Quality of Life
Health
Development

NORAH Knowledge No. 6

NORAH Noise Impact Study

Study on Health Risks

Tasks and Method

forum flughafen & region
umwelt- und nachbarschaftshaus

NORAH

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Tasks and Method

"NORAH Knowledge" provides information on the methods and results of the NORAH noise impact study. The aim of this series is to communicate to as many people as possible what exactly NORAH researched. This is why there is an explanation in the glossary at the end for all terms marked "▯ glossary".

If you would like to receive further issues of "NORAH Knowledge", please use the enclosed order form.

The NORAH Study investigated the effects of aircraft, road and rail traffic noise on humans.

von Aichberger

NORAH ("Noise-Related Annoyance, Cognition, and Health") is the most extensive investigation into the effects of exposure to aircraft, road and rail traffic noise that has ever been carried out in Germany. It was conducted by nine independent scientific institutes from all over Germany. The client was the Umwelt- und Nachbarschaftshaus, a subsidiary of the state of Hessen and part of the "Forum Flughafen und Region". Alongside the state of Hessen, communities, Fraport AG and Lufthansa were also involved in the financing.

Contents

The NORAH Study examines the long-term effects of traffic noise on health, quality of life and early childhood development in the Rhine-Main Region. The initiator of the study is the Airport and Region Forum (ARF). The scientists were accompanied from the start by an external Scientific Advisory Board for Quality Assurance (WBQ). This is what distinguishes NORAH from similar, predecessor studies. The study addresses some of the most topical issues currently being dealt with by international noise impact research. It also covers a wider range of investigation aspects than previous studies. In order to find out more about how human beings respond to traffic noise, the NORAH scientists also looked at the medical histories of more than one million people, and reconstructed the noise exposure at around 900,000 addresses in the Rhine-Main Region.

A total of five sub-studies form the core of the NORAH Study. Each one builds on the current international state of research. In this edition of "NORAH Knowledge" we present the tasks and methods of the Study on Health Risks, one of the five sub-studies.

Further information on the NORAH Study is available on the Internet at **www.laermstudie.de**. There you can also subscribe to the newsletter "NORAH Brief".

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HEALTH RISKS IN THE RHINE-MAIN REGION

None of the NORAH sub-studies evaluated data from more people than the Study on Health Risks: medical information from around a million health-insured persons in the Rhine-Main Region was used for the investigations. For a selection of the persons surveyed, the NORAH team calculated the noise exposure long into the past. The scientists are going to great lengths in an attempt to close the gaps in our knowledge which previous traffic noise studies leave open: they would like to find out to what extent traffic noise increases the risk of suffering from a cardiovascular disease, breast cancer or depression.

How much noise has which effect?

With its investigations, the NORAH team wants to determine as precisely as possible the exposure-effect relationships (glossary) for all of the disease profiles examined. This means that the scientists want to quantify which traffic noise exposure increases the health risk and by how much. In order to identify these links, the scientists investigated a very large area. Only by including regions heavily and less heavily exposed to noise is it possible to answer the research questions. For their project, the NORAH scientists are evaluating the data from around one quarter of the population in the 9,000-square kilometre investigation area in the Rhine-Main Region. Three major health insurers provided the researchers with the necessary data of their policy holders for this purpose – without, of course, revealing names, addresses or other identifying details. The NORAH acoustics team had already calculated the individual noise exposure for all residential addresses in the investigation area.

In addition to this, a more detailed survey was carried out on several thousand health-insured persons to find out which factors for an increased risk of cardiovascular disease they are subject to alongside traffic noise. In this way, the NORAH scientists want to determine more precisely the influence of traffic noise.

The research team

The director of the Study on Health Risks is Prof. Dr med. Andreas Seidler, Director of the Institute and Policlinic of Occupational and Social Medicine at the Technical University of Dresden. The surveys were carried out on-site by project workers from the University of Gießen.

In this edition of "NORAH Knowledge", we explain how the Study on Health Risks is structured, which questions the scientists are trying to answer, and which methods they are using.

Prof. Dr Andreas Seidler from the Technical University of Dresden (Institute and Polyclinic for Labour and Social Medicine) is director of the Study on Health Risks. He is also the overall coordinator of all health-related studies within the framework of NORAH.

Stephan Wiegand

BACKGROUND: CASE-CONTROL STUDY

The Study on Health Risks is what is known as a secondary data-based case-control study with in-depth survey. What does this mean?

