Individuals' interpretation of Air Quality Information

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Individuals' interpretation of air quality information: customer insight and awareness study.

Executive Summary

Air pollution is increasingly recognised as a trigger for the exacerbation of cardiovascular and respiratory conditions (*e.g.* asthma, chronic obstructive pulmonary disease (COPD) and heart attacks). Exposure to air pollution constitutes a significant risk for susceptible groups within the UK population (*i.e*. those with pre-existing cardio-respiratory conditions, the young and the elderly) (Bellamy and Harris, 2005, Holgate and Polosa 2006). In addition, non-susceptible active members of the population may also be affected by pollution at higher concentrations (COMEAP 2009, WHO 2006). The UK is unlikely to achieve the European Union air quality standard for oxides of nitrogen (NO_x) by the target date (EEA 2009). This combined with the fact that, for some pollutants, there is no safe level, the provision of accurate and understandable information concerning the spatial and temporal distribution of air pollution at a local scale, is necessary to allow individuals behavioural choices.

Studies have shown that there is a lack of awareness amongst the general public regarding the links between air pollution and ill health (Bickerstaff and Walker 2001, Wakefield *et al.,* 2001) and that individuals with medical conditions are unsure of how to access such information and what it actually means for their health (Bickerstaff *et al 2001;* Howell *et al.,* 2003). There is also an issue of whether the existing provision of air quality information is accessible and understandable to the general public (Shooter and Brimblecoombe 2008, Bickerstaff *et al.,* 2001*)*. This research therefore examined the public awareness and comprehension of air quality information, and it assessed the opportunities and challenges to the general public of understanding and interpreting such material.

A mixed methods approach was chosen for this study. An in-depth exploration of the key issues used focus groups and small group workshops whilst a quantitative online questionnaire was employed to gather a broad spectrum of views. Focus group participants were selected to ensure a balance of gender, ethnicity, health status and age, while workshop participants were selected by age and cardio-respiratory condition. A sampling frame for the online survey was not possible owing to the short time frame of this research. The findings presented in this report should therefore be viewed with caution, however, as they are not representative of the UK population as a whole, are taken from a small sample size and have a higher percentage of participants with respiratory illnesses (due to recruitment criteria) than would be found in the general public.

Air Quality Awareness: In terms of awareness, respondents appeared informed about the main sources of air pollution in urban areas and identified traffic as the main source of air pollution. There was limited awareness of rural pollutants and worryingly, those with (and without) respiratory illnesses, perceived the countryside as a place to 'escape' from air pollution, in other words a 'safe space'. Participants in this research were also unaware of the connection between climate change and air pollution.

Research suggests that understanding of the causes of climate change motivates the public to reduce their impact on the environment (Bord *et al.,* 2000). Consequently, increasing awareness of the causes of air pollution and its effect on health and the environment may encourage people to change their behaviour and take effective action to reduce air pollution, thus simultaneously reducing activities causing climate change. Finally, awareness of the effect on air pollution health was higher in those with a health condition than those without, but overall participants were aware of the

effect of air pollution on the young, those with respiratory conditions and the older population. The only exception to this was in relation to participants' awareness of the effect of air quality on those with heart conditions, where knowledge was generally low.

Needs and requirements for air quality information: This research has indicated that there is a lack of awareness of the existence of an air quality index (AQI) amongst participants both with and without a health condition. Any revision to that index, it is suggested, should take into account the information requirements identified by participants in this research. Such requirements include the need for the AQI to include information on the level and spatial distribution of air pollution, accompanied by pertinent advice on symptom exacerbation and suggestions for mitigation for both sensitive and non-sensitive groups. The study showed that participants preferred advice to be focused, concise and jargon free, but without being vague.

Expansion of the number of bands used in the AQI was requested to allow greater gradation in the reported level of air pollution and to allow participants to better judge at which level of air pollution their health became affected. A greater spectrum of levels would also remove the frustration of having a wide 'moderate' band, and therefore the perception that air quality either does not vary, or that the system is too crude to identify such variation.

Air quality information sources: The research indicated that the preferred method of communicating air quality information was *via* daily (and 5-day) forecasts reported on the television. Information should only be issued however, when air pollution constituted a risk to health.

Over half of participants with a health condition reported that they would change their behaviour as a result of receiving information on air pollution. This compared to only a fifth of those without a health condition who would make the same behavioural change and is comparable to the findings of Wen *et al.,* (2009). Actions that participants stated that they would perform in order to change their behaviour included increasing their preparedness (by keeping preventative medications nearby) and reducing their exposure (by avoiding perceived polluted locations, staying indoors more).

Recommendations: Based on the findings of this research, it is recommended that the provision of air quality index information (AQI) is accompanied by a simple explanation of the data generation and validation process, plus an assessment of the independence, or otherwise, of the agencies supplying the data. Further recommendations for improving the current provision of AQI information include providing information *via* a more graduated scale (i.e. using the existing 10-point scale, rather than the more commonly reported 4 bands) on the level and location of pollution; and ensuring that the accompanying advice is clear and concise, jargon free, detailed and informative, easy to understand, provides clear advice on health and exposure reduction actions and avoids 'fear' generation or 'scaremongering'.

The provision of such information, accompanied by focused, relevant advice for sensitive, and non-sensitive groups on actions that can be taken to mitigate both exposure and cardiorespiratory symptoms, would reduce feelings of fatalism and anxiety about an issue the participants felt they can do little about. Such information may empower both those with a relevant health condition, and healthy individuals to take control of their exposure. Furthermore, it may thus engender behavioural changes in the population and potentially reduce primary care costs due to fewer exacerbations and improve peoples' sense of wellbeing and overall quality of life.

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1: Introduction

Globally, air pollution is increasingly recognised as a trigger for the exacerbation of cardiovascular and respiratory conditions (*e.g.* asthma, chronic obstructive pulmonary disease (COPD) and heart attacks), (Bellamy and Harris 2005, Holgate and Polosa 2006, Niedell and Kinney 2008, Grineski *et al.,* 2010, Silverman and Ito, 2010). For example, 75,000 emergency department admissions (UK and Republic of Ireland) and 1,300 deaths in the UK were attributed to asthma exacerbated by air pollution in 2008 (Braganza and Thomson 2009). It has been suggested that 5% of all UK emergency department admissions for asthma could be avoided if the annual mean air quality standard for particulate matter[1] less than 10 microns in size (PM_{10}) was achieved (Mindel and Joffe 2004).

Air pollution, in the short to medium term, is unlikely to be reduced below levels at which susceptible individuals will be affected. Indeed, the UK did not achieve the European Union air quality standard for nitrogen dioxide (NO_2) by the target date (EEA 2009). Furthermore, for a number of pollutants it is doubtful that there is a 'safe' limit and therefore, it is necessary to develop an air quality index which can be used by both susceptible and non-susceptible people to reduce their exposure to air pollution.

The provision of accurate and understandable information concerning the spatial and temporal distribution of air pollution at a local scale, will allow people to make behavioural choices. Currently there are 245 local authorities (AEA 2010) in the UK that have declared areas where they will not achieve, or are not achieving the national air quality standards. Furthermore, the spatio-temporal nature of air pollution and the proximity of emission sources to receptors (people) means that personal exposure to air pollution will vary within and between urban areas (Cyrys *et al.,* 2008, Ashmore and Dimitroulopoulou 2009, Putaud *et al.,* 2010).

Exposure to air pollution, therefore, constitutes a significant risk for susceptible groups within the UK population (*i.e*. those with pre-existing cardio-respiratory conditions, the young and the elderly) (Bellamy and Harris, 2005, Holgate and Polosa 2006). In addition, non-susceptible active members of the population may also be affected by pollution at higher concentrations (WHO 2006, COMEAP 2009).

A number of studies have shown that there is a lack of awareness amongst the non-scientific community regarding the links between air pollution and ill health (Bickerstaff and Walker 2001, Brody, *et al.,* 2004, Wakefield *et al.,* 2001). This lack of awareness is variable by socio-economic grouping, with those living in more polluted areas less aware of the risk of air pollution exposure (Howell *et al.,* 2003, Hussein and Partridge 2002).

Furthermore, research suggests that individuals with medical conditions that may be exacerbated by air pollution, such as asthma and COPD, are unsure of how to access relevant information and what it actually means for their health (Bickerstaff *et al 2001;* Howell *et al.,* 2003). There is also the issue of whether the existing provision of air quality information is accessible and understandable to the general

[1] Particulate matter (PM) is derived from tiny particles in the atmosphere and is often referred to by size (*e.g.* PM_{10} is particulate matter less than 10 microns in diameter). Sources of such particles vary; some are natural in origin such as sea salt or windblown dust for example, while others are derived from human activities such as burning fossil fuels etc. More information on particulate matter can be found at www.airquality.co.uk.

public (Shooter and Brimblecoombe 2008, Bickerstaff *et al* 2001*)*. Research undertaken in London and the South East examining the direct delivery of air quality forecasts to the public *via* their landline phones and mobiles, using the current air quality 'traffic light' index, corroborates these findings (Smallbone 2009). The extract below is typical of the view of the current system.

"You get a message saying 'moderate air pollution' and you don't know what it means, so you just ignore it" (Male COPD).

A number of researchers have drawn attention to the usefulness of air quality alerting systems in increasing awareness of air pollution amongst the general population (Neidell and Kinney 2010, Semenza *et al.,* 2008). Research from America by Wen *et al.,* (2009) went further by suggesting that such information was responsible for changing the response of people with lifetime asthma to air pollution alerts.

Similar systems already exist for the UV (sunburn) index and the extreme heat index. These have been shown to be effective at reducing exposure (Sheridan 2007, Semenza *et al*., 2008). Air quality, however, is less readily understandable to the general public (Cole *et al,*. 1999). Unlike temperature, which everyone is familiar with, factors such as variations in monitoring methods, averaging times, permissible concentrations between pollutants, make delivering an air quality index that is clear, accessible and understandable, a considerable challenge.

1.2: Aim

The principal aim of the current study is to examine the public awareness and comprehension of air quality information, and to assess the opportunities and challenges to understanding and interpreting such material. This aim will be achieved by exploring:

- The population's current perception of air quality,
- current understanding and methods of accessing advice,
- how the current air pollution index is interpreted and,
- which methods of communication would be most easily understood.

Such work is key in determining the usefulness of the current air quality index and in providing recommendations for improvements. In addition, this research project will also compare the effectiveness of different forms of participatory methods. The research methodology for this project is specified in Section 2.

1.3: Report Structure

The report is divided into a number of sections, with the later sections focusing on a particular theme.

- Section 2 provides a brief overview of the projects methodology.
- Section 3 describes the demographics and health status of the research participants by data collection method.
- Section 4 explores current awareness and understanding of air quality and health.
- Section 5 examines the needs and requirements of air quality information.
- Section 6 investigates current and preferred methods of information delivery, and the issue of trust in information providers.
- Section 7 provides a brief conclusion and key recommendations.

2: Methodology

A mixed methods approach was employed within this research project, involving both qualitative and quantitative techniques. Qualitative techniques included small group workshops and focus groups, both of which allowed an in-depth exploration of the key issues; while a quantitative online questionnaire was employed to gather a broad spectrum of views. The aim of this research was to obtain the views of those who are most likely to find air quality information useful (those with cardio-respiratory illnesses), alongside the views of the general public. It should be noted however, that given the methods used to acquire the data, and the small sample sizes in each of the methodological techniques, the data that appears in this report might not be representative of the views of the general public.

Key themes investigated include:

- Current environmental and air quality awareness.
- Perceived indicators of air quality and health effects.
- Current understanding and awareness of air quality indicators.
- Needs and requirements of air quality information.
- Trust, responsibilities and influence.

It is usual research practise to use a staggered methodological timeframe to allow issues and themes identified in preliminary work to be incorporated and explored in detail in later work. Given the time scale of this project, however, the focus groups, workshops and the online questionnaire ran concurrently.

Quantitative data was analysed for descriptive statistics using SPSS statistical analysis package (version 16.0). The qualitative data was transcribed and coded using a combination of discourse and content analysis in accordance with standard methodological procedure. When reporting results from the focus groups and small group workshops, the gender, age and health condition of the participant is reported to enable the reader to judge the characteristics of the respondent.

2.1: Research ethics

The operation of the focus groups / small group meetings and the data collection / interpretation of the online questionnaires, was undertaken in accordance with the University of Brighton's code of conduct for research and ethics. Informed consent was obtained from all participants/guardians in the focus groups/workshops, and all questionnaires were anonymous. Any names that appear in quotes were changed to protect the identity of the participants.

2.2: Online questionnaires

An online questionnaire was created using the live web tool, 'Survey Monkey '(www.surveymonkey.com), which contained both closed and open-ended questions. An electronic copy of the questionnaire can be supplied on request. It was piloted and then opened for online data collection for a period of four weeks. A total of 411 questionnaire responses were received, although not every respondent completed

every question. Response rates ranged from 259 to 411, depending on the number of respondents and the sub-grouping within those questions. For example, some questions were aimed only at those with respiratory illnesses and therefore will have excluded a proportion of respondents, hence a lower response rate to these questions was observed.

A combination of email and web-based 'e-snowball'[2] sampling was used to avoid the perception that the email was 'spam' and to prevent physical, psychological, interactional and privacy violations common to web-based surveys. This was in accordance with the methodology of Andrews *et al.,* (2003). The disadvantages of taking such an approach was, however, in developing the initial contacts, the time consuming nature of the work and the lack of representativeness of the general public (for example, the survey results will not reflect the views of those without access to a computer/internet.

Ideally it was hoped that the online sample would reflect the views of the general public with access to a computer. Owing to the limited time frame of the project, however, it was not possible to apply a sampling methodology to the online survey data that would allow the online profile to replicate the general public (*e.g*. random sampling of every *nth* respondent). In addition it was not possible to translate the questionnaire in to other languages and thus increase accessibility of the survey to those for whom English was not their first language.

2.3: Small group workshops

The aim of the small group workshops was to ensure that it was possible to access the views of those population groups deemed 'hard to reach'. In particular, the views of older people with respiratory/cardiovascular illnesses and children (both with and without respiratory illnesses) were required. Consequently, two small group workshops were held, one with school children aged 9 – 11, (ten children) and one with older people with cardio-respiratory illnesses (twelve adults).

These age groups were specifically chosen for this method, as they are otherwise difficult to access *via* online surveys or focus groups. Furthermore, it is difficult to access the views of people with relatively severe respiratory conditions using traditional participatory methods owing to their disability. Consequently, the small group workshops ensured that these difficult to access groups were considered in the research, thus increasing the representativeness of the data.

Small group workshops were held in Luton, for the older group, and Sussex, for the younger group. Attendance was between ten and twelve participants per workshop. Participants were recruited by snowball sampling. Similar in format to the focus groups, small group workshops had the added advantage that the participants were familiar with the facilitation space and each other, and thus allowed for an in-depth exchange of information in a non-threatening environment, which was considered important for these age groups. The aim of the small group workshop was therefore to undertake a more in-depth micro-exploration of perceptions and attitudes towards air quality and air quality information, which would hopefully lead to a greater understanding of the meaning and context of behaviour amongst these age/health groups.

[2] Snowball sampling is a technique used in the social sciences whereby research participants are recruited *via* social networks. In the case of e-snowball sampling, the web-link to the online survey was sent to community leaders, interest group leaders *etc* who were asked to distribute the web-link amongst their networks.

2.4: Focus groups

Five focus groups, comprising of 36 people, were held in total, three in the daytime and two in the evening to ensure a cross-section of society attended. The aim of these focus groups was to ensure that the view of those with and those without respiratory conditions were obtained and that the make-up of the participants matched the general population in terms of ethnicity, age and gender. It should be noted, however, that the views of the focus groups cannot necessarily be considered representative of the general public due to their small sample size.

Focus group were held at locations in London, Leicester and Nottingham and all venues had disabled access. The range of locations was to ensure that the data did not have a London-centric bias and that an ethic mix was achieved. The locations in the Midlands were also chosen to ensure that participants were not aware of any direct-delivery air quality information services such as airTEXT, a London-based service, or airAlert, a similar service based in Sussex, Bedfordshire and Hertfordshire. Each focus group had between six and seven participants, recruited from the range of demographic, socio-economic, cultural and ethnic backgrounds using recruitment agencies. The only exception was the London focus group that had mainly white participants. All groups had a good age range with participants ranging from 18 to over 65 years of age. All participants were screened in accordance with industry standards to ensure that they had not previously taken part in a focus group in the last 6 months and had not taken part in more than four focus group / workshops in their lifetime. Consequently, it is possible to be confident that the findings from these groups are representative of the attitudes and behavioural positions of the wider general public, although they only represent a small sample size and caution must be exercised in interpreting the results. Initially it was hoped to hold separate focus groups for those with and those without respiratory illnesses. Owing to difficulties in recruiting sensitive participants from the younger age group within the timescale of the project, it was decided to hold mixed groups. A good level of insight was forthcoming from the groups of mixed sensitivities. All groups had a diversity of attitudinal and behavioural positions, which made for insightful and interesting results.

