

The effect of noise from overflying aircraft on a young adult population

Frits van den Berg

Imke van Moorselaar

Claudia Verhagen

GGD Amsterdam Public Health Service, Amsterdam, the Netherlands.

Summary

A student housing complex is situated close to the international Schiphol Amsterdam Airport, under one of the aircraft routes to the airport. Several apartment blocks complex were built in the late '60s. Since then the number of aircraft has risen substantially, at the time of the survey (2013) resulting in a noise level of 60 dB Lden and 49 dB Lnight. The apartments were soundproofed in 2010/11.

A survey was held to investigate the self-reported health of the residents and their satisfaction with the indoor and outdoor environment. The results could be compared to an earlier health survey that included adults from municipalities in a wider area around the complex.

Most residents (96%) were 19 to 26 years old. The results show that 35% of them reported serious annoyance from aircraft noise. This is significantly less than expected for an average adult population (46%). Serious sleep disturbance due to aircraft noise was reported by 15%, where 17% was expected for the general adult population in the region. Noise annoyance was not correlated to the time of residence or the wish to move. Nine out of ten residents were satisfied with the house and the residential environment, which was comparable to young and older adults in the wider area.

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1. Introduction

Two factors influenced recent building activities in the Amsterdam region. One was the slowing down of all building activities, the other the increase in vacancies in commercial real estate, both in the wake of the 2007-08 global financial crisis. In the same time the population in the working area of the Amsterdam Public Health Service (Dutch acronym: GGD) increased with 8%, but the age group of young adults (20-29 years) increased with 17%. In recent years this combination of factors has lead to a surge in building activities for young people (students and starters), including the transformation of vacant offices into dwellings.

One of the possible transformation projects was near an existing student housing complex. Offices there had been vacant for some time and other uses were considered such as an expansion of the student housing complex or hotels.

From available knowledge there is reason to believe that a student population differs from the general population with respect to the effects of noise exposure. According to Miedema and Vos people aged 20-29 report less annoyance from transportation sources than those in age groups 30-39, 40-49 and 50-59 [1]. The difference is equivalent to approximately 1 dB DNL. On the other hand, noise can have cognitive effects impairing the intellectual effort of students. This had been shown for the effect of aircraft noise on children's' learning [2]. Aircraft noise can also lead to sleep disturbance which in turn can lead to tiredness or sleepiness in daytime.

Before plans were developed further, the municipality wanted to know how the presence of the air route impacted on the living environment and health of students living in the existing housing complex. The GGD Amsterdam investigated this with the help of a survey.

2. Situation

The housing complex consists of 15 residential buildings, housing a total of about 3000 students in one-room and (10%) two-room apartments. Some have shared kitchen/dining rooms. Two buildings are newly built (2012). The other buildings date from the late '60s, but have been acoustically isolated for aircraft noise in recent years (2010-2011) to reduce indoor L_{night} to 26 dB(A).

According to the complex owner, students stay in the housing complex on average for a period of 2.5 years. Renting contracts have a maximum of 4.5 years. Young adults in the Netherlands move easily. In 2008 about half of all adults up to 30 years think they will move in the near future and more than half had indeed moved within the two preceding years [3].

Results from the Health Survey carried out every four years show that the airport and associated air routes are a major noise source in the municipality and the surrounding area. The housing complex is below one of the main air routes to Schiphol Amsterdam Airport and thus exposed to noise from overflying aircraft. The outdoor noise limits at this location are 60.5 dB L_{den} and 51.7 dB L_{night} . According to dose-response relations determined from surveys in a wide area around this airport [4], at these noise levels 48.9% of the exposed will be highly annoyed and 22.5% highly sleep disturbed. With the current regulations new residential addresses are not allowed.

3. Aim of study

The study addresses two questions:

- to what extent do residents of the student housing complex report (serious) annoyance and sleep disturbance?
- are residents of the student housing complex less sensitive to annoyance and sleep disturbance from aircraft noise when compared with the general population?

4. Methods

4.1. Questionnaire

The survey was presented as a study of the perception of the residential environment. The purpose was to gauge the effects of aircraft noise in the context of the perception of the total residential environment including home.

Relevant questions of the Health Survey were copied into the study survey so answers could be compared. These included questions on gender, year of birth, perceived health, satisfaction with the house and dwelling environment (11-point scale) and neighbourhood amenities. The question about noise annoyance was the 11-point ISO-question on noise with a number of sources (city traffic, highway traffic, trains, trams/metro, aircraft, airport, neighbours, mopeds/scooters) and a question on sleep disturbance from the same noise sources in the same format as the annoyance question. There was also a question on odour annoyance from road traffic, aircraft and fireplaces, and a question on being worried about one's health or safety in a number of situations, both with an 11-point scale.