Secondary data

This means that the study uses data that somebody else collected for a different purpose. In this case it refers to the pseudonymised data (glossary "Pseudonym") that the NORAH team received from the health insurers.

Case-control study

This research method is used in epidemiological investigations (glossary "Epidemiology") dealing with the causes and risk factors for important diseases in the population. Case-control studies want to find out how much a certain factor – in the case of NORAH, traffic noise – changes the risk of contracting a certain disease. To do this, they compare persons who suffer from the disease ("cases") with individuals who do not suffer from the disease ("control persons"). For both groups they calculate how severely the persons were exposed to the investigated factor. This allows them to work out to what extent this factor changes the risk of disease. For example, former case-control studies made a major contribution towards the finding that smoking causes lung cancer or that stress can lead to cardiovascular disorders.

In-depth survey

The NORAH team is taking a closer look at some of the insured persons voluntarily participating in the so-called in-depth survey: several thousand persons with certain cardiovascular disorders – as well as several thousand control persons not suffering from these diseases – are taking part in this exhaustive survey. In this way the scientists want to take into account other factors that play a role in the disease risk but are not contained in the health insurance data – for example if the persons smoke or how much exercise they get. By taking into account these other factors, it can be determined more precisely how much of the disease risk is accounted for by traffic noise.

With its research approach of a secondary data-based case-control study with in-depth survey, the Study on Health Risks is devoting considerable effort – hardly any other noise impact study before NORAH examined the influence of noise on the health of so many people so precisely.

FOCUS ON FIVE DISEASES

Heart attack, stroke, heart failure (known medically as "cardiac insufficiency") or hypertensive heart disease, depression and breast cancer are completely different diseases. But they also have some things in common: they are widespread and responsible for a large number of premature deaths in Germany. Alongside human suffering, they also cause considerable costs for the country's healthcare system. And studies up to now suggest – to a greater or lesser extent for the individual diseases – that traffic noise can increase the risk of suffering from them.

The cardiovascular system under the influence of noise

Constricted blood vessels can trigger a whole series of cardiovascular diseases – including heart attacks and strokes. In simple terms, these diseases occur as follows: as important arteries are constricted or completely congested, not enough oxygen can reach the heart, brain and other organs. The consequences: depending on how severely the oxygen supply is reduced, these organs gradually or even suddenly cease to function.

One of the main causes for constricted arteries is high blood pressure: if the walls of the blood vessels are subject to constant high pressure, deposits build up and slow down the blood flow. Alongside the familiar risk factors such as smoking and poor dietary habits, regular stress can also cause a permanent increase in blood pressure. As constant traffic noise can cause stress, the scientists suspect that this can lead to a permanent increase in blood pressure. Since blood pressure plays a central role in health, a separate sub-study – the Blood Pressure Study – within the framework of NORAH investigates the effects of traffic noise on blood pressure *(for more on this see the "NORAH Knowledge" edition of the Blood Pressure Study)*.

The connection between traffic noise, blood pressure and cardiovascular diseases has been examined by several studies in the past – in different ways: some studies analysed how frequently doctors in regions with high noise exposure prescribed medication to lower blood pressure. Others investigated how frequently cardiovascular diseases were diagnosed in hospitals, and what type of traffic noise the patients were exposed to at home. The NORAH Study examines the connection between cardiovascular diseases and traffic noise even more thoroughly. Unlike many previous studies, it looks not only at present, but also, if possible, past noise exposure. In addition to this, the Study on Health Risks also includes outpatient diagnoses, i.e. diagnoses made by a doctor and not in the hospital. With the in-depth survey of several thousand health-insured persons, it also wants to delineate the traffic noise-specific risks from other influencing factors more precisely than previous studies – this can help to carry out a more accurate assessment of the risks caused by traffic noise.

Constricted blood vessels can trigger a whole series of cardiovascular diseases – including heart attacks and strokes.

Davide Trolli/Shutterstock

The NORAH Study examines, among other things, the connection between cardiovascular diseases and traffic noise.

Depression due to traffic noise?

