

Pulse rate variations during respiratory events in children with sleep-disordered breathing



Nöhren A¹, Urschitz MS^{1,3}, Moss DM¹, Urschitz-Duprat PM¹, Schlaud M², Poets CF^{1,4}

¹ Department of Pediatric Pulmonology and Neonatology, Hannover Medical School, Hannover, Germany

² Department of Epidemiology, Social Medicine and Health System Research, Hannover Medical School, Hannover, Germany

³ Division of Neonatology, Department of Pediatrics, Vienna General Hospital, University of Vienna, Vienna, Austria

⁴ Department of Neonatology, University of Tuebingen, Tuebingen, Germany



BACKGROUND

In adult patients with sleep-disordered breathing (SDB), respiratory events (RE) are associated with characteristic heart rate changes, e.g. event related bradycardia and an abrupt increase in heart rate upon resumption of breathing (i.e., subcortical activation).¹ Little is known about the extent of these autonomic changes in children with SDB.

METHODS

- Polygraphic recordings (Embletta PDS[®], Flaga^{hf}; Reykjavik, Island) from children participating in a population-based study on the prevalence of SDB in primary school children and having a mixed-obstructive-apnea-hypopnea-index (MOAHI) >3 were examined for the extent of pulse rate variations (PRV) during quite periods (QP), central apneas (CA) and obstructive events (OE; i.e., obstructive apneas and hypopneas). Minimal duration for all RE was two breath cycles.
- Maximal (A, D) and minimal pulse rate (B, C) were determined for each RE (Fig.1). Percent decrease ($PD=(A-B)/A*100$) and percent increase ($PI=(D-C)/D*100$) of pulse rate were calculated.
- In addition, the highest PD and PI during quite periods (QP; i.e., the first 2 minutes of undisturbed signal during each new clock hour) were identified.
- Because of the different prevalence of RE in these subjects, the number of RE were weighted to enable similar sizes of RE groups.
- Statistical significance was assessed using Student's unpaired t-test and Mann-Whitney-U-test following a Bonferroni correction for multiple testing.

RESULTS

- 789 RE and 54 QP were analyzed in seven children (four boys, age: 10.5 ± 0.9 years; Table 1).
- Compared to quite periods PD and PI were significantly higher during central apneas and obstructive events in both boys and girls.
- Compared to obstructive events PD was higher during central apneas in girls and in boys, but this was significant only in boys (Figure 2).
- The results for the PI were different between boys and girls: In boys the PI was significantly higher in central apneas compared to obstructive events, whereas in girls the PI was significantly higher in obstructive events compared to central apneas (Figure 3).
- Boys showed higher PD and PI during central events than girls, whereas girls showed higher PD and PI during obstructive events (Figure 2 and 3).
- There was no significant difference between girls and boys in PD and PI during quite periods (Figure 2 and 3).

CONCLUSION

- Respiratory event-related bradycardia was more severe in central apneas compared to obstructive events in these children with SDB. This may be due to the lung inflation reflex causing accelerations in heart rate during obstructed breathing.²
- Central apneas and obstructive events (obstructive apneas and hypopneas) were associated with significant pulse rate accelerations following the resumption of normal breathing. Such subcortical activations could partially explain the impact of sleep-disordered breathing on daytime functioning.
- Boys had wider pulse rate fluctuations during central apneas than girls, whereas girls showed increased fluctuations during obstructive events. This finding implicates a gender difference in autonomic heart rate control during respiratory events in these children with SDB.

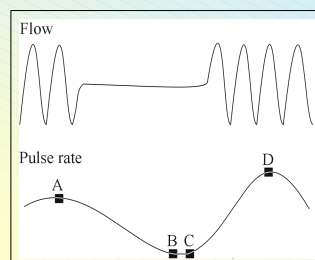


Fig. 1. Nasal airflow and pulse rate during a respiratory event.

A and D: maximal pulse rate
B and C: minimal pulse rate

		CA	OE	QP	CA v. OE	RE v. QP
PD	Boys	29.5±10.8	19.9±9.0	12.7±7.6	<0.001	<0.001
	Girls	25.5±8.8	24.7±9.8	12.6±8.1	n.s.	<0.001
Boys v. Girls		<0.001	<0.001	n.s.		
PI	Boys	33.3±18.4	26.4±16.4	13.5±8.4	<0.001	<0.001
	Girls	27.4±10.3	39.1±14.4	15.5±13.7	<0.001	<0.001
Boys v. Girls		<0.001	<0.001	n.s.		

Tab. 1. Pulse rate variations during respiratory events in boys and girls.

PD: percent decrease, PI: percent increase
CA: central apneas, OE: obstructive events, QP: quiet periods

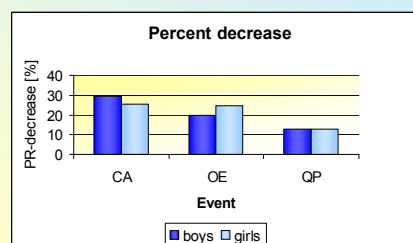


Fig. 2. Differences in percent decrease in pulse rate (event related bradycardia) between boys and girls according to central apneas (CA), obstructive events (OE) and quiet periods (QP).

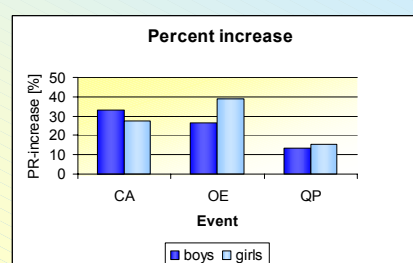


Fig. 3. Differences in percent increase in pulse rate (event related sub-cortical activation) between boys and girls according to central apneas (CA), obstructive events (OE) and quiet periods (QP).

References

1. Guilleminault C, Connolly S, Winkle R, Melvin K and Tilkian A. Cyclical variation of the heart rate in sleep apnoea syndrome. Mechanisms, and usefulness of 24 h electrocardiography as a screening technique. *Lancet* 1984;1(8369):126-131.
2. Angell-James JE, de Burgh Daly M. Cardiovascular response in apnoeic asphyxia: role of arterial chemoreceptors and their modification of their effects by a pulmonary vagal inflation reflex. *J Physiol* 1969;201:87-104.