2.5: Perceptions of air quality indices

An innovative aspect of this research was the exploration of participants' perceptions of existing air quality indices. This was undertaken in order to develop recommendations for the provision of relevant, easy to understand air quality information and focused activity advice.

Air quality indices should provide clear, focused and relevant information on the level of air quality, the effects of pollution on health and suggestions for controlling symptom exacerbations and exposure reduction. A number of researchers have noted that there is no standardised approach to providing air quality information across Europe, or indeed the globe (Cairncross *et al.,* 2007, de Leeuw and Mol 2005, Kyrkilis *et al.,* 2007, Mayer *et al.,* 200, Shooter and Brimblecoombe 2008, van den Elshout *et al.,* 2008).

Most current air quality indices provide both a 'value' and a 'named band', however the format and presentation of both the value and the band name vary considerably from country to country (see Table 2.1). The USA system uses a maximum index

value of 500, while the Australia air quality index (AQI) only goes up to 200. Canada, Ireland, and Germany all use an index value of 100. *Citeair*, an EU funded project, attempted to develop a common air quality index for Europe, but as yet it has not been adopted by any country and does not provide any health advice. It used a maximum index value of 100+, while France, Belgium and the UK all use a less complex 10-point system.

Table 2.1 Variation in air quality index values by country

Country	Index Value	Named bandings	Pollutants[3]
Australia*	200	6	CO, NO_2 O_3, PM_{10}, SO_2
Belgium**	10	10	NO_2 O_3, PM_{10}, SO_2,
Canada	100	10 (4 named)	CO, NO_2 O_3, PM_{10}, SO_2,
Citeair	100	5	CO, NO_2 O_3, PM_{10}, SO_2,
France	10	6	NO_2 O_3, PM_{10}, SO_2,
Germany	100	6	CO, NO_2 O_3, PM_{10}, SO_2,
Ireland	100	5	NO_2 O_3, PM_{10}, SO_2,
UK	10	4	CO, NO_2 O_3, PM_{10}, SO_2,
USA	500	6	CO, NO_2 O_3, $PM_{2.5}$, PM_{10}, SO_2

* *provides health advice by pollutant.*

** *compute both a general AP index covering the region and an urban AP index which deals with the urban centres of the major cities.*

In order to provide easy to understand information to the general public, each country has divided their numerical index into bands. The bands are then subdivided to indicate the level of air pollution. The number of divisions in the bands varies by country, from four (*e.g*. UK) up to ten (*e.g.* Belgium) as shown in Table 2.2. Each band has words associated with it, which imply either the quality of the air, the level of air pollution or the level of risk to human health.

There is an important balance to be struck between the complication that results from too many bands, and the loss of information by using bands which are too restricted (Cole *et al*., 1999, Shooter and Brimblecoombe 2008). For example, the UK uses a 10 point index, but the data is usually presented as a 4 point banding system, thus much of the detail is lost.

The research participants' perceptions of representative indices were explored using all participatory methods. Only four air quality indices were chosen for use within the online survey, in order to ensure respondents to the survey did not loose interest. Within the workshops and focus groups, an additional index (from Australia) was used as it provided separate advice for sensitive and non-sensitive groups by pollutant, but this was considered rather too complex for use in the online survey. The indices chosen for use in this research were;

[3] *CO - carbon monoxide, O_3 – ozone, NO_2 - nitrogen dioxide, SO_2 – sulphur dioxide, PM_{10} – particulate matter less than 10 microns.*

- France (scale/bandings only)
- UK
- Canada
- USA
- Australia (for focus groups and workshops only).

These countries AQI's were specifically chosen as they provided a representative selection of the range of available air quality indices. They included a range of bandings (4 to 10), a wide span of index values (10 to 500) and a mix of health advice (simple to complex; combined *versus* separate advice for 'at-risk' and non 'at-risk' groups; combined and separate health advice by pollutant). Due to the difficulties of translation, the French health advice was excluded from the research. Participants were shown the health advice from the four remaining countries. The scale/bandings and descriptive words used to describe the different levels of air quality from all five countries are shown in Appendix A.

Table 2.2 Variation in air quality banding descriptors by country

Country	AQI banding description									
Australia	Very good	Good	Fair	Poor	Very poor	Hazardous				
Belgium	Excellent	Very good	Good	Fairly Good	Moderate	Poor	Very poor	Bad	Very bad	Horrible
Canada	Low health risk	Moderate health risk	High health Risk	Very high Health risk						
Citeair	Vey low	Low	Medium	High	Very high					
France	Very good	Good	Average	Mediocre	Bad	Very bad				
Germany	Very good	Good	Satisfactory	Sufficient	Bad	Very bad				
Ireland	Very good	Good	Fair	Poor	Very poor					
UK	Low	Moderate	High	Very High						
USA	Good	Moderate	Unhealthy for Sensitive groups	Unhealthy	Very unhealthy	Hazardous				

3: Setting the context - demographics & health status

The following section details the research participant demographics and their current health status. These data are necessary to set the context of the research findings and identify any inherent bias in the results.

In order to reduce the effect of potential bias, people were asked if they worked in either the air quality sector or the health profession linked to respiratory or cardio-vascular health. 24 out of 411 questionnaire respondents (6%) stated that they worked in the air quality sector, while only 3 out of 411 respondents (1%) worked in the respiratory/cardio-vascular heath profession. Within the focus groups and older group workshop, no one worked / had worked for either profession.

An additional factor that may have introduced bias into the questionnaire findings was participation in direct delivery of air quality information systems, such as airAlert and airTEXT. These deliver air quality forecasts to individuals via home or mobile telephones, or by e-mail. Registration on such a service may, therefore, potentially have increased a persons' understanding of air quality issues and indices. Consequently, the number of research participants registered on such a system was investigated.

Of the questionnaire respondents, only 24 (n=402) people (6%) were registered on either system. No one in the focus groups participated in these services, and only three people in the small group workshop held in Luton, were registered with airAlert. Consequently, given the low number of respondents in each of these categories, registration on airALERT or airTEXT was considered unlikely to influence the results. Where relevant, the respondents with a link to the subjects of air quality and health, or users of airTEXT/airAlert were excluded from the analysis. The following section examines the demographics of the respondents (both from the questionnaires and the small group workshops/focus groups) and sets them in the wider context of the general population.

3.1 Demographics

3.1.1 Age & gender

Questionnaires: Of the questionnaire participants, those aged 24 or under (8% n= 31/396) and those in the 65 or over age group were poorly represented (7%, n= 27/396) in the survey. The low number of those over 65 completing the survey may be due to this age groups lack of access to the internet or, as with the younger group, it may illustrate the difficulty in accessing these specific age groups through web-based community sites. The remaining age categories all had a similar number of respondents. In comparison to the age distribution of the general public of England, those aged between 25 and 64 were well represented in the online survey (see Figure 3.1).

Examination of the questionnaires by gender indicated that there was a §significant female bias, as almost two thirds of responses (62%, n=244/396) were from women (t =24.9, p<0.0). This gave a male to female ratio of 0.62 compared to the UK average of 0.95 (ONS 2010).

Focus Groups: Participants in the focus groups were evenly distributed across the age groups, as this was a specification of recruitment. The only exception was in the 24 or under age group who were under represented. Owing to ethical considerations, only those aged 18 or over were recruited to a focus group. In terms of gender, nineteen men and seventeen women were recruited to participate in this stage of the research project. Each group had a relatively equal gender balance.

Small group workshops: For the workshops, age was a criterion of the recruitment process and therefore all participants were aged between 9 and 11 for the children and were over 55 for the vulnerable older peoples group, with the majority over 60. Again there was a gender balance in each of these groups.

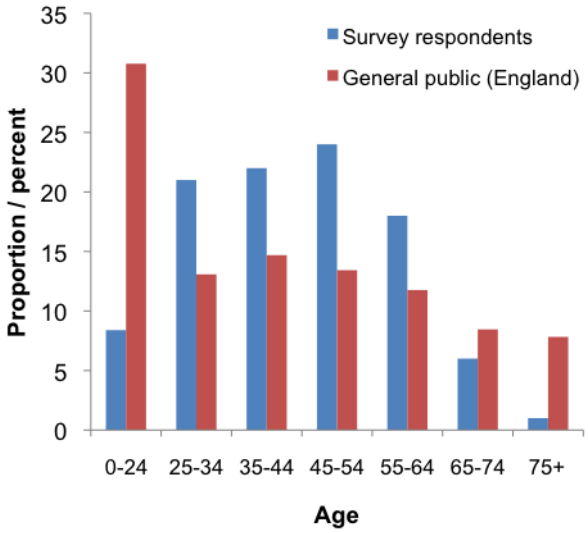

Figure 3.1 Age of questionnaire respondents

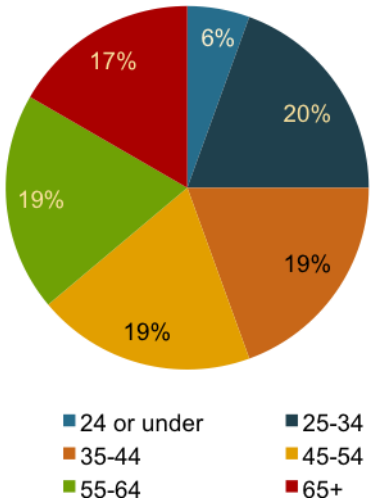

Figure 3.2 Age of focus group participants

3.1.2 Ethnicity

Questionnaires: The questionnaire responses were dominated by participants who classed themselves as white or white British (92%, n=349/381) (see Figure 3.3). This is comparable to the UK national population where 92% were classed as white or white British (according to the 2001 Census). The Asian population and those classing themselves as black/black British, however, were under represented in the online survey (1% compared to the UK population of 4% and 1% compared to the UK population of 2% respectively). Consequently, the data from the survey is not necessarily representative of the UK population.

One of the aims of the focus groups was to obtain the views of those from an ethnic background, as according to Hussein and Partridge (2002) this group is often overlooked and has difficulty accessing health information. The focus groups had a greater ethnic make-up than the questionnaire responses, but were also dominated by people of a white or white British ethnic origin (see Figure 3.4). The workshops were 100% white / white British.

Overall, the questionnaire responses were not considered as representative of UK ethnic groupings (ONS 2010), whilst the focus groups deliberately contained a higher number of participants from an ethnic background compared to the UK population to ensure that the attitudinal and behavioural aspects of this group was considered.

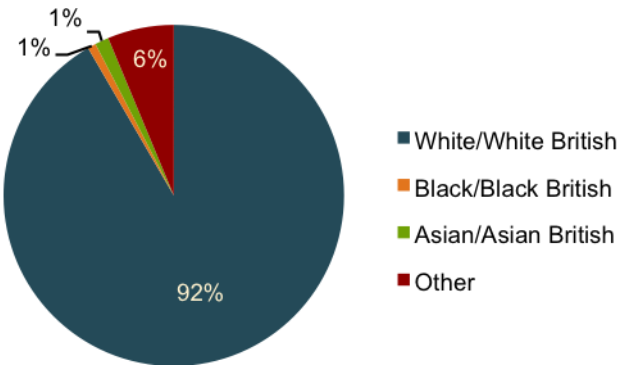

Figure 3.3 Ethnicity of questionnaire respondents

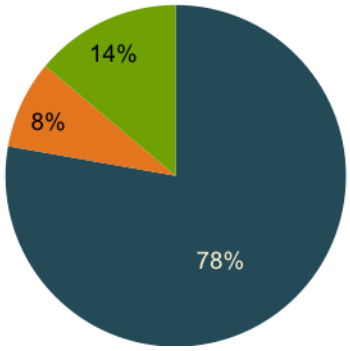

Figure 3.4 Ethnicity of focus group participants

3.1.3 Socio-economic status

Socio-economic status is considered by many researchers to be a key determinant in exposure to air pollution, with exposure increasing as socio-economic status decreases (Bell *et al.,* 2005, Burra *et al.,* 2009, Day, 2007, Gold and Wright 2005). It was therefore interesting and informative to examine peoples' views by socio-economic status. Accessing such information, however, can be difficult and therefore in the questionnaires, proxy indicators of socio-economic class were used.

People were asked their employment status and the number of vehicles they owned, considered by the Office of National Statistics as a proxy indicator of wealth and part of both the Carstairs and Townsend index of multiple deprivation (Carstairs and Morris 1989, Townsend *et al., 1988)*

Overall, 19% (n=71/381) of questionnaire respondents did not have access to a vehicle (see Figure 3.5) while 7% (n=25/381) had access to three or more cars, indicating greater household income (ONS 2010). In terms of employment, the majority of questionnaire respondents were employed (76% n=297/392), with most in full time employment. This compares to the UK population of 72% (ONS 2010). Of the remaining respondents, only 9% (n=37/392) were retired and 12% (n=47/392) were in education (see Figure 3.6). This indicates that the number of retired respondents was under represented in this survey (UK population: 18% retired).

Focus groups: Direct questions concerning socio-economic status were not considered helpful in facilitating relationships within the focus groups, and were therefore avoided. Car ownership, a proxy variable, was not considered a good marker of socio-economic status amongst a group of people with respiratory illnesses, as their disability may either prevent them from driving, or entitle them to a mobility vehicle. With hindsight, however, this question would have allowed a straightforward comparison between questionnaire respondents and focus group/workshop respondents. Instead participants were asked their housing occupancy and their employment status plus job title. This allowed an estimation of each participants socio-economic status to be made.

Thirty two out of thirty six participants in the focus groups owned their home, while the four remaining participants lived in council- or privately-rented accommodation (see Figure 3.7).

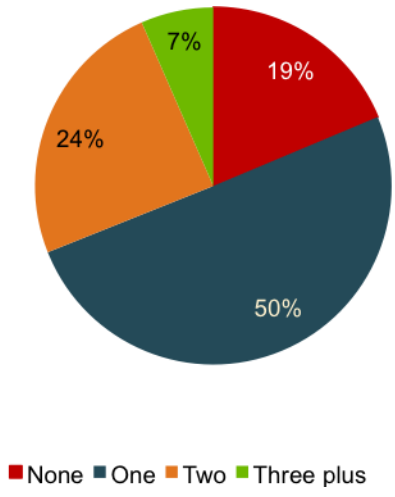

Figure 3.5 Car ownership of questionnaire respondents

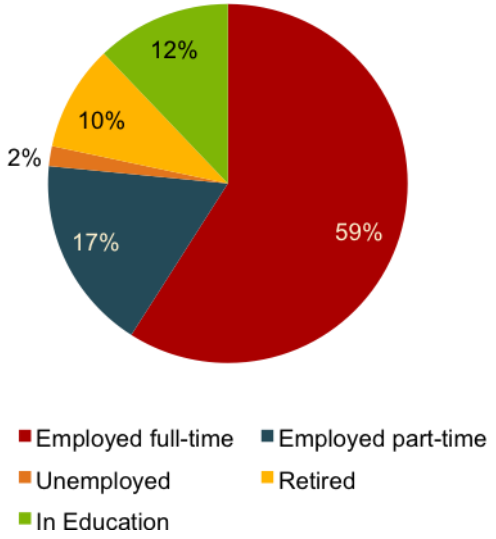

Figure 3.6 Employment status of questionnaire respondents

These four participants were either under 30 (n=1) or over 55 (n=3). The latter three were retired and experienced respiratory problems. In terms of employment, twenty two focus group participants were employed in either full-time or part-time work, while eleven were retired (see Figure 3.8).

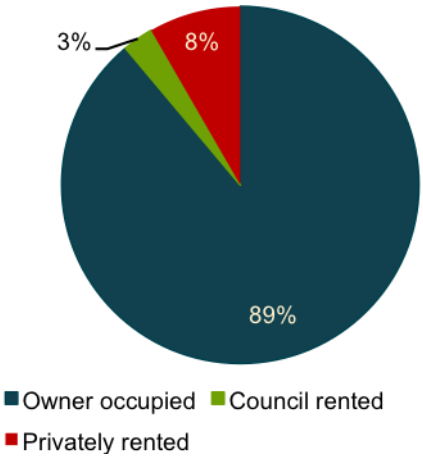

Figure 3.7 Housing status of focus group participants

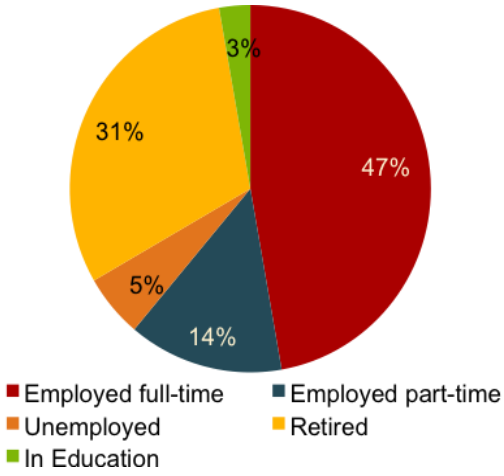

Figure 3.8 Employment status of focus group participants

3.2 Health status

People with respiratory or heart conditions might be expected to be more aware of air quality issues than those without (Wen *et al.,* 2008). The health status of both questionnaire respondents and workshop and focus groups participants were therefore investigated.

