

Noise Burden in Europe



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Abstract The consequences of noise on the health of the population, as well as the policies and measures that can be adopted to minimise the problem, are a growing concern in Europe. This is highlighted in the recent report prepared in 2020 by the European Environment Agency (EEA), Environmental noise in Europe report (ENER). The main aim of the chapter is to quantify the noise generated by air transport at the EU level and discuss the consequences that this can have on the health of the population exposed to it. The summary of results for air transport contained in the aforementioned report will be presented, as well as those that the EEA presents in more detail for each country in the EEA 2019 Noise country fact sheets (NCFS). All results are derived from the 3rd Environmental Noise Directive (END) round, reported in 2017 and based on 2016 annual traffic data.

Keywords Major airports · Agglomerations · People exposed · High annoyance · High sleep disturbance · Reading comprehension · Ischaemic heart disease · Premature mortality · Cognitive impairment · Years of life lost · Years of life lived adversely

Giving Some Indication on the Actual Impact of Noise on the European Citizen, Mostly by Popularising Data from the Environmental Noise in Europe Report.

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Introduction

The chapter includes an analysis of the data, summarising the main problems detected throughout the different data delivery phases, as well as exploring future potential challenges. Figure 1 provides an overview of the scope of the noise burden analysis in Europe.

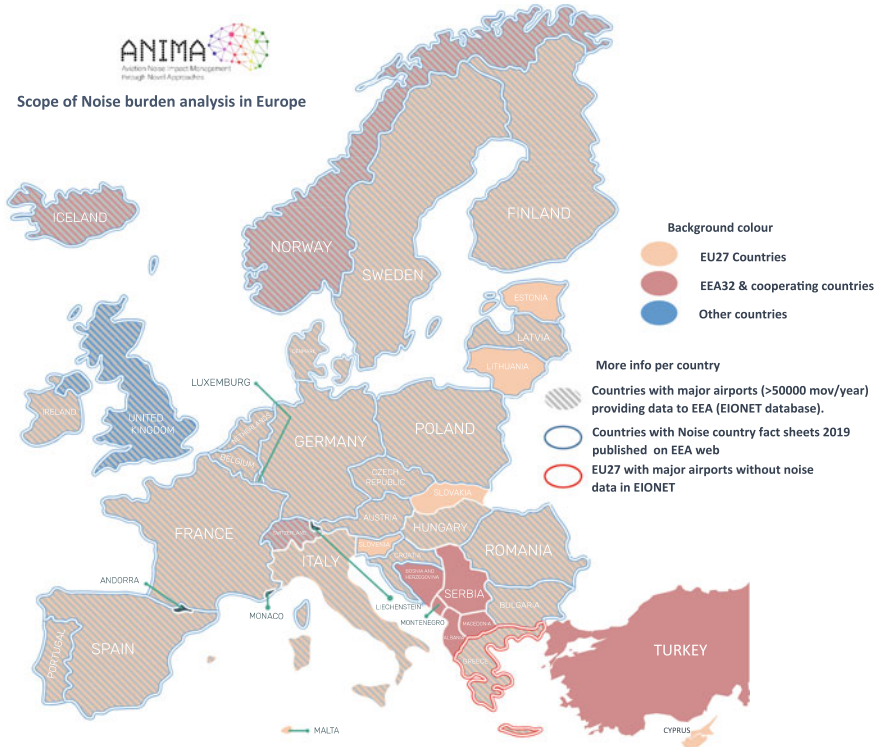


Fig. 1 Scope of noise burden analysis in Europe. The map contains a base colour for the different countries reporting data to the EEA–EU countries, EEA countries and others. Over these colours, there are 3 types of plot: one that indicates the countries that have major airports and the duty to report on them, another for countries that have never reported data to date despite being obliged to do so by the END (EU countries), and another for the countries where the EEA has prepared detailed information on the health condition in the EEA 2019 Noise country fact sheets (NCFS)

The Regulation Behind the Data Collection

The Directive 2002/49/EC, also known as the Environmental Noise Directive (END), aims to “define a **common approach** intended to avoid, prevent or reduce on a prioritised basis, the harmful effects, including annoyance, due to exposure to environmental noise”.

