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Cleaner air, clearer lungs, better lives

Exploring the intersection of air quality,
health inequalities and lung health

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Contents

3	Key findings and calls to action
4	About this report
5	Introduction
7	Background
7	International concern about air pollution
8	Complications arising from climate change
8	The socioeconomic angle: do we all breathe equally?
9	Focusing on the EU5: a distinct region in key respects
12	Findings
12	Air quality problems still substantially affect the health of many Europeans living with lung conditions
13	Poor air quality contributes to worsening symptoms and lower quality of life for people with lung conditions
14	The impact of air pollution reaches beyond physical health—it also negatively impacts mental health
15	Climate-related factors and pollution from the built environment are the main causes of pollution
15	Good air quality may act as a buffer to climate-related challenges
16	Those in urban areas face a greater burden of poor air quality
18	Surprisingly, results do not vary significantly by education or income
20	Discussion
20	Changes in what we breathe and what we measure: how air quality continues to impact health
22	Conclusion: progress has been made, but more is needed
24	References

Key findings and calls to action

- This survey of 500 people with lung conditions in **France, Germany, Italy, Spain** and the **UK** found that, despite reductions in the concentration of key air pollutants, poor air quality negatively affects symptoms, overall health and quality of life for people living with lung conditions.
- Generally, the study countries have good air quality, but the data highlight the need to maintain and increase progress in reducing key pollutants. **Policymakers should consider this ongoing health impact and how to further incentivise action as they review national and international legal pollutant concentration limits and air quality guidelines.**
- The increasing number of heatwaves and increased pollen load—both generally associated with climate change—are already having a notable negative impact on people living with lung conditions. **Data collection must be improved to understand their extent and impact, enabling evidence-based policymaking.**
- Continuing climate change requires that **policymakers integrate heatwaves and pollen in air quality policies, and they should include different perspectives in the making of such policies**—for example, lung experts and environment experts working alongside each other, with people with lived experiences, and so forth.
- These issues were reported by survey respondents in all five study countries, but the problems are especially acute in urban areas, highlighting that **policy needs to continue to focus on the impact of air quality specifically on urban populations.**
- Our research did not uncover any significant variation in the extent of these issues among people of different socioeconomic status or education levels, possibly due to the broad protective effect of universal health coverage in the study countries. However, **policymakers, when defining universal health packages and comprehensive respiratory health plans, should consider how heatwaves and increased pollen will likely affect those living with lung conditions.**
- Our research is a starting point; **more research is needed to further explore the intersection of air quality, health inequalities and lung health, and to understand specific risks, vulnerabilities and adaptive strategies for people with lung conditions.**

About this report

Cleaner air, clearer lungs, better lives: exploring the intersection of air quality, health inequalities and lung health is an Economist Impact report, supported by **Chiesi Group**, a pharmaceutical company. This independent research explores the links between air quality, health inequalities and lung health. The study focuses on Western Europe, in particular five countries: France, Germany, Italy, Spain, and the United Kingdom. The findings of the report are based on a literature review and survey results.

The report was written by **Paul Kielstra** and edited by **Miranda Baxa**, **Michael Guterbock**, and **Elly Vaughan** of Economist Impact, with copy editing by **Melissa Lux**. Survey research and analysis was carried out by **Georgina Lovati** with support from Miranda Baxa, Michael Guterbock and Elly Vaughan. The findings and views expressed in this report are those of Economist Impact and do not necessarily reflect the views of the sponsor or the experts who contributed.

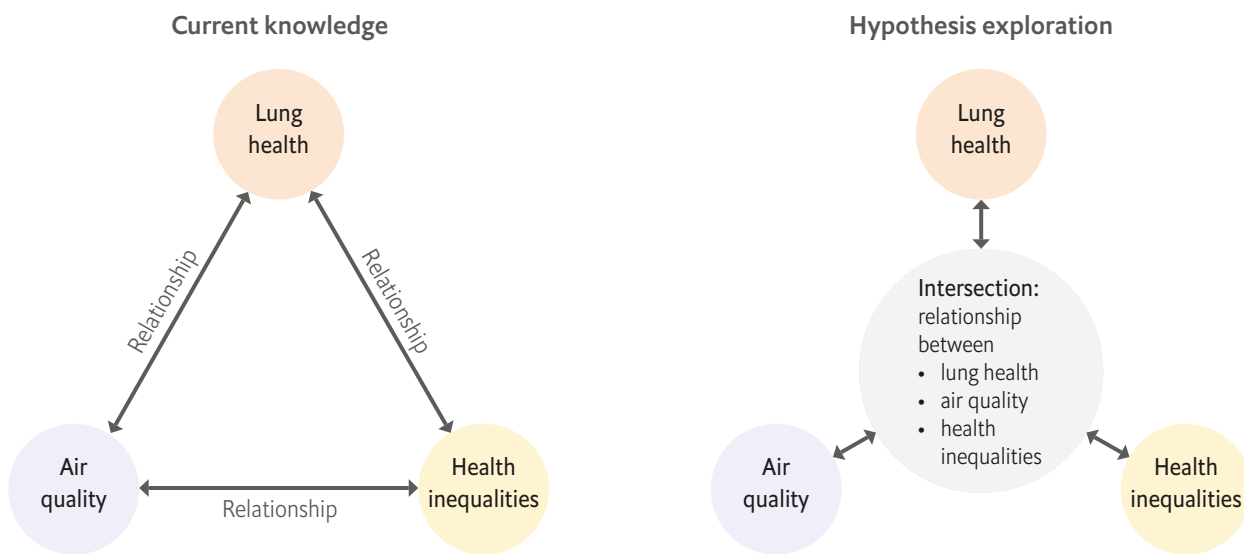
Introduction

Research on lung health often views the health of those affected by lung conditions through two narrow lenses: (1) attributes of the illness and (2) medical interventions available to treat or improve lung conditions. While some studies focus on the presence and effect of lung health inequalities, patient perspectives are often missing from these discussions. With this gap in mind, Economist Impact set out to better understand the realities and concerns of those with lung conditions by capturing lived experiences in the EU5.