Questionnaires: All questionnaire respondents were asked about their general health in a question that asked them to assess their own health over the preceding 12 months on a three-point scale from ‘good health’ to ‘not good health’ (see Figure

3.9). This question was used for the first time in the last census to judge the health of the nation (ONO 2010). To support these findings, all questionnaire participants were also asked to provide information of any cardio-respiratory illness they had using a close-ended question. Just over two thirds of respondents did not have any health issues (67% n= 266/397), while 131 reported a relevant health condition. This subgroup was then asked what their health condition was. A total of 150 responses were obtained from the 131 participants with health conditions, indicating that a number of these people had co-morbidity, the most common of which was asthma and either a heart condition or chronic obstructive pulmonary disease (COPD), . The most commonly reported illness was asthma reported by ninety participants (60%, n=150) while 29% stated they had another respiratory illness (n=44/150) and 11% reported they had a heart condition (n=16/150) (see Figure 3.10).

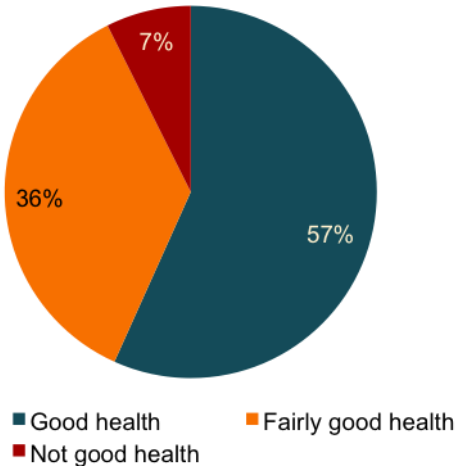

Figure 3.9 General health status

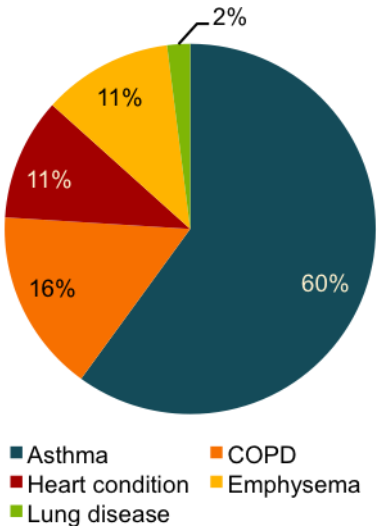

Figure 3.10 Specific health condition

Those that stated they had a health condition were asked about their level of breathlessness (see Table 3.1). Although designed for people with COPD, and therefore not entirely appropriate for every illness, the breathlessness scale had the advantage of being easy to comprehend and allowed a comparison of severity between respondents with the same illness. It also removed a level of subjectivity inherent in asking participants to define the severity of their health condition on a mild to severe scale. Just under half of those with asthma (44%, n=40/90) reported that they experienced breathlessness when hurrying or walking up a slight hill, while 29% (n=7/24) of those with COPD reported more severe problems of breathlessness which would interfere with their quality of life.

Small group workshops: In the workshops, the entire 'older' group had either COPD or severe asthma, while for the children's workshop, those without respiratory illnesses comprised the majority. Those in the 'older' group workshop had a mean breathlessness of 3.8, indicating a relatively ill group of participants, given that those with very severe breathlessness are often housebound.

Focus groups: Within the focus groups, seventeen participants did not report any illness. The health profile of the remaining nineteen focus group participants is shown in Table 3.2. Again this matched the desired profile for the focus groups with an even split between those with and without a respiratory or cardio-vascular illness.

Table 3.1. Health condition by level of breathlessness in questionnaire respondents

	Breathlessness scale	Asthma % (n)	COPD % (n)	Lung Cancer % (n)	Heart Condition % (n)	Emphysema % (n)	Response Totals % (n)
0	No breathlessness except with strenuous exercise	35.6 (32)	0.0 (0)	0.0 (0)	28.6 (4)	0.0 (0)	29.8 (34)
1	Short of breath when hurrying or walking up a slight hill	44.4 (40)	16.7 (4)	50.0 (1)	21.4 (3)	11.8 (2)	42.1 (48)
2	Walk slower on flat ground than friends/have to stop for breath when walking at your own pace	7.8 (7)	29.2 (7)	0.0 (0)	14.3 (2)	17.6 (3)	8.8 (10)
3	Stop for breath after walking for a few minutes on the flat	6.7 (6)	29.2 (7)	0.0 (0)	14.3 (2)	35.3 (6)	10.5 (12)
4	Breathless when dressing/ undressing or too breathless to leave the house sometimes	2.2 (2)	16.7 (4)	0.0 (0)	7.1 (1)	23.5 (4)	6.1 (7)
5	Breathless when sitting still	3.3 (3)	8.3 (2)	50.0 (1)	14.3 (2)	11.8 (2)	2.6% (3)
	Total	**90**	**24**	**2**	**14**	**17**	**114**

Table 3.2 Illness by age within the focus groups

Illness	No of People	Mean Age	Mean Scale of Breathlessness
COPD	7	64	3.1
COPD & Emphysema	1	63	4
Emphysema	0	-	-
Asthma & COPD	1	73	2
Asthma & Bronchiectasis	1	72	5
Industrial Asthma	1	73	2
Asthma	8	36	-

3.3 Summary

Overall, the data in this report is not necessarily representative of the general population. This is due to the relatively small number of respondents to the questionnaire and the relatively few focus groups/workshops; dictated by time and budgetary constraints. Furthermore, the number of respondents in this research project with respiratory complaints was higher than in the general public owing to the nature of this research. When interpreting the data in the following chapters it is important to bare in mind the following issues.

Questionnaires: the questionnaire sample has a female gender bias and did not capture the views of the older (65 or older) or younger (under 25) age groups. This may have been owing to the use of an online survey distributed by snowball sampling as women tend to have stronger social networks than men and therefore may pass the survey on to other women (Shye *et al.,* 1995; Matthews *et al.,* 1999; Pilar Matud *et al.,* 2003). Attempts were made to access male dominated networks, but this is obviously an area where more work needs to be undertaken. The lack of participation in the questionnaire by the older generation may be owing to internet access issues (Morris *et al.,* 2007). Networks used by younger people were avoided because of ethical constraints. Finally, those with a white/white British ethnicity dominated the questionnaire responses. Obtaining the views of people from a non-white background was difficult and the language barrier may have been an issue. Given, however, the short time frame in which these results were collected it was not possible to translate the questionnaire in to additional languages.

Focus groups: The focus groups contained an equal gender balance, age range distribution and, for those groups held in Leicester and Nottingham, a representative ethnic mix. They therefore matched the desired profile of the focus groups, which was chosen to be representative of the general public. However, the focus groups did contain a greater number of participants with a respiratory illness than would be expected in the general public and this, along with the small sample size (36 participants) should be borne in mind when considering these findings.

Small Group Workshops: The small group workshops were focused on specific populations (children and older people with respiratory illnesses) and thus cannot be considered representative of the general population.

In conclusion it can be stated that despite the small sample size in this project and the issues mentioned above, the results obtained here provide a valuable insight into the thoughts and views of the specific groups involved in the research. The methodology has been successful in obtaining the views of those with cardio-respiratory illnesses and those involved in this project.

The following section explores the environmental awareness of the research participants with emphasis on the sources and types of air pollution.

4: Air quality awareness

Both the online survey and the focus groups/workshops asked participants about their current environmental awareness with specific emphasis on the sources and types of air pollution and the link to climate change. Those who worked in the field of air quality were excluded from the analysis.

4.1 Sources and types of air pollution

Respondent of all ages, genders and ethnicities were aware of the major sources of air pollution. Both questionnaire respondents (via open ended questions) and focus group participants, identified the following as perceived pollution sources:

- Road traffic
- Aircraft/airports
- Industrial emissions (factories, chimneys, power stations)
- Agricultural spraying
- Grass cutting/trees
- Bonfires & biomass burning
- Combustion

For all three methods of data collections, participants, no matter their age range, gender or ethnicity, stated that they believed that the biggest source of air pollution was road traffic.

Road transport emissions were perceived as the biggest contributor to poor air quality by 78 % (n=283/361) of questionnaire respondents (see Figure 4.1). This data was collected using an open-ended question so as not to bias responses, and subsequently coded and analysed by ethnicity, gender and age.

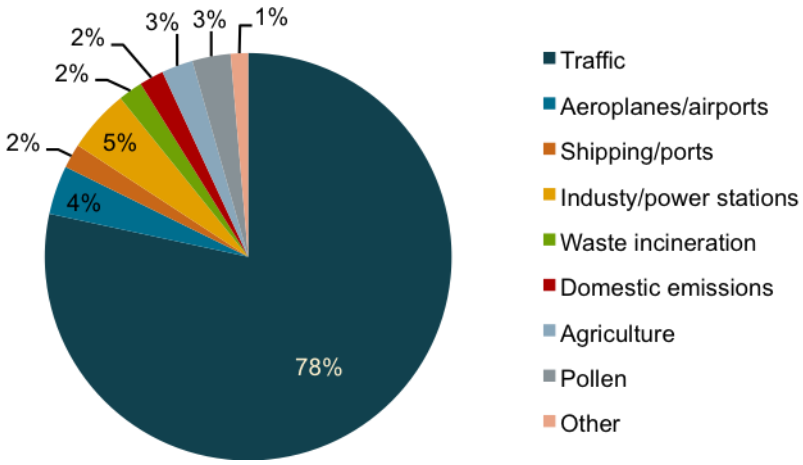

Figure 4.1 Perceived importance of emission sources (questionnaire respondents)

Similar finding emerged from the focus groups and workshops with the following quote typical of the responses obtained.

> *"The worst is the buses down town, 3 or 4 of them lined up all stationary, and all the fumes coming straight out on the pavement". (Male, COPD, 65+)*

> *"Years ago we had a big hosiery trade and a lot more factories, but I suppose in the city centre, we've still got quite a lot of factories, and things round there, so you know, I'd imagine we still get pollution around there". (Male, asthma, 35-44)*

As can be seen from Figure 4.1, a number of questionnaire respondents stated that pollen was a pollutant. The same issue was raised in the focus groups and there was a discussion in a number of groups as to whether 'pollen' constituted an air pollutant or not, owing to the fact that it was 'natural' in origin.

> *"Sometimes it comes on the weather, it often says you will get more pollen". (Female, asthma and COPD, 55-65)*

> *"Yes but that's pollen isn't it, it's not pollution". (Female, COPD, 65+).*

In an open-ended question, questionnaire respondents were asked to name any air pollutants that they were aware of. In total 71% (n= 234/332) of respondents stated that they were aware of air pollutants. This figure fell to 63% (n=210) once those who stated that they worked in the air quality field were excluded. With this group of respondents excluded (those who worked in air quality), 51% (n=158) of respondents could name one or more air pollutants. By far the most commonly stated pollutants were carbon monoxide and carbon dioxide. The increased awareness of these two gasses may be owing to the current climate change / carbon reduction advertising campaigns in the media as this was mentioned frequently within the focus groups, and especially within the children's workshop, however this is an area for further research.

Within the focus groups a similar pattern was observed. Pollutants that focus group participants stated they were aware of included;

- Carbon monoxide/dioxide (commonly mentioned in connection with climate change)
- Methane (again frequently mentioned in connection with climate change)
- Sulphur
- Pollen
- Nitrogen
- Benzene

Carbon (either on its own, or as carbon monoxide or carbon dioxide) was mentioned as a pollutant linked to climate change. When explored further, it was clear that the media, especially television, was the source of this knowledge for the majority of respondents who mentioned this pollutant.

> *"All the documentaries in the last few years that have gone on about animals and the environment, carbon monoxide you know – obviously [in] suburban areas, the minute we see the pole cap going, we think it's untouchable, well we know it's really bad". (Male, no health condition, 35-44)*

Focus group participants also stated that they were unaware of either ozone or particulate matter:

> *"What is a particulate matter? It sounds like something out of Dr Who!" (Female COPD, 55-64)*

No one in either the focus groups or the workshops made the connection to tropospheric ozone, although a small number of participants stated they were aware of stratospheric ozone[4]. Furthermore, a number of participants believed that ozone was beneficial to health. All participants assumed that if air pollution was reported as 'poor' or 'bad', this applied to urban areas only and that air pollution would be lower in the countryside.

A number of the younger asthma sufferers reported wheezing and shortness of breath following outdoor sporting activities in the summer, despite no such symptoms occurring if the same activities were performed indoors. No one made the connection between his or her symptoms and air pollution.

4.2 Spatial perceptions of air quality

Bickerstaff and Walker (2001) and Howell *et al*., (2003) found there was little variation in the perception of air quality at different geographic scales. A similar pattern was found amongst questionnaire respondents. Only those that lived in rural areas (described as villages or countryside) thought that the air quality in their immediate vicinity was better than the air quality in the local area, or the UK as a whole.

Questionnaire participants were also asked to identify the biggest source of local and national air pollution. Variation was found in the answers to this question, with people identifying 'local sources' (*e.g.* local airports, docks, motorways and industry). For example;

> *"A27 - runs along bottom of my garden". (R104)*[5]
>
> *"Traffic using the village as a rat run to avoid the trunk road". (R111)*
>
> *"Aeroplanes, cars from M4, M40, Chiswick roundabout". (R99)*

At a national level, as previously reported, the majority of respondents in both the questionnaires and the focus groups/workshops identified road traffic as the biggest source of air pollution. Traffic was perceived as the main source of air pollution at a local level by 82% of questionnaire respondents (n=285/347) compared to 78% of respondents at the national level (n=283/361).

---

[4] Ozone naturally forms in relatively large abundance (~ 7 – 8 ppmV) in the upper atmosphere. Referred to as stratospheric ozone (owing to its concentration peak occurring in the stratosphere), it consists of three oxygen atoms covalently bonded together. Ozone has a significant absorption cross section in the ultraviolet region of the electromagnetic spectrum and consequently it acts to reduce the amount of UV radiation penetrating to the troposphere and the Earths surface. So-called tropospheric ozone is ozone, which forms in the lower levels of the atmosphere, specifically the boundary layer of the troposphere. Excess tropospheric ozone can form in the boundary layer from the chemistry of 'ozone precursor gases', including oxides of nitrogen and volatile organic compounds, released from combustion processes. Tropospheric ozone is a key component of photochemical smog, which at high concentrations, has been shown to exert adverse health effects on human beings and also to impact negatively upon the environment.

[5] Quotes from questionnaire respondents are identified with their unique respondent number, *e.g*. R22.

The public perception of air quality within and between neighbourhoods was further explored within the focus groups/workshops. Results indicated that, unless they lived next to a 'major' source of pollution (*e.g.* motorways, main roads, factories), participants perceived their 'area' or neighbourhood as less polluted than the surrounding towns.

> *"I live in Luton, Jane lives in a village. I'm at the end of a quiet cul-de-sac, not near the motorway and not on a flight path. Jane's pollution is worse than mine, because although she's in a village, she lives next to a motorway". (Female, COPD, 55-64)*

These findings agreed with both the results from the online survey and the work of Howell *et al*., (2003) who found that the greatest variation in air quality perception was related to distance to major pollution source. Furthermore, focus group participants related the perceived level of air pollution to their perception of the city itself.

> *"Derby is a slightly darker city to be honest, so I'd imagine the pollution is worse there, but it's probably in my mind isn't it?" (Male, asthma, 45-540)*

> *"The buildings in Leicester are taller and closer together, whereas in Nottingham, it is more spaced out, so I'd say Leicester is considerably worse". (Female, asthma, 35-44)*

> *"I work in Nottingham, and live in Leicester, and I'd say Leicester has far more pollution. In Nottingham there's a good one way system, so the cars are going in the same direction and not standing still". (Female, no health condition, 35-44)*

Finally, participants were not aware of any rural sources of air pollution and perceived the countryside as less polluted than the urban areas and therefore a 'safe space'.