Other questions were added for the specific purpose of this study. One was about disturbed from aircraft noise (during a conversation, when concentrating, when resting or sleeping, each on a 4-point scale) taken from early surveys on specific annoyance since the '60s. Finally there was a question about the time of residence and plans to move.

Results were available from the 2010 general Health Survey for the population aged 19-64 (for information on this survey, see [5]). A new analysis gave the results for those aged 19-26, corresponding to the age of the student housing population. This survey was carried out in five municipalities directly south of Amsterdam. the Health Survey results were weighted to represent both age groups (19-26 and 19-64) in the entire Health Survey area.

4.2. Study group

The study group consisted of all residents of the student housing complex. The online survey was announced by e-mail to all those known to the owner as having an e-mail address and speaking

Dutch. To increase response, gift certificates would be allotted to those completing the online survey (for which they had to give a name and address, that were not used for other purposes).

5. Results

5.1. Respondents

Of the study population, 897 men and 1141 women had a valid e-mail address and were registered as Dutch speaking. The valid response rate was 26% (523 respondents), which is low but common for surveys in Amsterdam. Respondents were more often female (67%) than the study group (56%). The average year of birth was 1990 and almost all (96%) were borne in the period 1987-1994. The median time of residence was 1.3 year. If average time of residence is 2.5 years and there is no preferred time of the year that residents move in or out, then the average time of residence at a random point in time would be 1.25 year. Thus, with respect to time of residence respondents are representative.

In the sections below, study results will be compared to the general Health Survey results from 2010. The study results apply to the respondents, the Health Survey results are weighted to represent the age groups in the survey area.

5.2. Residential satisfaction

Satisfaction with the dwelling and the residential environment was gauged with an 11-point scale. If we take the percentage satisfied as the percentage of residents scoring 6 or more, then 90% of all respondents of the student housing complex were satisfied with their dwelling, which is comparable to the percentage amongst the same age group (91%) or all adults from 19-64 years (94%) in the Health Survey. The same is true for satisfaction with the living environment, with 88%, 90% and 90%, respectively.

5.3. Noise annoyance and sleep disturbance

In figure 1 the percentages of those highly annoyed (HA) or highly sleep disturbed (HSD) are plotted for various sound sources and three groups: respondents from the student housing complex and young adults and all adults from the regional Health Survey. The figure shows that respondents are most annoyed from aircraft sound, but they are also highly annoyed by their neighbours in the housing complex (both 20% HA and 20% HSD).

Of course the location of the respondents is selected and hence their sound exposure depends on the location. Young and older adults from the

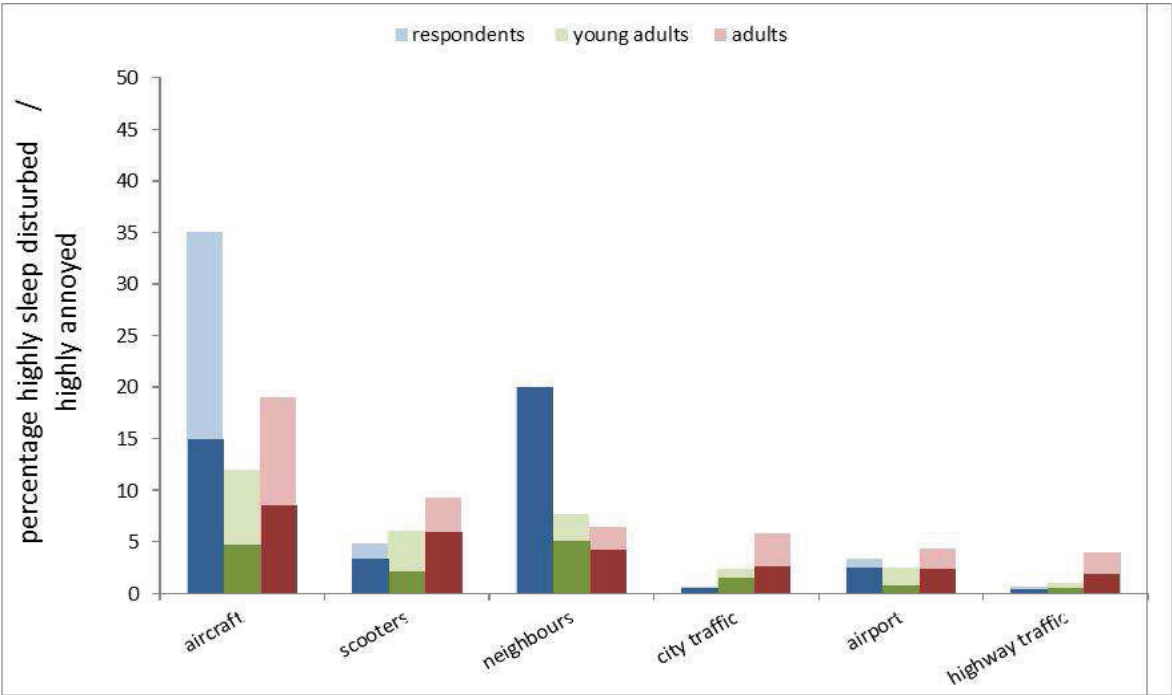


Figure 1. Percentages of respondents and of young (19-26 years) and all (19-64) adults in Health Survey that are highly annoyed (light colours) or highly sleep disturbed (dark colours)

