Are European citizens concerned about the health consequences of air pollution? A secondary analysis of Eurobarometer data from 27 European countries

Georgios Ktenidis[1,2], Katerina Aslanoglou[1,2], Angeliki Bakou[3], Zinovia Plyta[1,2], Constantine Vardavas[1,2,4]

AFFILIATION
1 Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Athens, Greece
2 School of Medicine, University of Crete, Heraklion, Greece
3 Department of Midwifery, Faculty of Health and Caring Sciences, University of West Attica, Athens, Greece
4 Department of Oral Health Policy and Epidemiology, Harvard School of Dental Medicine, Harvard University, Boston, United States

CORRESPONDENCE TO
Georgios Ktenidis. Department of Hygiene, Epidemiology and Medical Statistics, Medical School, National and Kapodistrian University of Athens, Mikras Asias 75, 11527, Athens, Greece. Email: ktengior@gmail.com

KEYWORDS
Eurobarometer, air pollution, health consequences, public concern

Received: 19 February 2025, **Revised:** 27 March 2025, **Accepted:** 29 March 2025
Public Health Toxicol 2025;5(1):5
https://doi.org/10.18332/pht/203586

ABSTRACT

INTRODUCTION Air pollution is considered one of the major public health challenges. As the European Union has vowed to significantly reduce air pollution by 2050, it is important to understand the public's views concerning air pollution. Thus, the aim of this study is to evaluate EU citizens' perception of the severity of respiratory diseases, cardiovascular diseases and asthma as consequences of air pollution.

METHODS We performed a secondary data analysis using data of 26509 randomly selected EU citizens from 27 member states from the Special Eurobarometer 524 cross-sectional survey. We used adjusted logistic regression models in order to examine factors associated with considering respiratory diseases, cardiovascular diseases and asthma as serious consequences of air pollution.

RESULTS Most EU citizens consider respiratory diseases (89.0%; 95% CI: 88.4–89.5), cardiovascular diseases (82.4%; 95% CI: 81.7–83.2) and asthma (88.1%; 95% CI: 87.4–88.7) as serious consequences of air pollution. Women (AOR=1.43; 95% CI: 1.26–1.63), individuals facing financial difficulties (AOR=1.19; 95% CI: 1.03–1.63) and residents of urban centers (AOR=1.64; 95% CI: 1.39–1.94) were more likely to consider the above conditions as serious implications of air pollution. Additionally, citizens of Central and Eastern Europe (AOR=4.32; 95% CI: 3.73–5.00), Southern Europe (AOR=6.73; 95% CI: 5.54–8.18) and Western Europe (AOR=3.21; 95% CI: 2.81–3.69) all appeared more likely to be concerned compared to Northern Europeans. Similar findings emerged from our other models examining concern for cardiovascular diseases and asthma as consequences of air pollution.

CONCLUSIONS Even though the majority of the EU population considers respiratory diseases, cardiovascular diseases and asthma as serious consequences of air pollution, we observed significant differences between different groups. These results highlight the prospects of targeted awareness campaigns to address these variations in perceptions regarding the severity of the effects of air pollution on human health.

INTRODUCTION

Pollution, defined as the 'unwanted waste of human origin released to air, land, water and the ocean without regard for cost or consequence' has evolved into one of the major public health challenges in the world, raising significant health, social, economic and legislative concerns[1,2]. According to the World Health Organization (WHO), air pollution specifically is the contamination of the indoor or outdoor environment by any chemical, physical or biological agents that modify the characteristics of the atmosphere[3]. Household combustion devices, industrial facilities, motor vehicles and forest fires constitute major sources of air pollution[3]. The main air

pollutants that have serious implications on public health include particle matter (PM), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2)[3,4].

