Aviation Noise Attitudes Survey 2023-2024

CAP 3131

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Executive Summary

Study aims

S1 This report provides findings from the Aviation Noise Attitudes Survey 2023-2024 (ANAS). This study gives evidence of current attitudes to aviation noise around airports in the UK. ANAS was commissioned from the CAA by the Department for Transport and builds on earlier noise attitudes surveys, such as the Survey of Noise Attitudes, (SoNA) 2014.

S2 The study aims as originally set out were:

Main aims:

i) To provide data on the relationship between aviation noise exposure and annoyance in order to inform government policy development in the UK

ii) To provide evidence to inform policy thresholds and metrics such as for DfT's Transport Analysis Guidance (TAG)

iii) To provide evidence on how annoyance to aviation noise varies across personal, social and environmental contextual factors

Secondary aims:

iv) To provide exposure-response analysis for specific airports in the study

v) To provide associations between aviation noise exposure and health and wellbeing measures

vi) To track trends over time through the survey being regularly repeated

S3 The report focuses on the main aims i) and ii), as well as the secondary aims iv) and vi), to ensure that this information is published as soon as possible. It is intended that future analysis would address the remaining aims (iii and v).

Survey and analysis methodology

S4 ANAS is a socio-acoustic study designed to understand how people perceive, experience, and are affected by aviation noise. It combined noise acoustic modelling with subjective information collected via questionnaires sent to people living in the vicinity of airports in the UK.

S5 Respondents were selected using a random, un-clustered approach[1] from around ten airports in England and Scotland, having been estimated to be exposed to aircraft noise level of at least 45 dB $L_{Aeq,16h}$ in the summer of 2023. The ten airports surveyed were:

- Birmingham
- East Midlands
- Edinburgh
- Glasgow
- Leeds Bradford
- London City
- London Gatwick
- London Heathrow
- Luton
- Manchester

S6 The aim was to select 500 people from six 3 dB wide noise bands from 45 dB $L_{Aeq,16h}$ to more than 60 dB $L_{Aeq,16h}$. Three additional noise bands were subsequently incorporated into the survey design at Birmingham, London Heathrow and Manchester airports, to separate the more than 60 dB $L_{Aeq,16h}$ band into two bands, 60-62.9 dB and 63 and above dB respectively.

S7 The survey was administered in two waves, the first wave between September and November 2023 and the second wave between March and May 2024. After excluding respondents that were not resident for at least three months prior to each wave, Wave 1 achieved 29,792 responses (almost twice than originally planned due to uncertainty regarding anticipated response rates that led to intentional oversampling), and Wave 2 achieved 15,694 responses for a combined total of 45,486 responses.

S8 The survey used the ISO/TS 15666:2021 recommended 5-point verbal scale and 11-point numerical scale of reported annoyance from aircraft noise and analysed responses using all three definitions of being highly annoyed in ISO/TS 15666:2021. From the two scales recommended in ISO/TS 15666, it recommends three thresholds for defining if a response should be categorised as being highly annoyed. Of the three thresholds, HA_N was selected as the definition for core analysis and reporting.

[1] Historically, surveys of this nature were undertaken using face-to-face interviews. Respondents were typically sampled in clusters of around 30 people, in order to make data collection practical and efficient for interviewers. In contrast, an un-clustered survey is where individual addresses are drawn at random from an address database and there is no clustering or grouping of address selection, i.e. the address selection is un-clustered. This offers advantages in that much broader geographic areas can be surveyed than compared with a clustered approach.

How does annoyance relate to exposure?

$L_{Aeq,16h}$

S9 The core survey annoyance questions were Q5-Q8, which asked views over the past three months and past 12 months on two different annoyance scales. Q8 was the question used to determine the final SoNA exposure-response function:

> *Thinking about the last three months or so, when you are here at home, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by noise from aeroplanes?*

S10 According to ISO/TS 1566, responses of 8, 9 or 10 represent being highly annoyed (HA_N). The percentage of respondents found to be highly annoyed was found to be correlated with both average summer day and average annual 24h noise exposure. The exposure-response function found is not linear, but follows a logistic function, a S-shaped curve that is bounded at 0% highly annoyed at low noise levels and 100% at high noise levels.

S11 Figure S1 presents the overall exposure-response function during the last 3 months (Q8) Wave 1, HA_N, along with the envelope of the individual airport exposure-response functions.

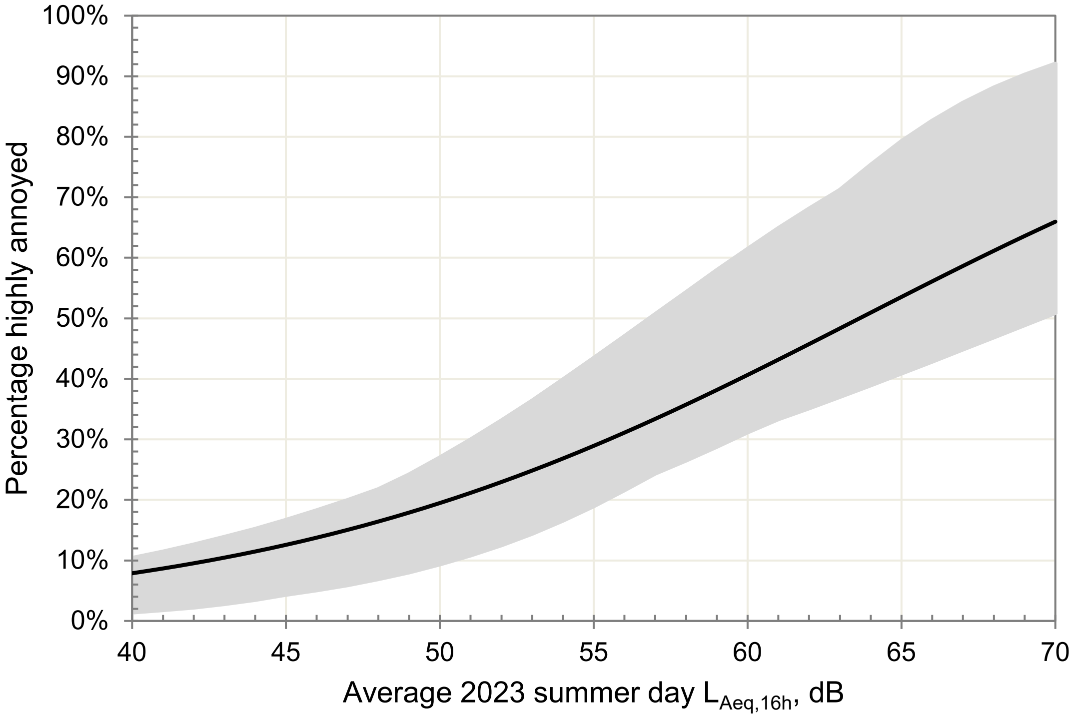
S12 At 40 dB $L_{Aeq,16h}$[2], the percentage highly annoyed is 7.9%, at 50 dB $L_{Aeq,16h}$ it is 19.5%, at 60 dB $L_{Aeq,16h}$ it is 40.6%, at 70 dB $L_{Aeq,16h}$ it is 66.0%.

S13 Between 55 dB and 75 dB $L_{Aeq,16h}$ the combined airports exposure-response function is approximately in the middle of the range of individual airport functions. Below 55 dB $L_{Aeq,16h}$ the combined airports exposure-response function lies in the upper half of the range of individual airport functions.

S14 Individual airport exposure-response functions show the expected large variation between individual airports, though the variation is less than observed in a similar recent study (the US FAA Neighborhood Environmental Survey).

[2] Addresses were sampled based on a forecast noise exposure level of at least 45 dB $L_{Aeq,16h}$. However, as noted in para 5.19, noise exposure levels calculated after survey were found to be lower for some addresses, due to a combination of deviations from long-term wind patterns that altered anticipated runway use and, in some cases, lower than expected growth as aviation continued to recover from the Covid-19 pandemic.

Figure S1 Percentage highly annoyed exposure-response function during the last 3 months for Wave 1, (HA_N Q8) and the envelope of all individual airport exposure-response functions (N=29,792)



L_{den}

S15 Because L_{den} is an annual weighted noise metric[3], it was considered most appropriate to develop an exposure-response function for both Waves 1 and 2 combined, reflecting both an average annual noise dose and an average annualised response. Responses based on attitudes regarding the last 12 months on an 11-point scale (Q6) were used to determine this exposure-response function.

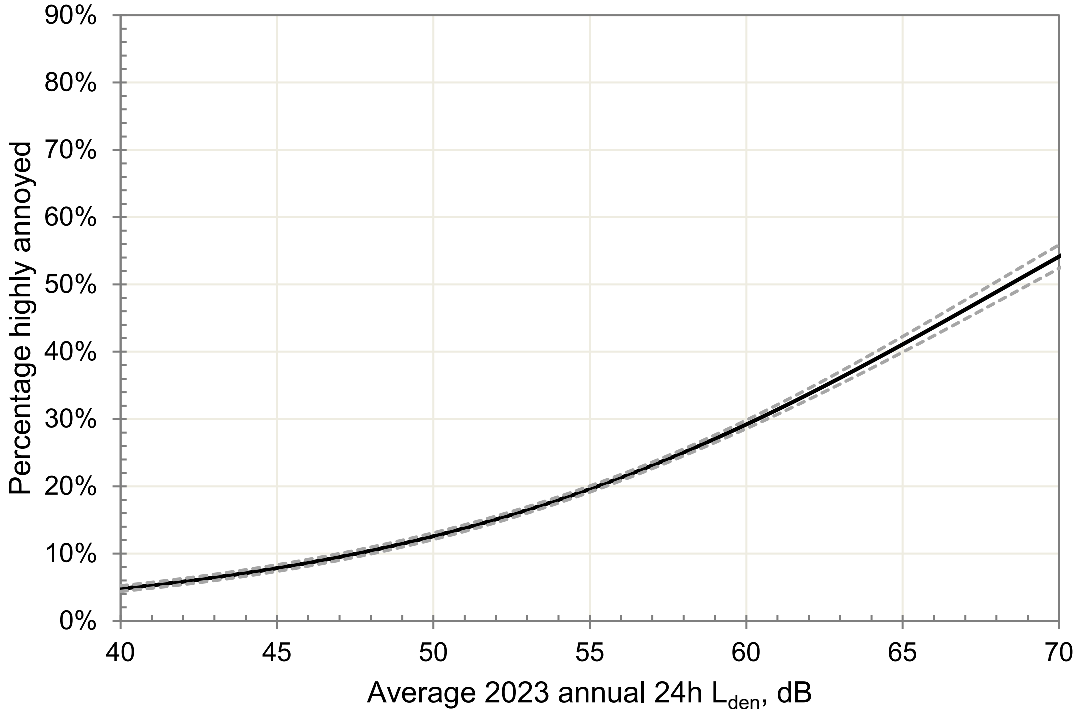
S16 Because the Wave 2 sample size was smaller than Wave 1, it was scaled up to the same size as Wave 1.

S17 Figure S2 presents the exposure-response function for Waves 1 and 2 combined based on attitudes regarding the last 12 months using the ISO numerical scale HA_N (Q6) and the L_{den} noise metric.

S18 At 40 dB L_{den}, the percentage highly annoyed is 4.8%, at 50 dB L_{den} it is 12.6%, at 60 dB L_{den} it is 29.2%, and at 70 dB L_{den} it is 54.1%.

3 L_{den} is an annualised weighted noise metric with three periods, a daytime period from 7am to 7pm with a weighting of 1, an evening period from 7pm to 11pm with a weighting of 3.16 (5 dB added to each evening flight) and a night period from 11pm to 7am with a weighting of 10 (10 dB added to each night flight).

Figure S2 Percentage highly annoyed for all airports with 95% confidence interval, last 12 months, (HA_N Q6), Waves 1 and 2 combined, L_{den}, (N=45,449[4])



N65

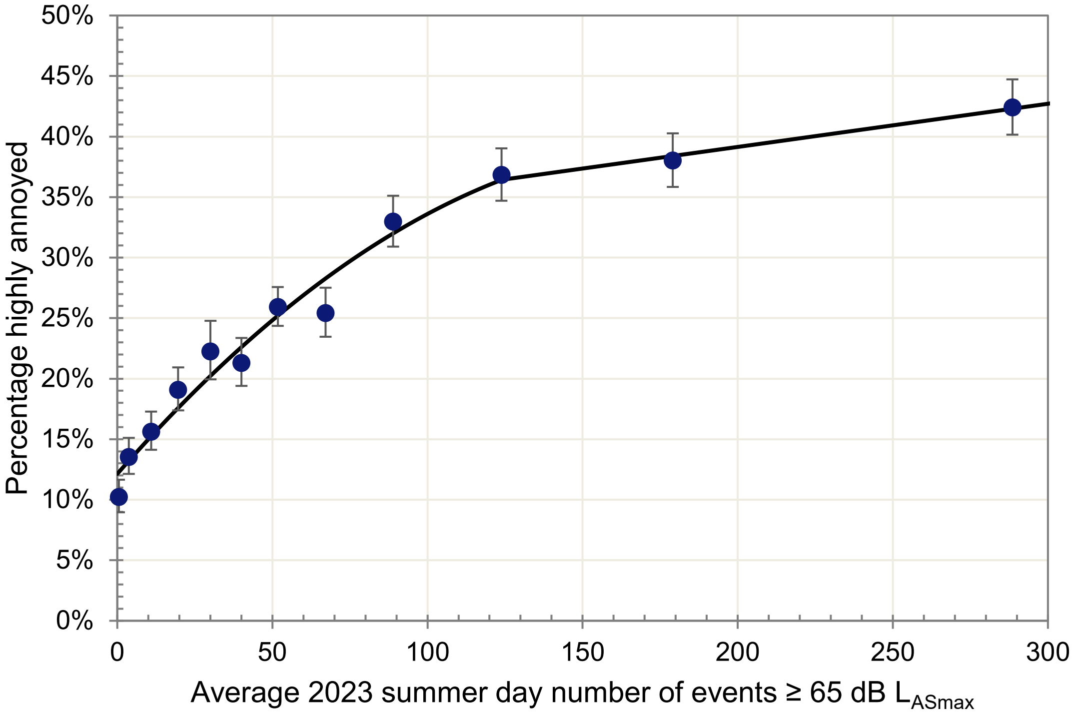
S19 The exposure-response function associated with the average summer day noise metric N65 was neither linear nor followed a logistic function. Initially it follows a quadratic function, but then the percentage highly annoyed rises at a lower rate with respect to N65 noise exposure.

S20 Therefore, a quadratic model[5] was fitted up to a 'knot' at N65 = 124, where the exposure-response function transitioned to a linear model. The resulting exposure-response function is shown in Figure S3.

[4] Although the survey samples for Waves 1 and 2 for Q7-Q8 were 29,792 and 15,694 respectively, some paper questionnaires were returned without Q5-Q6 completed, and thus sample sizes decrease slightly with respect to analysis of Q5-Q6. Consequently, for Q6 the combined sample was 45,449, rather than 45,486 (combined sample for Q7-Q8).

[5] A quadratic model or function is a function that has a square term as well as linear and constant terms. Thus, the function is dependent on noise exposure level squared as well as a term multiplied by noise exposure and a constant.

Figure S3 N65 exposure-response function for all airports, last 3 months, HA_N (Q8), Wave 1, overlaid with data for twelve N65 noise exposure groups (N=29,792)



S21 At zero N65, the $\%HA_N$ is 12.1%, at 50 N65 it is 24.8%, at 100 N65 it is 33.6%, at 200 N65 it is 39.1%, and at 300 N65 it is 42.7%.

How does annoyance vary over time?

S22 The percentage highly annoyed was calculated for both the last three months (Q8) and the last 12 months (Q6). The percentages for both time periods differed between Wave 1 and Wave 2. The difference was greater for attitudes related to the last three months (Q8) (Figure S4) than for the last 12 months (Q6) (Figure S5). The difference in $\%HA_N$ from Q6 between both Waves ranged from 1.4% to 3.6%.

S23 When the two waves were combined, the difference between the resulting exposure-response function and the function using either Wave 1 or Wave 2 was comparable to the 95% confidence interval from either Wave. This suggests that attitudes relating to longer term periods, e.g. 12 months, are more stable over time than attitudes regarding shorter periods. This is the first UK study to produce such evidence.

Figure S4 Exposure-response function for all airports, based on attitudes during the last 3 months, HA_N (Q8), Wave 1 (N=29,792) and Wave 2 (N=15,694)

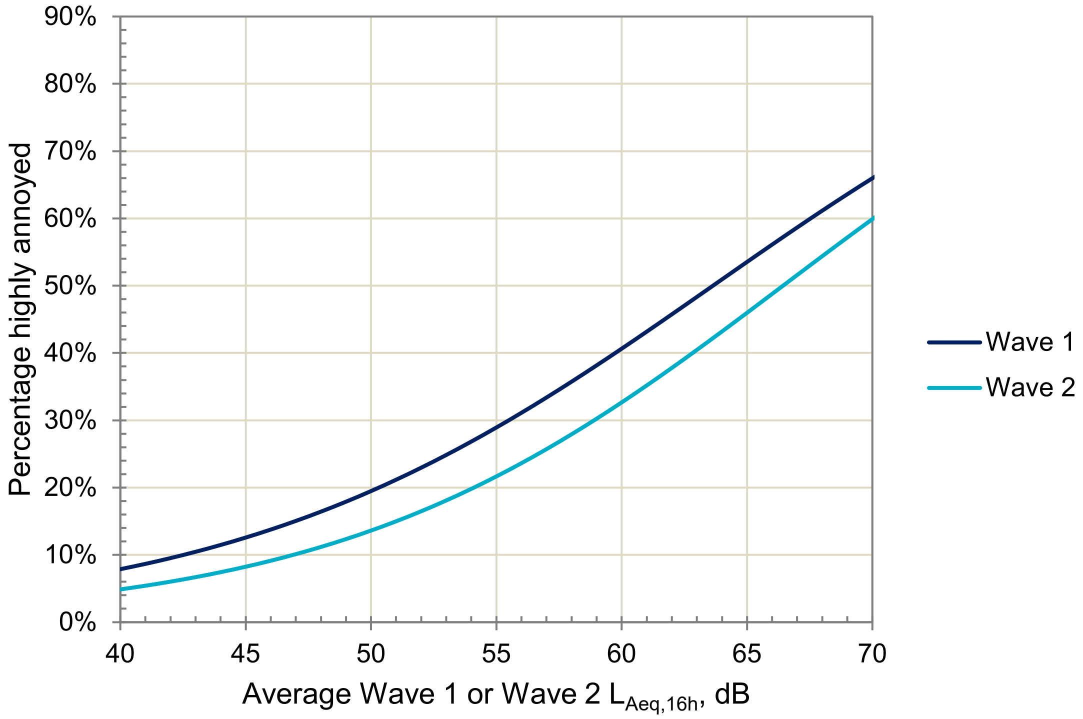
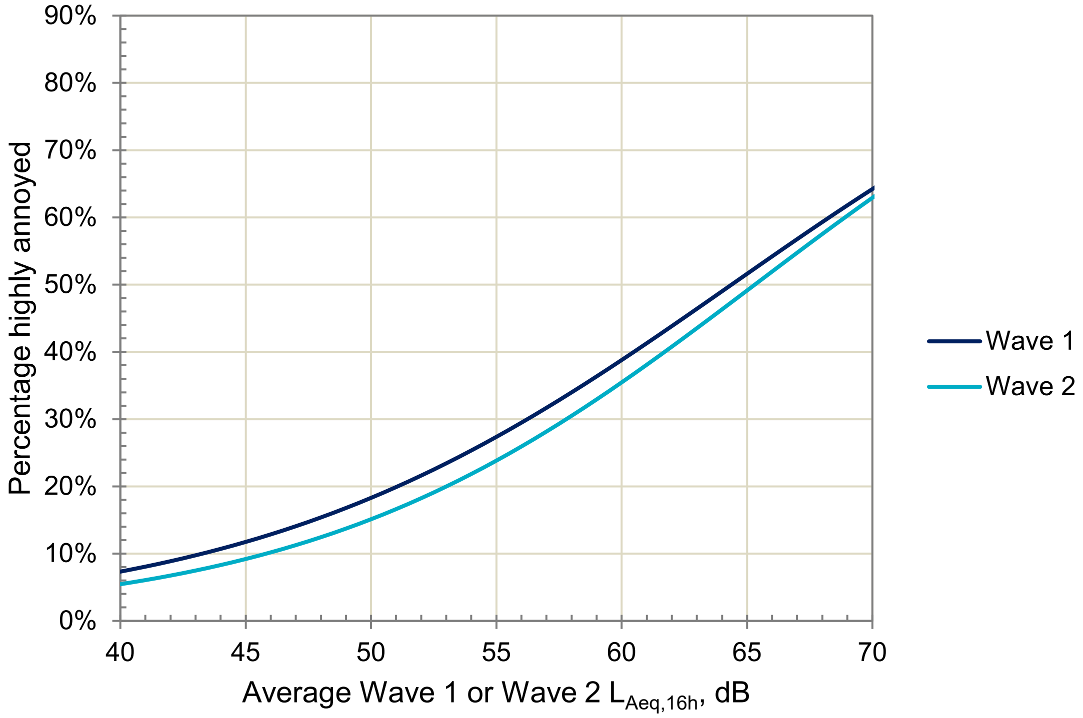


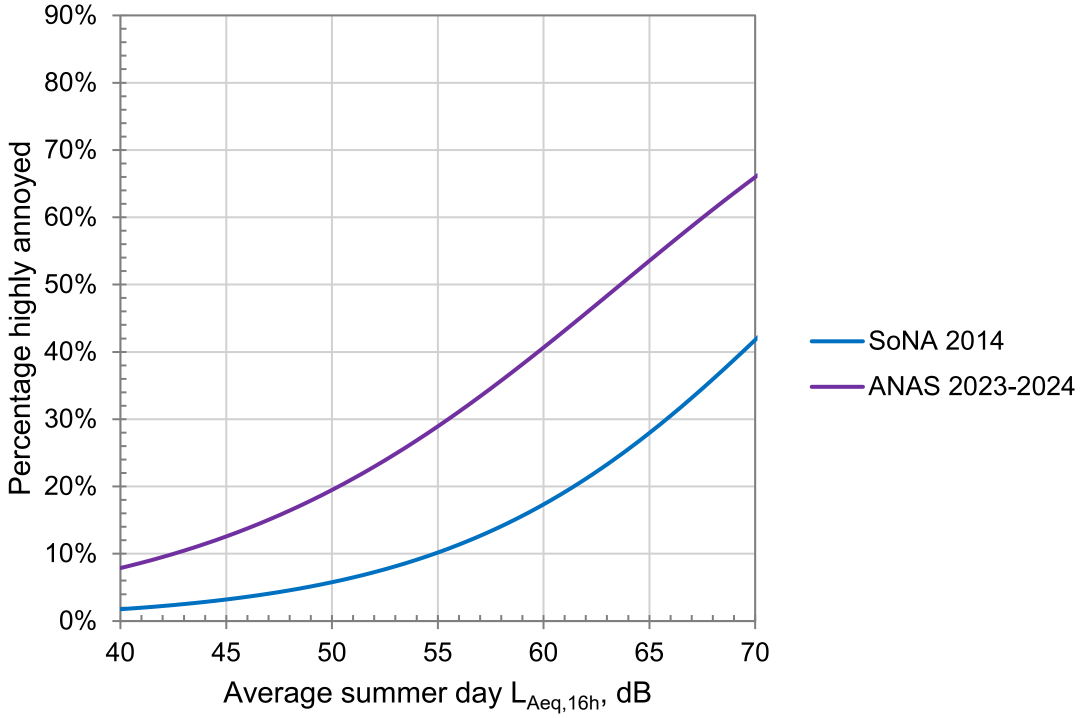
Figure S5 Exposure-response function for all airports, based on attitudes during the last 12 months, HA_N (Q6), Wave 1 (N=29,770) and Wave 2 (N=15,679)



How do the results compare with SoNA 2014 and WHO 2018?

S24 The exposure-response function for ANAS 2023-2024 (Wave 1) is found to differ markedly from SoNA 2014 (Figure S6). The average noise level corresponding to 10% of the population highly annoyed was found to occur at around 43 dB $L_{Aeq,16h}$, compared with 54 dB $L_{Aeq,16h}$ for SoNA 2014.

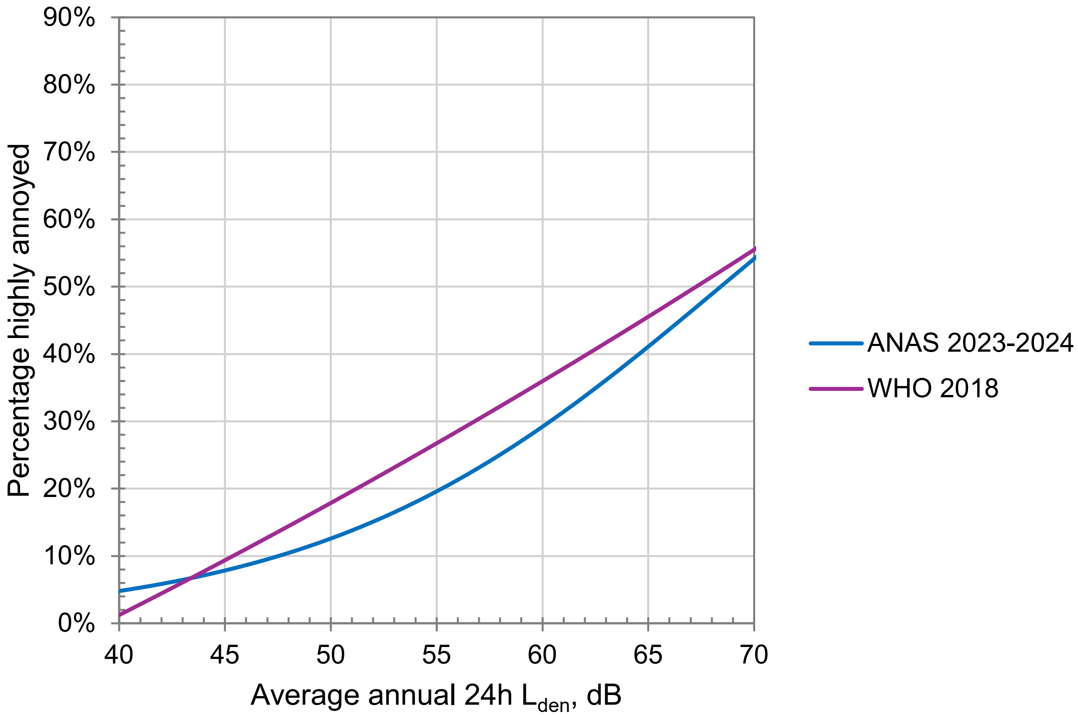
Figure S6 Comparison of the ANAS 2023-2024 exposure-response function to SoNA 2014 based on attitudes during the last three months, HA_N (Q8), Wave 1



S25 This change is not the result of surveying to lower noise levels. The percentage highly annoyed from ANAS 2023-2024 is found to be higher than SoNA 2014 at all noise exposures, including in the same geographical areas surveyed in SoNA.

S26 Comparing against the WHO 2018 the ANAS 2023-2024 function is similar (Figure S7), but the function is less linear and, whilst within a few percent of the WHO function at around 45-50 dB L_{den}, at 55 dB L_{den} it is 7% lower than the WHO 2018 function. At 65 dB L_{den} it is 4% lower than the WHO 2018 function.

Figure S7 Comparison of ANAS 2023-2024, HA_N (Q6) with WHO 2018



Have noise attitudes changed between SoNA 2014 and ANAS 2023-2024?

S27 It is not possible to attribute changes between 2014 and 2023-2024 quantitatively to specific reasons. There are both methodological and societal differences that prohibit a direct comparison between the results of the SoNA and ANAS 2023-2024 results.

Recommendations for future surveys

S28 ANAS 2023-2024 has established a new way of administering aviation noise attitude surveys in the UK. It is not only the largest survey of its kind in the UK but also one of the largest globally by number of people surveyed. It is recommended that future surveys build on this legacy.

Chapter 1

Introduction

Aviation Noise Context

1.1 This report provides findings from the Aviation Noise Attitudes Survey 2023-2024 (ANAS). This study gives evidence of current attitudes to aviation noise around airports in the UK. ANAS was commissioned from the CAA by the Department for Transport and builds on earlier noise attitudes surveys, such as the Survey of Noise Attitudes, (SoNA) 2014[6].

1.2 Fieldwork for the study took place almost a decade after the predecessor study, SoNA 2014. During that period, several contextual factors may have influenced attitudes to noise. For example, sustained growth from 2014 to 2019 was disrupted by Covid-19 (which had far-reaching impacts on the economy and lifestyle choices) and followed by a rapid recovery of aviation activities in the years leading up to this study.

1.3 Whatever the prevailing contextual factors, including actual or proposed changes to normal or previous levels of exposure, it remains essential that accurate information is available to explain how populations are affected at this point in time. In producing this study, we are updating the evidence base of how annoyance varies with noise exposure levels. This is essential since, while noise from aeroplanes is often cited as one of the trade-offs for the convenience of air travel, it is recognised that it can affect human health and wellbeing in a variety of ways.

1.4 Government and the aviation industry have worked towards reducing the impact of noise by promoting the use of quieter aircraft, effective land use planning where possible, restricting the times airports can operate and the routes that can be used and, in some cases, capping the total number of flights that can depart from and arrive at an airport. The Government's overall noise policy on aviation noise is "to balance the economic and consumer benefits of aviation against their social and health implications in line with the International Civil Aviation Organisation's Balanced Approach to Aircraft Noise Management."[7]

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6 CAP 1506, Survey of Noise Attitudes, first published February 2017, second edition, July 2021, Civil Aviation Authority.

7 Department for Transport (2023) *Overarching aviation noise policy* – Available at: GOV.UK

1.5 Adverse effects can be defined as those related to health and quality of life. There is no one threshold at which all individuals are considered to be significantly adversely affected by noise.

1.6 The following aims were established for ANAS to deliver:

Main aims:

iii) To provide data on the relationship between aviation noise exposure and annoyance in order to inform government policy development in the UK

iv) To provide evidence to inform policy thresholds and metrics such as for DfT's Transport Analysis Guidance (TAG)

v) To provide evidence on how annoyance from aviation noise varies across personal, social, situational and physical contextual factors

Secondary aims:

vi) To provide exposure-response analysis for specific airports in the study

vii) To provide associations between aviation noise exposure and health and wellbeing measures

viii) To track trends over time through a survey being regularly repeated

1.7 With regard to the first aim in paragraph 1.6, in this field, a relationship between aviation noise exposure and annoyance are often referred to as Exposure-Response Function (ERF)[8] and this is the term used throughout this report. Data on the relationship is interpreted to mean the national relationship between aviation noise exposure and annoyance, i.e. representative on UK populations living in the vicinity of UK airports.

1.8 During the development and detailed design of the study methodology an additional aim was identified: to provide evidence on the impact of seasonality on annoyance. This aim had a significant impact on the overall study design and is described further in Chapter 3, which covers Methodology.

1.9 This report focuses on our analysis supporting aims (i) and (ii), principally reporting on the main 'annoyance questions' in the survey. The scale and size of the study present us with vast analytical potential. In recognition that there is a keen interest in the results from ANAS amongst a broad range of aviation stakeholders, we have taken the approach of prioritising the analysis from the survey which will produce new and updated Exposure-Response Functions from the data. These are provided in Chapter 5 of the report.

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8 See paragraph 2.2 for a definition of Exposure-Response Function (ERF).

1.10 The findings of this report focus on daytime exposure. A separate study, the Aviation Night Noise Effects (ANNE) study, is being undertaken by the Department for Transport (DfT) and is focussed on understanding the relationship between night-time aviation noise and sleep disturbance and annoyance. Consequently, this report does not include data on associations with night noise indicators.

Study Structure

1.11 The report is structured as follows:

- Background
- Project governance
- Methodology
- Social survey results
- Noise exposure and annoyance
- Summary
- Appendices

List of Appendices

1.12 Appendix A provides a glossary to the report, giving definitions of the more commonly featured technical terms concerning aircraft and airport operations used here. Appendix B provides a brief overview of the characteristics and lead findings of some prior UK and International noise attitude surveys. Appendix C reproduces the survey questionnaire. Appendix D provides information on the areas surveyed around the ten airports studied. Appendix E gives information on exposure-responses functions not included in the main report text. Appendix F gives information on noise attitudes by individual airport. Appendix G gives information on the local context around each airport that may have affected the survey.

Chapter 2

Background

2.1 This section outlines broader contextual factors including definitions of noise indices relevant to the study. It also identifies other similar studies on aviation noise annoyance.

2.2 For the purposes of managing aviation noise and, indeed, noise from other sources, is it essential to have information on how people are bothered, disturbed or annoyed by a certain amount of noise. In such situations, the outcome is referred to as the 'response' and the input that generates the response is the exposure. By assessing different combinations of exposure and response a relation or Exposure-Response Function (ERF) can be estimated. Such functions are used to assess the impact of policy interventions and prioritise mitigations.

2.3 In the context of aviation noise (and transport noise), the determination of average community response has evolved over the last 70 years, and the way the responses are determined through surveys is now carefully controlled and governed through international standards (see paragraph 3.9).

2.4 This study is primarily concerned with responses to daytime noise exposure. Whilst day and night-time noise exposure are linked, the effect of night noise on sleep gives rise to other impacts e.g. on sleep patterns, which a separate DfT sponsored study is obtaining evidence on.[9]

2.5 An annoyance threshold currently exists within UK policy for the purposes of managing aviation noise. The time period for noise exposure used is an average summer day, from June 16th to September 15th and from 7am to 11pm. The Wilson Committee report (1963) originally recommended the use of summer days (7am – 7pm) due to the increased likelihood of more people being outdoors and having windows open, and also because aviation levels are at their highest during summer months. The 1982 Aircraft Noise Index Study[10] concluded that a 24h metric was the best indicator in terms of correlation with annoyance, but it acknowledged that going from the prior 12h NNI to a 24-hour indicator was a big jump, and noted that since 16h was almost as good an indicator as 24h, it was a good compromise. The outcomes of ANIS were adopted in policy in 1990, and thus extended the original reference day period to 16 hours, from 7am to 11pm to reflect that there is a difference in terms of daytime and night-time noise

9 Aviation Night Noise Effects (ANNE) FAQs | City St George's, University of London

10 DR report 8402, United Kingdom Aircraft Noise Index Study: main report, CAA, January 1985.

exposure and consequently, annoyance reactions, resulting in the need for distinctive daytime and night-time noise exposure metrics. The noise exposure metric $L_{Aeq,16h}$, was adopted in 1990 based on the ANIS findings. The UK government defined three thresholds for policy consideration: 57, 63 and 69 dB $L_{Aeq,16h}$, representing low, moderate, and high annoyance levels.

2.6 The 2003 Air Transport White Paper subsequently defined 57dB $L_{Aeq,16h}$ as marking the approximate onset of significant community annoyance, and this was reaffirmed in the Government's 2013 Aviation Policy Framework. Critics argue that attitudes have changed since the 1982 survey. This could be due to a number of factors, including general shifts in attitudes to environmental exposures, changes in the pattern of aircraft noise experienced, changes in housing stock and/or because of changes to lifestyle that are affected by aircraft noise. This ultimately led to the UK government commissioning the Survey of Noise Attitudes (SoNA) 2014: Aircraft Noise and Annoyance study.

2.7 The government published their Response to their Airspace Consultation in 2017[11] and acknowledged the evidence from the SoNA study, which showed that sensitivity to aircraft noise has increased, "with the same percentage of people reporting to be highly annoyed at a level of 54 dB $L_{Aeq,16h}$ as occurred at 57 dB $L_{Aeq,16h}$ in the past". The same consultation response also noted, "The research [SoNA] also showed that some adverse effects of annoyance can be seen to occur down to 51dB $L_{Aeq,16h}$". The supporting Impacting Assessment[12] also noted that 51 dB $L_{Aeq,16h}$ was "the lowest level at which it is currently possible to reliably attribute the effects to the level of aviation noise itself", and that "Supplementary event-based metrics for overflight frequency… …are proposed to reflect the fact that there are people outside the 51 dB average noise contour who are affected by aviation noise."

2.8 Taking account of these and other evidence on the link between exposure to noise from all sources and chronic health outcomes, the government decided to adopt the risk-based approach proposed in their consultation, meaning that airspace decisions are made in line with the latest evidence and consistent with current guidance from the World Health Organisation. This approach led to the government setting a LOAEL at 51 dB $L_{Aeq,16h}$ for daytime aviation noise, and 45 dB $L_{Aeq,8h}$ for night-time aviation noise.

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11 Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace, Cm 9520, Department for Transport, October 2017.

12 Assessing Aviation Noise Impacts during Airspace Change, Impact Assessment DfT00392, Department for Transport, October 2017.

Previous Equivalent Noise Attitude Studies

2.9 ANAS is the latest UK daytime noise attitudes survey and builds on the heritage of previous UK studies including SoNA 2014, ANASE 2007 and ANIS 1982. It also stands alongside various studies conducted outside of the UK.

2.10 Appendix B provides a brief overview of the characteristics and lead findings of some of these studies and some comparisons with our analysis from ANAS are provided in Chapter 5: Noise exposure and annoyance.

Project Governance

Transfer to CAA from ICCAN

2.11 ANAS was originally the responsibility of the Independent Commission on Civil Aviation Noise (ICCAN). ICCAN was established in 2019 as an independent non-departmental body with the objective of being the impartial voice on civil aviation noise and its impact on communities. ICCAN cited reviewing SoNA 2014 as an immediate priority and began with targeted discussions with acousticians, health experts, survey teams, aviation bodies, government, CAA and community groups. ICCAN also conducted desk research and ran a workshop to discuss SoNA 2014 before publishing its conclusions in December 2019.[13]

2.12 The report recommended that a new regular attitudinal survey was required to provide robust, up-to-date evidence to inform policy decisions. ICCAN commissioned the National Centre for Social Research (NatCen) to conduct a development study to explore options for the development of the new survey and reported its conclusions in 2021[14], including NatCen's report 'Recommendations on survey design'.[15] The issues arising from ICCAN's work are discussed in Chapter 3: Methodology, below.

2.13 ICCAN ceased operating on 30 September 2021 and in its place, CAA was asked by the Secretary of State for Transport to perform a range of research and policy advisory functions. ANAS was confirmed as part of the CAA's Additional Noise Advisory Functions under Section 16 Work Programme 2022/23[16] in April 2022.

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[13] https://webarchive.nationalarchives.gov.uk/ukgwa/20220414141043/https://iccan.gov.uk/iccan-our-work/publications/

[14] ICCAN - Designing an aviation noise attitudes survey (ANAS) - June 2021

[15] NatCen - ANAS - Recommendations on survey design - June 2021

[16] Letter from Department for Transport commissioning ANAS under CAA Act 1982 Section 16, 6 April 2022.

Stakeholder involvement in ANAS

2.14 CAA created a steering group to provide expert advice to support the study, with membership from the Department for Transport (DfT), the Department for Environment, Food & Rural Affairs (Defra) and the UK Health Security Agency (UKHSA). The steering group provided expert advice to ensure that a robust and practical design was achieved for the project, given the study aims. The steering group's role also ensures the results from the study can be held in a high level of confidence. The steering group was chaired by the CAA and met regularly to review progress and support decision-making throughout the duration of the study. CAA also sought advice from the CAA's Environmental Sustainability Panel[17] during the development of the study.

2.15 CAA recognised that ANAS was highly anticipated by a wide range of stakeholders. CAA engaged via a Communities Engagement Group, established by ICCAN, involving representation from the Aviation Environment Federation (AEF), the UK Airport Consultative Committees (UKACCs) and Heathrow Airport's Teddington Action Group. Meetings were held with the group to share information and invite input about the development of the study.

2.16 The CAA also established an Industry Engagement Group with representation from Airports UK (previously the Airport Operators' Association), Airlines UK, and Heathrow Airport, London City Airport and Manchester Airport Group (MAG). Meetings were held with the group to share information and invite input about the development of the study.

2.17 During the course of the study, the ANAS Steering Group also met with the two Engagement Groups.

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[17] The CAA Environmental Sustainability Panel is a specialist, non-statutory body providing expert technical advice to the CAA. The Panel supports and challenges us on the delivery of our environmental sustainability strategy as we develop our policy and position across our regulatory and advisory functions. Environmental Sustainability Panel | UK Civil Aviation Authority

Appointment of Ipsos UK

2.18 For a survey of this scale, it was necessary to appoint a specialist supplier; the CAA invited tenders for the work in autumn 2022 and appointed Ipsos UK as an independent supplier of survey development and delivery services in February 2023.

2.19 The role of Ipsos UK was to support the overall research design, including questionnaire design and sampling methodology. Ipsos also managed the survey data collection and processing and fieldwork logistics, provided data management and supplied survey response data file outputs fit for analysis purposes, to specifications agreed with CAA. While Ipsos participated in stakeholder meetings discussing methodological challenges, it did not make any decisions on the strategic direction of the survey.

Chapter 3

Methodology

Building on SoNA 2014

3.1 ICCAN published its initial review of SoNA 2014[18] in December 2019 followed by its recommendations for designing a new survey, in June 2021 in a report produced by the National Centre for Social Research (NatCen) for ICCAN[19]. The later report summarised its predecessor's findings as having concluded that 'the survey had sought to follow best practice in the methodology that was used within its budgetary constraints'. It continued: 'However, it was clear that there were disputes over the use of the evidence base from SoNA in relation to issues such as the change effect, the 'snapshot' nature of the study, the sampling methodology, the lower limit of 51 dB $L_{Aeq,16h}$, and its use in government policy settings'. ICCAN commissioned a development study 'to explore whether methodological improvements could be made for future attitudinal surveys of aviation noise'.

3.2 The NatCen report identified that the main aim for the survey should be "to provide up-to-date evidence on the relationship between aviation noise exposure and annoyance". It also commented on how frequently future surveys should be fielded, recommending that it 'should be repeated every 3-5 years with different participants at each wave'.

3.3 Further key recommendations from NatCen's review were recorded as follows:

- *"A range of noise metrics should be used to select the sample. The target population should be people who are currently exposed to aviation noise. This should be defined by average noise during the day ($L_{Aeq,16h}$) as the primary noise metric. However, other metrics should also be used in the stratification scheme when selecting addresses to participate in the survey, to allow for the full range of experiences of noise to be included.*
- *Sample should include those exposed to >45dB $L_{Aeq,16h}$. This is the lowest level where there is enough confidence in the data currently available to be accurate. There is too much uncertainty around the quantification of exposure below this level in current estimates.*

[18] ICCAN (2019), "Review of the Survey of Noise Attitudes 2014", Independent Commission for Civil Aircraft Noise, December 2019.

[19] ICCAN (2021), "Designing an aviation noise attitudes survey (ANAS)", Independent Commission for Civil Aircraft Noise, June 2021.

- *Recommended sample size is 6,500 respondents. This large sample size will ensure that robust measures of annoyance are produced for the key measures feeding into policy decisions. It will allow robust analysis to a more detailed level which would provide a deeper understanding of annoyance and its drivers. This includes analysis at an airport level, by aviation noise exposure band, and by exploring non-acoustic factors to identify key differences in annoyance.*
- *A purposive sampling method should be used to select airports included in the survey. Airport characteristics should be taken into account including airport size, urban/rural location, night operations and availability of exposure data.*
- *Recommend rolling fieldwork across all seasons of the year with as many as practically possible within summer period. A pre-set number of interviews will be allocated to take place in the summer period as this is currently a key measure used by policy makers. Data will be collected systematically for all sampled airports/acoustic bands. This will allow for representative seasonal analysis to establish how annoyance varies across the year and when annoyance is highest. This deeper insight will provide a more robust understanding of annoyance to be fed into policy making.*
- *Recommend face-to-face surveys administered by Computer Assisted Personal Interviews (CAPI-only) as the data collection method for the first round of this survey. CAPI-only is the most robust data collection method for the research questions this survey aims to address.*
- *The questionnaire developed should collect information on annoyance, socio-demographic factors, non-acoustic factors, standardised wellbeing measures, sleep, impact on day-to-day activities and perceptions of change in aviation noise exposure. The questionnaire is anticipated to last around 35 minutes.*
- *Consider running a web-pilot alongside the first wave of the survey. A web-CAPI mode would have some advantages for this survey and would offer some small cost savings per wave. However, there are risks and uncertainty about the robustness of a web-based method of data collection, therefore, it is recommended to run a web-pilot to test this method for future waves."*

3.4 The recommendations supplied by ICCAN provided helpful background for CAA when it began work on ANAS from April 2022.

General overview of research design

3.5 ANAS is a large-scale public survey using a push-to-web (online) approach for data collection, with postal completion offered as an alternative response mechanism. Fieldwork was conducted in two waves: September to November 2023 and March to May 2024. A random selection of households located around 10 UK airports was targeted, with an equal number of respondents sought from each airport and at each noise dose exposure level. The research design sought a total of 30,000 responses overall: 3,000 per airport and 500 for each individual 3-decibel noise band; the lowest band at 45-48 dB $L_{Aeq,16h}$ and the highest at 60 dB $L_{Aeq,16h}$ and above. An additional sample of 1,000 responses was targeted to enable further precision at higher exposure levels.

3.6 The research design for ANAS was developed in consultation with the steering group and drew on the extensive post-publication reviews of SoNA conducted by ICCAN/NatCen. The design phase also took into account new approaches to survey design as implemented in other comparable studies, such as the Swiss SiRENE and FAA's Neighborhood Environmental Survey (NES)[20]. The surveys, among the largest of their kind to date, introduced the concept of a sampling model based on achieving an equal number of responses per noise exposure level per airport as a design consideration for ANAS. The NES report explains that sampling weights were not used because of the use of a logistic regression function with high statistical efficiency (large sample of equal size per noise band), as part of the underlying design, features subsequently adopted for the ANAS design.

3.7 The main characteristics of the ANAS study in terms of questionnaire design, fieldwork and sampling, data collection, airport selection, noise metrics and sample design are described below with full methodological detail supplied separately in a technical report prepared by Ipsos UK, which supported the design and execution of the survey[21].

Questionnaire Design

3.8 The ANAS questionnaire was developed with input from the ANAS steering group, and by considering feedback from industry and community groups' representatives and from the CAA's Environmental Sustainability Panel. Building on the legacy of previous studies, the questionnaire was designed by adapting the surveys used for SoNA 2014, and also referenced the survey used in the first part of the Aviation Night Noise Effects (ANNE) study carried out in 2022.

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20 See Appendix B for more details on these studies.

21 CAP 3131a, Aviation Noise Attitudes Survey, Technical Report, Ipsos UK, June 2025.

3.9 To ensure compliance with international specifications, ANAS employed standardised annoyance questions taken from the International Standard ISO/TS 15666:2021 - Acoustics - Assessment of noise annoyance by means of social and socio-acoustic surveys[22]. ISO/TS 15666:2021 provides specifications for socio-acoustic surveys and social surveys which include questions on noise effects. It contains questions to be asked, response scales, and advice on key aspects of conducting the survey and reporting the results. ANAS included four versions of the key annoyance question stipulated by ISO/TS 15666:2021: 'thinking about [time period] when you are here at home, how much does noise from aeroplanes bother, disturb or annoy you?' enabling the study to examine how participants considered noise during the last three months and the last 12 months, and to answer both on a 5-point verbal response scale (from 'not at all' to 'extremely') and an 11-point numeric scale (from 0 to 10).

3.10 The questionnaire was designed and developed throughout the spring and summer of 2023, including a cognitive testing phase, before the final questions were agreed and signed off. In total, the questionnaire contained 63 questions within six distinct sections covering:

ix) The local area – including length of time living in the local area, satisfaction with the local area as a place to live, and aspects participants most like and dislike about their local area.

x) Aviation noise – including if participants are bothered, disturbed or annoyed by aviation noise (both within the last 12 months and last three months); when participants are bothered, disturbed or annoyed by aviation noise; if aviation noise interferes with their sleep patterns and quality of life when at home; and whether participants think organisations including government, airports and airlines are doing anything to reduce noise from aeroplanes.

xi) Road traffic and neighbour noise – whether participants are bothered, disturbed or annoyed from road traffic noise and/or from neighbours.

xii) Health and wellbeing – including questions about participants' health in general, mental health and wellbeing, and sensitivity to noise in general.

xiii) Homes and housing – questions about housing tenure, length of residence in current home, type of home and whether participants have access to an outdoor space such as a garden, terrace or balcony, type of windows (e.g. single or double-glazed), and reasons why participants close their windows or keep them closed, including for safety, security, warmth and noise reasons.

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22 PD ISO/TS 15666:2021 Acoustics — Assessment of noise annoyance by means of social and socio-acoustic surveys, Edition 2, International Standard Organisation, 31 May 2021.

xiv) Demographics – standard background questions on household composition, including gender, age, ethnicity and working status of survey participants. Key demographics are important for the analysis of survey findings so that an assessment can be made of how representative the achieved sample is of the population being surveyed.

3.11 While the questionnaire was based on SoNA's, significant changes were made to the structure. This included the location of the key annoyance questions which were brought forward from the SoNA equivalent to be located as questions 5, 6, 7 and 8 in ANAS. Other adaptations included simplification of response options to remove previously unanalysed factors and cutting questions which were not considered relevant. The questionnaire was also adapted to suit an online data collection methodology with questions rephrased from the conventions associated with SoNA's face-to-face interview model. The questionnaire's topic areas align with the recommendations advocated by the ICCAN/NatCen review.

Fieldwork Timing and Two-Wave Strategy

3.12 The study was designed with two phases of fieldwork, with data gathering exercises covering the summer period (Wave 1) and the winter period (Wave 2). The design was selected to investigate the potential impact of seasonality on noise attitudes and to mitigate a potential risk of the entire set of results being impacted by any unusual external events taking place during a single wave of fieldwork.

3.13 UK noise policy has historically been based on populations' recent exposure to aviation noise during the 92-day summer period, from 16 June to 15 September, and under the $L_{Aeq,16h}$ metric (7am to 11pm). The ANAS steering group considered various approaches to what was an appropriate reference period for ANAS in terms of the key question on annoyance. While UK noise policy has remained linked to summer exposure, other countries have adopted an annualised approach using the L_{den} noise metric. The steering group was also mindful of wider contextual evidence[23] that survey responses can be affected by a seasonality factor; with annoyance levels varying depending on when respondents were interviewed.

3.14 The design for ANAS has therefore aimed to meet current policy requirements[24] while enabling flexibility to support future policy aims that may arise from any new evidence emerging about the seasonality impacts. Such evidence could provide a more robust and rounded view of annoyance than had previously been possible. Consequently, it was decided that ANAS would explore people's

[23] See, for example, Appendix B, the SiRENE study.