> *"There's no methane close to us, just from the cowpats, but there's not much of that". (Male, asthma, 24-35)*

> *"Only chemical fertilisers and spraying and that". (Male, no health condition, 54-65)*

4.3 Temporal perceptions of air pollution

Questionnaire respondents were asked if they perceived any difference in the level of air pollution during the day or over the year. In total 67 respondents skipped or were excluded from this question. This included the 24 people who worked in the field of air quality and therefore should have knowledge of the subject, and 43 people who chose not to answer.

Of the 338 questionnaire respondents who answered the question asking them when they felt air pollution was highest during the day, 32% (n=108/338) of people felt air pollution was highest in the afternoon, while 23% (n=77/338) were unsure (see Figure 4.2). Chi-square tests indicated that there was no significant difference in the perception by gender x^2 (4, n=338) = 3.8, $p=.44$ or by age (20, n=336) = 27.7, $p=.12$ Cramers' V =.14. There was, however, a significant difference amongst those with and without a health condition x^2 (4, n=340) = 17.5, $p=.00$ Cramers' V = .23.

Again, 338 people responded to the question asking them if they felt that air pollution was highest at a particular time of year. Over half of respondents stated that they felt that air pollution was worse in the summer (53% n=178/338), while 21% (n=72/338)

were not sure (see Figure 4.3). A Chi-sq test indicated no significant difference in time of day by gender (x^2 (4, n=338) = 5.9, p= *0.20* or by age (20, n=339) = 28.3, p=*.10* Cramers' V = .14) or between those with and without a health condition (x^2 (4, n=340) = 11.2, p=*.03* Cramers' V = .18).

A similar pattern was observed in data obtained from the focus groups and workshops. All participants, that expressed a view, said that air pollution was highest in the afternoons. In terms of seasonal variation, participants without medical conditions thought that air pollution was highest in the summer. They reported that their information came from either media influences or from personal experience. For people with respiratory conditions, the perceived influence of air pollution was difficult to separate from that of meteorology. This was especially true for people with COPD. Participants with COPD believed air pollution was highest during the summer and the winter. They based this perception on their own 'lived-experiences' of symptom exacerbations, but when questioned, it was clear that they were also affected by extremes of temperature and exposure to strong winds and humidity. These findings agree with the work of Bickerstaff and Walker (2001) undertaken in the West Midlands, UK.

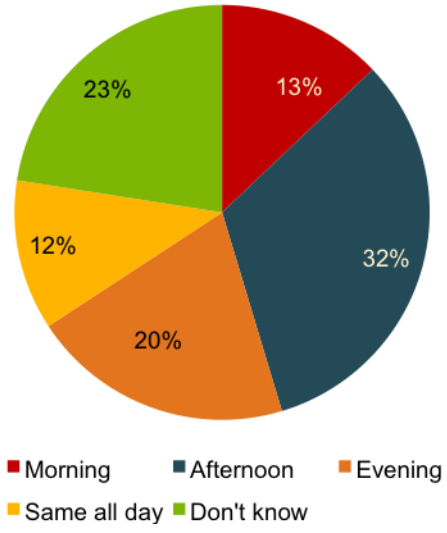

Figure 4.2 Perceived variation in daily air quality

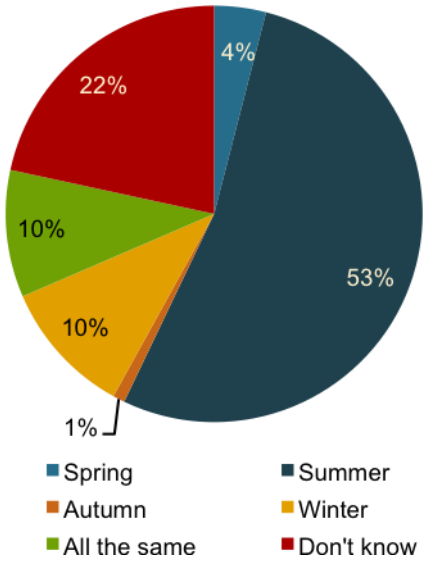

Figure 4.3 Perceived seasonal variation in air quality

Participants with asthma, however, stated that they were affected more during the summer. Most related this to the period of the year when they increased the use of their preventative medication, especially during recreational activities. The perceived differences in the seasonal variation of air pollution between participants with COPD and those with asthma, may be due to the variation in the severity of their condition, the effect of confounding weather conditions or the fact that air pollution may trigger an immediate exacerbation of symptoms in asthmatics (Braganza *et al.,* 2009, Neidell and Kinney 2010).

4.4 Perceptions of climate change versus air quality

The focus groups and small group workshops were used to explore participant's perceptions of the relationship between climate change and local air quality. This section should be interpreted with caution as it only represents the views of a small

number of people. It does, however, provide a valuable insight into the views of this group of participants.

Respondents' perception of air quality and climate change differed. Climate change was perceived as a global scale issue, which would be hard to influence, while air pollution was seen as a local issue. A key theme to emerge from the focus groups was that participants either did not connect climate change to air pollution, or were undecided as to whether or not there was a link.

> *"I don't see much connection between the two to be honest, I just think air pollution is what we have discussed, and the ozone layer is something different". (Male, asthma, under 25)*

There was also scepticism about the '*proof*' and '*science*' of climate change, within focus group respondents stating that it was, '*a natural phenomenon'*, '*exaggerated'*, and that they were beset by '*conflicting information'*.

> *"I think some of it is true, but I think they [the government] are making a big thing of it, I don't think it's all what they say it is at the moment". (Female, no health condition, 45-54)*

Within the children's workshop, all of the children were aware of the '*hole in the ozone layer*' and, of climate change in general, but incorrectly regarded them as the same phenomena. For example when asked what caused climate change a typical response was;

> *"It's the thing that surrounds the earth and if there's a hole in it, it makes a really bright light and it will hurt us". (Male, no health condition 9-11)*

They reported that their awareness came from school, family, friends and television. They perceived climate change as linked to 'carbon pollution' and they were all aware of the TV advertising campaign advocating reducing driving and the need to switch off electrical goods after use.

> *"Do you know how you can affect climate change"? (Researcher)*
>
> *"Yes your carbon footprint". (Male, no health condition 9-11)*
>
> *"How can you make your carbon footprint lower"? (Researcher)*
>
> *"Turn off your TV and unplug stuff when you go to bed, turn off your heating and stuff". (Male, no health condition 9-11)*
>
> *"And how do you know to do that sort of thing"? (Researcher)*
>
> *"Adverts, adverts on the telly, from the TV, and from school". (Female, no health condition 9-11)*

Consequently, within the focus groups and small group workshops there was variation in participants' views on the existence of climate change amongst the adults, although all of the children were aware of the existence of climate change. All age groups were aware of actions to mitigate climate change, although very few participants made the connection between air pollution and climate change. According to Bord *et al., (2000)* the greater the public's understanding of the causes of climate change (and equally those things that do not affect it), the more likely they are to undertake voluntary actions to reduce it. Such a theory could therefore be applied to air pollution. Increasing the awareness of air pollution and its causes and associated health effects, may encourage people to take mitigating action and

therefore have a dual benefit for climate change and air pollution. Hence, it may be sensible to consider further research in this area.

4.5 Perceived indicators of air quality and health

Asked how they knew that the level of air pollution on any one day was poor, both questionnaire respondents (via an open-ended question) and focus group participants identified a wide range of, what they perceived to be, indicators of air quality.

These included:

- Smell and taste
- Visual
- Residues
- Feelings (health effects)

Once health effects / feelings had been excluded from the analysis, visual clues (45%, n=97/218) such as visible haze and the sense of smell (41%, n=90/218) were the most commonly specified physical indicator of air pollution by both questionnaire respondents and by focus group participants. Odours included fumes, especially from road traffic (in particular buses); and from food processing plants, agricultural activities and biomass burning (bonfires, wood smoke). Taste was also mentioned as evidence of poor air quality by a small percentage of respondents (6% n=14/218).

> *"When there is no air (when wind is still), by my taste, smell, and when I can't breathe after I walk 30 meters". (R30)*

> *"[I can] physically smell fumes hanging in the air". (R183)*

Visual cues included visible haze and being 'able to see it', while residues, including dust on cars, windowsills and on washing, were also mentioned by 8% of questionnaire respondents (n=17/218).

> *"I live on quite a high hill and can see over central London. I can often see a yellow 'smog' as well as sometimes smell a large incinerator in Deptford". (R42)*

> *"I walk to work so car exhaust fumes are an issue for me. Apart from the more hazy air when I am walking to work, specks of dirt on my face and in my hair (dirtying my comb) alert me to the pollution on a day to day basis". (R224)*

> *"Well your white washing, if you're like a near a motorway, and it's left out, it's not white is it? So if that's what it's doing to the clothes, then I suppose it's bound to affect your lungs". (Female, asthma, 55-64)*

This links to the work of Bickerstaff and Walker (2001) who stated that visible cues and smell were the most common indicators of air pollution after health affects. Cole *et al.,* (1999) also found a similar pattern in his work undertaken in Canada.

Both questionnaire respondents (40% n=147/365) and focus group participants, with and without respiratory illnesses, reported feeling short of breath when exposed to air pollution. Perceived indicators of air pollution were explored in detail within the focus

groups and in the older adults workshop. Participants with respiratory illnesses reported headaches, wheezing, shortness of breath, and heaviness in the lungs.

> *"As soon as I step into Nottingham or Derby centre, then it just feels like my lungs have been squeezed, it feels more heavier to take in, it just feel's like I've breathed in a huge bunch of lead, you know, it just rests on your lungs. I don't know if it's the car pollution or chimneys or anything, but I do notice a big difference". (Male, under 24, Asthma)*

Van den Elshout (2007) stated that the majority of the public perceive air pollution as an impersonal risk, without direct (short-term) effects on health, and consequently air pollution is not seen, to those without health conditions, to be of high personal relevance. Participants were therefore asked if, before taking part in the research, they were aware of the link between air pollution and health; and if they were aware, who was most affected by air pollution.

The overwhelming majority of questionnaire respondents (90%, n=330/365) indicated that they were aware of a link between air pollution and health (27 responses from those who worked in air quality or health were excluded). When asked what they perceived the effects of air quality on health were, many research participants were conscious that it affected breathing. For example;

> *"Makes it harder to breathe, walking feels like running. I need to use my inhaler, which has side effects (like drinking double espressos too fast). If bad enough/I do not take my inhaler fast enough - asthma attack". (R8)*

> *"Pollution affects my asthma, causing wheezing, coughing, etc. It irritates my eyes and I suspect it also affects my overall health and wellbeing". (R45)*

As expected, those with respiratory or heart conditions were more aware of the effects of air quality on health than those without. Reported perceived effects included breathlessness, difficultly breathing and exacerbation of existing conditions.

Participants were then asked whom they supposed were affected by air pollution (see Figure 4.4). They were asked to identify as many 'groups' as they could, that they perceived were at risk.

The majority of respondents (82%, n=268/327) were aware that people with respiratory conditions are affected by air pollution (see Figure 4.4). Just under two thirds (66% n=215/327) of participants recognised that children may also be affected, while over half of respondents (58%, n=188/327) thought that air pollution could affect the elderly. Only 38% of participants (n=124/327) were aware that air pollution could affect people with heart conditions and a fifth of respondents (20% n=64/327) believed that air pollution would affect everyone equally.

Amongst the online survey respondents, there was awareness that air pollution can affect children, the elderly and those with respiratory health conditions. Most were not aware that air pollution can also influence the health those with heart conditions. The same findings were observed from the focus groups.

When examined by illness, 85% (n=89/105) of those who stated that they had a health condition, were aware that air pollution would affect them. For those with COPD and asthma, 74% (n=17/23) and 87% (n=72/83) of respondents were aware that air pollution affected those with respiratory conditions. Two thirds of those with cardio-vascular issues (75%, n=9/12) were aware that air pollution may have an affect on their condition. The number of participants with heart conditions, however, was small and these findings should therefore be treated with caution.

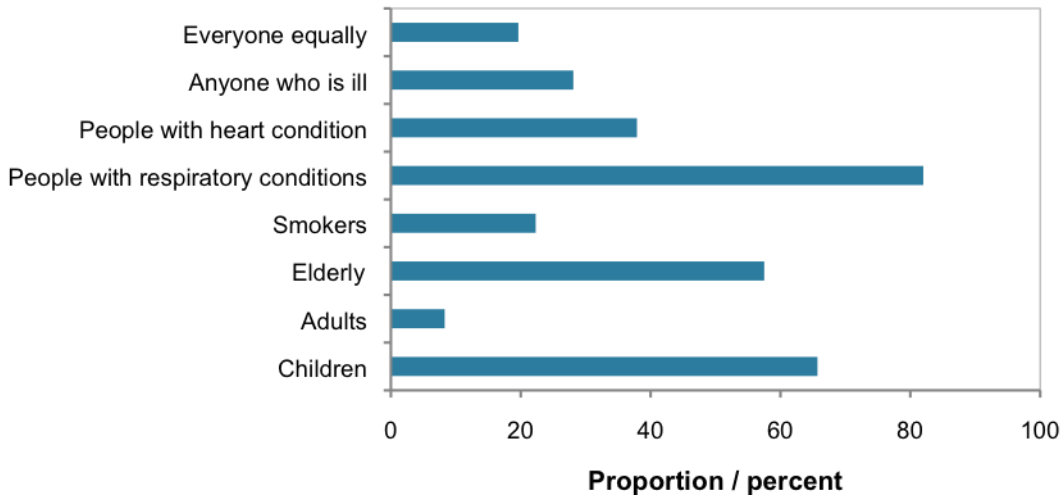

Figure 4.4 Perceived groups 'at-risk' from the effects of air pollution

The survey showed that there was awareness of the influence of air pollution on peoples' health amongst participants with a health condition. For those without a health condition, there was still a good understanding that air pollution will affect those with respiratory conditions and children. This finding conflicts with the findings of van den Elshout (2007) and Morton and Duck (2001) who both stated that those without a personal-risk from air pollution, would not see it as relevant.

4.6 Summary

The research participants appeared informed about the main sources of air pollution in urban areas. Almost all participants in the online survey, focus groups and the workshops identified traffic as the main source of air pollution. Participants within urban areas perceive little variation in air pollution levels at different geographic scales, although all were aware of pollution sources local to them. There was little understanding of the temporal (daily or annual) variation in air pollution.

Few participants were aware of tropospheric ozone, or indeed the fact that pollution levels may be higher in rural areas compared to urban areas. Participants perceived the countryside as a place to 'escape' from air pollution, in other words a 'safe space'. The lack of awareness of rural air pollution, especially for those with respiratory illnesses, is surprising given that rural pollution can also exacerbate symptoms and therefore activities to raise awareness could be undertaken in this area.

Participants in this research reported that visual clues and smell were the most common indicators of air pollution, after health effects/feelings. This agrees with the work of Bickerstaff and Walker (2001) and Cole *et al.,* (1999). It should be noted that perceived indicators of air quality do not always coincide with actual air quality levels.

The majority of participants did not make the connection between air pollution and climate change, with climate change perceived as a global issue, while air pollution was seen as a local concern. Further, a key theme to emerge from the focus groups, was that participants were sceptical about the existence of climate change and felt beset by conflicting information. It is worth noting that this view was obtained from a small sample and therefore should be treated with caution.

Research from the USA suggests that an increased understanding of the causes of climate change will motivate the general public to take effective action to reduce their impact on the environment (Bord *et al.,* 2000). Increasing awareness of the causes of air pollution and its effect on health and the environment, may encourage people to change their behaviour and take effective action to reduce air pollution. Furthermore, it is possible that increasing awareness of the link between air pollution and climate change, may therefore encourage people to make behavioural changes, to improve their immediate environment which will in fact also reduce climate change causing activities.

Finally, participants in this research project were aware of the effect of air pollution on sensitive groups, and also who comprised those sensitive groups (*e.g.* children, the elderly and those with respiratory illnesses). Although knowledge of the relationship between health and air pollution was higher in those with a health condition; awareness of this relationship was also observed in those without any health issues. The only exception to this finding was in participants' awareness of the effect of air quality on those with heart conditions, where knowledge was generally low. This may constitute an area for future research.

5: Needs and requirements of air quality information

An air quality index (AQI) is an attempt to distil and condense a complex amount of information into a system "capable of communicating as simply and accurately as possible, the health risks associated with a certain level of exposure" (Caincross *et al.,* 2007, p8450). Research by Wen *et al*., (2009) found that media alerts of air quality index exceedances, combined with health advice from medical professionals, were associated with reported changes in outdoor activities amongst those with respiratory conditions.

Any system used for communicating air quality information to the general public, therefore, needs to be easily understandable by the non-scientist (Hussein *et al., 2002; Semenza* et al., *2008),* contain information that is clear and focused, and provide relevant advice and suggestions (Shooter and Brimblecoombe 2008). In addition, the content, tone, and framing of the message are also important. If the sender is considered by the public to have a hidden agenda, the information will simply be ignored (Duree, 2006, Kahlor *et al*. 2006).