Every year, it is estimated that 7 million premature deaths are associated with air pollution[3] as it can be held responsible for a wide range of health conditions, including cardiovascular and respiratory diseases[2]. Respiratory infections, asthma, allergic rhinitis, lung cancer and chronic obstructive pulmonary disease have all been linked to exposure to high levels of air pollution[5]. Similarly, air pollution significantly increases the risk for various cardiovascular diseases, such as arterial hypertension, stroke, myocardial infarction, atherosclerosis and the subsequent attributable mortality from these conditions[6,7]. According to the WHO, it is estimated that more than 99% of people worldwide live in an area where air pollution is above the WHO air-quality guidelines[3]. Within the European Union (EU), air pollution constitutes the largest environmental health risk[8] with an estimated 96% of the urban population in 2020 exposed to levels higher than the WHO guidelines for air pollution[9]. Moreover, during the same year, exposure to PM alone was estimated to cause 238000 premature deaths in the EU[9].

In order to address this situation, the European Commission adopted the EU action plan towards zero pollution for air, water and soil, which was adopted in May 2021[10], aiming to significantly reduce pollution and its implications on human health and the environment by 2050[10]. As public opinion can play a substantial role in shaping government decisions on environmental policies[11], it is important to understand European citizens' perceptions towards air pollution.

Thus, the aim of this study is to assess the factors associated with EU citizens' concern about respiratory diseases, cardiovascular diseases and asthma as consequences of air pollution.

METHODS

Data source and design

A secondary data analysis was conducted using the data of the Special Eurobarometer 524 survey examining the attitudes of Europeans towards air quality. This cross-sectional survey was carried out in the 27 EU Member States (EU MS). Data collection took place between 21 March and 20 April 2022 through face-to-face interviews conducted either in people's homes or through remote video interaction.

This Eurobarometer survey employed a stratified multi-stage, random sample design. The number of sample points in each stratum was proportional to the region's population size and density[12]. In each sample point, a starting address was selected randomly and identify additional addresses were identified by 'standard random route' procedures. Once a household at the selected address was reached, only one person from it was interviewed in the appropriate national language. After data collection, weights were applied to ensure that the responding sample matched the overall population of the country in terms of age, region and degree of urbanization[12].

The population of the study includes randomly selected EU citizens aged ≥15 years from every EU MS[12]. Countries with a population exceeding 1 million were represented by approximately 1000 participants, while countries with a smaller population contributed with approximately 500 participants[13]. In total, the study included 26490 respondents[12].

Measures

To evaluate our study's outcomes, we assessed a question from the Eurobarometer survey concerning the participants' level of concern about the consequences of air pollution. The question asked was: 'Would you say that the following consequence of air pollution is a very serious problem, a fairly serious problem, not a very serious problem or not a serious problem at all in (OUR COUNTRY)?'. Participants were asked this question three times in order to assess their level of concern regarding the impact of air pollution on: 1) respiratory diseases, 2) cardiovascular diseases, and 3) asthma, which were our three primary outcomes. The possible responses were: 'A very serious problem', 'A fairly serious problem', 'Not a very serious problem', 'Not a serious problem at all', and 'Don't know'. Responses of 'A very serious problem' and 'A fairly serious problem' were categorized together as 'A serious problem'. Similarly, responses 'Not a very serious problem' and 'not a serious problem at all' were grouped as 'Not a serious problem'.

Factors evaluated were education level (age finished education: ≤15 years or no formal education, 16–19 years, and ≥20 years), gender (woman, man, none of the above/non binary/do not know), age (15–24, 25–45, 45–65, and ≥65 years), financial status (through a proxy question related to the difficulty paying bills during the last 12 months: never/almost never, from time to time, most of the time), employment status (self-employed, employed, not working), area of residence (rural area or village, small or middle-sized town, large town) and European region of residence. EU MS were grouped as follows: Central and Eastern Europe (Hungary, Poland, Romania, Bulgaria, Croatia, Slovakia, Czechia, Slovenia), Northern Europe (Finland, Sweden, Denmark, Estonia, Latvia, Lithuania), Southern Europe (Greece, Italy, Malta, Portugal, Cyprus, Spain), Western Europe (France, Germany, Ireland, Luxembourg, Netherlands, Austria, Belgium)[14].

