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PROGRESS REPORT ON SYDNEY AIRPORT HEALTH STUDIES, PHASE 1

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1. INTRODUCTION

In November 1991 The Australian Government approved a proposal by the Federal Airports Corporation (FAC) to construct a new runway, additional to the existing North-South and East-West Runways at Sydney Airport. This runway (called the Third Runway) was to be parallel to and one kilometre east of the existing North-South Runway.

When giving approval, the Federal Government stated that the FAC should consider funding a "definitive" study of the effects of aircraft noise in Sydney on health and the Sydney Airport Health Study (SAHS) Committee, comprising staff members of the National Acoustic Laboratories (NAL) and the Departments of Psychology and Public Health at Sydney University, was formed to develop research proposals for the studies. A comprehensive series of studies [1] was reduced to three, to meet funding limits. The three studies were:

(i) A cohort study of adult mental health and reaction to aircraft noise;
(ii) A cohort study of effects on children's blood pressure (BP);
(iii) An evaluation of Air Services Australia's (ASA) Noise and Flight Path Monitoring System (NFPMS). If found to be accurate, the NFPMS was to be used to estimate the aircraft noise exposure at each dwelling and school of the subjects of the mental health and blood pressure studies.

The three studies were designed to investigate the effects of change of noise environment on individuals, by comparing noise and health changes in areas of Sydney in which aircraft noise exposure was (a) high before and after opening of the parallel runway; or (b) low before and after opening; or (c) low before, but high after (change up); or (d) high before, but low after, opening the parallel runway (change down).

The FAC later agreed to fund a further study by Sydney University, on the process of community reaction to change in noise exposure. NAL was also funded to carry out additional noise measurements and to develop means for calculating noise contours independently of Air Services Australia's Noiseload program.

This paper summarises progress on Phase I of these studies to April 1996. Those results which are available at this point are only preliminary and do not justify any conclusions as yet.

Any opinions expressed in this paper are not necessarily those of the Federal Airports Corporation (the funding body).

2. NOISE MEASUREMENT AND ASSESSMENT

Background

Air Services Australia (ASA) monitors aircraft noise levels around Sydney Airport using their Noise and Flight Path Monitoring System (NFPMS). This system originally had eight noise monitoring terminals (NMTs) under the flight paths, two for each runway approach. With the introduction of the parallel runway, four more NMTs were commissioned. Noise level data from these NMTs are processed by a central computer and stored along with data on aircraft type. Flight track and altitude data on individual aircraft obtained from primary radar, and aircraft identification derived from secondary radar, are also stored and checked against 'Avcharge' data on take-off and landing times.

ASA also uses the (U.S.) Federal Aviation Authority's (FAA) Integrated Noise Model (INM) software to calculate noise contours. INM has its own database on noise of a number of aircraft types, obtained at certification. Numbers of aircraft of each type, their flight tracks and the time period are entered.The appropriate night weighting is also selected, to produce Australian Noise Exposure Forecast (ANEF) contours, which are Noise Exposure Forecast (NEF) contours with a modified evening/night weighting.

In addition, ASA has commissioned a new program, 'Noiseload', intended to directly access empirical aircraft noise certification data and flight track data from NFPMS. It is much faster than INM, and could enable quick estimation of noise environments from radar-derived flight tracks. The data from the NMTs can be used to check and, if necessary, correct the noise database in Noiseload.

The aims of Phase I of the Noise Study were to check and, if required, correct the ASA systems, and then use these systems to calculate noise exposures for subjects in the blood pressure and mental health studies.

NAL Evaluation of ASA Systems

Evaluation of ASA Noise Monitoring Terminals (NMTs). Noise measurements were taken at all NMT locations and checked against ASA NMT records. In general, NMT levels were reasonably accurate.

Assessment of ASA NFPMS Flight Path Data. Several months of flight path data in the critical period were found to be missing or incomplete.

ASA Noiseload Software. Several problems with Noiseload were identified. This, along with some missing flight tracks, meant that Noiseload could not be used to derive noise exposures for the health studies. (ASA has since rectified most of the these problems, but could not apply these solutions to past data).

