EFFECTS OF ROAD TRAFFIC NOISE ON SLEEP
Studies on sleep assessed by wrist-actigraphy and sleep logs for children and adults

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Introduction Many children are exposed to high levels of road traffic noise in their home environment and may also attend schools and other places/activities exposed to high levels of noise. Known noise-induced effects in children are hearing impairment, stress-related somatic effects and cognitive effects (1). Adverse effects of noise exposure at school and other places may be moderated by noise exposure at home, especially due to opportunities for relaxation and sleep in quiet environments. Very little is however known about how sensitive children are to sleep disturbances caused by road traffic noise and comparative research between children and adults is lacking. Eberhardt (2) studied the effects of road traffic noise on sleep in the home for young children who lived along streets with night traffic. A more quiet condition was obtained by mounting a transparent plastic pane over the window reducing the noise level by 11 dBA. The most significant effects of the noise reduction were a reduction in time for falling asleep and a very small, but statistically significant increase amount of REM sleep. Since sleep is very important to the health and development of children, more research is needed to obtain insight into possible adverse noise-induced effects on sleep. The objective of this Swedish project within the RANCH-program (Contract No: QLRT-2000-00197), was (A) To provide knowledge on exposure-effect relationships between road traffic noise in the home and the effects on health and well being including sleep comparatively for young children and adults (B) to provide knowledge on effects of noise on sleep by using perceived sleep quality and sleep assessed by wrist-actigraphs and thereby assess possible differences in sleep for young children and adults. This paper gives the first preliminary results on sleep assessed by wrist-actigraphs and sleep logs from a sub sample of children and adults.

Methods Sleep quality among children and their parents was studied in four road traffic noise exposed areas in three Swedish cities. The areas in Stockholm, Gothenburg and Örebro were defined based on $L_{\text{Aeq}, 24h}$ levels: $<55$, 55-59, 60-64 and $>64$dB. Wherever possible areas have been matched as regards physical and population characteristics. Families, with children 9-12 years old, in each area were contacted by mail, and asked if they would agree to participate in the study. In each noise exposure category about 20 children aged 9-12 years and one of their parents, usually the mother, were selected for studies of sleep quality during 4 consecutive nights in their homes. Before the sleep study period children and their parents also took part in a more extensive interview study. Their sleep was evaluated by sleep logs and wrist-actigraphs (Mini-motion-logger actigraph tri-mode from Ambulatory Monitoring Inc.) and they were instructed to follow their normal sleep routine. In total 39 boys and 40 girls with an average age of 10.5 years and 79 parents (74 women, 5 men) participated.

Results and comments Sleep quality did not differ between the four noise areas. Sleep assessed by wrist-actigraphy (e.g. sleep latency, activity mean, activity index, wake episodes) across the four noise areas didn’t show any significant differences either for children or for adults. This was also the case for sleep quality assessed by sleep logs (e.g. minutes to fall asleep, sleep quality, awakenings, movements, tired-alert in the morning). The children who slept in a room with windows facing the road (85% of the children in the three noisier areas) had similar sleep to the children who had a room with windows facing a courtyard.
No differences in sleep quality were found between the parents who had bedroom windows facing the road (49% in the three noisier areas) and those who had not. Noise annoyance, “Traffic noise interferes when I am going to bed” was correlated with reported minutes to fall asleep and sleep quality among children (r = .30 and r = .28, p<0.05) and with sleep quality among adults (r = .25, p<0.05). A higher percentage of children reported noise interference with sleep than adults (p<0.001).

Some of the health variables studied were significantly correlated to sleep quality. Among children reported sleep quality [scale 0-10] and sleep latency [assessed by wrist-actigraph] was correlated to “Don’t feel well” (r = .27, p<0.05 and r = .24, p<0.05 respectively). Tiredness in the morning [scale 0-10] was significantly related to physiological and psychological symptoms in both children and parents (r = .26, p<0.05).

There were several significant differences in sleep quality between children and adults. In sleep parameters evaluated by sleep logs children reported significantly better sleep quality (p<0.001) and felt less tired in the morning (p=0.01) than adults. The figures below show some of the results on sleep parameters assessed by wrist-actigraphy.

The children spent on average 2 hours more in bed (557 min, Sd 39) than the parents (444 min, Sd 43). The children had higher activity mean (8.04 versus 5.79, Sd 2.7 and 3.2, p<0.001) and they moved 32% of the time in bed (activity index) compared to the parents 26% (p<0.001). The parents had shorter sleep latency than the children (10.3 versus 19.2 min, Sd 12.5 and 13.0, p<0.001). The children had almost twice as many wake episodes during night as the parents (12.5 versus 6.8, Sd 5.9 and 5.3, p<0.001).

These, very preliminary, results show that children might have better sleep than adults for some sleep parameters but not for others. There are some indications (see fig.) of a decrease in sleep among adults in areas with higher noise levels. In the lowest noise area, however sleep tends to be worse (higher activity mean (p=0.08), with longer sleep latency and more wake periods. The data from this sub-study on sleep will be linked to data obtained in interviews with the children and parents to allow for in depth analyses of the link between socio-economic, demographic and health variables etc that probably have a large effect on sleep. The results will be analysed in relation to individual based noise levels (LAeq, 24h, Lnight).

**Keywords:** Sleep, children, road traffic noise, actigraphy, sleep logs

**References**