Even though it is not quite as widespread as cardiovascular disease, depression occurs much more frequently than many people are aware of: five percent of Germans between the ages of 18 and 65 suffer from this life-threatening disorder; every fifth individual experiences a depressive episode at least once in their life. Most suicides and suicide attempts are attributed to depression *(Source: Stiftung Deutsche Depressionshilfe)*. The World Health Organization (WHO) predicts that depression will be the second most frequent cause of health disorders worldwide by the year 2020. The causes of this mental disorder are many – genetic, personal and social factors can all play a role. In 2010 a study carried out in the area of Cologne/Bonn Airport found that aircraft noise can also increase the risk of depression – at least in women. Men did not appear to be affected. The Study on Health Risks wants to examine this link in more detail.

Breast cancer in the airport vicinity

More than 70,000 women in Germany are diagnosed with breast cancer every year. In the ranking list of illnesses causing loss of years of healthy life drawn up regularly by the WHO, breast cancer in women in Germany is placed at number six. In 2010, the same study that examined the effects of aircraft noise on the risk of depression in the Rhineland was also able to identify a connection between noise and breast cancer. The NORAH Study wants to examine this result, for which there is otherwise very little scientific proof up to now.

WHO TOOK PART IN THE STUDY?

Case-control studies are often very extensive. Large volumes of data have to be evaluated in order to gain reliable findings on the health of people in a particular region. This is also the case with NORAH.

The investigation area

The investigation area of the Study on Health Risks is larger than that of all the other NORAH sub-studies. It extends around 150 kilometres from west to east, and around 120 kilometres from north to south. The area covers all the residential areas in the government district of Darmstadt – this also includes the cities Frankfurt am Main, Offenbach and Wiesbaden, as well as Mainz and Worms and the administrative districts Mainz-Bingen and Alzey-Worms. The reason for such a large study region: the research concept demands a comparison between people with severe traffic noise exposure and people who have practically no exposure to traffic noise. This is why the study also includes areas which are further away from Frankfurt airport.

The noise exposure

For the quietest residential areas included in the study, the acoustics team calculated the annual long-term energy equivalent sound levels (glossary "Long-term energy equivalent sound level") under 40 dB (glossary), in some cases the value was much lower. Persons living at these quietest places, and for whom the maximum aircraft sound level at night (glossary "Maximum sound level") remained below 50 dB, form the so-called reference group. This means that the scientists assume that these persons constitute a group whose health is practically unaffected by traffic noise.

The NORAH team also divided all of the other residential areas into so-called sound level classes (glossary). Each of these classes covers a range of 5 dB. The quietest category above the reference group includes, for example, all places with a long-term energy equivalent sound level of 40 to 45 dB. In the loudest class, the 24-hour long-term energy equivalent sound level for aircraft noise is 60 to 65 dB. With regard to road and rail traffic noise, the study also investigated persons exposed to an average sound level of over 70 dB over 24 hours. For each sound level class the study examined whether the health risks were increased compared with the control group with low noise exposure – and if yes, to what extent.

The investigation area of the Study on Health Risks

TU Dresden

The NORAH scientists evaluated the data from around one quarter of the population in the investigation area of approximately 9,000 square kilometres in the Rhine-Main Region. (Investigation according to 5-digit post codes and municipal/rural districts; independent municipalities highlighted in colour)

The health-insured persons included in the study

Three major health insurance companies in the Rhine-Main Region made selected data from around one million policy holders available for the Study on Health Risks – for example, diagnoses and prescribed medications. The Technical University of Dresden analysed the data in anonymised form. The law allows health insurance companies, subject to certain requirements, to release data for research projects such as NORAH. Data protection regulations and the rigorous examination by a state-appointed data protection officer ensure that the private sphere of the policy holders is protected.

The cooperation with the persons taking part in the in-depth survey was somewhat different: they made direct contact with the survey centre in Gießen, having been notified accordingly by their health insurance company. They also disclosed personal information in the questionnaire, for example their addresses. This personal data was deleted again, however, as soon as the noise calculations for these participants were concluded. Only then was the data passed on to the evaluation centre in Dresden *(more on the subject of data protection in the study on page 11)*.

All of the health insurance policy holders whose data was used in the NORAH Study were over 40 years old. This enhances the statistical reliabliliy of the results, since the investigated diseases occur so frequently from this age onwards.