This briefing paper describes the results from a survey of 500 people living with lung conditions in France, Germany, Italy, Spain and the UK. Much literature investigates the impact of air quality and health inequalities on lung health separately but not the intersection of all three. The aim of the survey was to explore a hypothesised relationship between lung health, air quality and health inequalities, focusing on the perspectives of people with lung conditions (Figure 1). By first exploring the policy landscape for improving air quality and then incorporating individual perspectives, this study takes a much-needed wider view to examine the impact of the environment within which people with lung conditions live.



Figure 1. Lung health, air quality and health inequalities – current knowledge and hypothesis exploration



Source: Economist Impact 2023

Background

Evaluating the physical, policy and socioeconomic context is a critical first step in understanding the survey responses. Air quality in particular is an important aspect of this context. While this report focuses on the EU5, the global view of air pollution is also significant. First, international health policy is intended to act as the foundation for national health policy, with organisations such as the UN and the World Health Organization (WHO) setting guidelines for individual countries and supranational organisations. Second, and more notably, air pollution does not recognise national borders. That is, the action (or inaction) related to air pollution in one country can impact the populations of neighbouring nations. Thus, the following discussion takes a global view of air quality and related policy before focusing on the countries included in this study.

International concern about air pollution

Impure air is a substantial global health challenge. The WHO estimates that outdoor air pollution resulted in 4.2m premature deaths in 2019.¹ Of this total, roughly 52% of deaths resulted from lung conditions that were either caused or exacerbated by pollutants: 18% due to chronic obstructive pulmonary disease (COPD), 23% due to acute lower respiratory infections, and 11% due to cancer in the respiratory tract.¹

International health policy has, accordingly, grown more active in the area. In 2015, for example, the UN Sustainable Development Goals (SDGs) included a commitment to reduce mortality and illnesses from pollution, including air pollution (Goal 3.9). Two of four related SDG progress indicators monitor deaths from ambient (outdoor) and indoor air pollution.²



More recently, in 2021, the WHO revised its 2005 air quality guidelines (AQG) on maximum concentrations of exposure to air pollutants (see Table 1).³ Citing a growing evidence base, the updated AQG substantially reduced recommended levels, especially for nitrogen dioxide (NO₂) and particulate matter with a diameter of 2.5 micrometres or less (PM_{2.5})—which is often cited as the most dangerous air pollutant.^{3,4}

Table 1. Recommended 2021 AQG (Air Quality Guideline) levels compared to 2005 AQG

Pollutant, $\mu\text{g}/\text{m}^3$	Averaging time	2005 AQG	2021 AQG
PM _{2.5}	Annual	10	5
	24-hour*	25	15
PM ₁₀	Annual	20	15
	24-hour*	50	45
O ₃	Peak season [†]	-	60
	8-hour*	100	100
NO ₂	Annual	40	10
	24-hour*	-	25

μg = microgram

* 99th percentile (ie 3–4 exceedance days per year)

[†] Average of daily maximum 8-hour mean O₃ concentration in the six consecutive months with the highest six-month running average O₃ concentration

Note: Annual and peak season indicate long-term exposure, while 24-hour and 8-hour indicate short-term exposure

Source: Adapted from WHO. What are the WHO air quality guidelines?²⁵

Complications arising from climate change

Climate-related factors are of growing interest in understanding the link between air quality and health—specifically, the increasing impacts of heatwaves and pollen. Climate change is expected to drive significant increases in both of these.^{6,7} While the impacts of climate change such as worsening heatwaves and increased pollen levels are of concern, the evidence base for the extent of these problems is lacking. For example, the term heatwave continues to lack a single, accepted definition. Still, the trend of a growing percentage of summer days falling into this category in Europe is upward, albeit unevenly so (Figure 2). This shift is generally associated with climate change, although the exact mechanism remains debated.^{8,9} Heatwaves also appear to be increasingly common in Europe. According to the Climate Change Service, the ten warmest years on record in Europe occurred since 2000, with the five warmest years occurring since 2014.¹⁰

Comprehensive, long-term data series of pollen levels, meanwhile, remain relatively scant. Only in 2019 did researchers—in this case, looking at information from across the northern hemisphere—find a statistical link between higher average temperatures, the length of the pollen season, and the extent of the pollen load.¹² The evidence suggests that most people are breathing in more pollen.

The socioeconomic angle: do we all breathe the same quality air?

The social determinants of health—the conditions in which people are born, grow, live, work and age, including their socioeconomic status (SES)—have long been known to have a substantial impact on health inputs and outcomes.¹³

Evidence from much of the world indicates that social determinants play a role in air quality and lung conditions. In most regions, those living in lower-SES neighbourhoods breathe

more polluted air and have worse health outcomes.¹⁴ The degree and impact vary, but any examination of the link between air quality and health has to consider the socioeconomic aspect.

Focusing on the EU5: a distinct region in key respects

Worldwide trends related to air pollution and climate affect Western European countries, but the region also differs from global norms in important ways. To a large degree, air quality and the health outcomes arising from it are better in the five survey countries. Nevertheless, air quality issues continue to threaten the health of those living with lung conditions.

- **Policy lags behind WHO guidelines:** The current EU Ambient Air Quality Directive, originally published in 2008, covers four of this study’s countries—France, Germany, Italy and Spain. The directive’s exposure limits are higher than the 2005 WHO AQG. A proposed revision drafted in October 2022 includes more stringent restrictions, but these still exceed the levels recommended in the 2021