Statistical analysis

We estimated weighted percentages of responses at the national level for all three of the Eurobarometer questions used to evaluate concern for respiratory diseases, cardiovascular diseases and asthma. We performed three adjusted logistic regression models in order to evaluate the level of concern of European citizens for the impact of

air pollution on their health. All models were adjusted for gender, age, difficulty paying bills, area of residence, level of education, employment status, and European region as independent variables.

Results are presented as weighted percentages or adjusted odds ratios (AORs), with 95% confidence intervals (95% CI). Participants with any missing values were excluded from both descriptive and regression analyses and those who answered 'don't know' to the questions evaluating our primary outcomes were excluded only from the regression analyses. In order to account for the sampling designs, we applied the Stata survey-specific command, svy, and the official Eurobarometer weights in the analysis. Each observation is weighted according to the official Eurobarometer weights (weight total W92)[15] to ensure the estimates are representative of the overall population, taking into account population size and non-response. Stratification was performed based on the European Commission's Nomenclature of Territorial Units for Statistics Level II (NUTS II) and within each unit by measure of Urbanity (DEGURBA)[16]. Statistical significance was defined as $p<0.05$. All analyses were conducted using Stata version 13.

RESULTS

Respiratory diseases as a consequence of air pollution

Overall, the vast majority of EU citizens aged >15 years view respiratory diseases as a serious consequence of air pollution (89%; 95% CI: 88.4–89.5). Participants from France (97.5%; 95% CI: 96.3–98.3) and Malta (97.1%; 95% CI: 95.2–98.3) report the highest percentages of concern, while those from Estonia (55.7%; 95% CI: 52.5–58.8) and Finland (52.5%; 95% CI: 49.1–55.9) report the lowest level of perceived severity in the EU (Table 1).

Our adjusted regression model, presented in Table 2, indicates that gender, financial status, area of residence, work status and EU region were associated with the likelihood of considering respiratory diseases as a serious consequence of air pollution. Women (AOR=1.43; 95% CI: 1.26–1.63) were found to have significantly higher odds of viewing respiratory diseases as a serious implication of air pollution. Moreover, concern over the detrimental impact of air pollution on respiratory health was higher among EU citizens who were not working (AOR=1.32; 95% CI: 1.08–1.60) and those of higher financial status (AOR=1.19; 95% CI: 1.03–1.63). Residents of small and middle-sized towns (AOR=1.18; 95%

Table 1. Weighted proportion (%) of European citizen respondents considering respiratory diseases, cardiovascular diseases and asthma as serious consequences of air pollution, Special Eurobarometer 524, March–April 2022 (N=26490)

