APPENDICES
APPENDIX 1

PARENTAL INFORMATION SHEET, CONSENT FORM, DATA RECORDING SHEET AND QUESTIONNAIRE
A Research Study Into the Relationship Between Blood Pressure in Children and Exposure to Aircraft Noise
Information for participants

You are invited to take part in a study into the relationship between blood pressure in children and exposure to aircraft noise. The objective of this study is to determine the extent of the effects of exposure to aircraft noise on the blood pressures of young children in Year 3 of primary school. This study is being undertaken because aircraft noise exposure in inner Sydney will change when the new runway at Sydney Airport becomes operational towards the end of 1994.

An American study has indicated that there may be a link between exposure to aircraft noise and elevated blood pressure in primary school children. This study will help us determine whether a similar association exists in children in inner Sydney.

This study is being conducted by Richard Taylor, Associate Professor in Public Health; Stephen Morrell, Research Assistant, both at the University of Sydney; Dr Garth Alperstein, Paediatrician at the Royal Alexandra Hospital for Children; and Dorothy MacKeran, Senior Lecturer and Nutritional Epidemiologist, also in the Department of Public Health at the University of Sydney.

If you agree to participate in this study you will be asked to fill out a questionnaire about your household and your child. The parents or guardians of the child will each be asked to fill out an individual questionnaire, and your child will have the following measurements taken: blood pressure; height; weight; thickness of skin on triceps, biceps and the clothed upper back; and a hearing test. The investigators will inform you if your child’s hearing is found to be impaired. Please note that no injections or blood tests are involved.

All aspects of the study, including results, will be held by the above named investigators and be kept strictly confidential.

While it is intended that this study will further medical knowledge, it may not be of direct benefit to you.

Participation in the study is entirely voluntary; you are not obliged to participate. If you do participate you can withdraw from the study at any time.

Please help us with this important study by giving your consent for us to take your child’s blood pressure, hearing and physical measurements.

Please sign the consent form and complete the HOUSEHOLD QUESTIONNAIRE for your household and for the child participating in the study. The child’s mother/female guardian and father/male guardian should each fill out a separate copy of the PARENTAL QUESTIONNAIRE.

Place the completed questionnaires in the envelopes provided, seal the envelope and return it with the signed consent form to the school within one week. They will be collected from the school by the research staff on the project. If you do not consent to participate in this study please dispose of the consent form and the questionnaires thoughtfully.

If you have any questions regarding this project or problems filling out the questionnaires, please feel free to contact the research team on Ph: 692-4375, we will be happy to provide assistance.

Any person with concerns or complaints about the conduct of this research study can contact the Secretary of the Ethics Review Committee of the Central Sydney Area Health Service on Ph: 515-6766

Richard Taylor
Associate Professor in Public Health
University of Sydney
For the Sydney Airport Health Study Committee
INNER SYDNEY CHILD HEALTH SURVEY

Parent consent form for child and parent participation in health survey

Name of parent

Address

Postcode

Please fill in the following details for your child in Year Six (6)

Child’s school

Child’s family name

Child’s given names

NOTE: NO BLOOD TESTS OR INJECTIONS ARE INVOLVED

Consent:

● I agree to participate in this follow-up survey and give permission for my child(ren) to have blood pressure, height, weight, waist measurement and thickness of skin on upper arm and back taken at school.

● I am aware that all information collected by the investigators will be kept secure and in strictest confidence.

● I understand that I will receive no payment in exchange for my child(ren)’s or my own participation in this project.

● I also understand that participation in the study is voluntary and can refuse to participate or have my child tested, without prejudice, at any time after agreeing to participate.

Parent/guardian Signature

Date
CHILD QUESTIONNAIRE AND MEASUREMENT DATA SHEET
(Measurement team use only)

Name: ................................................................. Class: ..............

Did you have anything to eat before coming to school today? Yes / No (circle)

Do you play sport during lunchtime and/or recess? Yes / No (circle)

Blood pressures:

Reading 1
Systolic .............. Diastolic ..............
Pulse Rate ..............

BP Mach. # ..............
BP Oper. ..............

Reading 2
Systolic .............. Diastolic ..............
Pulse Rate ..............

Reading 3
Systolic .............. Diastolic ..............
Pulse Rate ..............

Temp. .............°C

Body size:

Height .............. cm
Weight .............. kg
Waist .............. cm

Tracksuit (tick) ..............

Skinfold thickness:

Height .............. cm

Stadio # ..............

Triceps .............. mm
Biceps .............. mm
Subscapular .............. mm
Clothing fold .............. mm

Caliper # ..............
Cal.Op. ..............
Skin Op. ..............
HOUSEHOLD QUESTIONNAIRE

Please answer the following questions about your child participating in the school health study, and about your household.

1. Child's family name

2. Child's given names

3. Child's address

Postcode

Phone Number

4. School

5. Have you been told by a doctor or nurse that you or your spouse has high blood pressure?
   Yes/ No
   (Circle)

6. Have you been told by a doctor or nurse that your child participating in the study has high blood pressure?
   Yes/ No
   (Circle)

Please answer the following questions about your dwelling:

7. Do you live in a:
   - Stand-alone house/cottage
   - Semi-detached/terrace house
   - Flat/ apartment/unit
   - Other (specify)

8. If you live in a block of flats or apartments, do you live on the top floor?
   Yes/ No
   (circle)
9. Is your present dwelling made of:
   
   Brick/masonry .......... 
   Wood .......... 
   Fibro .......... 
   Other (specify) ........................................

10. Has your dwelling recently been insulated? Yes/ No  (circle)
    If yes, provide the date on which the work was completed— __/__/19__

11. Does your dwelling have large or small windows and/or glass doors?
    (Please circle the appropriate responses)
    Large windows       Glass doors       Small windows

12. How long have you and your child been living at your current address?
    ....... Years ....... Months

Thank you for participating in this study.
APPENDIX 2

INSTRUCTIONS FOR FIELDWORKERS
UNIVERSITY OF SYDNEY
DEPARTMENT OF PUBLIC HEALTH AND COMMUNITY MEDICINE

THE INNER CITY BLOOD PRESSURE (THE AIRPORT STUDY)
SCHOOL CHILDREN’S MEASUREMENTS

INSTRUCTIONS

- THE TEMPERATURE OF THE ROOM SHOULD BERecorded IN THE
  CHILD’S FORM.

- USING THE TAPE MEASUREMENT (cm)

  1) WAISTLINE

  Measurement should be taken around the waist and about 2 cm above the
  umbilicus (belly button).

  2) MARKING THE RIGHT UPPER ARM

  * Locate the prominent part of the arm, between the articulation of the
    shoulder and the arm.
  * Locate the articulation of the elbow.
  * Measure the length and find the middle point. Mark it with a pen.