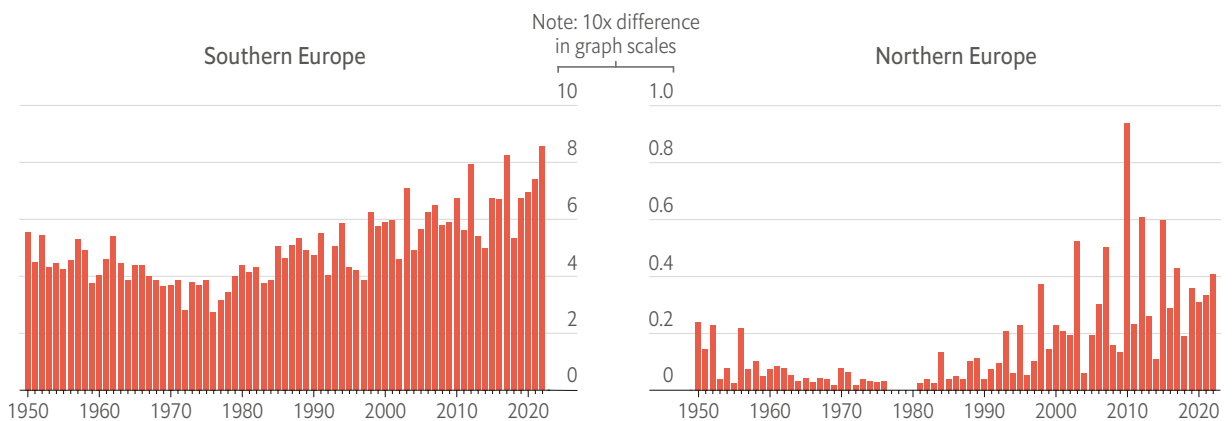
AQG.¹⁵ In July 2023, all countries in the WHO European Region agreed in the Budapest Declaration to use the WHO guidelines as reference points for stricter air pollution limits (although they did not commit to necessarily meeting them fully).¹⁶

- **Actual pollution concentrations in our five study countries, however, are good relative to global levels:** In contrast to global rates, these countries have seen substantial progress toward cleaner air over the last decade (Figure 3). Using average PM2.5 concentrations as an example, in 2019, Spain met the previous WHO AQG with an average annual exposure of 9.73 µg/m³, and the UK almost did (10.1 µg/m³). The worst exposure was in Italy (16.1 µg/m³), which was still well below the European limits (Directive 2008/50/EC).¹⁷

Nevertheless, improvements remain necessary. France, for example, has had to pay fines for breaching European guidelines.¹⁸ Meanwhile, the WHO evidence noted above shows that even states that have reached the old AQG need to improve. Doing so will help to save lives.

Figure 2. Is it hot in here?

Percentage of days during summer with ‘very strong heat stress’ (UTCI* between 38 and 46°C) in Europe, 1950 to 2022

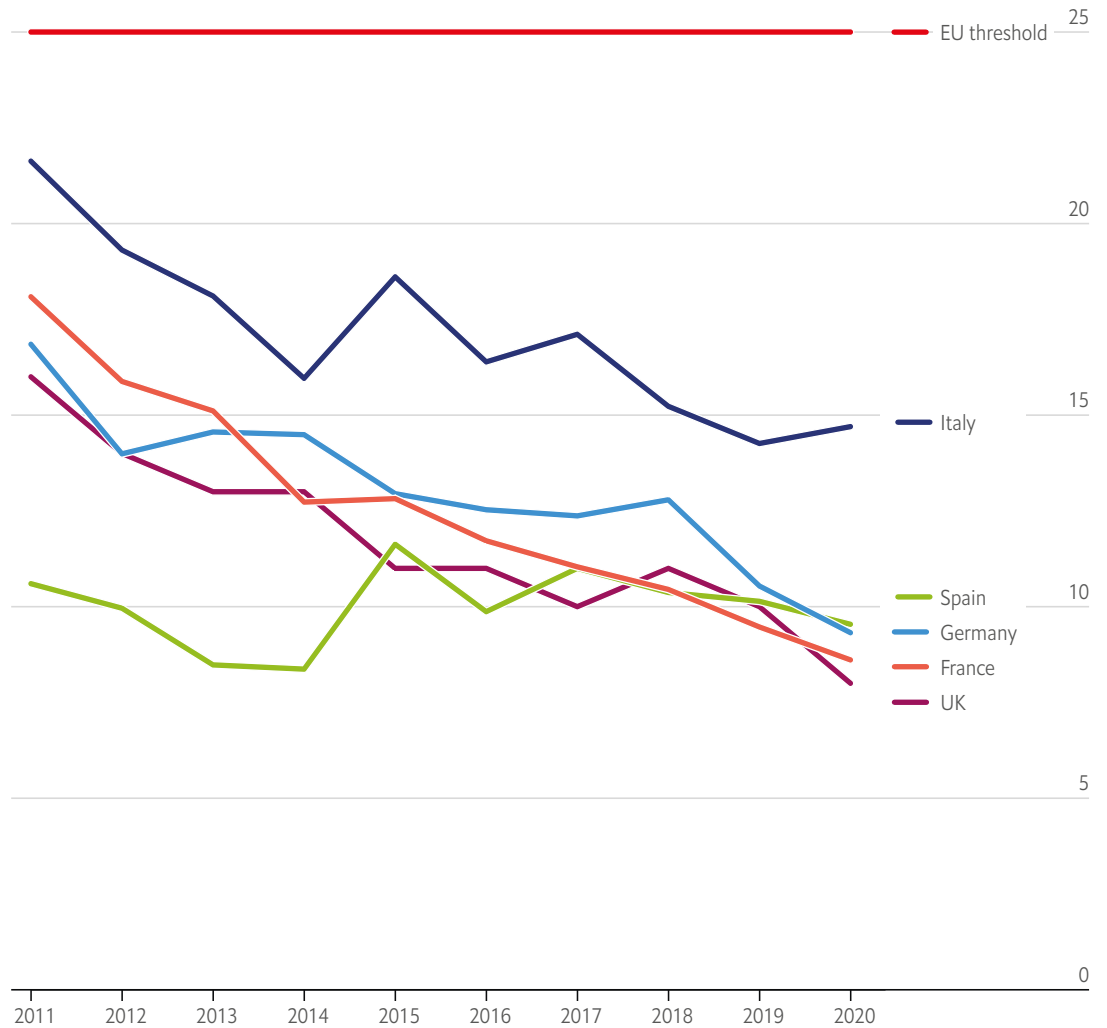


* Universal Thermal Climate Index

Source: Copernicus Programme, “Extreme Heat,” European State of the Environment 2022,¹¹ (data from ERA5-HEAT with credit to C3S/ECMWF), <https://climate.copernicus.eu/esotc/2022/extreme-heat>