Country	Respiratory diseases Weighted % (95% CI)	Cardiovascular diseases Weighted % (95% CI)	Asthma Weighted % (95% CI)
Austria	70.1 (66.8–73.1)	63.9 (60.5–67.1)	69.2 (65.9–72.3)
Belgium	93.3 (91.3–94.8)	85.4 (82.8–87.6)	91.8 (89.7–93.5)
Bulgaria	95.7 (94.3–96.8)	93.6 (91.9–94.9)	93.8 (92.2–95.1)
Croatia	93.3 (91.3–94.8)	91.1 (88.8–93.0)	92.4 (90.4–94.1)
Cyprus	95.7 (93.2–97.3)	91.6 (88.6–93.9)	96.5 (94.3–97.9)
Czechia	84.9 (82.5–87.1)	80.3 (77.6–82.7)	85.4 (83.0–87.5)
Denmark	78.4 (75.4–81.1)	61.2 (57.8–64.6)	78.8 (75.7–81.6)
Estonia	55.7 (52.5–58.8)	51.0 (47.9–54.2)	58.3 (55.1–61.4)
Finland	52.5 (49.1–55.9)	50.8 (47.4–54.2)	58.8 (55.5–62.2)
France	97.5 (96.3–98.3)	90.4 (88.1–92.2)	97.5 (96.3–98.3)
Germany	81.3 (79.0–83.4)	68.9 (66.3–71.4)	78.4 (76.0–80.6)
Greece	94.9 (93.3–96.1)	89.9 (87.8–91.7)	94.4 (92.8–95.7)
Hungary	94.4 (92.6–95.8)	91.1 (88.9–92.8)	92.1 (90.0–93.8)
Ireland	80.5 (77.8–82.9)	74.6 (71.6–77.3)	83.0 (80.4–85.3)
Italy	95.3 (93.8–96.5)	94.9 (93.3–96.1)	95.2 (93.7–96.4)
Latvia	79.5 (76.7–82.0)	76.9 (74.0–79.5)	81.7 (79.1–84.1)
Lithuania	90.8 (88.6–92.6)	89.7 (87.4–91.6)	90.1 (87.9–91.9)
Luxembourg	89.6 (86.5–92.1)	77.7 (73.7–81.2)	87.6 (84.3–90.4)
Malta	97.1 (95.2–98.3)	93.7 (91.1–95.6)	98.0 (96.4–98.9)
Netherlands	88.1 (85.6–90.1)	59.6 (56.2–62.9)	89.4 (87.1–91.3)

Continued

Table 1. Continued

Country	Respiratory diseases Weighted % (95% CI)	Cardiovascular diseases Weighted % (95% CI)	Asthma Weighted % (95% CI)
Poland	92.2 (90.2–93.8)	92.0 (90.1–93.6)	90.8 (88.8–92.5)
Portugal	80.7 (78.1–83.1)	78.5 (75.8–81.0)	79.4 (76.7–81.8)
Romania	85.4 (83.1–87.5)	88.4 (86.2–90.3)	83.6 (81.1–85.8)
Slovakia	92.1 (90.2–93.7)	90.8 (88.8–92.5)	90.3 (88.2–92.1)
Slovenia	88.0 (85.8–90.0)	81.6 (79.0–83.9)	86.5 (84.1–88.6)
Spain	93.7 (92.0–95.0)	86.7 (84.3–88.7)	92.0 (90.2–93.5)
Sweden	72.9 (70.0–75.6)	64.0 (61.0–67.0)	74.9 (72.0–77.6)
EU total	89.0 (88.4–89.5)	82.4 (81.7–83.2)	88.1 (87.4–88.7)

All values were rounded to the first decimal place.

Table 2. Demographic factors associated with viewing respiratory diseases, cardiovascular diseases and asthma as serious consequences of air pollution, Special Eurobarometer 524, March–April 2022 (N=26490)

Variables	Respiratory diseases		Cardiovascular diseases		Asthma	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Age (years)						
15–24 ®	1		1		1	
25–44	0.99 (0.74–1.32)	0.946	0.92 (0.69–1.23)	0.573	0.87 (0.63–1.19)	0.368
45–64	1.05 (0.78–1.4)	0.758	0.83 (0.62–1.12)	0.226	1.00 (0.72–1.37)	0.988
≥65	1.12 (0.81–1.56)	0.495	0.86 (0.62–1.19)	0.373	1.17 (0.82–1.67)	0.386
Education level (years)						
<15 ®	1		1		1	
16–19	1.14 (0.91–1.43)	0.249	1.02 (0.83–1.24)	0.872	1.39 (1.12–1.73)	0.003
≥20	1.18 (0.93–1.49)	0.182	0.83 (0.67–1.02)	0.071	1.20 (0.96–1.51)	0.111
Still studying	0.83 (0.56–1.21)	0.332	0.69 (0.48–1.01)	0.059	0.82 (0.54–1.22)	0.326
Gender						
Man ®	1		1		1	
Woman	1.43 (1.26–1.63)	<0.001	1.33 (1.19–1.49)	<0.001	1.52 (1.34–1.73)	<0.001
Difficulty paying bills						
Most of the time/from time to time ®	1		1		1	
Almost never/never	1.19 (1.03–1.63)	0.019	0.95 (0.83–1.08)	0.440	1.16 (1.01–1.34)	0.036
Residence						
Rural area or village ®	1		1		1	
Small or middle-sized town	1.18 (1.02–1.38)	0.027	1.27 (1.11–1.45)	0.001	1.15(0.99–1.33)	0.064
Large town	1.64 (1.39–1.94)	<0.001	1.53 (1.33–1.78)	<0.001	1.47(1.25–1.73)	<0.001
Occupation						
Employed ®	1		1		1	
Not working	1.32 (1.08–1.60)	0.006	1.30 (1.10–1.55)	0.002	1.23 (1.01–1.49)	0.038
Region						
Northern Europe ®	1		1		1	
Central and Eastern Europe	4.32(3.73–5.00)	<0.001	4.96 (4.32–5.70)	<0.001	3.09 (2.68–3.58)	<0.001
Southern Europe	6.73(5.54–8.18)	<0.001	5.31 (4.50–6.28)	<0.001	4.92 (4.07–5.93)	<0.001
Western Europe	3.21 (2.81–3.69)	<0.001	1.89 (1.69–2.13)	<0.001	2.42 (2.11–2.78)	<0.001