This section explores the existing awareness of air quality indices amongst those who participated in the online survey, focus groups and the workshops, and investigates future needs and requirements regarding the provision of air quality information.

5.1 Existing air quality index awareness

Participants were asked if they were aware of any air quality indices and if so, did they make use of them.

A small number of questionnaire respondents worked in the field of air quality or were cardiorespiratory health professionals. It would be hoped, therefore, that these individuals would have a better awareness of air quality and air quality indices than the general public.

In terms of air quality index awareness, 58% (n=14/24) of those who worked in the field of air quality, and three of the four respondents who worked in health-related fields were aware of the existence of air quality indices. By comparison, only 35% (n=109/314) of the questionnaire respondents who did not work in air quality had an awareness of air pollution indices.

When examined by health condition, 59% (n=10/17) of participants with a heart condition were aware of the existence of an air quality index, while almost equal numbers of respondents with COPD (44% n=11/25) and emphysema (47%n=8/17) were aware of the air quality index (see Table 5.1). It should be noted that this represents a very small sample size and therefore should be interpreted with caution. Of those participants with asthma, just over a third of respondents (37% n=31/83) were aware of an air quality index or scale. This may be because asthmatics were either unaware of the existence of such information, or that they did not perceive the link between air pollution and health as important. Lack of an awareness of any air quality index was also observed in those without a health condition. This finding agrees with the work of Bell *et al.,* (2005) and Hussein and Partridge (2002), both of whom stated that there was a lack of public knowledge concerning the existence of, and access to air quality information.

Table 5.1 Awareness of air quality index by health condition in questionnaire respondents

Are you aware of AQI's?	Asthma % (n)	COPD %(n)	Heart Condition % (n)	Emphysema % (n)	No health condition % (n)	Total % (n)
Yes	37.3 (31)	44.0 (11)	**58.8 (10)**	47.1 (8)	30.1 (63)	34.7 (109)
No	**62.7 (52)**	**56.0 (14)**	41.2 (7)	**52.9 (9)**	**69.9 (146)**	**65.3 (205)**
Total count	83	25	17	17	209	314

Given a lack of awareness of the air quality index amongst certain sectors of the research sample, it is useful to explore what the respondents in this study would like from a future air quality index; would they think the provision of such information necessary at all, and if so, what method of communication would be preferable.

5.2 Air quality index information requirements

In order to raise awareness of air pollution, and provide relevant and easy to understand information, online survey respondents were asked to express their aspirations for air information using an open-ended question. This was designed to ensure participants were not prompted in their response and were able to make multiple responses.

There was no clear single factor that respondents would like to know. Results indicated that there was a desire for information on the **level** of air pollution from just under half of all respondents (see Table 5.2). **Advice** on the health effects of air pollution, especially on vulnerable groups was considered important by just under a third of respondents. In addition, **locational** air quality information was also requested (see Table 5.2). These factors represented the three most reported responses by the participants in this research project.

Table 5.2 Requested air quality information (coded)

Requested information	**Response Count**	**Percentage**
Level of air pollution	92	43.2
Location of air pollution	64	30.0
Advice on health effect / exposure reduction	49	23.0
Time of day of peak levels	20	9.4
Pollen	12	5.6
Type of air pollution	11	5.2
Sources/causes of air pollution	10	4.7
Long term trends in air pollution	6	2.8
Links to more information	5	2.3
Total number of responses	**213**	

These figures, although highlighting the three key issues that participants would like to see reported in air quality information, do not indicate a strong consensus. This may be because participants are uncertain of the possible format and amount of air quality information available.

Questionnaire respondents were therefore asked how important they felt information on level, type, sources, name, range, effect of air pollution and advice on mitigation actions, was. Both the **level** of air pollution and the **effect** on the 'at-risk' group were considered very important by over 50% of respondents (50% (n=151/300) and 53% (n=156/296) respectively), thus reinforcing the importance of including information on the level of air pollution and on the affects of air pollution on the 'at-risk' group. Furthermore, advice on what action individuals should take to avoid/reduce their exposure to air pollution, was considered important or very important by 91% (n=263/289) of those questioned.

Representative comments on the public requirements of air quality included:

> *"How it affects my living and working environment and how I can protect myself against its effects or help improve levels". (R37)*

> *"What the levels of pollution are in my area. What the information means in plain English". (R53)*

Interestingly, only 5% (n=11/213) of respondents wanted to know the **type** of pollutant. The comment below is an example of the exception, rather than the rule:

> *"What particular pollutants are high in your area, and also what pollutants have increased or decreased. Also what are causing these pollutants". (R142)*

Pollen was raised as an issue by 6% (n=12/213) of respondents, with participants in both the focus group and from the online survey requesting that it be included in the air quality index:

> *"Pollen count / times of day pollution is at its worst so I can avoid venturing out at those times". (R43)*

> *"When not to venture outdoors, pollen count". (R58)*

Previous research by Beaumont *et al.,* (1999), Bickerstaff and Walker (2001), Bush *et al.,* (2000), Day, (2007) and Shooter and Brimblecoombe, (2008) showed similar findings. This thus suggests that the general public have definite views on the provision of air quality information.

It is clear that participants in this research project would like air pollution information that includes the:

- Level of pollution
- Location (at a local rather than regional scale) of the pollution
- Relevant health effects and
- Advice on what action can be taken in order to avoid/reduce exposure

Of secondary importance to a smaller group of participants was detailed information about the type of pollution.

5.3 Air quality index lexis

In order to provide relevant, easy to understand information, air quality indices need to provide clear, focused information and advice on activity suggestions (Shooter and Brimblecombe 2008, Bush *et al.,* 2001, Howell *et al* 2003). There are a range of suggestions on how to communicate air quality information and health advice. Sutton (1982) mentioned that 'fear arousal' should be avoided in any message, as although the generation of fear may cause an increased perception of risk, it does not necessarily lead to a change in behaviour. More recent research by Payne-Sturges *et al.,* (2004) argued for a risk-based approach to communicating ambient exposure to air pollution. They stated that such information provides communities (and therefore individuals) with a means to compare risk and prioritise their activities.

Workshop and focus group participants were given four samples of health advice and asked to explain their preference. The UK advice was short, to the point and had only four bands. The American health advice was selected for comparison as it had two additional bands and was also relatively short. Both the UK and the USA air quality index (AQI) provided integrated health advice for both the general public and those considered sensitive to air pollution. Health advice from Canada contained separate advice for the general public and those considered sensitive, and was therefore selected as the third set for investigation. The Canadian advice also had four bands. Finally the Australian advice was used as it provides separate advice by pollutant and by vulnerability. Participants were also asked what they liked and disliked about a number of the existing air quality indices and this opened the discussion into a more indepth exploration of the issues surrounding air quality indices.

Questionnaire respondents were also asked about the health advice from the UK, USA and Canada, and asked to identify what they did and did not like about each one via open-ended questions. This allowed respondents to write as much or as little as they wanted, and did not prompt them in their answer. The data was subsequently coded, and analysed using a combination of content and discourse analysis.

5.3.1 Positive measures

Key issues that emerged from both the online and workshop/focus group participants included the need for:

- Concise information
- Easy to understand information
- Focused, jargon-free, activity advice
- In-depth information and links to further advice
- Provision for separate health advice for sensitive and non-sensitive groups
- The use of colour/colour gradations (visual cues) to enable those with poor literacy skills to access the information.

Feedback from the online survey indicated that participants wanted focused, informative advice about the level of pollution and the effect it may have on their health. They wanted information that was easy to understand without complex jargon.

> *"Language is jargony and poorly written. Numerical values are uncontextualised." (R232) [Re: USA AQI]*

Similar themes also emerged from the focus groups. The main wish was for jargon-free advice, written in clear simple language;

> *"I didn't really understand 'effects are likely to be noticed by individuals who know they are sensitive to air pollution'. No one is going to know what that's trying to say". (Male, asthma, under 25) [Re: UK AQI].*

> *"How many times can you mention 'sensitive' in one paragraph? You know, people might not understand that concept, older people and children". (Female, no health condition, 35-44) [Re: UK AQI]*

> *"I think A [UK advice] is quite funny, it just sounds quite funny, 'asthmatics will find that their reliever inhalers are likely to reduce the effects on the lung". (Male, asthma, 25-34)*

> *"I have to go over that one [UK] again, do you know what I mean, I mean what are they saying?" (Female, no health condition, 45-54)*

An indepth discussion of the sample air quality index health advice with focus group participants revealed that they found it difficult to recognise who the term '*sensitive'* referred too in the UK air quality index advice. The Canadian advice was praised for using phrases such as 'children, the elderly and people with heart or breathing problems' rather than the term 'sensitive' or 'vulnerable'. A number of parents who had children with asthma did not recognise their child as being in the sensitive group.

> *"If you read this [UK] advice, would you think of your son as being in the sensitive group?" (Researcher)*

> *"No, no. I think he would have to be a lot more ill, like [he was] before you know, than how he is [now] to be honest". (Female no health condition, 35-44)*

> *"Sensitive individuals, we are all sensitive. It's not targeted enough considering it's something important enough to have its own brief, sensitive individuals doesn't quite cut it". (Female, no health condition, 25-34)*

Participants also wanted advice that was simple, quick and easy to understand:

> *"There's too many big words in this one [UK], you know, we are not thick but I think you get lost. After so much you'd get bored reading this and the same with B [USA]. But C [Canada] is straightforward; straight in there, whereas this one [UK], you'd be half way through and think, 'I can't be fagged'". (Female, no health condition, 55-64)*

> *"I like C [Canada] because I looked at the other two and, it's like when you look at the plain English campaign, they are all garbled. This [Canada] seems to be most straightforward and simple to me, you're in a group and then you look to see if you're effected, it's simple". (Male, asthma,35-44).*

> *"Gives relevant information. Easy to understand at a glance". (R172) [Canadian AQI]*

> *"Again, very easy to understand and very informative, gives all the information required". (R34) [USA AQI]*

The findings from this research indicate that despite requiring information that was focused and easy to read, the information also had to contain enough detail to

explain, in simple language, what the health effects may be and what action individuals could take to mitigate or avoid exposure.

> *'[UK] and [USA] tell me that there is going to be health risks and the air quality; what it's going to be like and what I should experience, but not what I should do. Whereas [the Canadian] C actually tells me, I should avoid, or reduce heavy outdoor exertion…so I like C for that reason". (Male, no health condition, under 25).*

> *"I prefer A [UK] to be honest. It's quite fair and straightforward. It's telling me it's polluted and I can use my puffer and it would make it all right for me". (Male, COPD, 65+)*

> *"I like B [USA] least because it has an unnecessary amount of words. A [UK] has a certain level of detail (e.g. asthmatics and their inhalers) but I had to read over B the most times, whereas A seemed more clear cut. (Male, sinusitis, under 25)*

> *"Gives you plenty of information on both the level and the health risk, but [it] is also very easy to understand" (R68) [Re: Canadian AQI]*

A message that emerged from the online survey, the workshops and the focus groups was the importance of providing information in such a way that it will not cause panic or fear. Examples of responses from the questionnaire included:

> *"Scary. Would end up worried to go out". (R28) [Re: USA AQI]*

> *"Suggests/implies 'at risk' even on a low-risk day, which could be alarmist". (R76) [Re: Canadian AQI]*

> *"Not as 'scary' as the last one, seems more user friendly and informative without trying to alarm people". (R30) [Re: UK AQI]*

The focus groups and workshops gave the same message:

> *"If I get too much information beforehand, I go into a panic situation and then I wouldn't go out because someone else says it's not good enough for me. I'm trying to train my mind to say 'I should find out for myself'". (Male, COPD, 55-64)*

> *"I liked that [the USA] best, it's just the right kind of information without being too vague and without sounding scary, which I think C [Canada] does. I think A [UK] is a bit vague". (Female, no health condition, 25-34)*

> *B [USA] scares me to flaming death! I'd never set foot outside the house with that one". (Male, COPD, 65+)*

'Fear'- or 'threat-generated' messages, according to Will *et al.,* (2009), only work in situations where they are targeted effectively and designed to promote high efficacy. Air pollution is not something that can be avoided or controlled at an individual level and therefore threat-generated messages should be avoided.

Conversely, the provision of air pollution and associated health advice was felt to be comforting and reassuring by a number of other participants.

> *"I'd be more frightened if I didn't know what was going to happen" (Female, COPD, 55-64).*

> *"I like it 'cause my missus would then say, 'Oh I'd better make sure we don't go and do so and so today' rather than nagging me" (Male, asthma, 65+)*

"I can understand what this one is about, it makes positive recommendations about outdoor activities". (R226) [Re: Canadian AQI]

Participants also liked the provision of separate health advice for those in the 'at-risk' category and for those not at risk.

"Like the advice for both at risk and general population". (R131) [Re: Canadian AQI]

"I like the big easy to understand level and risk description, good description for the at risk groups and it tells you who is at risk" (R240) [Re: Canadian AQI]

"This is quite sensible for asthma, compared to the others because it splits it up into two groups. It's giving sensible advice, it's not frightening that advice. I think it's quite good". (Male, COPD, 55-64)

"If you know which group you are in, and if you're going somewhere and you want to look up more information, then that one [Canada] would be really good because you don't have to read all this text". (Male, asthma, 65+)

Currently, separate advice for sensitive and non-sensitive groups is not included in the UK AQI. However, this research indicates that it is something that participants felt would be beneficial to those with 'health concerns'. Health advice by pollutant was considered too complex and should be avoided.

Finally, the presentation and in particular, the use of a colour scale was an important issue for many participants. Online respondents were shown the colours, words and values associated with the French, American, Canadian and UK AQI, while for focus group and workshop participants; the Australian AQI was also used (see Section 2).

The provision of a visual clue to the current daily level of air pollution was considered useful by participants. Furthermore, the location of the daily 'level' in relation to the overall scale was considered important.

"Colours are a good idea to communicate info quickly and in easy to understand format". (R103) [USA AQI]

"Coloured scale makes it clear at first glance". (R172) [USA AQI]

These findings support the work of Bush *et al.,* (2001) who also identified the need to provide the public with a simple quantification of air pollution data. The issue of scale and 'bandings' is discussed further in Section 5.4.

5.3.2 Negative measures

The focus groups, workshops and online questionnaire participants identified a number of features of the sample advice that they disliked. The key issues included:

- the provision of too must text and information (especially for those with reading difficulties)
- poor colour schemes (colours which were too similar or too brash/bright)
- a lack of detailed, focused information and
- trivialisation of air quality information

Although the research participants required in-depth and detailed information, there was a feeling amongst the research participants that the information should not be verbose or overwhelm users.

> *"The language is jargony and poorly written". (R232) [Re: USA AQI]*
>
> *"Bit wordy, garish, what are sensitive groups?" (R190) [Re: USA AQI]*
>
> *"For some reason I find the word 'descriptor' irritating; smacks of jargon". (R15) [Re: UK AQI]*
>
> *"It's easier for kids but the words are not easy to understand, they are scientific words". (Male, no health condition, 9 - 11)*
>
> *"It's all very well, but we are not all brain surgeons, you know, keep it simple". (Male, COPD, 65+)*

Comments were also made about the problems people with learning disabilities, such as dyslexia may have in accessing the information, while participants also thought the provision of a large 'block' of text off-putting.

> *"Too much text, I can't be bothered reading it all". (R226) [Re: USA AQI]*
>
> *"Too confusing for those whose sight is poor and depends on everyone having a good standard of English". (R200) [Re: USA AQI]*
>
> *"When I was reading A [UK] and B [USA], I was thinking 'I can't be bothered to read these' " (Female, no health condition, 45-54)*

In addition participants did not like colour gradients/scales that were either too bright, lacked definition, or would be difficult for people with colour blindness to read.

> *"Not enough differences with the colour. e.g. very little difference between 7,8,9". (R43) [Re: Canadian AQI]*
>
> *"Too "busy", colours are off putting, and too many words with little easy to understand info". (R191) [USA AQI]*

Participants commented that air quality indices should not 'trivialise' the subject nor patronise those that the information was aimed at. The French scale, for example, which uses the image of a giraffe to display both the level of air pollution and the physical affects on health, was particularly disliked. Comments included;

> *"It makes air pollution seem trivial". (R116) [Re: French AQI]*
>
> *"Childish – aimed at Primary School level. Level's grouped in pairs is confusing: are they one level or two?" (R86) [Re: French AQI]*
>
> *"It's bright & catches the eye. Might appeal to children". (R70) [Re: French AQI]*

There were suggestions that the French AQI was suitable for children, however, participants in the children's workshop, felt that it was 'babyish' and would be suitable for younger children only.

