



Validation study of the AirGo™ device for the continuous monitoring of respiratory function

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Background

Standard functional respiratory tests require patient cooperation and do not allow continuous and accurate assessment of respiratory function under natural physiological conditions.

AirGo™ is a non-invasive wearable device that continuously records breath dynamics during sleep and daily activity.

By a wearable comfortable, stretchable and elastic band, that encircles the lower chest and floating ribs of subject (figure 1) AirGo™, coupled to a microprocessor, measures a lower thoracic circumference changes during physiological conditions.



Figure 1: The AirGo™ system (on the left): the stretchable, knitted chest band and the electronic device. The correct positioning of AirGo™ around the subject's torso (on the right).

AirGo™ generates tidal volume information based on the change in girth band resistance over time and by calculating the duration of each breath. It is able to estimate, indirectly, other respiratory parameters such as respiratory rate, minute ventilation, inspiratory and expiratory times.

AirGo™ wirelessly communicates with computational devices (computer or smartphone) and the data collected may later be easily analysed (figure 2).

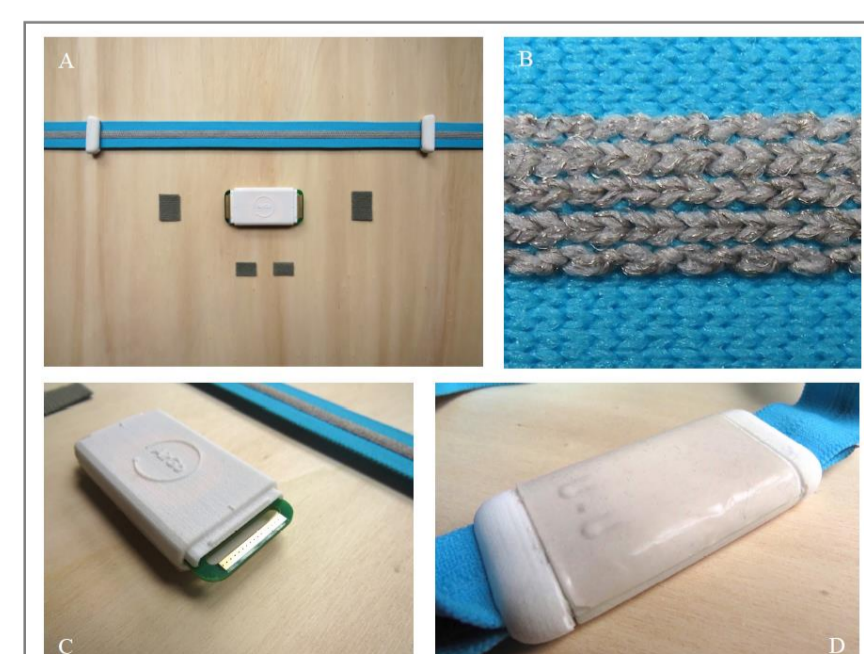


Figure 2: the AirGo™ system components: the band, the electronic device and the Velcro's straps to avoid band shifts (A). The knitted elastic band (B): silver yarn interweaved with the band's fabric (C). The electrical connections (pins) between the microprocessor and the band (D), and the backside of AirGo™ made by GECKO®.

Aims

To validate the accuracy of the AirGo™ device (MyAir LLC, Boston, MA, USA) comparing its performance in terms of respiratory parameters, with respect to gold standard methods.

Methods

21 healthy subjects were studied [median age 38 (range 24-51), 10 males, median body mass index 22.1 (range 17.7-30.0)].

Tidal volume (Vt) and respiratory rate (RR) have been recorded for 4 minutes at rest and in different body positions (standing, seated, supine, right and left side) simultaneously by AirGo™ and SensorMedics Vmax 2900 metabolic cart spirometer (figure 3).

The raw signal acquired by AirGo™ was processed through the AirGo™ algorithm in order to obtain a clean breath signal.



Figure 3: Acquisition protocol; quiet breathing in different body positions. The subjects are wearing the AirGo™ device under the T-shirt directly on the skin.

Results

To synchronize AirGo™ and SensorMedics registration, every subject has been asked to perform an initial big breath as a mark. Then AirGo™ and SensorMedics parameters were correctly aligned.