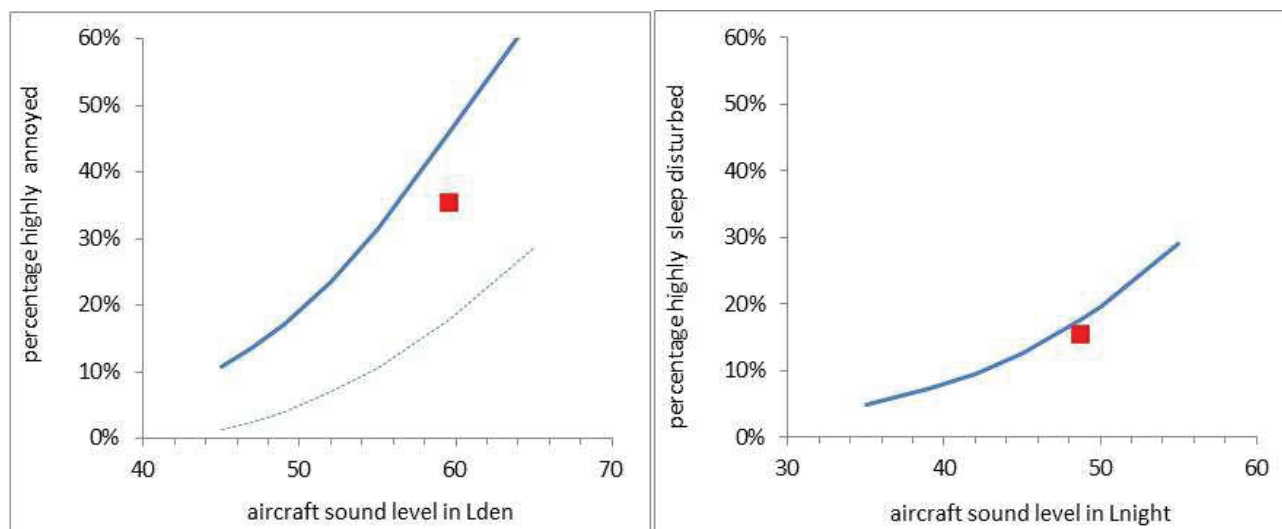


Figure 2. Percentages of respondents (■) that are highly annoyed (left) or highly sleep disturbed (right) and dose-response relations for the regional general population (thick lines) and Miedema (thin line)

Health Survey are more likely to be randomly located in the region and hence to be exposed to similar noise levels. Figure 1 shows that annoyance and sleep disturbance levels are consistently lower for young adults, with the exception of neighbours. The ratio of %HA for younger and all adults is on average 0.5 (0.3 – 0.8), but 1.2 for neighbour noise. The same is true for %HSD. This indicates that young adults may be less sensitive to environmental sounds. The relatively high percentages associated with neighbours is likely to be associated with the building characteristics and/or lifestyle, not with outdoor (environmental) exposure.

In figure 2 the percentages HA and HSD found in the student housing complexes (red squares) are compared to percentages expected for the region. In the early 2000's in a large survey around the airport dose-response relations for annoyance and sleep disturbance from aircraft sound in the general population [4] have been determined as shown by the blue lines in figure 2. Also in the left panel of figure 2 the 'Miedema-curve' for annoyance from aircraft sound is plotted, which is the dose-response relation found from data spanning the years 1967-1993 [6]. It has been shown that around a number of major airports, including Schiphol Amsterdam Airport, in later years up to 2005 annoyance percentages had increased [7]. The thick blue line in figure 2 is what was found to be valid for Schiphol Amsterdam Airport [4]. Amongst respondents in our study the %HA is significantly lower than in

the general population at the same level of exposure in L_{den} . The %HSD amongst respondents and the general population do not differ significantly at the same level of exposure L_{night} . There was no significant difference in aircraft noise annoyance according to building type. This agrees with the fact that acoustic isolation for aircraft noise is the same for all dwellings, as all have been isolated to the same indoor level from aircraft noise.