To this end, Member States must develop strategic noise maps in order to estimate the level of the population’s and/or buildings’ exposure to environmental noise using harmonised noise indicators L_{den} and L_{night} . These maps and data are used **to estimate the number of people annoyed and sleep-disturbed** respectively throughout Europe.

The Directive requires the Member States to prepare and publish, every 5 years, the strategic noise maps (SNM) and noise management action plans (NAP) for major airports (i.e. those with more than 50.000 movements a year) and for airports (major and not-major) affecting population agglomerations with more than 100,000 inhabitants.

There have been 3 rounds of SNM thus far: 2007 (showing the noise situation in 2006), 2012 (showing 2011) and 2017 (showing 2016), and 3 NAP rounds in 2008, 2013 and 2018.

The next round (round 4) of SNM has to be delivered by the Member States in 2022, illustrating the situation in 2021. In this round, some changes are expected because of two new directives:

- Directive (EU) 2015/996 establishing common noise assessment methods, to provide complete and homogeneous content to Annex II of the END.
- Directive (EU) 2020/367 establishment of assessment methods for harmful effects of environmental noise, to provide complete and homogeneous content to Annex III of the END.

The Scope of the END Exclusions

Military activities (flights) are excluded from the scope of the Directive 2002/49/CE and from the noise maps, but they are not excluded from the annoyance to residents. There are still quite a few examples of airports with dual-use, civil and military, affecting populations.

The scope of the Directive is major airports and all airports affecting agglomerations. There are many other airports excluded from the scope, but there is still annoyance associated with these. Most countries do not carry out any noise map assessment for airports with less than 50.000 movements/year. Only a few European countries have their own rules about the noise assessment and control for all kinds of airports—large, medium or small airfields, with or without military movements. Moreover, sometimes, training flights with light aircraft—excluded as well from the scope—are the subject of noise complaints because they are flying repeatedly in

circles over the same area. Residents may become annoyed and feel helpless because there are no regulations or assessments available to them.

The Method Exclusions

The Annex II of the END, applicable up to 2015, recommended to the Member States, which have no national computation methods, to use ECAC Doc. No 29 “Report on Standard Method of Computing Noise Contours around Civil Airports” (1997 2nd edition) as the method to calculate a noise contour around an airport. Following this, most EU Members have included in their own laws a specific reference to this document and/or to its successive updates. Thus, the first three rounds of SNM were prepared mostly using this “Doc. 29”. Where the noise exposure derives mostly from propeller-driven light airplanes or helicopters, **this guidance is not applicable.**¹ **Most countries do not have regulations for light airplane operations or for helicopter operations.** Consequently, most European countries do not include these kinds of operations in their noise contours for major airports. Although not every airport has light airplane and helicopter operations, the associated noise annoyance from these kinds of operations is often overlooked by those that do.

Finally, the aircraft noise calculations in this guidance only take account of noise from aircraft movements. All ground noise sources such as taxiing aircraft, auxiliary power units and aircraft undergoing engine testing are excluded from the guidance. Consequently, most EU countries do not include these kinds of operations in their noise contours for major airports. Once again, not all airports are affected by ground noise, only some of them.

The new Directive (EU) 2015/996 will solve some of these problems. Noise from helicopters, taxiing, engine testing and use of auxiliary power units have to be included with the new methodology, which has to be applied for the next (4th) round of SNM. Accordingly, in some cases, there will be an increase in the number of people exposed as a result of these changes in Annex II. Some other changes are expected because of the method and the way to assign and count people, for example, but in those cases, the noise contours will change homogeneously.

The new Directive (EU) 2020/367 has finally provided a common way to estimate two harmful effects of aviation noise: people who experience high annoyed people (HA) and those with high sleep disturbed (HSD). An additional harmful effect indicator, Ischaemic heart disease (IHD), has been provided solely for road noise. Future revisions of this directive are expected to the extent that research on the matter progresses. Hence, the 4th round will have estimations per country.

¹ ECAC/CEAC Doc 29 2nd, 3rd & 4th Editions “Report on Standard Method of Computing. Noise Contours around Civil Airports” Volume 1: Applications Guide.

