

SLEEP DISTURBANCES FROM NOISE

LABORATORY EXPERIMENT ON ROAD TRAFFIC AND VENTILATION NOISE

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Introduction Most research on noise-induced sleep disturbances has been conducted on transportation noise and very few studies have dealt with the effects of ventilation noise on sleep. It is vital to attenuate noise from outdoor ventilation systems mounted in courtyards, which often destroys an otherwise quiet environment in courtyards or at the rear of the building that is shielded from traffic noise. The aims of this study were to assess the effects on sleep of these to different types of noise exposures, typical for an open window situation.

Methods Eighteen healthy young subjects slept six nights in the laboratory and their sleep was evaluated with wrist actigraphs and questionnaires. The first two nights were for habituation. The third night was a quiet reference night and during the remaining 3 nights, subjects were exposed to recorded noise either from road traffic, ventilation noise or a combination of noise from ventilation and road traffic. The exposure levels were: traffic noise 39 $L_{Aeq, 23-07h}$ with 64 passing vehicles 55 L_{Amax} , ventilation: 40 $L_{Aeq, 23-07h}$ and the combined noise 43: $L_{Aeq, 23-07h}$.

Results Table 1 shows the results on sleep assessed by actigraphy. No significant differences were found for any variables between the quiet reference night and traffic exposure or the quiet night and the combined exposure.

Table 1 *Sleep assessed by actigraphy for quiet night and nights with different noise exposure*

	Quiet		Traffic		Ventilation		Combined	
	M	Sd	M	Sd	M	Sd	M	Sd
Activity Mean, score	6.4	(3.5)	6.5	(3.9)	5.7	(3.2)	6.3	(2.9)
Sleep latency, minutes	13.6	(12.6)	10.7	(9.8)	10.4	(9.6)	11.3	(12.4)
Wake episodes, number	7.9	(6.1)	7.2	(5.3)	7.0	(5.7)*	7.1	(4.3)
Mean wake episodes, minutes	3.8	(2.2)	3.7	(2.3)	4.0	(2.2)	3.6	(1.9)
Sleep episodes, numbers	7.3	(6.2)	6.8	(5.3)	6.6	(5.6)*	6.7	4.2
Mean sleep episodes, minutes	116	(80.9)	124	(110.5)	182	(173.7)*	106	(74.0)

Significant differences were found between the quiet night and the night with ventilation noise for some sleep variables. These differences indicate better sleep during the night with ventilation noise. There were fewer numbers of wake episodes ($p=0.03$), mean sleep episodes were 67 minutes longer ($p=0.02$) and the number of sleep episodes was fewer ($p=0.03$) during the night with ventilation noise than during the quiet night.

Results on judged sleep quality are shown in Table 2. Significant differences were found between the quiet night and the different types of noise exposure for some sleep variables.

The number of awakenings was higher during the night with combined noise exposure ($p=0.042$) while the increase in awakenings during the night with traffic noise did not reach significance. Sleep quality decreased significantly during all exposure nights in comparison

with the quiet night (traffic $p=0.016$; ventilation $p=0.049$; combined $p=0.008$). The mean value of subjective movements was higher ($p=0.012$) during the night with combined exposure.

Table 2 *Judged sleep variables for quiet night and nights with different noise exposure*

	Quiet		Traffic		Ventilation		Combined	
	M	Sd	M	Sd	M	Sd	M	Sd
Minutes to fall asleep	19.9	(12.8)	19.1	(14.5)	17.3	(12.5)	18.4	(14.7)
Awakenings, number	0.89	(0.9)	1.44	(1.29)	0.89	(1.08)	1.44	(1.10)*
Sleep quality	74.6	(17.0)	58.4	(23.0)*	65.4	(22.1)*	55.8	(26.2)**
Movements	33.6	(18.7)	39.2	(22.2)	36.8	(20.1)	47.4	(22.1)**

Discussion Judged sleep quality was decreased by 22 % after nights with exposure to road traffic noise, this is very close to what Öhrström, and Öhrström and Rylander found [1; 2]. The combined noise from ventilation and road traffic caused more awakenings; worse sleep quality (- 25 %) and more movements measured by questionnaire. None of these significant results was detected by actigraphy. The reason that combined exposure did not affect judged sleep quality more than exposure to traffic noise alone is probably explained by the fact that the combined noise had a more even and therefore less arousing character. It has previously been shown that an intermittent and fluctuating noise such as road traffic noise disturbs sleep more than an even noise, [1, 3]. Noise from ventilation caused a decrease in judged sleep quality by 12 %, while sleep assessed by actigraph, indicated better sleep as compared with the quiet reference night. The reason for this discrepancy is not clear.

Comments Traffic noise is more disturbing for sleep than ventilation noise at exposure levels used in this study. It thus seems to be better to place a dwellings bedroom towards the courtyard even if there is ventilation equipment in the courtyard; it is a better solution than locating the bedroom towards a busy road.

The effects on sleep obtained by questionnaires and by actigraphy were contradictory and the results obtained by questionnaires seem more reliable since they point in the same direction, e.g. reduced sleep quality after exposure to noise.

Keywords: sleep disturbances; actigraphy; laboratory study

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References

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