Figure 3. Annual Mean Concentrations of PM2.5

Mean concentrations of PM2.5 from all monitoring stations, $\mu\text{g}/\text{m}^3$



Sources: European Environment Agency;^{19,22} UK Department for Environmental and Rural Affairs²³

- Resultant mortality is also comparatively low:** The age-standardised rate of deaths attributable to air pollution in the study countries ranged between 10.03 (France) and 15 (Italy) per 100,000. All of these national figures were among the 22 lowest in the world. France and Spain were among the ten lowest.²⁴
- Heatwaves and pollen load will likely grow:** The data described in Figure 2 suggest that these problems are increasing in the northern hemisphere, including Western Europe, likely due to climate change. A recent report from the Intergovernmental Panel on Climate Change warned that the number of days hot enough to cause death has been increasing globally.²⁵

- **Any relationship between health inequalities and air quality is less clear than in other regions:** Studies of differential pollutant exposure by either area or SES in eight Western European countries yielded inconsistent results: disadvantaged groups faced higher levels of air pollution in some; the reverse was true in others.²⁶

The survey aims to help understand the complex interrelationships in the lived patient experience between air quality, health inequality and lung health in a region which is, in many ways, better off than most.

Findings

The survey, conducted in June 2023, had 500 respondents, with even numbers from each of France, Germany, Italy, Spain and the UK. Of those surveyed, 86% reported having asthma, 20% COPD and 4% chronic pneumonia. Several individuals were living with more than one of these. Those surveyed were also from across the economic spectrum, with 35% classified as low income (annual income less than €38,000); 34% medium income (annual income above €38,000 and below €103,000); and 31% high income (annual income above €103,000). Of respondents, 47% lived in cities, 33% in towns or semi-dense areas and 20% in rural areas. Finally, those surveyed had a range of education levels: 29% held at most a high school certificate, 45% a bachelor's degree and 19% a postgraduate qualification.

Air quality still substantially affects the health of many Europeans living with lung conditions

It is no surprise that air quality has an impact on people with lung conditions. More striking, though, is the extent of the effect.

Overall, our respondents were more likely to say that air quality where they live has deteriorated over the last five years (38%) than improved (24%). The rest (38%) think thought it was about the same. In all five countries and across urban, suburban and rural areas, those who said that air



quality had declined outnumbered those who said the opposite.

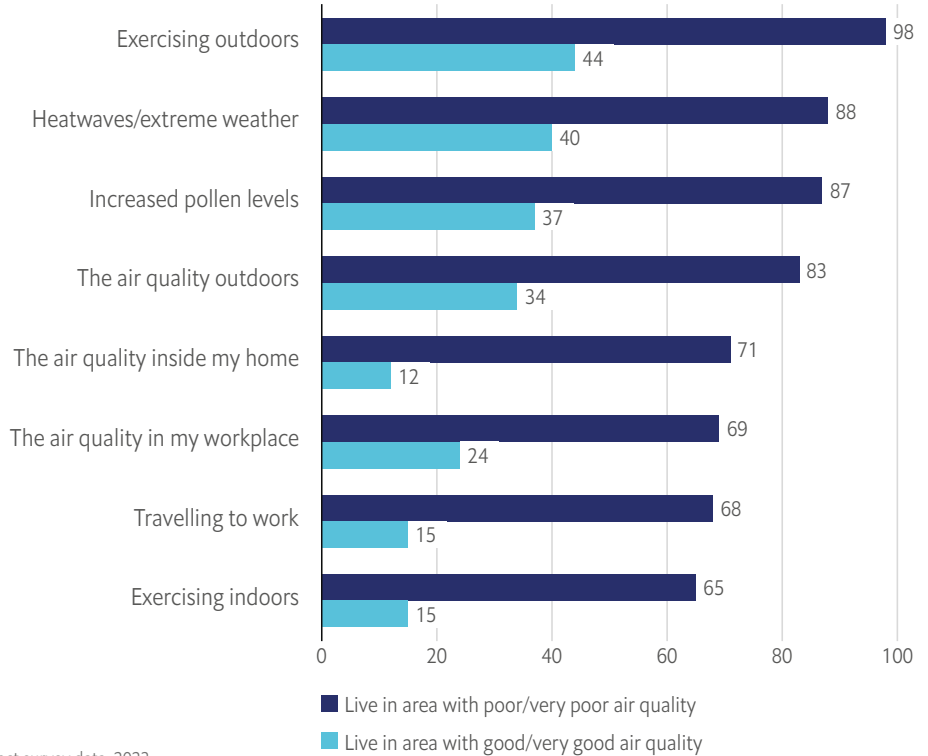
In our survey, 37% of respondents said that where they live currently has good or very good air quality that is better than five years ago. In contrast, 25% of respondents reported that the air quality is currently poor or very poor. A total of 69% believed that the air quality had worsened in the previous five years, regardless of whether they thought that current air quality was good or bad.

These two groups have markedly different answers to several other questions related to physical health (Figure 4).

Figure 4. Reported impact of air quality on symptoms of lung conditions, %

Question 11: Percentage agreeing with the following statements

The following makes my lung condition(s) worse:



Source: Economist Impact survey data, 2023

Poor air quality contributes to worsening symptoms and lower quality of life for people with lung conditions

Respondents who reported living in areas with poor air quality believed that it makes the symptoms of their lung conditions worse (Figure 4): 48% said that it affects their symptoms a great deal, and 52% said it somewhat affects their symptoms. In contrast, only 30% of respondents reporting good air quality believed that the air affects their symptoms a great deal, and 37% reported that the air quality has little to no effect at all.

Where the air quality is poor, 83% of respondents reported that merely going outside exacerbates their lung condition, and 71% report that the air in their own homes makes

their symptoms worse. These problems are much less common for individuals who reported good air quality, affecting only 34% and 12%, respectively.