Normalized amplitude, tidal volume (relative to rest) and RR estimated by the AirGo™ device were able to follow very well the SensorMedics parameter variations over time with a breath-by-breath correspondence analysed (figure 4).

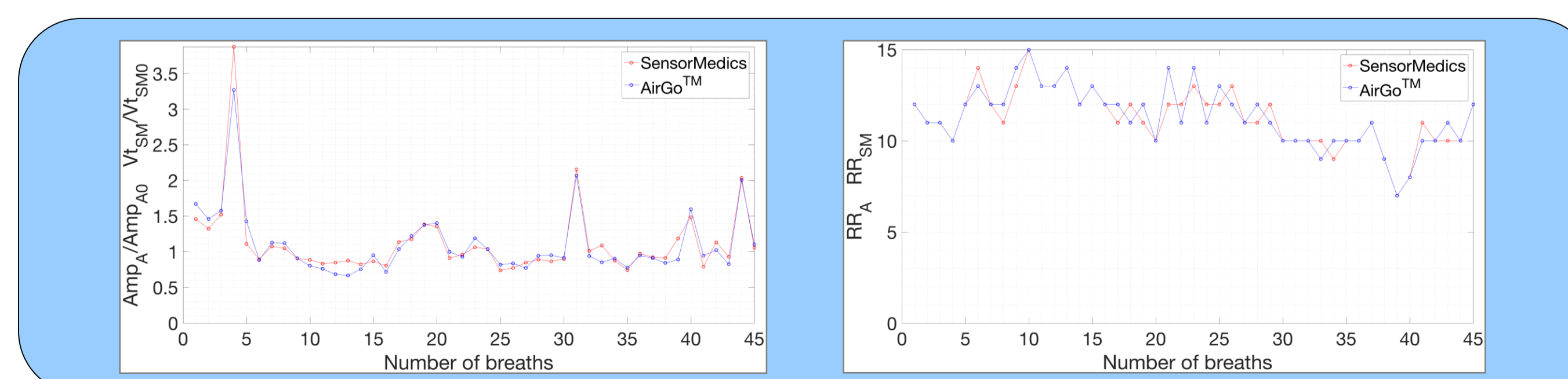


Figure 4: Breath-by-breath comparison of normalized amplitude (Amp), tidal volume (Vt) and respiratory rate (RR), subject S21, standing position.

Respiratory rate demonstrated high accuracy compared to the other parameters.

Relative box plots confirm these results: medians of RR were exactly on the zero error line, while the other parameters tended to move from the zero error line between one position and the other (figure 5).

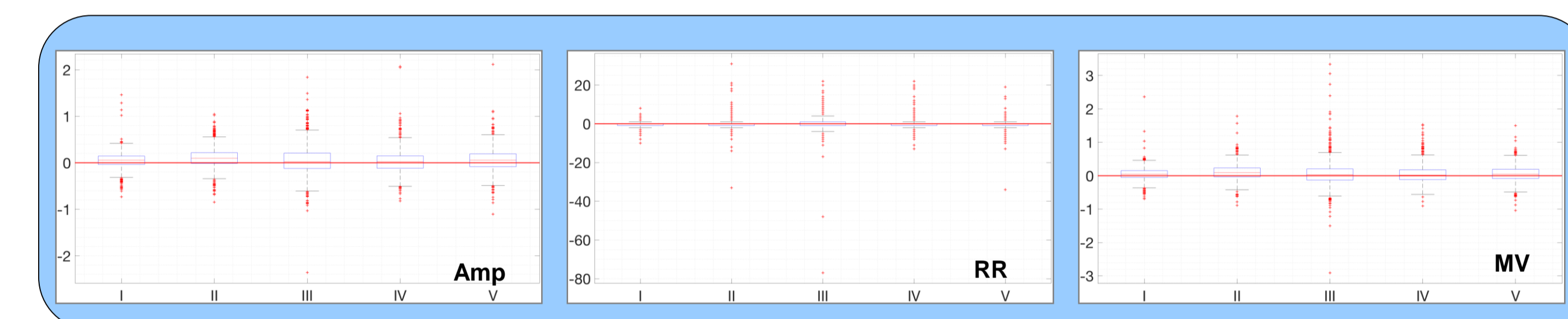


Figure 5: error box plots for different positions, pooled subjects. I: standing position, II: seated position, III: supine position, IV: right side, V: left side.

