

Continuous respiration rate monitoring using photoplethysmography technology in patients with Obstructive Sleep Apnea

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Potential conflict of interest: None

Full word count: 3540 (excluding abstract, keywords, figures, tables, acknowledgement, references)

Number of tables: 2

Number of figures: 3

Abstract

Introduction - Respiration rate is an important physiological parameter whose abnormality has been regarded as an important indicator of various serious illnesses. Photoplethysmography (PPG) in wearable sensors potentially plays an important role in early disease detection by making respiration rate measurements more accessible. We investigated the accuracy of a new non-invasive, continuous, wrist-worn and wireless monitoring PPG device (Corsano CardioWatch 287) in measuring respiration rate (RR) and pulse rate (PR) at rest.

Methods - Subjects with and without diagnosed Obstructive Sleep Apnea (OSA) underwent simultaneous, continuous overnight PPG and respiratory polygraphy (RP), which includes respiratory inductance plethysmography and pulse-oximetry. We assessed the PPG sensor's RR and PR measurement accuracy through Bland Altman and correlation analysis. Subgroups were defined based on skin type, hair density, age, BMI, gender and OSA severity.

Results - In 26 participants a total of 31'083 RR and 38'693 HR valid measurement pairs were obtained. For RR measurements, mean absolute error (MAE) was 0.34 breaths per minute (brpm) and root-mean-square deviation (RMSD) was 0.60 brpm. Correlation was high ($r = 0.964$ (95%CI 0.963 - 0.965)) and 95% Limits of Agreement (LoA) were -1.28 to 1.71 brpm (mean bias -0.14 brpm). For HR measurements, MAE was 0.65 beats per minute (bpm) and RMSD was 0.95 bpm. Correlation was similarly high ($r = 0.996$ (95%CI 0.996 - 0.996)) and 95% LoA were -2.09 to 1.17 bpm (mean bias -0.46 bpm). Results were comparable across all subgroups, including no significant difference in RR accuracy between subjects with and without diagnosed OSA.

Conclusion - We showed that the Corsano Cardiowatch 287 using PPG technology can monitor continuous RR and HR with high accuracy in healthy subjects as well as in patients diagnosed with OSA, with no significant performance differences among subgroups.

We conclude that wearable devices like these enable new and more convenient/accessible ways to measure health, ultimately improving healthcare delivery.

Key words - Photoplethysmography; wrist-worn device; wearable diagnostics; respiration rate; Obstructive Sleep Apnea;