The models were adjusted for all factors presented in the table. AOR: adjusted odds ratio, from logistic regression models. The participants who selected 'Refusal/don't know', 'none of the above/non binary/do not know' or 'refuse' were included in the analysis but their AORs are not presented in the table. All values were rounded to two decimal places. ® Reference categories.

CI: 1.02–1.38) as well as large towns (AOR=1.64; 95% CI: 1.39–1.94) were also found to have higher odds compared to those living in rural areas or villages. Finally, EU citizens of Central and Eastern Europe (AOR=4.32; 95% CI: 3.73–5.00), Southern Europe (AOR=6.73; 95% CI: 5.54–8.18) and Western Europe (AOR=3.21; 95% CI: 2.81–3.69) were all found to report significantly higher levels of concern on the impact of air pollution on respiratory diseases compared to those living in Northern Europe. Significant associations were not found between the factors of age and education level and concern for the effect of air pollution on respiratory diseases.

Cardiovascular diseases as a consequence of air pollution

The majority of the EU population reported to be seriously concerned about cardiovascular diseases as an implication of air (82.4%; 95% CI: 81.7–83.2). Respondents in Italy (94.9%; 95% CI: 93.3–96.1) and Malta (93.7%; 95% CI: 9.1–95.6) presented the highest percentages of concern while participants in Estonia (51%; 95% CI: 47.9–54.2) and Finland (50.8%; 95% CI: 47.4–54.2) reported the lowest percentages (Table 1).

Our model indicated that education level, gender, financial status, area of residence, work status and EU region were significantly associated with concerns about cardiovascular diseases as consequences of air pollution. Women (AOR=1.33; 95% CI: 1.19–1.49) were found to have higher odds of viewing cardiovascular issues as serious problems causes by air pollution as did individuals who were unemployed (AOR=1.30; 95% CI: 1.10–1.55). Residents of small and medium-sized towns (AOR=1.27; 95% CI: 1.11–1.45), as well as those living in large urban areas (AOR=1.53; 95% CI: 1.33–1.78), were more likely to voice concerns compared to those in rural areas or villages. Similarly, citizens of Central and Eastern European MS (AOR=4.96; 95% CI: 4.32–5.70), citizens of Southern European MS (AOR=5.31; 95% CI: 4.50–6.28), and Western Europe (AOR=1.89; 95% CI: 1.69–2.13) reported significantly higher levels of concern regarding the cardiovascular effects of air pollution compared to those from Northern Europe (Table 2).