[24] "Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace", Cm 9520, Department for Transport, October 2017.

experience of exposure during the summer months but, additionally, would ask about experience over a 12-month period. The survey would also gather data in two waves of fieldwork to enable a more rounded perspective of annoyance. This is in line with other similar studies and the WHO noise guidelines that health impacts are correlated with an annualised noise dose. The UK could be seen as somewhat of an outlier focusing on the summer period only.

3.15 The next consideration was when to run fieldwork for the survey. Ipsos estimated that it would be necessary to run fieldwork for eight weeks to achieve the desired number of responses. For Wave 1, covering the traditional summer period, this would mean that anyone responding towards the end of the likely 8-week fieldwork period would be answering about the defined summer period later, with the risk that recall may not be as accurate. It was agreed, therefore, that fieldwork would be launched as early as possible, even if this meant that the conventionally defined summer period of 16 June to 15 September had not yet expired. The chosen date to begin Wave 1 fieldwork was identified as 1 September 2023 judging that, while this was two weeks before the formal end of the summer period, it would minimise recall bias.

3.16 It was noted that the SoNA study, based on face-to-face interviews, asked respondents to consider 'the summer' and defined it as 'roughly from mid-June to mid-September' and 'the last 12 months or so'. Given the possible risk of confusion about definitions of summer through the online and paper questionnaire approaches, the annoyance questions were phrased as 'the last 3 months or so' and 'the last 12 months or so'.

3.17 For the second wave of fieldwork, it was noted that flight frequency was at its lowest from November to March. As a main purpose of running Wave 2 was to explore seasonality, it was seen as sensible to run fieldwork in a period which would contrast with Wave 1. The date chosen for the launch of Wave 2 fieldwork was 1 March 2024. This provided a gap of six months between each wave of data collection. The corresponding noise dose for Wave 2 was set as 16 December to 15 March, and thus the noise dose and survey were aligned with a two week overlap in March, exactly the same as for Wave 1 in September.

3.18 In choosing this design, ANAS conformed with the rationale advocated in the ICCAN/NatCen study design report referred to in paragraph 3.3 for running fieldwork across the year. However, it adapted the initial recommendation of a 12-month rolling fieldwork programme into a two-wave strategy. This enabled data collection to be managed more efficiently than a rolling 12-month fieldwork programme. Secondly, it mitigated the risk of coordinated information campaigns influencing the integrity of individual responses and compromising the integrity of responses, and also mitigated the risk and any airport related activities influencing the survey (see Appendix G: Airport Developments, consultations and trial during 2023-2024).

Data Collection Method and Execution

3.19 In a change from previous data collection approaches, ANAS deployed a push-to-web approach. The push-to-web approach does not conform with the recommendation made by the ICCAN/NatCen review to use Computer Assisted Personal Interviews (CAPI) data collection: a face-to-face interview method where the interviewer uses an electronic device to ask questions and record the answers. While the recommendations cited the CAPI method as 'the most robust data collection method', this perspective is no longer widely accepted, with push-to-web surveys now being used widely in social research studies for the reasons outlined in the following paragraph.

3.20 A push-to-web format has significant advantages over other methods of data collection, such as face-to-face or phone interviewing, as online completion of questionnaires does not require the resource of a human interviewer. Additionally, there are no geographical restrictions to where the survey can be fielded. It therefore allows a much higher number of participants to complete the survey for the same budget. Push-to-web is now firmly established as a research method and is widely used for social research surveys of similar scale, having become increasingly popular during the Covid-19 pandemic when personal contact restrictions were in place. Push-to-web is the first step in the Office of National Statistics Opinions and Lifestyle survey mixed mode design[25].

3.21 Participants were selected randomly from eligible postcodes based on estimated aviation noise exposure. Letters branded with Ipsos and Department for Transport logos invited up to two adults per household to take part in the Local area environmental issues study. The invitation deliberately did not mention noise or aeroplanes to minimise the risk of response bias. As is common with surveys of this kind, a £10 gift voucher was offered as an incentive for completed surveys to encourage responses to the survey.

3.22 To access the online questionnaire, participants could type in the supplied URL or scan the QR code provided on the invitation letters. Each participant needed to input a unique password included on their invitation. It was possible to pause the online questionnaire at any time and re-access it from the previous question answered.

3.23 To avoid excluding any respondents who were unable to complete the survey online, postal questionnaires and pre-paid return envelopes were posted to non-responding addresses. Around three-quarters of respondents completed the online version of the survey, and a quarter returned postal questionnaires across both waves of fieldwork. Ipsos's survey materials also included a link to FAQs

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[25] ONS Opinions and Lifestyle survey Quality and Methodology Information, 16 May 2025.

which included contact information to request large print or non-English language versions of the questionnaire.

Selection of Airports

3.24 Ten airports were selected as survey locations for the study:

- Birmingham
- East Midlands
- Edinburgh
- Glasgow
- Leeds Bradford
- London City
- London Gatwick
- London Heathrow
- Luton
- Manchester

3.25 Airports were selected purposively in consultation with the steering group and in line with the recommendations made in the NatCen/ICCAN review. The goal was to select ten airports which could be seen as covering a reasonable range of aviation noise characteristics experienced by the UK population. The characteristics considered were:

- Volume of commercial flights at each airport. Noting that aviation was still recovering from the pandemic at time of selection, with fewer flights still operating than in 2019, a minimum benchmark of at least 10,000 flights a year in 2022 was the starting point.
- Evidence of sufficient population exposed to noise to meet the sample design which required 500 responses per noise band at each airport.
- Airports from across the UK.
- To include a mixture of airports with and without night flights.
- Most airports have a mixture of urban and rural populations, so the selection aimed to reflect this.

3.26 Due to the selection criteria outlined above, it was not possible to include airports in Wales or Northern Ireland. The two Belfast airports: (Belfast City and Belfast International) did not have sufficient population exposed at higher noise levels, while Cardiff did not meet the threshold of enough flights per year. Similarly, the English airports Bristol and London Stansted were not selected due to a lack of population affected at higher noise exposure levels.

Noise metrics and sample design

3.27 The sample design for ANAS is significantly different to predecessor UK surveys in terms of the overall target sample size, its distribution, and the scope. In previous surveys, including SoNA, overall sample size was limited by budget constraints arising from the labour-intensive nature of using face-to-face data collection methods. The decision to move to the push-to-web fieldwork approach enabled for much higher volumes of responses to be sought.

3.28 The sampling for SoNA and all predecessor UK surveys were drawn to reflect population density, resulting in the combined overall conclusions being dominated by Heathrow, which has a 70% share of the UK population affected by aviation noise. This approach resulted in London airports representing 77% of addresses chosen (Heathrow 67%; Gatwick 10%), leading to the perception of a 'Heathrow-dominant' effect. In contrast, the design for ANAS was influenced by the study objective to report on findings by individual airport and by an intention to address concerns from some that the SoNA design was too dominated by Heathrow. This approach mimicked that taken by the FAA NES.

3.29 The design concept also drew on the recommendations outlined in the NatCen report 'Population and Sampling for a new survey of Aviation Noise'[26], which provided various power calculations to support decisions on sample size required to fulfil different levels of precision in the analysis. For example, it identified that: 'a future survey would need a sample size of 508 respondents in each exposure band across all airports to be adequately powered to detect a statistically significant 5% point difference between an estimate of 11% of the population being very or extremely annoyed at the 51-53 dB exposure band and 6% of the population being very or extremely annoyed at the <51dB exposure band'. CAA also discussed the role and conclusions of these power calculations with an independent statistical expert and confirmed that a sample size of around 500 responses per airport per noise band would be a robust design.

3.30 To enable the availability of a robust sample for detailed analysis by various factors, the design for ANAS targeted achieving 500 responses per noise band per airport. Noise exposure for sample selection was organised into six 'noise bands' of three decibels per band, with the lowest band at 45-48 dB $L_{Aeq,16h}$ and the highest covering exposure at 60 dB $L_{Aeq,16h}$ or above. This design meant that the target sample overall was 3,000 responses per airport and 30,000 responses overall across all ten airports combined. This total target sample considerably exceeded the proposal made by the ICCAN/NatCen review of aiming for a sample of 6,500 but reflected the enhanced ambition of ANAS to be able to analyse different facets with a robust sample available for each consideration.

[26] NatCen - ANAS - Population and sampling - June 2021.

3.31 As previously noted, survey addresses were selected at random. Surveys of this type require an initial expectation of the survey response rate to ensure that the targeted number of responses will be achieved within an appropriate time frame. A key criticism of SoNA 2014 was that responses continued long after the summer period (over the Christmas period and into the following February). These concerns regarding response rate and delays in receiving responses led to CAA encouraging Ipsos UK to issue additional invitations early in Wave 1 to ensure that the target responses were achieved close to the end of the three-month summer noise period. However, the response rate was higher than anticipated and combined with the additional invitations issued, this led to Wave 1 achieving double the number of responses it set out to achieve (see paragraph 4.8). For Wave 2 fewer invitations were issued in anticipation of a similar response rate and this was achieved, thus Wave 2 achieved the planned 15,000 responses.

3.32 Additional work was carried out to improve the accuracy of modelling that could be performed to identify addresses exposed to this lower noise dose. This also included examining the likelihood that noise exposure from an adjacent airport might overlap between 45 and 51 dB $L_{Aeq,16h}$, which is not the case above 51 dB $L_{Aeq,16h}$.

3.33 Since population density at higher exposure levels varied around the selected airports, it was identified that smaller populations may lead to a potential deficit of responses at some airports at higher exposure levels. Where this was anticipated, an adjustment was made to the sampling plan to reallocate any unused sample to the adjoining noise band at the same airport, to support achieving the full sample target at the airport overall. In addition, a further 1,500 responses were targeted at a specific noise exposure of 63 dB $L_{Aeq,16h}$ and above from three airports which had enough population exposed. The aim was to boost the number of responses at the highest noise exposure levels to determine with greater precision whether there were differences in attitudes at these higher noise exposures.

Chapter 4

Social Survey Results

Introduction

4.1 This chapter presents an overview of the social survey results. It examines the social survey results for Wave 1 and Wave 2 and highlights certain characteristics of the sample group. It reports:

- the number of respondents in each wave of fieldwork,
- the basis for excluding certain responses,
- our approach to weighting the data,
- information about the demographics of participants.

Responses per airport and wave

4.2 An initial data cleaning exercise was carried out by Ipsos prior to providing the survey response data set to CAA for analysis. This determined a minimum qualifying criteria that respondents must reach the final survey question (Q63) in the online version of the survey to be accepted for analysis. For Wave 1, 2,342 online survey responses were excluded from the final dataset as they failed to meet the criteria; and 1,182 from Wave 2.

4.3 For postal questionnaires, the criteria for acceptance were completion of the age (Q49a or Q49b) and gender (Q50) questions, and also the questions about annoyance with aviation noise over the last 3 months or so (Q7 and Q8). Following checks, 30 returned paper questionnaires were excluded from the final dataset for Wave 1 and 233 from Wave 2.

4.4 Consequently, after respondents who failed to meet the initial qualifying criteria were excluded for this study, there were 30,724 respondents in Wave 1 and 16,064 respondents in Wave 2 from around ten airports. As described in paragraph 3.10, the questionnaire included six sections including one to determine the demographic makeup of the two waves. This included questions on residence, age, gender, number of adults in household and employment status.

Exclusions

4.5 In addition, further responses were excluded from analysis where it was deemed that answers were ineligible. The first consideration was length of residency at the current address with reference to the requirements of the annoyance question to answer with respect to ‘the last three months or so’ and ‘the last 12 months or so’. Evidence of length of residency was determined by responses to question 42: ‘How long have you lived in this home?’. Any respondent who answered ‘less than three months’ or ‘don’t know’ was excluded from the analysis. Those who answered, ‘less than 12 months’ to question 42 were not excluded from the analysis because the questionnaire included a mitigating instruction: ‘if you have lived here for less than 12 months, please answer about the period you have lived here’. Additional exclusions were made where a respondent provided an invalid response. The combined number of additional exclusions is shown by airport and wave in Table 1.

Table 1 Additional excluded responses by airport and wave

	Excluded responses		
Airport	**Wave 1**	**Wave 2**	**Merged waves**
BHX	70	45	115
EDI	57	35	92
EMA	73	33	106
GLA	62	18	80
LBA	198	43	241
LCY	114	67	181
LGW	59	13	72
LHR	120	49	169
LTN	90	40	130
MAN	89	27	116
Total	932	370	1,302

4.6 Following the exclusions in Table 1, the final analysed responses are set out in Table 2.

Table 2 Final analysed responses by airport and wave

	Analysed responses		
Airport	**Wave 1**	**Wave 2**	**Merged waves**
Birmingham	2,756	1,607	4,363
Edinburgh	3,085	1,611	4,696
East Midlands	3,944	1,474	5,418
Glasgow	2,607	1,473	4,080
Leeds Bradford	3,301	1,645	4,946
London City	2,000	1,585	3,585
London Gatwick	3,407	1,357	4,764
London Heathrow	2,910	1,841	4,751
Luton	2,311	1,517	3,828
Manchester	3,471	1,584	5,055
Total	29,792	15,694	45,486

Weightings

4.7 Data has not been weighted. While weighting is frequently used in social research studies to correct for over- or under-representation of certain groups, it is not always practised – notably for the US FAA NES which used a similar research design to ANAS. A decision not to weight the data according to likelihood of selection was made due to the highly specific sampling design of ANAS, which sought to select the same number of respondents for each airport and by noise exposure irrespective of the density and type of population available for selection. While the distribution of responses by noise band per airport (Chapter 5, Tables 4 and 5) was not identical, it was relatively even overall, and the large sample size mitigates the risk of the data being inadvertently skewed by particular elements. Weighting the data according to population exposure in the UK, as was done in SoNA 2014, would have resulted in Heathrow being the dominant airport, something that was criticised in SoNA 2014 and in prior UK surveys[27] and would have undermined the balanced design envisaged for the survey.

4.8 A scaling factor was used to merge the two waves of fieldwork for the purpose of conducting an analysis of the summer and winter waves combined under the L_{den} metric. This was necessary because Wave 1 generated almost double the planned number of responses as explained in paragraph 3.31. This was achieved by scaling the Wave 2 response data set to match the size of the Wave 1 data set through applying a scaling factor equal to 1.8983 to all Wave 2 responses. The scaling factor was calculated by dividing the total number of analysed Wave 1 responses (29,792) by the total number of analysed Wave 2 responses (15,694). This adjustment enabled the contribution of each wave to be equalised, in line with the original study design specifications. This approach was taken to avoid skewing the overall combined results towards the dominant Wave 1 sample. There was no statistical difference between scaling Wave 2 up to match the size of Wave 1, or vice-versa.

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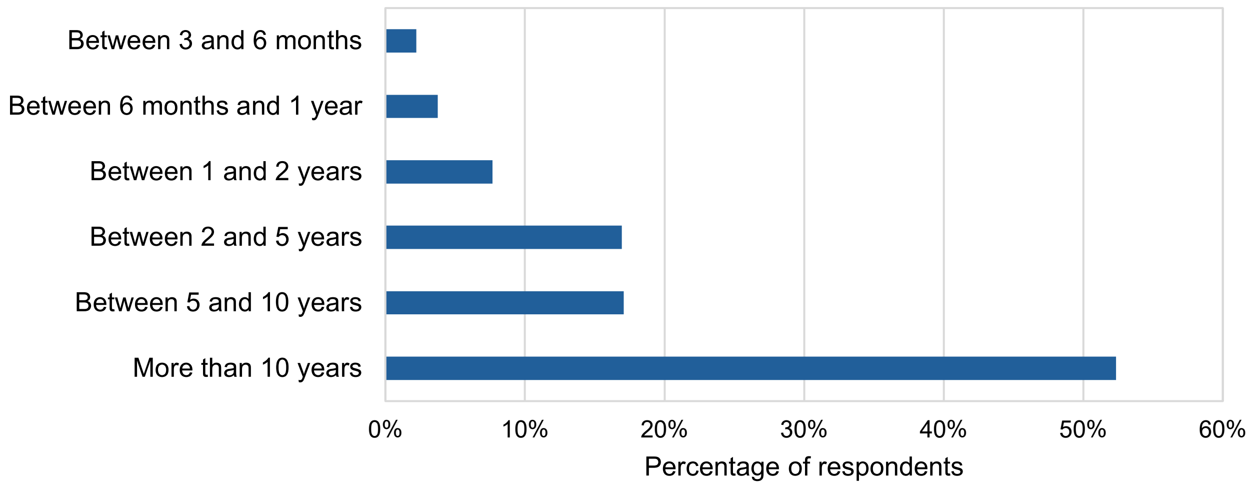
27 DORA Report 9023, "Use of L_{eq} as a noise index", para 2.3.2, Civil Aviation Authority, September 1990.

Demographics of respondents

Length of time in home (Q42)

4.9 Figure 1 and Figure 2 show the distribution of respondents based on question 42: “How long have you lived in this home?”.

Figure 1 Wave 1 Q42: “How long have you lived in this home?”

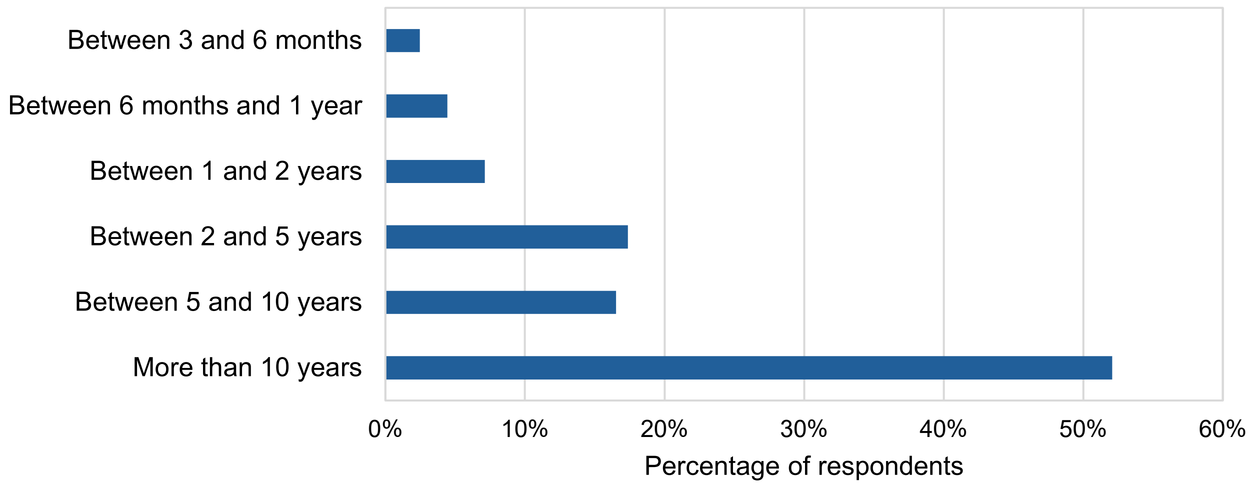


4.10 The y-axis of Figure 1 shows category of residence of duration. The x-axis shows the percentage of respondents per category and ranges from 0 to 60%.

4.11 Of the 29,792 respondents in Wave 1, 52.4% (15,599 respondents) had lived in their home for more than 10 years, and 17.1% (5,088 respondents) between 5 and 10 years. 16.9% (5,045 respondents) reported living in their home between 2 and 5 years and 7.7% (2,287 respondents) reporting between 1 and 2 years. 3.7% (1,116 respondents) had lived in their home between 6 months and 1 year, and 2.2% (657 respondents) between 3 and 6 months.

4.12 Any respondents who answered, ‘Don’t know’, ‘Less than 3 months’, or gave an invalid answer to Q42 were excluded from the analysis, and are therefore not included in Figures 1 and 2.

Figure 2 Wave 2 Q42: "How long have you lived in this home?"



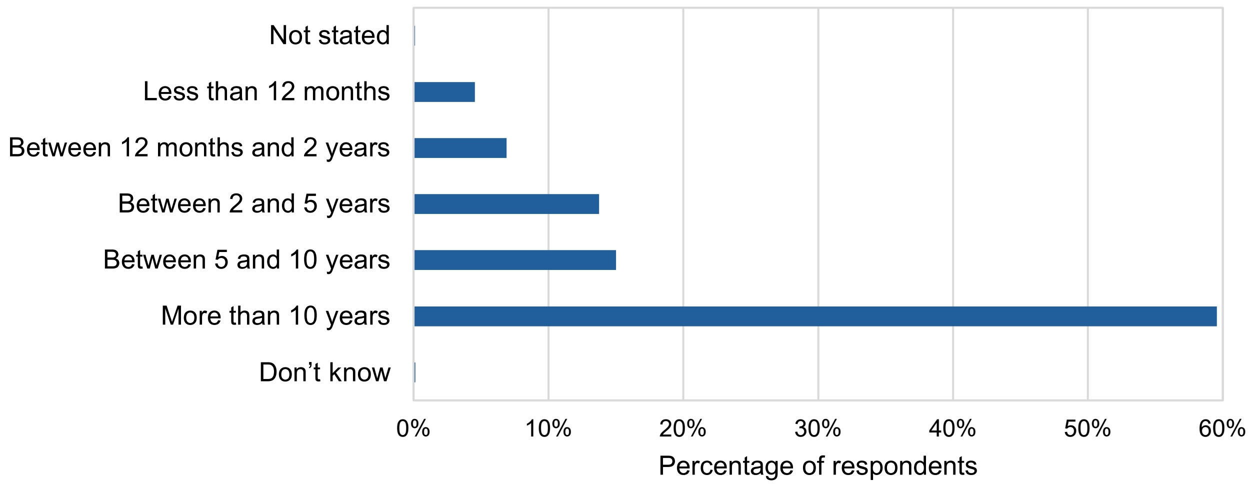
4.13 The y-axis of Figure 2 shows category of residency duration. The x-axis shows the percentage of respondents per category and ranges from 0 to 60%.

4.14 Of the 15,694 respondents in Wave 2, 52.1% (8,171 respondents) had lived in their home for more than 10 years, and 16.5% (2,593 respondents) between 5 and 10 years. 17.4% (2,727 respondents) reported living in their home between 2 and 5 years and 7.1% (1,118 respondents) reporting between 1 and 2 years. 4.4% (697 respondents) had lived in their home between 6 months and 1 year, and 2.5% (388 respondents) between 3 and 6 months.

Length of time in area (Q1)

4.15 Figure 3 and Figure 4 show the distribution of responses to question 1: "How long have you lived in the local area?".

Figure 3 Wave 1 Q1: "How long have you lived in the local area?"

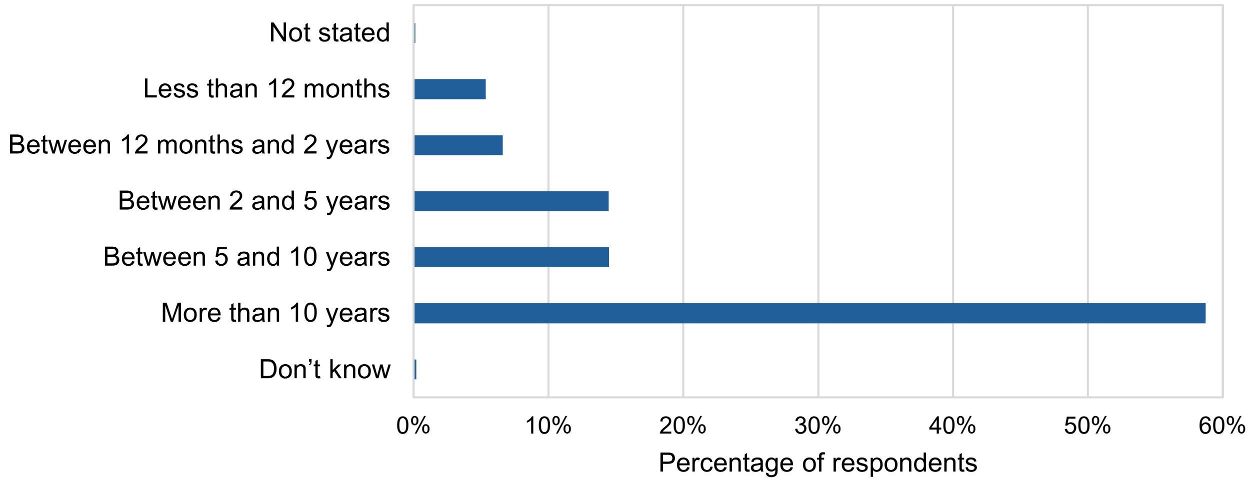


4.16 The y-axis of Figure 3 shows groupings of residency duration in the local area. The x-axis shows the percentage of respondents per category, ranging from 0 to 60%.

4.17 Of the 29,792 respondents in Wave 1, 59.6% (17,747 respondents) had lived in the local area for more than 10 years, and 15.0% (4,473 respondents) between 5 and 10 years. 13.7% (4,096 respondents) reported living there between 2 and 5 years and 6.9% (2,052 respondents) reporting between 1 and 2 years. 4.5% (1,354 respondents) had lived in their local area less than 12 months.

4.18 Several responses were either "Don't know" (0.1%, 36 respondents), or not stated (0.1%, 34 respondents).

Figure 4 Wave 2 Q1: "How long have you lived in the local area?"



4.19 The y-axis of Figure 4 shows categorical bins of residency duration in the local area. The x-axis shows the percentage of respondents per category, ranging from 0 to 60%.

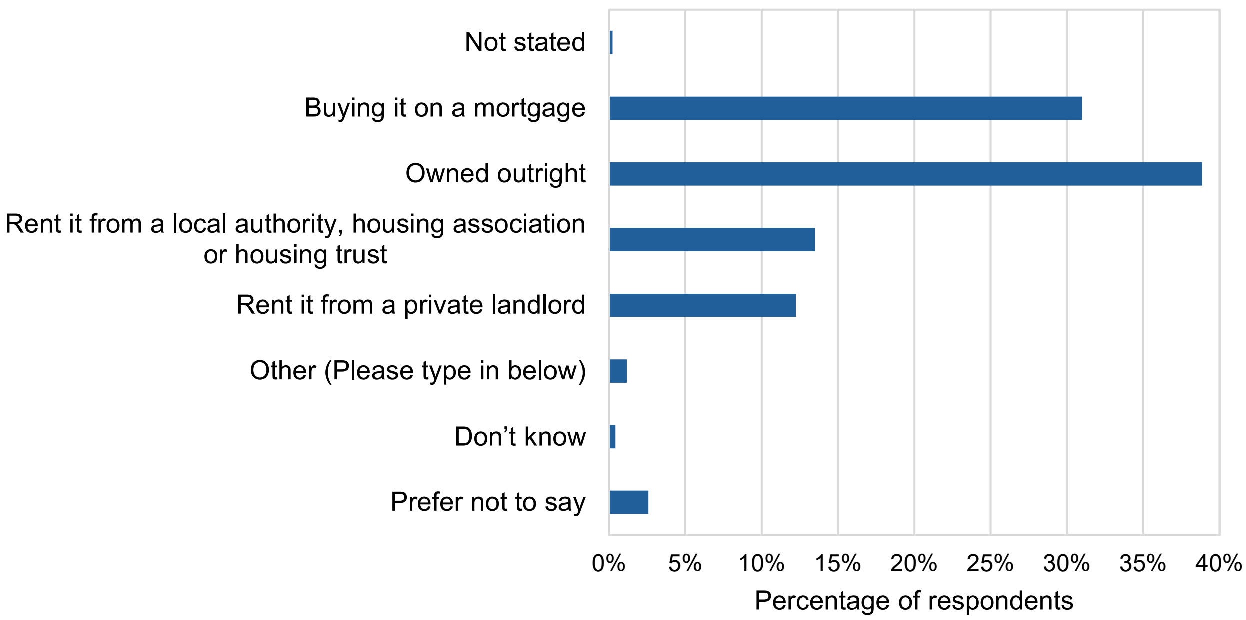
4.20 Of the 15,694 respondents in Wave 2, 58.7% (9,217 respondents) had lived in the local area for more than 10 years, and 14.5% (2,275 respondents) between 5 and 10 years. 14.5% (2,271 respondents) reported living there between 2 and 5 years and 6.6% (1,038 respondents) reporting between 1 and 2 years. 5.4% (841 respondents) had lived in their local area less than 12 months.

4.21 Several responses were either "Don't know" (0.2%, 30 respondents), or not stated (0.1%, 22 respondents).

Ownership status of home (Q41)

4.22 Figure 5 and Figure 6 show the distribution of responses to question 41: “Does your household own or rent this accommodation?”.

Figure 5 Wave 1 Q41: “Does your household own or rent this accommodation?”

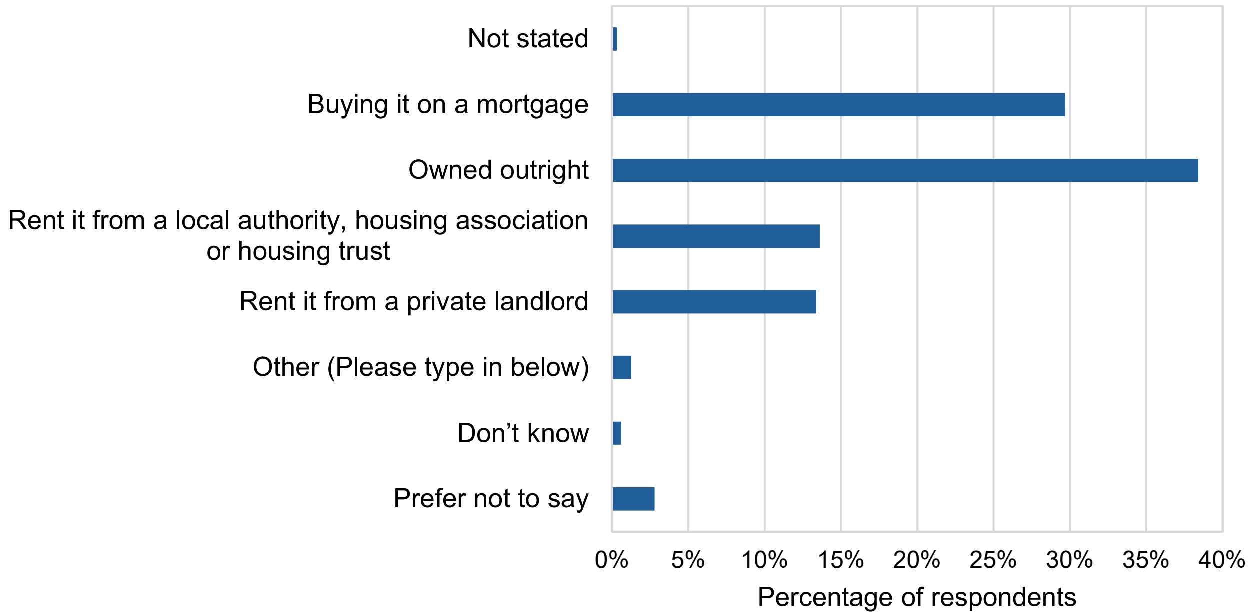


4.23 The y-axis of Figure 5 shows categorical bins for the ownership status of the respondent’s home. The x-axis shows the percentage of respondents per category, ranging from 0 to 40%.

4.24 Of the 29,792 respondents in Wave 1, the majority reported ownership of their accommodation: 31.0% (9,230 respondents) reported buying their house on a mortgage and 38.9% (11,576 respondents) reported ownership of the residence outright. Renting was less common; 13.5% (4,025 respondents) reported renting their residence from a local authority, housing association or housing trust, and 12.2% (3,647 respondents) reported renting their residence from a private landlord. Just 1.2% (351 respondents) reported a form of ownership that was not listed.

4.25 A number of responses were either “Don’t know” (0.4%, 127 respondents), or not stated (0.2%, 66 respondents). 2.6% (770 respondents) preferred not to say.

Figure 6 Wave 2 Q41: "Does your household own or rent this accommodation?"



4.26 The y-axis of Figure 6 shows categorical bins for the ownership status of the respondent's home. The x-axis shows the percentage of respondents per category, ranging from 0 to 40%.

4.27 Of the 15,694 respondents in Wave 2, the majority reported ownership of their accommodation: 29.7% (4,656 respondents) reported buying their house on a mortgage and 38.4% (6,025 respondents) reported ownership of the residence outright. Renting was less common; 13.6% (2,137 respondents) reported renting their residence from a local authority, housing association or housing trust, and 13.4% (2,101 respondents) reported renting their residence from a private landlord. Just 1.2% (196 respondents) reported a form of ownership that was not listed.

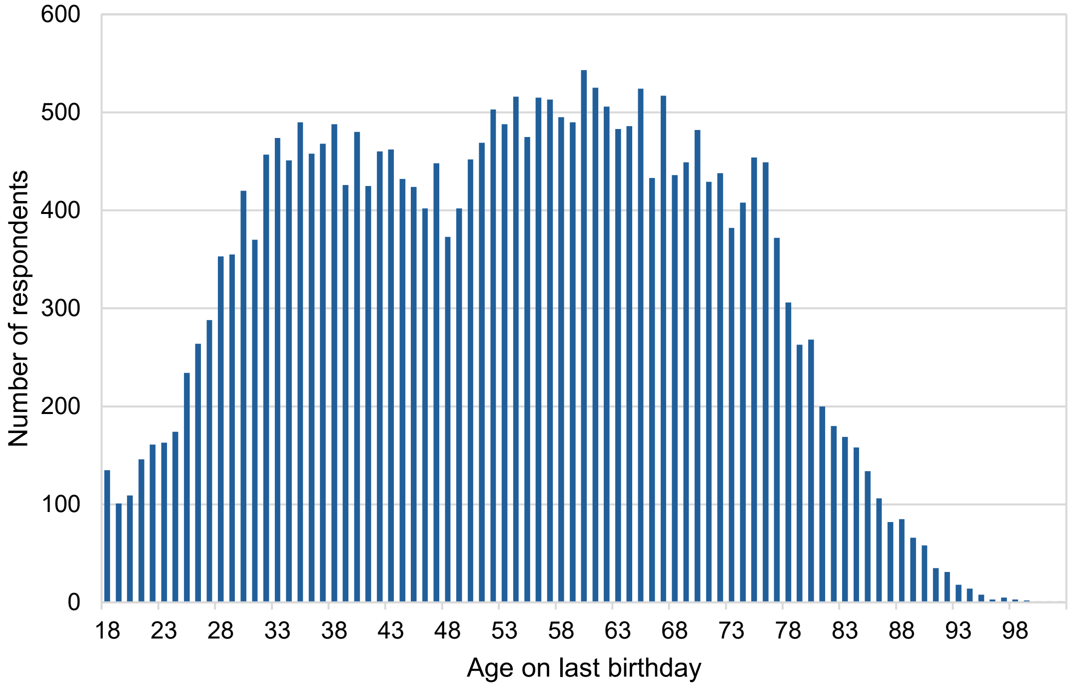
4.28 A number of responses were either "Don't know" (0.6%, 92 respondents), or not stated (0.3%, 48 respondents). 2.8% (439 respondents) preferred not to say.

Age (Q49)

4.29 Figure 7 and Figure 8 show the distribution of respondents to question 49: "What was your age at your last birthday?".

4.30 Respondents had to be aged 18 or above to be eligible to answer the survey. Distribution of respondents' age was approximately normal for both waves, but with multimodal features near the ages of 35 and 60, and slight asymmetry due to the age cut-off of 18.

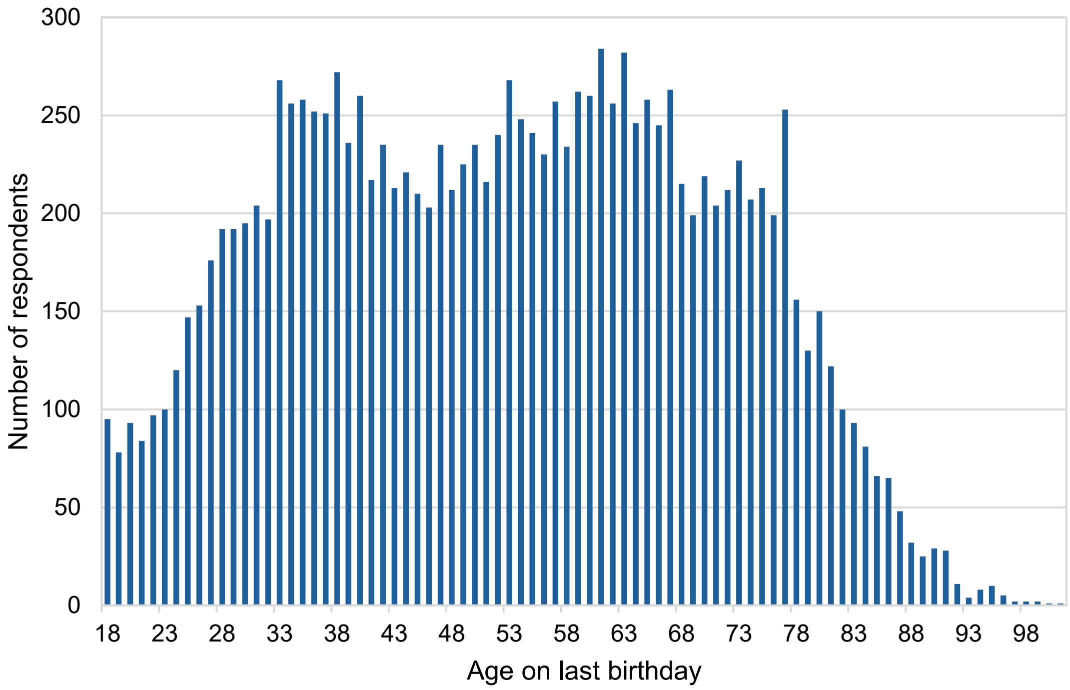
Figure 7 Wave 1 Q49: "What was your age at your last birthday?"



4.31 The x-axis of Figure 7 shows the respondent's given age at their last birthday. The x-axis ranges from 0 to 103 years, although responses were not received for all ages. The y-axis shows the number of respondents for each category. The y-axis ranges from 0 to 600.

4.32 Those who answered 'Prefer not to say' were excluded, leaving 26,722 respondents for this question. The mean age in Wave 1 was 53.3, with a standard deviation of 17.4.

Figure 8 Wave 2 Q49: "What was your age at your last birthday?"



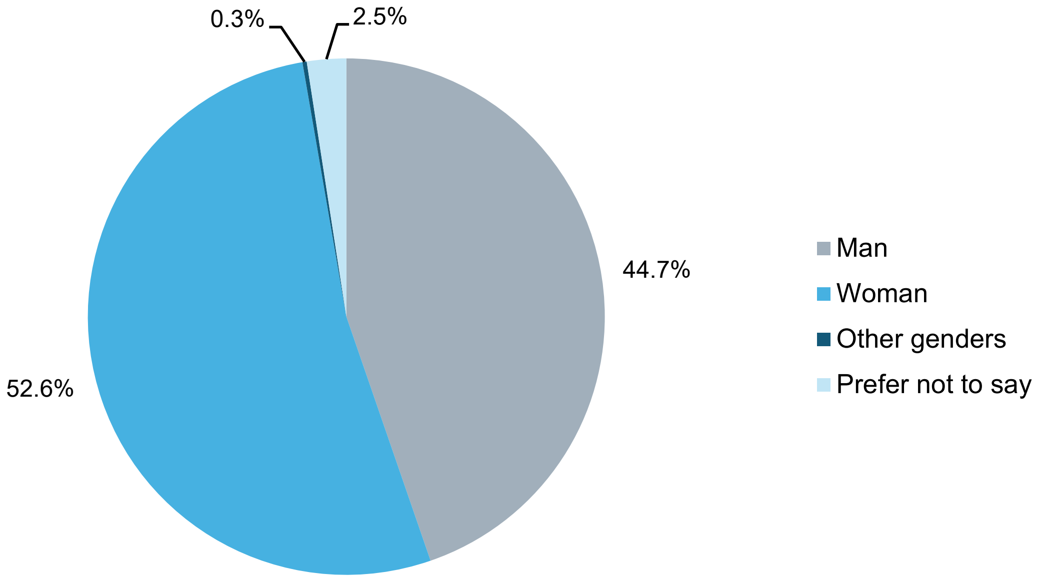
4.33 As with Wave 1, the x-axis of Figure 8 shows the respondent's given age at their last birthday. The x-axis ranges from 0 to 103 years, although responses were not received for all ages. The y-axis shows the number of respondents for each category. The y-axis ranges from 0 to 300.

4.34 Those who answered 'Prefer not to say' were excluded, leaving 13,991 respondents for this question. The mean age in Wave 2 was 52.7, with a standard deviation of 17.8.

Gender (Q50)

4.35 Figure 9 and Figure 10 show the distribution of respondents to question 50: "Which of the following best describes your gender?".

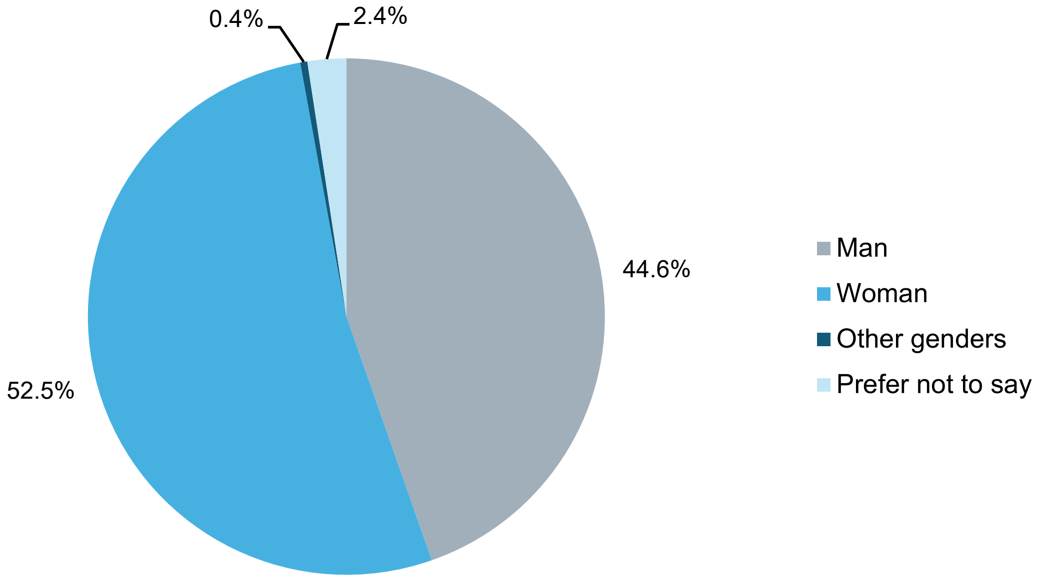
Figure 9 Wave 1 Q50: "Which of the following best describes your gender?"



4.36 Of the 29,792 respondents in Wave 1, more identified as women than men (Figure 9). Under half, 44.7% (13,322 respondents), identified as men, whilst over half, 52.7% (15,659 respondents), identified as women. 0.2% (58 respondents) identified as non-binary, and 0.1% (22 respondents) identified as a gender that was not listed.

4.37 A minority, 2.5% (731 respondents), preferred not to say.

Figure 10 Wave 2 Q50: "Which of the following best describes your gender?"



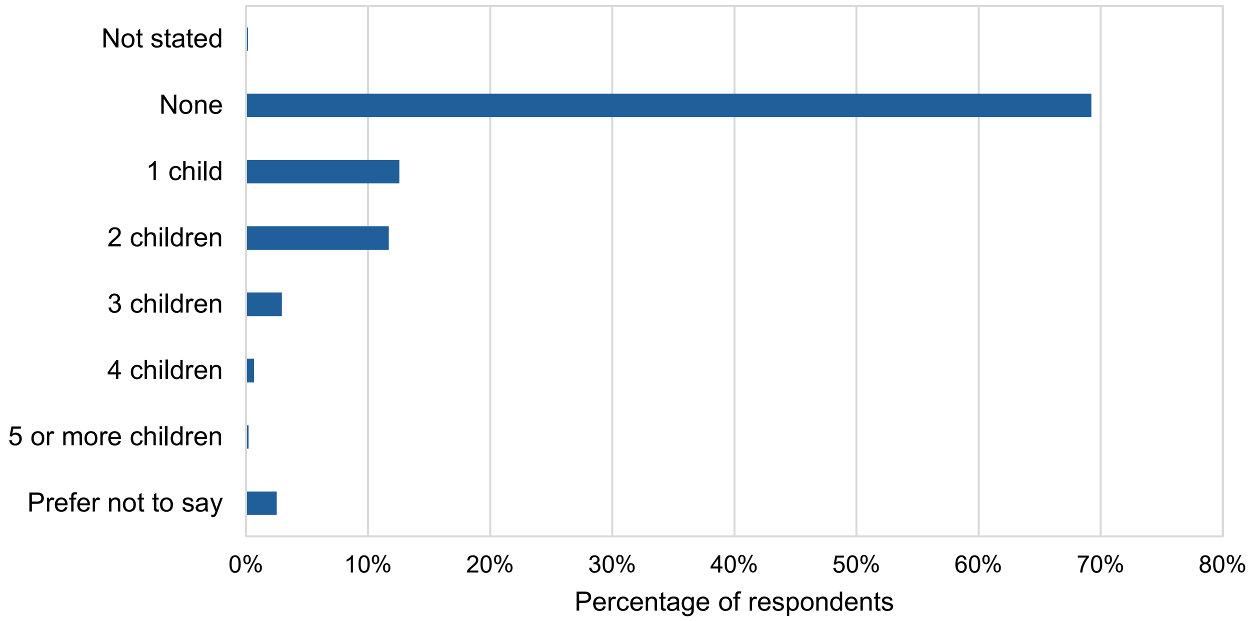
4.38 Of the 15,694 respondents in Wave 2, more identified as women than men (Figure 10). Under half, 44.6% (7,006 respondents), identified as men, whilst over half, 52.5% (8,239 respondents) identified as women. 0.3% (49 respondents) identified as non-binary, and 0.1% (20 respondents) identified as a gender that was not listed.

4.39 A minority, 2.4% (380 respondents), preferred not to say.

Children in house (Q51)

4.40 Figure 11 and Figure 12 show the distribution of respondents to question 51: "How many children aged 0-17 live with you as part of your household?".

Figure 11 Wave 1 Q51: "How many children aged 0-17 live with you as part of your household?"

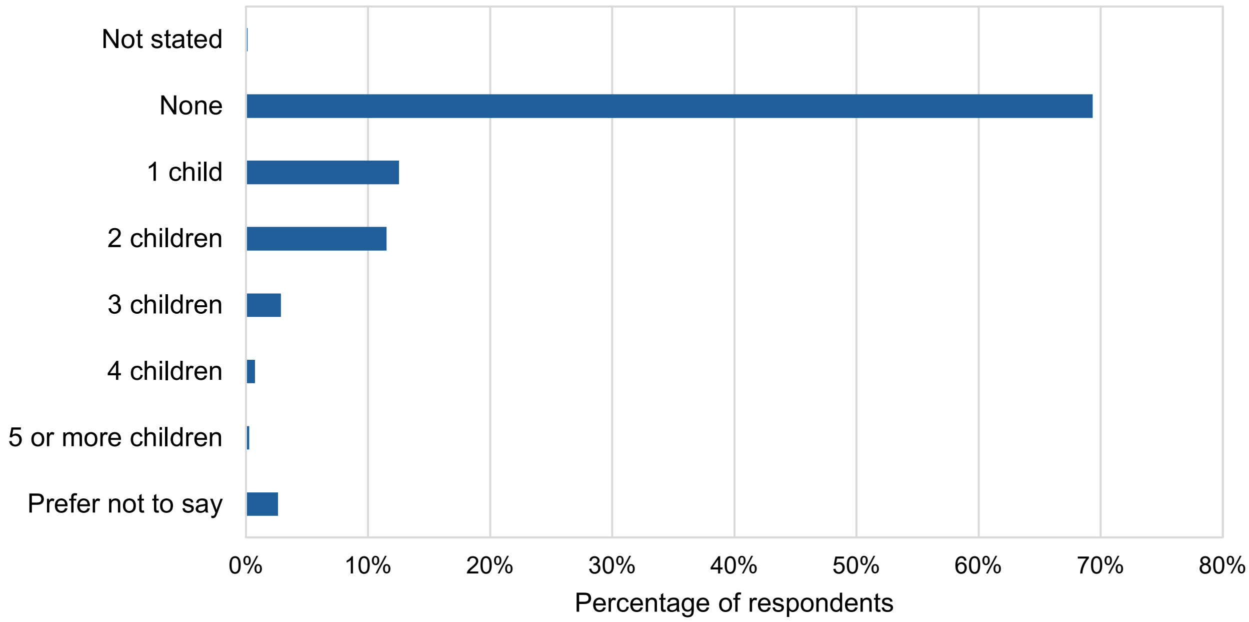


4.41 The y-axis of Figure 11 shows categorical bins for the number of children in the respondent's household. The x-axis shows the number of respondents per category, ranging from 0 to 80%.

4.42 Of the 29,792 respondents in Wave 1, the majority, 69.2% (20,624 respondents), had no children. Under half of respondents had children, with 12.6% (3,739 respondents) having one child, 11.7% (3,486 respondents) having two, 3.0% (879 respondents) having three, 0.7% (200 respondents) having four, and 0.2% (62 respondents) having five or more.

4.43 Just 0.2% (50 respondents) were not stated, and 2.5% (752 respondents) answered 'prefer not to say'.

Figure 12 Wave 2 Q51: "How many children aged 0-17 live with you as part of your household?"



4.44 The y-axis of Figure 12 shows categorical bins for the number of children in the respondent's household. The x-axis shows the number of respondents per category, ranging from 0 to 80%.

