

Air quality control in Plovdiv, Bulgaria: the citizens' awareness. Results from a pilot quantitative study

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Abstract. Air pollution is a leading risk factor for individual and public health. It is a major environmental stressor responsible for hundreds of thousands of premature deaths in Europe every year. Monitoring and controlling air quality is about the importance of managing public health, as is ensuring people are aware of the dangers of polluted air and getting them involved in the issue. The article presents a summary of the results and data analysis from a pilot study conducted in May-June 2025 on the awareness, interest, personal engagement, and assessment of citizens in Plovdiv (Bulgaria) – one of the most polluted cities in Europe – regarding the control of air quality in the city.

Key words: air pollution, citizens' awareness, quantitative study.

Introduction

Air pollution is primarily an environmental threat. It damages the biodiversity of crops, causing major economic losses and problems with feeding the world's population. But it is also a leading risk factor for the quality of public health, directly linked to significant economic and social costs for societies. In recent decades, evidence of the harms of air pollution on individual and public health has been growing exponentially. Studies have noted the link between air pollution, public health, economic growth, healthcare expenditures and work capacity in different countries (Landrigan, 2017; Wallbanks et al., 2024; West et al., 2016). Exposure to polluted air is associated with higher rates of hospitalisations, disability, and premature death from lung and heart disease, stroke, lung cancer, and diabetes, as well as from infectious diseases such as viral illnesses and their complications.

Air pollution is a leading environmental risk factor for poor health and premature death in human populations (Evangelopoulos et al., 2020).

The main identified pollutants include coarse and fine particulate matter (PM₁₀ and PM_{2.5}), nitrogen oxides (NO and NO₂), ozone and sulfur dioxide (SO₂). By 2020, it was estimated that 96% of the urban population in the European Union (EU) was exposed to concentrations of fine particulate matter (PM_{2.5}) above the recommended by the World Health Organisation (WHO) risk value of 5 micrograms per cubic metre of air (µg/m³). Based on the WHO Global Air Quality Guidelines updated in 2021, the European Environment Agency's analysis shows that at least 238,000 people died prematurely in the EU in 2020 due to exposure to PM_{2.5} pollution above the WHO limit of 5 µg/m³. Nitrogen dioxide pollution led to 49,000 premature deaths and ozone pollution to 24,000. Air pollution not only causes premature death, but also permanent health damage and, in many cases, disability (European Environment Agency Report No. 05/2022).

The levels of air pollution and the regions within Europe with poor air quality are very familiar. Ironically, even decades after the fall of

the Berlin Wall, there is still a division between Western and Eastern Europe when it comes to the quality of the air that local communities breathe. The extent of poor air quality and its impact on human health varies across the continent, with the highest levels found in Central and Eastern Europe.. This leads to critical environmental and health inequalities within the EU and across the continent, creating a clear east-west divide (Andersen et al., 2025; Pisoni et al., 2022; Richardson et al., 2013).

Although this region has seen reductions in PM_{2.5} exposure over the past two decades, major cities in Poland, Bulgaria, Romania, Hungary, Serbia and North Macedonia have mortality rates four to six times higher than those in Western Europe. According to estimates by the Health Effects Institute (2023, 2024), in 2022, almost the entire population of Bulgaria was exposed to PM_{2.5} levels exceeding the WHO annual guideline value, resulting in at least 11,000 premature deaths from air pollution each year. Large cities such as Sofia and Plovdiv are among the world leaders in terms of PM_{2.5}-related mortality (Andersen et al., 2025).

This article presents data analysis from a pilot quantitative study conducted in the city of Plovdiv in June 2025. The aim is to identify the attitudes, opinions, and positions of citizens and permanent residents of Plovdiv regarding air pollution in the city and its impact on health, as well as their assessments of the work of public institutions responsible for air quality control. The survey provides an opportunity to examine citizens' positions on five blocks of topics related to interest, awareness, personal commitment, and assessment of the activities of local authorities and trust in institutions regarding air quality in the city.

Materials and methods

A quota sample was constructed by gender and age, comprising 400 respondents distributed across 20 clusters corresponding to the administratively defined micro-districts in the city.

