



RANCH



Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health: Exposure-Effect Relationships and Combined Effects.


Introduction

Previous studies have found associations between exposure to aircraft noise and children's school performance and health. This suggests that children may be a high risk group vulnerable to the effects of noise. However, most studies have not examined exposure-effect relationships nor the effects of combinations of aircraft and road traffic noise. An exposure-effect relationship, that shows increasing effects on health with greater exposure to noise, is an important step in confirming causal associations between noise and child health outcomes.

The RANCH project, the largest study of noise and children's health to date, was designed to examine exposure-effect relationships between aircraft and road traffic noise exposure and school performance, annoyance and blood pressure in 9-10 year old children living around major airports in the Netherlands, Spain and the United Kingdom (**airport field studies**). The project also included studies of road traffic noise and sleep at home in Sweden (**road traffic field study**) and studies of soundscapes in the UK and Sweden (**soundscapes studies**). The RANCH project provides a robust evidence base to inform pan-European noise policy based on health effects in children.

Airport Field Studies

Children were selected to take part in these studies on the basis of school noise exposure around Heathrow, Schiphol and Barajas airports. Schools were selected from a wide range of aircraft and road traffic noise exposures to examine exposure-effect relationships for different levels of aircraft noise, road traffic noise and combinations of aircraft and road traffic noise. Children completed tests of reading comprehension, memory and attention in their classrooms. They also completed a questionnaire about their attitudes to noise in the school and at home. Blood pressure measurements were taken in a sub-sample. Parents completed a questionnaire about the family's health and social background. The following table shows the number of schools and children that took part.

	No. of Children	No. of Schools	Child Response Rate	Parent Response Rate
UK	1174	29	87%	82%
Netherlands	762	33	92%	86%
Spain	908	27	88%	72%

Key Findings

- ❑ Aircraft noise exposure was related to impaired performance in reading comprehension and recognition memory. Reading age in children exposed to high levels of aircraft noise was delayed by up to 2 months in the UK and by up to 1 month in the Netherlands for a 5 dB change in noise exposure.
- ❑ Road traffic noise exposure was unexpectedly related to better performance in recall memory but was not associated with reading comprehension, recognition memory or working memory.
- ❑ Both aircraft and road traffic noise exposure were related to annoyance. Annoyance is a stress response to noise exposure implying reduced well-being and quality of life.
- ❑ Chronic exposure to aircraft and road traffic noise was not associated with general health status and mental health and inconsistently associated with elevated blood pressure.

Road Traffic Field Study

In the road traffic field study, school children (160 children aged 9-12 years) from four different road traffic noise level areas in Sweden participated in a face to face interview in their home. Each child's parent also completed a questionnaire. Questions were asked about health, sleep quality and disturbance from traffic noise. A sub-sample of these participants (80 children & 80 parents) also took part in a sleep study using wrist actigraphs and sleep logs to evaluate sleep quality.

Key Findings

- ❑ Children have better reported sleep quality and a lower number of awakenings than parents. Children and parents reported the same extent of difficulties falling asleep and feeling alert in the morning.
- ❑ Children reported more frequent problems with daytime sleepiness in areas with high noise levels. There was a weak association between road traffic noise exposure and reported sleep quality.
- ❑ For both children & parents, disturbance from traffic noise and well-being were related to sleep quality.



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Soundscape Studies

Children's and adult's 24 hour acoustic soundscapes were mapped by sound recordings, indoors and outdoors, at homes and schools. A soundscape considers all the sounds in the environment together and is like a landscape of sounds. Two laboratory experiments (UK and Sweden) with children and adults assessed the loudness and pleasantness of the soundscapes. The UK study focused on soundscapes dominated by aircraft and road traffic noise at school, and the Swedish study on soundscapes dominated by road traffic noise at home.

A health evaluation model for children was developed and tested at a pan-European level to identify potential harmful and protective influences on children's health and development. This model included assessing children's opportunities for psychological restoration when living in noise dominated soundscapes. The psychological restoration questionnaire was included in the airport field studies and in the Swedish road traffic noise study.

Key Findings

- Children are as skilled as their parents in assessing the loudness of sounds and in judging the unpleasantness of soundscapes. This supports the validity of annoyance responses in children. Children are as able as adults to evaluate and respond to noise.
- Children from a wide-range of aircraft noise exposures did not differ in their judgements of soundscapes. This means that children respond to noise in the same way regardless of their personal noise exposure.
- Children's psychological restoration combined with adult social support may serve as protective factors for reducing children's self-reported annoyance at school and at home.

Overall Conclusions

On the whole we found similar effects of noise on school performance and annoyance across the Netherlands, Spain and the United Kingdom.

The RANCH results, considered with evidence from previous studies, suggests that aircraft noise has specific causal effects on children's school performance and health. The functions most adversely affected by noise are reading, recognition memory and annoyance. It is not known whether these effects are temporary or permanent.

The results of the RANCH project suggest that road traffic noise is associated with annoyance. There was no evidence that road traffic noise affected reading. The unexpected association between road traffic noise and recall memory needs further investigation.

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Opportunities for psychological restoration and restorative environments improve children's well-being and potentially protect against adverse reactions to noise.

Action is recommended at a European level to provide healthy educational environments for children attending high noise exposed schools.

Benefits to Europe and Policy Recommendations

The results of the RANCH project, adding to previous research, provide an evidence base that has implications for European environmental health policy. Our advice is as follows:

1. Since similar effects were found across Europe, guidelines and policies setting the same external aircraft noise limits for children could be applied across Europe.
2. The results from the exposure-effect studies show aircraft noise effects on children's school performance and health within the range of the suggested guidelines for external noise at schools proposed by the World Health Organization.
3. Guidelines and policy should be developed to provide healthy educational environments for children exposed to high noise levels. These include measures to provide restorative and relaxing environments for children.
4. Our results confirm the need to consider noise exposure, with other environmental aspects, when planning new schools. New schools should not be planned or built close to existing airports, where there is excessive noise exposure. Measures should be taken to reduce noise in existing schools, where there is excessive noise exposure.

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The RANCH Study is funded by the European Community (QLRT-2000-00197) in the 5th framework programme under Key Action 1999/C 361/06 'Quality of life and management of living resources'.