instruments in all the three groups.

TABLE I : Comparison of mean peak flow values.

Group	*Peak flow (litres/min)*					
	A		*B*		*C*	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
I (n = 16)	313.44	44.83	339.17	39.28	329.37	51.02
II (n = 17)	424.12	49.00	429.80	34.69	407.94	33.55
III (n = 16)	563.75	48.96	542.08	30.45	518.54	38.86

An ANOVA test done on groups I, II and III for the PEF values obtained with the three different instruments showed no significant trend. However, using paired t-tests,

In Group I,	B > A by 8%	(P < 0.02)
	C > A by 5%	(NS)
	B > C by 3%	(NS)
In Group II,	B > A by 1%	(NS)
	A > C by 4%	(NS)
	B > C by 5%	(P < 0.001)
In Group III,	A > C by 9%	(P < 0.005)
	A > B by 4%	(P < 0.05)
	B > C by 5%	(P < 0.01)

TABLE II : Comparison of variabilities.

Group	Variabilities of instruments			P values		
	A	B	C	A vs B	A vs C	B vs C
I	4.28	2.60	2.28	< 0.05	< 0.05	NS
II	3.11	1.98	1.88	< 0.05	< 0.10	NS
III	2.85	1.90	1.74	< 0.05	< 0.01	NS

An ANOVA test showed a significant trend (P < .0005).

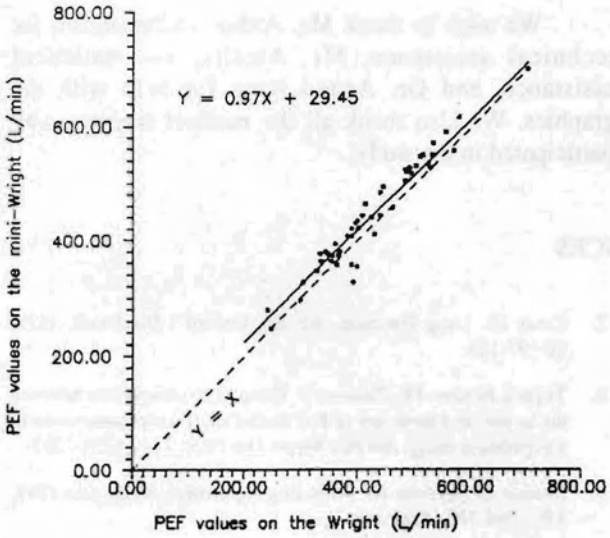

Fig. 1 : PEF values on the Wright and mini-Wright.

DISCUSSION

The accepted standards for peak flow meters require that they be accurate over the full range (100-400 L/min for children and 100-700 L/min for adults) within ±10%. Furthermore, they should also have a good reproducibility of within ±5% or 10 L/min, whichever is larger, so that small changes in PEF can be detected (10).

Although the PEF values obtained by instrument A were within ±10% of those obtained on B and C, they were found to be significantly lower than those recorded by B and C in group I and significantly higher in group III (Table 1). In other words, A tends to underestimate PEF in the lower ranges and overestimate it in the higher ranges as compared with instruments B and C (Fig. 2). A similar trend has been observed on comparing the Assess and mini-Wright peak flow meters with a pneumotachograph (11). On the other hand, values of PEF on B and C paralleled each other, although the former were higher by 3-5% than the latter (Fig. 1).

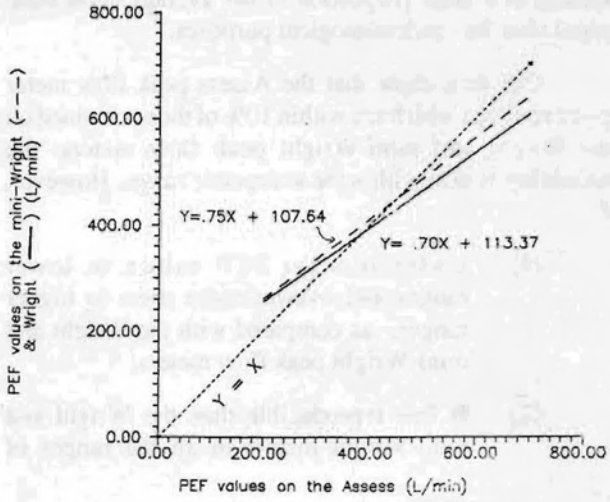

Fig. 2 : PEF values on the three instruments compared.

In all the three groups, A meets the requirement for reproducibility but its variability was still significantly greater than for the other two instruments. The variabilities of B and C did not differ significantly from each other in any of the three groups. These results were obtained in a healthy, co-operative population. In patients with obstructive aiway disease, the variabilities are likely to be even higher. The use of a less reproducable instrument to tailor medication in such patients can lead to undesirable over or under-treatment of the problem.

The lower variability observed in all three instruments in group III may reflect the fact that all the subjects with PEF in the "high" range were men students. We have observed that women tend to have higher intra-individual variabilities (Walter S, unpublished data).

Eleven of the 30 men subjects had to be excluded from the study because instrument A was unable to measure PEF values >670 L/min. This means that it cannot be applied to a large proportion of the average adult male population for epidemiological purposes.

Our data show that the Assess peak flow meter gives readings which are within 10% of those obtained on the Wright and mini-Wright peak flow meters: the variability is also within the acceptable range. However, it

(1) Underestimates PEF values in lower ranges and overestimates them in higher ranges, as compared with the Wright and mini-Wright peak flow meters;

(2) Is less reproducible than the Wright and mini-Wright meters in all the ranges of PEF studied, and

(3) Has limited application with regard to range as it cannot read values above 670 L/min.

Therefore, the obvious advantage of the low cost of the Assess peak flow meter needs to be carefully balanced against its above mentioned limitations when it is given to patients for domestic self-monitoring of obstructive airway disease.

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