Low air quality imposes a trade-off for many of those wishing to engage in physical activity, causing them to weigh the benefits of exercise against the exacerbation of their lung conditions. Nearly all (98%) respondents living in areas with poor air quality reported that exercising outdoors makes their lung conditions worse, and the majority (65%) reported that exercising indoors has the same effect. Fewer respondents living where air quality is good or very good face this choice: exercising causes worsening symptoms in this group for 44% when outdoors and only 15% when indoors. Given the established benefits of exercise (particularly

outdoor exercise) for maintaining and improving lung health, these results suggest that those living in areas with poor air quality are at a disadvantage compared to their counterparts.²⁷

context, we incorporated survey questions related to quality of life and mental health to examine the impact of air quality. Findings from this portion of the survey indicate that poor air quality can impede activities that have been shown to improve mental health and quality of life.



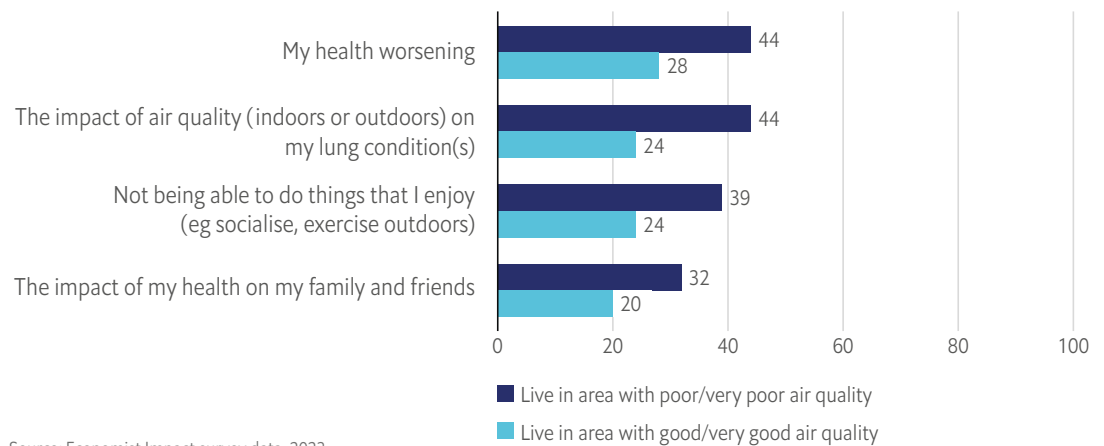
The impact of air pollution reaches beyond physical health—it also negatively impacts mental health

As described above, people living with lung conditions reported that poor air quality exacerbates their symptoms and results in worsening health. Changes in physical health can also affect quality of life and mental health, for example the Mental Health Foundation in the UK reporting that 1 in 3 individuals with a chronic condition also experiences a mental health condition (eg depression).²⁸ In this

Social interaction is important for maintaining good health and quality of life.²⁹ This is especially true for individuals with chronic conditions, including COPD, where studies have found that social support can lead to fewer exacerbations and better health status.^{30,31} Yet, over half (57%) of those living in an environment with poor air quality reported that they have had to avoid outdoor activities, such as exercise/ sports or social engagements (Figure 4). In areas with good air quality, only 36% of respondents reported having to avoid these activities. Thus, individuals in areas with poor air quality are more likely to miss out on activities that could benefit their mental health and quality of life.

In addition, those living with poor air quality are more likely to worry about potential problems associated with their conditions. In fact, 44% of this group think a lot about their health worsening, compared to just 28% of those living in a less polluted environment (Figure 5).

Figure 5. Reported concern related to statements about the future, by reported air quality, %
Question 15: Percentage who think about the following a lot



Source: Economist Impact survey data, 2023

Climate-related factors and pollution from the built environment are the main causes of pollution

When asked about the leading causes of air pollution where they live, 67% of respondents said traffic exhaust—by far the most commonly cited issue (Figure 6). Traffic fumes and pollutant concentrations tend to be greater in urban areas, where the majority of residents in our study countries live. Indeed, more than 67% of respondents in urban areas ranked traffic exhaust number one among causes of pollution, which we discuss later in this report.

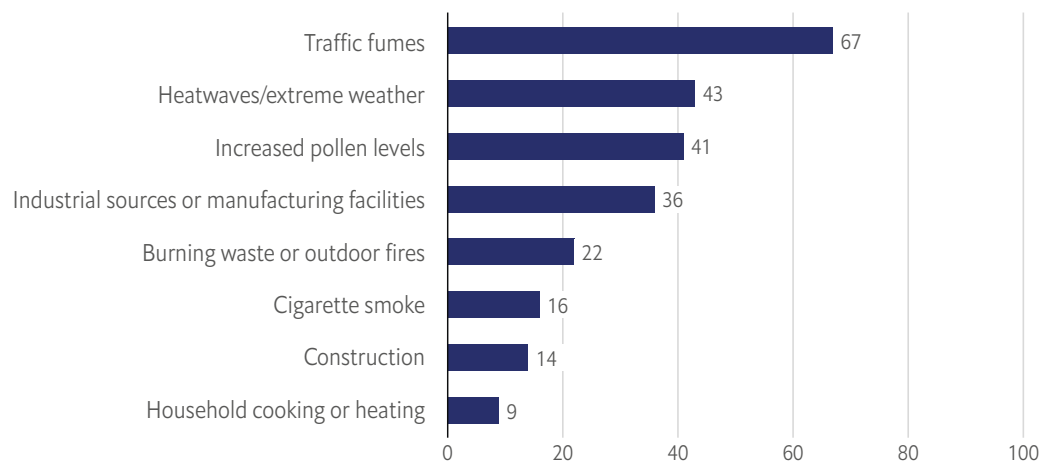
The second and third most frequently reported causes were climate-related factors: namely, heatwaves/extreme weather (43%) and increased pollen levels (41%). Pollen is a particular issue for those living with asthma: 43% listed it as a leading cause of pollution, versus just 20% of those with COPD. Air pollution caused by climate-related factors is not included in the WHO’s AQG nor is it routinely measured as an indicator of progress towards clean-air goals. Still, our findings suggest that these factors have a significant impact on those with lung conditions.



