

Aircraft Noise and Health Effects – a six monthly update

CAP 1971



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Contents

Contents	3
Chapter 1	4
Introduction	4
Chapter 2	5
Internoise Findings	5
Chapter 3	10
Aircraft noise and health outcomes	10
Annoyance	10
Birth Outcomes	15
Mental health	16
Sleep disturbance	18
Chapter 4	19
ICCAN Review	19
Chapter 5	22
Summary	22
Chapter 6	23
References	23

Chapter 1

Introduction

- 1.1 This report is an update on recent work and findings in the field of aircraft noise and health effects. It covers published research from March 2020 to September 2020 and includes relevant findings presented at the Internoise Congress held in August. Due to the Covid-19 pandemic, this year Internoise was held as an E-Congress online. The ICBEN (International Commission on Biological Effects of Noise) Congress, due to be held in Stockholm in June this year has been postponed to 2021.
- 1.2 The aim of the report is to provide a succinct overview of new work relating to aviation noise and health and such updates are published on a six-monthly basis. This report has been published to provide the public and the aviation industry with a concise and accessible update on recent noise and health developments. It should be noted that the CAA has not validated any of the analysis reported at the conference, nor takes any view on their applicability to UK policy making. The authors would like to thank Bernard Berry (Bel acoustics) for his valued contribution to the source material.

Chapter 2

Internoise Findings

- 2.1 The Internoise Congress was held on 23-26th August as an E-Congress due to the Covid-19 pandemic. There were fewer papers relating to aircraft noise and health this year than we normally would have expected, probably due to ICBEN being scheduled in the same year, and authors choosing to present there (now postponed until 2021). The relevant findings that have been made available relating to aircraft noise and health outcomes are presented in this chapter.
- 2.2 **Spilski et al** authored a paper asking whether we need different metrics to predict the effects of aircraft noise on children's wellbeing and health. CAP1883 included reference to a similar paper by this author, which looked at the idea of using different aircraft noise metrics to predict annoyance for different groups of people. Although L_{eq} and L_{den} are the most commonly used metrics for annoyance studies, the authors suggest that other metrics such as Number of aircraft noise events above a certain threshold (NA), L_{max} and Emergence¹ should not be ignored as they may explain further the variance of 19% that the WHO found between aircraft noise levels and raw annoyance scores. The study re-examined the NORAH dataset with the aim of assessing the effectiveness of alternative noise metrics and differences in the level of relationships in different groups of people (children, parents and teachers) and in different settings (school: workplace or learning environment; residential environment).
- 2.3 The Internoise paper examined the different metrics with regard to children's annoyance at home. The authors have previously reported that in the school context, based on the NORAH data, analysis of further noise metrics can significantly increase the explained variance of the outcomes (reading performance, aircraft noise annoyance in school). In this study, they used alternative acoustic metrics for the home context, to improve explained variance in the outcome variables (children's well-being, health, and aircraft noise annoyance at home). The aim was to examine the suitability of different noise exposure metrics (L_{Aeq} , L_{den} , L_{Amax} , Emergence, NAT55 to NAT80) for analysing the associations between aircraft noise and annoyance, well-being and health in the home context.
- 2.4 Over 1,200 children from 29 primary schools were included in the study, with a mean age of 8 years 4 months. 976 complete data sets were analysed.

¹ Emergence is the difference between L_{Amax} and L_{Aeq}

Table 1: Selected NORAH outcome variables concerning children’s annoyance due to aircraft noise exposure at home, health-related quality of life, physical diseases and developmental abnormalities. (Taken from Internoise proceedings)