Data provided by the health insurance companies (example)

Secondary data	Evaluation period (years)
Policy holder data	2005-2010
Data for outpatient treatment	2005-2010
Data for inpatient treatment	2005-2010
Data for prescribed medication	2005-2010

Excerpt from policy holder data	Example
Pseudonymised policy holder number	0014739291
Gender (1=male, 2=female)	1
Age group (5-year age classes)	60-64

Excerpt from inpatient treatment data	Example
Pseudonymised policy holder number	0014739291
Evaluation year (2005-2010)	2006
Quarter (1–4)	2
Duration of hospitalisation (days)	14
Discharge diagnosis	ICD 10: I21.-
Secondary diagnoses	-

Instead of the name of the insured person, the NORAH team only receives a randomly assigned number (pseudonym). Only the health insurance company knows which number belongs to which policy holder.

The example shows a patient who was treated in hospital for an acute heart attack in the second quarter of 2006. If it is a newly occurring diagnosis (in the evaluation period), this patient is assigned to the case group "heart attack".

DIAGNOSIS NUMBERS AND OTHER DATA

In order to answer the research questions, the NORAH team had to filter the information received from the health insurance companies according to certain criteria. Their most important instrument took the form of internationally standardised diagnosis numbers that doctors pass on to their patients' health insurers.

Which data did the health insurers provide and which did they not?

Three major health insurance companies in the Rhine-Main Region made a large quantity of data available to the NORAH team. What the data package did not contain, however, was information about the names of the policy holders and where they live – this is prohibited by data protection law. This data is only known to the health insurers. For the NORAH Study, the health insurers assigned numbers, so-called pseudonyms, (glossary) to all the health insurance policy holders.

Most of the information which the health insurers provided on the individual insured persons consisted of numbers: diagnosis codes according to the International Classification of Diseases ICD-10. Medical personnel, whether in general practice or in the hospital, use this number system to classify diagnoses and to bill the health insurers for their services. The "International Statistical Classification of Diseases and Related Health Problems" (ICD) is published by the World Health Organization (WHO) and is regularly revised. The ICD 10 is the tenth major revision of the classification.

For the NORAH Study, the health insurers had assigned numbers, so-called pseudonyms, to all the insured persons.

The NORAH team received from the health insurers all of the diagnoses made for the insured persons between 2005 and 2010 – in general practice and in the hospital. The scientists also received information on the medications prescribed to the insured persons – when the prescriptions were actually redeemed in the pharmacy. The advantage of this extensive information: this allows NORAH to identify more clearly than previous studies which insured persons became ill for the first time in the past years.

In addition to the diagnoses and the prescribed medications, the health insurers were also able to give the NORAH team further information about the insured persons which could have a statistical influence on the state of health: the age and gender, the educational level and, in some cases, the profession of the insured persons, were included in the data provided by the health insurers.

The in-depth study

Most of the health-insured persons with the cardiovascular diseases investigated in the study, as well as many randomly selected insured persons without these diseases, received post from their health insurer over the course of the study. This is how the health insurance companies informed them about the aims of the in-depth survey and about who they should contact if they wanted to take part. Several thousand recipients contacted the NORAH survey centre at the University of Gießen to request the questionnaire.

This included questions on lifestyle (e.g. smoking and alcohol consumption) and on weight and height. The participants also stated where they had lived in the past. With this information the scientists in the survey centre were able to calculate the noise exposure of the respondents going back 18 years. Another factor is also used in the calculations: on the basis of various criteria – including the usual window position (open, tilted open, closed) in the bedroom – the study takes into account how much traffic noise gets into the apartment.

7.1 Since when have you been living at your current address? ☐☐☐☐ (year)

7.1a Street ..... 7.1b House number .....

7.1c Floor ..... 7.1d Postcode ..... 7.1e City .....

7.2 How is your bedroom aligned with respect to the main street in your residential area?
Your bedroom is …

☐ turned away from the street (e.g. inner courtyard) ☐ turned towards the street
☐ sideways to the street (e.g. 90°) ☐ the distance to the street is more than 100 m

7.3 Is your house/apartment located near a railway line*?

☐ no ☐ yes, and at a distance of ☐☐☐☐ metres

**only railway, rapid rail and underground rail, not tram lines*

7.4 If you live near a railway line, how is your bedroom aligned with respect to the railway line?

☐ turned away from the line ☐ sideways to the line (e.g. 90°)
☐ turned towards the line

7.5 How do you usually have your windows during warm seasons?
("warm seasons": spring, summer, autumn)

	predominantly open?	… or predominantly tilted?	… or predominantly closed?
Do you have the windows in your living rooms … during the day	☐	☐	☐
Do you have the windows in your bedrooms … at night	☐	☐	☐

7.6 How do you usually have your windows during the cold season?
("cold season": winter)

	predominantly open?	… or predominantly tilted?	… or predominantly closed?
Do you have the windows in your living rooms … during the day	☐	☐	☐
Do you have the windows in your bedrooms … at night	☐	☐	☐

7.7 Were noise abatement measures carried out on your building, e.g. sound-insulating windows?

☐ No ☐ yes, self-financed ☐ yes, third-party-financed
☐ I don't know ☐ yes, carried out, but don't know who paid for them

Several thousand health-insured persons took part in the survey and completed the questionnaire for the NORAH team.