Good air quality may act as a buffer to climate-related challenges

Good general air quality may provide a buffer to the likely growing lung health challenges of heatwaves and pollen. Among respondents who reported poor air quality, 80% said that air quality where they live makes their conditions worse. In the same group, 75% reported the same about pollen. In contrast, among respondents who reported living in areas with good or very good air quality, these figures are about half as large (41% and 34% respectively).

Figure 6. Perceived causes of air pollution, %
Question 9: Perceived causes of air pollution where the respondent lives



Source: Economist Impact survey data, 2023

While both groups reported an impact of climate-related challenges on their symptoms, the difference shows that good general air quality may mitigate the impact of heatwaves and pollen on the symptoms of those with lung conditions, improving quality of life.

Those in urban areas face a greater burden of poor air quality

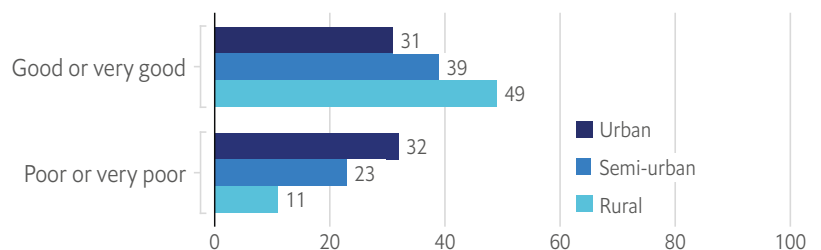
Responses about the degree and nature of air quality challenges differ—to a statistically significant degree—depending on whether the individuals live in cities or the countryside. Responses from those living in towns or suburban areas tended to fall in between, although replies from this group were often closer to those of respondents from rural areas than of urban ones.

Predictably, air is cleaner in the countryside, but the extent of population density’s impact is dramatic. Nearly half of those living in rural areas say that their air quality is currently good or very good, while only 11% believe it to be poor or very poor (Figure 7). In cities, slightly more consider it poor than good (32% to 31%). The urban centres of the surveyed Western European countries have left behind the intense pollution of an earlier age; however, poor air quality continues to be a widespread and important problem. This problem has an outsized effect population-wide because the majority of people in the study countries live in cities—between 72% (Italy) and 84% (UK).³²



The perceived origin of air pollution also differs markedly by residential area. The big difference between rural and urban areas is in the number who identified traffic fumes and, to a lesser extent, industrial facilities as major sources. As noted earlier, these results underline the importance of continued progress on pollutant concentrations. Rural respondents, in contrast, are much more likely than urban peers to cite increased pollen levels and burning waste or outdoor fires as problems in their areas.

Figure 7. Perception of air quality by population density, %
Question 8: Perception of air quality where respondent lives



Source: Economist Impact survey data, 2023

All of the above differences are statistically significant. They suggest that, while national efforts remain crucial, in some cases local clean-air policies for urban areas could have a positive impact on lung health.³³

Respondents in each area most frequently reported traffic fumes as the driver of air pollution, although it is tied with pollen in rural areas (Figure 8). Moreover, heatwaves and pollen fill out the top three sources according to respondents in each type of location, except in urban areas where pollen was the fourth most frequent choice. This consistency indicates that the changes in air quality associated with climate change pose a significant problem everywhere,

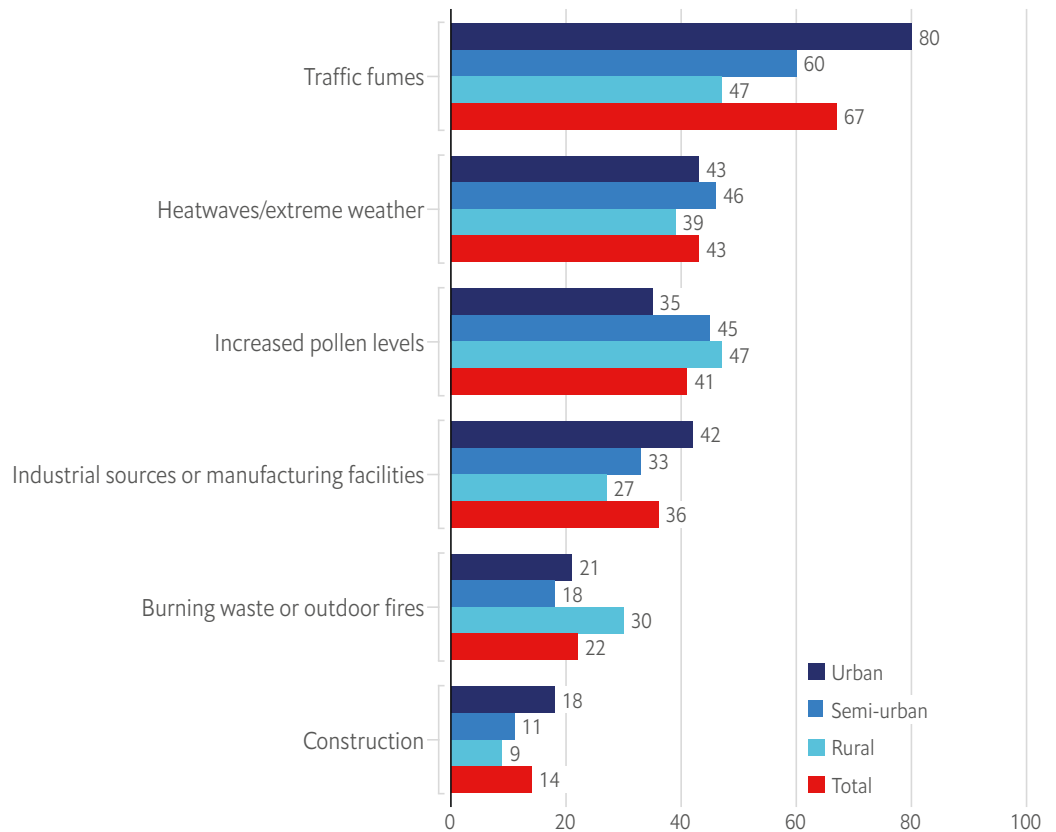
along with the ongoing issues arising from pollutants, which have been the traditional focus of air quality policy.