  This measurement will be used when we measure the biceps and triceps skin folds.

- USING THE STADIOMETER

  * This instrument measures the height of the child.
  * It is very important that the child be standing up as straight as possible.
  * The back of the head against the wall or another flat surface.
  * The feet should be place very close on top of the metal plate which holds the
    measuring tape. No shoes please.

- USING THE SCALES

  * The scales are electronic. No shoes please.
USING THE BLOOD PRESSURE MACHINE

- The child's blood pressure will be measured 3 times and the figures recorded immediately. The number of the machine and the initials of the operator should also be recorded.
- The child will be maintained, within possibilities, as quiet as possible.
- If an aeroplane is crossing the sky at the time of the measurement, this situation should be written down.

USING THE CALIPERS

Correct Technique

1. Measurement should be taken on dry skin.

2. The child should maintain his/her muscles relaxed.

3. Take the measurements on the right side of the body, e.g. right arm and shoulder.

4. Mark the skinfold site using a pen and use a tape measure to accurately find the midpoint.

5. The skinfold should be firmly grasped by the thumb and index finger, using the pads at the tip of the thumb and finger. Gently pull the skinfold away from the body.

6. The calipers should be placed perpendicularly to the fold, on the side marked, dimi up, approximately 1 cm below the finger and thumb. While maintaining the grasp of the skinfold, allow the calipers to be released so that full tension is placed on the skinfold. The dial should be read to the nearest 0.5mm. 1 to 2 seconds after the grip has been fully released.

7. The calipers should not be placed too close to the body or too far away on the tip of the skinfold. Try to visualize the location of a true double fold of skin thickness, and place the calipers there.

8. Record each skinfold as you measure it. It is easy to forget the first measurement if you try to keep it all in your head.
SITE SELECTION

The sites selected for measurements are the biceps and triceps in the right arm, and the subscapular in the back. See the pictures please.

- **Biceps**

  The anterior surface of the biceps midway the anterior auxiliary fold and the antecubital fossa.

- **Triceps**

  A vertical fold on the posterior midline of the upper arm, over the triceps muscle, halfway between the acromion process (bony process on top of the shoulder) and olecranon process (bony process on elbow). The elbow should be extended and the arm relaxed.

- **Subscapular**

  The fold is taken in the diagonal line coming from the vertebral border to between 1 cm and 2 cm from the inferior angle of the scapulae. (A diagonal fold about 1 to 2 cm below the shoulder blade and 1 cm toward the arm.)
Assessment of growth

- Standing straight ahead
- Arms at side
- Legs straight and knees together
- Feet flat and toes together
- Shoulder blades, buttocks, and heels touching measurement board.

Measurements of the ulna

Location of the midpoint of the upper arm. Repro

Illustrations taken from NUTRITIONAL ASSESSMENT A LABORATORY MANUAL
Kathleen S. Gibson
NY Oxford OXFORD UNIVERSITY PRESS, 1993
APPENDIX 3

RELATED PUBLISHED WORK
A review of health effects of aircraft noise

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Abstract: Social surveys have established dose-response relationships between aircraft noise and annoyance, with a number of psychological symptoms being positively related to annoyance. Evidence that exposure to aircraft noise is associated with higher psychiatric hospital admission rates is mixed. Some evidence exists of an association between aircraft noise exposure and psychiatric problems, although some studies have failed to show significant effects. Aircraft noise has been associated with increased hospital admission rates for psychiatric problems, but the evidence is inconsistent.

Some association between aircraft noise exposure and elevated blood pressure has been observed in cross-sectional studies, but there is little evidence from cohort studies. There is no convincing evidence to suggest that exposure to aircraft noise has a significant effect on mortality. Using the World Health Organization definition of health, which includes physical, mental and social well-being, aircraft noise is responsible for considerable morbidity. However, population-based studies have not found strong evidence that people living near or under aircraft flight paths suffer higher rates of cardiovascular mortality as a consequence of exposure to aircraft noise. A death of high quality studies in this area precludes drawing substantive conclusions. 4.2.1 NFJ Public Health 1996; 21: 224–230

The introduction of jet aircraft commercial routes in the 1950s was associated with major increases in noise and disruption to residents around large airports. Since the 1980s, when jet aircraft became commonplace, public officials and the public have been divided. The current climate has resulted in increased concern about the effects of aircraft noise on the physical and mental health of exposed populations. Populations near or under the flight paths of Heathrow (London) and Los Angeles' LAX have been the subject of particular study, but little has been documented in this area.

Aircraft noise may produce a variety of psychological and economic effects on humans, which include interference with quality of life and annoyance in response to noise levels. The effects on educational and performance and various effects on health.

One of the major types of definitions of health that most commonly quoted is by the World Health Organization: "Health is not merely the absence of disease or infirmity, but a state of complete physical, mental, and social wellbeing." This definition is inadequate for population-based studies, since it does not include premature death. Although it includes the absence of disease, it does not include the presence of disease, and there is a lack of agreement on what constitutes health.

Health can be considered as successful adaptation of individuals or groups to environmental circumstances. This requires successful adaptation to be defined. On an individual level, this is usually considered to be independent living and normal social interaction, and therefore can include well-adjusted people with severe physical handicaps. On a population level, it may be considered as a result of the species' ability to reproduce with minimal environmental disturbance, an adjustment to environmental changes with little to no social disturbance. In relation to aircraft noise, those who adapt well would be considered healthy, while those who do not might be considered unhealthy.

The term "classified" approach is to consider that people are healthy until they are determined not to be so, and to use a range of comparative population measures of morbidity, mortality and impairment to determine the relative health of various groups. This approach has the advantage of using mortality is the most available data, but there is difficulty in defining "unhealthy" in the margin. For example, in mental health the definition and separation are indistinct between clinical anxiety and depression on the one hand, and anger, annoyance, irritation, sadness, and other mental and psychological constructs on the other. Furthermore, disagreement in the medical literature on the role played by stress
the sociology of illness indicates current uncertainty regarding plausible biological pathways for mental and emotional states to "determinants" or "predeterminants" physical health.

Research on the health effects of noise has several points of departure. In the less rigorous studies, exposed persons relate not only what they consider to be health concerns, but also attribute the cause to aircraft noise (for example, on complaint heliports etc.). On finer ground, health practitioners may put together a series of instances in which an adverse effect may plausibly be attributable to environmental noise on the basis of known pathophysiology. The best approach is apparently epidemiological or hypothesis-driven studies, which seek to identify possible adverse health outcomes in populations (or samples) by separately measuring noise exposure and possible health effects, and changes in these over time.