The Data Collection Exclusions

Annex VI of the END establishes the data to be sent to the Commission by each Member State for each major airport and for each agglomeration affected by airport noise.

Eionet (European Environment Information and Observation Network) is the Central Data Repository for the EEA countries. The END data reporting must adhere to required rules and the EEA has developed Support guidance for reporting under the Environmental Noise Directive 2002/49/EC (END) that the countries must take into account.

The reporting mechanism is clear and well explained. However, checking the reported data per country reveals the following:

- Some countries have been late filing the data. In some cases after 15 years, there is no data.
- The data is not well reported by the countries so that the data are available in some documents but it is not available in the maps presented or in the database. In other words, the number of people exposed was calculated and is available online in Eionet web (or in other official country websites that publish the full documents prepared in accordance with the SNM or NAP), but the digital data to be able to compare and study at European level is not well reported and is not available.

Several significant problems exist with the aviation data and these are highlighted below:

1. Normally the airport/authority in charge of preparing a noise footprint of an airport, following the Annex II methodology, will generate noise contours and the data of people/dwellings/areas affected by these noise contours regardless of whether those people live in agglomerations or outside agglomerations. The SNM contains for both indicators (Lden –Lnight) data on the people, area and dwellings affected for each band of decibel levels established. Nevertheless, people exposed to the noise from the same airport have to be reported separately as people inside urban areas and people outside urban areas. Normally this means different authorities in the country are in charge of reporting data internally to the official EU reporter.
2. There is no information about how many and which agglomerations have an airport affecting them. In this case, the agglomeration has to consider all types of airports affecting the agglomeration, not only major airports. The reporting data for each round is entirely inconsistent, and it does not depend on the traffic (unlike the major airports definition). The agglomerations have to present the aviation noise data from major and not-major airports affecting their territories, but in some cases, the data are not reported even for major airports (Italy, Romania, Spain or Sweden). In contrast, the data for major airports in these states and their coverage (tab MAir_list & MAir_coverage from the Noise exposure information under the END Directive -2002/49/EC-

file END_DF4_DF8_Results_2017_190101tabs) were completed and reported.

The 4 country examples appeared with 100%

3. The provision of data, concerning the noise sources specified by the END, is reported per round (DF1_DF5) with a description of the location, size and number of inhabitants –agglomerations- or data on the traffic for major airports (> 50,000 movements/year). Nevertheless, not all the countries have adopted the same criteria. As an example, if the list of “major airports” included an airport –and its acoustic data were reported- in the first and second rounds, but in the third round, that airport did not reach 50,000 movements, some countries such as Denmark or Spain report this airport as “–1” –airport without obligation to report-, while others such as Italy report their acoustic data. France presents the same number of movements that they presented in the first round in all rounds. Even if the traffic had dropped below a major airport’s definition, they would continue to present data for all of them. Recognition of this disparity of criteria by country is important for global comparisons and by country (Fig. 2).

Notes

- NAR: No major airport to be reported.
- Denmark, Finland and UK expected more airports under the “major airport” definition (column 3 < 100%). They reported only airports complied with the definition (columns 5,7 & 9 = 100%).
- Cyprus, Malta & Slovakia EU27 No major airports to be reported & no NCFS 2019 available.
- Turkey & Liechtenstein EEA32 No data provided.
- Data submitted before 1–1-2019, but for technical reasons, they were not included in ENER.

Health Risk by Aviation Noise in Europe

Aircraft noise exposure is an environmental stressor and has been linked to various adverse health outcomes, such as annoyance, sleep disturbance and cardiovascular diseases.²

An updated assessment of the population exposed to high levels of environmental noise and the associated health impacts in Europe for air transport can be extracted from the aforementioned EEA 2020 Environmental noise in Europe report (ENER). Further details by country are also available in the EEA 2019 Noise country fact sheets (NCFS). General –EEA33 aggregated- data exposed come from the publication Health risk caused by environmental noise in Europe (Dec 2020).

² Further details in Chap. 9 of this book.