5.4. Specific annoyance

Three questions were included in the survey to gauge specific annoyance from aircraft noise: do you feel disturbed when a) ...having a conversation; b) ... being concentrated; c) ... resting or sleeping. These items were also used in the 1960's to study annoyance from aircraft close to Schiphol Amsterdam airport. The response was in four categories: never, occasionally, sometimes, often. Figure 3 shows the response to these questions as percentages of all respondents (thus the four light grey columns in each panel give a total of 100%). Also shown (dark grey in figure 3) are the percentages of respondents who responded as highly annoyed in the general noise annoyance question (section 5.3). The four dark portions of the columns add up to the aircraft noise annoyance percentage in figure 1. For the item on resting or sleeping the response to the general sleep disturbance question is given. There is a high correlation between general and specific annoyance.

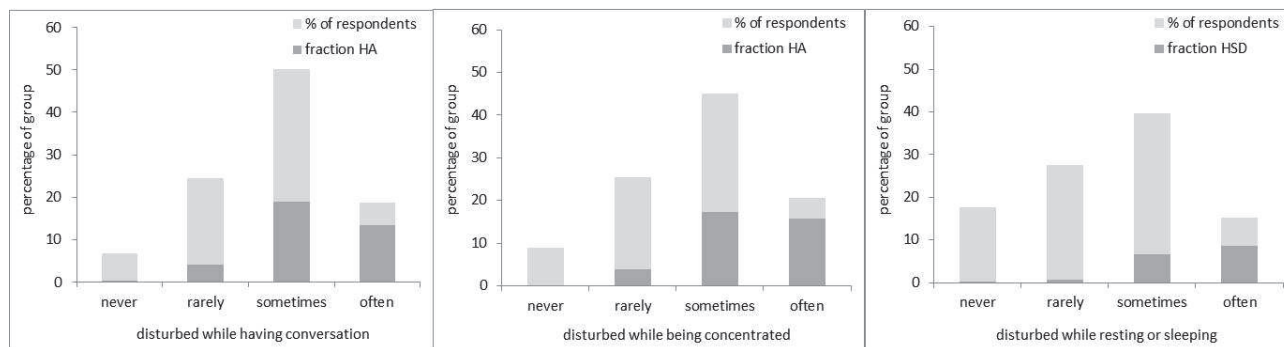


Figure 3. Percentages of respondents that are disturbed in 3 situations; dark part columns: part of these percentages where respondents indicated to be highly annoyed (left and middle)) or highly sleep disturbed (right) in general.

5.5. Motives to move

About one in three respondents would like to move: 19% certainly wanted to move, 16% would like to/could not find a place. Over half of the respondents had no plans to move within one year: 24% absolutely not, 33% possibly/perhaps). Others (7%) had found another place or had no opinion on moving.

Respondents wishing to move could tick several answers: 1) health or care needed; 2) study or end of study; 3) work; 4) dissatisfied with residence; 5) dissatisfied with residential environment; 6) other, viz.

The most important reason to (want to) move was study or end of study (42%). Dissatisfaction with the residence (14%) or with the residential environment (11%) were the other most prevalent motives. 'Other' motives were mentioned as: need for other space/live in more central area (10%), demolition or renovation of residence (7%), not living together anymore (6%) and neighbour disturbance/cheerlessness (4%). Only two respondents (0.4%) mentioned aircraft as a reason to move. However, aircraft noise could be one aspect for those dissatisfied with the residential environment (11%).

5.6. Age dependent mobility

Young adults are more inclined to move than older adults. There is a marked difference in mobility when comparing those above and below approximately 30 years of age [3]. In the Netherlands about half of all adults up to 30 years are willing to move (49%) or have actually moved in the preceding two years (56%). For other adults up to 55 years 25% want to move, but 18% have

actually done so. The percentages are less with increasing age up to 75+.

A similar trend is present in Amsterdam [6]. About 40% of adults up to 35 years wants to move, compared to about 25% of older adults up to 55 and less for adults above 55. Noise is not a dominant reason to move. For adults up to 25 years about 5% would like to move because of "noise, odour, congestion, pollution", which is a reason to move for over 15% of older adults. Other aspects of the residential environment are also less important for young adults: a low residential quality or neighbour disturbance is less reason to move when compared to older adults. The change occurs at about 25 years of age: those aged 25-44 think residential quality is the most important reason to move. For this age group a small residence and the absence of a garden or balcony are also more important reasons to move then they are for those aged under 25 or over 45.

6. Conclusions

Young adults appear to be less sensitive to noise then older adults, as has been shown earlier (Miedema and Vos, 1999). Young adults also appear to be less sensitive to other residential qualities than older adults are. At the same sound level, residents in a student housing complex report significantly less aircraft noise annoyance then the general population in the same region.

A relevant factor may be the high mobility amongst young adults: they are more inclined to move and actually do move more often then older adults do. Psychologically this may play an important role in coping with noise: if noise causes too much disturbance, young people are more inclined, or have more possibilities, to move away from the noise.

Acknowledgement

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