Asthma as a consequence of air pollution

In the EU, 88.1% (95% CI: 87.4–88.7) of participants in the Eurobarometer survey considered asthma as a serious consequence of air pollution. Among EU MS, participants from Malta had the highest percentage of concern (98%; 95% CI: 96.4–98.9) followed closely by those from France (97.5%; 95% CI: 96.3–98.3). In contrast, participants from Estonia (58.3%; 95% CI: 55.1–61.4) and Finland (58.8%; 95% CI: 55.5–62.2) reported the lowest percentages of concern (Table 1).

Gender, financial status, area of residence, work status, EU region, and education level were associated with the likelihood of viewing asthma as a serious implication of air pollution. Notably, women (AOR=1.52; 95% CI: 1.34–1.72) tended to be more concerned about asthma as a result of air pollution. Additionally, individuals who were not working (AOR=1.23; 95% CI: 1.01–0.49), as well as those with higher financial resources (AOR=1.16; 95% CI: 1.01–1.34), were more likely to express higher levels of concern. Residents in large urban areas (AOR=1.47; 95% CI: 1.25–1.73), were more likely to express similar views about asthma, compared to those living in rural regions or villages. Finally, respondents from Central and Eastern Europe (AOR=3.09; 95% CI: 2.68–3.58), Southern Europe (AOR=4.92; 95% CI: 4.07–5.93), and Western Europe (AOR=2.42; 95% CI: 2.11–2.78) were generally more concerned about asthma as a consequence of air pollution, than respondents from Northern Europe (Table 2).

Information concerning the percentages of respondents who did not consider the above health conditions as a serious consequence of air pollution as well as the percentages of those who answered 'don't know' can be found in Supplementary file Tables 1 and 2, respectively.

DISCUSSION

Our secondary analysis of the Eurobarometer data results indicates that the majority of the EU population aged >15 years considers respiratory diseases, cardiovascular diseases and asthma as serious consequences of air pollution. Despite this, we observed significant variations among EU MS and between different groups.

Our study results indicate that women were more likely than men to believe that air pollution's effects on cardiovascular and respiratory are serious problems. This finding agrees with other studies that have indicated that women tend to show higher levels of concern about environmental hazards[17,18]. This may be partially explained by the fact that women are more likely to adopt caregiver roles in the community, making them more sensitive to health hazards[19]. However, on the contrary, one study had indicated that men present higher likelihoods of being concerned of the impact of air pollution on health, which was suggested to be attributable to the fact that men are more likely to suffer from cardiovascular and respiratory diseases[20].

We did not find significant associations between age, education level and concern for cardiovascular and respiratory issues as implications of air pollution. As far as age is concerned, one study examining risk perception of environmental public health risk among US individuals[18] also found no statistically significant associations between age and reported risk perception, which refers to a person's beliefs about their vulnerability to harm and the severity of a hazard[18]. However, ambiguous literature exists suggesting that both older[20] and younger[21] individuals have been found to express higher levels of risk perception.

Moreover, we observed that people who never or almost never face difficulties paying their bills are more likely

to consider respiratory diseases and asthma as serious effects of air pollution, whereas no significant association was found for cardiovascular diseases. This result can be attributed to a variety of factors[22]. Firstly, citizens facing economic difficulties often are more focused to addressing their immediate every day needs, making them less likely to be concerned about the long-term health effects of air pollution[22]. Furthermore, it is supported that individuals belonging to low-income groups are less sensitive over the health consequences of environmental issues, as they have less resources and opportunities to protect themselves[22].

Overall, residents of large urban centers were more likely to express concerns for the health effects of air pollution. This finding is expected, as the majority of urban inhabitants live in areas exhibiting high pollution levels[23] deriving from motorized traffic, residential heating and industrial activities, as well as low dispersion conditions[24,25]. Finally, citizens of Northern EU MS were significantly less likely to consider cardiovascular and respiratory conditions as serious consequences of air pollution. This observation may be attributed to regional variations in air pollution levels among EU MS, as Southern and Eastern European countries are exposed to higher levels of air pollutants[26] and record significantly higher associated mortality rates[25] related to air pollution. Thus, this potentially leads to higher levels of awareness of the serious effects of air pollution on human health.