Reported data completeness: Major Airports & Airports Affecting Agglomerations

	Major airports	END DF4-DF8	Coverage Major Airports		Completeness Lden value		Completeness Lnight value		Completeness Lden value		Completeness Lnight value	
		Total DF4-DF8	Total NCF5	Total NCF5	Inside Urban ENER	Outside Urban ENER	Inside Urban ENER	Outside Urban ENER	Inside Urban ENER	Outside Urban ENER	Inside Urban ENER	Outside Urban ENER
Austria	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Belgium	1	100%	97%	97%	94,8	0 (a)	87,7	0 (a)	0 (a)	0 (a)	0 (a)	
Bulgaria	1	0	50%	50%	100%	100%	0	100%	0	0	0	
Croatia	0	0	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Czech Republic	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Denmark*	3	33%	100%	100%	100%	100%	90	100%	100%	100%	100%	
Estonia	0	NAR	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Finland	2	50%	91%	84%	24,2	100%	40	100%	100%	100%	100%	
France	9	0	35%	27%	35,3	0	26,6	0	0	0	0	
Germany	11	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Greece	1	0	-	-	0	0	0	0	0	0	0	
Hungary	1	100%	-	-	100%	100%	100%	100%	100%	100%	100%	
Iceland	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Ireland	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Italy	10	100%	-	-	0	0 (a)	0	0 (a)	0	0 (a)	0 (a)	
Latvia	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Lithuania	0	NAR	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Luxemburg	1	100%	-	-	100%	100%	100%	100%	100%	100%	100%	
Netherlands	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Norway	4	0	46%	36%	64,4	0	45,3	0	0	0	0	
Poland	1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Portugal	2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Romania	1	100%	25%	17%	0	0 (a)	0	0 (a)	0	0 (a)	0 (a)	
Spain	11	100%	61%	33%	0	100%	0	100%	0	100%	100%	
Slovenia	0	NAR	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Sweden	3	100%	89%	77%	78,4	100%	0	100%	0	100%	100%	
Switzerland	2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
United Kingdom	20	75%	100%	100%	100%	100%	100%	100%	100%	100%	100%	



NOTES:

- ✓ NAR: No major airport to be reported.
- ✓ Denmark, Finland and UK expected more airports under “major airport” definition (column 3<100%). They reported only airports complied with the definition (columns 5,7 & 9 =100%).
- ✓ Cyprus, Malta & Slovakia EU27 No major airports to be reported & no NCF5 2019 available.
- ✓ Turkey & Liechtenstein EEA32 No data provided.
- ✓ (a) Data submitted before 1-1-2019, but for technical reasons they were not included in ENER.

Fig.2 Reported data completeness from ANNEX 2 of EEA 2020 Environmental noise in Europe report (ENER), EEA 2019 Noise country fact sheets (NCF5) and END_DF4_DF8_Results_2017_190101

People Exposed to High Levels of Environmental Noise

The Environmental noise guidelines for the European region [9], define long-term noise exposure levels above which a relevant increase in negative health effects occur, expressed in terms of the indicators Lden and Lnight. For aircraft sources, these levels are 45 dB Lden and 40 dB Lnight.

However, the numbers presented at the European level correspond to the number of people above the END (Annex VI) reporting thresholds (i.e. 55 dB Lden and 50 dB Lnight). This means that there could be more people exposed to unhealthy noise levels than those that can be assessed with the current END thresholds (Fig. 3).

Notes

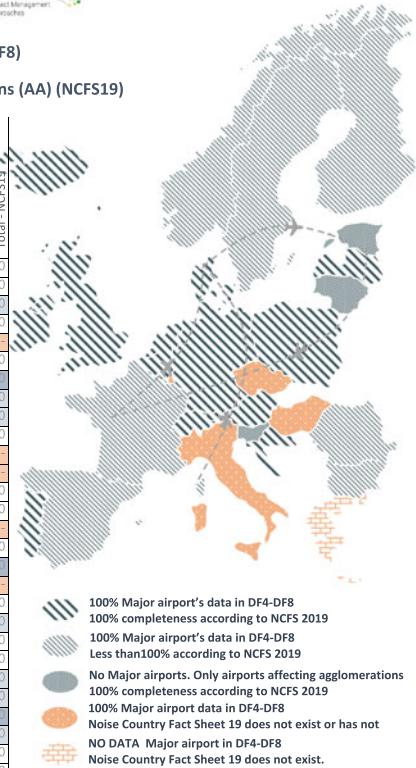


People exposed:

To Major Airports inside and outside agglomerations (DF4-DF8)

To major airports (MA) and no major affecting agglomerations (AA) (NCF519)

		Major airports Coverage major airports	People exposed MA Lden>55dB Total - DF4-DF8	Completeness Lden Total - NCF519	People exposed MA & AA Lden>55dB Total - NCF519	Completeness Lnight Total - NCF519	People exposed MA & AA Lnight>50dB Total - NCF519
Austria	1	100%	11100	100%	22300	100%	500
Belgium	1	100%	67600	97%	126400	97%	34600
Bulgaria	1	-	-	50%	5200	50%	600
Croatia	0	0	0	100%	0	100%	0
Czech Republic	1	100%	10500*	100%	-	100%	-
Denmark	3	33%	4600	100%	4300	100%	1400
Estonia	1	NAR	0	100%	3100	100%	-
Finland	2	50%	23500	91%	24100	84%	3100
France	9	-	-	35%	168600	27%	29800
Germany	11	100%	849800	100%	846600	100%	243000
Greece	1	-	-	-	-	-	-
Hungary	1	100%	31800*	-	-	-	-
Iceland	1	100%	1600	100%	3200	100%	2200
Ireland	1	100%	20600	100%	29000	100%	6600
Italy	20	100%	262400*	100%	-	100%	-
Latvia	1	100%	1700	100%	1600	100%	800
Lithuania	1	NAR	-	100%	10800	100%	400
Luxemburg	1	100%	68800*	-	-	-	-
Netherlands	1	100%	45000	100%	60300	100%	2500
Norway	4	-	-	46%	7600	36%	2400
Poland	1	100%	51600	100%	60100**	100%	6700
Portugal	2	100%	388900	100%	223800	100%	121400
Romania	1	100%	15600	25%	15400	17%	5500
Spain	11	100%	188700	61%	122900**	33%	22300
Slovenia	1	NAR	0	100%	0	100%	0
Sweden	3	100%	14700	89%	28300	27%	400
Switzerland	2	100%	103200	100%	93700**	100%	32600
United Kingdom	20	75%	1107800	100%	1108900	100%	437100



- NOTES:**
- ✓ NAR: No major airport to be reported.
 - ✓ Denmark, Finland and UK expected more airports under "major airport" definition (column 3<100%). They reported only airports complied with the definition (columns 5 & 7 =100%). Less airports than previous rounds. Denmark or Spain did not include these airports in DF1. In all the cases comparisons between rounds are not correct because they are considering different number of airports per country.
 - ✓ *No NCF519 available. Meaning estimated data in global numbers for EU region instead of real numbers.
 - ✓ **The column 6 should be equal or major than column 4 because it includes "no major airports" affecting agglomerations. Poland, Spain have not reported the data of the agglomerations in general, so the air data are not included in the NCF519, however it was included in DF4-DF8. Meaning estimated data instead of real data in NCF519 to calculate health impacts.
 - ✓ Switzerland appears in NCF519 with 93700 people affected by MA in Agglomerations. Nevertheless, in DF4-DF8 appears with 103200.
 - ✓ Bulgaria, Finland, France, Norway, Romania, Spain & Sweden have estimated data in NCF519.

Fig. 3 People exposed to aviation noise in Europe

- NAR: No major airport to be reported.
- Denmark, Finland and UK expected more airports under “major airport” definition (column 3 < 100%). They reported only airports complied with the definition (columns 5 & 7 = 100%). Fewer airports than previous rounds. Denmark or Spain did not include these airports in DF1. In all the cases comparisons between rounds are not correct because they are considering a different number of airports per country.
- *No NCFS19 available. Meaning estimated data in global numbers for the EU region instead of real numbers.
- **The column 6 should be equal or greater than column 4 because it includes “no major airports” affecting agglomerations. Poland, Spain have not reported the data of the agglomerations in general, so the air data is not included in the NCFS19, however, it was included in DF4-DF8. Meaning estimated data instead of real data in NCFS19 to calculate health impacts.
- Switzerland appears in NCFS19 with 93,700 people affected by MA in Agglomerations. Nevertheless, in DF4-DF8 appears with 103,200.
- Bulgaria, Finland, France, Norway, Romania, Spain & Sweden have estimated data in NCFS19