The impact of poor air quality, meanwhile, is noticeably higher in cities than in the countryside. Of respondents in urban centres, 35% said that it has affected their symptoms a great deal, and only 5% said not at all. Among those surveyed in rural areas, the equivalent figures are 22% and 14%, respectively.

More granular results indicate that poor air quality in cities affects a larger proportion of those living with lung conditions, and it affects them in a range of places and while

Figure 8. Causes of air pollution by population density, %

Question 9: Leading causes of air pollution by population density



Source: Economist Impact survey data, 2023

doing a variety of activities (Figure 9). In the accompanying chart, the differences between the urban and other responses are statistically significant except for that between urban and semi-urban figures for outdoor exercise. While more common in urban areas, these challenges exist elsewhere. Over half of rural and semi-urban residents, for example, still said that outdoor exercise worsens their conditions.

Just as striking as the differences, especially given the rising frequency of heatwaves and level of pollen, is how similar the effects of these are across all three groups. Two survey questions asked about the impact of these factors on respondents' illnesses. In the responses to one of the questions, the differences between urban and rural respondents were only on the cusp of statistical significance; in the other, the variations were insignificant. Overall, between a half and two-thirds of respondents in every

kind of residential area said that pollen and heatwaves worsen their symptoms and their overall conditions. These figures make clear that the increase in the frequency of heatwaves and the pollen burden is already having a widespread effect. It will grow only worse with any rise in these problems.

Surprisingly, results do not vary significantly by education or income

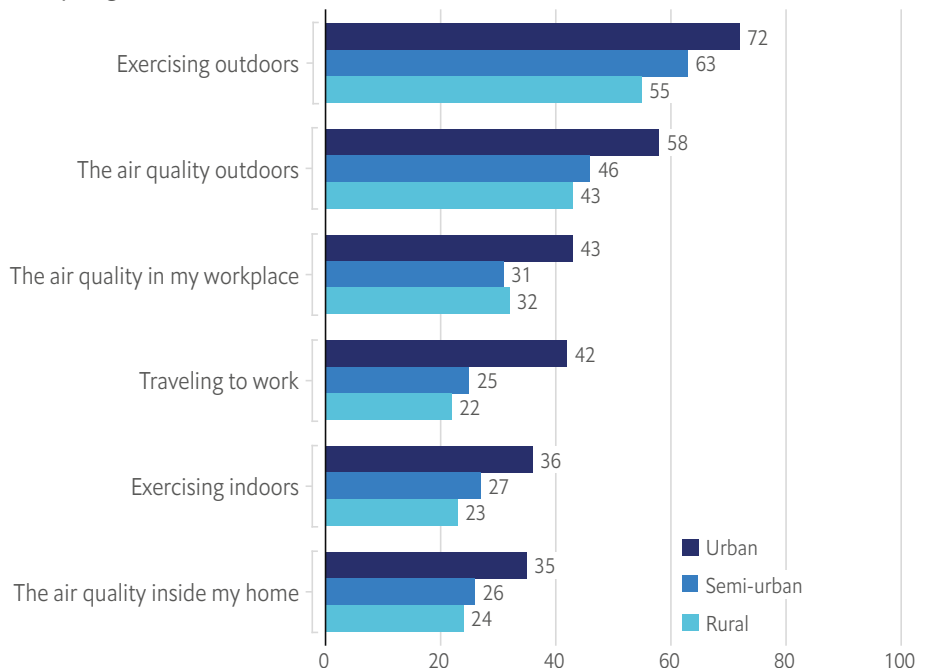
Typically, health outcomes vary—sometimes dramatically—by education and income levels. However, in the survey results, answers about the impact of air quality on conditions, symptoms and quality of life are similar across these divides.

The few statistically significant differences in the responses by education level are so minor that, overall, the survey data do not reveal difference in the lived experience of people affected with

Figure 9. Reported causes of worsening symptoms by population density, %

Question 11: Percentage agreeing with the following statements

The following makes my lung condition(s) worse:



Source: Economist Impact survey data, 2023

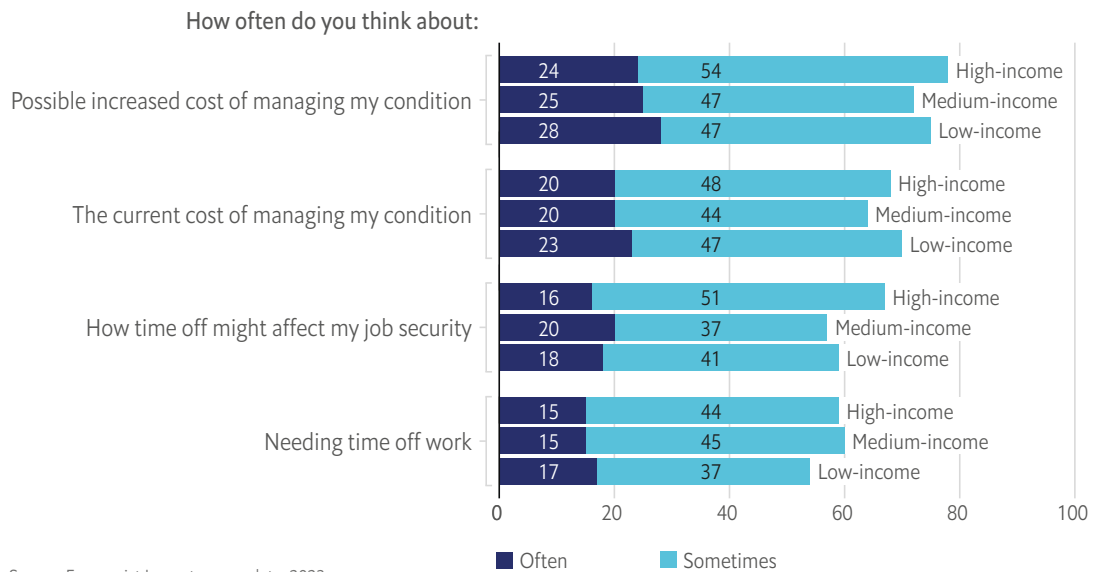
lung conditions based on the extent of their schooling.