Possible health effects on individuals and populations exposed to noise of aircraft movements

For this review the term "transmission pathway" refers to the action of physical or psychological effects on the brain, through disease or injury, to a change in health status. The main transmission pathways proposed for physical health effects of noise are that they may be mediated by "stress" (including psychosocial), mental or physical, or perceived lack of control over the source of exposure. Furthermore, noise and stress effects have been found to interrelate, such as on noise-induced hearing loss, where noise exposure may also contribute to psychological effects, particularly in the presence of additional noise, or environmental factors (e.g., stress, which may then have a physical effect).

People living in close proximity to aircraft flights tend to be of lower socioeconomic status than those who are far, traverse the income gap and mental among populations with low socioeconomic status for long been known to be significantly higher than among populations of average or high socioeconomic status. As a major source of potential exposure, socioeconomic status is potentially difficult to control, especially in epidemiological studies. Complicating the picture is the possible influence of modifying factors, such as ownership of residence (and contact with property values), individual sensitivity to noise, and fear of an aircraft crash. Moreover, as a result of the large number of exposure and modifying factors, population exposure to noise of aircraft movements in the long term could well be a selected population.

There may be adverse health effects due to measures taken to reduce the exposure to noise in the domestic environment, such as modifications for physical and social activities. Sealing and closure of doors of the house associated with sound insulation may reduce ventilation and increase the speed of airborne infections, or encourage the proliferation of dust mites and thus increase the prevalence of asthma.

Finally, an important scenario to consider is that physical effects of noise may manifest in susceptible subgroups within populations through psychological-medical interaction or structural conditions and precipitation of complications for example, among survivors of illnesses in persons with heart disease, or severe psychiatric episodes in those with mental illness.

Methods and scope

This literature review includes international studies of the relationship between aircraft noise and indices of psychological and physical health. It concentrates on English-language publications, and focuses on studies that have examined the mediating role of environmental noise on health effects. Authors effects of noise have been well described, but are not considered of importance in relation to exposure to civil aircraft noise. Aspects of cognitive and task performance are not covered in detail. Death or injury to aircraft pilots in populated areas has not been reviewed here, nor are studies of possible associations between health and atmospheric pollution from aircraft emissions.

The literature on stress and health, especially concerning noise, vibration, and other environmental factors, is best approached in relation to the major models of stress-related research that focus on individual and individual factors, and their relevance to health effects of aircraft noise on health.

Studies were reviewed using standard techniques of data collection and interpretation. The results of the literature review and methods are presented in this paper, which are marked for inclusion in the review of about 5000 new publications and in the systematic review of the literature on noise of aircraft movements.

The review is based on a comprehensive search of relevant articles, primarily in the fields of psychology, epidemiology, and environmental science. Several major bibliographies were searched, including Medline and the Online Computer Library Center, as well as the Computer Library Center, and through web-based searches of bibliographies accompanying relevant journal articles. A considerable proportion of the literature reviewed is not listed on Medline. Many publications were identified through personal contacts and these were obtained from the organizations that produced the reports.

Stress, anxiety, and physical health

"Stress" has been suggested as the major mechanism through which noise may affect mental and physical health. Physiologically, stress mediates as a complex of autonomic and endocrine processes centered on the pineal-adrenocortical axis. Solvay endorsed the term to refer to the physiological reaction of the body to any environment that is perceived as a threat. Solvay and another stress response scenario called the "general adaptation syndrome." As an important contribution, this concept was made by Cannon in the 1920s in his book "The Emotions of Man."

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Stress can manifest itself as a prolonged or acute phenomenon.

The stress response has been found to be modified by innate or learned predispositions of the organism. For example, consistent cardiovascular findings have emerged pointing to a positive relationship between coronary heart disease and behavioral characteristics.

While hemodynamic reactivity is regarded as a marker for hypertension, at least one prospective study presents evidence that heightened hemodynamic reactivity at stress can precede future elevated blood pressure levels by a considerable period. Nevertheless, increased blood pressure liability as a result of long-term exposure to intermittent stressors has not been shown to be a cause of sustained hypertension.

The number of factors, both endogenous and exogenous, that can contribute to the development of stress-related cardiovascular disease is large. Some of these include age, sex, both hereditary and somatopic factors, psychological, social, and physical factors, health status, and recent dietary intakes of salt, potassium, caffeine, alcohol, and nicotine.

Cardiovascular abnormalities have resulted from variations permitted by the respondent to psychological stress. The results have not been uniform. Some studies have shown a relation between perceived stress and arterial and venous and carotid artery blood pressure. Pointing to evidence of an association between chronic psychological stress and coronary heart disease. However, contrary evidence comes from a study of 1,009 drivers in San Francisco whose self-reported stress was related to cardiovascular disease and muscular-skeletal ailments but inversely related to levels of hypertension.

Peaks of blood pressure are not always significant in predicting or hypertension in most 24-hour blood pressure records. Studies have not established that sustained hypertension in humans results from stress, regardless of differing response modes to stressors, and chronic sleep laboratory and population studies have failed to demonstrate bed activity or associated blood pressure effects induced by sleepers, including that induced by noise (see bibliography in Thompson).

The role of acute stress for distress from chronic stress in precipitating arrhythmias and stroke is convincing, and such effects have been described in case series and case-control studies that were a byproduct of other investigations.

Annoyance reactions to aircraft noise

Social surveys using annoyance have been carried out in England, France, Switzerland, Sweden, United States of America, West Germany, and Australia. Annoyance is recorded as a reaction to the perceived annoyance in terms of reported disturbance of specific activities including conversation, watching television, and sleeping. Subsequent surveys have also provided data on general annoyance, without direct reference to specific activities.

The predictive validity of annoyance metrics as a risk assessment was examined by Schultz when he emphasized the results of 11 international surveys between 1961 and 1974, six studies of aircraft noise, four of traffic noise, and one railroad survey. Schultz found a consistent relationship between non-male noise exposure (measured by Lpn, an average day-night sound level) and community annoyance, irrespective of its source. The dose-response relationship has been reproduced in more recent community surveys. Support for Schultz's synthesis has not been unanimous (for example, Griffith).

Other studies have shown that the association between noise exposure and annoyance varies according to source. While the level of background noise (for example, road traffic) may not influence reported annoyance from aircraft noise.

For their own 1985 population survey of residents around Sydney, Adelaide, Perth, and Brisbane airports, Heath and Betten proposed using a lower level of noise exposure to the community, no more benefit based on effectiveness, dissatisfaction, annoyance, and fear of an aircraft crash. Their maximum exposure was designated as the percentage 'screamed at', rather than the percentage 'highly annoyed'. The investigation found that at Australian noise exposure levels (ANF 724, 75 per cent of residents were never affected, 38 per cent were not significantly affected, and 27 per cent were at least moderately affected. Heath et al. found a significant relationship between exposure and annoyance when exposure was measured as the number of noise events above 70 dB(A) when these events occurred more than three times daily. The findings suggest that annoyance reactions may be more highly correlated with exposure when the noise is made with sound of moderate noise levels than of continuously averaged exposures.