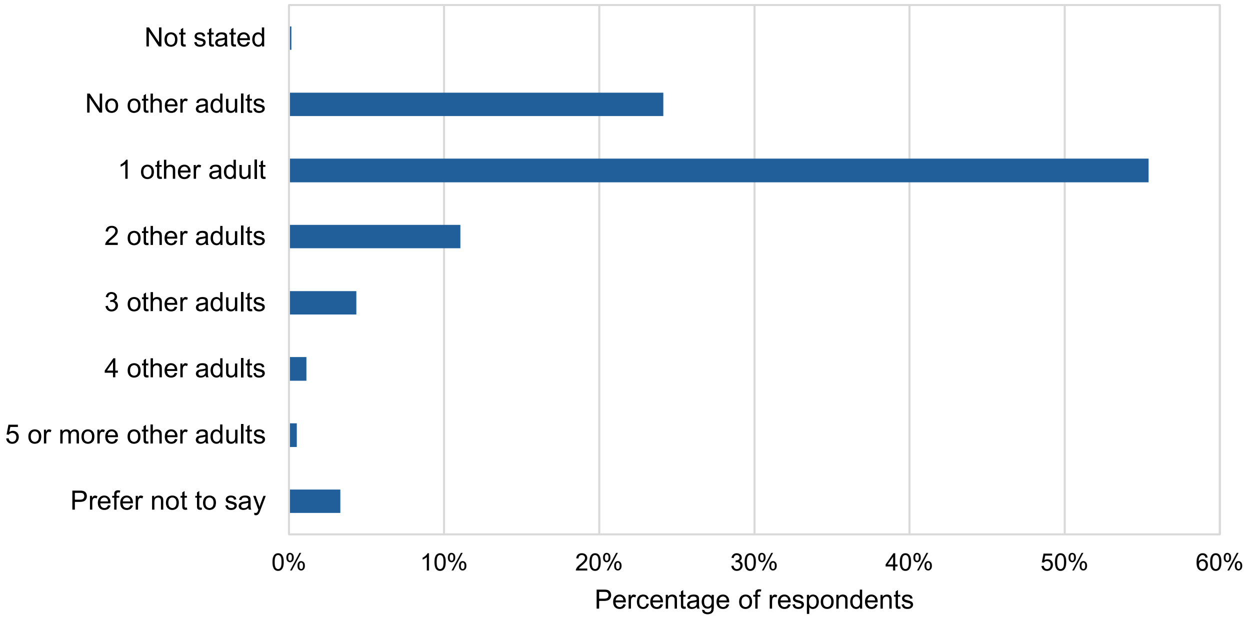
4.45 Of the 15,694 respondents in Wave 2, the majority, 69.3% (10,882 respondents), had no children. Under half of respondents had children, with 12.5% (3,739 respondents) having one child, 11.7% (3,486 respondents) having two, 2.9% (448 respondents) having three, 0.7% (116 respondents) having four, and 0.3% (41 respondents) having five or more.

4.46 Just 0.1% (22 respondents) were not stated, and 2.6% (441 respondents) answered 'prefer not to say'.

Adults in house (Q52)

4.47 Figure 13 and Figure 14 show the distribution of respondents to question 52: "How many adults aged 18 or over live with you as part of your household?".

Figure 13 Wave 1 Q52: "How many adults aged 18 or over live with you as part of your household?"

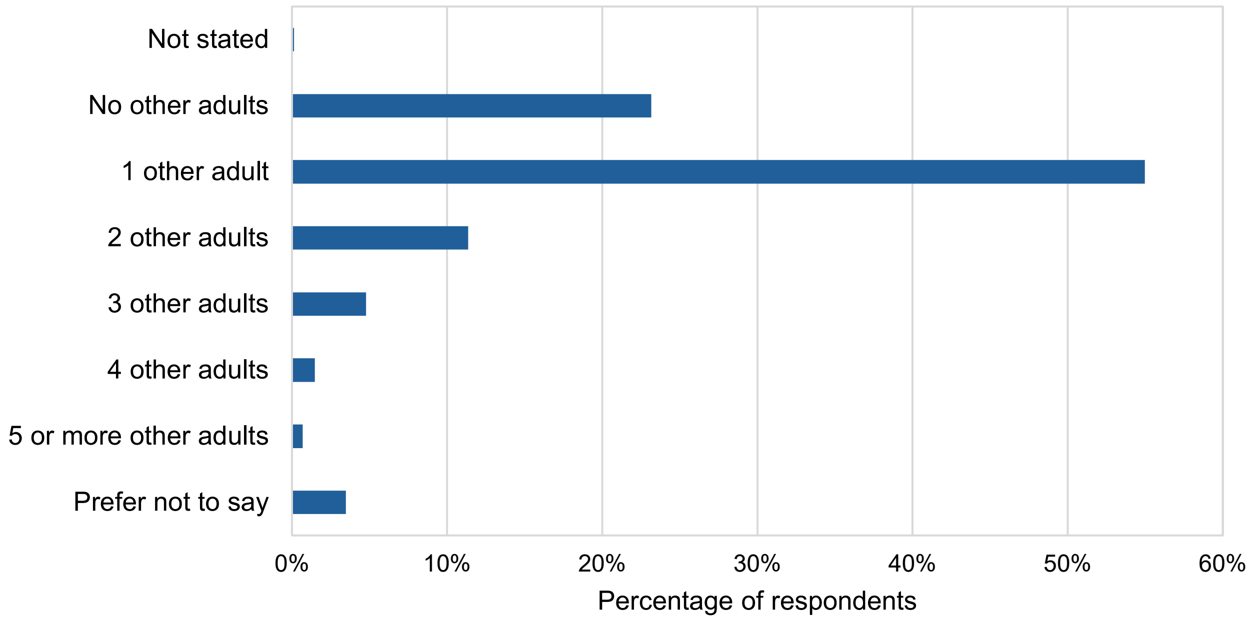


4.48 The y-axis of Figure 13 shows categorical bins for the number of adults in the respondent's household. The y-axis shows the percentage of respondents per category, ranging from 0 to 60%.

4.49 Of the 29,792 respondents in Wave 1, the majority lived with only 1 other adult. Specifically, 24.1% (7,186 respondents) were the only adult in the household and 55.4% (16,505 respondents) lived with 1 other adult. A household containing more than two adults was less common; 11.0% (3,292 respondents) lived with 2 other adults, 4.3% (1,292 respondents) lived with 3 other adults, 1.1% (337 respondents) lived with 4 other adults, and 0.5% (148 respondents) lived with 5 or more other adults.

4.50 Several responses were not stated (0.2%, 46 respondents). 3.3% (986 respondents) preferred not to say.

Figure 14 Wave 2 Q52: "How many adults aged 18 or over live with you as part of your household?"



4.51 The y-axis of Figure 14 shows categorical bins for the number of adults in the respondent's household. The x-axis shows the percentage of respondents per category, ranging from 0 to 60%.

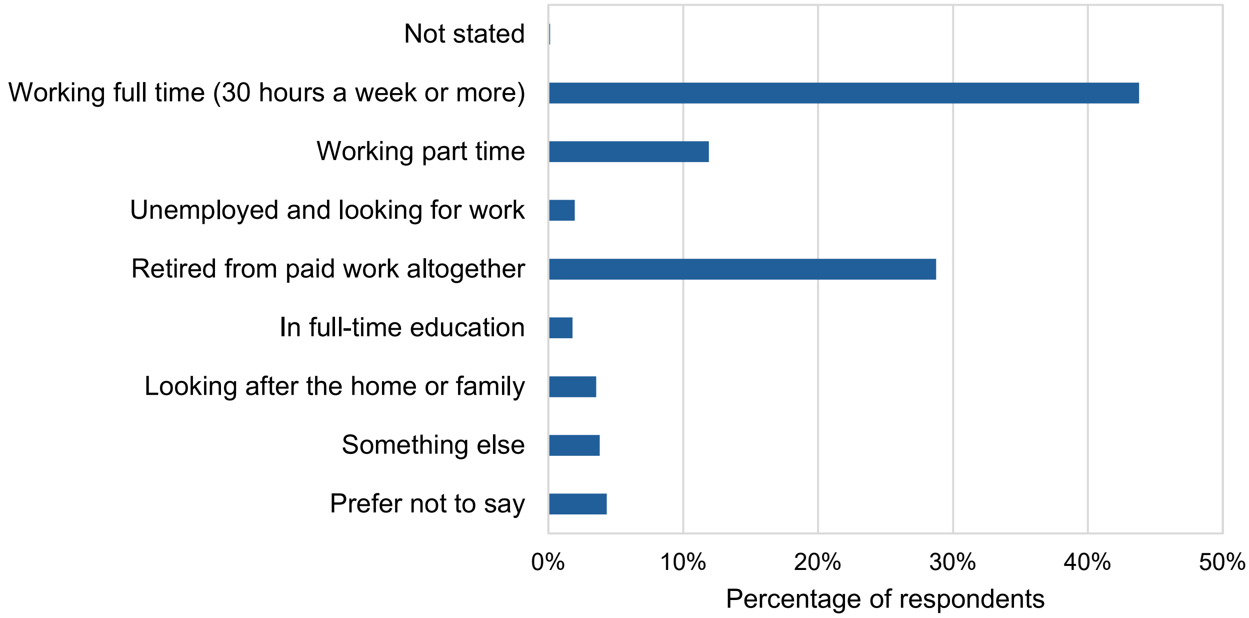
4.52 Of the 15,694 respondents in Wave 2, the majority lived with only 1 other adult. Specifically, 23.1% (3,633 respondents) were the only adult in the household and 55.0% (8,629 respondents) lived with 1 other adult. A household containing more than two adults was less common. Of these, 11.4% (1,782 respondents) lived with 2 other adults, 4.8% (748 respondents) lived with 3 other adults, 1.5% (230 respondents) lived with 4 other adults, and 0.7% (107 respondents) lived with 5 or more other adults.

4.53 Several responses were not stated (0.1%, 21 respondents). 3.5% (544 respondents), preferred not to say.

Employment status (Q53)

4.54 Figure 15 and Figure 16 show the distribution of respondents to the question 53: "Which of these best describes your current situation?".

Figure 15 Wave 1 Q53: "Which of these best describes your current situation?"

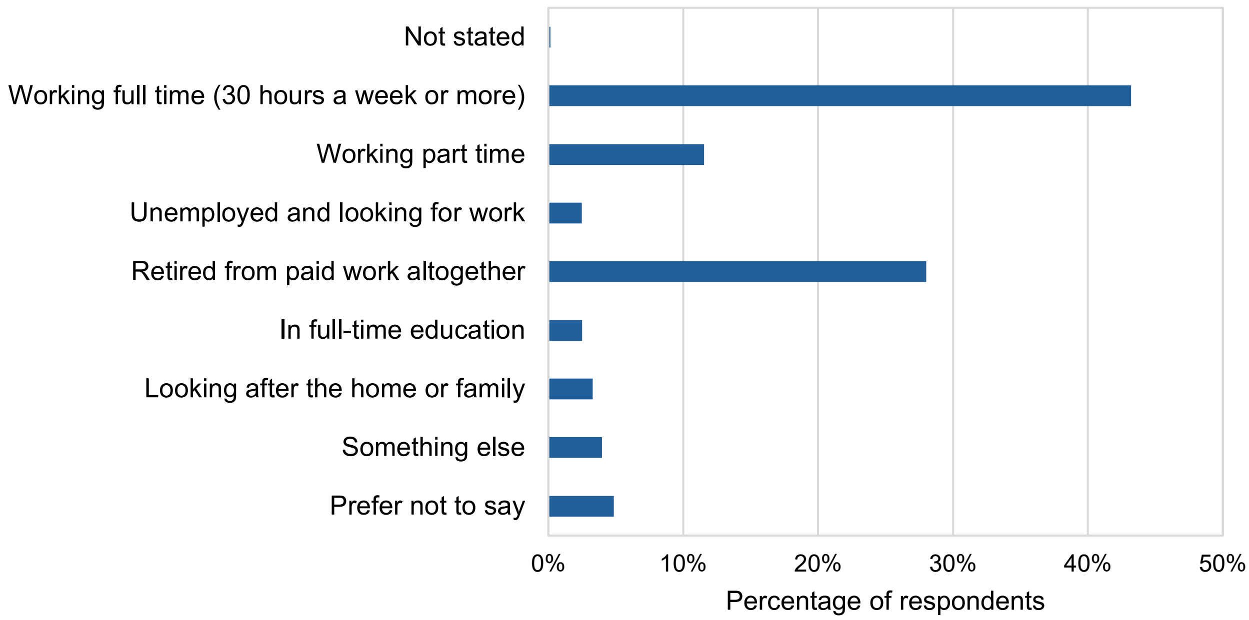


4.55 The y-axis of Figure 15 shows categorical bins for employment status. The x-axis shows the percentage of respondents per category, ranging from 0 to 50%.

4.56 Of the 29,792 respondents in Wave 1, the majority were working either full or part-time. Specifically, almost half, 43.8% (13,048 respondents), were working 30 hours a week or more, and another 11.9% (3,544 respondents) were working part time. Of those who weren't working, 2.0% (583 respondents) were unemployed and looking for work, 28.7% (8,564 respondents) were retired from paid work altogether, 3.6% (1,060 respondents) were looking after the home or family and 1.8% (532 respondents) were in full-time education. Finally, 3.8% (1,132 respondents) described their current situation as "something else".

4.57 Several responses were not stated (0.1%, 40 respondents), or preferred not to say (4.3%, 1,289 respondents).

Figure 16 Wave 2 Q53: "Which of these best describes your current situation?"



4.58 The y-axis of Figure 16 shows categorical bins for employment status. The x-axis shows the percentage of respondents per category, ranging from 0 to 50%.

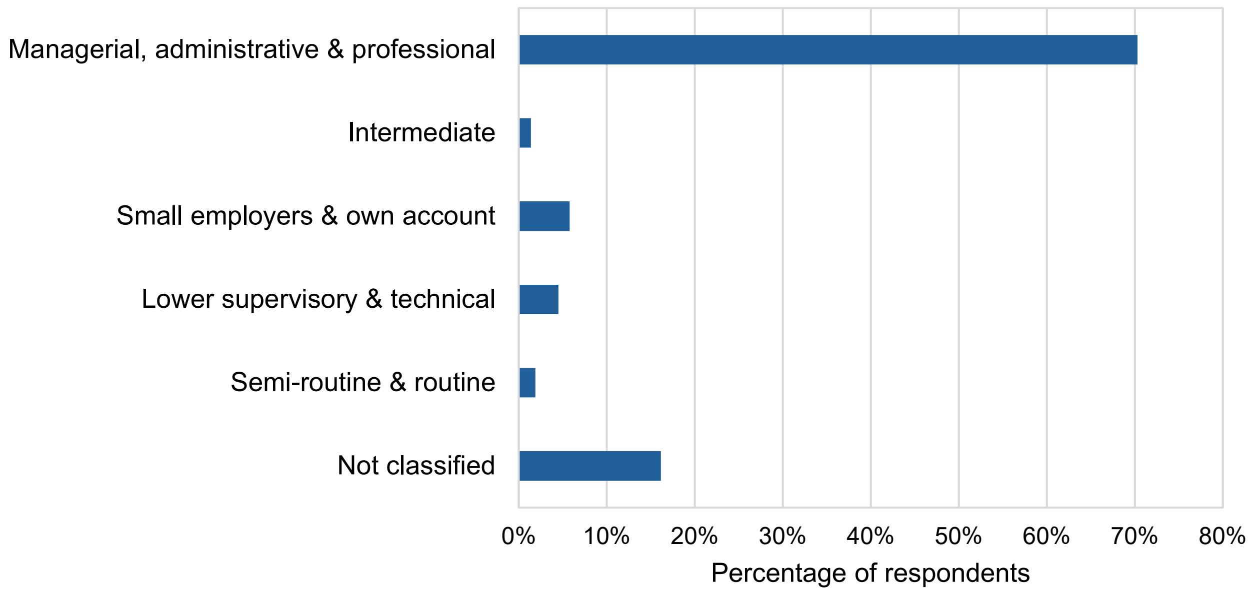
4.59 Of the 15,694 respondents in Wave 2, the majority were working either full or part-time. Specifically, almost half, 43.2% (6,781 respondents), were working 30 hours a week or more, and another 11.5% (1,811 respondents) were working part time. Of those who weren't working, 2.5% (390 respondents) were unemployed and looking for work, 28.0% (4,396 respondents) were retired from paid work altogether, 2.5% (394 respondents) were in full-time education and 3.3% (516 respondents) were looking after the home or family. Finally, 4.0% (622 respondents) described their current situation as "something else".

4.60 Several responses were either not stated (0.2%, 24 respondents) or preferred not to say (4.8%, 760 respondents).

Social grade (Q54-Q57)

4.61 Figure 17 and Figure 18 show the distribution of respondents' social grade derived based on answers to questions 54-57. These categories were based on the National Statistics Socio-economic classification28.

Figure 17 Wave 1 Respondent's social grade

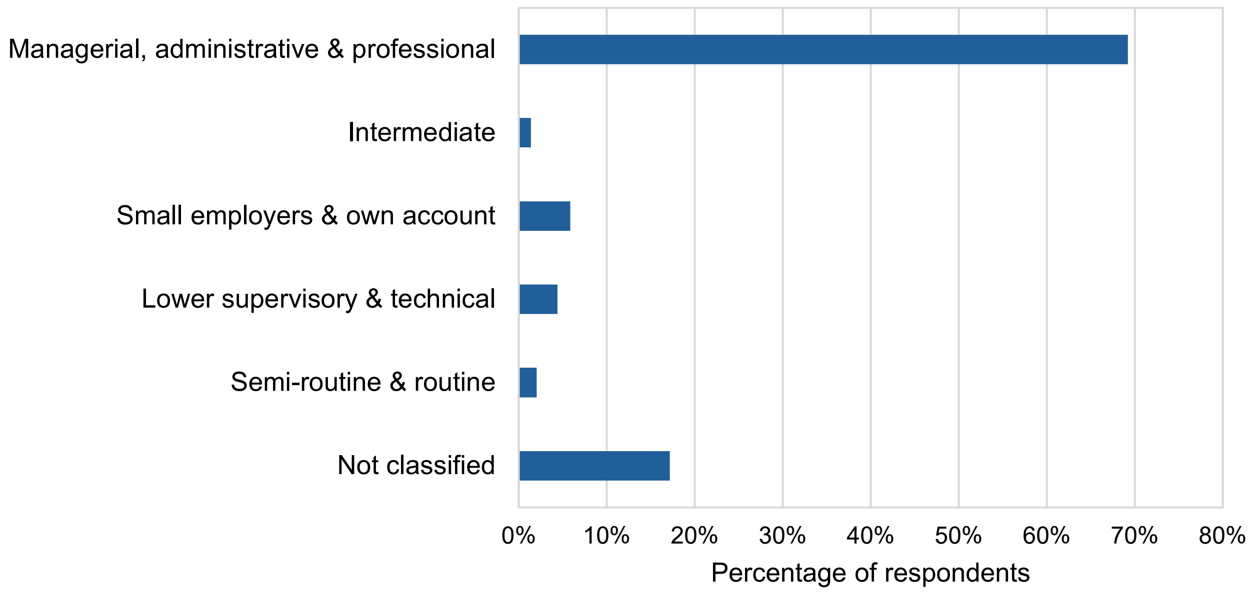


4.62 The y-axis of Figure 17 shows categorical bins for socio-economic classification. The x-axis shows the percentage of respondents per category, ranging from 0 to 80%.

4.63 Of the 29,792 respondents in Wave 1, the majority, 70.3% (20,943 respondents), were classified as "managerial, administrative and professional". An additional 1.4% (411 respondents) were classified as "intermediate", 5.8% (1,722 respondents) were classified as "small employers and own account", 4.5% (1,345 respondents) were classified as "lower supervisory and technical", and 1.9% (561 respondents) were classified as "semi-routine and routine". Finally, 16.1% (4,810 respondents) were "not classified" due to providing insufficient information.

28 Office of National Statistics Socio-economic classification

Figure 18 Wave 2 Respondent's social grade



4.64 The y-axis of Figure 18 shows categorical bins for socio-economic classification. The x-axis shows the percentage of respondents per category, ranging from 0 to 80%.

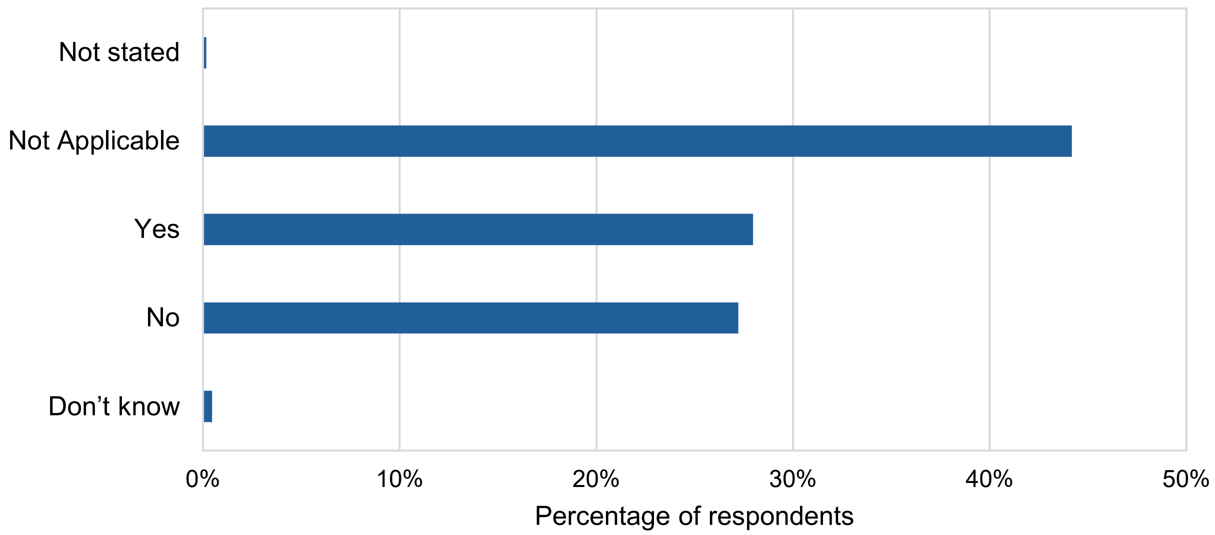
4.65 Of the 15,694 respondents in Wave 2, the majority, 69.2% (10,861 respondents), were classified as "managerial, administrative and professional". An additional 1.4% (216 respondents) were classified as "intermediate", 5.8% (916 respondents) were classified as "small employers and own account", 4.4% (690 respondents) were classified as "lower supervisory and technical", and 2.0% (317 respondents) were classified as "semi-routine and routine". Finally, 17.2% (2,694 respondents) were "not classified" due to providing insufficient information.

Work from home (Q58-Q60)

4.66 The following figures show the distribution of respondents to several questions related to working from home. These questions were "Q58: Are you able to work from home to do your job?", "Q59: And do you ever work from home?", and "Q60: In a typical working week, what proportion of your time is spent working from home?".

Question 58

Figure 19 Wave 1 Q58: "Are you able to work from home to do your job?"



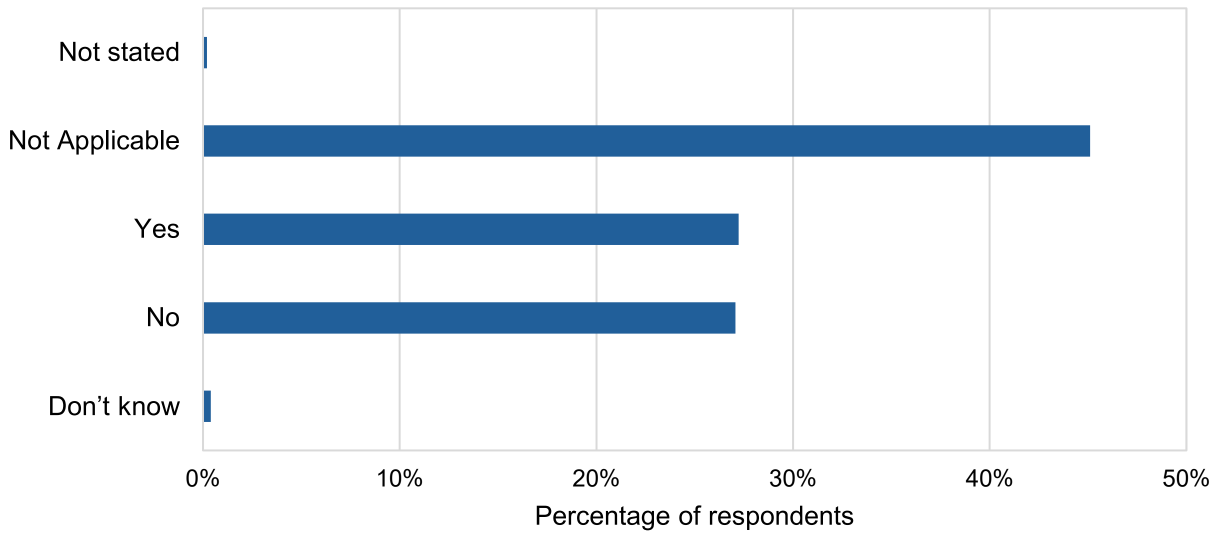
4.67 The y-axis of Figure 19 shows categorical bins for whether a respondent was able to work from home. The x-axis shows the percentage of respondents per category, ranging from 0 to 50%.

4.68 Possible responses to Q58 were "Not applicable", "Yes", "No", or "Don't know".

4.69 Of the 29,792 respondents in Wave 1, almost half, 44.2% (13,160 respondents), answered "not applicable" to this question. Roughly a quarter, 28.0% (8,334 respondents) answered "yes", and another quarter, 27.2% (8,110 respondents) answered "no".

4.70 Several responses were either not stated (0.2%, 50 respondents), or 0.5% (138 respondents) answered "don't know".

Figure 20 Wave 2 Q58: "Are you able to work from home to do your job?"



4.71 The y-axis of Figure 20 shows categorical bins for whether a respondent was able to work from home. The x-axis shows the percentage of respondents per category, ranging from 0 to 50%.

4.72 Possible responses to Q58 were “Not applicable”, “Yes”, “No”, or “Don’t know”.

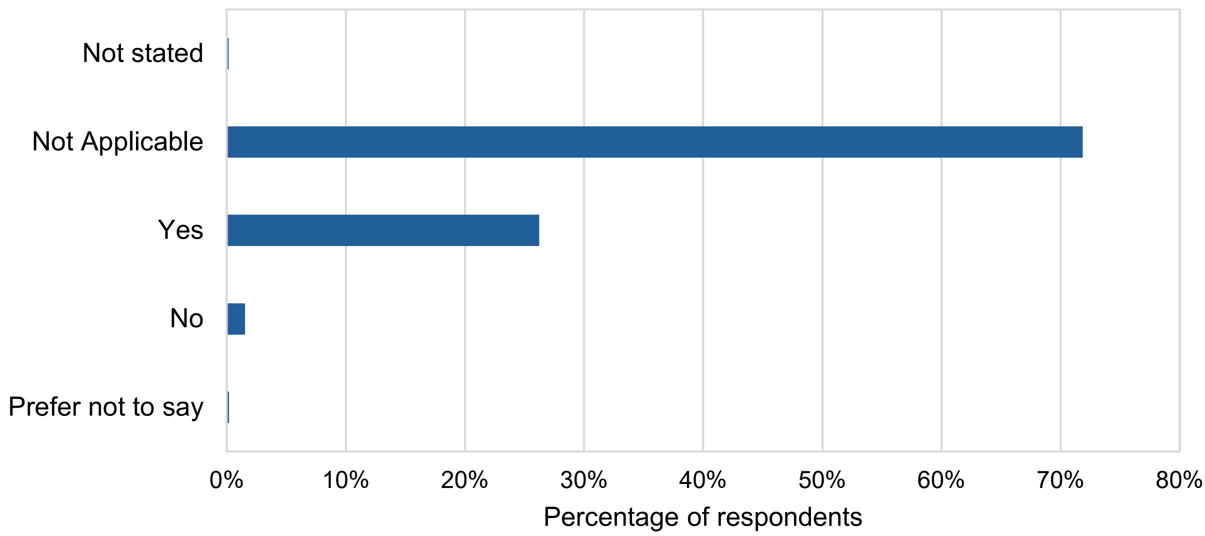
4.73 Of the 15,694 respondents in Wave 2, almost half, 45.1% (7,078 respondents), answered “Not applicable” to this question. Over a quarter, 27.2% (4,274 respondents), answered “Yes”, and another quarter, 27.1% (4,248 respondents), answered “No”.

4.74 Several responses were either not stated (0.2%, 32 respondents), or “Don’t know” (0.4%, 62 respondents).

Question 59

4.75 Figure 21 and Figure 22 show the distribution of respondents to question 59: “And do you ever work from home?”.

Figure 21 Wave 1 Q59: “And do you ever work from home?”



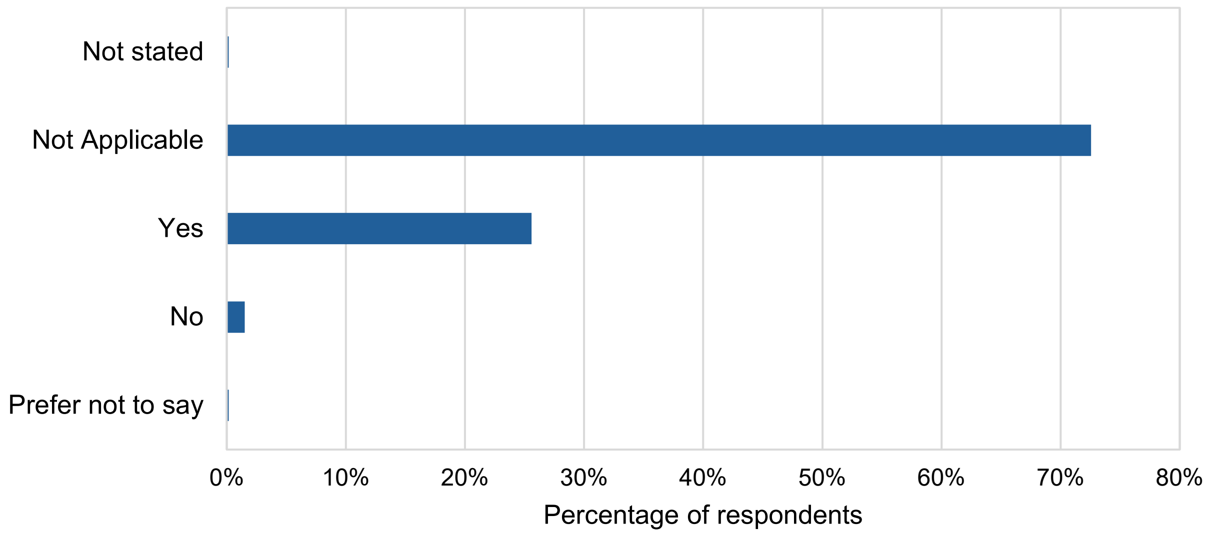
4.76 The y-axis of Figure 21 shows categorical bins for whether a respondent ever worked from home. The x-axis shows the percentage of respondents per category, ranging from 0 to 80%.

4.77 Possible responses to Q59 were “Not applicable”, “Yes”, “No”, or “Prefer not to say”.

4.78 Of the 29,792 respondents in Wave 1, just under three quarters, 71.9% (21,408 respondents), answered “Not applicable” to this question. A quarter, 26.2% (7,813 respondents), answered “Yes”, and a number, 1.6% (459 respondents) answered “No”.

4.79 Several responses were “Not stated” (0.2%, 52 respondents), or “Prefer not to say” (0.2%, 60 respondents).

Figure 22 Wave 2 Q59: "And do you ever work from home?"



4.80 The y-axis of Figure 22 shows categorical bins for whether a respondent ever worked from home. The x-axis shows the percentage of respondents per category, ranging from 0 to 80%.

4.81 Possible responses to Q59 were "Not applicable", "Yes", "No", or "Prefer not to say".

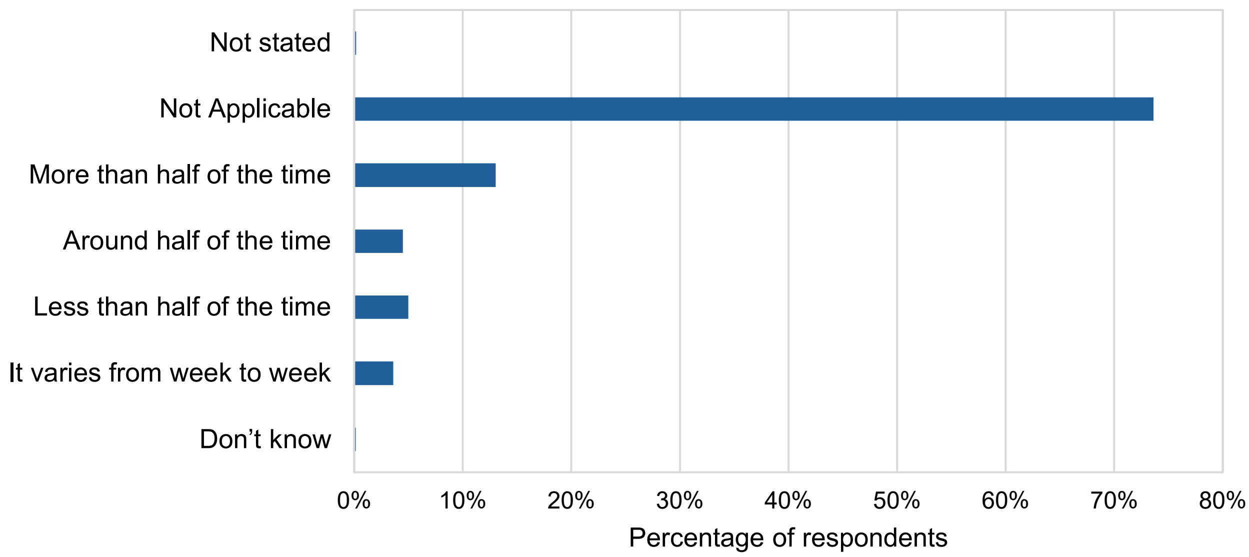
4.82 Of the 15,694 respondents in Wave 2, just under three quarters, 72.6% (11,388 respondents), answered "Not applicable" to this question. A quarter, 25.6% (4,016 respondents), answered "Yes", and a number, 1.5% (235 respondents), answered "No".

4.83 A smaller number of responses were "Not stated" (0.2%, 28 respondents), or "Prefer not to say" (0.2%, 27 respondents).

Question 60

4.84 Figure 23 and Figure 24 show the distribution of respondents to question 60: "In a typical working week, what proportion of your time is spent working from home?".

Figure 23 Wave 1 Q60: "In a typical working week, what proportion of your time is spent working from home?"



4.85 The y-axis of Figure 23 shows categorical bins for the proportion of time a respondent spends working from home. The x-axis shows the percentage of respondents per category, ranging from 0 to 80%.

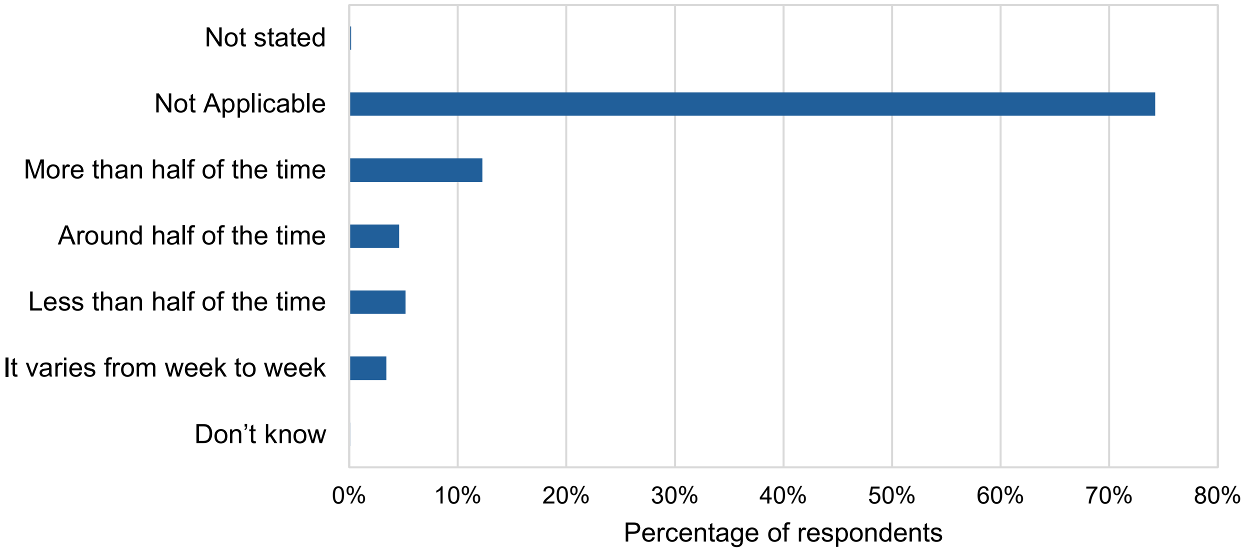
4.86 Possible responses to Q60 were "Not applicable", "More than half the time", "Around half of the time", "Less than half of the time", "It varies from week to week", or "Don't know".

4.87 Of the 29,792 respondents in Wave 1, over two thirds, 73.6% (21,927 respondents), answered "Not applicable" to this question. 13.0% (3,886 respondents), worked from home "More than half of the time" and 4.5% (1,334 respondents) worked from home "Around half the time". Finally, 5.2% (1,485 respondents) worked from home "Less than half the time", and 3.6% (1,068) answered "It varies from week to week".

4.88 Several responses were "Don't know" (0.1%, 42 respondents) or "Not stated" (0.2%, 50 respondents).

4.89 Comparing with SoNA 2014, the proportion of those working that said they worked from home more half the of week was 26%, in ANAS Wave 1 it was 49.8%.

Figure 24 Wave 2 Q60: "In a typical working week, what proportion of your time is spent working from home?"



4.90 The y-axis of Figure 24 shows categorical bins for the proportion of time a respondent spends working from home. The x-axis shows the percentage of respondents per category, ranging from 0 to 80%.

4.91 Possible responses to Q60 were "Not applicable", "More than half the time", "Around half of the time", "Less than half of the time", "It varies from week to week", or "Don't know".

4.92 Of the 15,694 respondents in Wave 2, over three quarters, 74.2% (11,649 respondents), answered "Not applicable" to this question. 12.3% (1,925 respondents), worked from home "More than half of the time" and 4.6% (724 respondents) worked from home "Around half the time". Finally, 5.2% (815 respondents) worked from home "Less than half the time", and 3.4% (539) answered "It varies from week to week".

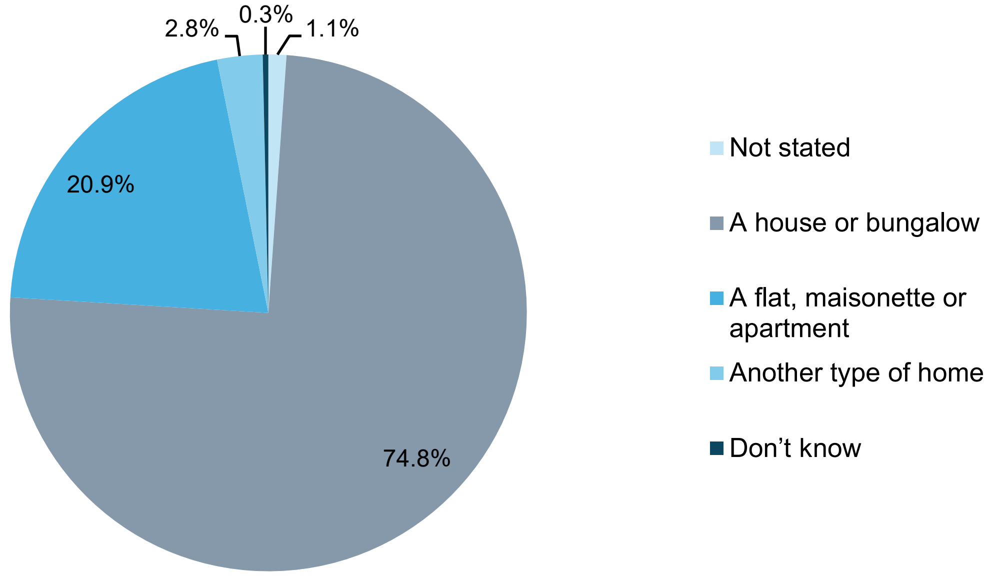
4.93 Several responses were "Don't know" (0.1%, 13 respondents), or "Not stated" (0.2%, 29 respondents).

4.94 Comparing with SoNA 2014, the proportion of those working that said they worked from home more half the of week was 26%, in ANAS Wave 2 it was 49.4%.

Type of home (Q43)

4.95 Figure 25 and Figure 26 show the distribution of respondents to question 43: "What type of home do you live in?". Possible responses were "A house or bungalow", "A flat, maisonette or apartment", "Another type of home", or "Don't know".

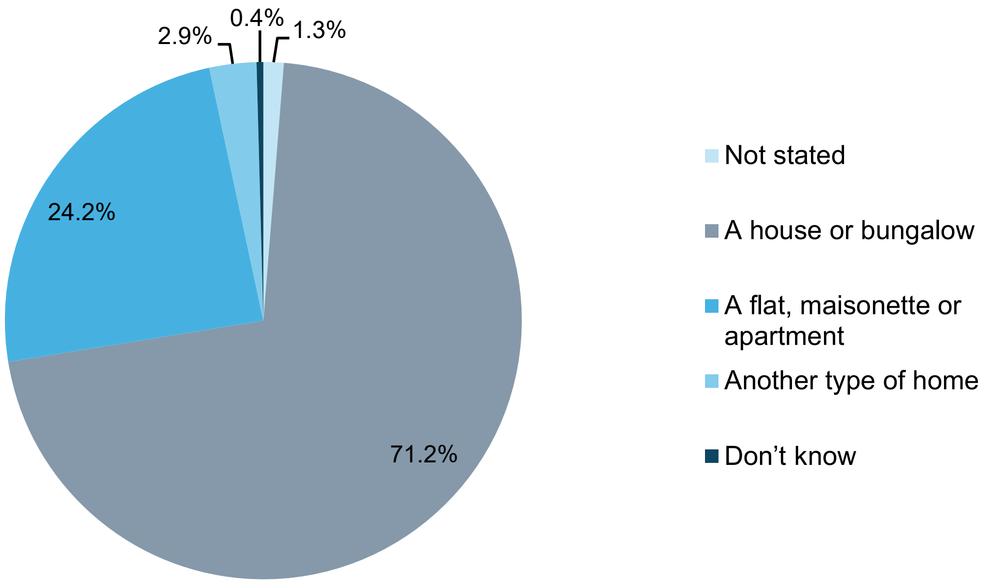
Figure 25 Wave 1 Q43: "What type of home do you live in?"



4.96 Of the 29,792 respondents in Wave 1, almost three quarters, 74.8% (22,294 respondents), lived in "A house or a bungalow". Just over a fifth, 20.9% (6,214 respondents), lived in a "Flat, maisonette or apartment", and 2.8% (845 respondents) lived in "Another type of home".

4.97 Several responses were "Don't know" (0.3%, 104 respondents), or "Not stated" (1.1%, 335 respondents).

Figure 26 Wave 2 Q43: "What type of home do you live in?"



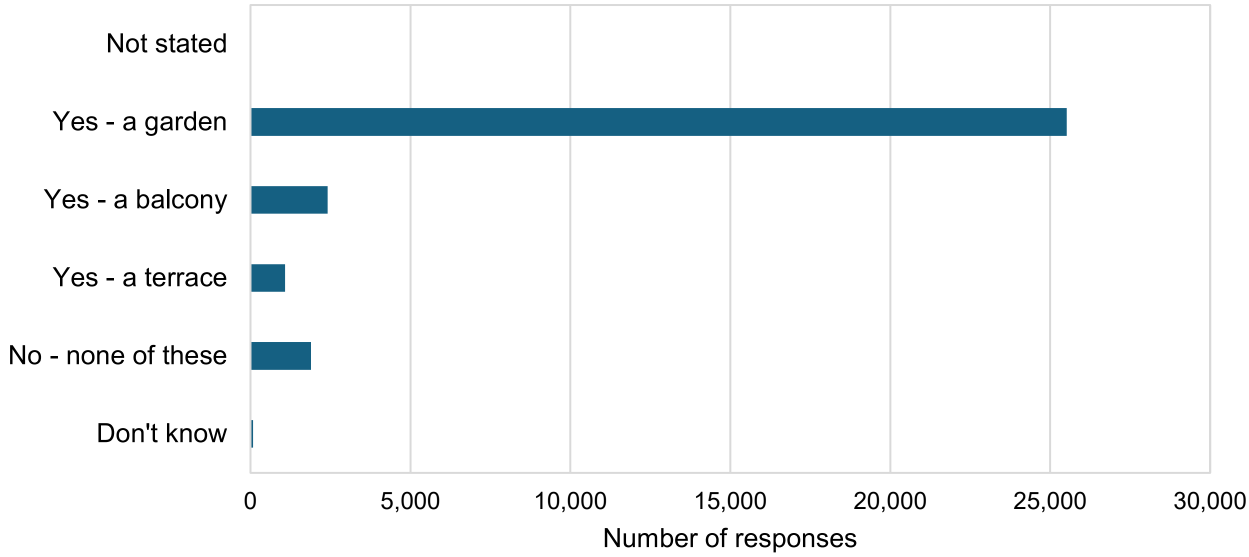
4.98 Of the 15,694 respondents in Wave 2, over two thirds, 71.2% (11,171 respondents), lived in "A house or a bungalow". Almost a quarter, 24.2% (3,796 respondents), lived in a "Flat, maisonette or apartment", and a number, 2.9% (462 respondents), lived in "Another type of home".

4.99 Several responses were "Don't know" (0.4%, 66 respondents), or "Not stated" (1.3%, 199 respondents).

Outdoor space (Q44)

4.100 Figure 27 and Figure 28 show the distribution of responses to question 44: "Do you have use of an outdoor space such as a garden, terrace or balcony?". It was possible to select all that applied from the following options: "Yes - a garden", "Yes - a balcony", "Yes - a terrace", "No - none of these", or "Don't know". Consequently, the responses to Q44 were expressed below as a count rather than a percentage of survey respondents.

Figure 27 Wave 1 Q44: "Do you have use of an outdoor space such as a garden, terrace or balcony?"

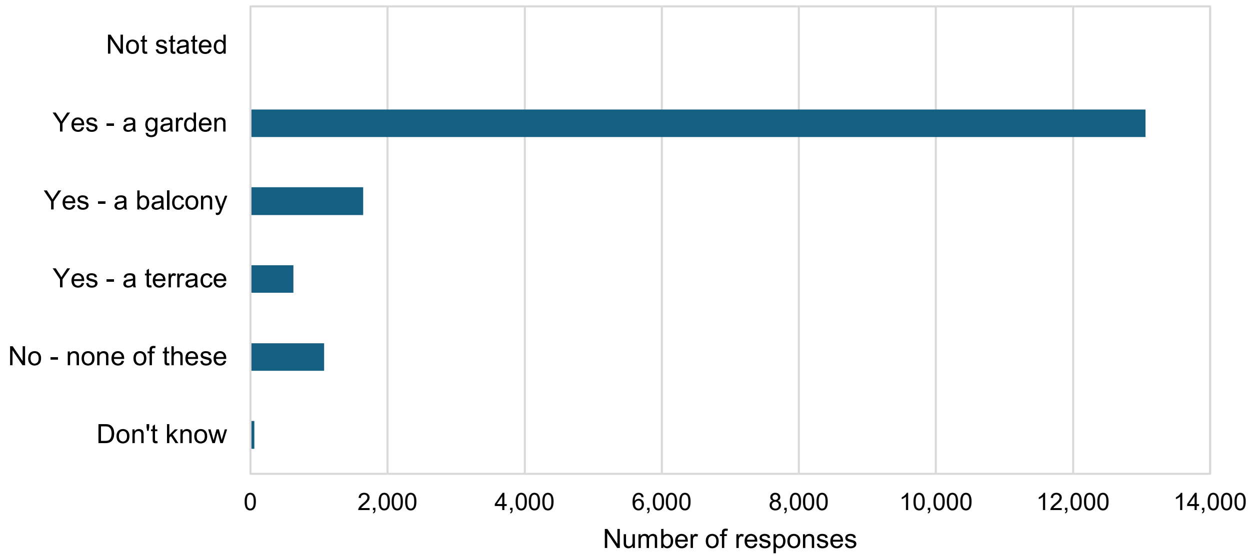


4.101 The y-axis of Figure 27 shows categorical bins for whether the respondent possesses an outdoor space. The x-axis shows the number of respondents per category, ranging from 0 to 30,000.

4.102 Of the 29,792 respondents in Wave 1, 25,520 had use of a garden, 2,411 had use of a balcony, and 1,083 had use of a terrace. Only 1,891 respondents had none of these.

4.103 Several responses were "Don't know" (79 respondents) or "Not stated" (12 respondents).

Figure 28 Wave 2 Q44: "Do you have use of an outdoor space such as a garden, terrace or balcony?"



4.104 The y-axis of Figure 28 shows categorical bins for whether the respondent had use of an outdoor space. The x-axis shows the number of respondents per category, ranging from 0 to 14,000.

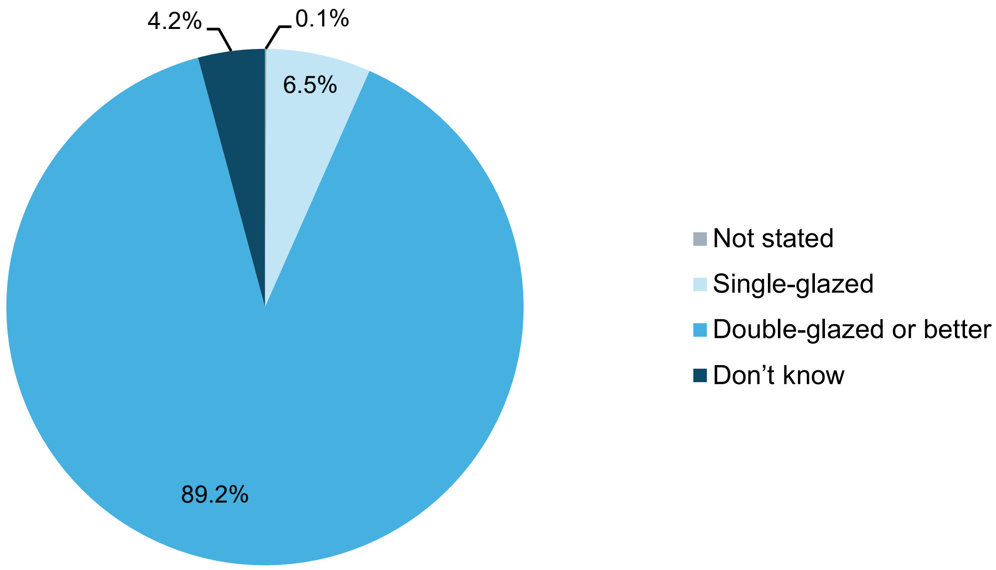
4.105 Of the 15,694 respondents in Wave 2, 13,055 respondents had use of a garden, 1,645 had use of a balcony, and 627 had use a terrace. Only 1,073 respondents had none of these.