Health Risk Associated with Noise Exposure

Only those health outcomes that have demonstrated a reasonable causal relationship between noise exposure and adverse human health effects have been estimated. All the health risks associated with noise exposure have been estimated by EEA based on exposure–response functions presented in the Environmental noise guidelines for the European region [9]. Additionally, baseline health statistics, such as incidence of and mortality rates from ischaemic heart disease per country, were used to estimate the number of cases of ischaemic heart disease and the number of premature deaths attributable to noise per year.

- Annoyance (-WHO [9]—exposure–response functions)
- Sleep disturbance (-WHO [9]—exposure–response functions)
- Ischaemic heart disease (-WHO [9] —do not make a recommendation to include these for aviation noise, however, EEA assumed that the cardiovascular effects of road traffic noise can be extrapolated to aircraft noise [10])
- Reading and oral comprehension in children -cognitive impairment- was included following the recommendation of [10]
- Premature mortality due to IHD was included following the recommendation of [10]

The health impacts were estimated using the number of people exposed to levels of noise starting at 55 dB Lden and 50 dB Lnight, as reported under the Environmental Noise Directive (END). The results quantify the concrete health effects of noise in Europe and are easily understood by the public and other stakeholders [10].



Aviation noise health effects estimation. NCF519

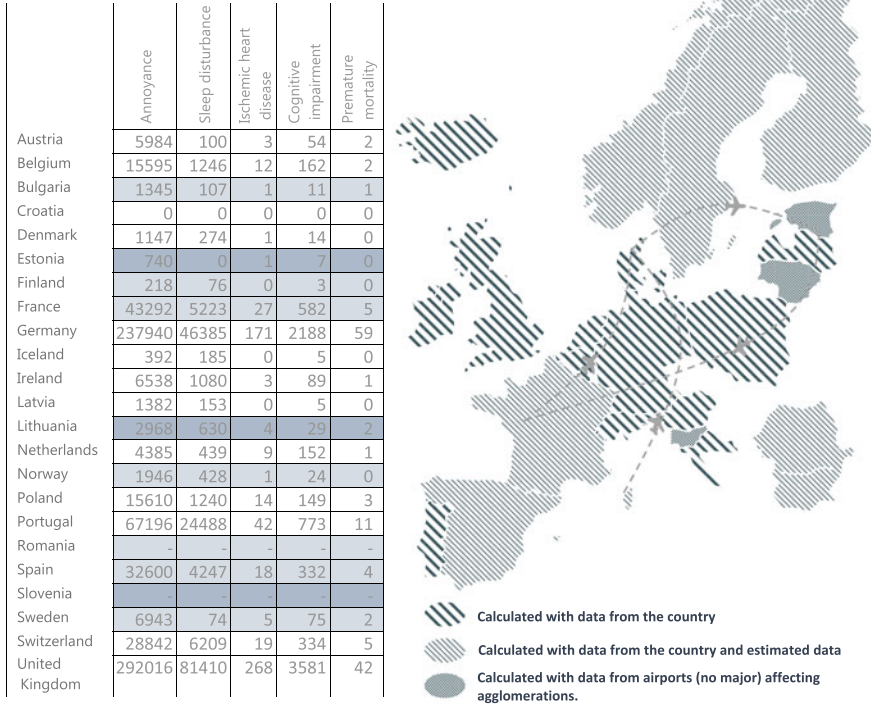


Fig. 4 People health affected by aviation noise in Europe

Nevertheless, uncertainties must also be taken into consideration. The methodology for calculating the burden of disease for noise is not well established and needs more data and further research across the various European countries (Fig. 4 and Tables 1 and 2).

Burden of Disease

Health risks can also be expressed in terms of Disability-Adjusted Life-Years (DALYs). The calculation requires the use of disability weighting as well as data on years of life lost and years lived with disability due to ischaemic heart disease per country. These data were taken from the Institute for Health Metrics and Evaluation.