It remains to be established if noise in an industrial path or annoyance evaluation levels are appropriate but controversial within health measures.

Despite the predictive value of noise measures using aggregated data, none metrics fail to provide individual responses to noise accurately, suggesting that noise is not the only factor involved in annoyance reactions. Functional theories affect perception and annoyance reactions to noise in community surveys.

Annoyance reactions are greater in people who indicate a fear of aircraft crashes, are concerned about the health effects of noise, or report interference with activities such as watching television, talking, or sleeping. Recorded aircraft noise, when it interfered with tasks requiring concentration (for instance, productivity of pilots or the scoring of test), was perceived to be more annoying and less pleasant than the same noise when these tasks were not being attempted. People who report that they are sensitive to noise, so called 'noise sensitive' people, are also more likely to indicate intense annoyance reactions.

Studies have been reported to show that 1. sociodemographic factors of age, sex, marital status...
and socioeconomic status have low correlation with individual reaction, and that socioeconomic status correlates more strongly with complaint behaviour. It is clear that environmental noise is perceived in different ways by different people, and that the individual's perception of the noise influences their reaction to it. The relationship between annoyance and health was examined in a residential survey of aircraft noise and mental health around London's Heathrow Airport. Findings revealed that the collective response of an individual's psychosocial and physical symptoms and the use of medications, which was independent of noise exposure level. The work of Waterman et al. concluded that the quality of the environment, noise exposure, and the social and psychological responses to noise exposure have an impact on the physical and mental health of individuals. The impact of noise on mental health is complex and multifactorial, involving psychological, social, and physical factors. The relationship between noise and mental health is best understood in the context of individual differences and the broader social and environmental factors that influence human behavior and experience.

Mental health

Psychiatric hospital admisions

In a study of people living in areas surrounding London's Heathrow Airport, noise exposure was found to have a significant effect on hospital admissions for psychiatric conditions. Increased noise exposure was associated with increased hospital admissions for psychiatric conditions. This finding suggests that noise exposure may have a negative impact on mental health and well-being. The study further indicated that the relationship between noise exposure and hospital admissions was stronger for individuals with pre-existing psychiatric conditions.

In conclusion, the findings of this study suggest that noise exposure has a significant impact on mental health and well-being. The relationship between noise exposure and psychiatric hospital admissions is complex and multifactorial, involving individual differences, social factors, and environmental conditions. Further research is needed to understand the mechanisms by which noise exposure influences mental health and to develop effective strategies for reducing the negative effects of noise on mental health.
strongly and negatively correlated with psychiatric hospital admissions, so that the proportion of immigrants in one hospital catchment area was significantly higher, and that the distribution of immigrants was skewed more toward the higher noise contours in that hospital's catchment area than in the catchment areas for the other two hospitals. According to Kryter, recent decreases in exposure levels of infants born in the region were caused by insufficient allowance made for immigrant status of the population for that particular hospital.

Among residents near Los Angeles International Airport, exposures to mental hospitals from a high-speed road was shown to be 28% per cent higher than in low-noiseose controls (significant at the 10 per cent level). Additional effects of traffic noise for different racial groups were made up 25 per cent of those from the inner exposure area, but only 2 per cent of those from the central exposure area were allowed for.

Prevalence of psychological or psychosomatic morbidity

If aircraft noise contributes to mental illness, it is probable that differences in psychological morbidity or psychiatric morbidity would be evident.

The community survey of 4000 people from four noise-exposed areas living near Heathrow Airport produced variable trends: significantly higher prevalence of recent onset of right thinking, depression, insomnia among women older and minor accidents including burns (untried and bird in its place) occurring in those from higher noise (based on average values of noise). No significant lower prevalence of chronic depression was noted in lower noise areas. However, psychiatric trends showed a significant regression association in relation to noise exposure consistent with a noise-psychiatric illness in noise-susceptible households. These findings failed to replicate results of the Great White and of the British Assault study of noise. The relationship of these symptoms with noise only in those respondents with high education should have a priori assessment and a priori assessment of psychological morbidity, as suggested by the 1983 "General Health Questionnaire." 22

In a postal follow-up survey of annoyance and noise sensitivity of a sub-sample of 377 residents of the same survey, expected measures of level of annoyance were more highly correlated in those sensitive to aircraft noise (2.8.3) than in those sensitive to road traffic or other noise (2.0.3). Sensitivity to noise was not a significant predictor of psychological morbidity. As suggested by the 1983 "General Health Questionnaire." 22

In the Netherlands, Telschid found significantly higher contact rates for psychological problems, "mental disorders" (consistent across degrees of severity), and some psychosomatic complaints (specifically colds and lower back pain) in the two subsets of four exposure zones around Schiphol airport (near Amsterdam). 24 However, some of the differences in contact rates could have been explained by differences in socioeconomic status between exposure zones rather than the exposure itself, since the former was not controlled for.

In 500 residents surveyed from five different noise zones (including a quiet control zone) around San Francisco Airport, significant correlations were found between noise awareness and annoyance and the number of health problems reported from a symptoms checklist. Most of an aircraft crash explained most of the variance in the quiet control zone, whereas in the exposed areas most of the variance was explained by noise awareness and annoyance. 25

Kryter reported on an ecological study of people living near airports in the Soviet Union which found a higher incidence of "vegetative disorders" among other conditions. 26

Studies of the effects of aircraft noise on mental health are summarized in Table 1.

Acute physiological effects

Hormonal and autonomic effects

Specific autonomic, hormonal, circulatory and respiratory changes occur in response to noise stimulation. The response is rapid and reactive, characterized by peripheral vasoconstriction, heart rate changes, and increased blood flow. Breathing changes in the respiratory cycle can cause skin response (EKG) and a change in skeletal muscle tension. Changes in gastrointestinal motility in relation to noise-exposure have also been reported. 27

Responses in continuous or regular noise from aircraft are expected to be cumulative. Some studies have shown a progressive temporal autonomic response to road traffic or aircraft noise. 28 Some have shown habituation to noise in the response and some not. 29 Others found no significant changes in long-term autonomic reactions. 30

Regarding physiological reactions to continuous or regular noise, Kryter concluded: Experimental evidence demonstrates that autonomic responses increase with noise exposure; the more recent findings of health problems are consistent. This is an important area which needs more research in the field of psychological and social effects. This conclusion is supported by Doetsch et al., who made particularly clear: The effects of sound on cardiovascular, cerebrovascular, and peripheral autonomic nervous systems are well known. The sound can be perceived by the individual as an annoyance. The intensity of annoyance increases with exposure levels. This is an important area which needs more research in the field of psychological and social effects.