4.106 Several responses were "Don't know" (58 respondents) or "Not stated" (5 respondents).

Glazed Windows (Q45)

4.107 Figure 29 and Figure 30 show the distribution of respondents to question 45: "What type of windows do you have in your living room or room where you spend most of your time when at home?". It was possible to answer "Single-glazed", "Double-glazed or better" or "Don't know".

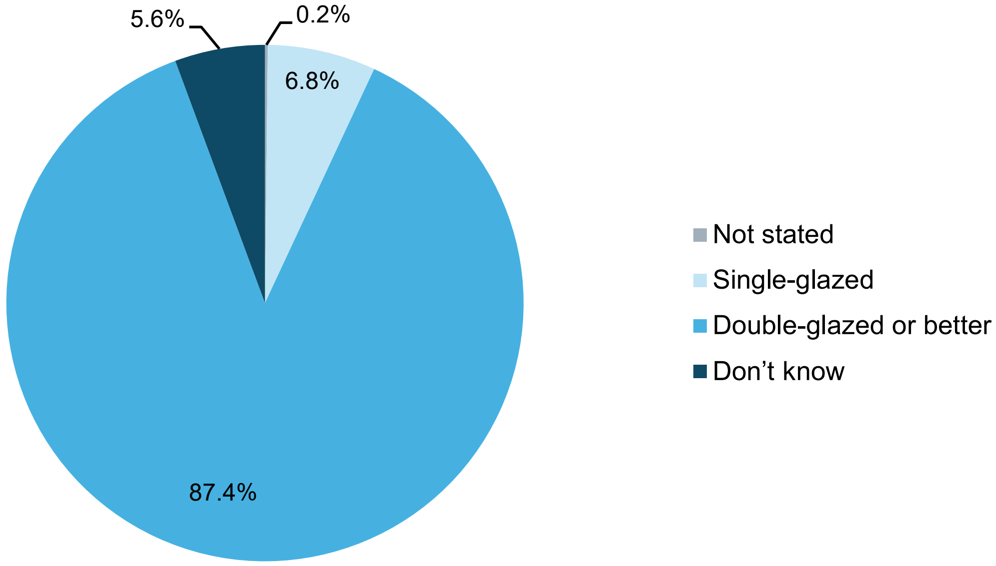
Figure 29 Wave1 Q45: "What type of windows do you have in your living room or room where you spend most of your time when at home?"



4.108 Of the 29,792 respondents in Wave 1, a minority, 6.5% (1,945 respondents), had single-glazed windows. The vast majority, 89.2% (26,576 respondents), had doubled-glazed or triple-glazed windows.

4.109 Several responses were "Not stated" (0.1%, 29 respondents), or "Don't know" (4.2%, 1,242 respondents).

Figure 30 Wave 2 Q45: "What type of windows do you have in your living room or room where you spend most of your time when at home?"



4.110 Of the 15,694 respondents in Wave 2, a minority, 6.8% (1,062 respondents), had single-glazed windows. The vast majority, 87.4% (13,720 respondents), had doubled-glazed or better.

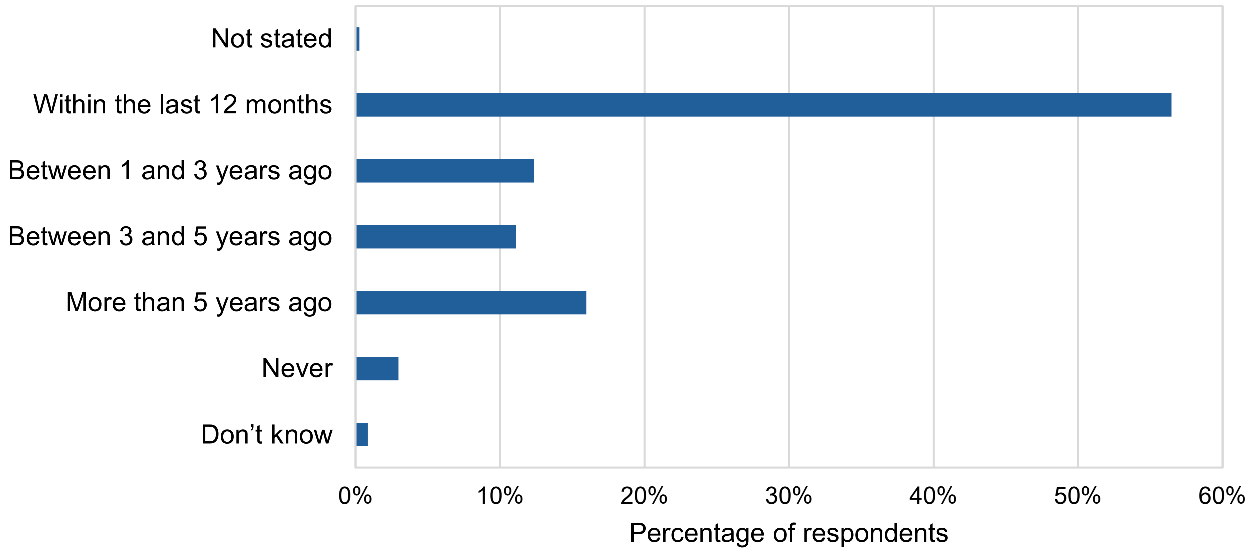
4.111 Several responses were "Not stated" (0.2%, 27 respondents), or "Don't know" (5.6%, 885 respondents).

Flights taken in last 5+ years (Q29-Q30)

Question 29

4.112 Figure 31 and Figure 32 show the distribution of responses to question 29: "When was the last time you flew from a UK airport?". It was possible to answer, "Within the last 12 months", "Between 1 and 3 years", "Between 3 and 5 years", "More than 5 years", "Never" or "Don't know".

Figure 31 Wave 1 Q29: “When was the last time you flew from a UK airport?”

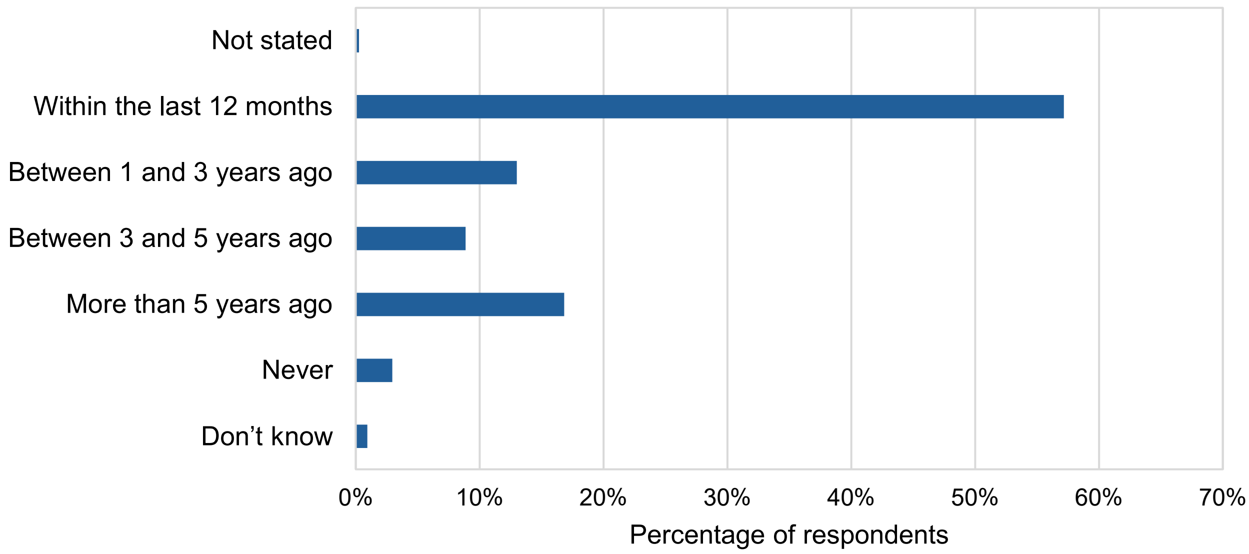


4.113 The y-axis of Figure 31 shows categorical bins for the length of time since a respondent flew from a UK airport. The x-axis shows the percentage of respondents per category, ranging from 0 to 60%.

4.114 Of the 29,792 respondents in Wave 1, over half, 56.5% (16,820 respondents) had flown from a UK airport in the last 12 months. A further 12.4% (3,683 respondents) had flown from a UK airport between 1 and 3 years ago, 11.1% (3,313 respondents) between 3 and 5 years ago, and 16.0% (4,762 respondents) more than 5 years ago. Only 3.0% (885 respondents) had never flown.

4.115 Several responses were “Not stated” (0.3%, 79 respondents), or “Don’t know” (0.8%, 250 respondents).

Figure 32 Wave 2 Q29: "When was the last time you flew from a UK airport?"



4.116 The y-axis of Figure 32 shows categorical bins for the length of time since a respondent flew from a UK airport. The x-axis shows the percentage of respondents per category, ranging from 0 to 70%.

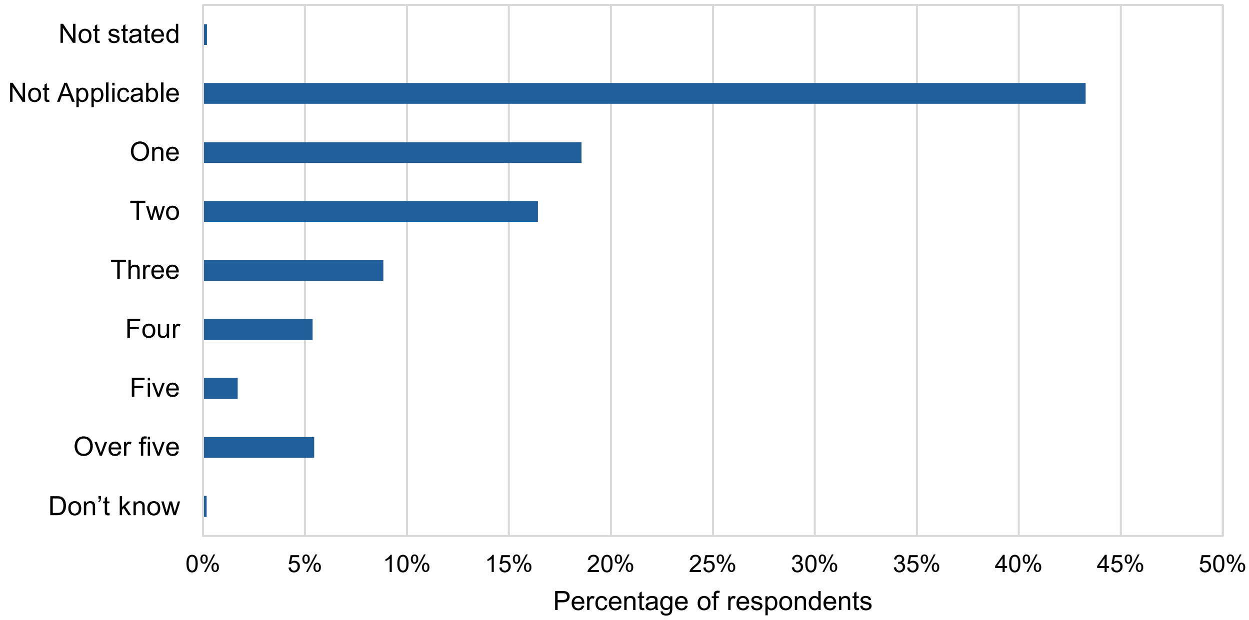
4.117 Of the 15,694 respondents in Wave 2, over half, 57.2% (8,973 respondents) had flown from a UK airport in the last 12 months. A further 13.0% (2,039 respondents) had flown from a UK airport between 1 and 3 years ago, 8.9% (1,391 respondents) between 3 and 5 years ago, and 16.8% (2,641 respondents) more than 5 years ago. Only 3.0% (463 respondents) had never flown.

4.118 Several responses were "Not stated" (0.3%, 42 respondents), or "Don't know" (0.9%, 145 respondents).

Question 30

4.119 Figure 33 and Figure 34 show the distribution of responses to question 30: "How many trips have you made in the last 12 months by aeroplane?".

Figure 33 Wave 1 Q30: How many trips have you made in the last 12 months by aeroplane?"

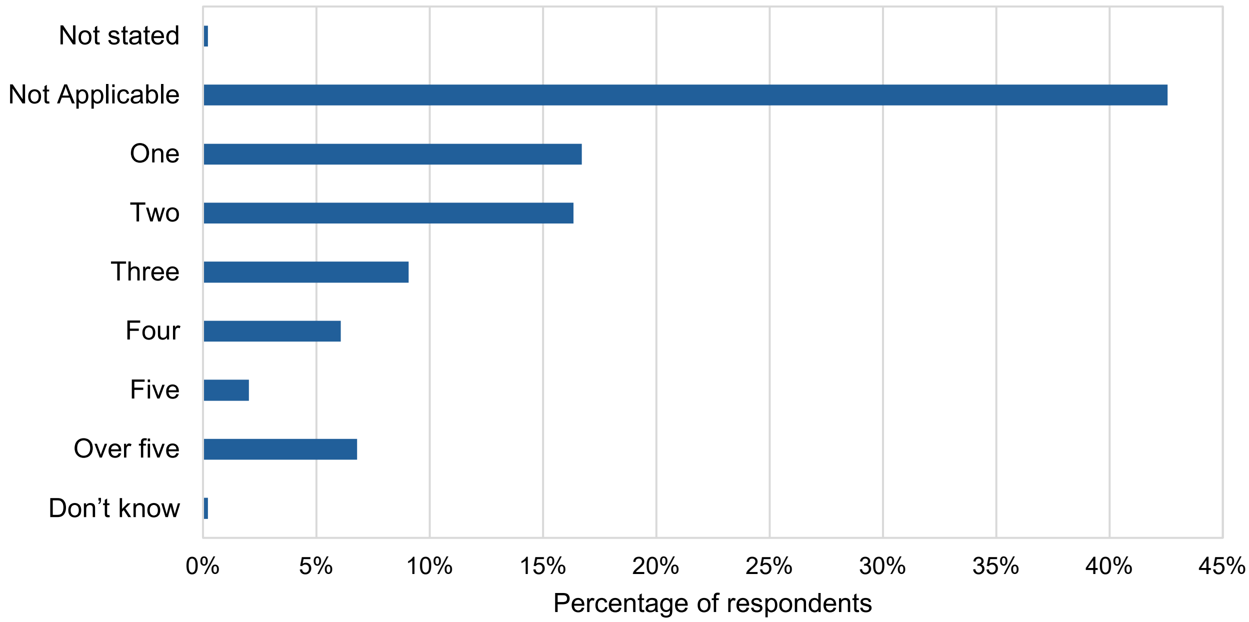


4.120 The y-axis of Figure 33 shows categorical bins for the number of times respondents flew in the previous 12 months. The x-axis shows the percentage of respondents per category, ranging from 0 to 50%.

4.121 Of the 29,792 respondents in Wave 1, 43.3% (12,893 respondents) had not flown at all in the last 12 months. Over half had flown, with 18.6% (5,529 respondents) having flown once, 16.4% (4,894 respondents) twice, 8.8% (2,636 respondents) three times, 5.4% (1,601 respondents) four times, and 1.7% (509 respondents) five times. Only 5.4% (1,622 respondents) had flown more than five times.

4.122 Several responses were "Not stated" (0.2%, 56 respondents), or "Don't know" (0.2%, 52 respondents).

Figure 34 Wave 2 Q30: How many trips have you made in the last 12 months by aeroplane?”



4.123 The y-axis of Figure 34 shows categorical bins for the number of times respondents flew in the previous 12 months. The x-axis shows the percentage of respondents per category, ranging from 0 to 45%.

4.124 Of the 15,694 respondents in Wave 2, 42.6% (6,679 respondents) had not flown at all in the last 12 months. Over half had flown, with 16.7% (2,623 respondents) having flown once, 16.3% (2,565 respondents) twice, 9.1% (1,423 respondents) three times, 6.1% (954 respondents) four times, and 2.0% (317 respondents) five times. Only 6.8% (1,066 respondents) had flown more than five times.

4.125 Several responses were “Not stated” (0.2%, 34 respondents), or “Don’t know” (0.2%, 33 respondents).

Comparisons to Other UK Demographic Surveys

4.126 This section outlines the demographic, household, and dwelling characteristics of ANAS in comparison to the 2021 England and Wales Census, the 2022 Scotland Census, and the Ordnance Survey (OS) data on access to private gardens, public parks and playing fields in Great Britain (2020). Note that the characteristics of ANAS respondents were not intended to be nationally representative, as participants lived near civil airports.

4.127 Comparisons were made where analogous data existed in recent censuses or another accessible data source. Demographics on ‘working from home’ were excluded as the censuses took place during COVID-19.

4.128 Where available, data specific to England was used, as Welsh airports were not included in ANAS. However, census data on gender, employment status, housing type, and number of children used datasets covering England and Wales.

2021 England and Wales Census and 2022 Scottish Census

4.129 The censuses are held every 10 years. The most recent census for England and Wales proceeded on 21st March 2021, despite the COVID-19 pandemic. Scotland's census was delayed and took place on 20 March 2022. The Office for National Statistics (ONS) oversaw the census in England and Wales, and National Records of Scotland oversaw the census in Scotland.

4.130 These were the first UK censuses primarily conducted online.

ONS Outdoor Space data

4.131 The Office for National Statistics provide information on access to gardens and public green space in Great Britain, based on analysis of Ordnance Survey (OS) data, the latest for which is 2020[29].

4.132 When interpreting Table 3 it must be kept in mind that the population eligible for participation in the ANAS lived in the vicinity of airports in England and Scotland and thus represent a small proportion of the national population. Notwithstanding this, we see broadly that the demographics of respondents were similar to the national Census characteristics, except for age, where we see an under representation in the 20-29 age group, and over representation of people over 30. Almost certainly associated with the over representation in older age groups we also see an over representation of those working full time in England only, and an over representation of retired people in both England and Scotland.

29 Office for National Statistics Access to gardens and public green space in Great Britan

Table 3 Demographic information for ANAS 2023/24 compared with National Data

Demographic	ANAS Wave 1	ANAS Wave 2	2021 England and Wales Census/ONS*	2022 Scottish Census/ONS*
House Ownership Status				
On Mortgage	31.0%	29.7%	29.7%	28.7%
Owned Outright	38.9%	38.4%	32.8%	33.9%
Rented from local authority, housing association or housing trust	13.5%	13.6%	17.1%	22.5%
Rented from a private landlord	12.2%	13.4%	20.3%	12.4%
Age				
20-29	6.6%	9.7%	12.6%	12.4%
30-39	16.1%	17.1%	13.7%	12.9%
40-49	16.6%	15.9%	12.7%	12.2%
50-59	17.6%	17.4%	13.7%	14.7%
60-69	18.7%	17.9%	10.7%	12.6%
70-79	16.1%	14.4%	8.6%	9.3%
80-89	7.0%	5.6%	4.1%	4.2%
90+	1.2%	0.7%	0.9%	0.8%
Gender				
Female	52.6%	52.5%	51.0%	51.4%
Male	44.7%	44.6%	49.0%	48.6%
Non-Binary	0.2%	0.3%	0.1%	0.2%
Other	0.1%	0.1%	<0.1%	0.1%
Adults in House				
One	24.1%	23.1%	30.2%	Not available
Two	55.4%	55.0%	47.0%	Not available

Demographic	ANAS Wave 1	ANAS Wave 2	2021 England and Wales Census/ONS*	2022 Scottish Census/ONS*
Three or more	16.9%	18.4%	17.9%	Not available
Employment Status				
Working Part-Time	11.9%	11.5%	13.9%	11.5%
Working Full-Time	43.8%	43.2%	32.7%	47.6%
Unemployed and Looking for Work	2.0%	2.5%	2.8%	1.9%
Retired from Work	28.7%	28.0%	21.7%	23.3%
Full-time Education	1.8%	2.5%	5.6%	4.0%
Looking After Home or Family	3.6%	3.3%	4.8%	3.4%
Something Else	3.8%	4.0%	3.1%	2.3%
Type of House				
A House or Bungalow	74.8%	71.2%	77.9%	67.0%
Flat, Maisonette or Apartment	20.9%	24.2%	21.7%	32.4%
Another Type of Home	2.8%	2.9%	0.4%	0.6%
Outdoor Space*				
Does the house have an outdoor space? E.g. Garden, Balcony, Terrace	93.3%	92.8%	88.4%	87.3%
Children in House				
No Dependent Children	69.2%	69.3%	71.6%	76.5%
One Dependent Child	12.6%	12.5%	12.5%	11.1%
Two Dependent Children or More	15.6%	14.4%	15.9%	12.4%

Chapter 5

Noise Exposure and Annoyance

Introduction

5.1 This chapter focuses on the analysis undertaken to examine how annoyance varies with noise exposure level. The research design presents potential for multiple types of analysis – including by individual fieldwork wave, by both waves combined, by all airports combined or by individual airport, by experience over the last three months or the last 12 months, and by responses provided both on a verbal and a numerical answer scale. We have also conducted analysis under three separate noise metrics: the $L_{Aeq,16h}$ summer indicator, L_{den}, and N65.

5.2 Given the range of possible reporting variables, we have chosen to focus our main reporting on outcomes which adhere to current policy definitions (annoyance in the last three months during the summer period, $L_{Aeq,16h,}$ numerical response scale (HA_N analysis)), alongside the equivalent configurations for the last 12 months and for each time period but with the verbal response scale (HA_V). We are also reporting the last three months during the summer period, numerical response scale (HA_N analysis) with the N65 metric, for broader perspective. We are additionally providing information which aligns to other international studies, reporting annoyance in the last 12 months combining both waves of fieldwork, and results for all airports.

5.3 The report also presents a breakdown of annoyance in the last three months during the summer period, $L_{Aeq,16h,}$ by numerical response scale disaggregated by airport. We are additionally providing analysis investigating if there were any differences in attitudes depending on whether respondents completed the survey online or on paper.

5.4 Other tables showing additional analysis outputs for the weighted verbal scale (HA_{VW}) and for the winter (Wave 2) period in isolation, and other configurations for individual airports, are included in appendices E and F.

Noise modelling for sampling

5.5 The sample design for ANAS aimed to achieve an equal number of responses at each designated level of noise exposure at each of the ten selected airports. In order to sample efficiently and effectively, we targeted responses based on six groups organised into 3 dB wide bands. Respondents were selected randomly from eligible postcodes identified by an estimate of the aviation noise exposure during the research period.

5.6 For Wave 1, representing the summer period, estimates were undertaken in late 2022 of the summer 2023 dose, based on summer 2022 traffic data and using a mixture of 2021 and 2022 noise and radar data. Coming out of the Covid-19 pandemic, aviation activity was growing and thus it was not appropriate to simply rely on the estimated 2022 exposure before survey, so an uplift in noise exposure of 1 dB, equivalent to a 25% increase in activity for summer 2023, was factored in. For some airports, 2022 noise contours were not available. For these airports, the most recent contours were scaled up to 2022 noise levels according to the total aircraft movements published by the CAA and then the 25% uplift applied. For the Wave 2 modelling, estimates were based on summer 2022 data adjusted to cover the period of 16 December 2023 to 15 February 2024 inclusive.

5.7 It must be emphasised that these noise estimates were only used to guide sample selection, to ensure it was applied cost effectively, and were not used in the determination of the ERF, which relied on the actual noise exposure determined post survey. Had an uplift not been applied, there was a high risk that the minimum noise exposure would be higher than 2022 (because of the ongoing Covid-19 recovery) and subsequently the post-survey minimum noise levels would be higher than 45 dB $L_{Aeq,16h}$, effectively undermining a key survey aim.

5.8 Runway modal splits were also considered. Aviation noise exposure is very sensitive to the direction of use of the runways at an airport, which is dependent on wind direction. For example, over the past 30 years, the proportion of westerly and easterly operations at Heathrow in the summer period has varied between 94% westerly/6% easterly, to 46% westerly/54% easterly. This represents a swing in noise exposure on the easterly side of the airport of up 6.9 dB $L_{Aeq,16h}$. The noise contours were calculated using a standardised modal split informed by a 20-year average of runway direction data for each airport (where data was available). A standardised modal split at each airport was used for this modelling exercise to better predict noise levels in 2023 by using a long-term average rather than the modal split from an individual year which could be atypical.

5.9 Checks were made to determine whether some postcodes were overflown by movements to and from more than one airport. After investigation it was found that only London City Airport and London Heathrow noise exposure overlapped in the region 45-51 dB $L_{Aeq,16h}$. To determine the most appropriate methodology for cumulatively adding noise levels and deciding which airport the noise levels are assigned to, a histogram of eligible postcodes and difference between noise levels was produced. The cumulative noise level was allocated to whichever airport had the higher individual noise level. The consequence of the chosen approach is that the cumulative noise level was assigned to only one airport and therefore no noise level was assigned to the other airport, which prevented the postcode being chosen twice for sampling.

5.10 Predictive modelling for the ten airports in the ANAS study was split amongst three different consultants using the same methodology and model routinely used at each airport in order to ensure that exposure-response functions relate to ongoing noise exposure calculations. The exception to this was London Heathrow, where the approach to model arrival noise was amended to better estimate noise exposure in the 45-48 dB $L_{Aeq,16h}$ region. Diagrams identifying the areas for which postcodes were in scope for selection for the study are included in appendix D.

Airport developments, consultations and trials during 2023-2024

5.11 During the two survey waves, several of the airports surveyed announced developments, undertook consultations and/or operated airspace trials that altered the noise exposure in their vicinity, leading to both increases and decreases in noise exposure at certain locations. Regardless of whether noise exposure differed during 2023 or 2024 from previous years, these changes may have also affected expectations or heightened awareness of aircraft noise and may have had an impact on reported attitudes. Details of relevant developments, consultations and trials are summarised in Appendix G.

Retrospective noise exposure

5.12 While best efforts were made to identify eligible participants for the study based on estimates, a further modelling exercise, referred to as 'retrospective contouring', was undertaken to identify the actual noise exposure experienced by participants during the research period.

5.13 Modelling was carried out in accordance with CAA CAP 2091[30] by the same suppliers that performed the predictive modelling for sampling purposes. Retrospective contouring modelling was provided for the following noise metrics and time periods:

1. 92-day summer period – 16th June 2023 to 15th September 2023
   a) Daytime $L_{Aeq,16h}$ (07:00-22:59)
   b) Daytime N65 (07:00-22:59)
2. Annual – 1st January 2023 to 31st December 2023
   a) 24h L_{den} (00:00-23:59)
3. 91-day winter period – 16th December 2023 to 15th March 2024
   a) Daytime $L_{Aeq,16h}$ (07:00-22:59)
   b) Daytime N65 (07:00-22:59)

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30 "CAA Policy on Minimum Standards for Noise Modelling", CAA CAP 2091, Civil Aviation Authority, January 2021.

5.14 The retrospective exposure data was incorporated into the survey response dataset so that all respondents to the survey could be matched to the real-life noise exposure for their postcode rather than the predicted estimate used for sampling purposes.

5.15 It can be argued that a 24h annual L_{den} noise dose for 2024 could have been generated for association with Wave 2, however, this would have delayed the study as it would have required waiting until January 2025 before beginning analysis of traffic and radar data for the calendar year 2024. Adjusting the L_{den} time period from a calendar year to the period say, 1 April 2023 to 31 March 2023, whilst enabling modelling to begin sooner, would have led to other problems, including the double counting of two Easter periods in one 12-month period. Consequently, the L_{den} noise dose is represented by calendar year 2023 for both Wave 1 and Wave 2.

5.16 Following the retrospective noise exposure, Table 4 and Table 5 show the distribution responses across the airports and $L_{Aeq,16h}$ noise bands for Waves 1 and 2 respectively.

Table 4 Distribution of analysed responses by airport for Wave 1 actual noise dose ($L_{Aeq,16h}$)

<table>
<tr><th>Airport</th><th><45</th><th>45-47.9</th><th>48-50.9</th><th>51-53.9</th><th>54-56.9</th><th>57-59.9</th><th>60-62.9</th><th>>63</th><th>Total</th></tr>
<tr><td>Birmingham</td><td>328</td><td>429</td><td>449</td><td>480</td><td>360</td><td>339</td><td>241</td><td>130</td><td>2,756</td></tr>
<tr><td>Edinburgh</td><td>164</td><td>399</td><td>487</td><td>712</td><td>658</td><td>333</td><td colspan="2">332</td><td>3,085</td></tr>
<tr><td>East Midlands</td><td>191</td><td>1,288</td><td>1,726</td><td>436</td><td>173</td><td>49</td><td colspan="2">81</td><td>3,944</td></tr>
<tr><td>Glasgow</td><td>276</td><td>375</td><td>358</td><td>442</td><td>650</td><td>425</td><td colspan="2">81</td><td>2,607</td></tr>
<tr><td>Leeds Bradford</td><td>205</td><td>433</td><td>529</td><td>898</td><td>857</td><td>267</td><td colspan="2">112</td><td>3,301</td></tr>
<tr><td>London City</td><td>40</td><td>340</td><td>382</td><td>399</td><td>407</td><td>247</td><td colspan="2">185</td><td>2,000</td></tr>
<tr><td>London Gatwick</td><td>126</td><td>495</td><td>718</td><td>1,112</td><td>710</td><td>138</td><td colspan="2">108</td><td>3,407</td></tr>
<tr><td>London Heathrow</td><td>26</td><td>365</td><td>407</td><td>398</td><td>469</td><td>419</td><td>270</td><td>556</td><td>2,910</td></tr>
<tr><td>Luton</td><td>87</td><td>408</td><td>479</td><td>371</td><td>370</td><td>396</td><td colspan="2">200</td><td>2,311</td></tr>
<tr><td>Manchester</td><td>257</td><td>509</td><td>499</td><td>524</td><td>482</td><td>609</td><td>300</td><td>291</td><td>3,471</td></tr>
<tr><td>Total</td><td>1,700</td><td>5,041</td><td>6,034</td><td>5,772</td><td>5,136</td><td>3,222</td><td>1,910</td><td>977</td><td>29,792</td></tr>
</table>

5.17 Notwithstanding that Wave 1 obtained almost twice the responses targeted, Wave 1 achieved the sampling it set out to achieve. Note that there are a number of responses with noise exposure below 45 dB $L_{Aeq,16h}$, after the actual noise dose for summer 2023 was calculated. This was due to a combination of deviations from long-term wind patterns that altered runway use and, in some cases, lower than expected growth as aviation continued to recover from the Covid-19 pandemic.

Table 5 Distribution of analysed responses by airport for Wave 2 actual noise dose ($L_{Aeq,16h}$)

Airport	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	>63	Total
Birmingham	133	239	349	202	247	282	138	17	**1,607**
Edinburgh	118	228	215	241	235	396	178		**1,611**
East Midlands	0	200	554	371	198	120	31		**1,474**
Glasgow	39	192	291	303	304	331	13		**1,473**
Leeds Bradford	135	203	291	460	406	150	0		**1,645**
London City	12	301	243	275	285	282	187		**1,585**
London Gatwick	24	192	216	311	318	225	71		**1,357**
London Heathrow	22	202	254	287	322	238	181	335	**1,841**
Luton	8	245	330	200	221	270	243		**1,517**
Manchester	9	238	222	266	265	267	125	192	**1,584**
Total	**500**	**2,240**	**2,965**	**2,916**	**2,801**	**2,561**	**1,167**	**544**	**15,694**

5.18 The distribution of responses to Wave 2 largely mimics that for Wave 1, except that the overall sample met its target and thus Wave 2 is almost half the size of Wave 1.

5.19 Every previous UK aviation noise survey, all the way back to the 1960s, collected around 2,000 responses. Wave 1 is fifteen times larger than any past UK survey and Wave 2 is over seven times larger. Combined, the two waves are over 22 times larger than any past UK survey. The WHO 2018 systematic review with 15 surveys combined had a combined sample of 18,947 people. Table 6 shows the distribution of responses across the airports and L_{den} noise bands for Waves 1 and 2 combined.

Table 6 Distribution of analysed responses by airport for waves 1 and 2 combined actual noise dose (L_{den})

<table>
<tr><th>Airport</th><th><45</th><th>45-47.9</th><th>48-50.9</th><th>51-53.9</th><th>54-56.9</th><th>57-59.9</th><th>60-62.9</th><th>>63</th><th>Total</th></tr>
<tr><td>Birmingham</td><td>61</td><td>433</td><td>628</td><td>774</td><td>715</td><td>589</td><td>579</td><td>584</td><td>4,363</td></tr>
<tr><td>Edinburgh</td><td>0</td><td>353</td><td>540</td><td>755</td><td>942</td><td>836</td><td colspan="2">1,270</td><td>4,696</td></tr>
<tr><td>East Midlands</td><td>0</td><td>0</td><td>323</td><td>643</td><td>1,753</td><td>1,719</td><td colspan="2">980</td><td>5,418</td></tr>
<tr><td>Glasgow</td><td>23</td><td>376</td><td>591</td><td>683</td><td>750</td><td>1,012</td><td colspan="2">645</td><td>4,080</td></tr>
<tr><td>Leeds Bradford</td><td>90</td><td>387</td><td>720</td><td>817</td><td>1,325</td><td>860</td><td colspan="2">747</td><td>4,946</td></tr>
<tr><td>London City</td><td>20</td><td>305</td><td>866</td><td>700</td><td>692</td><td>491</td><td colspan="2">511</td><td>3,585</td></tr>
<tr><td>London Gatwick</td><td>30</td><td>360</td><td>762</td><td>1,056</td><td>1,337</td><td>773</td><td colspan="2">446</td><td>4,764</td></tr>
<tr><td>London Heathrow</td><td>0</td><td>223</td><td>690</td><td>586</td><td>719</td><td>696</td><td>661</td><td>1,176</td><td>4,751</td></tr>
<tr><td>Luton</td><td>0</td><td>115</td><td>562</td><td>888</td><td>596</td><td>656</td><td colspan="2">1,011</td><td>3,828</td></tr>
<tr><td>Manchester</td><td>12</td><td>244</td><td>614</td><td>735</td><td>849</td><td>726</td><td>880</td><td>995</td><td>5,055</td></tr>
<tr><td>Total</td><td>236</td><td>2,796</td><td>6,296</td><td>7,637</td><td>9,678</td><td>8,358</td><td>7,730</td><td>2,755</td><td>45,486</td></tr>
</table>

5.20 The number of responses per L_{den} noise band differs compared with $L_{Aeq,16h}$, this being due to the fact that L_{den} is dependent on annualised traffic and the proportion of day, evening and night-time traffic. Thus, the difference between a respondent's calculated L_{den} and $L_{Aeq,16h}$ noise dose varies from airport to airport, as well as between respondents at a given airport.

5.21 Table 7 shows the distribution of responses across the airports and N65 noise bands for Wave 1. Selection of the N65 bands is discussed in paragraphs 5.37 to 5.41, however the broad aim was to define twelve bands with equal numbers of respondents in each band in order provide a similar design to that used for the $L_{Aeq,16h}$ noise metric[31].

[31] Aircraft noise exposure is calculated for an average day, either a summer period or an annual period. In the case of N65, the standard UK period is an average summer day (0700-2300). All operations during the 92-day summer period are normalised to an average summer day, leading to fractional numbers of operations, so that the output is the number of events that may be experienced of at least 65 dB L_{ASmax}.

Table 7 Distribution of analysed responses by airport for Wave 1 actual noise dose (N65)

Airport	Less than 1.5	1.5-6.9	7-14.9	15-25.9	26-33.9	34-44.9	45-59.9	60-75.9	76-105.9	106-139.9	140-226.9	227 and over	Total
Birmingham	405	185	93	114	118	253	350	247	211	710	70	0	2,756
Edinburgh	217	267	85	213	125	124	185	141	312	845	571	0	3,085
East Midlands	48	273	733	741	330	605	790	414	10	0	0	0	3,944
Glasgow	159	218	286	168	84	99	155	254	1,178	6	0	0	2,607
Leeds Bradford	97	95	289	290	317	422	1,666	75	50	0	0	0	3,301
London City	167	45	107	244	37	282	340	654	62	62	0	0	2,000
London Gatwick	535	559	375	266	71	74	66	219	201	223	116	702	3,407
London Heathrow	234	224	205	176	131	88	87	106	95	142	158	1,264	2,910
Luton	380	231	93	72	154	204	78	75	194	393	436	1	2,311
Manchester	253	565	375	230	115	68	62	52	107	122	1,113	409	3,471
Total	2,493	2,664	2,641	2,514	1,482	2,219	3,779	2,237	2,420	2,503	2,464	2,376	29,792

Survey Questions

5.22 All respondents were invited to answer our questions on civil aircraft noise. We used the annoyance question defined by ISO/TS 15666:2021 which asks:

‘Thinking about the last [time period] when you are here at home, how much does noise from aeroplanes bother, disturb or annoy you?’

We posed this question for two time periods: ‘the last three months’ and ‘the last 12 months’ and in both cases asked it using a 5-point verbal scale (not at all, slightly, moderately, very or extremely) and an 11-point numerical rating scale as required by ISO/TS 15666:2021. These options formed questions 5,6,7 and 8 in our survey. While annoyance is phrased as ‘being bothered, disturbed or annoyed’ in the questionnaire, these responses are simply referred to as annoyance in this report.

Percentage Highly Annoyed

5.23 ISO/TS 15666:2021 defines two scales, a verbal scale and a numerical scale. From these it defines three thresholds to determine whether a respondent is highly annoyed:

a) HA_N: 0 to 10 on a numeric scale, scores of 8, 9 or 10 are taken as being highly annoyed

b) HA_V: not at all, slightly, moderately, very, or extremely (verbal scale). All ‘very’ or ‘extremely’ responses are taken as being highly annoyed

c) HA_{VW}: not at all, slightly, moderately, very, or extremely (verbal scale). 40% of ‘very’ responses and all ‘extremely’ responses are taken as being highly annoyed

5.24 The combination of three definitions of being highly annoyed, two time periods (last three months and last 12 months), ten airports, plus a combined sample for all airports, together with three noise metrics, results in the potential to produce over 400 unique exposure-response functions.

5.25 So many exposure-response functions could not be sensibly used, so this report focuses on the most relevant ones. We note that the longstanding UK noise indicator is based on the 92-day summer period and the final exposure-response function from SoNA 2014 was based on ISO 11-point scale and HA_N. Additionally, we observe that fourteen out of fifteen of the aviation studies in the WHO 2018 systematic review used HA_N, and one used HA_V[32].

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[32] Guski et al (2017), “WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance”, Int. J. Environ. Res. Public Health 2017, 14(12), 8 December 2017. https://doi.org/10.3390/ijerph14121539.

5.26 The core analysis was therefore undertaken around HA_N and $L_{Aeq,16h}$, for all ten airports individually and for all ten airports combined over the 3-month period for Waves 1 and 2. HA_N and $L_{Aeq,16h}$ for all ten airports combined was also used to investigate responses over the 12 months, online versus paper responses and to investigate seasonality (Wave 1 vs Wave 2).

5.27 Additional assessment was then undertaken using HA_V for all ten airports combined. Assessment of HA_N and HA_V for Wave 1 are presented in the following section, whilst HA_{VW} for Wave 1 and analysis for all annoyance indicators for Wave 2 are presented in Appendix E.

Analysis of $L_{Aeq,16h}$ and L_{den}

5.28 For SoNA 2014, data were grouped into 3 dB wide bands (or equivalent N65 bands), and the percentage highly annoyed calculated for each band. Logistic regression functions were then fitted to the grouped data.

5.29 Best practice, as applied to most recent studies, is to code each response according to the three ISO highly annoyed thresholds and then using the noise dose for each respondent to undertake a logistic regression analysis on the individual responses, i.e. without any grouping. This is straight-forward for HA_N and HA_V but is more complex for HA_{VW}. For HA_{VW}, ISO/TS 15666:2021 assigns a highly annoyed response to 40% of responses that stated ‘very’ on the 5-point verbal scale. With grouped data, it is straight forward to take 40% of the group total, however, with ungrouped data it is more complex. Good practice is to take a 40% random sample of those that stated ‘very’[33]. In order that the 40% selection was repeatable, each response selected was given a seed so that it could be tracked throughout the analysis. Sensitivity analysis was performed on different random selections.

5.30 In parallel with this ungrouped approach, a visual indication was performed, as per SoNA 2014, using data in 3 dB wide groups to check that the data conformed to a logistic function.

Clustering

5.31 One of the challenges posed to SoNA 2014 was that it used a partially clustered sampling approach, with addresses clustered below 54 dB $L_{Aeq,16h}$ in order to make the process of face-to-face surveys feasible, which resulted in surveys being conducted in a restricted number of geographic areas below 54 dB $L_{Aeq,16h}$.

5.32 In contrast, by moving to a push-to-web approach, ANAS was able to benefit from a completely random un-clustered approach for household selection.

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33 Brink et al (2021), “Pooling and Comparing Noise Annoyance Scores and “High Annoyance” (HA) Responses on the 5-Point and 11-Point Scales: Principles and Practical Advice”, International Journal of Environmental Research and Public Health, 2021, 18, 7399. https://doi.org/10.3390/ijerph18147339.

However, up to two adults per household were invited to take part in the survey. Statistically, each household with two responses is a mini cluster. Although this has no effect on the calculation of survey averages, it does affect the statistical uncertainty of the survey and any associated confidence intervals calculated. To fully account for this effect, clustering of responses within households was accounted for in the statistical analysis by using Complex Samples analysis in IBM SPSS®[34].

Calculation of the 95% confidence interval of predicted logistic function

5.33 In surveys such as this, there are a wide range of responses from participants, and this contributes to the uncertainty of the exposure-response function.

5.34 For $L_{Aeq,16h}$ and L_{den}, we applied a logistic regression model to the data, with noise dose as the predictor (x) and high annoyance (HA) as the dependent variable (y):

$$p(HA) = \frac{e^{(b_0+b_1x)}}{1+e^{(b_0+b_1x)}}$$

where b_0 is the intercept, and b_1 is the slope of the function.

5.35 The confidence interval of the fitted function is dependent on both parameters in the model, b_0 and b_1. For such a case, the 95% confidence interval is a function calculated from the Standard Error, SE(y):

$$CI- \quad = \frac{e^{\,b_0 + b_1x - 1.96 * SE(y)}}{1+e^{\,b_0 + b_1x - 1.96 * SE(y)}}$$

$$CI+ \quad = \frac{e^{\,b_0 + b_1x + 1.96 * SE(y)}}{1+e^{\,b_0 + b_1x + 1.96 * SE(y)}}$$

5.36 And the Standard Error is calculated from the variance-covariance matrix:

$$SE(y) = \sqrt{var[b_0] + x^2 * var[x] + 2x * covar[x, b_0]}$$

Analysis of N65

5.37 The SoNA 2014 analysis of N65 appeared to suggest that an N65 exposure-response function may not accord with a logistic function, that is an S-shaped (sigmoid) function that is asymptotic to the x-axis (noise exposure) when the noise exposure approaches zero.

5.38 This is possible with the N65 noise metric because an N65 of zero does not mean no noise, since N65 is a measure of the number of events equal to or greater than 65 dB L_{ASmax}. Consequently, several hundred events at 64.9 dB L_{ASmax} or below, lead to an N65 of zero.

34 Complex Samples - IBM SPSS Statistics.

5.39 Analysis confirmed that the percentage highly annoyed was not zero at zero N65, and consequently the exposure-response function for N65 did not fit a logistic regression function. Instead, other functions, such as linear and polynomial functions were found to be more suitable.

5.40 A consequence of not being able to use logistic regression is that the data must be grouped in order to determine the percentage highly annoyed. The starting point for the N65 noise groups was that used for SoNA 2014, i.e. less than 1 event, 1-24, 25-49, 50-99, 100-199, 200-399 and more than 400 events per average day for the summer and winter periods. The ANAS sampling was designed around 3 dB $L_{Aeq,16h}$ wide intervals and the aforementioned N65 groups did not yield an even distribution of respondents and thus the groupings were amended accordingly. Further discussion with the Steering Group led to the adoption of 12 groups, all except one of which had a larger sample than the overall SoNA 2014 survey, i.e. 2,000 respondents in Wave 1.

5.41 The resulting N65 noise groups were:

- less than 1.5, 1.5-6.9, 7.0-14.9, 15.0-25.9, 26.0-33.9, 34.0-44.9, 45.0-59.9, 60.0-75.9, 76.0-105.9, 106.0-139.9, 140.0-226.9 and 227 events or greater

5.42 A sensitivity analysis was conducted to determine the effect of the choice between six, twelve or twenty groups.

5.43 The starting point was a quadratic function, however, it was clear that the data exhibited a kink. Thus, after further analysis it was found that the most appropriate function was a quadratic function (2nd order polynomial) up to a ‘knot’, followed by linear function above the knot, with the two functions joined at the knot. The piecewise function has the form:

For x < knot:

$$p(HA) = A + Bx + Cx^2$$

For x ≥ knot:

$$p(H_A) = A + knot \cdot B + C \cdot knot^2 + M(x - knot)$$

Where A is the constant, B is the linear parameter, C is the quadratic parameter, M is the slope of the function and x is the N65 noise exposure.

Calculation of the 95% confidence interval of the predicted N65 function

5.44 Calculation of the 95% confidence interval of the predicted quadratic/linear function uses the same method as for a logistic regression, except that the 95% confidence interval is now dependent on four parameters, A, B, C and M:

For x < knot:

$$CI- = A + Bx + Cx^2 - 1.96 \cdot SE(y)$$

$$CI+ = A + Bx + Cx^2 + 1.96 \cdot SE(y)$$

For x ≥ knot:

$$CI- = A + B \cdot knot + C \cdot knot^2 + M(x - knot) - 1.96 \cdot SE(y)$$

$$CI+ = A + B \cdot knot + C \cdot knot^2 + M(x - knot) + 1.96 \cdot SE(y)$$

5.45 The Standard Error is calculated from the variance-covariance of each parameter:

For x < knot:

$$SE(y) = \sqrt{\begin{matrix} Var(A) + x^2 \cdot Var(B) + x^4 \cdot Var(C) + 2x \cdot Cov(A,B) \\ +2x^2 \cdot Cov(A,C) + 2x^3 \cdot Cov(B,C) \end{matrix}}$$

For x ≥ knot:

$$SE(y) = \sqrt{\begin{matrix} Var(A) + knot^2 \cdot Var(B) + knot^4 \cdot Var(C) + (x - knot)^2 \cdot Var(M) + 2(knot) \cdot Cov(A,B) \\ +2(knot^2) \cdot Cov(A,C) + 2(x - knot) \cdot Cov(A,M) + 2(knot)^3 \cdot Cov(B,C) + \\ 2(knot)(x - knot) \cdot Cov(B,M) + 2(knot^2)(x - knot) \cdot Cov(C,M) \end{matrix}}$$

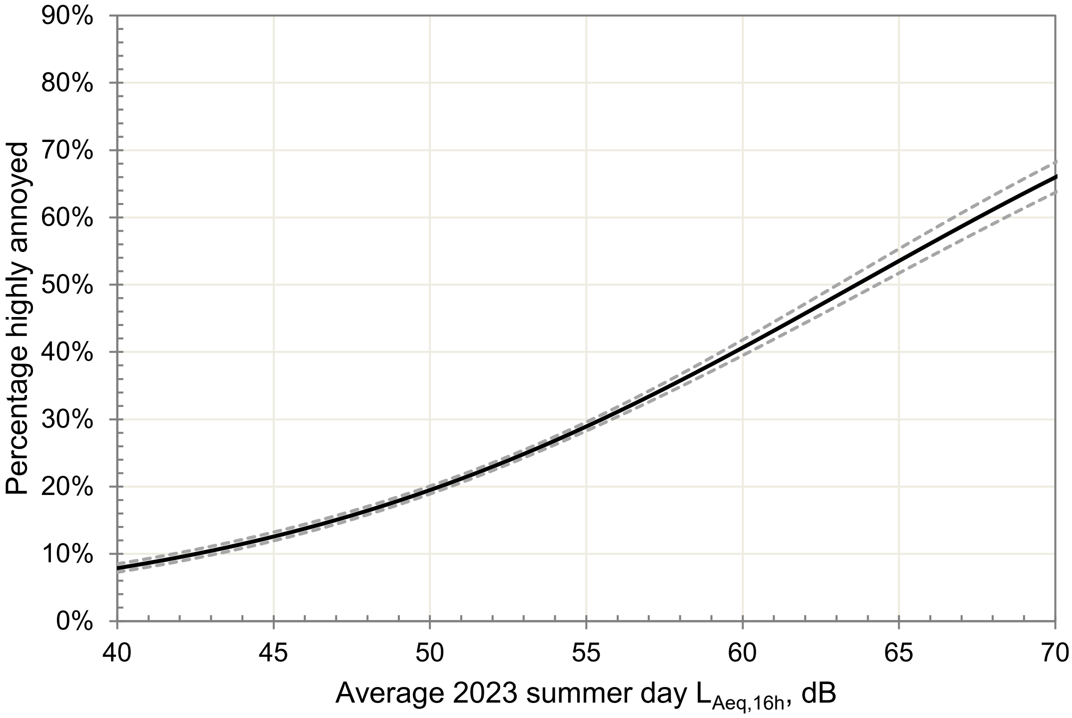
Exposure Response Functions

$L_{Aeq,16h}$

5.46 The following figures present analysis of the daytime $L_{Aeq,16h}$ (07:00-22:59) metric under different scenarios. Comparisons with SoNA 2014 and international surveys are presented in Chapter 7.

5.47 Figure 35 presents the exposure-response function for all airports based on attitudes during the last 3 months (Q8) using the ISO numerical scale HA_N and the Wave 1 noise dose.