> *"I think its good for children in Class 1 [5 to 6 year olds], because if you showed them this one they would understand". (Male, no health condition, 9 – 11)*

These observations support the suggestions of Shooter and Brimblecoombe (2008) who stated that an air quality index should not "demean public understanding and recognise issues in the public perception of air quality" (p7).

It is clear, therefore, that participants in the workshops, focus groups and through the online survey, liked clear focused 'jargon-free' information. Such information, it was felt, should be aimed at 'at-risk' and 'not at-risk' groups and contain clear advice on actions that could be taken to reduce or avoid exposure and protect health.

5.4 Air quality index imagery

Given the importance of colour to participants in the previous section, participants were asked which colours they felt best represented low and high air pollution.

50% (n=149/299) of respondents stated that good air quality should be represented by green, while blue was favoured by almost as many participants (45%, n=134/299) (see Table 5.3).

Red was felt to be the best colour to represent high air pollution by 50% (n=146/295) of respondents followed by black and brown with 23% (n=67/295) and 21% (n=61/295), respectively.

Table 5.3 Colour preference for representing 'good' and 'poor' of air quality

Preferred colour	Representing good air quality / %		Representing poor air quality/ %	
Black	0.0	(0)	22.7	(67)
Blue	**44.8**	(134)	0.3	(1)
Brown	0.0	(0)	20.7	(61)
Green	**49.8**	(149)	0.0	(0)
Orange	0.3	(1)	5.1	(15)
Red	0.0	(0)	**49.5**	(146)
Yellow	2.0	(6)	0.7	(2)
Don't know	3.0	(9)	1.1	(3)
Other		(7)		(11)

Participants were also asked about the type of image that they would like to see represent air quality. Over a third (36%, n=148/410) of participants in the online survey who answered this question were in favour of seeing air quality represented as a scale (see Figure 5.1). The familiar 'traffic light' format was the next highest category, with just over one third of positive responses (18%, n=74/410).

As the index is aimed at protecting peoples' heath and is most likely to be used by those with a respiratory or cardio-vascular illness, the same question was asked of this group. Straightforward representation as a scale was the preferred choice for 37% (n=57/156) of respondents (see Figure 5.1). This result was also observed in the focus groups and 'older' persons workgroup, with a simple scale considered the most appropriate image to represent air quality, being '*easy to understand*' and '*appropriate'*. Participants did not want a character such as the French 'Atmo' giraffe, or a 'speedometer' such as is displayed on the Scottish air quality website maintained by AEA (www.scottishairquality.co.uk). Rather, the majority of participants in the focus groups and workshops preferred a simple scale with a graduated colour scheme, clearly displaying the daily value against the full range. As with the questionnaire, within the focus groups, red and black colours were preferred

to symbolize poor air quality, while blue, green and white were favoured to represent good air quality.

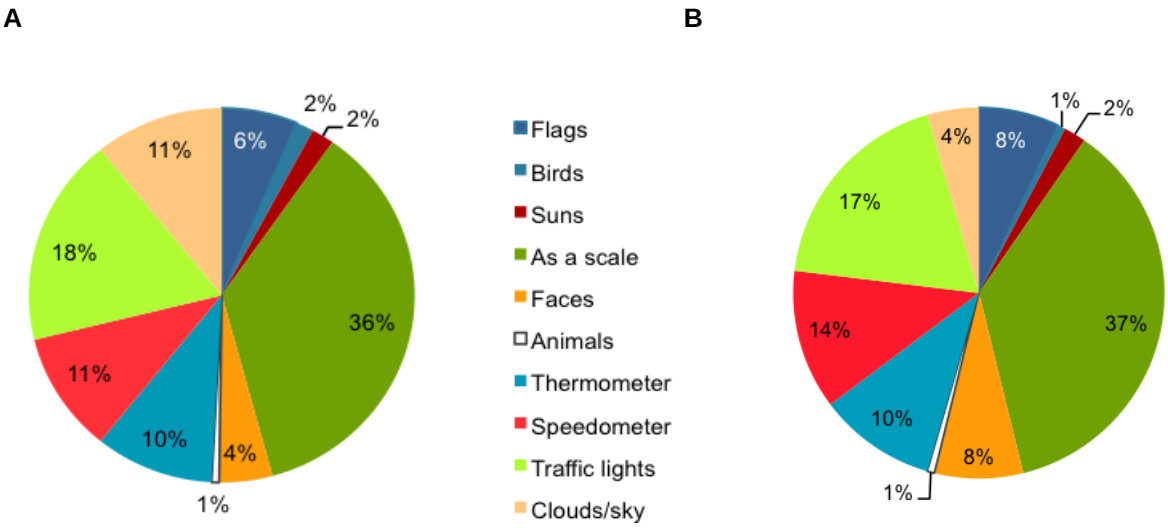

Figure 5.1 Preferred representation of (A) all questionnaire respondents (excluding those that work in air quality and health) and (B) questionnaire respondents with respiratory/cardiovascular health conditions. Note: percentages do not total 100% owing to rounding.

5.5 Bandings and scale

A major talking point of the workshops and focus groups was the use of a continuous scale for displaying air quality information. As stated by Bush *et al.,* (2000), some form of quantification for simplifying air quality data is desired by the general public.

In the UK, a continuous ten-point index value scale is used. The index has four associated, discrete 'named bands', from 'low' to 'very high' (see Table 3.2). Commonly, information on air quality is presented to the public using these four bands only (e.g. www.sussex-air.net). Indeed air quality information for the whole of London is commonly reported using only the four 'named' bands (www.londonair.org.uk/london/asp/default.asp). Furthermore, although the index values are sometimes shown in relation to the named bands, there is usually no explanation of what the index values mean, nor the full scale that is used. For example, '4 – moderate' is often how the AQI information is displayed. The user has no indication that the moderate band is actually represented by three values (4-6) and therefore that '4 – moderate' is actually at the bottom of the moderate banding. This is a common occurrence on many local government website across the UK. This lack of definition is, according to Beaumont *et al*., (1999) one of the key barriers to understanding air quality information.

A useful example of presenting air quality information to the general public can be found on the website managed by Cambridge Environmental Research Consultants (CERC) for Wakefield, West Yorkshire (www.cerc.co.uk/ YourAir/Wakefield/). It demonstrates through the display of a coloured index scale how the numbers relate to each other (1-10), and to the bands and associated health advice The combined

index and bandings used on this site (Figure 5.2) clearly demonstrates the colour scheme, 10 point scale and associated words.

Figure 5.2. Example of the combined index and bandings used in Wakefield (www.cerc.co.uk/yourair/wakefield)

The issue of discrete named 'bandings' and continuous 'index values' were explored within the focus groups and through the online survey. Participants were asked how many 'bands' they thought should be used to describe air quality.

Only one fifth of questionnaire respondents (21%, n=53/259) were in favour of using the current system of four bands, whilst a similar number of participants (23%, n=59/259) preferred five bands. Thirty five per cent (n=90/259) of questionnaire respondents were in favour of using a 10 point scale, similar to the index values used currently (see Figure 5.3). This finding is significant at the 0.05 level (x^2 *(n=259) = 303.0, p>0.05)).* Interestingly, a similar pattern was observed in those with respiratory conditions, with 36% (n=35/97) favouring a 10 point banding system. This relationship was not, however, statistically significant ((n=259) = 5.9, *p=0.75, Cramers' V = 0.15)*.

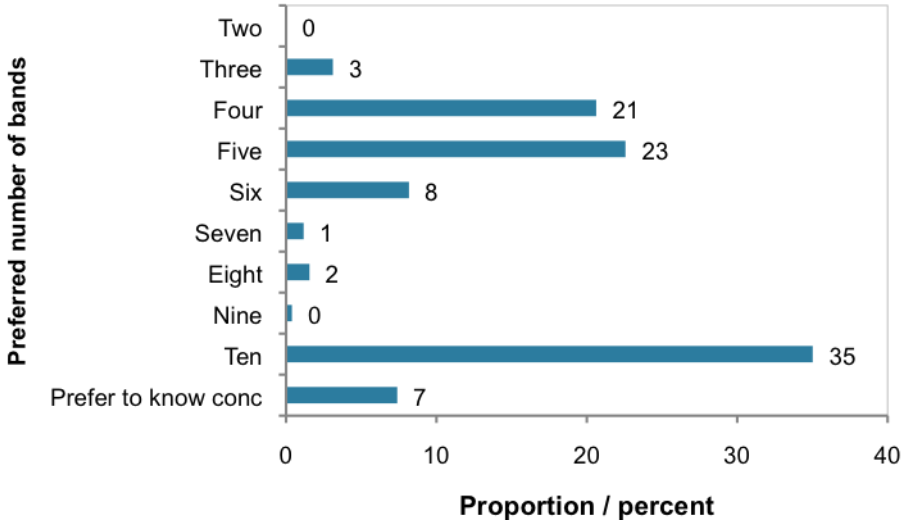

Figure 5.3 Preferred number of air quality index 'bands'

Overall, there was no clear preference for the number of bands used. In discussion of 'scales' within the focus groups and workshops, participants expressed a slight preference for a graduated 10-point scale.

> *"Good simple 1 - 10 scale, clear, I like the big easy to understand level and risk description, good description for the 'at-risk' groups and it tells you who is at risk, the colour scale is also good and appropriate". (R240) [Re: Canadian AQI]*

> *"[Don't like] limited levels, what affects you may not affect me and vice-versa". (R155) [Re: UK AQI]*

> *"The 10 - PLUS is worrying… (How much worse than 10 can it get?!). Perhaps ten should be [the] highest - best air quality score. i.e. more numbers = better air". (R103) [Re: Canadian AQI]*

From the focus groups and workshops it was clear that, for this set of respondents, the additional information provided by a 6 or 10 point band/scale, would be helpful in allowing participants with health conditions to make their own judgements concerning air quality and its affects on their health.

> *"If I could get a better idea of the air pollution, I can test myself against the condition of the day and then I know, at this level I can do that, and at this level I should stay in" (Male, COPD, 65+)*

> *'Moderate 65 is ok for example, but if you had a child with asthma, and it said moderate 97, you'd know that that was almost into the bad group so it's not too good for sensitive people" (Female, asthma, 35-44)*

> *"Having just a 1 on each side of the centre, there's less of an incentive for me to do anything about it. It might be borderline good but there's no incentive for me to try to improve my living condition". (Male, asthma, 25-33)*

These findings agree with Bush *et al.,* (2000) and Beaumont *et al.,* (1999), both of whom state that useful information is lost by compressing air quality data into a limited scale. The use of a six or ten point scale would also remove the frustration felt by participants at consistently receiving the same 'moderate air pollution' message. The problem was identified in previous research (Smallbone, 2009). Care must be taken, however, to ensure that the there is not a 'jump' between classifications (Shooter and Brimblecoombe, 2008).

The use of a large air quality index scale (*i.e.* 0 - 100) was also explored. It was clear that participants (in both the focus groups and the workshops) did not like the scales used by the USA and Australia, which go from 0 - 500 and 0 - 200+, respectively (see Table 3.1).

> *"0 - 500 scale not really meaningful". (R229) [USA AQI]*

> *"The numerical value seems redundant; no advice". (R126) [USA AQI]*

> *"I don't know why this one goes up to 200, why can't it be just a percentage number?" (Male, no health condition, 55-64) [Australia AQI]*

> *"That one there, says 1-33, what does that mean? 33 what? Numbers 1 to 10 you can deal with can't you" (Female, no health condition, 25-33) [USA AQI]*

> *"The numbering system is too large; most members of the public won't get it". (R211) [USA AQI]*

5.6 Summary

This research has indicated that, whilst participants were interested in air quality information, and aware of the relationship between air quality and health, they are not aware of the existing UK air quality index. This lack of awareness includes those without respiratory illnesses, who may be expected not to have an emotional and health related investment in this subject, and those with respiratory illness such as asthma. These research findings also agree with the work of Bell *et al.,* (2005) and Hussein and Partridge (2002). The lack of awareness in those whom one may have expected to have a vested interest in exploring the relationship between air quality

and their own health, may be because the individuals in question are either unconcerned about, or do not perceive a link between these subjects.

In terms of revising the existing air quality index (AQI), the findings of this study suggest that primary information needs, as identified by the research participants, included the level and spatial distribution of air pollution. Such information should be accompanied by focused advice on health effects and suggestions for mitigation for both sensitive and non-sensitive groups. Although not representing the majority view of the questionnaire respondents, these findings are in line with the work of Bush *et al.,* (2000). In addition, participants preferred advice to be focused, concise and jargon free, but without being vague. Participants also suggested that additional sources of information should be made available for those without access to the internet.

Respondents indicated that they would like to see more air quality bands than the four used in the current system. Although the preferred number of bands was not apparent from the online survey, information from the focus groups, suggested that the use of a wider banding system with six or ten intervals would allow users to appreciate the variation in the levels of air pollution, judge risk and adjust their activities accordingly. This view was widely expressed by those with respiratory illnesses, where a wider scale would allow for greater gradation in air pollution. Furthermore, it removes the frustrations of having a wide ‘moderate’ band, and therefore creating the perception that air quality either does not vary, or that the system is too crude to identify such variation.

6: Information sources & trust issues

Shooter and Brimblecoombe (2005) noted that air quality information, and in particular, air quality indices, need to be representative of the community they purport to characterize; and be '*trusted and understandable'* (p7). These characteristics were also highlighted by Bush *et al.,* (2000), who stated that official air quality information supplied by local authorities was often mistrusted. This section will examine, how respondents in the present study accessed air quality information, which organisation they believed was responsible for providing such information, and how much trust they placed in that source.

6.1 Accessing information

The Aarhus convention allows for public access to environmental information. This principle was enshrined in the EU Directive 2003/4/EC and provides every citizen of Europe the right to access environmental information. Furthermore, the directive declares that Member States have to ensure that public authorities make such information freely available and that such information should be organised in such a way as to make it accessible and understandable (van den Elshout *et al.,* 2008)

6.1.1 Information on air pollution

Many communication methods are available such as the internet, telephone helplines, electronic noticeboards, media bulletins and forecasts. Initially they appear to be extensive and easily accessible. On deeper investigation, however, access varies by age and social class. Questionnaire respondents were asked how they would go about accessing information on air pollution. This was an open-ended question and participants were not prompted in their response. Users of airAlert and airTEXT services were excluded from this analysis as they are not national services and therefore the inclusion of such users may have skewed the results. Those who worked in the field of air quality were also excluded from this analysis.

A total of 336 questionnaire respondents answered this question. Just over a fifth of respondents were unsure how they would go about finding this information (21% n=70/336). Of those that knew how to access the information, the most popular method was the Internet / web search (45%, n=119/266), followed by the local council 29% (n=78/266). Media services (TV, radio, newspaper) were also popular methods (13%, n= 35/266) (see Figure 6.1).

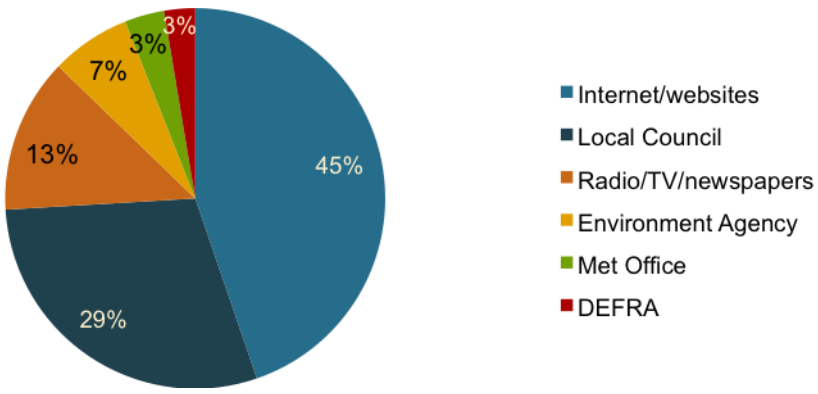

Figure 6.1 Perceived sources of air quality information

Questionnaire participants were also asked, if air quality information was to be supplied to them, what would be their favoured method of communication. Media outlets (TV and radio) along with the internet were preferred by the majority of participants (See Figure 6.2). Only 15 participants specified another method of communication, and all of these requested information by e-mail.