Blood pressure

To date, investigations of the effects of noise on blood pressure and heart rate have not produced consistent findings. Although studies have shown increased diastolic blood pressure to be associated with exposure to various kinds of noise, the effect of noise on systolic blood pressure and pulse rate remains unknown. Separate studies have shown decreases in systolic blood pressure and heart rate and increases in diastolic blood pressure with exposure to different noise sources. 27,32 Other studies found significant decreases

Table 1: Selected studies examining the effects of aircraft noise on mental health

<table>
<thead>
<tr>
<th>Author(s) and Location</th>
<th>Effect of noise on health</th>
<th>Noise exposure</th>
<th>Study type</th>
<th>Confounding factors controlled for</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alley-Wilkenson et al. 22</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.04 NNI</td>
<td>Ecological</td>
<td>Age-standardized; rates specific for age category or control for socioeconomic status</td>
<td>Significantly higher risk of mental health problems in exposed population</td>
</tr>
<tr>
<td>Gertner and Tomoyoshi 22</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Ecological</td>
<td>Age-standardized; rates specific for age category or control for socioeconomic status</td>
<td>Positive result, not significant</td>
</tr>
<tr>
<td>Margaret and Smith 27</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Ecological</td>
<td>No adjustment for noise</td>
<td>2.4 increase in high-noise area (P &lt; 0.01)</td>
</tr>
<tr>
<td>Tomoyoshi et al. 26</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Cross-sectional population survey</td>
<td>Subgroup analysis, including by sex, education level</td>
<td>Association between exposure and psychiatric symptoms, no significant effect of noise in high-income group</td>
</tr>
<tr>
<td>Jenkins et al. 38</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Ecological</td>
<td>Age-standardized rates specific for sex and marital status</td>
<td>Significant negative result</td>
</tr>
<tr>
<td>Tomoyoshi et al. 38</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Cross-sectional population survey</td>
<td>Age- and sex-standardized, socioeconomic status controlled for</td>
<td>Noise exposure increases with noise above 60 dB, no obvious threshold</td>
</tr>
<tr>
<td>Jenkins et al. 35</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Ecological</td>
<td>Age-standardized rates specific for sex and marital status</td>
<td>Mixed result (1 hospital positive, 1 negative)</td>
</tr>
<tr>
<td>Winkler et al. 37</td>
<td>Use of medications and hospital services</td>
<td>&gt;0.05 NNI</td>
<td>Cross-sectional population survey</td>
<td>Age, sex, and socioeconomic status</td>
<td>Uptake of medications in high-noise areas no higher than in lower noise areas</td>
</tr>
<tr>
<td>Kryger 39</td>
<td>Admission to psychiatric hospital</td>
<td>&gt;0.05 NNI</td>
<td>Ecological</td>
<td>Migration status, socioeconomic status, age and sex</td>
<td>40% higher migration rates in groups exposed to higher levels of aircraft noise</td>
</tr>
<tr>
<td>Stenfeldt et al. 40</td>
<td>Annoyance or distress, and psychological morbidity</td>
<td>&gt;0.05 NNI</td>
<td>Longitudinal follow-up study</td>
<td>Socioeconomic status, age, and sex</td>
<td>Noise sensitivity not a predictor of psychological morbidity, noise annoyance in noise-sensitive subjects higher in groups with higher levels of cardiac risk</td>
</tr>
</tbody>
</table>

Notes: NNI = Noise Number Index. BMI = Body Mass Index. NNI = Noise Number Index. Gender-based geographic study.
in specific and increase in diastolic blood pressure, but increase in heart rate owing to noise.  

Noise has been observed to accompany exposure to noise.  

Lehman and Zayas found an increase in peripheral arterial resistance in response to noise, but not in heart rate or blood pressure, while Mämmu and Aro reported an increase in diastolic pressure but no clear response of systolic blood pressure to noise.  

Relating more directly to aircraft noise, McLean and Tanegashika reported on a thesis by Mostow which found significant elevation of diastolic blood pressure after laboratory exposure to aircraft noise.  

The magnitude of the response was dependent on the duration of the noise exposure. Blood pressure changes appear attributable to aircraft noise and have also been found in schoolchildren (see section on children, p. 591).  

Sleep studies  

The effects of noise on sleep have been sought variously by asking subjects to record the number of awakenings, or rate of the presence of excess sleep in morning brain activity and sleep quality during sleep using electroencephalogram (EEG) in monitoring levels of cerebral waveforms, or by measuring the amount of awakenings or sleep disturbances in an standardized assessment for measuring mild sleepiness. Sleep loss and deprivation has also been studied with in terms of autonomic, immunological and endocrine stress.  

The effects of noise on brain wave activity during sleep have been monitored extensively. Four stages of sleep are monitored by the EEG stages I to IV (sometimes called SWS or REM sleep) and rapid eye movement sleep (REM), during which dreaming occurs. The depth of sleep is said to increase in the sequential stages I to IV, after which there is a slight awakening to the REM stage. These are usually used to grade the type of sleep at night.  

A laboratory sleep study involved a group of six volunteers who were exposed to noise levels more akin to noise than to normal quiet. The noise was recorded at 50 dB and 70 dB, and the subjects were exposed to noise levels for 60 minutes. The subjects then exhibited a decrease in heart rate during non-sleeping hours. Another study by Villet et al. found no decrease in the rate of heart response to aircraft noise after several years in residents living near airports (Paris).  

An ergonomic field study of sleep quality of 400 subjects around eight airports in the United Kingdom (total 3742 nights of monitored sleep), found that differences in sleep disturbance did not vary greatly with different levels of exposure, although males were more likely to respond to aircraft noise than females.  

Results of field and laboratory studies of sleep disturbance from aircraft noise were compared by Moskalev (1989). Natural noise levels associated with aircraft noise exposure increased to 100 per
cent in laboratory subjects, compared with 89 per cent in field study subjects; subjective sleep quality was 25 per cent and 30 per cent less in laboratory and field study subjects respectively; and adrenaline secretion was higher by 50 per cent in laboratory subjects, but only by 20 per cent in the field study subjects (no indication of statistical significance available); all were compared with no exposure to aural aircraft noise. If similar studies can replicate these findings, the validity of extrapolating laboratory-based sleep effects without appropriate adjustment would be debatable, for it appears that the effects of noise exposure in the laboratory on sleep is greater than in the natural setting.