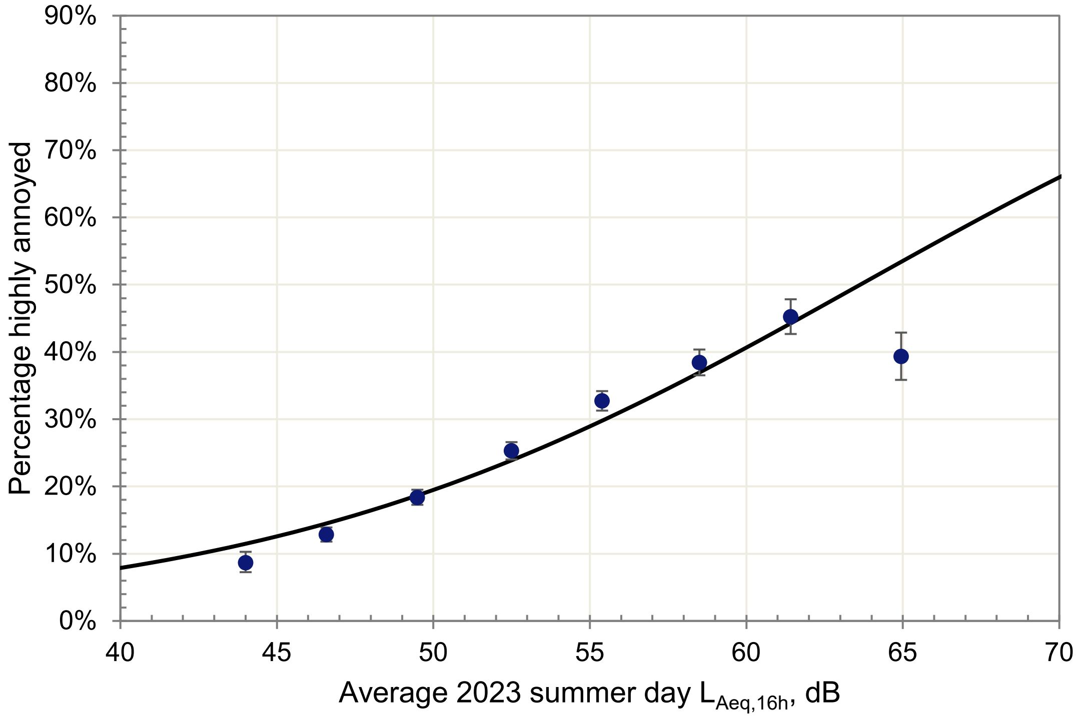
Figure 35 Exposure-response function, all airports, annoyance during the last 3 months, HA_N (Q8), Wave 1 (N=29,792)



5.48 The percentage highly annoyed is seen to rise from below 10% highly annoyed at 40 dB $L_{Aeq,16h}$, reaching 40% at 60 dB $L_{Aeq,16h}$ and just over 65% at 70 dB $L_{Aeq,16h}$. Below 55 dB $L_{Aeq,16h}$, the 95% confidence interval is ±1.3%, due to the large survey sample. By 70 dB $L_{Aeq,16h}$, where the sample is drawn from three of the ten airports, the 95% confidence interval increases to ±2.5%.

5.49 Recalling that the exposure-response function in Figure 35 is calculated from all 29,792 respondents with no grouping of the data, Figure 36 presents the same exposure-response function overlaid with the exposure-response data and 95% confidence intervals calculated from the data grouped into 3 dB wide bands to demonstrate a visual goodness of fit indication for the logistic regression model.

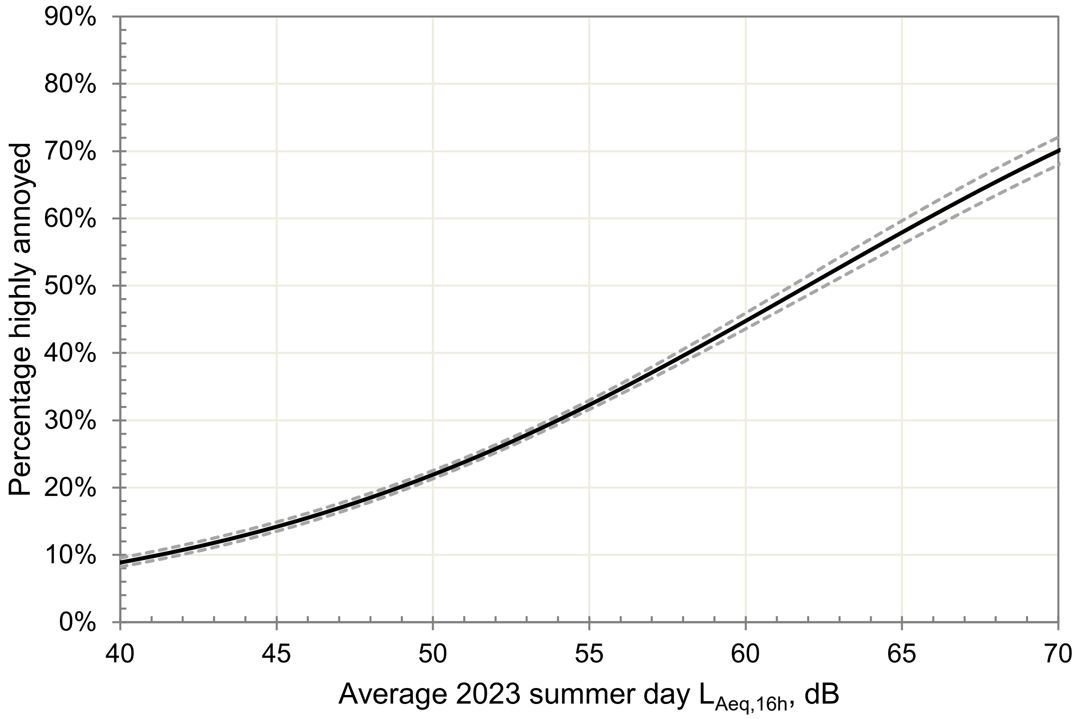
Figure 36 Percentage highly annoyed all airports, annoyance during the last 3 months, HA_N (Q8), Wave 1, overlaid with exposure-response data grouped in 3 dB wide bands (N=29,792)



5.50 The logistic model passes through almost all the grouped data confidence intervals except for less than 45 dB, one point around 55 dB and more than 63 dB $L_{Aeq,16h}$ groups respectively. The deviation below 45 dB $L_{Aeq,16h}$ is likely a consequence of airports splitting into two distinct groups (see Figure 40), with six of the ten airports having higher annoyance functions than the other four airports. Above 63 dB $L_{Aeq,16h}$, the much larger deviation from the logistic model is due to the grouped data representing only three airports: Birmingham, London Heathrow, and Manchester, for which substantive data was collected above 63 dB, and airports which are seen to exhibit lower annoyance than the other seven airports (again see Figure 40). Although the upper noise group for the other seven airports did include responses with noise exposure greater than 63 dB $L_{Aeq,16h}$, there were insufficient populations available to separate these out into a distinct band due to the underlying population distribution. Consequently, for these seven airports, respondents were placed into a single 60 dB $L_{Aeq,16h}$ or more group.

5.51 Figure 37 presents the exposure-response function for all airports based on attitudes during the last 3 months (Q7) using the ISO verbal scale (HA_V) and the Wave 1 noise dose.

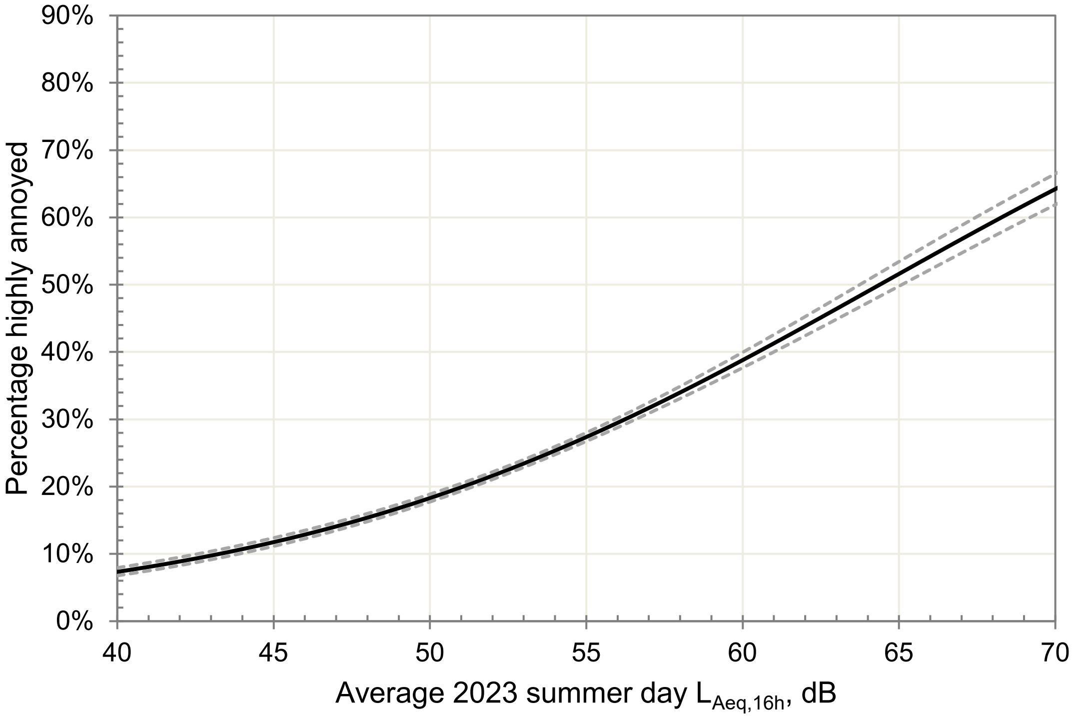
Figure 37 Percentage highly annoyed all airports during the last 3 months, HA_V (Q7), Wave 1 (N=29,792)



5.52 The exposure-response function in Figure 37 is seen to be very similar to that shown in Figure 35, except that it is uplifted by 1.0% at 40 dB $L_{Aeq,16h}$, by 3.0% at 53 dB $L_{Aeq,16h}$ and by 4.0% at 60 and 70 dB $L_{Aeq,16h}$ respectively. Figure 38 presents the exposure-response function for all airports based on attitudes during the last 12 months (Q6) using the ISO numerical scale HA_N for Wave 1 and an average summer day noise dose ($L_{Aeq,16h}$).

5.53 Comparing Figure 38 against Figure 35, i.e. attitudes over the last 12 months compared with the last three months, the exposure-response function (%HA_N) is reduced by 0.5% at 40 dB $L_{Aeq,16h}$, 1.2% at 50 dB $L_{Aeq,16h}$, 1.9% at 60 dB $L_{Aeq,16h}$, and 1.8% at 70 dB $L_{Aeq,16h}$.

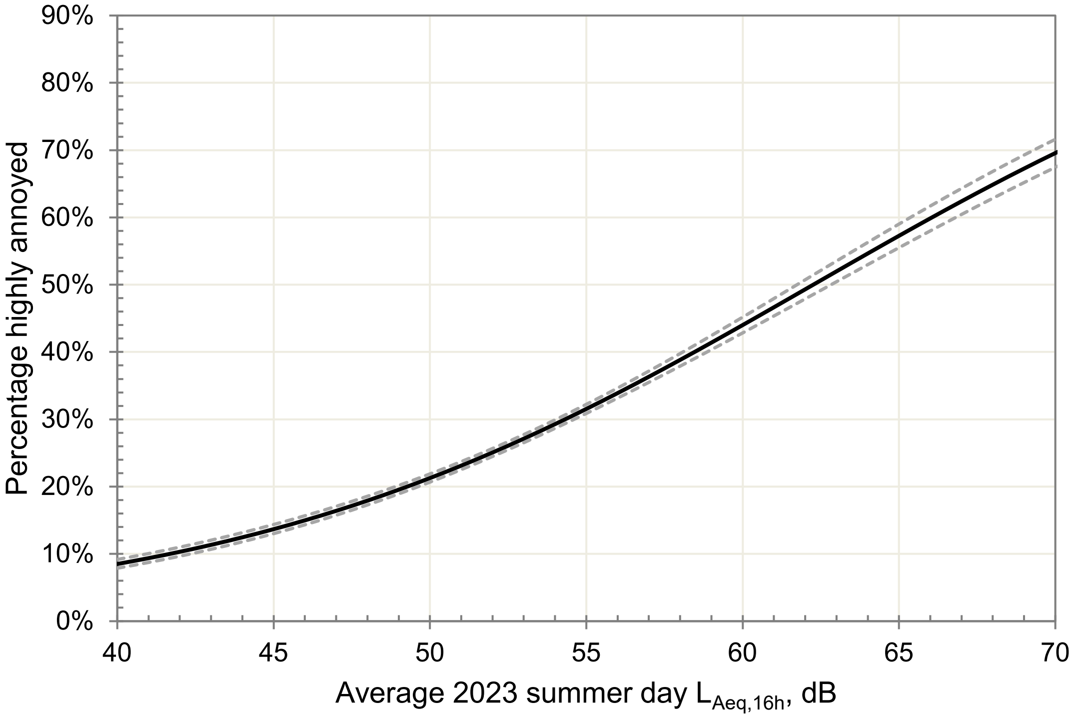
Figure 38 Percentage highly annoyed all airports during the last 12 months, HA_N (Q6), Wave 1 (N=29,770[35])



5.54 Figure 39 presents the exposure-response function for all airports based on attitudes during the last 12 months using the ISO verbal scale, HA_V (Q5) and the Wave 1 noise dose.

[35] 22 respondents did not complete Q6 when completing paper questionnaires, thus the Wave 1 Q6 analysis sample is 29,770.

Figure 39 Percentage highly annoyed all airports, during the last 12 months, HA_V (Q5), Wave 1 (N=29,689[36])



5.55 Compared with Figure 38, it can be seen that the HA_V definition of percentage highly annoyed leads to a higher percentage highly annoyed than the HA_N scale, with HA_V 1.2% higher than for HA_N at 40 dB $L_{Aeq,16h}$ and rising to 5.2% higher than HA_N at 60 dB $L_{Aeq,16h}$. The differences between the exposure-response functions between HA_N and HA_V are thus consistent for both responses regarding the last 3 months and the last 12 months for Wave 1.

5.56 The logistic regression model coefficients for the combined all airports exposure-response functions are shown in Table 8.

36 103 people did not answer Q5 when completing paper questionnaires, thus the Wave 1 Q5 analysis sample analysed was 29,689.

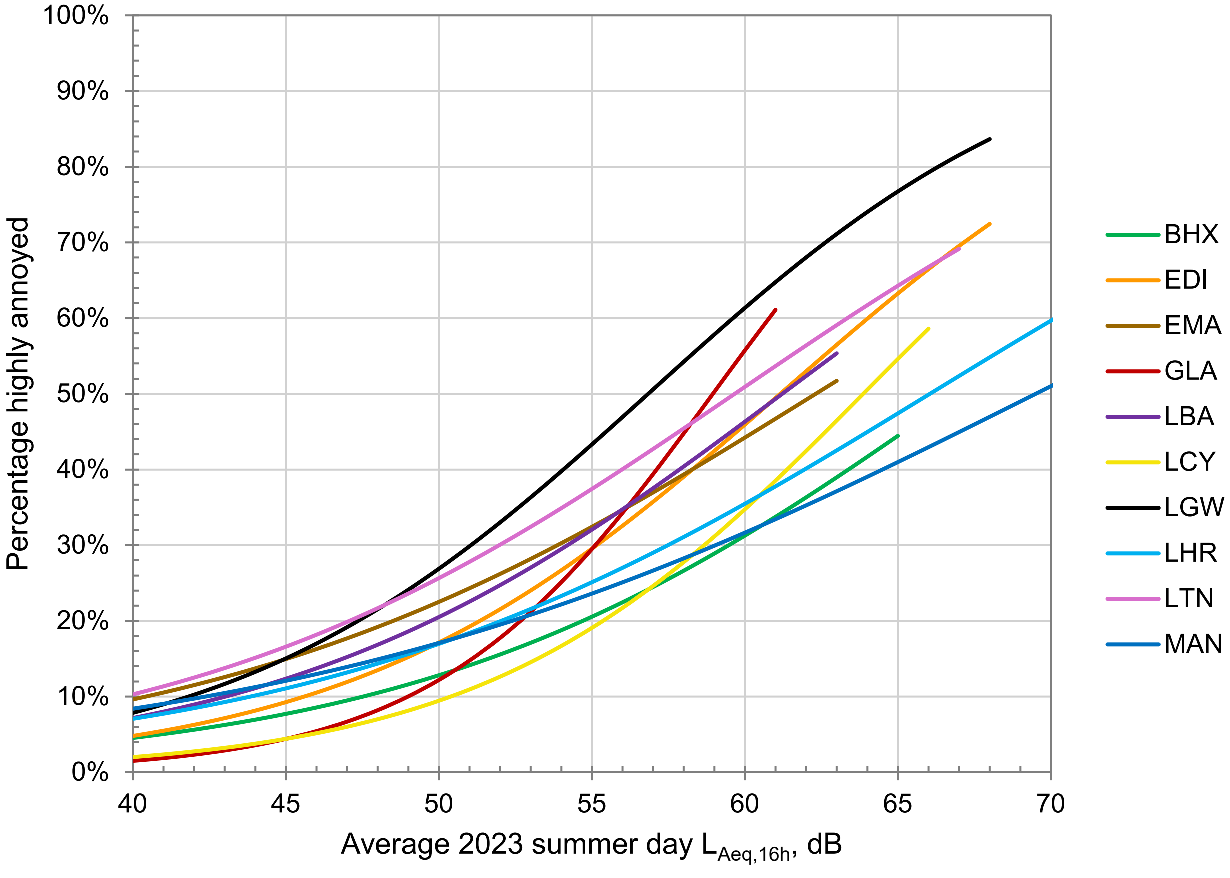
Table 8 Combined all airports exposure-response function model coefficients

Question/scale	Metric	Wave	Intercept (b_0)	Slope (b_1)	Variance (Intercept)	Variance ($L_{Aeq,16h}$ / L_{den})	Covariance
Last 3 months (Q8) HA_N	$L_{Aeq,16h}$	1	-6.62036	0.104029	0.025033502	8.62941E-06	-0.000462484
Last 3 months (Q7) HA_V	$L_{Aeq,16h}$	1	-6.56916	0.105977	0.023927346	8.28958E-06	-0.000443197
Last 12 months (Q6) HA_N	$L_{Aeq,16h}$	1	-6.69905	0.104052	0.025762233	8.84412E-06	-0.000474955
Last 12 months (Q5) HA_V	$L_{Aeq,16h}$	1	-6.64660	0.106760	0.024373434	8.41842E-06	-0.000450774
Last 3 months (Q8) HA_N	$L_{Aeq,16h}$	2	-7.46878	0.112422	0.058819212	1.93662E-05	-0.001062345
Last 3 months (Q7) HA_V	$L_{Aeq,16h}$	2	-7.45095	0.114023	0.055622203	1.83453E-05	-0.001005503
Last 12 months (Q6) HA_N	L_{den}	1+2	-7.19762	0.105196	0.021745841	6.61351E-06	-0.000377611
Last 12 months (Q5) HA_V	L_{den}	1+2	-7.03089	0.105473	0.020637978	6.31342E-06	-0.000359458

Noise attitudes by individual airport

5.57 Figure 40 presents the percentage highly annoyed by individual airport based on attitudes reported during the last 3 months, using the numerical scale, HA_N (Q8) for Wave 1. The logistic regression model coefficients for each of the ten airports are presented in Table 9. Separate figures for each airport, showing the model exposure-response function and the 95% confidence interval, are presented in Appendix F. As can be seen in the figures in Appendix F, the 95% confidence at each individual airport is larger than that for all airports combined, since the survey sample size is much smaller.

Figure 40 Percentage highly annoyed by individual airport, annoyance during the last 3 months (Q8), HA_N, Wave 1 (N=29,792)



5.58 The variability between airports is expected, however the trend of increasing probability of being highly annoyed with increasing noise exposure is common across all ten airports. At lower noise exposure, between 40-50 dB $L_{Aeq,16h}$, the variability is much less than that observed in the US FAA Neighborhood Environmental Survey[37], but at higher noise levels (60-70 dB $L_{Aeq,16h}$), it is comparable to the US FAA survey findings.

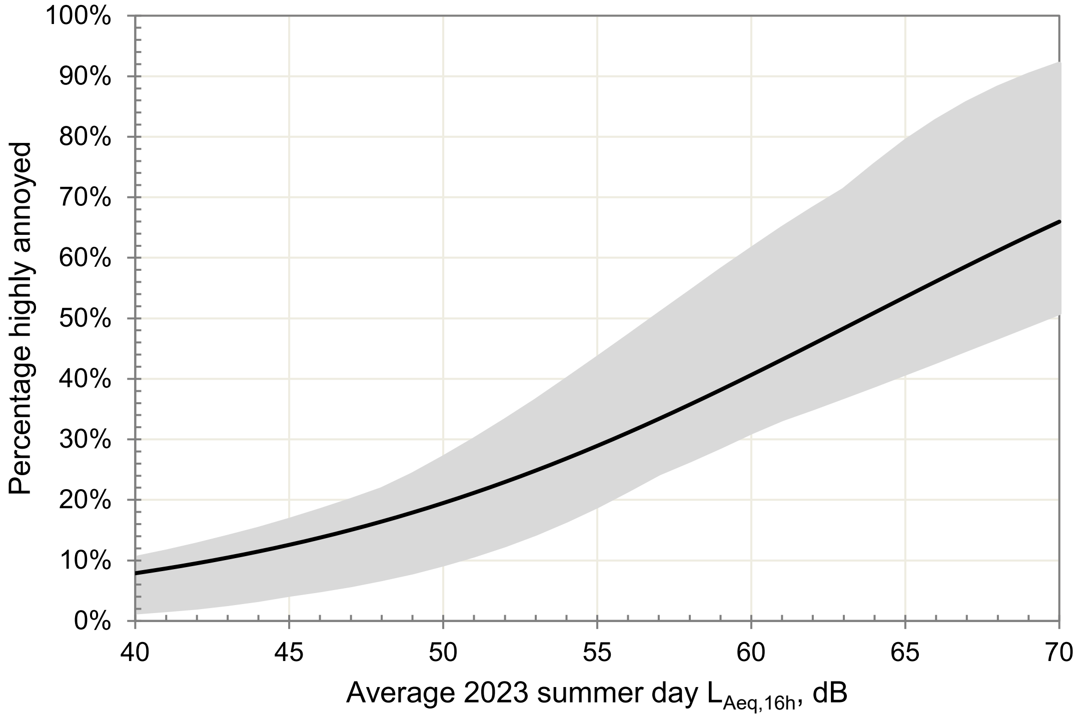
Table 9 Model coefficients for individual airport exposure-response functions

Airport	Intercept (b_0)	Slope (b_1)	Variance (Intercept)	Variance ($L_{Aeq,16h}$)	Covariance
Birmingham	-7.5657	0.1130	0.3022	9.9636E-05	-5.4565E-03
Edinburgh	-8.6389	0.1413	0.3324	1.1168E-04	-6.0711E-03
East Midlands	-6.2562	0.1004	0.4082	1.6443E-04	-8.1725E-03
Glasgow	-13.0026	0.2206	0.6009	1.9981E-04	-1.0930E-02
Leeds Bradford	-7.3930	0.1208	0.3698	1.2929E-04	-6.8943E-03
London City	-10.4111	0.1630	0.7534	2.4462E-04	-1.3531E-02
London Gatwick	-8.3135	0.1463	0.3747	1.3569E-04	-7.1128E-03
London Heathrow	-6.5366	0.0990	0.1956	5.9604E-05	-3.3934E-03
Luton	-6.5705	0.1101	0.3030	1.0451E-04	-5.6021E-03
Manchester	-5.6293	0.0810	0.1685	5.4526E-05	-3.0112E-03

5.59 Figure 41 presents the overall exposure-response function during the last 3 months (Q8) Wave 1, HA_N, along with the envelope of the individual airport exposure-response functions.

[37] Figure 8.1 in the US FAA Analysis of the Neighborhood Environmental Survey, Final Report, DOT/FAA/TC-21/4, Department of Transportation, Federal Aviation Administration, February 2021.

Figure 41 Percentage highly annoyed exposure-response function during the last 3 months (Q8), HA_N, Wave 1, and the envelope of all individual airport exposure-response functions (N=29,792)



5.60 Between 55 dB and 75 dB $L_{Aeq,16h}$ the combined airports exposure-response function is approximately in the middle of the range of individual airport functions. Below 55 dB $L_{Aeq,16h}$ the combined airports exposure-response function lies in the upper half of the range of individual airport functions. Examining Figure 40 in more detail shows that this is explained by the fact that six airports lie in the upper half of the range, whereas four lie in the lower half, thus the combined exposure function is naturally weighted towards those six airports.

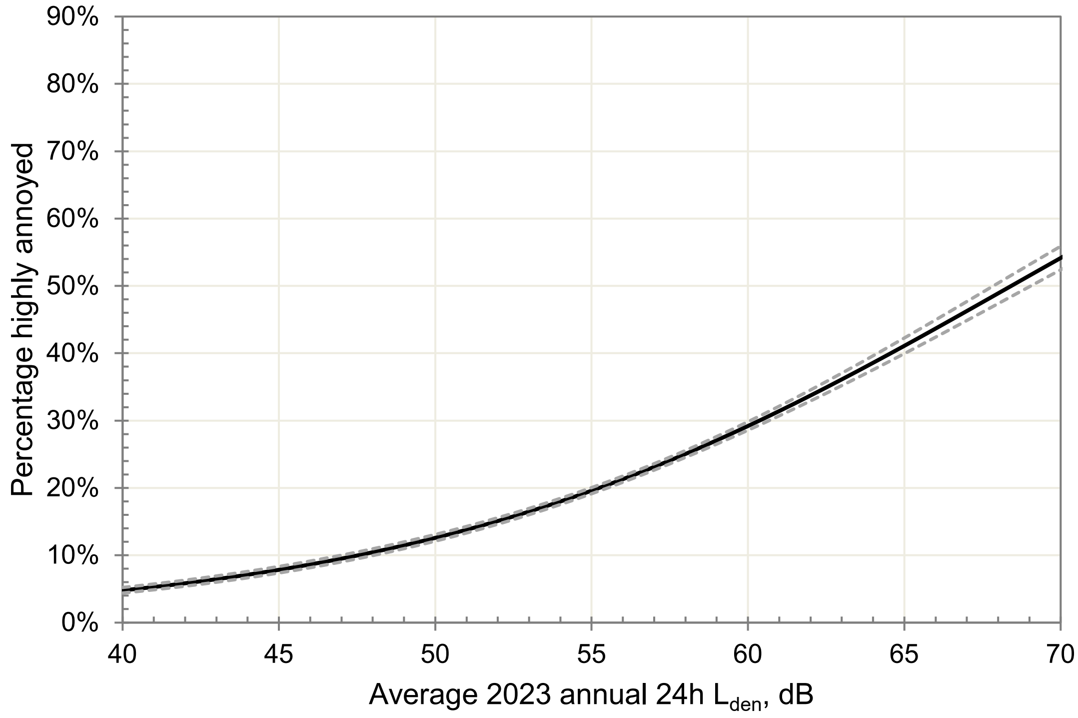
L_{den}

5.61 The next figures present analysis for all airports combined for the L_{den} noise metric. Because L_{den} is an annual noise metric, it was considered most appropriate to develop an exposure-response function for both Waves 1 and 2 combined, reflecting both an average annual noise dose and an average annualised response.

5.62 Because the Wave 2 sample size was smaller than Wave 1, it was scaled up to the same size as Wave 1, using a factor of 1.8983 to represent each Wave 2 response, thus giving equal representation for both Wave 1 and Wave 2.

5.63 Figure 42 presents the exposure-response function for Waves 1 and 2 combined based on attitudes regarding the last 12 months using the ISO numerical scale HA_N (Q6) and the L_{den} noise metric.

Figure 42 Percentage highly annoyed all airports, last 12 months, HA_N (Q6), Waves 1 and 2 combined, L_{den}, (N=45,449)



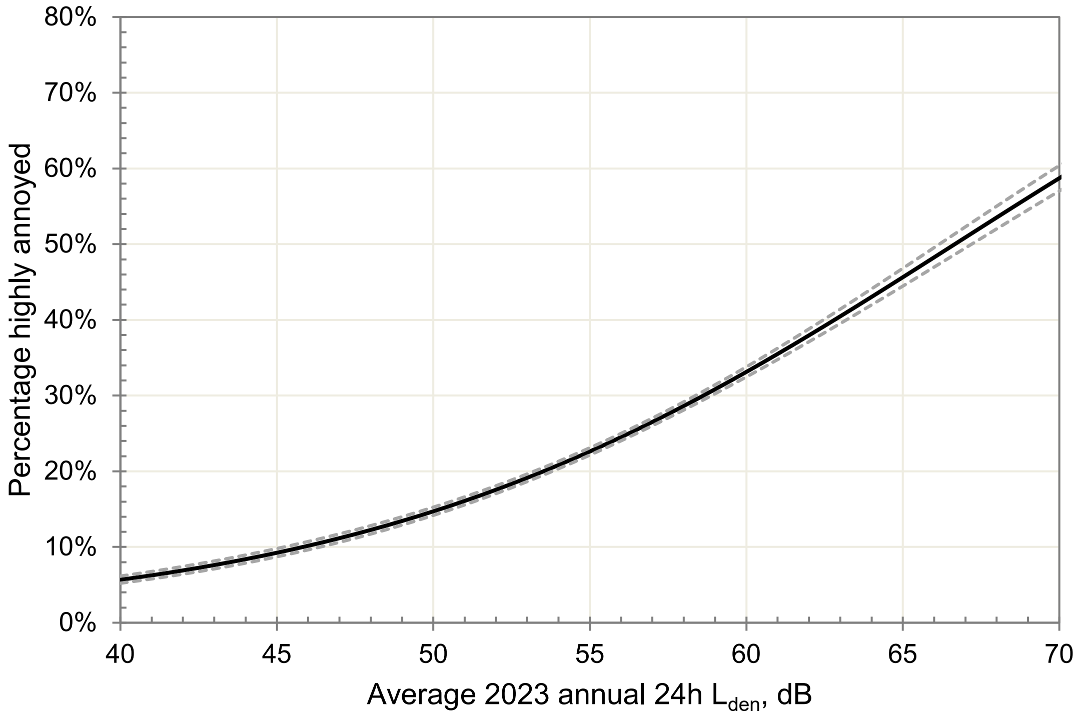
5.64 At 40 dB L_{den}, the percentage highly annoyed is 4.8%, at 50 dB L_{den} it is 12.6%, at 60 dB L_{den} it is 29.2%, and at 70 dB L_{den} it is 54.1%.

5.65 Comparing Figure 42 with Figure 38, there are two effects, i) combining responses from both Waves and ii) the change of noise metric from $L_{Aeq,16h}$ to L_{den}.

5.66 Combining both Waves reduces the percentage highly annoyed by an average 1.4% (based on the average of the combined waves relative to Wave 1 – see Figure 51, Seasonality Assessment).

5.67 Secondly, the average difference between the $L_{Aeq,16h}$ and L_{den} noise dose across both waves is 3.0 dB, effectively moving the exposure-response function to the right relative to Figure 38. The $L_{Aeq,16h}$ to L_{den} difference is higher than that found for SoNA 2014 (1.6 dB). Part of the reason is that i) SoNA 2014 was largely driven by Heathrow which is heavily restricted at night and that reduces the influence of the night time weighting in the L_{den} metric, ii) ANAS includes East Midlands airport which had a much higher $L_{Aeq,16h}$ to L_{den} difference, likely due to its night-time freight operations and iii) airports were still recovering from the effects of the Covid-19 pandemic and therefore continued to grow after the summer period. Figure 43 presents the complimentary exposure-response function for Waves 1 and 2 combined based on attitudes regarding the last 12 months using the ISO verbal scale HA_V (Q5) and using the L_{den} noise metric. It follows the trend seen between HA_V and HA_N observed in Figure 35 and Figure 37.

Figure 43 Percentage highly annoyed all airports, last 12 months, HA_V (Q5), Wave 1 and Wave 2 combined, L_{den}, (N=45,300)



N65

5.68 As set out in paragraphs 5.37 to 5.45, it was concluded that a logistic function was not a suitable form for an N65 exposure-response function.

5.69 Therefore, a quadratic model was fitted up to a ‘knot’ at N65 = 124, where the exposure-response function transitioned to a linear model. The resulting exposure-response function and grouped data are shown in Figure 44. The exposure-response function coefficients are:

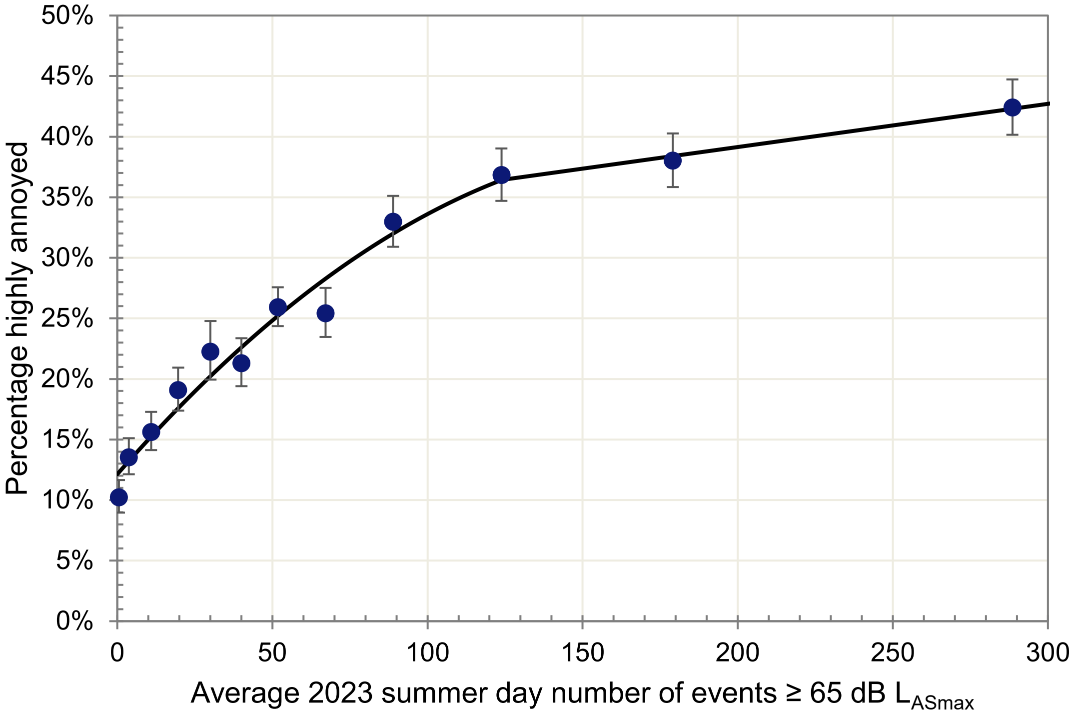
For N65 < knot:

$$p(HA) = 0.12132868 + 0.002929536 \cdot N65 + (-7.822302785\text{E} - 06) \cdot N65^2$$

For N65 ≥ knot:

$$p(HA) = 0.12132868 + 124 \cdot 0.002929536 + (-7.822302785\text{E} - 06) \cdot 124^2 + 0.0003567272 \cdot (N65 - 124)$$

Figure 44 N65 exposure-response function for all airports, last 3 months, HA_N (Q8), Wave 1, overlaid with data for twelve N65 noise exposure groups (N=29,792)



5.70 Figure 45 shows the same exposure-response function as shown in Figure 44, but now including the 95% confidence interval of the model fit around the grouped N65 data.

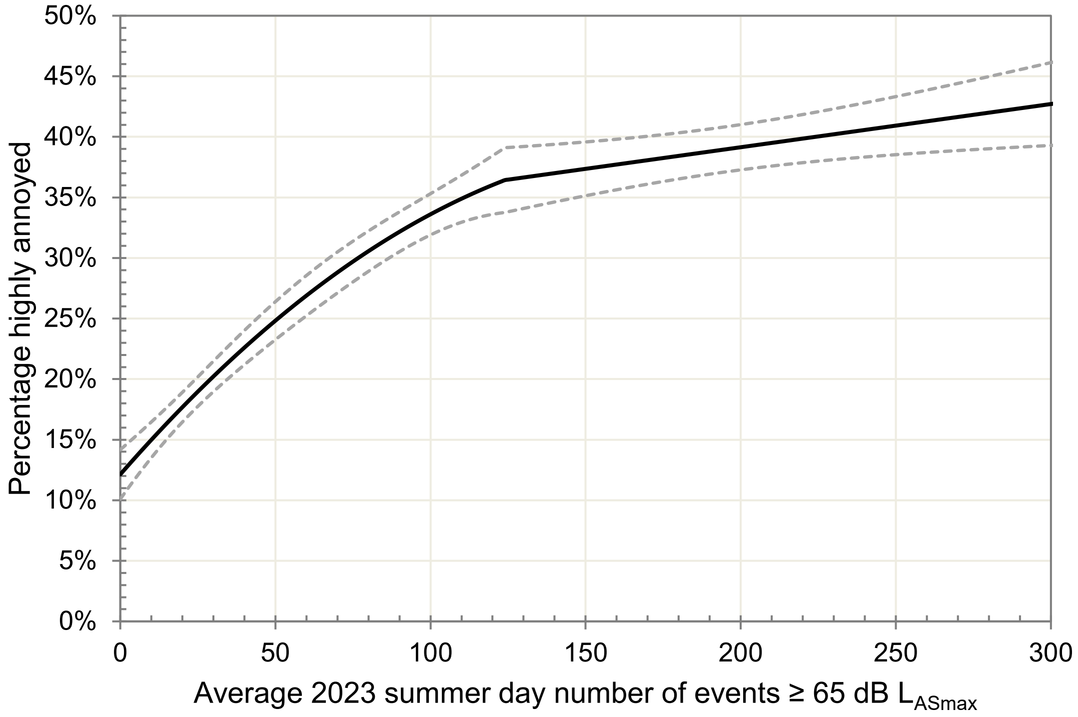
5.71 The N65 exposure function is quite different to those based on $L_{Aeq,16h}$ or L_{den}. This stems from the fact that N65 is count of noise events only where they exceed 65 dB L_{ASmax}. A noise event that occurs at 64.9 dB L_{ASmax} does not count towards N65. Consequently, beyond a certain distance from an airport, all events are below 65 dB L_{ASmax} and N65 reaches zero, however, events will still be audible and, as shown in Figure 44 and Figure 45, lead to around 10% of the population being highly annoyed based on HA_N (Q8).

5.72 At high noise exposure, noise events may be far above 65 dB L_{ASmax} but they still contribute the same to N65, whether the events are at 65.5 dB L_{ASmax} or more than 80 dB L_{ASmax}.

5.73 Consequently, noise exposure at zero N65 events covers the range 40-50 dB $L_{Aeq,16h}$ and more than 200 N65 event covers the range 60-70 dB $L_{Aeq,16h}$. In other words, N65 has a narrower working range than $L_{Aeq,16h}$ and compresses the survey data into this narrower range. This is especially so at higher noise exposure and leads to the rate of increase $\%HA_N$ per decibel reducing above N65=124, whereas the exposure-response functions based on $L_{Aeq,16h}$ and L_{den} continue to rise with increasing noise exposure.

5.74 At zero N65, the %HA_N is 12.1%, at 50 N65 it is 24.8%, at 100 N65 it is 33.6%, at 200 N65 it is 39.1%, and at 300 N65 it is 42.7%.

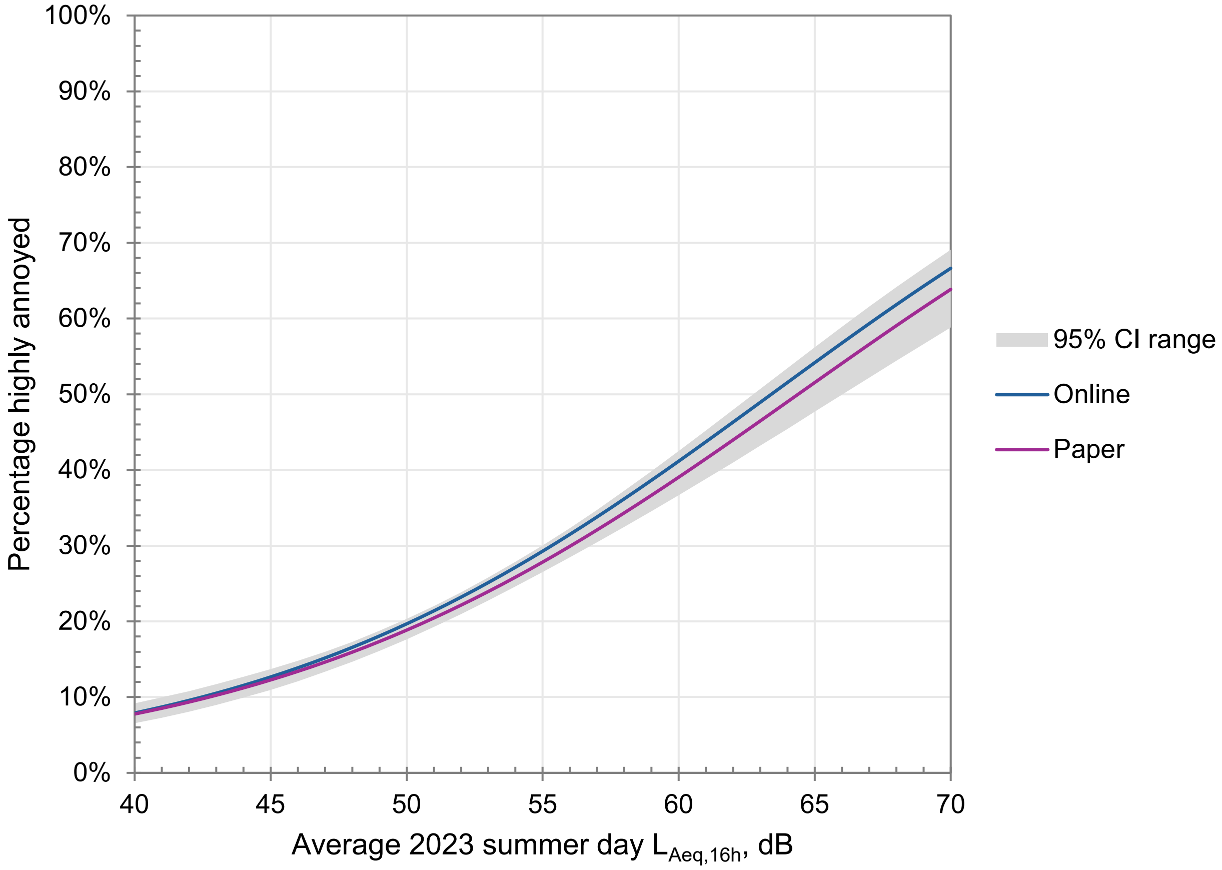
Figure 45 All airports, last 3 months, HA_N, Wave 1, N65 exposure-response function with 95% confidence interval based on twelve N65 noise exposure groups (N=29,792)



Effect of mode of completion

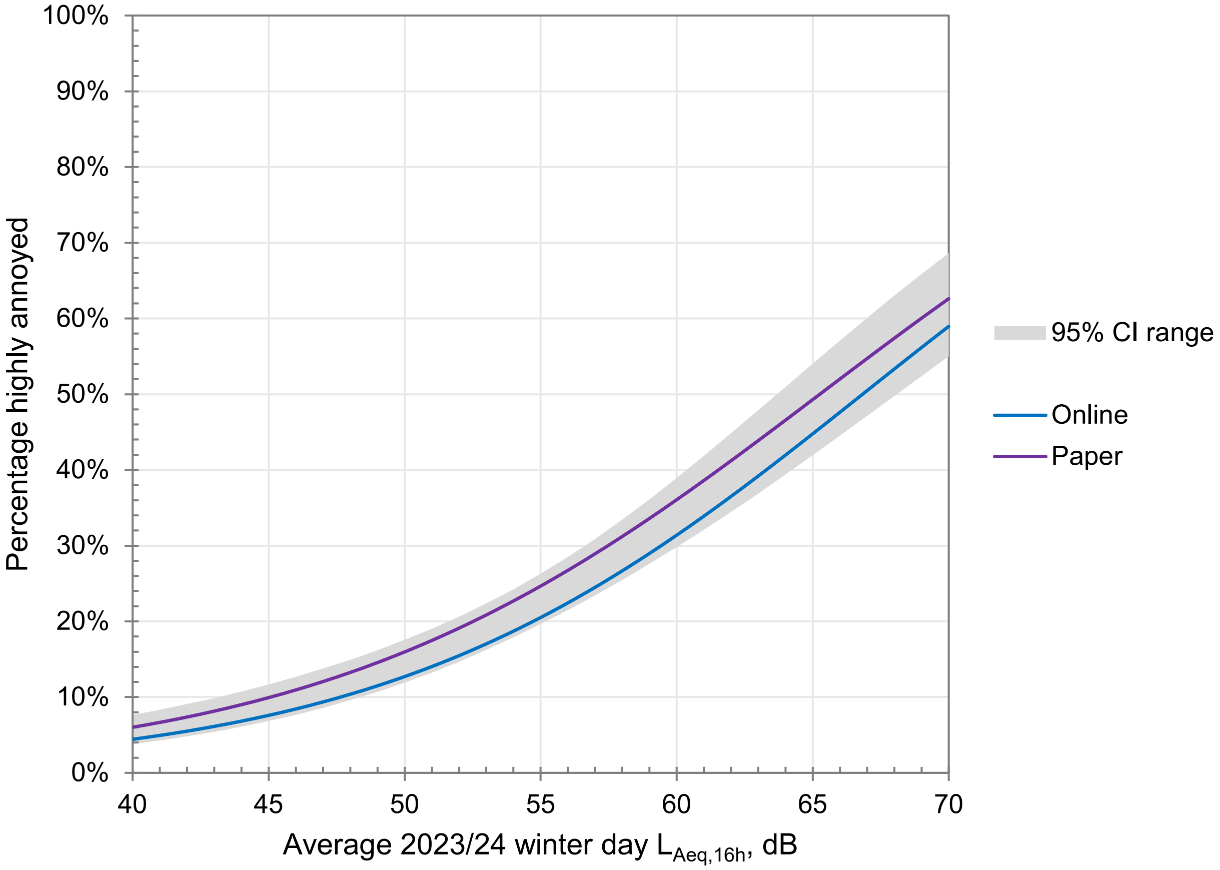
5.75 Figure 46 presents the exposure-response function by mode of completion for all airports based on attitudes during the last 3 months using the ISO numerical scale HA_N and the Wave 1 noise dose. As is evident, mode of completion had little effect on responses, and both functions lie within the 95% confidence interval range.

Figure 46 Exposure-response function by mode of completion, all airports, last 3 months HA$_N$ (Q8), Wave 1 (N=29,792)



5.76 Figure 47 presents the exposure-response function by mode of completion for all airports based on attitudes during the last 3 months using the ISO numerical scale HA$_N$ and the Wave 2 noise dose. More variation is visible between paper and online in Wave 2, possibly due to the smaller sample size, which also increases the size of the 95% confidence interval, which encompasses both logistic models and thus we can conclude that effect of mode of completion is not statistically significant.

Figure 47 Exposure-response function by mode of completion, all airports, last 3 months, HA_N (Q8), Wave 2 (N=15,694)



Effect of ISO 15666:2021 definitions of "highly annoyed"

5.77 The preceding paragraphs present exposure-response functions based on the ISO/TS 15666:2021 annoyance definitions for HA_N and HA_V. Functions for the third annoyance definition, HA_{VW} are presented in Appendix E.

5.78 Figure 48 combines all three functions onto a single chart based on attitudes during the last three months (Q7 & Q8) for Wave 1. Figure 49 combines all three functions onto a single chart based on attitudes during the last 12 months (Q5 & Q6) for Wave 1. The rank ordering of all three definitions remains the same regardless of the whether the question related to the last three months or the last 12 months. However, there is less difference between the functions in Figure 49, based on views regarding the last 12 months.

Figure 48 Exposure-response function by ISO annoyance definition, all airports, last three months, HA_N (Q8) and HA_V and HA_{VW} (Q7), Wave 1 (N=29,792)

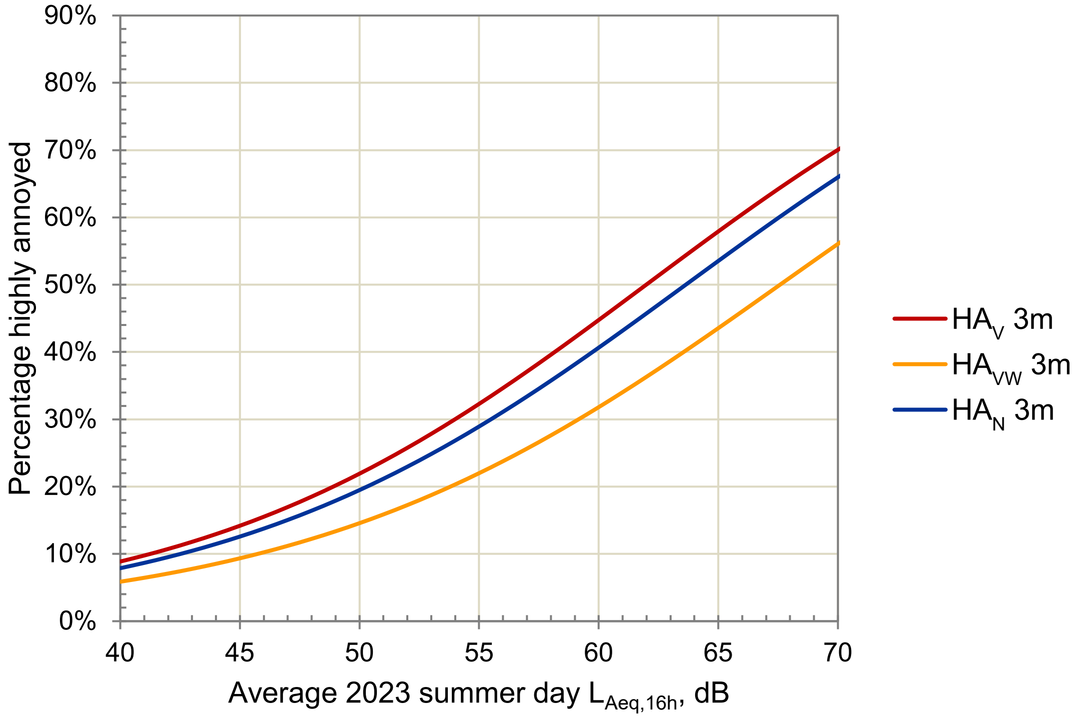
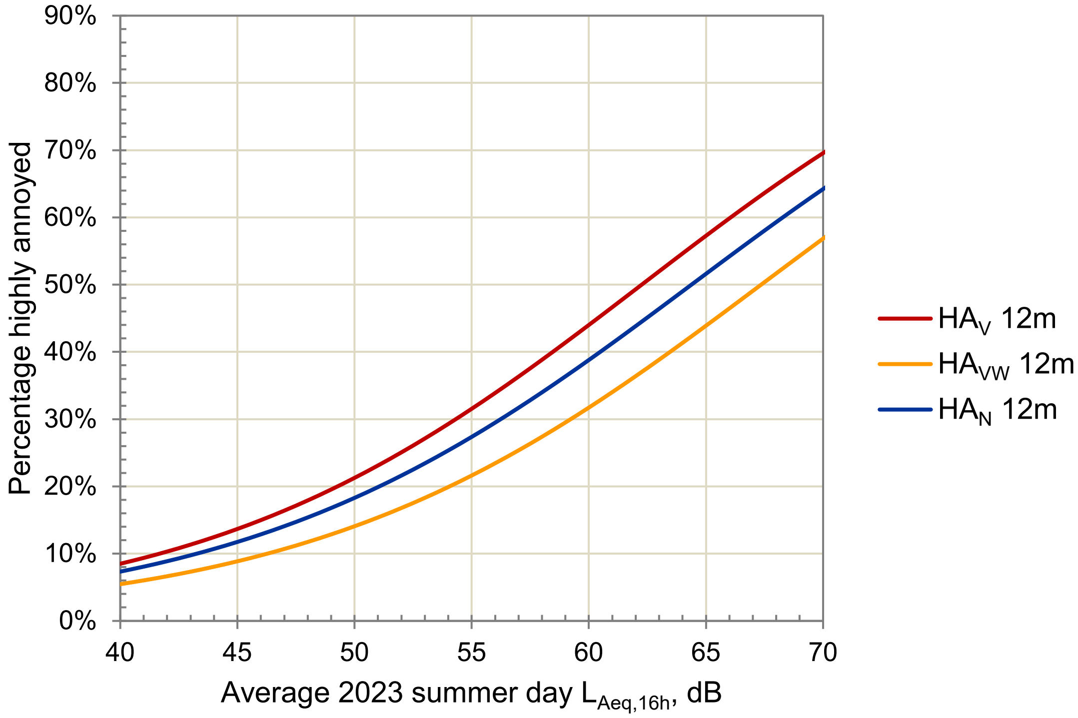


Figure 49 Exposure-response function by ISO annoyance definition, all airports, last 12 months, HA_N (Q6, N=29,770) and HA_V and HA_{VW} (Q5, N=29,689), Wave 1



Chapter 6

Seasonality Assessment

6.1 For the first time in the UK, ANAS provided the opportunity to investigate the effect on timing of a noise attitude survey. Wave 1 was conducted between September and November 2023 and Wave 2 was conducted between March and May 2024.