The DALY estimates how much disease affects the life of the population by combining the burden from mortality, in terms of Years of Life Lost (YLL) because

Table 1 Relationships between noise and the health effects used by EEA in all the sources consulted

Health effect	Relationship
High annoyance (all people exposed)	Guski et al. [7] $(-50.9693 + 1.0168 \times Lden + 0.0072 \times L^2den)/100$
High sleep disturbance (all people exposed)	Basner and McGuire [1] $(16.7885 - 0.9293 \times Lnight + 0.0198 \times L^2night)/100$
Reading comprehension (children exposed)	Clark et al. [2] and van Kempen [11] $1/(1 + \exp(-\ln(0.1/0.9) + (\ln(1.38)/10 \times (Lden - 50))))$ if $Lden \geq 50$ dB and 0.1 if $Lden < 50$ dB
Ischaemic heart disease incidence (all people exposed)	van Kempen et al. [12] relative risk (RR) derived from road noise (applied to aviation with not significant evidence) $RR = \exp(\ln(1.08)/10 \times (Lden - 53))$ if $Lden \geq 53$ dB, and $RR = 1$ if $Lden < 53$ dB
Premature mortality due to ischaemic heart disease (all people exposed)	van Kempen et al. [12] RR derived from road noise (applied to aviation with not significant evidence) $RR = \exp(\ln(1.05)/10 \times (Lden - 53))$ if $Lden \geq 53$ dB, and $RR = 1$ if $Lden < 53$ dB

Table 2 Estimated number of people health affected by aviation noise, EEA-33 (Turkey not included)³

	High annoyance	High sleep disturbance	Ischaemic heart disease	Premature mortality ^a	Cognitive impairment in children
Inside urban areas	848 300	168 500	700	200	9 500
Outside urban areas	285 400	82 900	200	50	2900

^aRefers to mortality due to ischaemic heart disease.

of premature death due to disease, and morbidity, in terms of Years of Life Lived adversely affected by Disease (YLD). One DALY corresponds to one lost year of a healthy life, attributable to morbidity, mortality or both. The disability weighting used are described in the WHO [9] (Fig. 5).

We argue in ANIMA for better communication and engagement, especially with the public and affected communities. The use of a term such as DALY can make such communication challenging: it is not readily comprehensible to the general public and this is undesirable. The fact that it needs further explanation could lead to

³ EEA 2020 Environmental noise in Europe report (ENER), Table 3.5.



Noise burden estimation. NCFS19

	Years Lived with Disability - YLD	Years of Life Lost - YLL	Disability-Adjusted Life-Years - DALYS	DALYs/yr per 100000
Austria	129	13	142	2
Belgium	404	22	426	4
Bulgaria	35	8	43	1
Croatia	0	0	0	0
Denmark	43	2	45	1
Estonia	15	3	18	1
Finland	9	1	24	0
France	1245	55	1300	2
Germany	8092	656	8723	11
Iceland	21	1	22	6.5
Ireland	209	10	219	5
Latvia	20	3	23	1
Lithuania	105	20	125	4
Netherlands	327	15	337	2
Norway	70	3	73	1
Poland	406	50	456	1
Portugal	3082	129	3213	31
Romania	-	-	-	-
Spain	958	43	981	2
Slovenia	-	-	-	-
Sweden	146	13	159	2
Switzerland	1022	55	1077	13
United Kingdom	11637	537	12602	19



Fig. 5 Aviation noise burden estimation in Europe

an unintended element of obfuscation which would not be acceptable for clear and succinct communication. Also, DALYs have considerable data requirements which may not be economically justifiable in increasingly financially straightened times.

Uncertainties in the Estimation Data

Uncertainties in the exposure level. Data collected in the 3rd round under the END do not cover all aviation sources as discussed earlier, nor do they cover populations exposed to levels of noise below 50 dB Lnight and 55 dB Lden -although Lden/Lnight 45/40 were suggested by WHO [9]. Noise data from different countries, regions or cities may be modelled using different methodologies, and are often reported late or in different ways (due to a lack of internal coordination in some countries). All of these issues introduce some inconsistencies into the EU wide combined

dataset. The completeness of the aviation data reported for the 2017 round of noise mapping is about 66% -75%. Therefore, gap-filling data were used to estimate the total area covered by the END following a clear methodology to estimate missing data. ETC/ATNI Report 1/2019: Noise indicators under the Environmental Noise Directive. Methodology for estimating missing data.—Eionet Portal (europa.eu).