More interesting is how similar the responses from these groups were on questions where income would presumably matter greatly (Figure 10). When asked how often they think about the cost of their illness and its impact on their employment, most say that they worry at least some of the time. However, this proportion is similar across all three income groups. In no case do the answers of the low- and high-income groups show statistically significant differences.

It should be noted that all five of the survey countries have comprehensive healthcare and disability support provisions, as well as rigorous labour laws, compared to global norms. These social protections may contribute to the lack of differences seen in the survey data. Whatever faults and deficiencies these systems and regulations may display, they appear to level important aspects of the economic burden of lung conditions. As such, maintaining support for these systems and regulations can continue to lessen the gap traditionally seen between income groups.

Figure 10. Concern about cost and job security by income group, %

Questions from the Economist Impact survey data, 2023



Source: Economist Impact survey data, 2023

Discussion

Changes in what we breathe and what we measure: how air quality continues to impact health

In general, survey respondents from EU5 countries reported that the air is worse than it was five years ago. In addition, the worsening air quality continues to impact the health and wellbeing of people with chronic lung conditions such as asthma and COPD.

These findings seem contrary to the progress demonstrated in air quality data from the countries in question. The low pollutant levels when compared to those in the rest of the world are no accident but, rather, the result of policy changes and action to improve air quality. For instance, a recent Lancet article opined

that “the European region is at the forefront of combatting ambient PM pollution.”³⁴ In contrast to the global average, the latest time series figures for the major airborne pollutants in Europe show a long-term decline for known pollutants (ie PM10, PM2.5 and, more recently, NO₂) (Figure 3). Ozone levels, however, show little overall change across the years. The only exception is in Spain, where levels of these pollutants have remained steady, but have long been below the recommended European threshold.¹⁹⁻²³

With so much progress on key environmental indicators, why are respondents more negative about how air is changing? The top three reported causes of air pollution provide some explanations (Figure 6).



Because the majority of EU5 populations live in urban settings where pollutant concentrations tend to be greater, residents of these countries experience built-environment pollutants (e.g. traffic fumes, industrial sources) on a daily basis. For them, these sources continue to be significant contributors to reduced air quality. That is, country-level progress to improve air quality may not be reflected in the subjective experiences of those who live and work near common sources of pollution. To alleviate the effects of these pollutants and improve lung health, countries should make greater efforts to adopt and reach WHO AQG concentration levels.

Still, relying solely on the most commonly measured pollutants gives an incomplete picture to policymakers and other stakeholders of the impact of air quality on those living with lung conditions. Based on our findings,

we posit that the likeliest explanation for the number of respondents who reported that their air is getting worse—rather than simply continuing to be bad—is due to the increase in air quality factors associated with climate change. Specifically, the impact of factors such as heatwaves/extreme weather and increased pollen levels is outweighing progress on chemical and particle pollutants. More and consistent data are needed on the actual impact of heatwaves and pollen, and this information urgently needs to be integrated into air quality assessment. As the effects of climate change are felt more heavily around the world, it is imperative that stakeholders improve awareness of the burden of these factors and increase support for the populations most susceptible to their effects.

Conclusion: progress has been made, but more is needed

Our survey has given an unusual window into the views of people living with lung conditions in Western Europe. Despite some policy weaknesses, and compared to other parts of the globe, this region has low levels of air pollution and pollution-related mortality. Like much of the rest of the world, however, heatwaves and higher pollen loads seem to be increasing. Despite the advantages for those living in these five countries, significant findings arise from the data:

- Air quality can be good in parts of these countries, but where it is poor, it continues to take a marked toll on the health outcomes and quality of life of those living with lung conditions.
- Progress against chemical pollutants in the air needs to go further. Otherwise, symptoms will worsen for individuals with lung conditions, from simply breathing the air indoors and outdoors.
- Heatwaves and pollen loads are already affecting air quality, according to our respondents. An expected increase in the future due to climate change will make matters worse.
- Urban areas require special attention in improving air quality even as national efforts need to remain the primary policy arena.
- Our research did not identify significant differences among people in various socioeconomic groups, possibly due to the protective effect of universal health coverage, but this does not mean that such differences do not exist.



“More research is needed to further explore the intersection of air quality, health inequalities and lung health, and to understand specific risks, vulnerabilities and adaptive strategies for people with lung conditions.”

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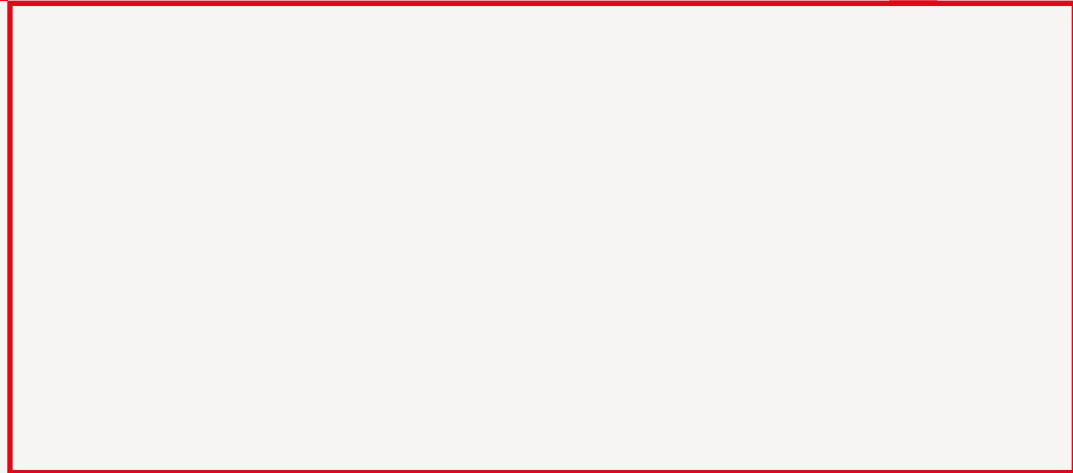
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