6.2 The effect of survey timing was investigated for attitudes during the last 3 months (Q8) and during the last 12 months (Q6) using the ISO HA_N scale. Figure 50 presents the exposure-response functions for all airports for Q8 and Figure 51 presents the exposure-response functions for all airports for Q6.

6.3 It is readily apparent there is a greater difference in the percentage highly annoyed for a given noise level based on Q8 (last three months, Figure 50) than based on Q6 (last 12 months, Figure 51). In Figure 50, the difference in $\%HA_N$ varies from 3.0% to 8.0%. Respondents were less annoyed in Wave 2 based on the three months prior to survey, even after taking account of the reduced air traffic between mid-December and mid-March.

6.4 In contrast, there is a smaller variation in responses based on the 12 months prior to survey between Waves 1 and 2 (Figure 51), with the difference in $\%HA_N$ ranging from 1.4% to 3.6%. This suggests that attitudes relating to longer term periods, e.g. 12 months, are more stable over time than shorter periods. This is the first UK study to produce such evidence.

Figure 50 Exposure-response function for all airports, based on attitudes during the last 3 months, HA_N (Q8), Wave 1 (N=29,792) and Wave 2 (N=15,694)

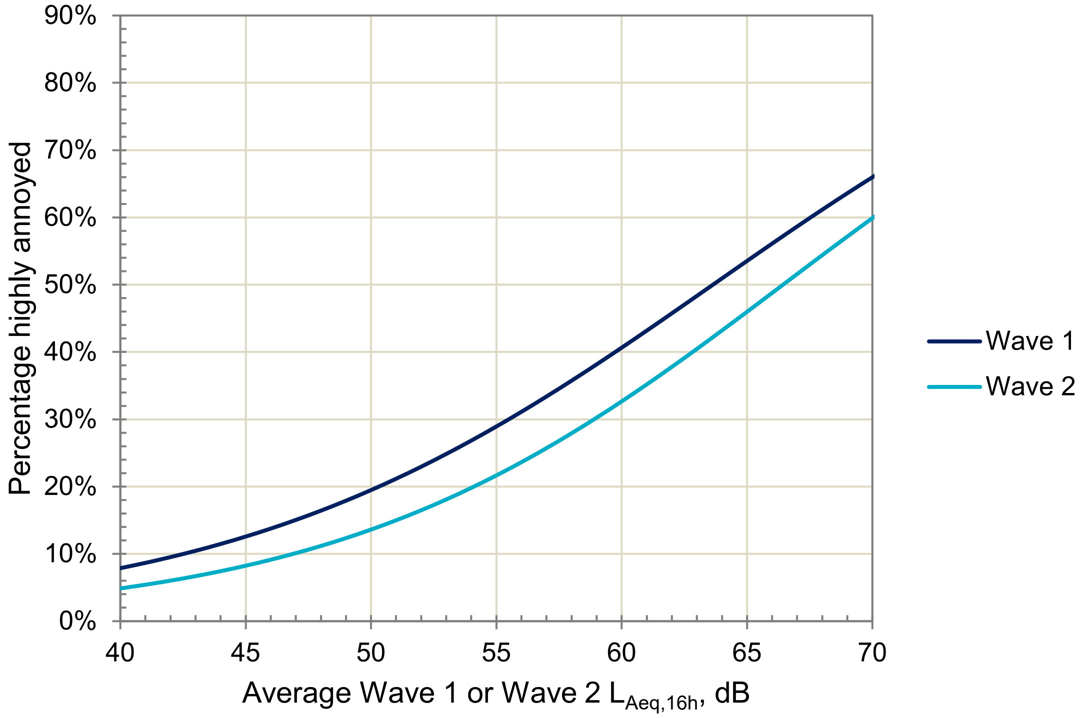
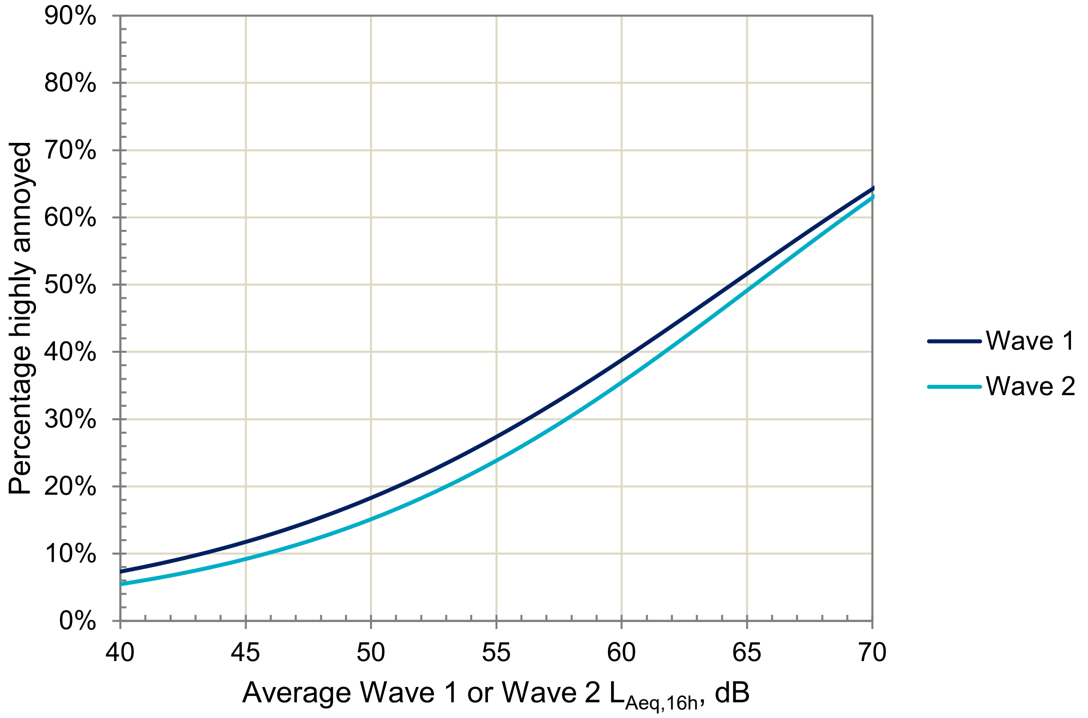


Figure 51 Exposure-response function for all airports, based on attitudes during the last 12 months, HA_N (Q6), Wave 1 (N=29,770) and Wave 2 (N=15,679)



Chapter 7

Comparisons with SoNA and other studies

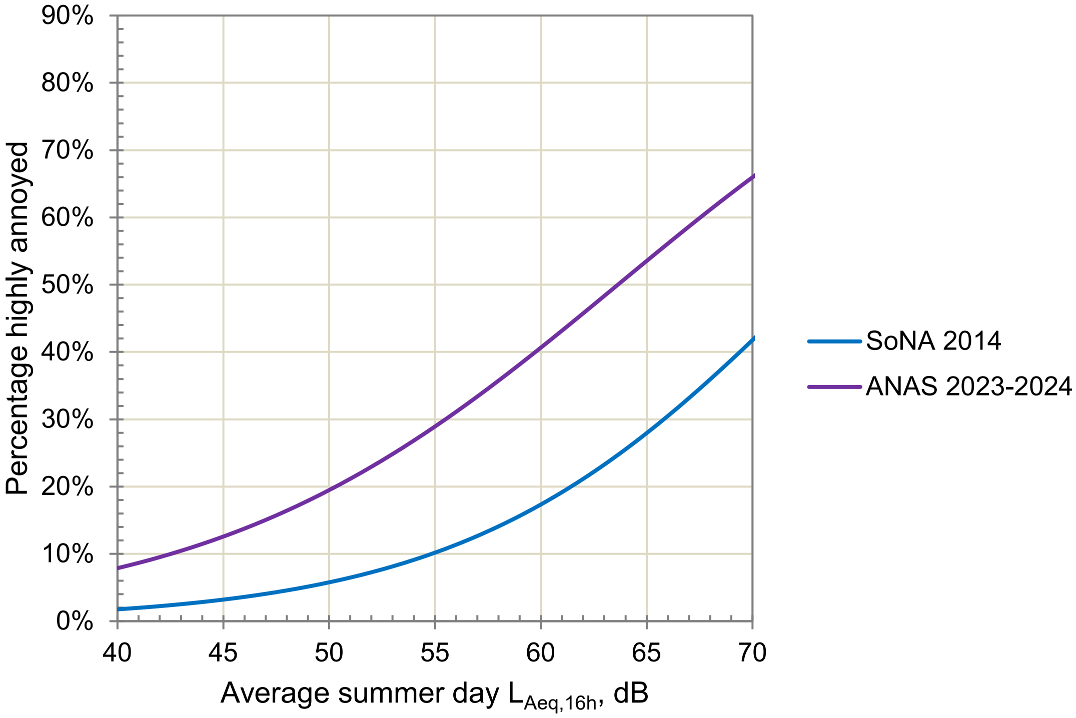
7.1 ANAS is the first UK study of aviation noise annoyance since SoNA 2014. However, other international studies published in this period, including the WHO 2018 Systematic Review and the 2016 US FAA Neighborhood Environmental Survey (published in 2021), present an opportunity to compare the findings of ANAS to a broader context of aviation noise annoyance.

7.2 By far the biggest contextual change since SoNA 2014 is the extreme contrast faced by populations between the silent skies experienced during the Covid-19 pandemic, and the return to normal operations in the last few years. By the time our fieldwork began, operational levels were at around 87% of pre-Covid levels, having built back up gradually as pandemic restrictions faded. We cannot evidence the extent of the likely influence on attitudes which may have occurred, but it does not feel unreasonable to conjecture that the reintroduction of aircraft noise following a near-total absence will have been noticeable to populations around our airports. The Covid-19 pandemic also presented another significant contextual change by heralding an increase in the number of people working from home (noting that the noise exposure is estimated for the home location) and, therefore, leaving them more affected by local environmental circumstances than they may have been previously.

7.3 Any comparison needs to recognise that each study is unique. There are distinct methodological differences between them with limited ways to identify to what extent these influence any findings. Each study was carefully designed to represent preferred or possible approaches at the time the research was performed. However, there is sufficient general similarity to enable ANAS to be compared to other recent studies so as to provide a contextual position.

7.4 Figure 52 presents a comparison of the ANAS exposure-response function based on attitudes during the last three months using the ISO annoyance scale HA_N (Q8) against the SoNA 2014 function, which was also based on attitudes during the last three months and HA_N.

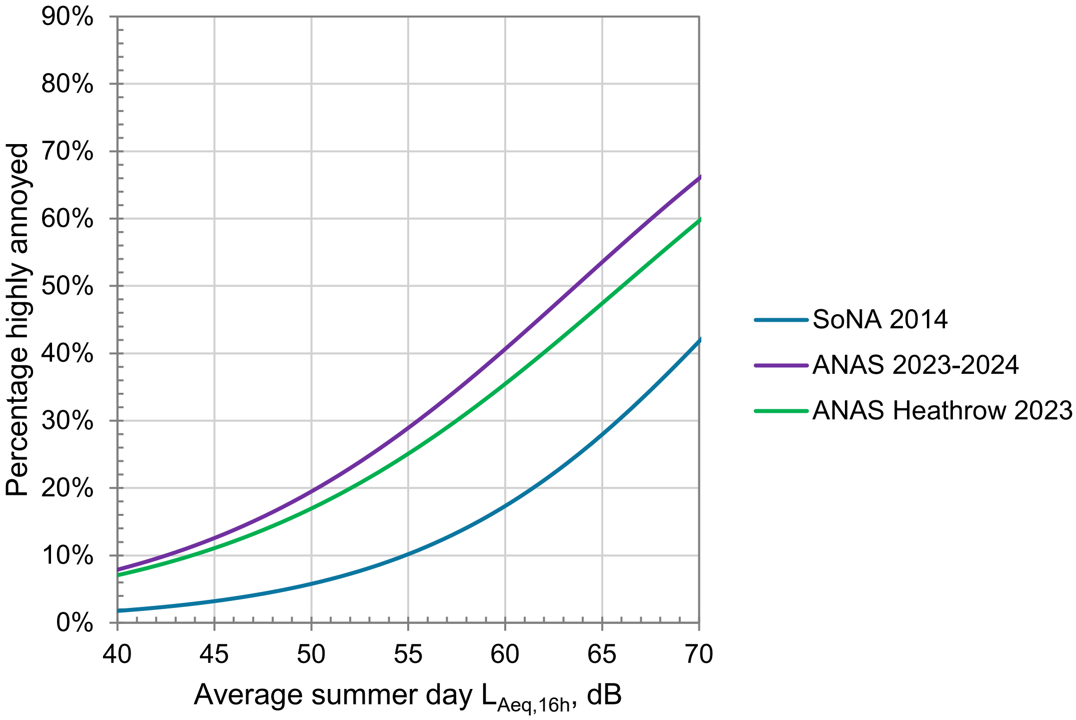
Figure 52 Comparison of the ANAS 2023-2024 exposure-response function to SoNA 2014 based on attitudes during the last three months, HA$_N$ (Q8), Wave 1



7.5 The large difference between functions is readily apparent. This is not just a consequence of sampling to lower exposure levels. Annoyance is elevated across the entire noise exposure, including in areas surveyed in 2014.

7.6 Recalling the individual airport functions (Figure 40), it is clear that Heathrow airport, which dominated the SoNA 2014 responses, lies at the lower end of responses in ANAS 2023-2024, so the less weight given to Heathrow in the ANAS 2023-2024 dataset could be a factor in the difference between the ANAS and SoNA functions. Recalling the individual airport functions (Figure 40), it is clear that Heathrow airport, which dominated the SoNA 2014 responses, lies at the lower end of responses in ANAS 2023-2024, so the less weight given to Heathrow in the ANAS 2023-2024 dataset could be a factor in the difference between the ANAS and SoNA functions. This is illustrated by adding the ANAS Heathrow function from Figure 40, as shown in Figure 53.

Figure 53 Comparison of ANAS 2023-2024 with SoNA 2014 and ANAS 2023-2024 Heathrow only exposure-response function



7.7 There are several potential reasons for the differences between SoNA 2014 and ANAS 2023-2024. The survey format changed to a primarily push-to-web survey with a paper option, compared with a face-to-face interview in SoNA 2014. The key question relating to HA_N was much later in the survey in SoNA 2014 than for ANAS 2023-2024 and interviews took place through to February in the following year. SoNA 2014 was also dominated by Heathrow airport, which makes up approximately 10% of the ANAS 2023-2024 responses. The effect of the Covid-19 pandemic must also be recognised. Not only did aviation virtually cease in 2020 and 2021, the pandemic also fundamentally altered working habits with working from home becoming more prevalent.

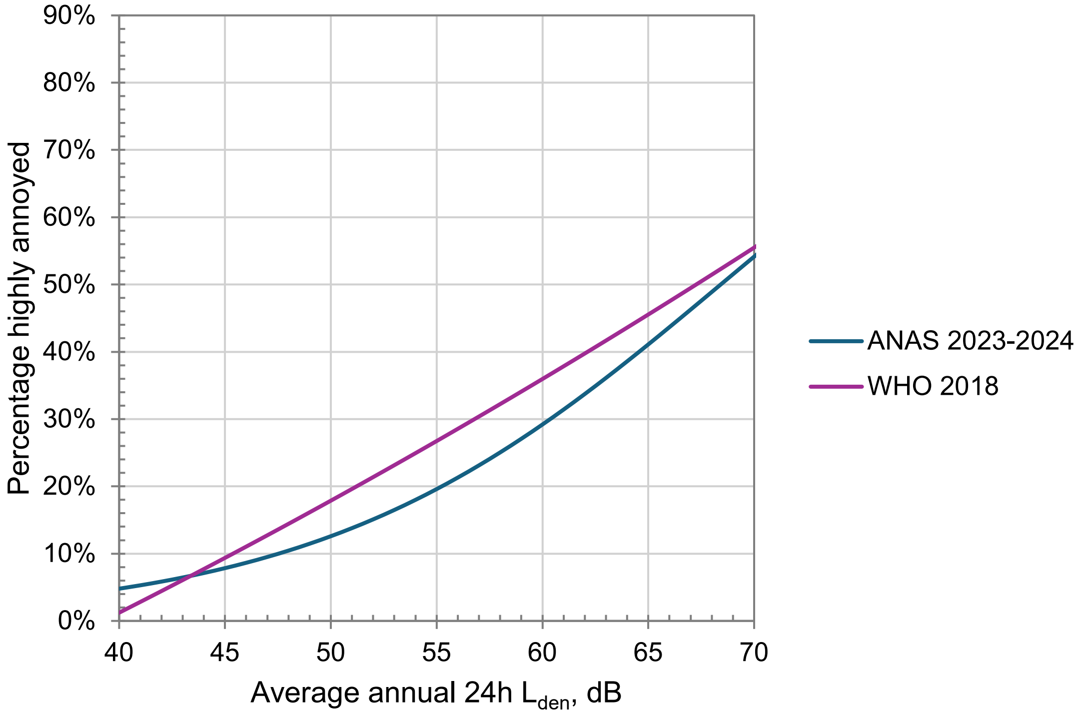
7.8 Looking further afield, Figure 54 presents a comparison of the ANAS 2023-2024 exposure-response function based on attitudes during the last 12 months using the ISO HA_N annoyance scale for both waves combined and the L_{den} noise metric, and the WHO 2018 function established from the WHO Systematic Review[32].

7.9 Comparing against the WHO 2018 function, the ANAS 2023-2024 function is similar, but the function is less linear and whilst within a few percent of the WHO function around 45-50 dB L_{den}, at 55 dB L_{den} it is 7% lower than the WHO 2018 function. At 65 dB L_{den} it is 4% lower than the WHO 2018 function.

7.10 In comparing ANAS 2023-2024 to the WHO 2018 Guidelines, it should be noted that the WHO Guidelines themselves encourage the use of locally derived exposure-response functions:

> "Instead, data and exposure–response curves derived in a local context should be applied whenever possible to assess the specific function between noise and annoyance in a given situation."

Figure 54 Comparison of ANAS 2023-2024 (HA_N Q6) with WHO 2018



Chapter 8
Summary

Study aims

8.1 This report provides findings from the Aviation Noise Attitudes Survey 2023-2024 (ANAS). This study gives evidence of current attitudes to aviation noise around airports in the UK. ANAS was commissioned from the CAA by the Department for Transport and builds on earlier noise attitudes surveys, such as the Survey of Noise Attitudes, (SoNA) 2014.

8.2 The study aims as originally set out were:

Main aims:

i) To provide data on the relationship between aviation noise exposure and annoyance in order to inform government policy development in the UK

ii) To provide evidence to inform policy thresholds and metrics such as for DfT's Transport Analysis Guidance (TAG)

iii) To provide evidence on how annoyance to aviation noise varies across personal, social and environmental contextual factors

Secondary aims:

iv) To provide exposure-response analysis for specific airports in the study

v) To provide associations between aviation noise exposure and health and wellbeing measures

vi) To track trends over time through the survey being regularly repeated

8.3 The report focuses on the main aims i) and ii), as well as the secondary aims iv) and vi), to ensure that this information is published as soon as possible. It is intended that future analysis would address the remaining aims (iii and v).

Survey and analysis methodology

8.4 Respondents were selected using a random, un-clustered approach from around ten airports in England and Scotland, having been estimated to be exposed to aircraft noise level of at least 45 dB $L_{Aeq,16h}$ in the summer of 2023.

8.5 The aim was to select 500 people from six 3 dB wide noise bands from 45 dB $L_{Aeq,16h}$ to more than 60 dB $L_{Aeq,16h}$. Three additional noise bands were subsequently incorporated into the survey design at Birmingham, London

Heathrow and Manchester airports, to separate the more than 60 dB $L_{Aeq,16h}$ band into two bands, 60-62.9 dB and more than 63 dB respectively.

8.6 The survey was administered in two waves, the first wave between September and November 2023 and the second wave between March and May 2024. After excluding respondents that were not resident during summer 2023, Wave 1 achieved 29,792 responses (almost twice than originally planned due to uncertainty regarding anticipated response rates that led to intentional oversampling), and Wave 2 achieved 15,694 responses for a combined total of 45,486 responses.

8.7 The survey used the ISO/TS 15666:2021 recommended 5-point verbal scale and 11-point numerical scale of reported annoyance from aircraft noise and analysed responses using all three definitions of being highly annoyed in ISO/TS 15666:2021.

How does annoyance relate to exposure?

8.8 The percent of respondents found to be highly annoyed was found to be correlated with both average summer day and average annual 24h noise exposure. The exposure-response function found is not linear, but follows a logistic function.

8.9 The exposure-response function associated with the noise metric N65 was neither linear nor followed a logistic function. Initially it follows a quadratic function, but then the percentage highly annoyed rises at a lower rate with respect to N65 noise exposure. Importantly, the percentage highly annoyed is not zero at zero N65.

8.10 Individual airport exposure-response functions show the expected variation between individual airports, though the variation is less than that observed in the US FAA Neighbourhood Study.

How does annoyance vary over time?

8.11 The percentage highly annoyed was calculated for both the last three months (Q8) and the last 12 months (Q6). The percentages for both time periods differed between Wave 1 and Wave 2. The difference was greater for attitudes related to the last three months (Q8) than for the last 12 months (Q6). The difference in $\%HA_N$ from Q6 between both Waves ranged from 1.4% to 3.6%.

8.12 When the two waves were combined, the difference between the resulting exposure-response function and either Wave 1 or Wave 2 was comparable to the 95% confidence interval from either Wave. This suggests that attitudes relating to longer term periods, e.g. 12 months, are more stable over time than attitudes regarding shorter periods. This is the first UK study to produce such evidence.

How do the results compare with SoNA 2014 and WHO 2018?

8.13 The exposure-response function for ANAS 2023-2024 (Wave 1) is found to differ markedly from SoNA 2014. The point at which an average person living in the vicinity of an airport becomes 10% highly annoyed was found to occur at around 43 dB $L_{Aeq,16h}$, compared with 54 dB $L_{Aeq,16h}$ for SoNA 2014.

8.14 This change is not the result of surveying to lower noise levels. The percentage highly annoyed from ANAS 2023-2024 is found to be higher than SoNA 2014 at all noise exposures, including in the same geographical areas surveyed in SoNA.

8.15 Comparing against the WHO 2018 exposure-response function, the ANAS 2023-2024 is similar, but the function is less linear and whilst within a few percent of the WHO curve around 45 dB L_{den} and above 65 dB L_{den}, it is up to 7% lower around 55 dB L_{den}.

Have noise attitudes changed between SoNA 2014 and ANAS 2023-2024?

8.16 It is not possible to attribute changes between 2014 and 2023-2024 quantitatively to specific reasons. There are both methodological and societal differences that prohibit a direct comparison between the results of the SoNA and ANAS 2023-2024 results.

Recommendations for future surveys

8.17 ANAS 2023-2024 has established a new way of administering aviation noise attitude surveys in the UK. It is not only the largest survey of its kind in the UK but also one of the largest globally by number of people surveyed. It is recommended that future surveys build on this legacy.

APPENDIX A

Glossary of Terms

ANAS	Aviation Noise Attitudes Survey
ANASE	Attitudes to Noise from Aviation Sources in England (2002 survey reported 2007)
ANIS	Aircraft Noise Index Study (1982 survey reported in 1985)
ANNE	Aviation Night Noise Effects study
A-weighting	A frequency weighting that is applied to the electrical signal within a noise measuring instrument as a way of simulating the way the human ear responds to a range of acoustic frequencies
dB (or dBA)	Decibel units describing sound level or changes of sound level. It is used in this report to define levels measured on the A-weighted scale, which incorporates a frequency weighting approximating the characteristics of human hearing
Defra	Department for Environment, Food & Rural Affairs
DfT	Department for Transport
EU	European Union
$L_{Aeq,16h}$	Equivalent continuous sound level. $L_{Aeq,16h}$ is the level of a notional steady sound between 0700 and 2300 that would have the same A-weighted sound energy as the fluctuating noise. For aviation in the UK, $L_{Aeq,16h}$ is conventionally expressed for an average summer's day between 16 June and 15 September inclusive
L_{ASmax}	The maximum sound level measured during an aircraft event, using frequency weighting A and time weighting S. Often abbreviated to L_{Amax} or L_{max}
L_{den}	Annual average 24-hour day, evening, night level, comprised of a 12-hour day period (0700-1900), a four-hour evening period (1900-2300) with a 5 dB time of day weighting and an eight-hour night period (2300-0700) with a 10 dB time of day weighting
N	Sample size
N65	Number of events of 65 dB L_{ASmax} or more during an average summer day (07:00-23:00)

PBN	Performance-Based Navigation
RNAV	*Area Navigation*. A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.
SID	Standard Instrument Departure route
SoNA	Survey of Noise Attitudes 2014
UKHSA	United Kingdom Health Security Agency

APPENDIX B

Previous Equivalent Studies

SoNA 2014

B1 In 2014 the Department for Transport commissioned the Survey of Noise Attitudes (SoNA) – Aviation study, which built on previous noise attitudes surveys by Defra with the addition of an aircraft noise section. The overall aims of SoNA 2014 were to:

- Obtain new and updated evidence on attitudes to aviation noise around airports in England, including the effects of aviation noise on annoyance, wellbeing and health.
- Obtain new and updated evidence on what influences attitudes to aviation noise, and how attitudes vary, particularly how attitudes vary with LAeq, but also other non-acoustic factors that may influence attitudes, such as location and time of day, and socioeconomic group of respondents.
- Examine whether the currently used measure of annoyance, LAeq, is the appropriate measure of annoyance for measuring the impact on people living around major airports.
- Consider the appropriateness of the policy threshold for significant community annoyance from aviation noise.
- Provide baseline results that can be used for a programme of regular surveys of attitudes to aviation noise.

B2 Respondents were selected using a random, partially clustered approach from around nine airports in England, having been exposed to average summer day noise levels of at least 51 dB $L_{Aeq,16h}$ in the summer of 2013. A total of 1,999 participants completed a face-to-face survey on attitudes to civil aircraft noise; 122 were not resident during summer 2014, leaving a sample of 1,877 valid responses. The survey used the ISO/TS 15666:2021 recommended 5-point verbal scale and 11-point numerical scale of reported annoyance from aircraft noise. Data transformation to annoyance scores and the threshold for being defined as highly annoyed followed international best practice subsequently adopted into ISO/TS 15666: 2021. Annoyance scores calculated from the 5-point and 11-point scale questions were found to be consistent.

B3 The study found that mean annoyance score and the likelihood of being highly annoyed increased with increasing noise exposure ($L_{Aeq,16h}$). It predicted that 9 per cent of the population was highly annoyed at 54 dB $L_{Aeq,16h}$ and 13% at 57 dB

$L_{Aeq,16h}$. It also identified that there was no evidence found to support a change from the current practice of basing $L_{Aeq,16h}$ on an average summer day.

NORAH Study 2015

B4 In 2015 the results of the NORAH (NOise-Related Annoyance, cognition and Health) study were published[38]. This was a large-scale, longitudinal German study that commenced in April 2011 and continued until 2014 and included 43 researchers from 11 institutes. The study examined aircraft noise annoyance and health-related quality of life (HQoL) before and after the opening of the fourth runway, at Frankfurt airport, in comparison to annoyance at three other airports, and a comparison of annoyance from aviation, railway and road traffic noise.

B5 Over 3,500 residents participated in all three phases of the study. At all four airports studied, the percentage of residents highly annoyed by air traffic noise was larger than expected from the curves presented by Miedema & Oudshoorn (2001) at comparable noise levels. In the vicinity of Frankfurt Airport, in 2011 (before the implementation of a new north-west runway) higher annoyance responses were observed than during a comparable survey performed in 2005. The annoyance response increased in 2012 (after the implementation of the new runway) and decreased marginally in 2013.

SiRENE study 2016

B6 Although not solely an aviation noise attitude study, the Swiss SiRENE – Short and Long Term Effects of Transportation Noise Exposure study[39] examined a number of study aspects particularly relevant to ANAS.

B7 The study published in November 2016[40] included analysis of the impact of the type of annoyance scale and response format, location within a questionnaire and other contextual factors on annoyance. The study used a balanced experimental design to investigate the effect of the type of annoyance question and corresponding scale (5-point verbal vs. 11-point numerical ISO/TS 15666:2021 scales, the presentation order of scale points (ascending vs. descending), question location (early vs. late within the questionnaire), and survey season (autumn vs. spring) on reported road traffic noise annoyance. The

38 Guski et al, NORAH (Noise Related Annoyance, Cognition, and Health): Questions, designs, and main results, paper ICA2016-157, International Congress on Acoustics, 5-9 September 2016.

39 SiRENE - Short and Long Term Effects of Transportation Noise Exposure.

40 *Effects of Scale, Question Location, Order of Response Alternatives, and Season on Self-Reported Noise Annoyance Using ICBEN Scales: A Field Experiment*: Mark Brink ,Dirk Schreckenberg, Danielle Vienneau, Christian Cajochen, Jean-Marc Wunderli, Nicole Probst-Hensch and Martin Röösli, International Journal of Environmental Research and Public Health. 23 November 2016.

study used a postal survey with a stratified random sample of 2,386 Swiss residents.

B8 The results showed that early appearance of annoyance questions was significantly associated with higher annoyance scores. Questionnaires filled out in autumn were associated with a significantly higher annoyance rating than in the springtime. No effect was found for the order of response alternatives. Standardised average annoyance scores were slightly higher using the 11-point numerical scale whereas the percentage of highly annoyed respondents was higher based on the 5-point scale, using common cutoff points. The study concluded that placement and presentation of annoyance questions within a questionnaire, as well as the time of the year a survey is carried out, have small but demonstrable effects on the degree of self-reported noise annoyance.

US Federal Aviation Administration Neighbourhood Environmental Study

B9 As part of the United States Federal Aviation Administration's (FAA) ongoing research program on aircraft noise, it published the findings of a nationwide survey regarding annoyance related to aircraft noise in January 2021[41]. The stated rationale for the new survey was to ensure that FAA's continued efforts to reduce the effects of aircraft noise exposure on communities are based upon accurate information.

B10 The FAA conducted a nationwide survey to measure the relationship between aircraft noise exposure and annoyance in communities near airports. This survey aimed to capture the community response to a modern fleet of aircraft as they are being flown today, and it would use best practices in terms of noise analysis and data collection.

B11 FAA surveyed more than 10,000 residents living near 20 representative airports via a mailed questionnaire. The questionnaire was presented to the public as a Neighborhood Environmental Survey and asked the recipient if different environmental concerns bother, disturb, or annoy them. Noise from aircraft was one of the thirteen environmental concerns that were covered in the survey. Since the aircraft noise question was one of 13 environmental concerns listed, the recipient did not know this was in fact an airport community noise survey. The data from the survey, the single largest survey of this type undertaken at one time, was used to calculate the new National Curve and provided a contemporary picture of response to aircraft noise exposure. A follow-up phone survey was also offered to the 10,000 mail survey respondents, and just over 2,000 chose to participate. The phone survey was designed to provide additional insights on how the mail survey respondents feel about aircraft noise.

41 Miller et al (2021), Analysis of the Neighborhood Environmental Survey (NES), Report DOT/FAA/TC-21/4, Federal Aviation Administration, February 2021.

B12 The responses from the survey were used to create a new National Curve. The results show that there has been a substantial change in the public perception of aviation noise, relative to previous evidence represented by the Schultz Curve[42], and "will ultimately inform future FAA noise initiatives".

World Health Organisation Systematic Review of Environmental Noise and Annoyance

B13 The systematic review[43] underpinning the WHO 2018 guidelines drew evidence from 15 aircraft noise studies which had generated exposure-response functions between the years 2001-2011, based on data from 17,094 participants. The estimated data points of each of the studies were plotted alongside an aggregated exposure-response function including the data from all the individual studies. Despite not being published as meta-analysis until 2017, all the studies assessed predate the SoNA 2014 study.

B14 Most of the studies applied the ISO/TS 15666:2021 11-point scale, with the top three scores defining highly annoyed, using a cut-off of 73%. The lowest category of noise exposure considered in any of the studies was 40 dB L_{den}, corresponding to approximately 1.2% highly annoyed. 10% highly annoyed was reached at approximately 45 dB L_{den} and the evidence was rated as 'moderate quality'.

[42] Schultz T J. (1978) 'Synthesis of social surveys on noise annoyance', Journal of Acoustical Society of America, 64, p. 377-405.

[43] Guski et al, "WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance", Int J Environ Res Public Health, 8 Dec 2017;14(12):1539.

APPENDIX C

ANAS Questionnaire

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Section 1: Your Local Area

The first questions are about your local area, which is the area within 10 to 15 minutes' walking distance from your home.

Q1. How long have you lived in the local area?

Please select one option only

- ○ Less than 12 months
- ○ Between 12 months and 2 years
- ○ Between 2 and 5 years
- ○ Between 5 and 10 years
- ○ More than 10 years
- ○ Don't know

Q2. Overall, how satisfied or dissatisfied are you with your local area as a place to live?

Please select one option only

- ○ Very satisfied
- ○ Fairly satisfied
- ○ Neither satisfied nor dissatisfied
- ○ Fairly dissatisfied
- ○ Very dissatisfied
- ○ Don't know

Q3. Which, if any, of these things do you <u>most like</u> about living here?

Please select up to three options

- ○ Being near family and friends
- ○ Generally clean and tidy
- ○ Good air quality
- ○ Good local services and facilities (e.g. health services, shops, schools)
- ○ Good neighbours and community spirit
- ○ Good quality roads and pavements
- ○ Good transport links
- ○ Good walking and cycling facilities
- ○ Low level of crime and antisocial behaviour
- ○ Low level of traffic congestion
- ○ Parks, lakes, countryside or other open spaces
- ○ Quiet and peaceful area
- ○ Something else (Please write in below)
- ○ None of these
- ○ Don't know

Q4. And which, if any, of these things do you most dislike about living here?

Please select up to three options

- ○ Air pollution
- ○ Being far from family and friends
- ○ Expensive to live here
- ○ Fouling by dogs
- ○ Lack of affordable housing
- ○ Lack of community spirit
- ○ Level of crime and anti-social behaviour
- ○ Light pollution from outside your home (e.g. from streetlights, shops)
- ○ Litter and rubbish
- ○ Noise
- ○ Not enough parking
- ○ Poor or few local services and facilities (e.g. health services, shops, schools)
- ○ Poor transport links
- ○ Something else (Please write in below)
- ○ Don't know
- ○ None of these

Section 2: Aviation

The next questions are about aeroplanes. When answering the questions, please only think about commercial aeroplanes. Do not include helicopters, military aircraft, hot air balloons, or people or vehicles coming or going from airports.

Q5. Thinking about the last 12 months or so, when you are here at home, how much does noise from aeroplanes bother, disturb or annoy you? If you have lived here for less than 12 months, please answer about the period you have lived here.

Please select one option only

- ○ Not at all
- ○ Slightly
- ○ Moderately
- ○ Very
- ○ Extremely

This next question uses a 0 to 10 opinion scale for how much aeroplane noise bothers, disturbs or annoys you when you are here at home. If you are not annoyed choose 0; if you are extremely annoyed choose 10; if you are somewhere in between choose a number between 0 and 10.

Q6. Thinking about the last 12 months or so, when you are here at home, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by noise from aeroplanes?

Please select one option only

- ○ 0 – not at all
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 – extremely

We would now like to ask you the same two questions again – but this time we want you to think about the last three months when answering.

Q7. Thinking about the last three months or so, when you are here at home, how much does noise from aeroplanes bother, disturb or annoy you?

Please select one option only

- ○ Not at all
- ○ Slightly
- ○ Moderately
- ○ Very
- ○ Extremely

This next question uses a 0 to 10 opinion scale for how much aeroplane noise bothers, disturbs or annoys you when you are here at home. If you are not annoyed choose 0; if you are extremely annoyed choose 10; if you are somewhere in between choose a number between 0 and 10.

Q8. Thinking about <u>the last three months or so</u>, when you are here at home, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by noise from aeroplanes?

Please select one option only

- ○ 0 – not at all
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 – extremely

PLEASE ANSWER FROM Q9 IF YOU ARE BOTHERED, DISTURBED OR ANNOYED BY NOISE FROM AEROPLANES AT Q8 (any code 1 through to 10 at Q8). OTHERS PLEASE GO TO Q15.

Q9. You said that you are bothered, disturbed or annoyed by noise from aeroplanes. At <u>which one</u> of the following times would you say you are <u>most</u> bothered, disturbed or annoyed by aeroplane noise?

Please select one option only

- ○ Between 6 a.m. and 7 a.m.
- ○ Between 7 a.m. and 7 p.m.
- ○ Between 7 p.m. and 11 p.m.
- ○ Between 11 p.m. and midnight
- ○ Between 11 p.m. and 7 a.m.
- ○ At all times equally
- ○ Don't know

Q10. Would you say there is a time of the week when aeroplane noise is worse?

Please select one option only

- ○ Worse on weekdays
- ○ Worse at weekends
- ○ There is no difference between weekdays and weekends
- ○ Don't know

Q11. Does noise from aeroplanes bother, disturb or annoy you the same amount all year round or more in certain seasons?

Please select one option only

- ○ More in certain seasons
- ○ The same all year round
- ○ Don’t know

PLEASE ANSWER Q12 IF YOU ARE MORE BOTHERED, DISTURBED OR ANNOYED WITH AEROPLANE NOISE IN CERTAIN SEASONS – OTHERS PLEASE GO TO Q13

Q12. Which season are you <u>most</u> bothered, disturbed or annoyed by noise from aeroplanes?

Please select one option only

- ○ Spring
- ○ Summer
- ○ Autumn
- ○ Winter
- ○ Don’t know

Q13. Which <u>one</u> of the following issues to do with aeroplane noise concerns you the <u>most</u>?

Please select one option only

- ○ Flights that do not appear to be on the expected flight path
- ○ The number of flights
- ○ The loudness of aeroplanes
- ○ The lack of quiet between individual flights
- ○ Not knowing when there will be times of the day without aeroplane noise
- ○ Something else (Please write in below)
- ○ Don’t know

Q14. How often are you <u>typically</u> bothered, disturbed or annoyed by noise from aeroplanes?

Please select one option only

- ○ All of the time
- ○ Often
- ○ Some of the time
- ○ Rarely
- ○ Don’t know

EVERYONE PLEASE ANSWER THE NEXT QUESTIONS

Q15. Does noise from aeroplanes interfere with any of the following aspects when you are at home?

Please select all that apply

- ○ Having a conversation (including on the phone or online)
- ○ Quiet leisure activities such as reading, writing or resting
- ○ Studying or working from home
- ○ Listening to TV, radio or music
- ○ Other leisure activities that involve sound such as gaming or making music
- ○ Being able to use every room in the home
- ○ Socialising with friends and family
- ○ Exercising outdoors
- ○ Enjoyment of peace and quiet when outdoors
- ○ Having windows or doors open
- ○ None of these
- ○ Don't know

Q16. Does noise from aeroplanes interfere with your sleeping patterns such as the time you go to bed or get up?

Please select one option only

- ○ Yes
- ○ No

Q17. Thinking about the last three months when you are here at home, how much does noise from aeroplanes disturb your sleep during the night (11 p.m. to 7 a.m.)?

Please select one option only

- ○ Not at all
- ○ Slightly
- ○ Moderately
- ○ Very
- ○ Extremely

Q18. Does noise from aeroplanes have any of these effects on your household?

Please select one option for each

A It frightens me
B. It frightens my children
C. It wakes me up
D It wakes my children up
E. It upsets or wakes my pets up

- ○ Yes
- ○ No

- ○ Not applicable
- ○ Don’t know

Q19. In the last three months, have you wanted to open a window anywhere in your home for any of the following reasons, but had to keep it closed to keep out noise from aeroplanes?
Please select all that apply

- ○ Too warm (to cool down the house)
- ○ To get rid of moisture or damp
- ○ To get rid of smells
- ○ To dry clothes
- ○ For fresh air / to air the room
- ○ Remove smoke (cigarettes, cooking, fires, etc.)
- ○ Connection / contact with outdoors
- ○ Another reason (Please write in below)
- ○ None of these
- ○ Don’t know

Q20. And still thinking about the last three months, how often, if at all, are you able to hear noise from aeroplanes when you are indoors and windows are closed?

Please select one option only

- ○ All of the time
- ○ Often
- ○ Some of the time
- ○ Rarely
- ○ None of the time
- ○ Don’t know

Q21. Thinking about this time next year, do you expect there will be more or less noise from aeroplanes, or do you expect it to be about the same as it is now?
Please select one option only

- ○ More noise from aeroplanes
- ○ Less noise from aeroplanes
- ○ About the same next year as it is now
- ○ Don’t know

Q22. Which of these things, if any, have you or anyone else in your household done about noise from aeroplanes within the last 12 months?

Please select all that apply

- ○ Made our own sound (e.g. playing music/white noise) so that we could not hear the noise
- ○ Used earplugs or headphones to avoid hearing the noise
- ○ Started, signed or participated in a campaign, protest or petition
- ○ Taken advice (e.g. from Citizen’s Advice Bureau or legal organisation)
- ○ Slept in a different room in the home
- ○ Improved the soundproofing (e.g. changing the windows)
- ○ Used medication or sought professional help (e.g. from a GP or pharmacist)
- ○ Sought a quieter space away from home
- ○ None of these

Q23. Did you complain to, communicate or engage with any of the following about noise from aeroplanes within the last 12 months?

Please select all that apply

- ○ An airport, airport owner or airport operator
- ○ One or more airlines
- ○ The Civil Aviation Authority
- ○ A newspaper or TV/radio station
- ○ A residents' association
- ○ The environmental health department in the local authority (council)
- ○ Another local authority (council) department
- ○ A government department
- ○ The police
- ○ A councillor
- ○ A community group campaigning on this issue
- ○ Posted something on social media
- ○ A Member of Parliament
- ○ Other (Please write in below)
- ○ None of these

Q24. Are you aware of any of the following provided by your local airport?

Please select all that apply

- ○ Airport Consultative Committee
- ○ Airport Noise Action Plan
- ○ Airport Master Plan
- ○ Airport website information on noise
- ○ Any schemes that provide direct benefits to eligible residents (e.g. double glazing windows for sound insulation, relocation or noise compensation)
- ○ I am not aware of any of these

Q25. As far as you are aware, has your home had any of the following changes made to it <u>as part of a noise insulation scheme run by an airport</u>?

Please select all that apply.

- ○ Soundproofing
- ○ Ventilation units (to allow fresh air into your home without opening windows and doors)
- ○ No changes have been made to my home as part of a noise insulation scheme run by an airport
- ○ Don't know

Q26. To what extent do you agree or disagree with the following statements?

Please select one option for each statement

A Noise from aeroplanes is bad for the health of myself or my household
B Noise from aeroplanes is bad for children's education at the local schools
C Aeroplanes cause air pollution around here
D Having an airport in the area is good for the local economy
E I worry about plane crashes around here
F Noise from aeroplanes makes my home less valuable
G Having an airport in the area makes my home more valuable
H It is convenient to have an airport in the area

I Air travel harms the environment
J I like flying
K I like watching the aeroplanes

- Strongly agree
- Tend to agree
- Neither agree nor disagree
- Tend to disagree
- Strongly disagree
- Don’t know

Q27. Prior to moving here, were you aware of a possibility of hearing noise from aeroplanes?

Please select one option only

- Yes, I was aware of this
- No, I was not aware of this
- I have always lived here
- Don’t know / can’t remember

PLEASE ANSWER Q28 IF YOU SAID YES AT Q27. OTHERS PLEASE GO TO Q29

Q28. You said that prior to moving here, you were aware of a possibility of hearing noise from aeroplanes. How does the noise compare with what you expected?

Please select one option

- Noise was more than I expected
- Noise was less than I expected
- Noise was about what I expected
- Don’t know / can’t remember

EVERYONE PLEASE ANSWER THE NEXT QUESTIONS

Q29. When was the last time you flew from a UK airport?

Please select one option only

- Within the last 12 months
- Between 1 and 3 years ago
- Between 3 and 5 years ago
- More than 5 years ago
- Never
- Don’t know

PLEASE ANSWER Q30 IF YOU HAVE PERSONALLY FLOWN FROM A UK AIRPORT WITHIN THE LAST 12 MONTHS. OTHERS PLEASE GO TO Q31

Q30. How many trips have you made in the last 12 months *by* aeroplane? Please count outward and return flights and any transfers as one trip. If you are not sure then your best estimate is fine.

Please select one option only

- ○ One
- ○ Two
- ○ Three
- ○ Four
- ○ Five
- ○ Over five
- ○ Don't know

EVERYONE PLEASE ANSWER THE NEXT QUESTIONS

Q31. How much, if anything, do you think each of the following organisations are doing to reduce noise from aeroplanes?

Please select one option for each

A. Airports
B. Airlines
C. Local authorities such as your local council
D. The UK Government
E. The Civil Aviation Authority (CAA)

- ○ A great deal
- ○ A fair amount
- ○ Not very much
- ○ Nothing at all
- ○ Don't know

Q32. To what extent, if at all, do you agree or disagree with each of the following statements about noise from aeroplanes?

Please select one option for each statement

A. I can protect myself against noise from aeroplanes
B. If it's too loud outside, I simply close the windows and then I am no longer disturbed
C. Sometimes it's impossible to escape noise from aeroplanes
D. When it's noisy outside I just accept it as a fact of life

- ○ Strongly agree
- ○ Tend to agree
- ○ Neither agree nor disagree
- ○ Tend to disagree
- ○ Strongly disagree

- ○ Don't know

Section 3: Road traffic and your neighbours

The next two questions are about road traffic and your neighbours.

Q33. Thinking about the last 12 months or so, when you are here at home, how much does noise from road traffic bother, disturb or annoy you? If you have lived here for less than 12 months, please answer about the period you have lived here.

Please select one option only.

- ○ Not at all
- ○ Slightly
- ○ Moderately
- ○ Very
- ○ Extremely

Q34. And still thinking about the last 12 months or so, when you are here at home, how much does noise from your neighbours bother, disturb or annoy you? If you have lived here for less than 12 months, please answer about the period you have lived here.

Please select one option only

- ○ Not at all
- ○ Slightly
- ○ Moderately
- ○ Very
- ○ Extremely

Section 4: Health and wellbeing

The next questions are about your health and wellbeing. As a reminder, your participation in this research is entirely voluntary and you can choose not to answer any questions you don't feel comfortable answering by selecting the "Prefer not to say" option. All of your responses are confidential and used for research purposes only.

Q35. How is your health in general?

Please select one option only

- ○ Very good
- ○ Good
- ○ Fair
- ○ Bad
- ○ Very bad
- ○ Prefer not to say

Q36. Do you have any physical or mental health conditions or illnesses lasting or expected to last for 12 months or more?

Please select one option only

- ○ Yes
- ○ No
- ○ Don't know
- ○ Prefer not to say

Q37. Do you have any problems or difficulties with your sense of hearing? This could include conditions that may affect your ability to hear (e.g. tinnitus, an ear infection)

Please select one option only

- ○ Yes
- ○ No
- ○ Don't know
- ○ Prefer not to say

Q38. The next few questions are about your feelings on aspects of your life. There are no right or wrong answers. For each question, please give an answer on a scale of 0 to 10, where 0 is "not at all" and 10 is "completely".

Please select one option for each

A. Overall, how satisfied are you with your life nowadays?
B. Overall, to what extent do you feel that the things in your life are worthwhile?
C. Overall, how happy did you feel yesterday?
D. Overall, how anxious did you feel yesterday?

- ○ 0 – not at all
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 – completely
- ○ Don't know
- ○ Prefer not to say

Q39. Here are some statements about feelings and thoughts. How often, if at all, have you felt this way over the last two weeks?

Please select one option for each statement

A. I've been feeling optimistic about the future
B. I've been feeling useful
C. I've been feeling relaxed
D. I've been dealing with problems well
E. I've been thinking clearly
F. I've been feeling close to other people
G. I've been able to make up my own mind about things

○ All of the time
○ Often
○ Some of the time
○ Rarely
○ None of the time
○ Prefer not to say

Q40. On a scale of 1 to 7 where 1 is not at all sensitive and 7 is very sensitive, how sensitive would you say you are to noise, in general?

Please select one option only

○ 1 - Not at all sensitive
○ 2
○ 3
○ 4
○ 5
○ 6
○ 7 - Very sensitive

Section 5: Homes and housing

The next section is about your home and housing in your local area. By your home, we mean the home to which the survey was addressed.