Strengths and limitations

It is worth mentioning that our survey has some important strengths. Eurobarometer surveys exhibit standardized data collection techniques throughout EU MS, offering highly reliable data on EU public opinions. Furthermore, the multi-stage random sampling technique guarantees that various regions are proportionately represented, allowing the results to be applicable to the overall EU population. Finally, employing validated and standardized questions ensures that our results are comparable across various countries and demographic groups within the EU.

It is important to acknowledge that there are limitations to this study, which should be taken into account when interpreting our results. Firstly, as Eurobarometer surveys adopt a cross-sectional design, we are unable to establish causal links between the factors evaluated and perception towards the seriousness of the health consequences of air pollution. It is also important to bear in mind that our results represent subjective health perceptions towards the health effects of air pollution and not actual health risks. Additionally, grouping EU MS regionally may neglect specific differences for each country. Moreover, the depth of our analysis may be limited, as participants did not provide information on their current health status which is a factor that may impact perceptions towards the studied outcomes. Moreover, even though we adjust for various variables, we cannot eliminate residual confounding caused by variables not assessed by the Eurobarometer questionnaire.

CONCLUSIONS

This analysis contributes to the evidence base regarding the relationship between various sociodemographic factors and perceptions towards the severity of the health implications derived from air pollution. We found that most of the EU population considers respiratory and cardiovascular diseases and asthma as serious consequences of air pollution, with higher levels of concern being recorded among women, residents of urban centers and citizens without financial difficulties. At the same time, citizens of Northern EU MS appeared to be less likely to worry about these effects. These results are particularly important for policy makers and may contribute to the development of public awareness initiatives regarding the impact of air pollution on human health.

REFERENCES

1. Fuller R, Landrigan PJ, Balakrishnan K, et al. Pollution and health: a progress update. 2022;6(7):e553-e547. doi:10.1016/S2542-5196(22)00090-0
2. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and Health Impacts of Air Pollution: A Review. Front Public Health. 2020;8:14. doi:10.3389/fpubh.2020.00014
3. World Health Organization. Air Pollution. World Health Organization. Accessed March 29, 2025. https://www.who.int/health-topics/air-pollution#tab=tab_1
4. World Health Organization. Types of pollutants. World Health Organization. Accessed March 29, 2025. https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants
5. Tran HM, Tsai FJ, Lee YL, et al. The impact of air pollution on respiratory diseases in an era of climate change: A review of the current evidence. Sci Total Environ. 2023;898:166340. doi:10.1016/j.scitotenv.2023.166340
6. de Bont J, Jaganathan S, Dahlquist M, Persson Å, Stafoggia M, Ljungman P. Ambient air pollution and cardiovascular diseases: An umbrella review of systematic reviews and meta-analyses. J Intern Med. 2022;291(6):779-800. doi:10.1111/joim.13467
7. Bourdrel T, Bind MA, Béjot Y, Morel O, Argacha JF. Cardiovascular effects of air pollution. Arch Cardiovasc Dis. 2017;110(11):634-642. doi:10.1016/j.acvd.2017.05.003
8. Laurent É. Air (ine)quality in the European Union. Curr Environ Health Rep. 2022;9(2):123-129. doi:10.1007/s40572-022-00348-6
9. European Environment Agency. Air Quality in Europe 2022. European Environment Agency. Accessed March 29, 2025 https://www.eea.europa.eu/publications/air-quality-in-europe-2022
10. European Commission. Environment: Zero Pollution Action Plan. European Commission. Accessed March 29, 2025 https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en
11. Fairbrother M. Public opinion about climate policies: A review and call for more studies of what people want. PLOS Clim.