RR parameter provided the best correlation, in all positions, also at the scatter plots (figure 6).

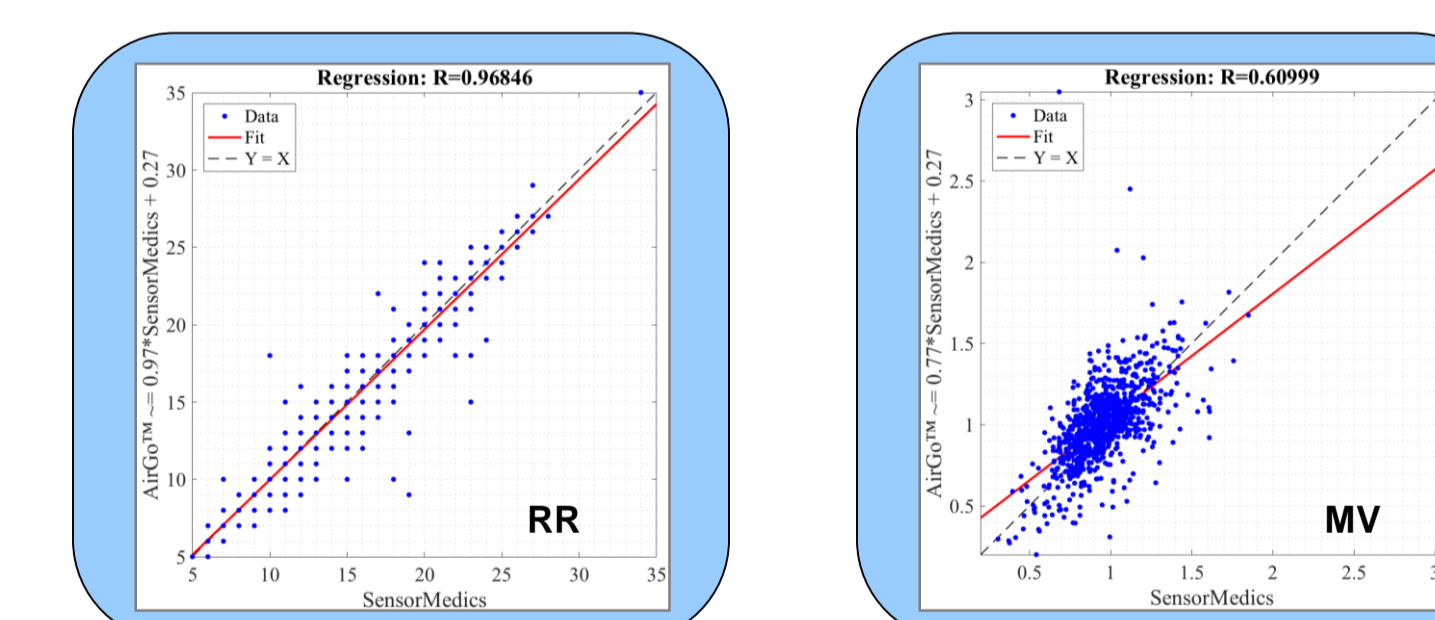


Figure 6: Scatter plots, respiratory rate (RR) and minute ventilation (MV), all positions, pooled subjects.

In terms of RR and tidal volume, for each position, we calculated a percentage error median as indicated in Table 1.

	Seated	Standing	Supine	Side R	Side L
Tidal volume	9.0% (26.0)	6.8% (21.5)	0.8% (33.2)	4.4% (28.7)	1.1% (27.0)
RR	0% (8.9)	0% (3.5)	0% (15.0)	0% (6.8)	0% (4.7)

Table 1: percentage error median (interquartile range mean).

Conclusions

AirGo™ provides, especially for RR, an acceptable estimate of respiratory parameters at rest and could be a helpful tool for management of lung disease, sleep respiratory disorders and early detection of worsening respiratory conditions.