Q41. Does your household own or rent this accommodation?

Please select one option only

○ Buying it on a mortgage
○ Owned outright
○ Rent it from a local authority, housing association or housing trust
○ Rent it from a private landlord
○ Other (Please type in below)
○ Don't know
○ Prefer not to say

Q42. How long have you lived in this home?

Please select one option only

- ○ Less than 3 months
- ○ Between 3 and 6 months
- ○ Between 6 months and 1 year
- ○ Between 1 and 2 years
- ○ Between 2 and 5 years
- ○ Between 5 and 10 years
- ○ More than 10 years
- ○ Don't know

Q43. What type of home do you live in?

Please select one option only

- ○ A house or bungalow
- ○ A flat, maisonette or apartment
- ○ Another type of home (Please write in below)
- ○ Don't know

Q44. Do you have use of an outdoor space such as a garden, terrace or balcony?

Please select all that apply

- ○ Yes – a garden
- ○ Yes – a balcony
- ○ Yes – a terrace
- ○ No – none of these
- ○ Don't know

Q45. What type of windows do you have in your living room or room where you spend most of your time when at home?

Please select one option only

- ○ Single-glazed
- ○ Double-glazed or better
- ○ Don't know

Q46. Are the windows in the room where you spend most of your time at home openable or non-openable?

Please select one option only

- ○ Openable
- ○ Non-openable
- ○ Don't know

Q47. And what is the condition of the windows in the room where you spend most of your time when at home?

Please select one option only

- ○ Very good
- ○ Good
- ○ Average
- ○ Poor
- ○ Very poor
- ○ Don't know

Q48. Thinking about the last three months, what are the <u>main reasons</u> why you close your windows or keep your windows closed?
Please select up to three options

- ○ To prevent noise from outside
- ○ Other reasons to do with conditions outdoors (e.g. smoke, smells, wind, rain)
- ○ To keep warm or save energy
- ○ For security reasons (e.g. to prevent burglaries)
- ○ Safety (e.g. to prevent children falling out, or to keep pets inside)
- ○ To keep animals, insects and pests out
- ○ No particular reason – just out of habit or preference
- ○ Windows not openable or difficulty opening the windows
- ○ For other reasons
- ○ None of these
- ○ Don't know

Section 6: About you

Finally, a few questions about you. As a reminder, your participation in this research is entirely voluntary and you can choose not to answer any questions you don't feel comfortable answering by selecting the "Prefer not to say" option. All of your responses are confidential and used for research purposes only.

Q49a. What was your age on your last birthday?

Please write in below

Prefer not to say

ASK Q49B IF PREFER NOT TO SAY AT Q49A. OTHERS GO TO Q50

Q49b. Which age group are you in?

Please select one option only

- ○ 18 to 24 years
- ○ 25 to 34 years
- ○ 35 to 44 years
- ○ 45 to 54 years
- ○ 55 to 64 years
- ○ 65 to 74 years
- ○ 75 years or older
- ○ Prefer not to say

Q50. Which of the following best describes your gender?

Please select one option only

- ○ Man
- ○ Woman
- ○ Non-binary
- ○ My gender is not listed
- ○ Prefer not to say

Q51. How many children aged 0-17 live with you as part of your household?

Please select one option only

- ○ None
- ○ 1 child
- ○ 2 children
- ○ 3 children
- ○ 4 children
- ○ 5 or more children
- ○ Prefer not to say

Q52. How many adults aged 18 or over live with you as part of your household?

Please select one option only

- ○ No other adults
- ○ 1 other adult
- ○ 2 other adults
- ○ 3 other adults
- ○ 4 other adults
- ○ 5 or more other adults
- ○ Prefer not to say

Q53. Which of these best describes your current situation?

Please select one option only

- ○ Working full time (30 hours a week or more)
- ○ Working part time
- ○ Unemployed and looking for work
- ○ Retired from paid work altogether
- ○ In full-time education
- ○ Looking after the home or family
- ○ Something else
- ○ Prefer not to say

ASK ALL

THE NEXT FEW QUESTIONS REFER TO YOUR CURRENT MAIN JOB, OR IF YOU ARE NOT WORKING NOW TO YOUR LAST MAIN JOB.

Q54. Do (did) you work as an employee or are (were) you self-employed?

Please select one option only

- ○ Employee
- ○ Self-employed with employees
- ○ Self-employed or freelance without employees
- ○ I have never had a job

PLEASE ANSWER Q55 AND Q56 IF YOU ARE (WERE) AN EMPLOYEE OR SELF-EMPLOYED (ANY CODE 1/2/3 AT Q54)

IF YOU HAVE NEVER HAD A JOB PLEASE GO TO Q62

Q55. How many people work (worked) for your employer at the place where you work (worked)?
If you are self-employed: How many people do (did) you employ?

Please select one option only

- ○ 1 to 24
- ○ 25 or more
- ○ Don't know
- ○ Prefer not to say

Q56. Do (did) you supervise any other employees? A supervisor is responsible for overseeing the work of other employees on a day-to-day basis

Please select one option only

- ○ Yes
- ○ No

ANSWER Q57 IF YOU ARE WORKING OR HAVE EVER WORKED (ANY CODE 1/2/3 AT Q54). IF YOU HAVE NEVER HAD A JOB (CODE 4 AT Q54) PLEASE GO TO Q62.

Q57. Which of the following best describes the sort of work you do in your current job? If you are not working now, please select which best described what you did in your last job.

Please select one option only

- ○ **Modern professional occupations** such as: teacher, nurse, physiotherapist, social worker, welfare officer, artist, musician, police officer (sergeant or above) or software designer
- ○ **Clerical and intermediate occupations** such as: secretary, personal assistant, clerical worker, office clerk, call centre agent, nursing auxiliary or nursery nurse
- ○ **Senior managers or administrators** (usually responsible for planning, organising and co-ordinating work, and for finance) such as: finance manager or chief executive
- ○ **Technical and craft occupations** such as: motor mechanic, fitter, inspector, plumber, printer, tool maker, electrician, gardener or train driver
- ○ **Semi-routine manual and service occupations** such as: postal worker, machine operative, security guard, caretaker, farm worker, catering assistant, receptionist or sales assistant
- ○ **Routine manual and service occupations** such as: HGV driver, van driver, cleaner, porter, packer, sewing machinist, messenger, labourer, waiter/waitress or bar staff
- ○ **Middle or junior managers** such as: office manager, retail manager, bank manager, restaurant manager, warehouse manager or publican
- ○ **Traditional professional occupations** such as: accountant, solicitor, medical practitioner, scientist or civil/mechanical engineer
- ○ **Prefer not to say**

ANSWER Q58 IF YOU ARE CURRENTLY WORKING FULL OR PART TIME (CODE 1 OR 2 AT Q53). OTHERS PLEASE GO TO Q62.

Q58. Are you able to work from home to do your job?

Please select one option only

- ○ Yes
- ○ No
- ○ Don’t know

ANSWER Q59 IF YOU SAID YES AT Q58. OTHERS PLEASE GO TO Q61.

Q59. And do you ever work from home?

Please select one option only

- ○ Yes
- ○ No
- ○ Prefer not to say

ANSWER Q60 IF YES AT Q59

Q60. In a typical working week, what proportion of your time is spent working from home?

Please select one option only

- ○ More than half of the time
- ○ Around half of the time
- ○ Less than half of the time
- ○ It varies from week to week
- ○ Don't know

ANSWER Q61 IF WORKING FULL OR PART TIME

Q61. Does your job require shift work?

Please select one option only

- ○ Yes
- ○ No

EVERYONE TO ANSWER THE NEXT QUESTIONS

Q62. Do (did) you, or anyone else in your household have work that includes any of these kinds of employment?

Please select all that apply

- ○ Work for an airport
- ○ Work for an airline
- ○ Work at an airport for a different company (e.g. a shop)
- ○ Work that is not at an airport but gets some benefit from the airport being there
- ○ Other work related to the aircraft or air travel industry
- ○ None of these

Q63. Which one of the following best describes your ethnic group or background?

Please select one option only

A. White

- ○ English/Welsh/Scottish/Northern Irish/British
- ○ Irish
- ○ Gypsy or Irish Traveller
- ○ Roma
- ○ Any other White background

B. Mixed/Multiple ethnic groups

- ○ White and Black Caribbean
- ○ White and Black African
- ○ White and Asian
- ○ Any other Mixed/Multiple ethnic background

C. Asian/Asian British

- ○ Indian
- ○ Pakistani
- ○ Bangladeshi
- ○ Chinese

- Any other Asian background

D. Black/African/Caribbean/Black British

- African
- Caribbean
- Any other Black/African/Caribbean background

E. Other ethnic group

- Arab
- Any other ethnic group

Prefer not to say

Section 7: Thank you gift voucher

QG1 Thank you for taking the time to complete this survey. In appreciation, we would like to email you a £10 high street gift voucher.

Please enter your email address below

<<<ADD BOX FOR EMAIL ADDRESS>>

- I do not have an email address
- Prefer not to say
- I do not wish to receive a gift voucher – THANK AND CLOSE

SHOW THE FOLLOWING TEXT IF PARTICIPANT DOES NOT HAVE AN EMAIL ADDRESS OR PREFERS NOT TO SAY FROM QG1

As you have not provided an email address, we will send you your gift voucher by post after the survey closes in November 2023.

ASK QG2 TO ALL EXCEPT THOSE WHO DO NOT WISH TO RECEIVE A GIFT VOUCHER FROM QG1

QG2 What is your name? This is to allow us to address your gift voucher to you personally.

Please type in your first name and last name in the box below

- Prefer not to say

PENULTIMATE SCREEN

You have now reached the end of the survey. To submit your answers, please click the 'Submit' button below.

FINAL SCREEN

Your answers have been submitted, thank you for your time.

APPENDIX D

Noise Exposure Contours Used for Survey Selection

D1 The following maps presented the noise contours used to provide the master list of addresses for random survey selection. They are based on 2022 summer average $L_{Aeq,16h}$ noise contours using long-term runway use, uplifted by 1 dB, to reflect the anticipated recovery in air traffic following the Covid-19 pandemic. These contours were selected because the resulting ‘retrospective’ noise dose in summer 2023 is, in many cases, less than 45 dB $L_{Aeq,16h}$, and thus the forecast noise dose is the best representation of the survey areas.

Figure D1 Birmingham survey area

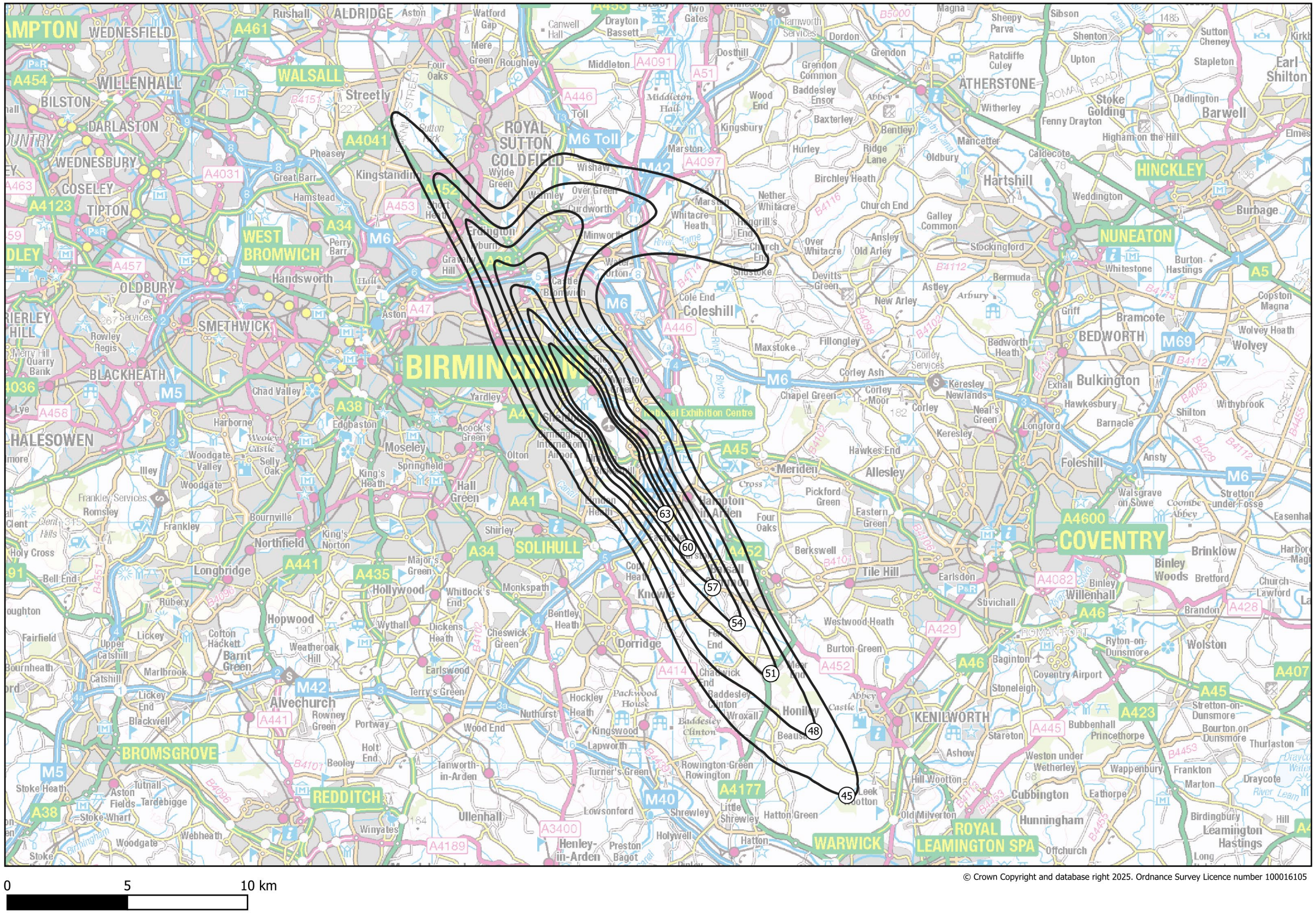


Figure D2 East Midlands survey area

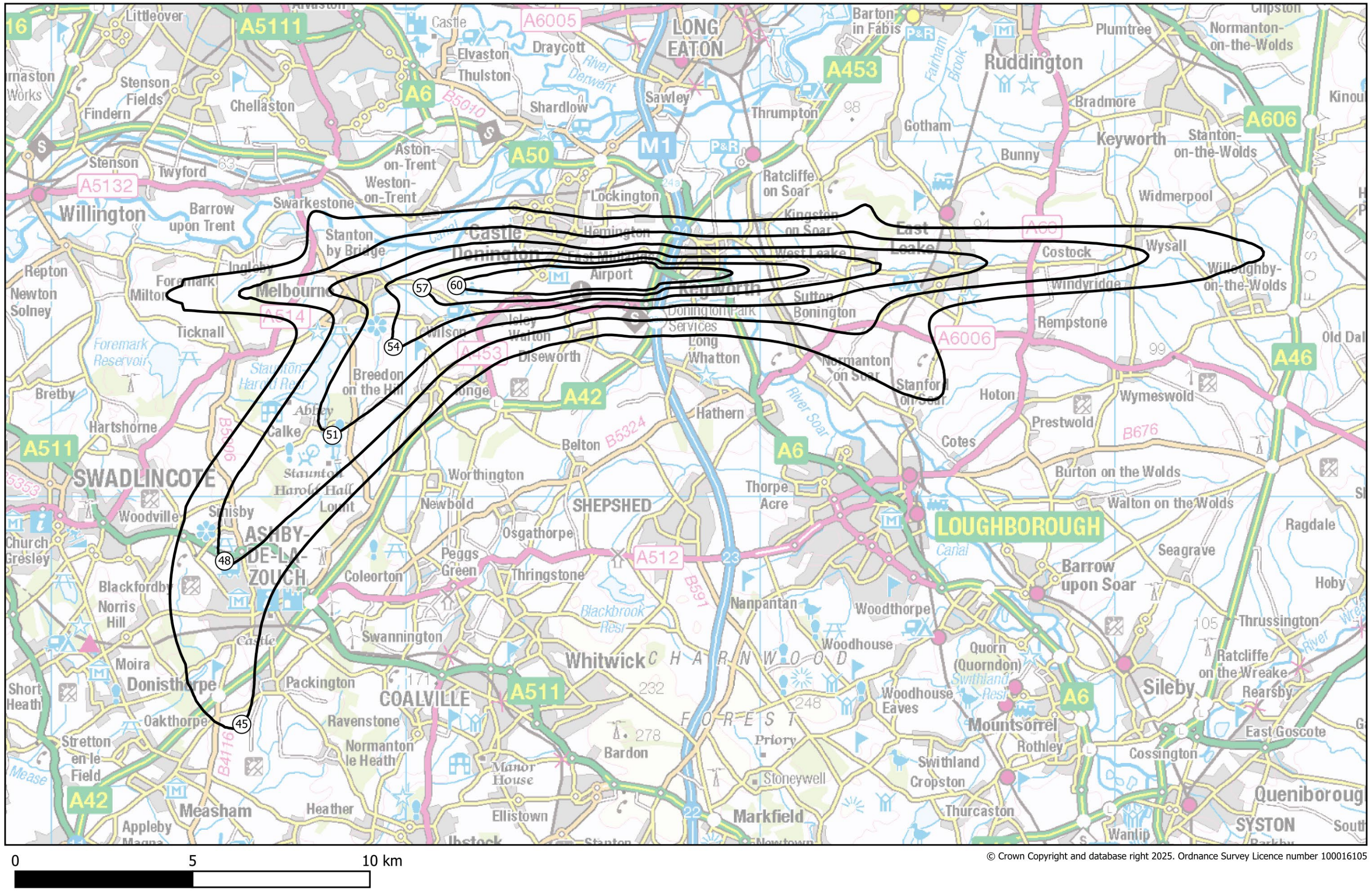
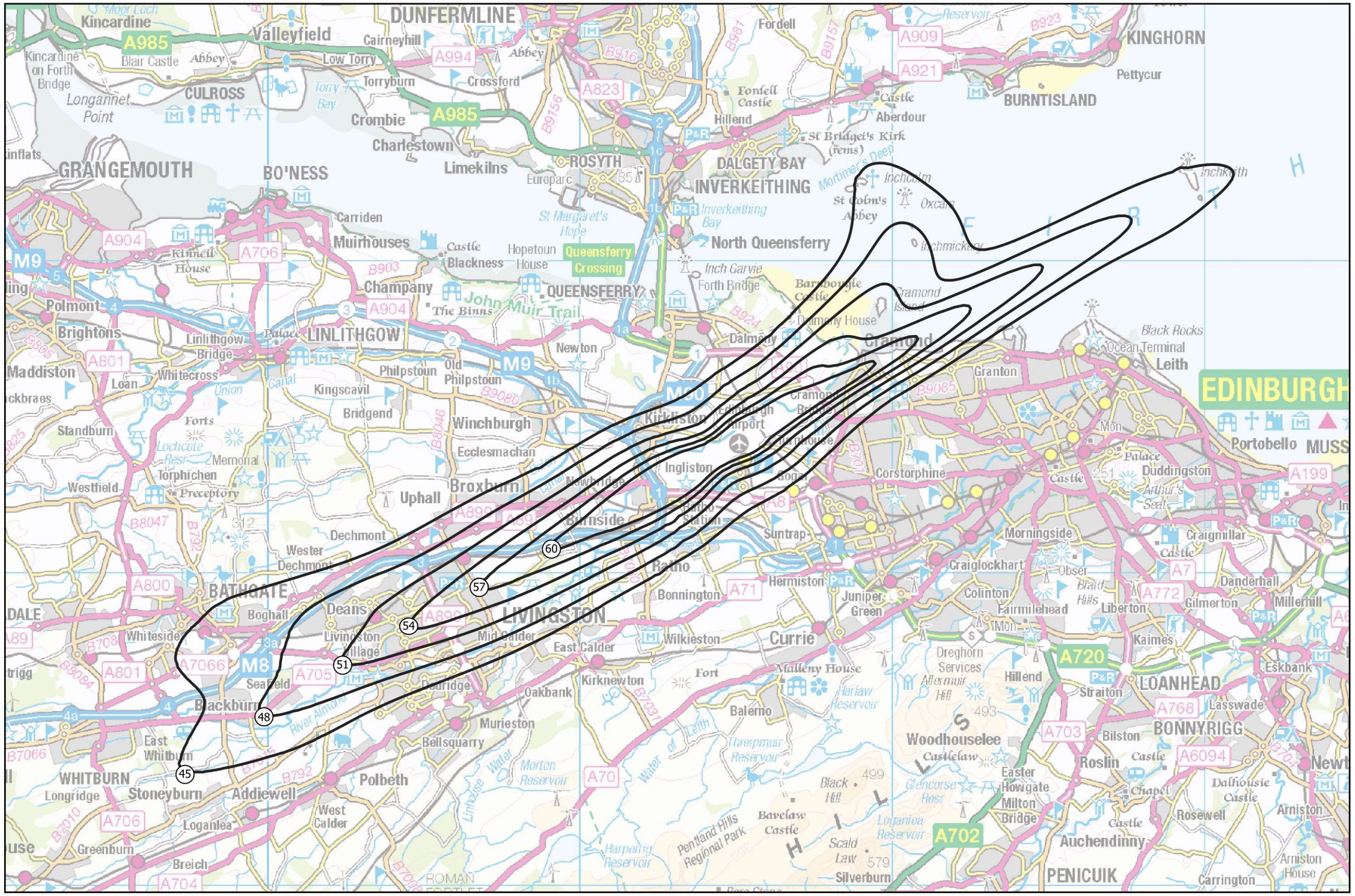


Figure D3 Edinburgh survey area



0 5 10 km

Figure D4 Glasgow survey area

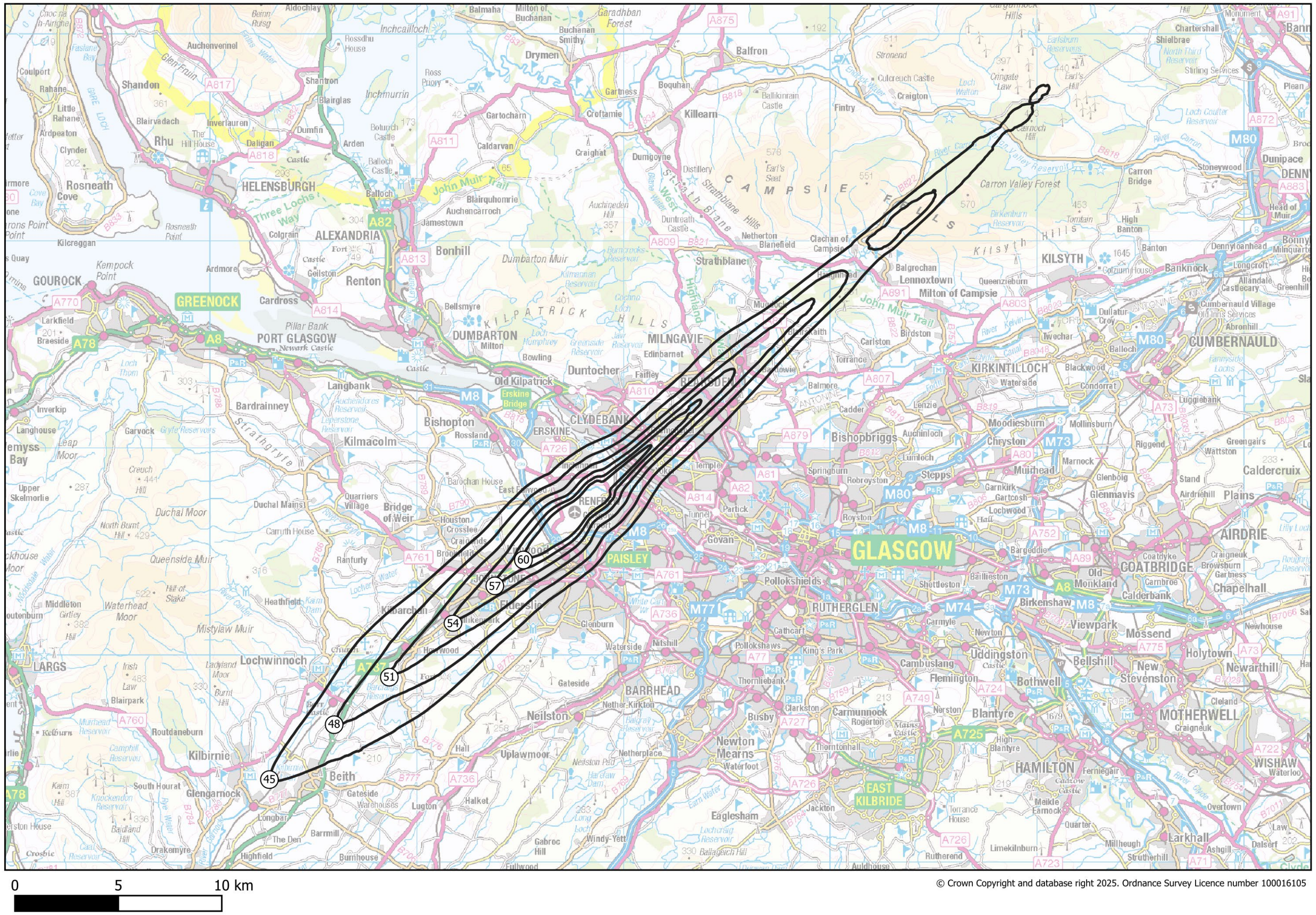


Figure D5 Leeds Bradford survey area

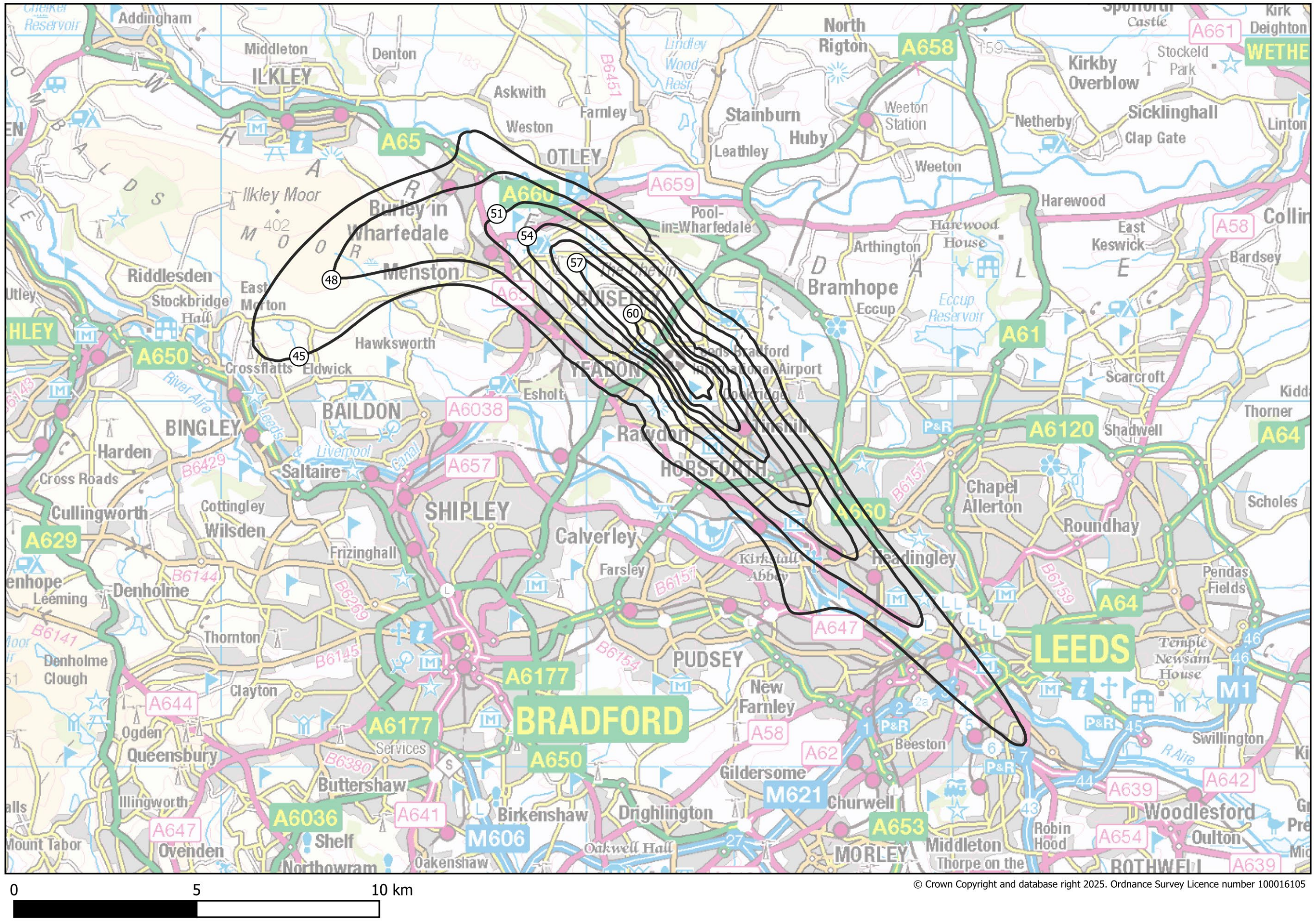
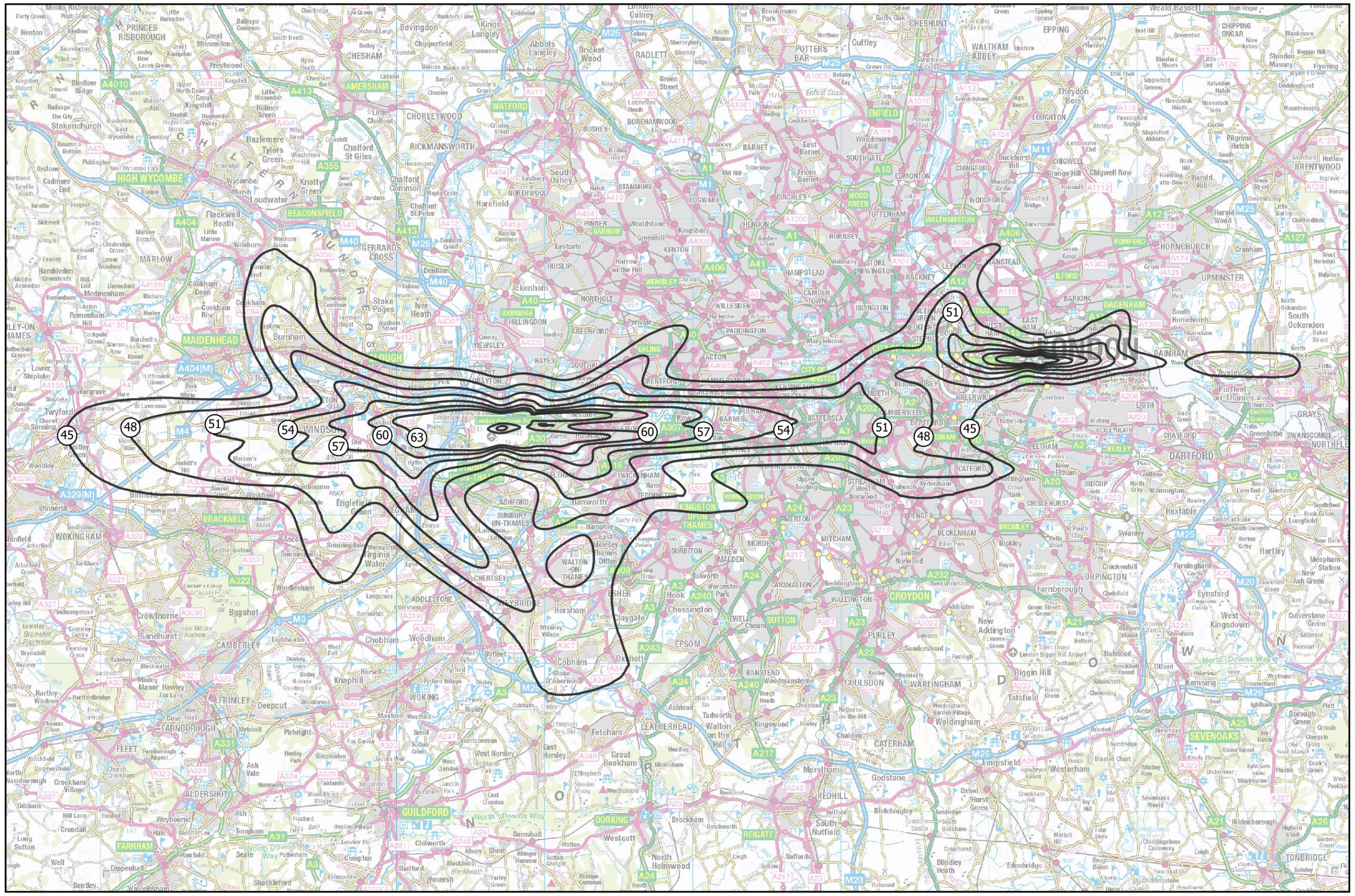


Figure D6 London City and London Heathrow combined survey area



0 5 10 km

Figure D7 London Gatwick survey area

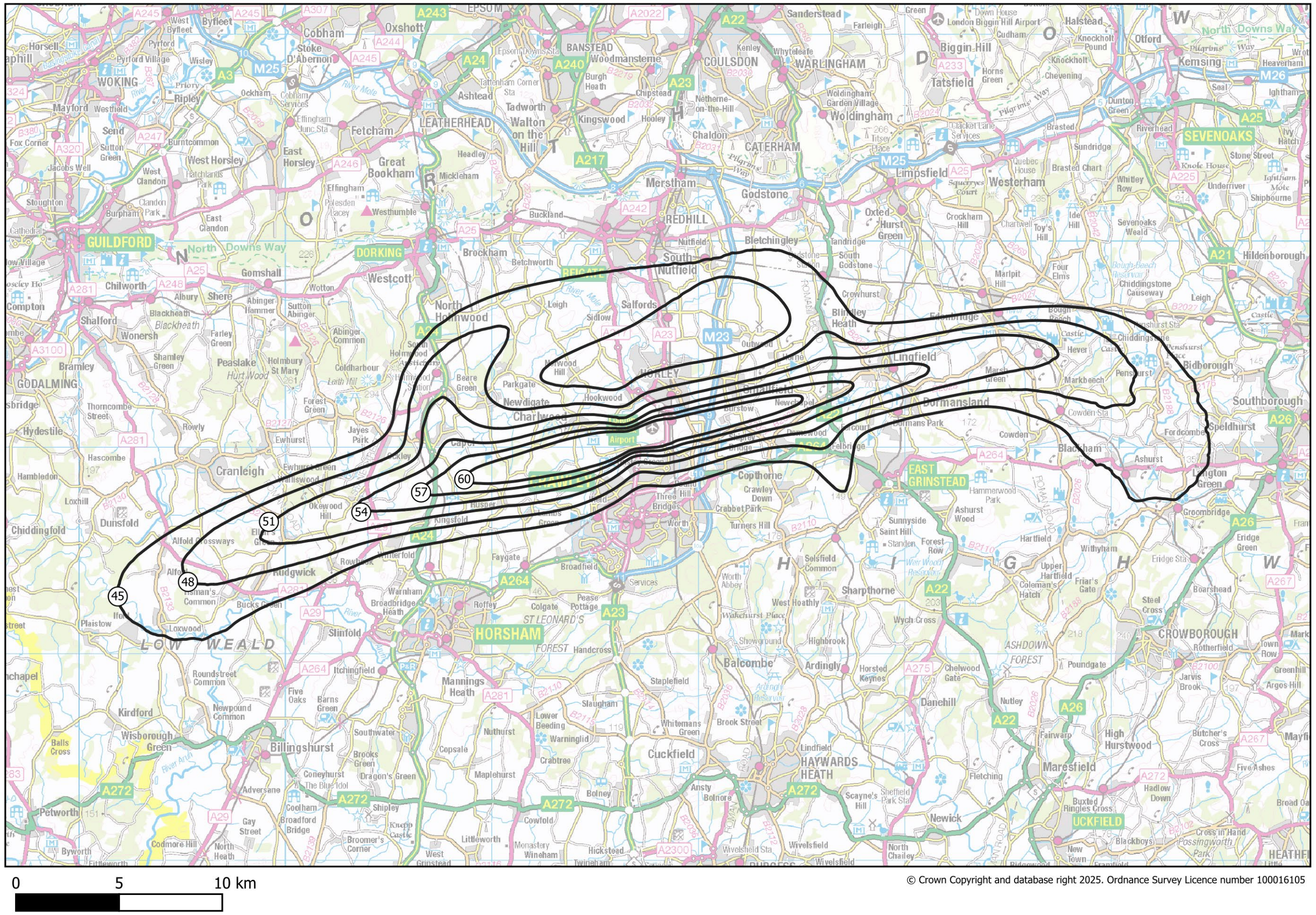
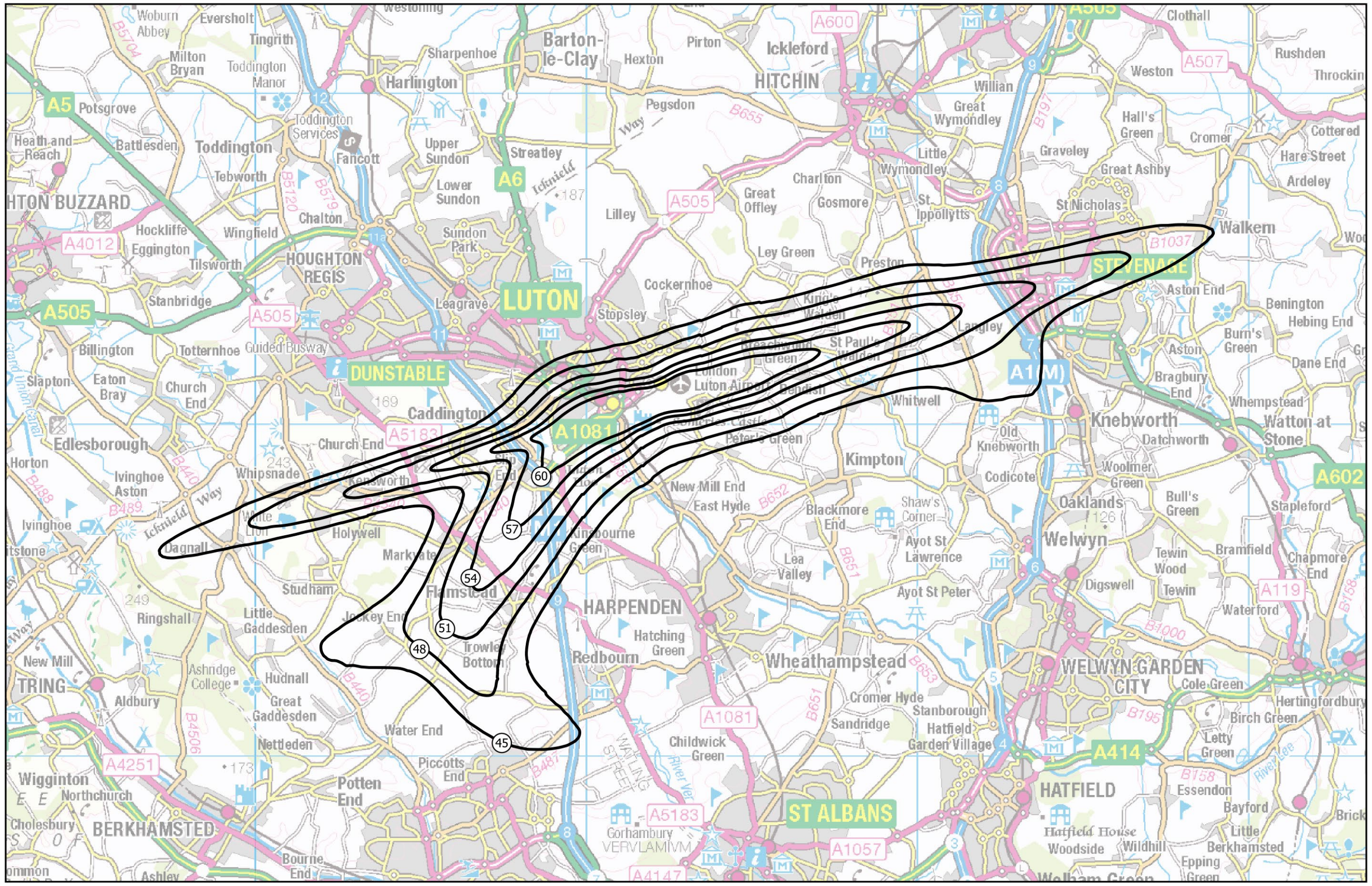


Figure D8 Luton survey area



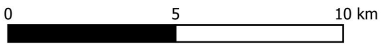
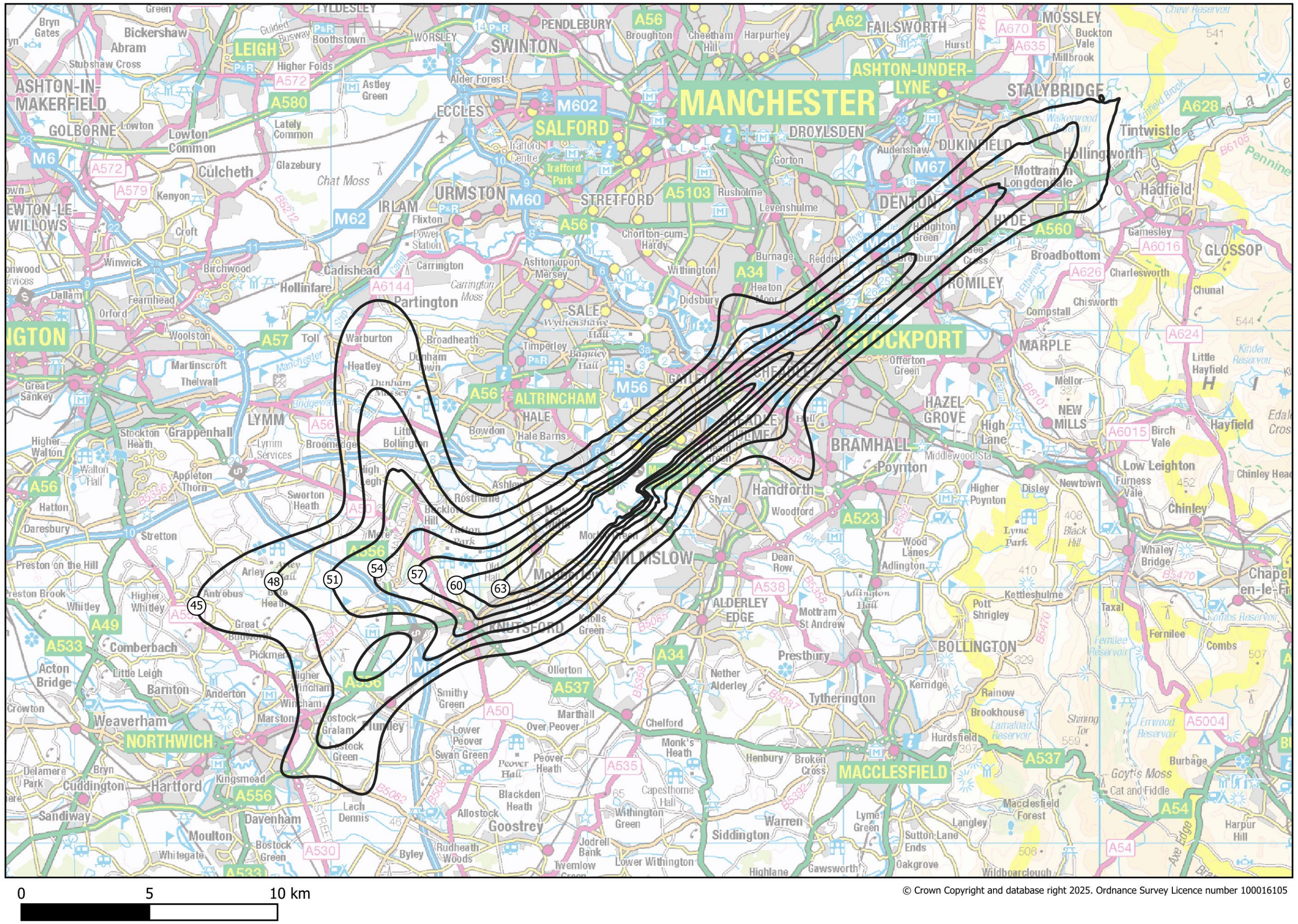


Figure D9 Manchester survey area



APPENDIX E

Noise exposure and annoyance

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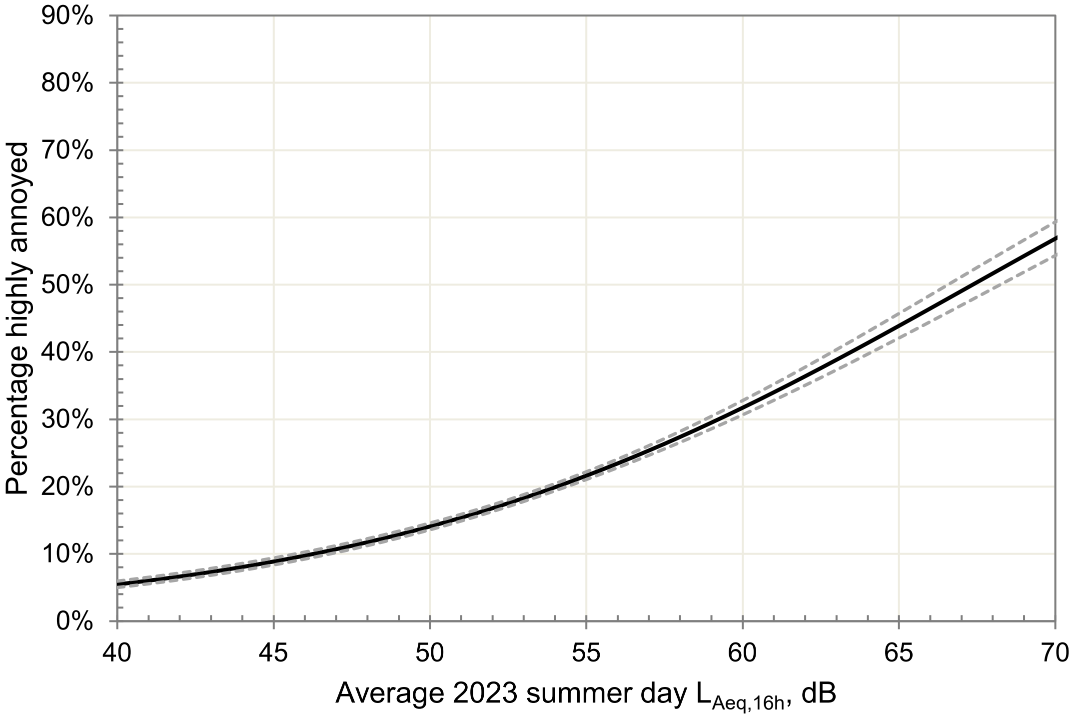
Figure E1 Exposure-response function, all airports, annoyance during the last 12 months, HA_{VW} (Q5), Wave 1 (N=29,689)

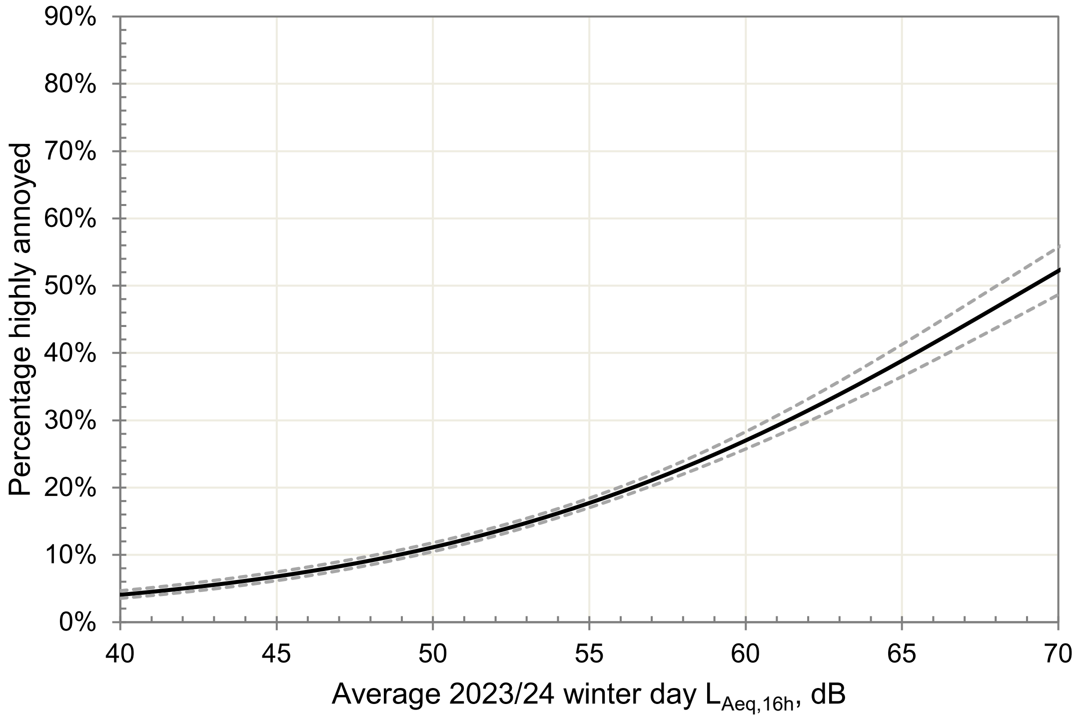


E1 Figure E1 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around surveyed UK airports in Wave 1.

E2 For Figure E1, a HA_V scale (5-point verbal) was used to calculate annoyance, meaning all 'very' or 'extremely' annoyed responses on a 5-point verbal scale (not at all, slightly, moderate, very and extremely).

E3 Figure E1 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 5.0%–6.0% assuming a 95% confidence interval. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 54.3%–59.3% assuming a 95% confidence interval.