NOISE IN THE PAST AND THE PRESENT

How much noise from a passing aircraft arrives at a residential address depends on many factors – among other things, the type of aircraft and the aircraft altitude play an important role. Particularly in the case of rail and road traffic noise, the terrain and the type of building have an influence on how the sound is propagated. On open ground, for example, it can be heard over a wide area, while dense building diverts the sound or absorbs it. For this reason, the noise exposure can be very different at two places just a few hundred metres apart. All these factors are taken into consideration by the Study on Health Risks: this delivers individual noise values for the addresses of all the surveyed persons. Insofar as the residential history of the person is known, the Study on Health Risks also takes into account noise data going back several years.

Traffic noise reconstructed

The aircraft noise calculations were based on radar aircraft records from Frankfurt Airport. These provide information not only on when, at which altitude and in which direction, planes were in the air in Germany, but also identify the aircraft type. With this information the NORAH acoustic experts were able to calculate how much aircraft noise the people on the ground were exposed to. The NORAH team received information on rail traffic from the German railway company Deutsche Bahn, while data on road traffic was provided by the communities. In order to better understand the propagation of the sound, the scientists worked with a three-dimensional terrain model that takes hills and valleys into account as well as buildings *(more on this in "NORAH Knowledge" no. 2 – Sound and noise)*.

Knost, DLR

Noise slice by slice

The acoustics team calculated long-term energy equivalent sound levels (glossary) for all three traffic noise sources. These state how loud it is at a certain location due to traffic noise. Alongside a 24-hour long-term energy equivalent sound level, the scientists also calculated the noise exposure in certain "time slices", for example between 10 p.m. and 6 a.m., 11 p.m. and 5 a.m. or 11 p.m. and 7 a.m. For aircraft noise there are also some noise values for individual "hour slices". In this way it is possible to calculate whether traffic noise at certain times has different effects, for example whether there is a difference between the effects at night-time, morning or afternoon.

In addition to this, the Study on Health Risks also takes into account the maximum sound level – the maximum loudness generated, for example, by a passing aircraft at the residential address.

Each party can only ever see part of the data, giving no complete picture of the insured persons included in the study.

DATA PROTECTION: WHO KNOWS WHAT?

The Study on Health Risks looks at the individual state of health of more than 900,000 individuals. Their names and addresses are not known to the scientists. The assignment of the noise data to the addresses is governed by a comprehensive data protection concept. Here it was ensured that none of the parties concerned – neither the study direction, the evaluation centre in Dresden, the survey centre in Gießen, nor the acoustics experts – had access to all data. Each party can only ever see part of the data, giving no complete picture of the insured persons included in the study:

- The acoustics team first calculated the noise exposure for all addresses in the vicinity. During the whole study it received no addresses or health insurance data of the insurance policy holders.
- An external confidential body or the health insurance company itself linked the noise data with the addresses of the insured persons. Then they deleted all the addresses from the database. Only then was the data sent to the evaluation centre in Dresden.
- The evaluation centre in Dresden knows the information provided by the health insurers such as diagnoses and prescribed medications, but has no access to personal data such as addresses. In order to ensure this, the health insurers only gave the scientists the data of the policy holders with a randomly formed number, the pseudonym (glossary).

This is why the Data Protection Officer of Hessen, the State Officer for Data Protection and Freedom of Information of Rhineland-Palatinate as well as the Federal Officer for Data Protection and Freedom of Information had no objections to the conducting of the case-control study.