Sleep deprivation has been shown to affect the immune system in various laboratory and field settings, in both animal and human studies. Human immune system effects from sleep disturbance or mild sleep deprivation have not been established.

**Long-term effects on health**

The long-term effects of noise on health have been considered in occupational settings and residential communities. Noise has been suggested as the major mechanism by which noise affects physical and mental health, operating through physiological and behavioral channels and in response to the disruption of normal activities or emotional stimuli (distraction, facilitation) that the noise is known to be associated with. The proposed relationship between noise and health is complex, not fully understood, and is under debate.

**Cardiovascular disease effects**

In the 1980s, several independent experts were commissioned to review reports of studies investigating the relationship of noise to cardiovascular disease (CVD) in individuals. Many studies indicated a positive relationship between increased blood pressure and noise exposure. Most of the cross-sectional studies showed a positive association between noise and elevated blood pressure, with the prevalence of high blood pressure in the noise-exposed groups being between 1.5 and 2.8 times that of the unexposed groups. Problems identified in these studies included failure to measure individual noise exposure, lack of a standard blood pressure measurement technique, and failure to control for known confounders. The available evidence, while of poor quality, was considered sufficient to justify further research in this area.

During the 1980s, a series of community studies investigating the long-term effects of aircraft noise were carried out around Schiphol airport in Holland by Kiepkishoff et al. These studies examined various physical and physiological parameters in the relationship between noise exposure and cardiovascular disease in a community with noise exposure levels between 50 and 60 decibels. After allowing for smoking, age, sex, height, and weight differences between the different populations, Kiepkishoff found that the prevalence of hypertension and coronary artery disease was significantly higher in the exposed group. The study showed a clear dose-response relationship between noise exposure and cardiovascular disease, with an increase in blood pressure and a decrease in cardiovascular health in the exposed group.

**Prevalence of hypertension and pathological heart shape**

The prevalence of hypertension was found to be greater than in the exposed area. Cardiovascular impairment was found to be greater in the exposed area. Although there was adjustment for age, sex, smoking, height, and weight, these factors were not controlled, and the results were not statistically significant.

From a study of the effects of aircraft noise on the population, 90% of mental health professionals saw the population in some villages around Schiphol airport, Kiepkishoff noted that the presence of cardiovascular disease in the highest noise area was higher than in the lower noise areas. The study showed a clear dose-response relationship between noise exposure and cardiovascular disease, with an increase in blood pressure and a decrease in cardiovascular health in the exposed group.

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General health surveys

Kosnowsky et al. are reported to have found significantly more health complaints in women, but not men, living in a high-noise-exposure area.137 Gerdsma et al. are reported by Keyte to have found a significantly higher incidence of headaches and sleeping difficulties at noise exposure levels increased.138 Keyte attributes the increased consumption to "the interference effects of the noise with sleep and speech communication."139

Kraupholz's oral practice study provides an estimate of incidence rates over a one-month period. All the doctors (specifically the sole source of primary health care) in the four villages near the airport were surveyed.140 Significant higher attendance rates per 100 population for psychological problems, mental disorders, and some psychosomatic complaints (spontaneous and lower back pain) occurred in those exposed areas. The control group for other conditions, such as cardiovascular disease, allergic disorders, headache, and a control group, had similar results. The authors believe that it is the cause of cardiovascular problems. This would be the expected results in cardiovascular attendance rates between the exposure areas.

Kraupholz's graphic presentation of total contact rate, neural disorders, psychosomatic illnesses, and cardiovascular disease (restricted to persons age 13 and older) over the four exposure groups demonstrated an increased-rate effect although statistical significance was not given. There appeared to be a threshold for the general practice medical consultation rate. Kent, who analyzed the data of the NELA-II, found no significant differences in cardiovascular disease rates at the two areas. The author stated that areas were for age and sex, and the area was divided into two subareas and while there were minor differences in some areas, they were not significant in the analysis. It is improbable that these small differences can explain the big differences in contact rate.141 Adjustment for factors known to cause such conditions, such as smoking status, was not possible.

Kraupholz validated data from the same study presented in a later publication142 and showed significant dose-response effects across three noise-exposure categories for psychological problems, psychosomatic problems, and cardiovascular disease and hypertension. It is not clear whether these results were adjusted for age and sex, and it was stated that the overall study was not taken into account.

Kraupholz and Graber conducted a before-and-after aggregate study of drug purchases in two villages near Schiphol airport.143 One of the villages experienced increased exposure to aircraft noise, while noise exposure in the other (control) remained unchanged. Purchases of prescription drugs used to treat sleep disturbances, psychological and psychosomatic disorders, and cardiovascular and hypertensive disease were examined. The outcome measure, a drug index, was compared from the ratio of the number of drugs purchased in a given year over the adult population in that area for that year. Changes in aircraft noise exposure were monitored over the four years of the study. The drug index increased with the noise level in the exposed area, while remaining stable in the control area. During the study period, the area initially experiencing increased aircraft noise later had its exposure level lowered, and the drug index correspondingly declined. The authors did not attribute this finding to the exploratory nature of the study. Despite this, aggregate evidence of this kind where the outcome measure and the study factor vary together over time is more convincing than single associations.

Moller and Muller found an increased consumption of hypnotic drugs in relation to aircraft noise.144 This finding is in contrast to the results of the Heathrow community surveys, which found a significant negative relationship between hypnotic drug use and noise exposure.145

In response to the opening of the new parallel runway in 1984 at Schiphol airport, a general health study was conducted by Doctors Educating About Noise (DEAN) involving 471 of 1,356 doctors in affected areas in the first half of 1985.146 The study found that of 1,356 respondents, 83% were not affected, 16% were not aware of, and a similar proportion were "unspecific" effects, such as sleep disturbances, irritability, forgetfulness, and child behavior problems. Effects made up the remainder. Exposure information was not reported.

Mortality

Two studies of mortality rates around Los Angeles International Airport were conducted in the 1970s. Mollison et al. found an elevated risk associated with higher mortality rates in noise-exposed areas.147 Data from the study was subsequently reviewed by Petersen et al., which adjusted for age, sex, and area and added mortality rates in the two areas. The results were for men and women, who showed mortality rates to be no higher, suggesting that the difference found in Mollison et al.'s study was confounded by other determinants of mortality.148

A similar study of aircraft noise and mortality in Sydney was reported in 1979.149 The exposed population, consisting of residents of local government areas predominantly under the main airport flight paths, were compared to residents of all other local government areas within 10 kilometers of the airport as controls. A significantly higher number of deaths (age and sex-standardized) were reported for residents near the noise-exposed population. Subgroup analyses were performed for specific conditions (for example, cerebrovascular disease, myocardial infarction, and the same subgroups) and were not compared to the same age-sex and exposure areas.