Uncertainties in the population exposed.⁴ Different countries use varied methodologies to assign the population to dwellings, which creates inconsistencies. In addition, the exact distribution of the population per decibel level is not known, as reporting is aggregated into 5 dB bands.

Uncertainties arising from the baseline and health data.⁵ Baseline morbidity and mortality data are based on national statistics. Therefore, using national health data for other sub-national units (e.g. urban areas) may bring about uncertainties, as health baseline data may not apply to the territory uniformly.

Uncertainties arising from the exposure–response functions used.⁶ Using the generalised exposure–response functions from the World Health Organisation may introduce uncertainties, for example, if the magnitude of the exposure–response estimate in different countries varies with age and gender distributions [10]. The health impact depends on the ‘baseline’ prevalence (frequency) or incidence (new cases per year) of health effects. These differ between countries and were taken into account in the calculations. The calculations in this assessment include a non-uniform distribution across noise bands, which was estimated using a 1-dB resolution for calculating the average exposure in each band. The methods employed for this Health Impact Assessment (HIA) are described in more detail in ETC/ACM [6].

The results of acoustic insulation interventions or a quiet façade implemented in the surroundings of one airport **are not reflected** within the conclusions of noise exposure maps provided in the 3rd round. Noise insulation measures or façade interventions might have significantly reduced the indoor exposure and thereby annoyance and sleep disturbances.

Challenges for the Near Future

It is evident that there need to be movements towards more reliable data collection and improved development of knowledge about the noise burden and how it can be addressed effectively and efficiently.

The chapter describes the data collected and the directives that govern its acquisition. There are evident inconsistencies across the piece and it is important that solutions be considered to address the exceptions from the scope, the method and the data collection. In addition, there need to be efforts made to reduce the number

⁴ EEA 2020 Environmental noise in Europe report (ENER).

⁵ EEA 2020 Environmental noise in Europe report (ENER).

⁶ EEA 2020 Environmental noise in Europe report (ENER).

of data missing from various countries. This needs to be complemented by improved national and EU-country coordination.

Also, there would seem to be a need to reduce the time spent on obtaining better and updated results with higher quality. For example, the estimation of health impacts from the 2016 data were not made available until the end of 2020, yet data from some countries was still missing.

As the ANIMA work has revealed throughout, effective communication of information to the public is vital for progressive policy-making, community learning and intervention development to address noise and health concerns. To this end, the public should be presented with clear horizons and noise objectives for both individual airports and countries.

It is equally important to tackle differences in the estimations of health effects by country and within a country. Thus, for example, it is also essential to investigate the application of interventions like noise insulation within the estimation of harmful effects, especially in light of the newly published Annex III.

ANIMA research on noise and health [8] calls for efforts to build consensus on what constitutes a socially acceptable response to the challenge of health risk reduction in the EU. It underlines that addressing sleep disturbance and annoyance is most important as research moves forward, indicating that these two elements are associated with annoyance in local communities and that persistent annoyance has been linked to adverse health effects through the stress mechanism. By reducing both sleep disturbance and annoyance, it follows that there should be a decrease in adverse health effects of aircraft noise. (Please see Chap. 9 for further details.)

Comprehensive approaches to lessening the burden of aircraft noise should be based on sound frameworks that are built on consistent and reliable data that clearly communicates the noise picture across the EU. With consistent, improved and timely data availability that is open to comparison across and within territories, the emerging extent of the noise burden can be more easily understood. This would allow, for example, for the assessment of noise interventions (e.g. sound insulation) across different geographical areas and increased knowledge of how they may be applied and adapted to better suit local conditions, with associated lowering of adverse health impacts. While, at the same time, this would enable shared learning for airport operators which may preclude unnecessary and expensive trials if good practice is revealed and built upon instead. In this way, financial and other resources may be released from investment in insulation and may be better used to address health impacts of noise through effective engagement with affected communities to co-design alternative and/or improved interventions and offers that optimally serve their experience and needs.

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