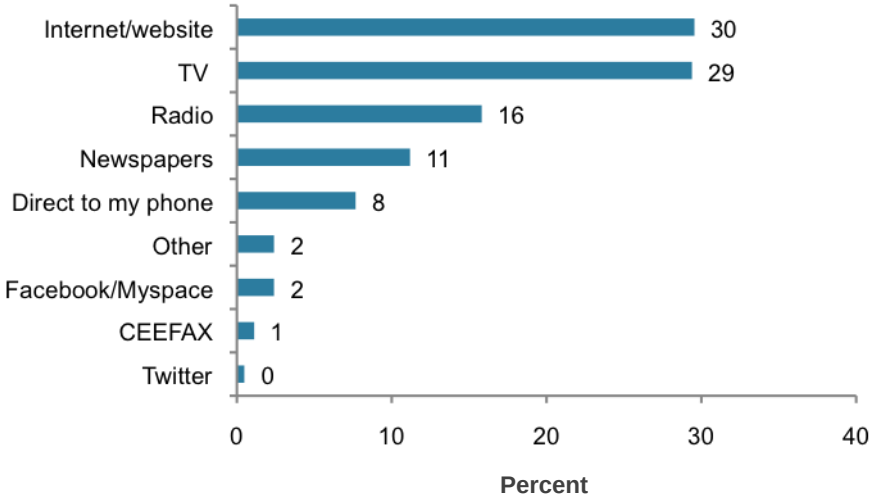

Figure 6.2 Preferred method of receiving information on air quality

This research has found that the media (especially television and radio) are useful tools in communicating air pollution information to the public and echo results of Beaumont *et al., (*1999). Technology that was not generally accessible a decade ago, such as the internet and smart phones were also highlighted as important communication methods by this research cohort. Newer forms of communication such as social networking sites (e.g. facebook, myspace, twitter) were less popular than expected, but this may have been due to the age range of the respondents. The responses were therefore investigated by age (see Figure 6.3).

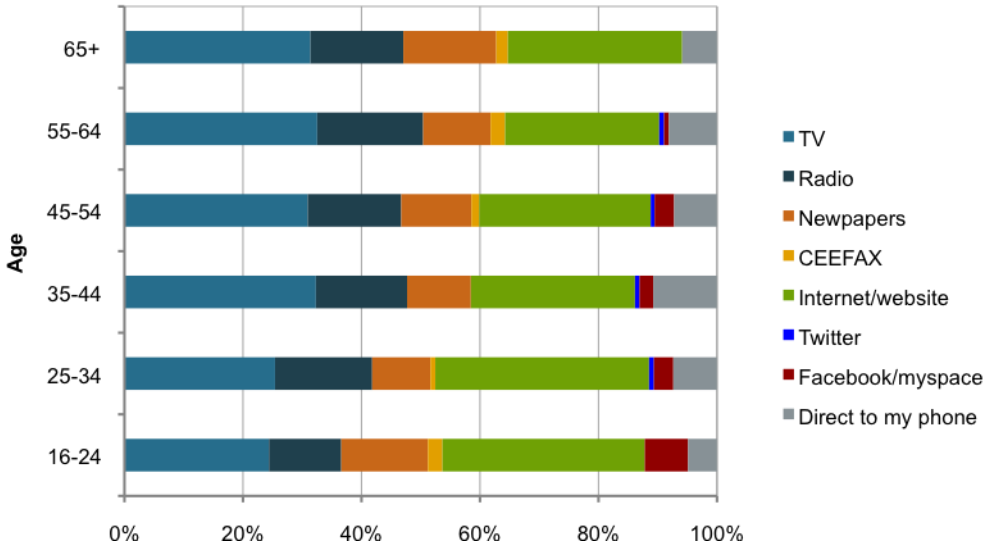

Figure 6.3 Preferred method of communication by age

The television was the preferred method of communication for those aged over 34, while the internet was preferred by those aged between 16 and 34. Social

networking sites were chosen by only 7% (n=3/41) of the under 25's and under 5% of all other age groups and therefore they are not recommended as a method of communication at this current time.

6.1.2 Information on the effects of air quality on health

Questionnaire respondents with a specified medical condition were also asked how they accessed information on the health effects of air pollution. Respondents could specify more than one information route. Over a third of participants with all health conditions specified that they would undertake their own research (see Figure 6.4). Specialist medical professionals (*e.g.* respiratory nurses etc) were the preferred source of information for those with emphysema and COPD, while GP's were the secondary source of information for those with asthma.

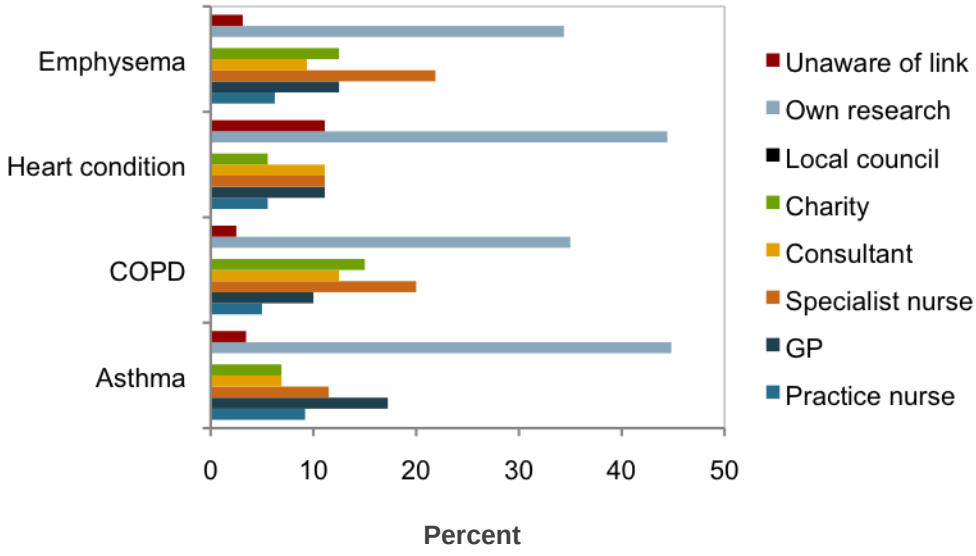

Figure 6.4 Source of information on the effects of air quality on health by medical condition.

6.2 Frequency of Information

Both questionnaire respondents and participants in the focus groups and workshops were asked how often they would like to receive information on air quality and health. Just over half of respondents would only wish to receive information on air pollution when it poses a threat to health (see Figure 6.5). Just over a fifth of respondents (21% n=64/304) stated that they would like access to weekly forecasts, while 22% (n=67/304) stated they would like daily forecasts even if pollution was predicted to be low. This was also an issue raised in the workshop and focus groups.

Focus group participants suggested that a five-day forecast would be useful to allow them to plan their week. This was especially true of those with more severe respiratory conditions. Participants were aware (from their experience with long-range weather forecasts) that such forecasts would not be as accurate as a daily forecast. It was, however, something that particularly appealed to the older respiratory-focused workshop.

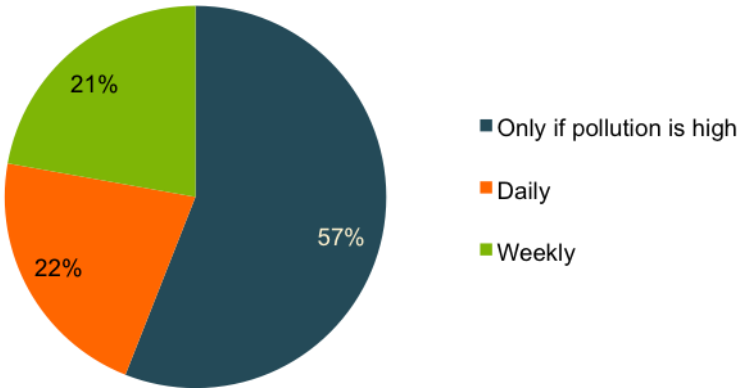

Figure 6.5 Preferred frequency of receiving air quality information

In relation to early warnings, the results of this study suggest that daily alerts should be issued on an intermittent basis, when air pollution is expected to reach the point where it may cause health affects. Additional two or five day forecasts should also be available via a variety of media sources, in order to allow people to plan ahead. Such a strategy would be in line with the approach adopted in Canada for example.

6.3 Behaviour changing information?

There is little research on the effectiveness of alerting sensitive people to air quality that breaches health thresholds. Wen *et al.,* (2009) stated that media alerts of air quality episodes in America changed outdoor activity behaviours in 31% of those with lifetime asthma, and in 16% of those without asthma. Similar reported findings have been observed in relation to heat alerts (Sheriden 2007, Semenza *et al.,* 2008) and UV (sunburn) warnings (Dobbinson *et al.,* 2008).

Questionnaire respondents were therefore asked if they would consider changing their behaviour (taking action) in response to an air quality index alert and if so, what kind of action would they take.

Over half of questionnaire respondents with a respiratory condition stated that they would alter their behaviour on receipt of air quality information (see Figure 6.7), while only 36% (n=32/88) said they would not or could not alter their plans. The opposite pattern was observed in the non-sensitive group (*i.e.* those with no health condition), indicating the importance of the perceived significance of the message.

The most popular change of behaviour reported by all questionnaire respondents (participants could select more than one answer) was to avoid locations that people thought to be polluted (39%, n=80/206), whilst 24%, n=50/206) said they would stay indoors more or keep preventative medication near them (27%, n=56/206). Twenty two per cent (n=46/206) stated they could not alter their plans. Only 15% (n=30/206) stated that they would not change their behaviour as the information was not important to them (see Figure 6.8).

Questionnaire respondents who said they had a respiratory condition were asked what they would do to alter their behaviour on receipt of an air quality warning. Of those with a respiratory illness, 64% (n=53/83) indicated that they would increase their preparedness by ensuring they had easy access to their reliever medications or take a preventative dose (30%, n=25/83).

Reducing their exposure by 'avoiding polluted areas', and 'staying indoors more or all day' was cited by 45% (n=37/83) and 41% (n=34/83) of respondents with a respiratory illness. 'Avoiding polluted areas' was the most popular response to air pollution information by participants without a respiratory illness, (36% n=42/118) followed by 'altering their exercise location' (14% n=16/118).

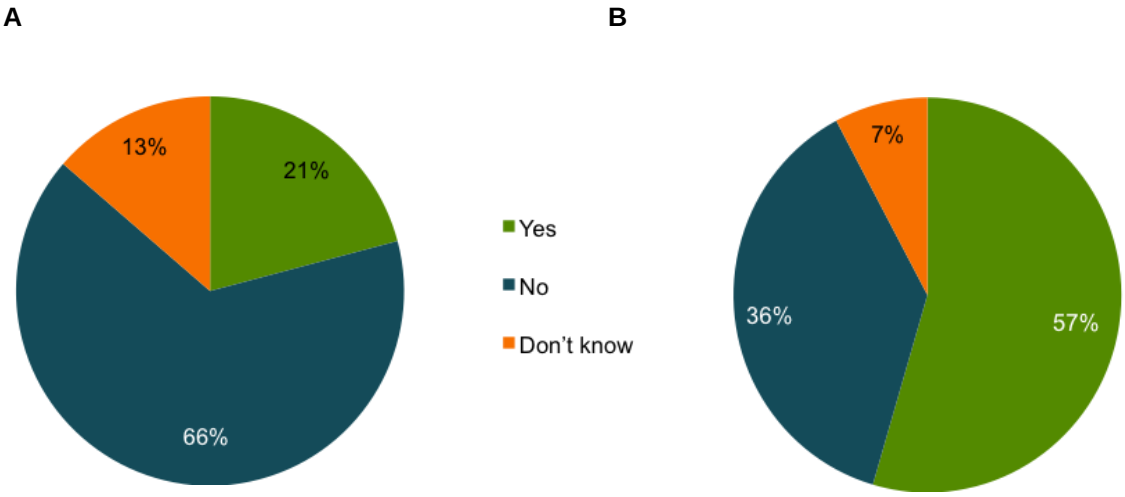

Figure 6.7 Behavioural change on receipt of air quality alerts of those A) without a health condition and B) with health conditions.

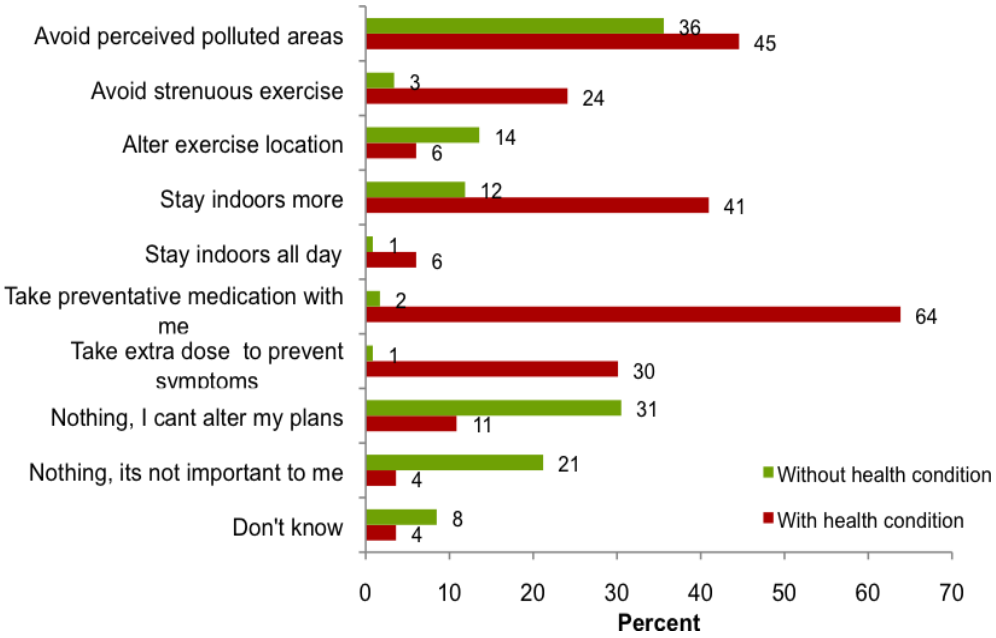

Figure 6.8 Proposed behavioural changes in those with and without a respiratory illness.

Only three questionnaire participants with a health condition said that they would not alter their plans as the information was not considered important (4%, n=3/83), while 11% (n=9/83) said they could not alter their plans. This agrees with work by Smallbone (2009) who investigated behavioural changes on receipt of air quality

alerts through direct delivery methods such as mobile or landline telephones or e-mails.

6.4 Responsibilities

Questionnaire participants were asked which organisation they believed was responsible for providing them with information on air quality. The most frequent response was the Environment Agency (38%, n= 115/305), followed by the Local Authority (22%, n=67/305) (see Figure 6.9).

There was a slight gender bias in the data, however, with 41% (n=77/190) of women and 33% (n=37/111) of men in this sample, choosing the Environment Agency. The proportions of men and women stating that they believed it was the responsibility of the local council to provide such information the same (22% n=24/111 and 22% n=42/190, respectively). Interestingly, only 9% (n=26/301) of questionnaire respondents stated that they thought DEFRA was responsible for supplying them with air quality information, with 13% (n=14/111) of men and only 6% (n=12/190) of women choosing this organisation.

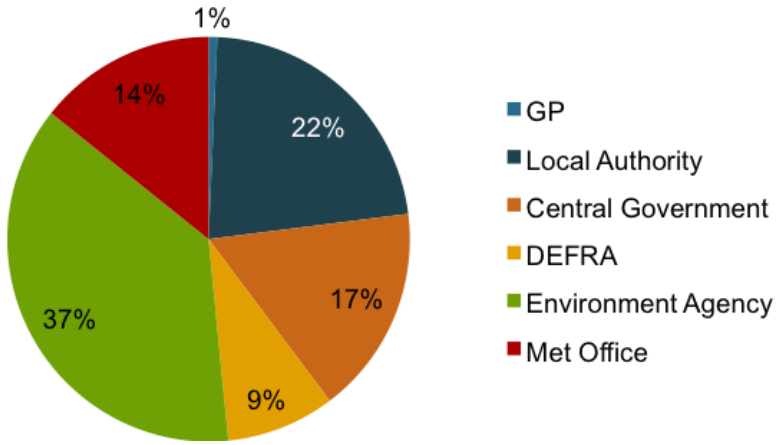

Figure 6.9 Perceived responsibility for providing air quality information.

The issue of 'responsibly for the issue of air quality information' was further investigated within the focus groups and the older group workshops. A similar response to that found through the online questionnaire was observed.

> *"I would like to think they [the Environment Agency] could think for themselves, given that they are the people you would turn to for these sort of issues and they are not directly linked to the Government". (Female, asthma, 45-54)*

> *"I would think the council should have a fair amount of responsibility for it [air quality] but whether they are providing the information for it I don't know. I think they should have a big responsibility to look after it properly really". (Female, no health condition, 25-34)*

Generally, the Environment Agency was first choice for most focus group and workshop participants, followed by the Local Authority. Reasons for this included the perception that the Environment Agency and the Local Council were there to '*protect'* the environment and were disconnected from Central Government. There was also the feeling that these organisations were *more trustworthy* and less prone to '*spin'*, an issue which will be explored further in the following section.