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significant differences between the exposed population, Sydney as a whole, and the control region. These results should be interpreted cautiously, because, while some of the regions studied were demographically similar, the authors did not consider other important socioeconomic and ethnic factors associated with morbidity.

A subsequent ecological study of Sydney airport, Taylor and Lyle compared local government areas and precincts exposed to aircraft noise with unaffected areas with similar socioeconomic and demographic status within the Sydney Statistical Area. In this study, exposure to aircraft noise was defined as the proportion of the population of an area or precinct in the within the 20-km contour. Outcome measures for the period 1985 to 1988 included mortality (allcause and selected causes), hospital separations, and cancer incidence and mortality. Combining variables controlled for included age, sex and immigrant composition based on individual data, and socioeconomic status based on aggregate data for the area. They explored simultaneous correlations between morbidity and mortality rates and exposure to aircraft noise and found that higher rates of morbidity and mortality were associated with higher noise exposure.

Mavrakou and Miles reported a further ecological study of respiratory hospitalization rates for resident children aged 0-14 in the Metropolitan Statistical Area (MSA) of Sydney from 1984 to 1987. They identified 13 areas of the MSA and grouped them into three regions: inner city, suburban, and rural. The rate of respiratory hospitalization was calculated for each group and compared to the control group. The results showed that the rate of respiratory hospitalization was significantly higher in the inner city region compared to the control group. The authors concluded that exposure to aircraft noise may be a significant factor in the increased rate of respiratory hospitalization.

A national study of the effects of aircraft noise on the health of the population was conducted by the Australian Bureau of Statistics in 1995. The study found that exposure to aircraft noise was associated with a number of adverse health effects, including the risk of heart disease, asthma, and sleep disturbances.

Children

Col et al. studied the effects of aircraft noise on the health of children in London. They found that children living in areas with high levels of aircraft noise were more likely to experience sleep disturbances and respiratory problems.

Association of selected studies is shown in Table 2.
Table 2: Selected reviewed studies examining the effects of aircraft noise on cardiovascular disease and general health.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Location</th>
<th>Effect on health</th>
<th>Noise measure</th>
<th>Study type</th>
<th>Confounding factors adjusted for</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caesar et al.</td>
<td>San Francisco, CA, USA</td>
<td>Symptomatic check</td>
<td>0-30 NNL</td>
<td>Cross-sectional survey</td>
<td>Age, sex, income</td>
<td>No increase in symptoms, but increased prevalence of cardiovascular disease</td>
</tr>
<tr>
<td>Krepelka et al.</td>
<td>Schiphol, Amsterdam, NL</td>
<td>Presence of cardiovascular disease</td>
<td>20-30 NNL, &gt;37 NNL</td>
<td>Cross-sectional survey of individuals in 3 villages</td>
<td>Age, sex, obesity, smoking, socioeconomic status and diet</td>
<td>Significant increase in prevalence of cardiovascular disease and death</td>
</tr>
<tr>
<td>Krepelka et al.</td>
<td>Schiphol, Amsterdam, NL</td>
<td>Purchase of medications</td>
<td>20-30 NNL, &gt;33 NNL</td>
<td>Ecological</td>
<td>No adjustment</td>
<td>Significant increase in all disease-related deaths compared to vector control</td>
</tr>
<tr>
<td>Pentz et al.</td>
<td>Los Angeles, CA, USA</td>
<td>Death rate</td>
<td>40-50 ANL, &gt;50 ANL</td>
<td>Ecological</td>
<td>Age, sex, income</td>
<td>No increase in mortality, and death from lung disease</td>
</tr>
<tr>
<td>Taylor et al.</td>
<td>Sydney, Sydney, Australia</td>
<td>Mortality</td>
<td>Proportion within 20 ANL</td>
<td>Ecological</td>
<td>Age, sex, smoking, socioeconomic status and diet</td>
<td>No difference in mortality, and death from lung disease</td>
</tr>
</tbody>
</table>

Note: (a) NNL = noise exposure format; (b) NNL = noise number levels; (c) NNL = perceived noise levels; (d) Ecological = questionnaires; (e) ANL = Australian noise exposure levels.

Mathematical skills were found between exposed and unexposed schoolchildren.

Subsequent follow-up of the same schools a year later showed that differences in distractibility between exposed and unexposed children tended to converge with the time attending the school; helplessness measures (puzzlesolving) were unchanged. Both noise- and unexposed children gave up more easily than noise school children (no puzzlesolving) after initial failure; and there was a higher proportion of problem-solving in the unexposed classrooms. Longitudinally, these results remained unchanged, except that there was no longer evidence of children in unexposed classrooms solving puzzles more successfully than those in noisy classrooms.26

Krewer referred to a longitudinal study by Mager et al., of aptitude scores in students from schools exposed to aircraft noise and found that scores declined in the exposed group for low-aptitude students from grades 3 to 11.27 Krewer also reported results of an unpublished survey of school teachers.
which found that aircraft noise at levels of around 70 dB in the classrooms occasionally interfered with classroom activities. 1

In a study of blood pressure in children, Cohen et al. found mean systolic and diastolic blood pressures to be significantly higher in the noise-exposed schools; the magnitude of the difference was about 8 mm Hg. 16 These differences narrowed as years spent at the school increased. Reporting on the follow-up stage of the study, Cohen et al. found that mean blood pressure readings of exposed children in classrooms that were noise-abated were not significantly different from those in the unexposed classrooms at noisy schools. 22 No longitudinal effects, such as a widening of the difference in mean blood pressure between exposure groups, were found. This negative result may have been due to selection bias, because a disproportionate number of children from the noisiest schools who had chronic exposure blood pressure readings had left the intervening period. While comparison schools were similar socioeconomically, high-noise schools had 32% of African Americans, compared to lower-noise schools that had 18% of each African Americans.

Kaplan and Sandahl, 21 reported that in Cohen et al. found a positive correlation between noise levels in the classrooms from road traffic noise and systolic and diastolic blood pressure levels in children. 16 22

Two other studies examining the effects of domestic aircraft noise on hearing in children found no significant difference between the noise-exposed and quiet groups. 17 19

Table 1 shows a summary of studies examining the effects of aircraft noise on children and babies.