	Outcome variable	Psychometrics/ Questions	Response scale
	Index “Annoyance due aircraft noise at home”	$CR = .83$, $\alpha = .80$; $AVE = .71$	4-point scale (<i>strongly disagree, disagree, agree, strongly agree</i>)
Child judgments	Physical well-being (single variables)	PWB 1: Last week I had a headache and stomach ache. PWB 2: Last week I felt sluggish and tired.	3-point scale (<i>never, sometimes, often</i>)
	Psychological (mental) well-being (single variables)	MWB 1: Last week I laughed a lot and had a lot of fun. MWB 2: Last week I was bored.	3-point scale (<i>never, sometimes, often</i>)
Parental judgments	Physical diseases and developmental disorders	e.g., middle ear inflammation, asthma, neurodermatitis, migraine, attention disorders, speech and language disorders	3-point scale (<i>no, never; yes, once; yes, several times</i>)

Notes. CR = composite reliabilities, α = Cronbach’s α , AVE = average variance extracted

- 2.5 Table 1 shows the items concerning health-related quality of life and annoyance due to aircraft noise exposure. The children were tested in groups and had the questions read out loud to them, with a combination of pictures and numbers for ease of understanding. They also took a questionnaire home for their parents to fill in on the children’s well-being, health related outcomes and potential confounding factors such as socio-economic status.
- 2.6 The results indicated that no significant association was found between aircraft noise levels at home and children’s wellbeing, except for one measure of psychological wellbeing: “I was bored last week”, which was strongest for L_{Aeq} ($p < 0.001$).
- 2.7 No association was found between aircraft noise exposure at home and children’s health (physical diseases and developmental disorders).
- 2.8 The regression models revealed significant associations between aircraft noise exposure at home and children’s aircraft noise annoyance (all p ’s < 0.001). This result was consistent for all nine aircraft noise metrics. The associations were lowest for the Emergence and NAT indicators $\geq 55 < 60$ ($\beta = 0.172$ and 0.171), and highest for L_{Aeq} , L_{den} and L_{Amax} ($\beta = 0.404$ to 0.429). The authors found no evidence that other exposure measures than L_{Aeq} could better relate to annoyance judgments. There was no evidence that combined models with

several exposure metrics led to better prediction of the outcomes for annoyance, well-being and various health outcomes.

- 2.9 The results indicated that the outcomes are not consistent when investigating children's annoyance and health outcomes in relation to aircraft noise. The authors suggest that the present results indicate that research on noise exposure effects is very complex and there is a need to consider different contexts (home versus school), different dependent variables (well-being, health, cognition) and different metrics (e.g. L_{Aeq} , NAT). Further research is needed to determine under which conditions effects could be found, and under which circumstances there is no effect.
- 2.10 **Lavia et al** from the UK authored a paper on Soundscape, engagement and planning practices within airport expansion projects in the UK. This paper formed part of Lavia's Doctoral thesis, investigating the role of soundscape management and public wellbeing with the planning processes for aviation expansion at two airports in the UK.
- 2.11 The study examines how people respond to sound environments, whether they are already in existence, are being imagined, or has been part of a development process. As found in all research relating to noise or sound, the importance of non-acoustic factors cannot be overlooked. Non-acoustic factors can contribute to a wide range of responses to the same sound, hence the need to control for them as much as possible within analyses.
- 2.12 Within soundscape management, the non-acoustic factor "perceived control" is known to be very important and can impact how engagement in planning processes are perceived by stakeholders. The element of perceived control can also influence wellbeing, and as such is an important consideration when planning and developing. This study investigates stakeholders' perceived control and the impact on effective engagement in the context of planning processes for airport expansion projects in the UK.
- 2.13 The paper discusses how non-acoustic factors are balanced with stakeholder engagement in the UK. For sustainable development this involves engagement with stakeholders concerning the possible mitigation strategies available for aircraft noise and communities. As mentioned above, the presence of non-acoustic factors and the subjective nature of one's response to sound serves to further challenge this process.
- 2.14 Lavia quotes the WHO statements that non-acoustic factors:
- i) are an 'important possible confounder in both exposure-response functions (ERFs) between noise levels and critical health effects and the effects of acoustic interventions on health outcomes';