Raising the awareness of DEFRA's role and responsibilities with respect to the environment may be helpful in increasing the profile of the organisation amongst the participants in this survey. Further research may be needed to identify if the findings from this small survey are applicable to the wider public community. This research has also highlighted that the provision of quality assurance / quality control procedural information on air quality monitoring may be also useful to disseminate to the general public.

6.5 Influence and issues of trust

Participants were asked how much they felt that they could personally influence air quality in their local area. Those who had reported that they worked in the area of air quality were excluded from this analysis. Over half of questionnaire respondents (52%, n=135/262) stated that they did not feel they could influence air quality very much, while a quarter of participants (26% (n=67/262) felt they had 'some' influence over air quality levels. There was no statistical difference by gender or age.

In terms of influencing air quality policy at different levels of Government, questionnaire respondents felt that they had no influence at the National government level, and slightly more influence at the Regional and Local government level (see Table 6.1). When examined by gender, the pattern at the National and Regional level of government (and for women at the local level) remained the same. However men felt they had '*some'* influence over policy at the Local level of government (39.3%, n=33). Again there was no difference by age.

Table 6.1 Perceived influence over air quality policy by level of government

Level of Government	A lot % (n)	Some % (n)	Not a lot % (n)	Not at all % (n)	Response Count
Local	2.1 (5)	30.2 (73)	**38.4 (93)**	29.3 (71)	242
Regional	0.8 (2)	13.5 (32)	**45.6 (108)**	40.1 (95)	237
National	2.5 (6)	10.5 (25)	37.1 (88)	**49.8 (118)**	237

An important issue was the level of trust that participants assigned to organisations responsible for providing air quality information. This issue was explored in more depth within the focus groups and the 'older participants' workshop.

Participants were asked who was responsible for providing information on air quality and health and whether they would trust that information source. Responses indicated that there was a lack of trust concerning the Central Governments' ability to provide unbiased information. For example,

> *"I wouldn't trust them [Central Government]. Well it depends on the spin doesn't it, do we want it to be good, or do we want it to be bad?" (Female, no health condition, 35-44)*

> *"Governments put a different spin on things, they want your vote". (Male, asthma, 25-34)*

> *"It should be the government, should be (laughs) but they can do what they like". (Male, no health condition, 35-44)*

> *"It's the [Central] government, but they're not going to give you a balanced view". (Male, no health condition, 25-34)*

Another view point put forward from the focus groups was the lack of choice in information provision, and therefore that the government was trusted to a degree by default.

> *"I don't think I have a choice really, I think if anyone is in the position to have the power and resources and the money to provide the [air quality] information, it's the government, so if I can't trust them, who can I trust". (Male, asthma, 35-44)*

Agencies that participants perceived as not connected to Central Government were accorded a higher trust status.

> *"I would trust them [the Environment Agency], because they are interested in the environment and that's their position" (Female, COPD, 55-64)*

> *"They [Central Government] say one thing and do another. So you'd want to get information from someone more specific, you know like Greenpeace or the Environment Agency, someone who has got environmental issues at their heart" (Female, no health conditions, 25-34)*

> *"Well maybe the Met Office, but do they have to report to the government?" (Female, COPD, 65+)*

In comparison to central government, local government received a more varied response in terms of trust issues. Where participants felt more connected to their local government, they were more likely to trust them as information providers. In addition, an individual's 'lived' experiences, both positive and negative, appeared to influence their perceptions of whether they would trust the local government to provide them with air quality information. Again it should be noted that this comes from a small sample of participants representing only 4 local authorities and is therefore not representative of the UK population.

> *"I'm not being funny but they [the Local Council] are more down to earth, more on our level" (Female, no health condition, 45-55)*

> *"It feels more personal in a way doesn't it? I think there's a personal relationship with the Local Council, they care more about a particular area, they focus on one particular area, it's not just an objective approach with the government handing out pamphlets, it's the council focusing on one area to make society better". (Male, no health condition, under 25)*

> *"I don't really know enough about it to make a valid judgement. I think there's a general feeling of uneasiness when you talk about councils. Personally I've only just got a recycling bin, and that's how many years behind? So you generally feel that you're not done a decent job by your council, I think anyway'. (Female, no health condition, 25-34)*

It is clear that the focus group participants, and those in the older persons workshop, had variable levels of trust in government. The amount of trust varied by experience and contact with government, and most participants would prefer to receive their information from an independent source. Only two focus group participants mentioned DEFRA as a source of information on environmental concerns and that they would trust DEFRA as an information source.

Overall, focus group participants were keen to see a degree of independence in the supply of information. Such independence, it was suggested, could be provided either by an independent observer to oversee the validity of the information, sitting

within local or central government, or by an organisation considered separate from central government control.

6.6 Summary

The most commonly reported source of information suggested by this group of research participants was the internet followed by local councils. The preferred communication method reported by the research participants, however, was via the television, followed closely by the internet.

In terms of frequency, this research indicates that participants would like to receive information on air quality and its effect on health in both a weekly and daily forecast format, but that the information should only be supplied when air pollution constitutes a risk to health.

The questionnaire and focus group participants suggested that information on health effects was more likely to be 'taken seriously' if a health professional was seen to be as the source of the information. Over half of those with a health condition participating in this research reported that they would change their behaviour as a result of receiving information on air pollution. This compares to only a fifth of those without a health condition who would make the same change. This agrees with the work of Wen *et al.,* (2009) who found that 31% of lifetime asthmatics would change their behaviour in response to air quality information in the media, placed there on the advice of health professionals. This compares to only 16% of the general public who would change their behaviour on receiving an air pollution alert.

Actions that participants stated that they would perform in order to change their behaviour included increasing their preparedness (by keeping preventative medications nearby) and reducing their exposure (by avoiding perceived polluted locations, and staying indoors more).

Research participants highlighted the importance of trust in those who supply air quality information. Agencies not seen as connected to Central Government were accorded a higher trust status. For example, the Environment Agency, followed by local councils were considered the most trustworthy sources of information, by this group of research participants, owing to the organisations perceived agenda of environmental protection. Trust in local authorities, however, was dependent on personal experience. It is recommended that the provision of air quality information is accompanied by a simple explanation of the data generation and validation process. It should be noted, however, that this research group of participants is relatively small, and represents only 5 geographical areas, with differing experiences of local councils, and therefore the findings, whilst valuable, should be backed up with further research, especially on the issue of trust.

7: CONCLUSION

Air pollution is increasingly recognised as a trigger for the exacerbation of symptoms in people with cardiovascular and respiratory illnesses. Two hundred and forty five air pollution hotspot zones, (air quality management areas) have been declared across the UK in locations where the national air quality standards have not been, or are unlikely to be, achieved (AEA 2010). Most hotspots have been identified in urban areas, and consequently there is a significant section of the population at risk of short-term (and longer-term) exposure to air pollution. Informing the public of air quality episodes could therefore be useful in allowing them to change their behaviour and reduce exposure if possible.

Research by Wan *et al.,* (2009) reported that the communication of poor air quality information encouraged behavioural changes in those with lifetime asthma in the USA. Similar behavioural changes have been reported on receipt of ozone, heat and UV-index warnings (Neidell and Kinney 2010, Sheridan 2007, Dobbinson *et al.,* 2008).

Any system of air quality communication, however, needs to be carefully constructed and consider the needs of the end-users. This research has used an inductive mixed methods approach (online survey, small group workshops and focus groups) to explore the public's air quality awareness, their information needs and desires and the challenges faced in communicating such information.

Participants in the focus groups were selected to provide a balance of gender, ethnicity, health status and age range (ages ranged from 18 to the over 60's). Participants in the workshops were selected by age criteria and cardio-respiratory condition. A sampling frame for the online survey would have been desirable, but was not possible owing to the short time frame of this research. Nevertheless, the views of those with and without cardio-respiratory illnesses were assessed, and the data analysed for differences in opinions by gender, age, ethnicity and health status. The findings presented in this report should be viewed with caution, however as they are not representative of the UK population as a whole, are taken from a small sample size and has a higher percentage of participants with respiratory illnesses (due to recruitment criteria) than would be found in the general public.

Air quality awareness

Overall, there was an awareness of the sources and effects of air pollution amongst all research participants. Participants of both the questionnaire and the focus groups/workshops identified traffic as the main cause of air pollution at the local and national scale. Participants with and without a health condition perceived rural areas, as 'safe spaces' and 'places to escape the pollution', in other words, as areas of low air pollution. The findings of this research recommend that information on the effects of 'rural pollution' be distributed to those likely to be affected.

Participants also were aware of the link between air pollution and sensitive groups (children, the elderly and those with respiratory illnesses). Knowledge was greater in those with a personal stake in the information; however, this research suggests that more should be done to increase awareness of the effects of air pollution on those with cardiovascular issues. It should be noted however, that these conclusions have been drawn from a very small sample size and are not considered representative if the population at large.

Interestingly, there was little awareness amongst this research cohort of the link between air pollution and climate change. Understanding the link between cause and effect may motivate individuals to change their behaviour (Bord *et al*. 2000, Whitmarsh 2009). This study found that the majority of participants did not make this connection and many were sceptical on the subject of climate change.

Air quality information needs and requirements

Participants in this research project were not aware of the existence of the current air quality index, and furthermore, were confused about which agency was responsible for providing them with this information. A recommendation is therefore, that the provision of air quality information is accompanied by a simple explanation of the data generation and validation process used by the agencies supplying the data.

In terms of revising the existing air quality index, this research has indicated that participants require information and advice that;

- is clear and concise,
- is jargon free,
- is detailed and informative,
- is easy to understand,
- provides information on the level and spatial distribution of air pollution,
- provides clear advice on health and exposure reduction actions and,
- avoids 'fear' generation or 'scaremongering'

Failure to provide positive action advice when presenting negative information on a subject over which people have little or no control, can engender a feeling of anxiety, stress and fatalism in recipients (Duree, 2006, Johnson 2006). This should not prevent advice from being given, however, as many participants with more severe forms of respiratory illnesses welcomed the idea of advice and found it reassuring.

The research participants stated that the current air quality index, which uses four bands, may give the impression that air quality either does not vary, or that the system is too crude to identify such variation. They preferred an increase in the number of categories or bands used to communicate air quality information. An air quality index with six or ten intervals would allow the participants to appreciate the variation in the levels of air pollution, judge risk and adjust their activities accordingly.

Communicating information, changing behaviour

The preferred method of communicating such information was by 'information bulletins' at the end of the weather forecasts on the television. Communication should be on both a daily and weekly forecast basis, but only when air pollution constitutes a risk to health. The internet was also mentioned as a good way of communicating this information. In a number of countries is it possible to sign up for email alerts for local air quality and 5-day forecasts of air quality through a national website. This could be something that is undertaken for the UK.

A number of previous studies have reported behavioural changes on receipt of warning information. This research suggests that at least half of those with a cardiorespiratory condition would alter their behaviour in response to an air quality

alert, while only a fifth of those without a relevant health condition would alter their plans.

Actions that participants stated they would take to change their behaviour, included increasing preparedness (by keeping preventative medications nearby) and reducing exposure (by avoiding perceived polluted locations, or staying indoors more). The provision of such information can have positive benefits on those in sensitive groups, as has been seen in Europe and the USA.

This research, although drawn from a small sample, reaffirms the need to deliver clear, concise material on the subject of air quality to the public in a way that is easy to understand and informative. Provision of such information, accompanied by focused, relevant advice for sensitive, and non-sensitive groups on actions that can be taken to mitigate both exposure and cardiorespiratory symptoms would reduce the feelings of fatalism and anxiety about an issue people feel they can do little about. Such information may empower both those with a relevant health condition, and also healthy individuals to take control of their exposure. It may therefore, engender behavioural changes in the population and improve peoples' sense of wellbeing and overall quality of life.

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APPENDIX A – Health advice

Australian health advice

Separate advice for the general public and those with a health condition by vulnerability and by pollutant. <http://ambulance.nsw.gov.au/PublicHealth/environment/air/sensitive_groups.asp>

AQI for older adults	PARTICLES
VERY GOOD 0-33	Ideal conditions to enjoy outdoor activities
GOOD 34-66	Ideal conditions to enjoy outdoor activities
FAIR 67-99	Unusually sensitive people should consider reducing prolonged outdoor exertion.
POOR 100-149	Older adults, especially those with heart or lung disease should avoid exercising outdoors. Levels will be lower indoors. If you have chest pain, shortness of breath or cough, use your reliever medicine. If symptoms persist, seek medical advice.
VERY POOR 150-200	Older adults should avoid outdoor exertion and stay inside as much as possible. Levels will be lower indoors. If you have chest pain, shortness of breath or cough, you should rest, take your reliever medicine or seek medical advice.
HAZARDOUS 200+	Everyone should avoid outdoor exertion and stay inside as much as possible. Levels will be lower indoors. If you have chest pain, shortness of breath or cough, you should rest, take your reliever medicine, or seek medical advice.

Canadian health advice

Separate advice is provided for the general public and the at-risk groups, combined pollution advice http://www.ec.gc.ca/cas-aqhi/default.asp?Lang=En

Air Quality Health Index Levels of Risk	Value	Accompanying Health Messages for At Risk Populations and the General Population	
		At Risk Population	General Population
Low Health Risk	**1 – 3**	Enjoy your usual outdoor activities.	**Ideal** conditions for outdoor activities.
Moderate Health Risk	**4 – 6**	If you have heart or breathing problems, and experience symptoms, **consider reducing** physical exertion outdoors or rescheduling activities to times when the index is lower.	**No need to modify** your usual outdoor activities, unless you experience symptoms.
High Health Risk	**7-10**	Children, the elderly and people with heart or breathing problems should **reduce** physical exertion outdoors or reschedule activities to times when the index is lower, especially if they experience symptoms.	Anyone experiencing discomfort such as coughing or throat irritation should **consider reducing** physical exertion outdoors or rescheduling strenuous activities to periods when the index is lower.
Very High Health Risk	**Above 10**	Children, the elderly and people with heart or breathing problems should **avoid** physical exertion outdoors.	Everyone should consider **reduce** physical exertion outdoors or reschedule strenuous activities to times when the index is lower, especially if they experience symptoms.

UK health advice

Combined health advice by pollutant and for both the general public and those with a health condition. www.airquality.co.uk

Banding	Health Descriptor
Low	Effects are unlikely to be noticed even by individuals who know they are sensitive to air pollutants
Moderate	Mild effects, unlikely to require action, may be noticed amongst sensitive individuals.
High	Significant effects may be noticed by sensitive individuals and action to avoid or reduce these effects may be needed (e.g. reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects on the lung.
Very High	The effects on sensitive individuals described for 'High' levels of pollution may worsen.

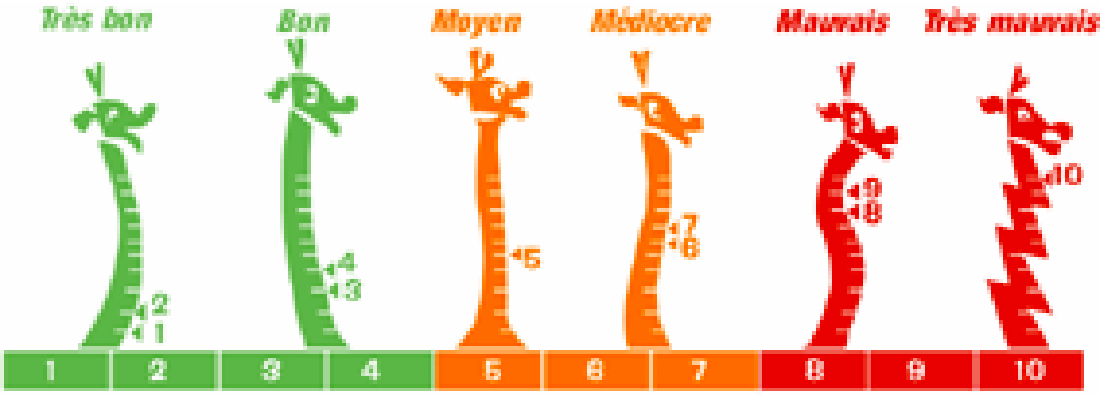
USA health advice

Provides combined advice by health status and pollutant www.airnow.gov

Air Quality Index Levels of Health Concern	Meaning
Good	Air quality is considered satisfactory, and air pollution poses little or no risk
Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	Health alert: everyone may experience more serious health effects
Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.

French air quality index

Atmo the giraffe is used to show the level of air quality. Atmos' neck becomes increasingly constricted as air pollution worsens. <http://www.airparif.asso.fr/indices/images/girafes3.gif



AQI	Descriptor
1	Very Good
2	Very Good
3	Good
4	Good
5	Average
6	Mediocre
7	Mediocre
8	Poor
9	Poor
10	Very Poor