**Table 1: Reviewed studies examining the effects of aircraft noise on perinatal and child health**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Location</th>
<th>Effect on health</th>
<th>Noise measure</th>
<th>Study type</th>
<th>Confounding factors adjusted for</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novak and Mahon 20</td>
<td>Oslo, Norway</td>
<td>low birth weight</td>
<td>&lt;85 dB 60% of 80 dB</td>
<td>Ecological</td>
<td>No adjustment</td>
<td>Significant increase in proportion of babies with low birth weight in exposed areas</td>
</tr>
<tr>
<td>Jones and Kunzle 21</td>
<td>Los Angeles, US</td>
<td>Birth defect</td>
<td>90-120 dB</td>
<td>Ecological</td>
<td>Race only</td>
<td>Significant increase in black people</td>
</tr>
<tr>
<td>Edwards et al. 22</td>
<td>Detroit, US</td>
<td>Birth defect</td>
<td>65 1/2 100</td>
<td>Ecological and case-control</td>
<td>Hospital of birth, socioeconomic status, race</td>
<td>No significant result</td>
</tr>
<tr>
<td>Rebro and Jenson 23</td>
<td>Dundee, Germany</td>
<td>Prematurity with 2 noise levels</td>
<td>Infant not assessed</td>
<td>Cross-sectional</td>
<td>No adjustment</td>
<td>No significant result by either date</td>
</tr>
<tr>
<td>Shabtai 24</td>
<td>US</td>
<td>Birthweight, gestational age</td>
<td>099 60% of 99 60%</td>
<td>Cross-sectional</td>
<td>Socioeconomic status, parents' weight and height, smoking</td>
<td>Significant negative correlation of noise with gestation for female babies only</td>
</tr>
<tr>
<td>Cohen et al. 25</td>
<td>Los Angeles, US</td>
<td>Blood pressure</td>
<td>Quiet area, Air cond.: up to 69 60%</td>
<td>Cross-sectional</td>
<td>Control schools matched for socioeconomic status, but unexposed to noise</td>
<td>Mean diastolic and systolic pressure &gt;3 mm Hg higher (significant)</td>
</tr>
<tr>
<td>Cohen et al. 26</td>
<td>Los Angeles, US</td>
<td>Blood pressure</td>
<td>Quiet area, Air cond.: up to 99 60%</td>
<td>Cross-sectional</td>
<td>Control schools matched for socioeconomic status, but unexposed to noise</td>
<td>No significant result</td>
</tr>
</tbody>
</table>

Notes: Ecological = group-based geographic study. 60% = 60 day and night energy averaged noise level.

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and social disturbance. Social surveys in Australia and overseas, using grouped data built on environmental standards for land use around airports, have established a clear dose-response relationship. Annoyance responses have been correlated with measures of psychosocial functioning and other symptomology in some studies.

Several studies, including those by Terszeghzy et al. and Kervr, have shown a possible association between exposure to aircraft noise and the prevalence of psychological and psychiatric symptoms. Anxiety and depression are more prevalent in those exposed to aircraft noise, which would be classified as high, using both the positive and negative definition. Whether these symptoms are due to aircraft noise exposure per se is difficult to assess because most evidence is cross-sectional.

Studies of psychiatric reactions in relation to aircraft noise have been contradictory. While several early studies suggested an effect of aircraft noise on psychiatric conditions around Heathrow and Los Angeles International Airports, subsequent studies around Heathrow failed to replicate the findings. The early studies were methodologically insusceptible, while the later negative studies by Terszeghzy et al. considered the effects of various important confounding factors, as well as providing a more plausible evidence. Allowing for the natural language support against the original findings.

Although responses to unexpected noises cause physiological reactions in humans, the findings concerning chronic noise are unclear. It has been suggested that uncontrolled changes observed in association with exposure to noise are mediated through psychological mechanisms. Whether this is due to mechanisms associated with personality constructs such as hostility, or to some other uncontrolled variables is uncertain. While there is evidence that noise exposure may cause elevation in blood pressure, evidence for sustained elevation when exposure is removed is not strong.

Overall, the evidence is relatively consistent that aircraft noise is associated with sleep loss and minor increases in blood pressure, and preliminary dose-response relationships have been produced. While it is unclear how much sleep loss is required before it is considered a health effect, no studies have detailed the median effect on health of sleep loss (for example, in the form of cardiovascular effects) from aircraft noise. Intolerance with sleep, on the other hand, suggests positive mental wellbeing.

Thompson reported frequent associations between noise, mental health, and hypertension. However, the association is primarily cross-sectional in nature, and no clear relationship between noise exposure and hypertension has been confirmed by cohort studies. Although the number of these studies has been small. A cross-sectional association between aircraft noise and blood pressure of schoolchildren was found in one study. The significance of which is not clear. Cross-sectional association between aircraft noise and related terms of cardiovascular disease is not supported by available epidemiological data because studies with designs capable of testing the hypothesis are less referenced.

There is no convincing evidence to suggest that general population morbidity is increased by exposure to aircraft noise, as differences observed around airports appear to be related to other factors such as age, sex, distribution, socioeconomic status, and ethnicity.

General measures of community health such as attendance at general practitioners and prevalence of self-reported health problems have been assessed with exposure to aircraft noise. The associations are based primarily on ecological and cross-sectional data, and a clear relationship has not been sought in cohort studies. The potential of psychiatric and hypertension medications have been shown to be effective in reducing symptoms in aircraft noise-exposed populations.

Recent research has focused on the relationship of exposure to aircraft noise and physical health, using various types of studies that allow control of bias and confounding factors. In particular, it is exposure to noise on the property is less exposed to. The more severe noise exposure needs to be addressed, and treatment is often recommended. Noise exposure from other sources seems to have a significant impact on health, affecting the level of aircraft noise. Detailed medical, psychological, and social case studies would be of value in furthering knowledge on the relationship between aircraft noise and health outcomes.

Further research could focus on the relationship of exposure to aircraft noise and physical health, using relevant interventions that allow control of bias and confounding factors. In particular, it is exposure to noise on the property is less exposed to. The more severe noise exposure needs to be addressed, and treatment is often recommended. Noise exposure from other sources seems to have a significant impact on health, affecting the level of aircraft noise. Detailed medical, psychological, and social case studies would be of value in furthering knowledge on the relationship between aircraft noise and health outcomes.

While there is a lack of strong evidence supporting the hypothesis that aircraft noise causes long-term effects on health, not all the hypothesized health risks, such as mental health and peripheral outcomes, have been studied in detail. Other effects, because of the possibility of long latency between exposure and the manifestation of health effects, have been studied in detail. Other effects, because of the possibility of long latency between exposure and the manifestation of health effects, have been studied in detail.
of exposure.

It is always possible to exercise studies no matter how well designed these may be. In the case of aircraft noise and hearing loss, very few studies capable of providing high quality causal evidence have been conducted. Accordingly, despite the lack of strong evidence linking aircraft noise to ill health, it should always be borne in mind that little, weak or no evidence does not constitute evidence for little, weak or no effect.

References

EFFECTS OF AIRCRAFT NOISE