The results and analysis of the data are a valuable resource for researchers, policy makers, and stakeholders in identifying potential problems, challenges, and opportunities for optimising policies to build greater coherence in the interactions between actors along the "Science-Policy-Society" axis.

Results and Discussion

As part of the study, 349 individuals aged between 18 and 85 and living and/or working in Plovdiv were surveyed. Of these, 43.7% are men and 56.3% are women. 57.2% had completed secondary education, 41.1% had completed higher education, and approximately 1.7% had not completed secondary education. Almost half of the respondents indicated that they manage to save part of their income (51.3%), while 40.8% manage to cover their basic needs and 7.9% experience difficulties with even the most necessary goods, such as paying utility bills and buying food. The sociodemographic characteristics of the respondents enable a multidimensional analysis of the obtained data and the identification of correlations with answers to further questions based on certain established social norms in Bulgarian society.

The analysis is structured according to the study's focus on the following areas: "Interest and Awareness", "Personal Commitment", "Assessment of Local Authorities' Activities" and "Trust in Institutions".

The data from the study clearly show that the citizens of Plovdiv consider air quality in the city to be an important issue (95.5%), while a small proportion of respondents (4.5%) do not consider it important. Almost half of them consider the issue of air pollution to be a very serious problem (43.9%). As for citizens' perceptions of air quality, almost all respondents consider it unhealthy (95.7%), with more than half (51.8%) finding it highly polluted. In addition, nearly three-quarters of respondents (74.6%) say they are aware of the main factors causing air pollution. Among the polluters mentioned, the leading ones are vehicles in the city (excessive car traffic combined with an excessively old car fleet), large-scale construction of residential buildings, industrial enterprises in the city and its surroundings, solid fuel heating, and the burning of household waste. Just over half of those surveyed (57.7%) say they have information about air quality in the city, with traditional media (television, radio, press) are the main sources for almost half of them (47.3%), followed by social media (31.3%), and lastly specialized platforms and channels (18.7%).

On the surface of it, these percentages seem high enough to conclude that Plovdiv citizens are well informed and actively seek information.

However, a closer look reveals that slightly more than half of the respondents (57.7%) do not have information about air quality, and of those who do seek information, only 21.3% do so regularly (at least several times a week). As mentioned, 18.7% rely on specialised platforms and channels, which is both a prerequisite for actively seeking information on the issue and a testament to the reliability of the data.

This raises questions whose answers and solutions can be explored in ongoing research focused on public awareness. One of them is the problem of the accessibility and reliability of the sources and channels through which the citizens receive information and/or can actively seek it. It is no coincidence (at first glance paradoxical given the declared relatively high level of awareness) that the respondents unanimously state (98.7%) that information on the state and quality of atmospheric air should be more accessible and convenient to "search for" and should be the focus of traditional media (including regional media). In addition, there is a clear need to develop specialised platforms and applications that provide quick and convenient access to information on air quality, like platforms offering weather forecasts. In this regard, it is important to note that the use of specialised platforms does not correlate with the gender, age, education, and income of respondents—i.e., the levels of digitization and digital skills in Bulgaria are sufficiently high.

The "Personal Commitment" section was designed to check the citizens' readiness to take proactive steps to prevent and protect themselves from the harmful effects of air pollution. Less than half of the respondents (46.8%) indicated that they take measures to protect the air in the city (which includes walking more often, using electricity for heating instead of solid fuel, limiting the use of personal cars, using carpooling services and public transport), with no correlation found with their gender, age, education and income. Respondents (mostly highly educated) who would engage in initiatives to protect air quality account for 57.2%. Less than one-third of respondents (30.7%) take personal protective measures (such as wearing protective masks and keeping windows closed at home, using an air purifier), with this group being more highly educated. A similar proportion of respondents (34.8%) say they are willing to change their lifestyle to help protect air quality in the city,

with the most common measure being "walking more", but it should not be overlooked that just under half of respondents (42.8%) are willing, but not yet completely determined, to change their lifestyle. It is striking that although almost all respondents consider the air in the city to be polluted and a large proportion of them are concerned about this, there is a low level of personal protection, proactive engagement, and willingness to change behaviour patterns to reduce risks to individual and public health. According to respondents, this is a shared commitment between citizens, local government, regulatory agencies, and the national government. To the multiple-choice question "What measures do you think should be taken to reduce air pollution in Plovdiv?", the most frequently cited answers were "Strengthen control" (275 times), "Increase green spaces" (256 times), "Use more environmentally friendly means of transport" (205 times), "Reduce the number of cars" (194 times), "Impose higher fines on offenders" (192 times), "Improve the cleanliness of streets and boulevards" (181 times). This clearly shows citizens' expectations for stronger commitment on the part of public authorities and the development of effective strategies for controlling air quality and the strict implementation of the programs and measures set out in them.