Figure E2 Exposure-response function, all airports, annoyance during the last 12 months, HA_{VW} (Q5), Wave 2 (N=15,611)

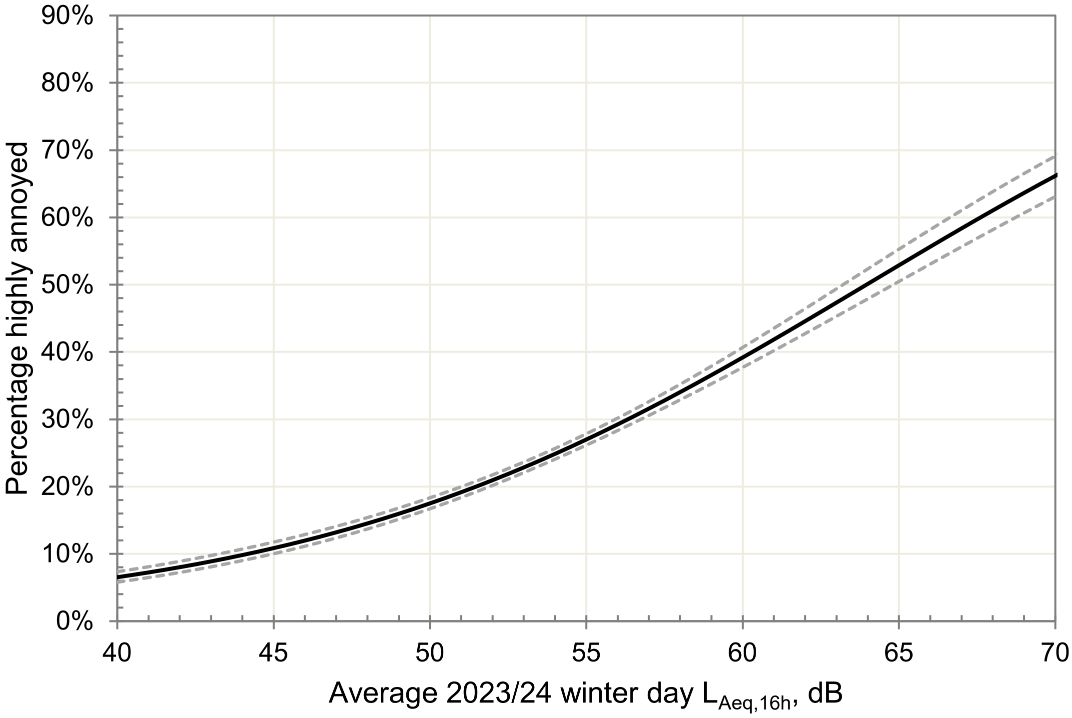


E4 Figure E2 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around surveyed UK airports in Wave 2.

E5 For Figure E2, a HA_{VW} scale (5-point verbal) was used to calculate annoyance, meaning 40% of all 'very', and all 'extremely' annoyed responses on a 5-point verbal scale (not at all, slightly, moderate, very and extremely).

E6 Figure E2 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 3.5%–4.7% assuming a 95% confidence interval. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 48.7%–55.7% assuming a 95% confidence interval.

Figure E3 Exposure-response function, all airports, annoyance during the last 12 months, HA_V (Q5), Wave 2 (N=15,611)

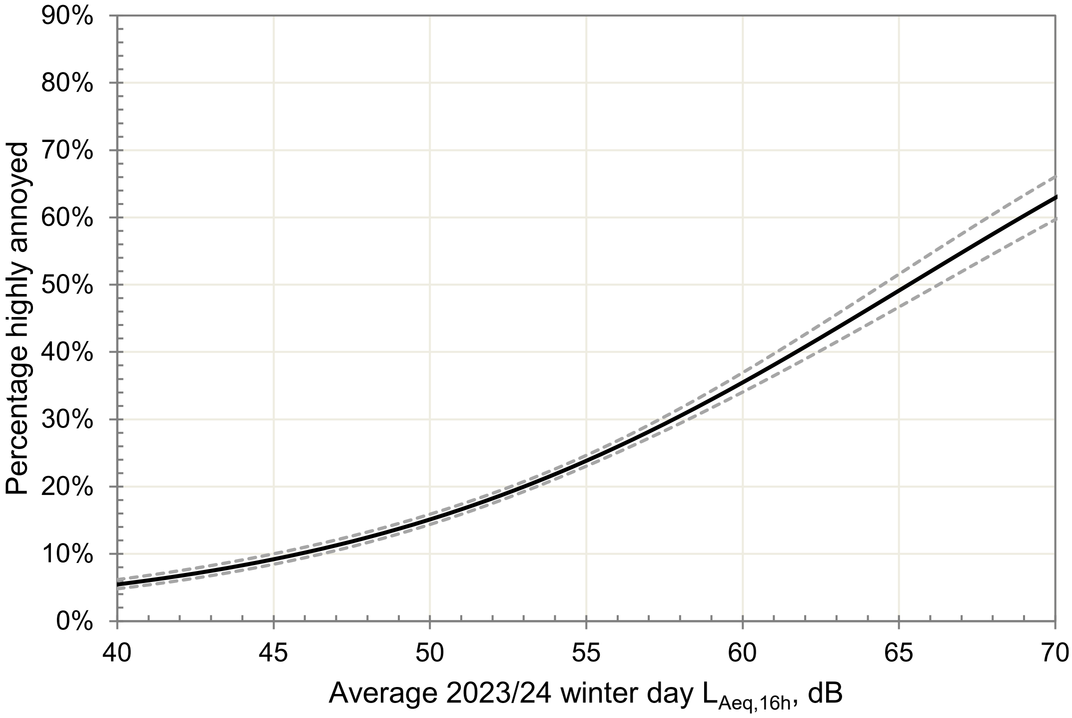


E7 Figure E3 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around surveyed UK airports in Wave 2.

E8 For Figure E3, a HA_V scale (5-point verbal) was used to calculate annoyance, meaning all 'very' or 'extremely' annoyed responses on a 5-point verbal scale (not at all, slightly, moderate, very and extremely).

E9 Figure E3 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 6.5%–7.4% assuming a 95% confidence interval. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 63.1%–69.1% assuming a 95% confidence interval.

Figure E4 Exposure-response function, all airports, annoyance during the last 12 months, HA_N (Q6), Wave 2 (N=15,679)



E10 Figure E4 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around surveyed UK airports in Wave 2.

E11 For Figure E4, a HA_N scale (11-point numerical) was used to calculate annoyance, meaning scores of 8 or above (8–10).

E12 Figure E4 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 4.8%–6.2% assuming a 95% confidence interval. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 59.7%–66.0% assuming a 95% confidence interval.

APPENDIX F

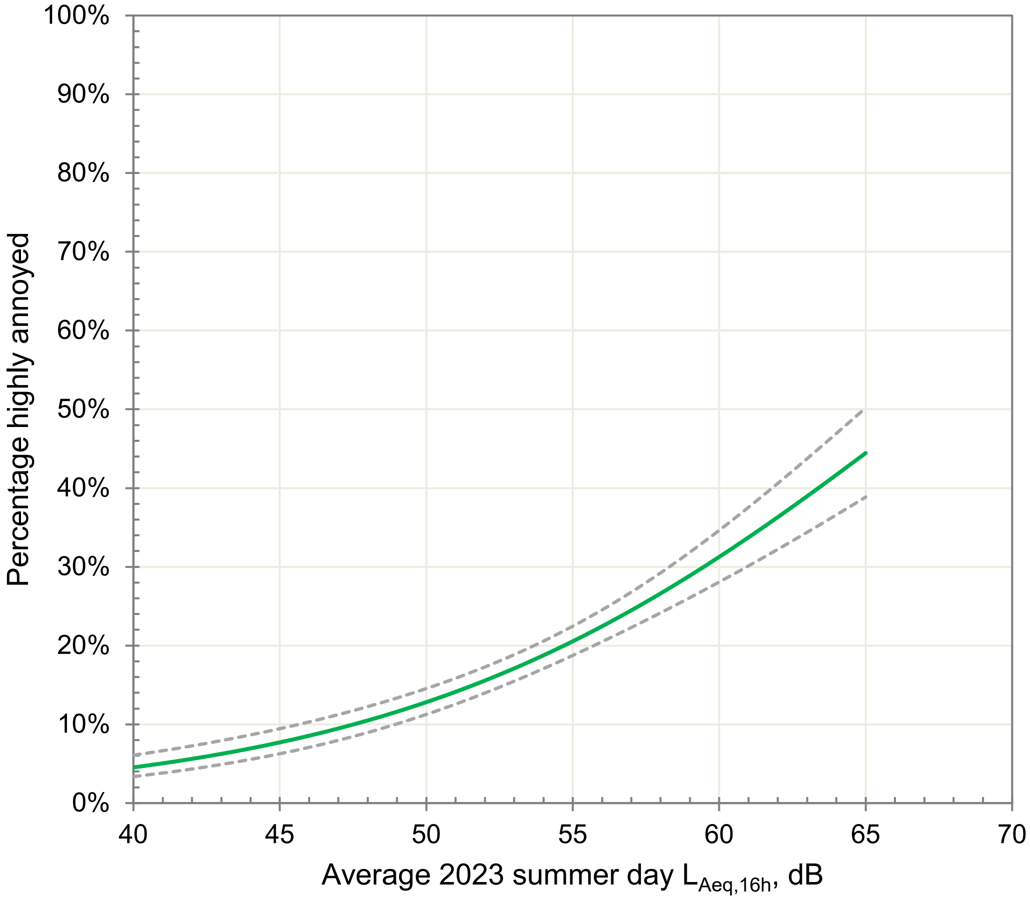
Noise attitudes by airport

F1 The following figures present the exposure–response functions between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around each surveyed airport, and the 95% confidence interval. The figures are derived from HA_N Wave 1 survey data for question Q8, which refers to annoyance during the previous three months.

F2 The figures show an exposure–response function with an S-shaped relationship. At lower exposure levels (40–45 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 2–15% depending on the airport. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 55–84%.

F3 Note that the 95% confidence at each individual airport is larger than that for all airports combined, since the survey sample size is smaller.

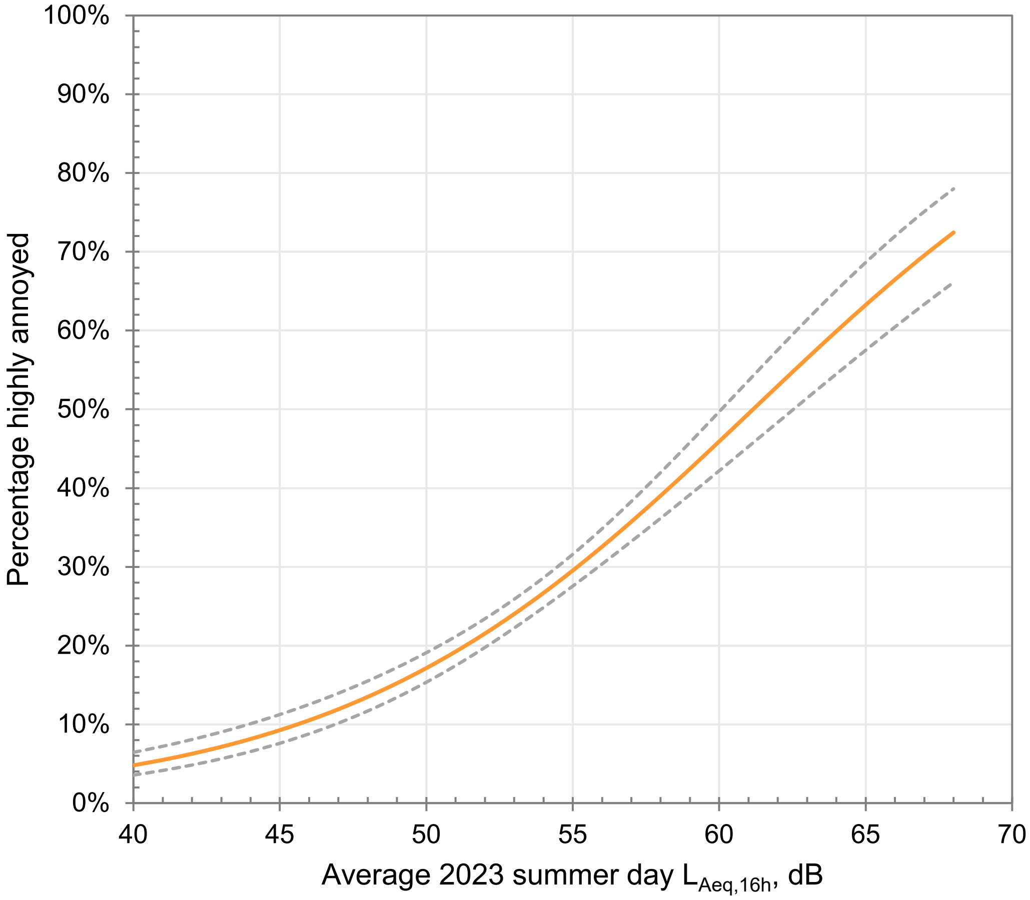
Figure F1 Exposure-response function with 95% confidence interval Birmingham, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=2,756)



F4 Figure F1 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around Birmingham Airport.

F5 Figure F1 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 3.4–6.1% assuming a 95% confidence interval. At the upper end of the exposure range (65 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 38.9–50.2% assuming a 95% confidence interval.

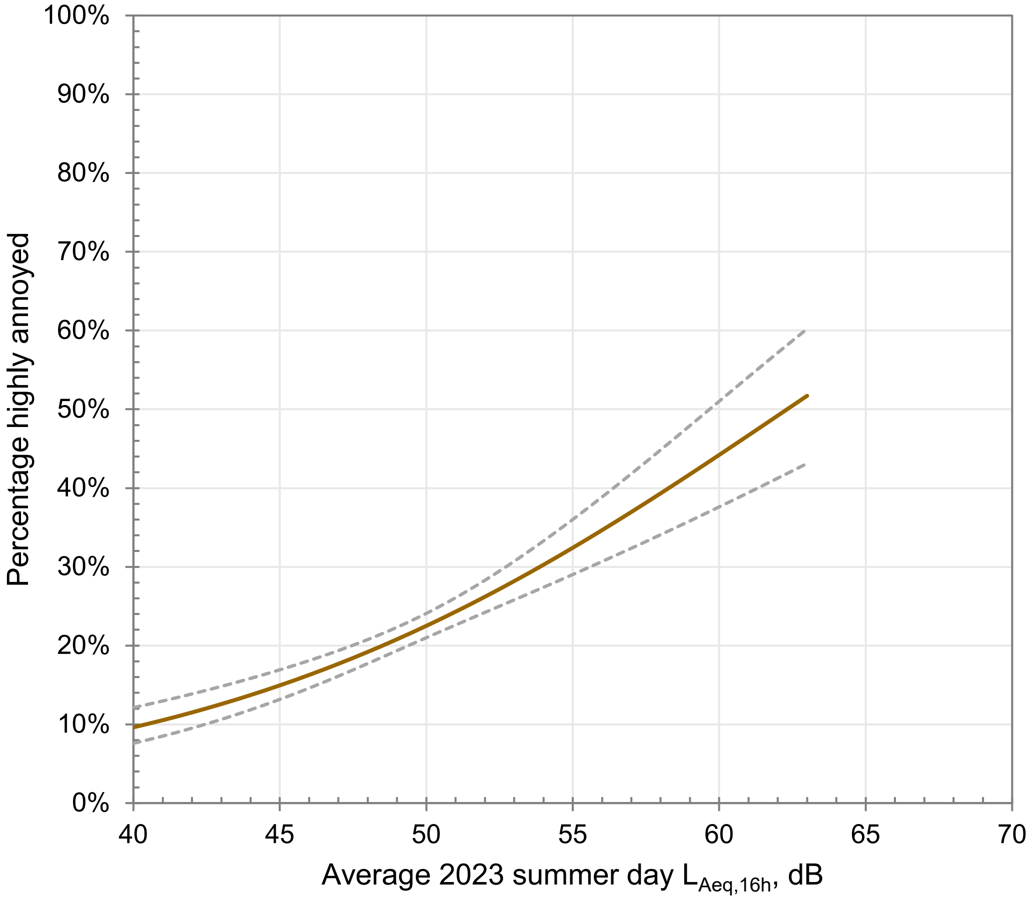
Figure F2 Exposure-response function with 95% confidence interval Edinburgh, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=3,085)



F6 Figure F2 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around Edinburgh Airport.

F7 Figure F2 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 3.6–6.4% assuming a 95% confidence interval. At the upper end of the exposure range (68 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 66.1–78.0% assuming a 95% confidence interval.

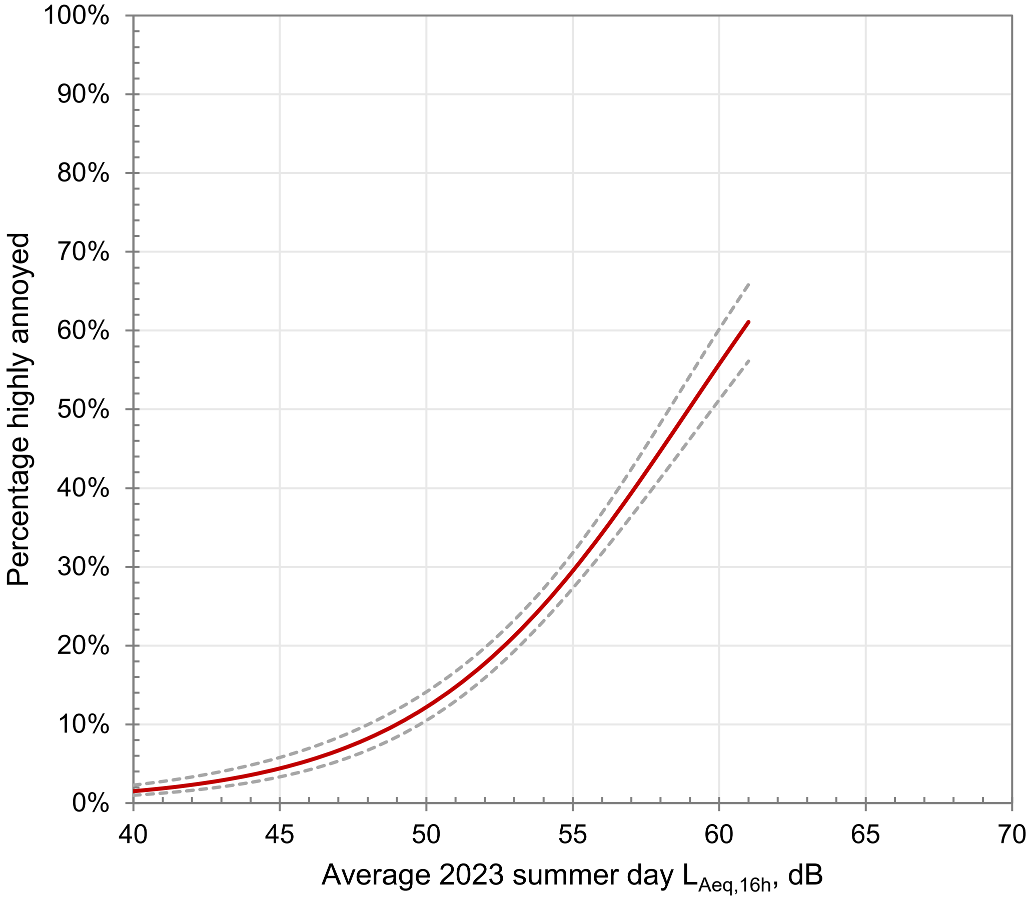
Figure F3 Exposure-response function with 95% confidence interval East Midlands, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=3,944)



F8 Figure F3 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around East Midlands Airport.

F9 Figure F3 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 7.6–12.1% assuming a 95% confidence interval. At the upper end of the exposure range (63 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 43.1–60.2% assuming a 95% confidence interval.

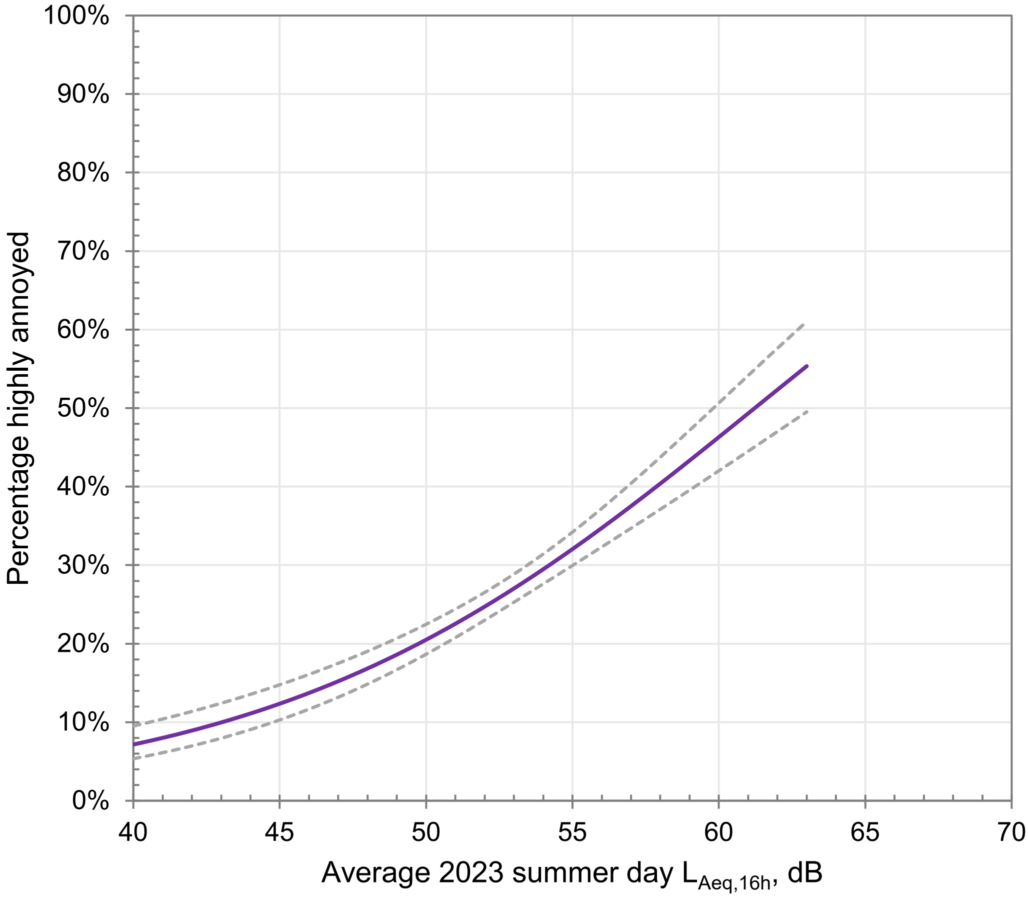
Figure F4 Exposure-response function with 95% confidence interval Glasgow, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=2,607)



F10 Figure F4 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around Glasgow Airport.

F11 Figure F4 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 1.0–2.3% assuming a 95% confidence interval. At the upper end of the exposure range (61 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 56.1–65.8% assuming a 95% confidence interval.

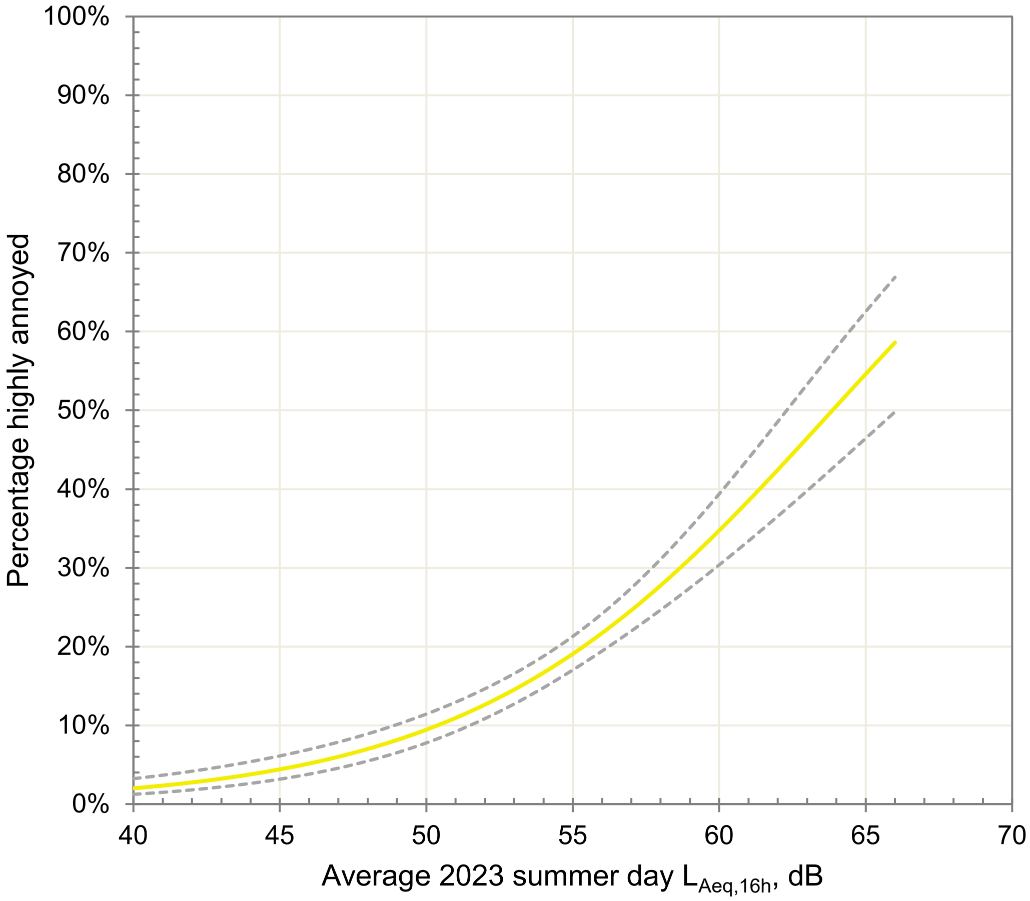
Figure F5 Exposure-response function with 95% confidence interval
Leeds Bradford, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=3,301)



F12 Figure F5 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around Leeds Bradford Airport.

F13 Figure F5 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 5.3–9.5% assuming a 95% confidence interval. At the upper end of the exposure range (63 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 49.5–61.0% assuming a 95% confidence interval.

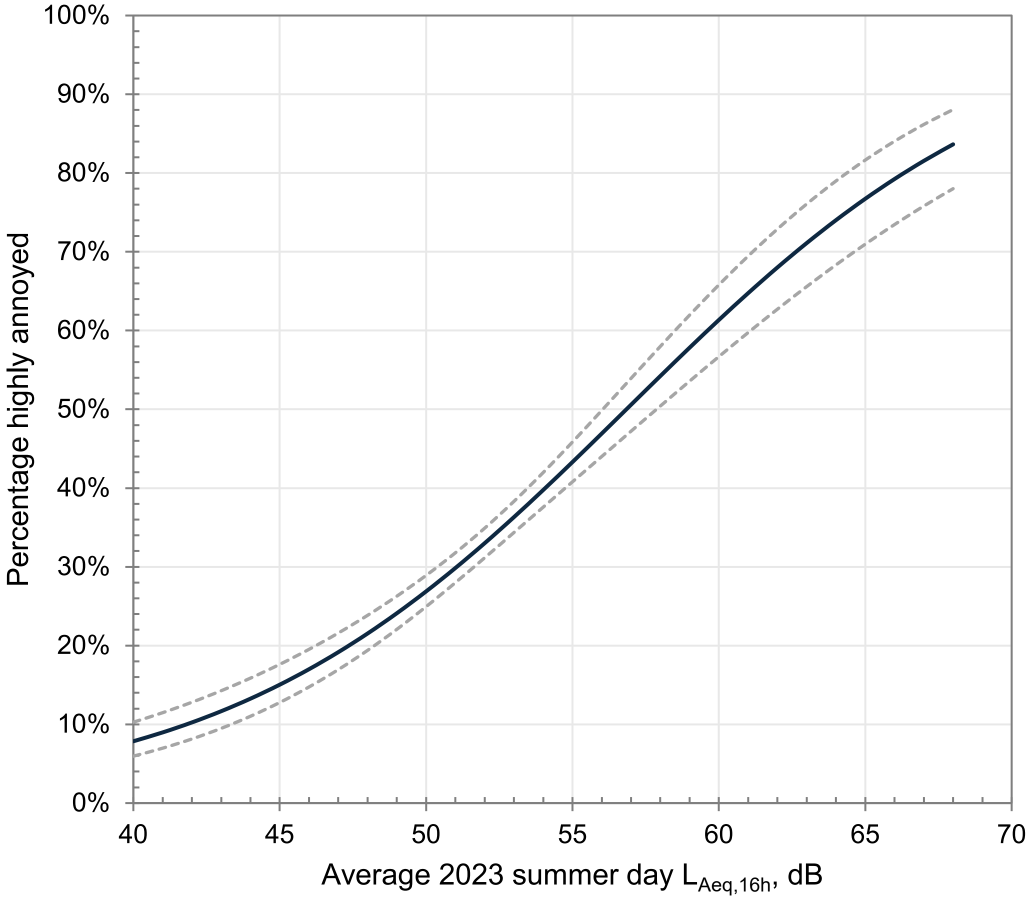
Figure F6 Exposure-response function with 95% confidence interval London City, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=2,000)



F14 Figure F6 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around London City Airport.

F15 Figure F6 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 1.2–3.2% assuming a 95% confidence interval. At the upper end of the exposure range (66 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 49.8–66.9% assuming a 95% confidence interval.

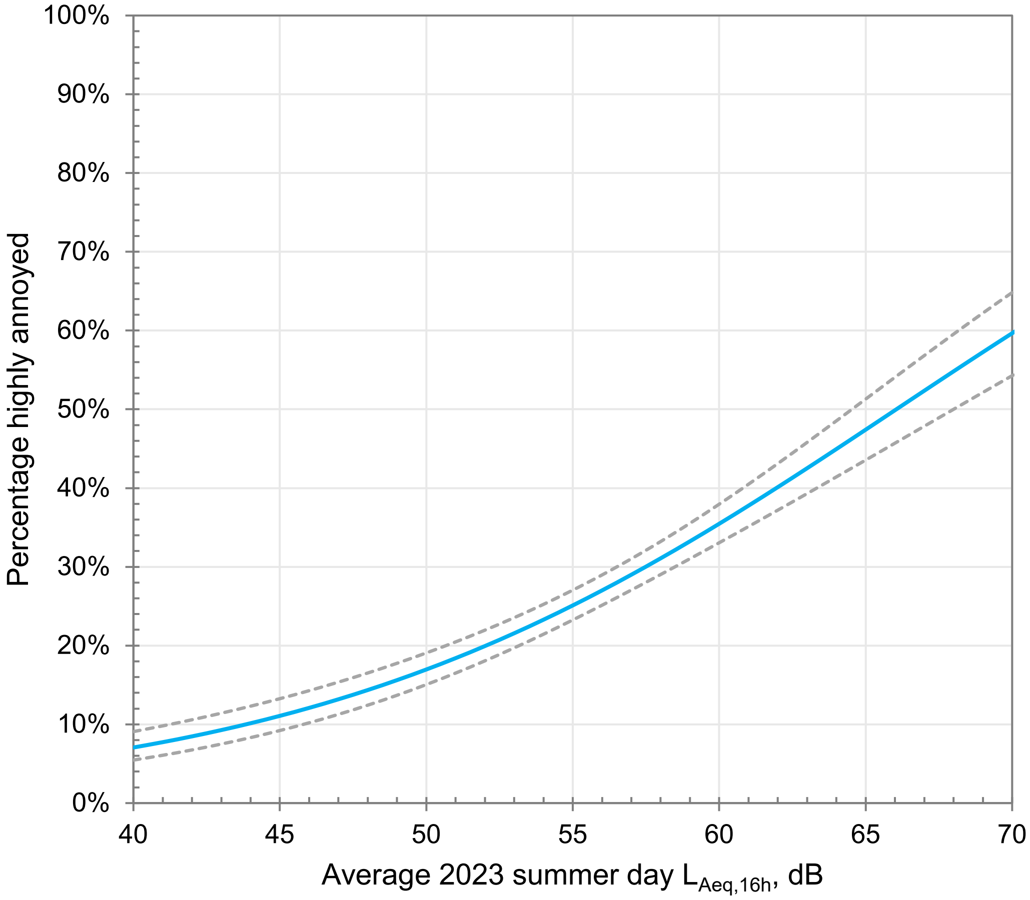
Figure F7 Exposure-response function with 95% confidence interval
London Gatwick, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=3,407)



F16 Figure F7 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around London Gatwick Airport.

F17 Figure F7 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 6.0%–10.3% assuming a 95% confidence interval. At the upper end of the exposure range (68 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 78.0–88.1% assuming a 95% confidence interval.

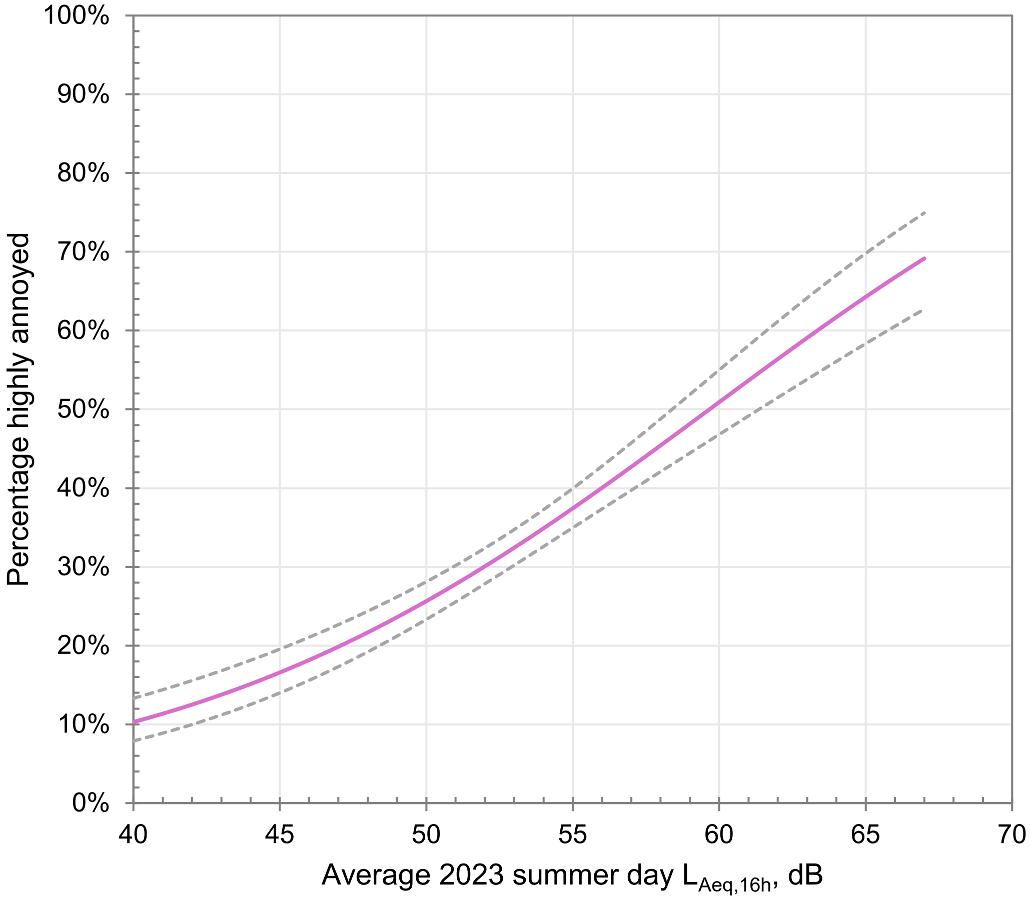
Figure F8 Exposure-response function with 95% confidence interval
London Heathrow, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=2,910)



F18 Figure F8 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around London Heathrow Airport.

F19 Figure F8 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 5.5–9.1% assuming a 95% confidence interval. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 54.3–64.8% assuming a 95% confidence interval.

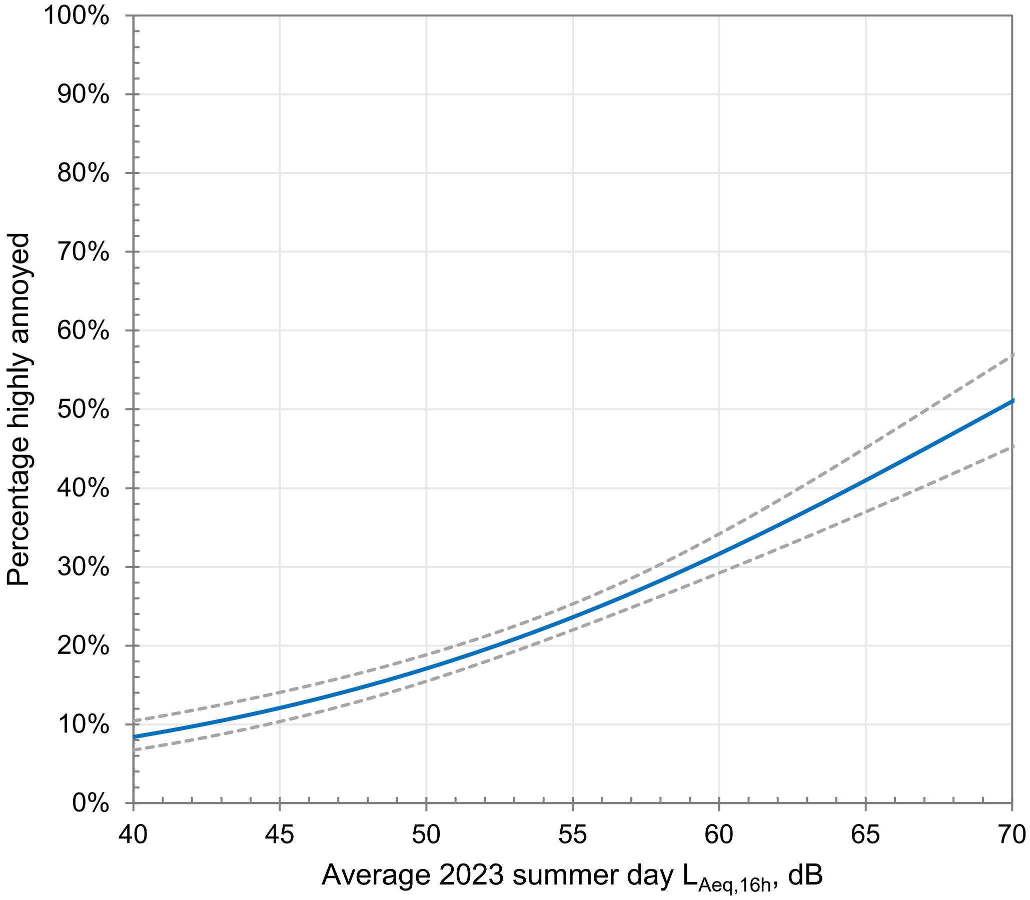
Figure F9 Exposure-response function with 95% confidence interval Luton, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=2,311)



F20 Figure F9 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around Luton Airport.

F21 Figure F9 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 7.9–13.3% assuming a 95% confidence interval. At the upper end of the exposure range (67 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 62.7–74.9% assuming a 95% confidence interval.

Figure F10 Exposure-response function with 95% confidence intervals Manchester, annoyance during the last 3 months, HA_N (Q8) Wave 1 (N=3,471)



F22 Figure F10 shows the estimated exposure–response function between aircraft noise exposure ($L_{Aeq,16h}$) and the percentage of highly annoyed respondents amongst residents around Manchester Airport.

F23 Figure F10 shows an exposure–response function with an S-shaped relationship. At the lowest exposure level (40 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 6.7–10.4% assuming a 95% confidence interval. At the upper end of the exposure range (70 dB $L_{Aeq,16h}$), the percentage of highly annoyed respondents is 45.2–56.8% assuming a 95% confidence interval.

APPENDIX G

Airport developments, consultations and trials during 2023-2024

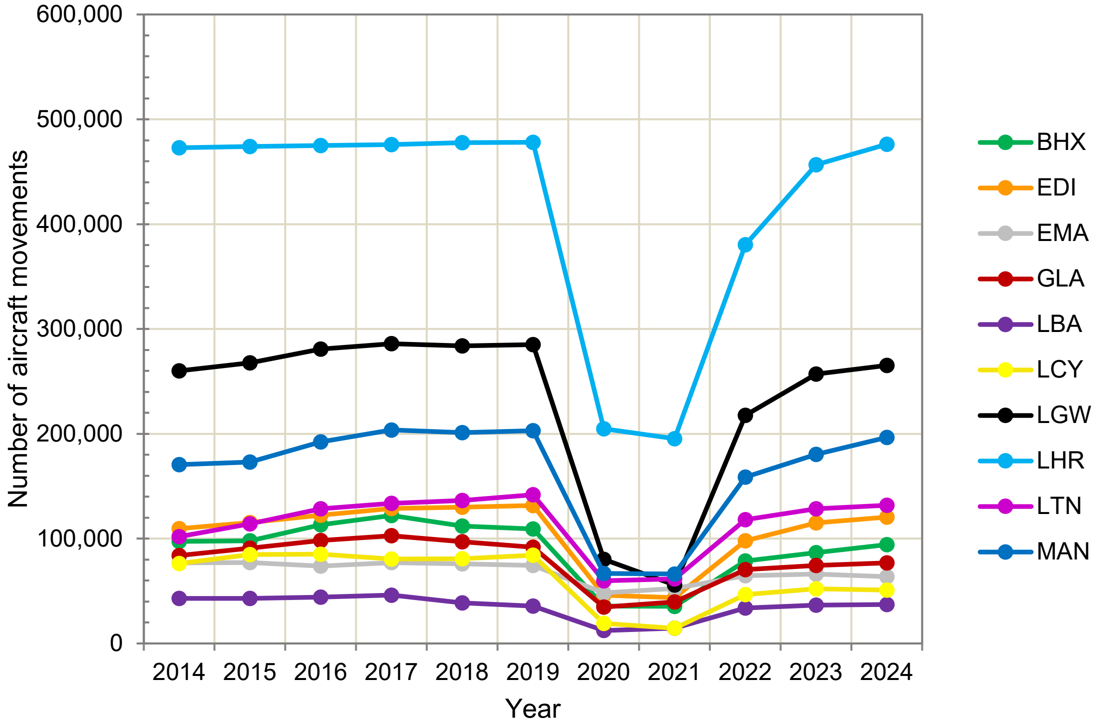
G1 This appendix summarises any relevant developments or events that took place at the surveyed airports during the period of the ANAS survey, mid-2023 to mid-2024.

G2 During this period, surveyed airports may have undertaken consultations, operational changes, airspace trials, or may have been impacted by external events resulting in changes to actual or perceived noise exposure in the surrounding area. Events such as these can influence survey responses.

COVID-19

G3 COVID-19 may have impacted this study's responses. COVID-19 lead to a significant reduction in flight movements across the entire world. Restrictions on travel in the UK and abroad resulted in a fall in demand for air travel. As a result, aviation noise near airports and under flight paths dramatically reduced. At many of the surveyed airports, air traffic had not returned to pre-COVID levels during the survey period. Furthermore, restrictions resulted in increased time spent at home and led to fundamental changes to working habits for many. Both of these impacts may have influenced responses to this study.

Figure G1 Air traffic movements 2014-2024



Individual Airports

Birmingham

G4 Birmingham Airport introduced Performance-Based Navigation (PBN), Area Navigation (RNAV), and Standard Instrument Departures (SIDs) in two stages, the first for departures to the south in relation to the runway extension, in 2016, and the second stage for SIDs to the north in 2019. Since 2019, the airspace arrangements have not changed.

G5 Birmingham Airport consulted on its draft Noise Action Plan between 19 June and 7 August 2023.

G6 On 1 April 2024, Birmingham Airport reduced the noise limit for aircraft departing at night from 83 dB to 81 dB L_{ASmax}. Aircraft that exceed this pay a surcharge that funds the Airport's Community Trust Fund.

G7 During summer 2024, Birmingham Airport was engaging with the Noise Subgroup of the Airport Consultative Committee, Ward Councillors, and the Airport's Consultative Committee, on a proposal to reduce their annual noise quota during the night-flying period from 4,000 to 2,800.

East Midlands

G8 During the research period, East Midlands Airport used conventional arrival and departure airspace procedures.

G9 East Midlands Airport consulted on its Noise Action Plan between 23 May and 31 July 2023.

G10 On 1 January 2024, East Midlands Airport introduced a ban on aircraft with a QC4 rating during night-time hours (23:00-7:00).

Edinburgh

G11 During the research period, Edinburgh Airport used conventional arrival and departure airspace procedures.

G12 During the research period, Edinburgh Airport were in Stage 2 of their ongoing Airspace Change proposal. The public and the Edinburgh Airport Noise Advisory Board (EANAB) were aware and actively participating in the process, but no public consultations were underway.

G13 Edinburgh Airport's Noise Action Plan consultation began on 11 Nov 2024, after the research period finished.

Glasgow

G14 During the research period, Glasgow Airport used conventional arrival and departure airspace procedures.

G15 During the research period, Glasgow Airport was in Stage 2 of their ongoing Airspace Change proposal and were engaging with community members about changes to routes.

G16 Glasgow Airport's Noise Action Plan consultation began on 12 Aug 2024, after the research period finished.

Leeds Bradford

G17 During the research period, Leeds Bradford Airport used conventional arrival and departure airspace procedures.

G18 Leeds Bradford Airport were granted planning permission to expand the airport terminal in 2019. The airport subsequently submitted a new application for a new terminal building and associated developments, rather than an expanded terminal building, but this was withdrawn in 2022.

G19 In June 2023, Leeds City Council found that the airport was in breach of its planning condition restricting night flights and a breach of condition notice was served by the Council on the airport. In September 2023 an Enforcement Notice was issued by Leeds City Council in relation to night flight restrictions. This was followed by the submission of several planning applications by the airport in relation to night flights and a subsequent call for evidence issued by the Council in January 2024.

G20 Leeds Bradford Airport consulted with the Airport Consultative Committee on its draft Noise Action Plan but did not undertake any wider consultation during the research period. The airport began construction of an expanded terminal building in November 2023, based on the permissions granted in 2019.

London City

G21 London City Airport has used PBN arrival and departure procedures since 2016.

G22 During the research period, London City Airport appealed their Section 73 planning application for additional Saturday afternoon operating hours and additional early morning flights. The appeal was submitted to Newham Council in August 2023[44]. From August 2023, London City, and those opposed to the appeal, were focused on gathering evidence. From 15 to 25 January 2024, a public inquiry took place. The appeal was subsequently allowed in a decision by

44 London City Airport Limited, Planning Appeal, APP/G5750/W/23/3326646, 17 August 2023.

the Secretary of State for Housing, Communities and Local Government and by the Secretary of State for Transport in August 2024[45].

London Gatwick

G23 London Gatwick Airport has used PBN RNAV departure procedures since 2013, with the exception of SID 26LAM/route 4, which was de-notified and reverted to a conventional departure route in February 2021.

G24 London Gatwick is progressing ACP-2018-86 to reintroduce an RNAV-based route to the standard instrument departures currently utilising the 26LAM/Route 4 Noise Preferential Route. Since 2023, London Gatwick has engaged with the wide range of stakeholders as part of its Stage 2 and 3 progress and is preparing a public consultation, due in early 2026, as per the CAP1616 guidelines.

G25 Under its Airspace Modernisation Programme, London Gatwick is progressing its ACP-2018-60 (FASI-South)[46] airspace change. This airspace change passed its Stage 2 in October 2023 and is awaiting formation of the UK Airspace Design Service to progress onwards, with the deployment to the south of airport being split into a separate airspace change being progressed jointly by London Gatwick and NATS (En route) plc (NERL), called London Airspace South.

G26 The London Gatwick Northern Runway Project public examination took place from February 2024 to August 2024. This was a significant public engagement as part of the Development Consent Order (DCO) process. There was also an acceptance test with local authorities between July and August 2023, Relevant Representations with interested parties from September to November 2023, and project changes consultation from December 2023 to January 2024.

G27 From April 2023 to April 2024, consideration of the proposed format for London Gatwick's Round 4 (R4) Noise Action Plan was ongoing with Gatwick's stakeholders through various engagement groups.

G28 On 23 December 2023 London Gatwick Airport began a six month Reduced Night Noise (RNN) Trial, which tested arrival airspace procedures in the hours of lowest traffic, 0130-0500, using PBN arrival 'transition' procedures during the final approach.

G29 The Rapid Exit Taxiway (RET), also known as Echo Romeo, was opened in February 2024 to enable quicker runway exists and reduce congestion. During its construction throughout 2023, the Main Runway was closed throughout the night, and the Northern Runway came into frequent use. An amendment to the Route 4/26LAM Noise Preferential Route came into effect on 1 April 2023. This

45 https://www.gov.uk/government/publications/recovered-appeal-london-city-airport-hartman-road-silvertown-london-e16-2px-ref-3326646-19-august-2024

46 https://airspacechange.caa.co.uk/PublicProposalArea?pID=54

adjusted the 3km wide corridor in the airport's Noise and Track Keeping system. It did not affect tracks over the ground, but track keeping conformance was reduced significantly, which impacted noise perception. In addition, Main Runway maintenance works frequently occur throughout the calendar year to ensure the quality of the runway for aircraft operations. This means that the Northern Runway frequently came into operation during nighttime hours.

London Heathrow

G30 During the research period, Heathrow Airport used conventional arrival and departure airspace procedures.

G31 There were several consultations at Heathrow during the research period. From 1 June until 31 October 2023, Heathrow's Council for the Independent Scrutiny of Heathrow Airport (CISHA) commissioned a consultancy to conduct an independent review of the local community's views on air quality, including perceptions of Heathrow's actions and commitments to improve air quality.

G32 Heathrow Airport's Noise Action Plan consultation ran from early June to mid-July 2023 and was final plan was published in November 2024.

G33 Heathrow Airport published documents associated with Stage 2 of its Airspace Modernisation Airspace Change Proposal. In October 2023 the CAA announced that the airport had not passed the Stage 2 Gateway.

Luton

G34 During the research period, Luton Airport used a mixture of conventional and PBN RNAV departure routes, the latter having been introduced in 2015.

G35 NATS, on behalf of Luton and Stansted Airports, implemented the Swanwick Airspace Improvement Programme - Airspace Deployment 6 (SAIP AD6)[47] airspace change in February 2022. While this happened prior to the ANAS study period, this could have influenced the surveyed population's noise attitudes due to the ongoing Post Implementation Review (PIR) process, which ended in September 2023.

G36 Luton Airport's Noise Action Plan consultation ran from 10 May to 21 June 2023.

G37 Between August 2023 and February 2024, the Development Consent Order (DCO) public examination took place. The examining authority formally recommended refusal on 10 May 2024.

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[47] https://airspacechange.caa.co.uk/PublicProposalArea?pID=51

Manchester

G38 During the research period, Manchester Airport used conventional arrival and departure airspace procedures.

G39 Manchester Airport Noise Action Plan consultation began on 5 July 2024, after the research period finished.