NAL Aircraft Noise Data

Because of difficulties with Noiseload and its database, alternative means were used to calculate noise exposures. Extensive noise measurements were taken under and alongside the East-West Runway as well as the original North-South Runway. For every noise measurement taken, the NFPMS was interrogated for the corresponding flight track to obtain aircraft ID and aircraft height and slant distance. These data have been used to establish relationships between the noise levels of the principal aircraft types and slant distances to residences.

New NAL Programs

Effective Perceived Noise Level (EPNL) Calculations. A software program was developed by NAL to enable the calculation of EPNLs and Sound Exposure Levels (SELs) from tape-recordings and third octave measurements of aircraft flyovers. These EPNLs were compared with the EPNLs for a number of aircraft types in the Integrated Noise Model (INM) database. The EPNLs were also used to calculate noise exposures independent of INM and other ASA systems.

SANEI Program And Comparisons With INM And Noiseload. The SANEI (Sydney Airport Noise Exposure Index) program was developed by NAL to calculate noise exposures for the major aircraft types, based on actual noise measurements of aircraft in and out of Sydney Airport. This was done by first establishing the relationship between EPNL and SEL for aircraft arriving and departing from Sydney Airport. This enabled the simpler measurement (SEL) to be used in calculating noise contours. A data bank of SEL v. distance for each aircraft type was then built up which gave relationships between aircraft noise levels and distance for use in the SANEI program.

The output of the SANEI program was compared with that of INM for selected data. Although there were some differences, sufficient agreement was found to justify the use of INM, which was preferred to SANEI because INM is easier to use when aircraft flight tracks are complex and a number of sets of contours are required. INM was used to calculate noise contours for each month for the period August 1994 to

May 1995 (the period of Phase I of the Adult Mental Health and Children's Blood Pressure studies). A geocoding program has been purchased, which, when combined with a Sydney Area geographic database, will enable the calculation of ANEIs for every dwelling and school involved in the Adult Noise Reaction and Mental Health, and Children's Blood Pressure studies.

3. NOISE REACTION AND MENTAL HEALTH STUDY

Methods

Study Plan. Mental health and reaction to the aircraft noise were to be assessed by means of a questionnaire, administered in an interview to 250 subjects in each area, prior to (Phase I), and also (to the same people) two years after Third Runway opening (Phase II). (A survey 6 months after runway opening was not proceeded with for budgetary reasons).

The Phase I Survey. The sample frame was based on Census Collection Districts (CDs) in each of the four study areas (200-300 households). Starting points and rules for household selection were provided by the Australian Bureau of Statistics (ABS), to ensure a random selection of households within the CDs. Interviews were carried out in the evenings and at weekends. Subjects were over 18, selected within the household on the basis of the most recent birthday.

One thousand and twelve successful interviews were completed prior to opening of the Third Runway on 5 November 1994. Some analyses have been completed of the relations of noise reaction to anticipated noise changes and of reliability of reaction [2] and of modifier variables [3]. These are reported elsewhere in these Proceedings. Further cross-sectional relationships with noise exposure will be explored when noise exposure data are available for each dwelling (see below). The longitudinal effects of changed aircraft noise conditions, associated with opening of the Third Runway, will be examined after Phase II of the study is completed.

4. COMMUNITY REACTION STUDY

Aims

The primary aim of this study is to assess the degree of reaction to aircraft noise associated with change in aircraft noise exposure, and the reasons for differences between this reaction and reaction to unchanged levels.

Procedure

A new sample of two hundred subjects, 50 from each of the four study areas, was interviewed soon after opening of the Third Runway, using the same questionnaire as the Noise Reaction and Mental Health Study.

It is planned to compare reaction, attitude to government and airlines, noise sensitivity, and mental health in this sample with subjects interviewed before runway opening, to assess possible acute effects. This sample will also be re-interviewed in several months and analysed for within subject comparisons.