Evidence of this can be found in the data analysis from the section "Assessment of Local Authorities' Activities". Almost all respondents believe that more serious measures are needed to protect air quality (95.2%). Although more than half of the respondents (62.3%) declare that they are not familiar with the details of the Clean Air Act, and only 11.8% are familiar with the specific measures at the local level, almost all of them find these efforts ineffective. The high percentage of people who are unaware of the current regulations and the strategies, programs, and measures taken to control air quality speaks not only to ineffective communication between public authorities and citizens but also to the underdeveloped institutional structure of civil society. A big share (88.17%) of respondents said they hadn't heard about local environmental organizations focused on air quality in the city, with only a few mentioning the NGO "BG Be Active" and a few social media-based communities as the "Green Plovdiv" civic platform, "For Clean Air in Plovdiv" and

“Breathe Plovdiv”. All of this indicates a problem that can be solved through focused policies for gaining synergy in the interactions between public authorities, experts, and civil society.

Furthermore, 40% of respondents express doubts about the quality and reliability of the officially published data on air quality. A significant proportion of them (78.3%) believe that new, more effective (and environmentally friendly) monitoring technologies are needed. Almost all of the respondents agree that the air measurement data from independent experts and scientific organisations should be more widely available and publicised (91.6%). The high percentages expressing a desire for publicity and accessibility may indicate both greater trust in independent expertise and curiosity and a desire for comparability of information between different data sources. At the same time, however, almost all the respondents (93.24%), with only a few exceptions, are not familiar with the organisations and platforms operating in the country and the city that provide data from their independent studies on the state of atmospheric air.

Conclusions

The data analysis presented in the pilot study on the awareness and engagement of citizens in Plovdiv, conducted in June 2025, revealed some problems and prospects for further research on air quality control.

For citizens and permanent residents of Plovdiv, air quality is a topic of significant importance, affecting their individual and public health. However, the analysis reveals serious shortcomings in terms of citizens' awareness and knowledge, as well as problems with access to, perception of, and trust in the official air quality data. Although the interest in this topic is high and citizens are aware of the risks posed by some of the main air pollutants, there are lower levels of awareness and insufficiently developed habits for regular information and adaptability of behavioural patterns regarding prevention and protection against the harmful effects of polluted air. The high percentage of ignorance of the regulatory framework, air quality standards and healthy air levels, as well as the specific measures taken to protect them, puts the population at risk. Added to this is a certain passivity, lack of awareness of the activities of

non-governmental organisations involved in the issue, and low personal commitment.

On the other hand, it is an undeniable fact that the respondents are dissatisfied with the implementation of specific programmes and measures for air quality control by public authorities and responsible institutions, as well as with the low level of trust in the accessibility and reliability of the data provided on air quality. Regardless of whether the problem is due to poor communication between public authorities and civil society or whether there is a problem in the work of state bodies regarding quality monitoring, targeted efforts are needed to improve this relationship.

Finally, it should be emphasised that a large proportion of the respondents strongly support the need to develop new reliable technologies for monitoring air quality, involve more independent organisations that measure pollution levels, and provide faster and more accessible platforms and channels for informing the public.

The analysis of the data from the study is a prerequisite and basis for future systematic, concentrated interdisciplinary research. In-depth studies of the interactions between public authorities, experts, and civil society are needed, as well as raising the level of synergy between them. To achieve high levels of effectiveness of measures to limit the risks and direct and indirect harm from air pollution and sustainable control over its quality, it is important to work towards establishing a transparent public institutional environment and innovative infrastructure in which all participating stakeholders are represented equally, including by raising the scientific literacy and awareness/responsibility of the population and engaging citizens as collaborators (“citizen science”).

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