2022;1(5):e0000030. doi:10.1371/journal.pclm.0000030
12. European Union. Special Eurobarometer 524 Report: Attitudes of Europeans towards air quality. European Union. Accessed March 29, 2025. https://europa.eu/eurobarometer/surveys/detail/2660
13. European Union. About Eurobarometer. European Union. Accessed March 29, 2025. https://europa.eu/eurobarometer/about/eurobarometer
14. European Union. EU Vocabularies: 7206 Europe. European Union. Accessed March 29, 2025 https://op.europa.eu/en/web/eu-vocabularies/concept-scheme/-/resource?uri=http%3A%2F%2Feurovoc.europa.eu%2F100277
15. GESIS Leibniz Institute for the Social Sciences. Eurobarometer Data service: Weighting overview. GESIS Leibniz Institute for the Social Sciences. Accessed March 29, 2025. https://www.gesis.org/en/eurobarometer-data-service/data-and-documentation/standard-special-eb/weighting-overview
16. European Environment Agency. Degree of Urbanisation (DEGURBA). European Environment Agency. Accessed March 29, 2025. www.eea.europa.eu/data-and-maps/data/external/degree-of-urbanisation-degurba
17. Quintyne KI, Kelly C. Knowledge, attitudes, and perception of air pollution in Ireland. Public Health Pract (Oxf). 2023;6:100406. doi:10.1016/j.puhip.2023.100406
18. Shin M, Werner AK, Strosnider H, Hines LB, Balluz L, Yip FY. Public Perceptions of Environmental Public Health Risks in the United States. Int J Environ Res Public Health. 2019;16(6):1045. doi:10.3390/ijerph16061045.
19. Scalia AM. The Influence of Sociodemographic, Location, and Health Characteristics on Environmental Risk Perception. Master's thesis. Clemson University; 2017. Accessed March 29, 2025. https://open.clemson.edu/all_theses/2671
20. Pignocchino G, Di Baldassarre G, Mondino E, Raffetti E. Public risk perception of air pollution in the general population of Italy and Sweden during the COVID-19 pandemic: Environmental and socio-demographic drivers. Prev Med. 2023;173:107601. doi:10.1016/j.ypmed.2023.107601
21. Dixon JK, Hendrickson KC, Ercolano E, Quackenbush R, Dixon JP. The environmental health engagement profile: what people think and do about environmental health. Public Health Nurs. 2009;26(5):460-473. doi:10.1111/j.1525-1446.2009.00804.x
22. Ramírez AS, Ramondt S, Van Bogart K, Perez-Zuniga R. Public Awareness of Air Pollution and Health Threats: Challenges and Opportunities for Communication Strategies To Improve Environmental Health Literacy. J Health Commun. 2019;24(1):75-83. doi:10.1080/10810730.2019.1574320
23. Southerland VA, Brauer M, Mohegh A, et al. Global urban temporal trends in fine particulate matter (PM2·5) and attributable health burdens: estimates from global datasets. Lancet Planet Health. 2022;6(2):e139-e146. doi:10.1016/S25425196(21)00350-8
24. Gariazzo C, Carlino G, Silibello C, et al. A multi-city air pollution population exposure study: Combined use of chemical-transport and random-Forest models with dynamic population data. Sci Total Environ. 2020;724:138102. doi:10.1016/j.scitotenv.2020.138102
25. Khomenko S, Cirach M, Pereira-Barboza E, et al. Premature mortality due to air pollution in European cities: a health impact assessment. Lancet Planet Health. 2021;5(3):e121-e134. doi:10.1016/S2542-5196(20)30272-2
26. Shen Y, de Hoogh K, Schmitz O, et al. Europe-wide air pollution modeling from 2000 to 2019 using geographically weighted regression. Environ Int. 2022;168:107485. doi:10.1016/j.envint.2022.107485

CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

FUNDING
There was no source of funding for this research.

ETHICAL APPROVAL AND INFORMED CONSENT
Ethical approval and informed consent were not required for this secondary analysis of existing data.

DATA AVAILABILITY
The data supporting this research are available from the following source: https://search.gesis.org/research_data/ZA7887

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer-reviewed.