5. CHILDREN'S BLOOD PRESSURE STUDY

Background

This study sought to replicate a previous study near Los Angeles which found that average blood pressures (BP) of children from areas impacted by aircraft noise were higher than that of children from low-noise areas [4]. The present study also sought to determine whether changes in noise exposure were associated with changes in children's blood pressure, and whether these were more or less than might be expected on the basis of the 'new' noise exposure, had that level been maintained for some time. Small, persistent increases in children's blood pressure may be significant because the likelihood of harmful long term effects on the cardiovascular system is presumed to be greater, the lower the age of the subject at onset of the BP increase.

Study Plan. Blood pressure, and certain confounding and modifying variables, are to be measured in children in each of the noise 'areas' in Year 3 (Phase I), and repeated in the same children when they reach Year 6 (Phase II of the study).

Procedure (Phase I)

Sampling. All schools in each of the 4 exposure zones described above were listed, and an equal probability cluster sample was constructed within each of the exposure categories. One thousand two hundred and thirty children from 75 schools were tested.

Physical Measurements

Each child's weight, height, and waist measurement were taken, subscapular, bicep and tricep skinfolds were measured, and blood pressures recorded. Room temperature at the time of blood pressure testing was also recorded. All measurements were made at school.

Parental Questionnaire. Parents and children were surveyed using a self-administered questionnaire sent home from the schools. The questionnaire concerned family history of hypertension/cardiovascular disease, diet, country of birth, type and structure of domestic accommodation, activity levels of the child, and the child's birthweight.

Data Collection

Measurements were carried out on small groups of children to minimise disruption to classes. Data collection began on 3 November 1994 and concluded on 5 June 1995.

Preliminary Data Analysis

Full statistical analyses of the relations between noise exposure and blood pressure adjusted for the influence of significant confounders and effect modifiers will not be possible until estimates of individual noise exposures (see Section 2) are available. Results reported here are therefore limited to simple unadjusted descriptive statistics on several of the subject variables, corresponding to the four original nominal exposure transition zone categories (Section 1). These are coded D (expected decrease in noise exposure after the opening of the third runway); H (remain high); I (increase); and L (remain low).

Descriptive Statistics of Some Subject Variables

Gender. The 1232 children included 612 girls and 620 boys. Numbers of boys and girls in each of the nominal exposure zones were 148/145 (Zone D); 67/64 (Zone H); 113/122 (Zone I); and 292/281 (Zone L).

Age. Mean ages for zones were 8.97 (D); 8.99 (H); 8.96 (I); 9.27 (L).

Non English-Speaking Background. Overall, 333 of the 1232 children came from non English-speaking backgrounds. The breakdown of non English-speaking backgrounds (NESB)/English-speaking (ES) background by exposure zone was: 82/211 (D); 40/91 (H); 38/197 (I); 173/400 (L).

Descriptive Statistics of Blood Pressure

Mean Blood Pressures for Entire Sample. Mean systolic blood pressure (N = 1232) was 111. 48 mm Hg (SD = 9.79). Mean diastolic blood pressure (N = 1232) was 59.47 mm Hg (SD = 8.53). Mean blood pressures for boys and girls were almost identical.

Blood Pressures by Nominal Exposure Zone. Mean Systolic blood pressures were 112.04 (Zone D); 112.70 (Zone H); 112.53 (Zone I); and 110.48 (L). Mean diastolic blood pressures were 60.1 (Zone D); 59.99 (Zone H); 60.88 (Zone I); and 58.45 (L).

Blood Pressures by ESB/NESB. Mean systolic blood pressure was 110.86 for ESB children and 113.15 mm Hg for NESB children. Mean diastolic BP was 59.08 for ESB and 60.51 mm Hg for NESB children.

No conclusions can yet be drawn from these results. Analysis is continuing.

References

[1] Sydney Airport Health Study Committee (N.L.Carter, Chairman), 'Proposal For Studies Of The Effects Of Aircraft Noise From Sydney (Kingsford Smith) Airport On Health.' (Sydney, National Acoustic Laboratories, 1993).

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[4] S.Cohen, G.W.Evans, D.S.Krantz and D.Stokols, Amer. Psychol., 35, 231 (1980).