OVERVIEW: WHAT DISTINGUISHES THE STUDY

Science is a process: every investigation answers questions, but also poses new ones. No study can answer all of the important questions. This also applies to the NORAH Study: it builds on the findings of earlier studies and seeks answers to unanswered and new questions. To do this, it was necessary to further refine the methods used in previous studies. The methodological advantages of the Study on Health Risks at a glance:

More complete diagnoses

Unlike earlier studies, the NORAH Study takes diagnoses not only from hospitals, but also from general practices into consideration. The diagnosis and therapy of a cardiac insufficiency or depression do not always necessarily take place in a hospital. The insured parties treated by general practitioners did not appear in earlier studies.

Recognition of new incidence of disease

The more precisely the time at which a person became ill can be determined, the easier it is to establish that the calculated noise actually occurred before the illness. In order to identify new incidences of disease as accurately as possible, the NORAH team analyses the health insurance data with the aid of a complex formula – more precise than earlier studies: it examines, for example, for all illnesses over several quarters, when an illness occurs for the first time.

Social status more precisely calculated

How healthy a person is also depends on their education and profession – this has been repeatedly verified in studies. This is why the NORAH team also received pseudonymised (glossary "Pseudonym") information on education and profession for many insured persons from the insurers. Earlier studies had to get by with less precise data because they had no individual data on social status.

Better acoustic data

Hardly any other noise impact study before NORAH has recourse to such precise acoustic data. The acoustics team calculated the current aircraft noise exposure very precisely on the basis of radar data and, in some cases, also even reconstructed past noise exposures as far back as 1996. In addition to the average sound levels, the study also takes into account the peak values (glossary "Maximum sound level"). This is a significant advantage of the NORAH Study, because short and severe exposure to noise can also have an impact on health.

Comprehensive quality assurance

Independent experts from all the relevant disciplines accompany the scientists in the NORAH sub-study and ensure that the methods, conduct and evaluation meet the highest standards. Other experienced epidemiologists – Prof. Dr Hajo Zeeb and Dr Enno Swart – are also involved in the quality assurance and conduct of the study. The scientists had already established how they wanted to analyse the data before they had access to them. In this way it is ensured that they answer their original research questions as objectively as possible.

Glossary

You can find further explanations in the glossary on **www.laermstudie.de**.

Long-term energy equivalent sound level

The long-term energy equivalent sound level (in short: L_{pAeq}) is a measure for the average noise exposure over a certain period in which frequency, duration and level of the individual sound events are taken into account. The L_{pAeq} is the basis for the determination of noise protection zones pursuant to the aircraft noise act – separated according to day (6 a.m. – 10 p.m.) and night (10 p.m. – 6 a.m.). The L_{pAeq} is stated in dB.

Decibel

The decibel – "dB" or "dB(A)" – is a measure of sound pressure level and thus of loudness. The decibel scale from 0 to 120 dB(A) reflects the range from the absolute threshold of hearing to the pain threshold. The scale is not linear. We perceive an increase of ten decibels as roughly doubling of loudness – in the lower and at the upper ends of the range.

Epidemiology

Epidemiology is the study of the distribution of risk factors and diseases in populations. It contributes towards a better understanding of the causes of disease. Epidemiology develops measures to prevent disease or to prevent the spread of disease. It also helps to develop strategies for the treatment of diseases.

Exposure-effect relationship

The results of noise impact studies such as NORAH can often be expressed in exposure-effect relationships. This means that the scientists quantify as accurately as possible at which traffic noise exposure the risk of a certain disease increases and by how much.

Maximum sound level

The physical value which best describes how strongly nocturnal aircraft noise impacts sleep is the maximum sound level. It shows to what extent the aircraft noise stands out from the existing background noises. The annoyance effect overall depends on the level and the frequency of occurring maximum sound levels.

Pseudonym

In everyday usage a "pseudonym" is a false name, artist's name or code name. The pseudonym makes it impossible to trace statements back to the author personally. The Federal Data Protection Act defines pseudonymisation as "substituting a person's name and other identifying characteristics with a label, in order to preclude identification of the data subject or to render such identification substantially difficult." In other words: features that can identify the individual person – for example the name – are substituted with a code, for example a randomly selected number. All personal details have to be substituted so that it is not possible to identify a person.

Sound level classes

In order to calculate the effect of different levels of noise exposure, the acoustics team first calculated an annual long-term energy equivalent sound level for every residential address in the investigated region. Then, addresses with similar noise exposure levels were grouped in sound level classes. The quietest class had addresses with a long-term energy equivalent sound level up to 40 dB, the next class had addresses with levels between 40 and 45 dB, then 45 to 50 dB and so on.

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