

How Residents of Almaty Perceive Air Quality and Its Impact on Health.

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Abstract

Almaty's air pollution routinely exceeds guidelines; on some days, particulate exposure approximates five–six cigarettes. Following the city's 2025 Rules for the Protection of Atmospheric Air (with major transport curbs due in 2028), this paper examines how residents perceive health risks and policy change. Using 11 semi-structured interviews across districts, transcribed and thematically coded, three main findings are reported: (1) consistent links between polluted air and acute symptoms (congestion, allergies, headaches, cough, skin irritation), with relief reported outside Almaty; (2) strong temporal/spatial patterns worst in winter and evenings, cleaner in mornings and higher-elevation south; and (3) convergent policy preferences: stricter emissions enforcement, expanded/electrified public transport (including metro extensions), demand management for high-emitting vehicles, car-free pilots, and civic eco-actions. Results guide targeted seasonal/diurnal measures and risk communication; limitations include small, non-representative sampling and reliance on self-reports.

INTRODUCTION

On Almaty's dustiest days, residents inhale particulate matter roughly equivalent to smoking five–six cigarettes in a single day. In response, the Almaty Maslikhat has adopted new Rules for the Protection of Atmospheric Air – the first comprehensive, citywide climate and air-quality framework of Kazakhstan's 34 years of independence, as reported by Zakon.kz (2025). The Rules entered into force on September 18, 2025; the strictest transport measures (para. 72) are scheduled to begin on January 1, 2028. This policy window creates an urgent need to understand how people living in Almaty perceive the health consequences of polluted air and how they anticipate the coming regulations.

This paper examines public perceptions of the health impacts of air pollution in Almaty and situates them within the city's evolving regulatory context. It asks: How do Almaty residents understand and experience the health risks of air pollution? Which sources of information and everyday exposures shape those beliefs? And how, if at all, do the new Rules alter perceived risks, behaviors, and expectations from government and business? Methodologically, the study draws on in-depth, semi-structured interviews informed by comprehensive desk research on urban air quality, environmental health communication, and policy implementation in comparable cities. Interview guides are grounded in this literature.

The paper proceeds as follows. First, a literature review synthesizes global and regional research on health effects of air pollution and risk perception. Second, the study presents research questions, data, and methods. Third, it reports empirical findings on residents' perceptions, lived experiences, and responses to the new Rules. The conclusion discusses implications for public communication, policy design, and equitable implementation in Almaty.

Literature Review

In analyzing Almaty's air quality, we concentrated on the specific constituents of ambient pollution. Routine monitoring indicates three primary pollutants: fine particulate matter (PM_{2.5}), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂). PM_{2.5} – particles with an aerodynamic diameter $\leq 2.5 \mu\text{m}$ – originates predominantly from vehicular traffic and construction activities and poses elevated health risks due to its ability to penetrate deep into the respiratory tract. NO₂ arises chiefly from fossil-fuel combustion, most notably emissions from power plants and motor vehicles. SO₂ is likewise a combustion by-product of sulfur-containing fuels. Both NO₂ and SO₂ irritate the respiratory system and contribute to secondary environmental impacts, including smog formation and acid deposition.

During winter, Almaty experiences its most hazardous air quality. According to [IQAir reports](#), the Air Quality Index (AQI) on 10 February 2024 reached 208 as reported by Tengrinews. AQI is derived from concentrations of several pollutants, including PM_{2.5}, PM₁₀, ozone (O₃), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and carbon monoxide (CO). On that date Almaty ranked first among the world's most polluted cities. Seasonal contrasts are pronounced: average winter PM_{2.5} concentrations approach $\sim 50 \mu\text{g}/\text{m}^3$ (49.9), whereas summer values are roughly fivefold lower ($\sim 11.5 \mu\text{g}/\text{m}^3$). As reported in [98mag](#), in 2024, the number of days meeting WHO air-quality guidelines increased from 137 to 164, with improvements concentrated in May-August; other seasons showed no change. Spatial and diurnal patterns are also evident: the northeast of the city exhibits the highest pollution, the south is approximately twice as clean, the cleanest hours occur around 04:00-06:00, and the dirtiest around 19:00-21:00. Despite frequent “red” days, we observe only modest mid-annual improvement relative to 2023. Notwithstanding gains, Almaty's 2024 mid-annual PM_{2.5} remains about 4.8 times the WHO annual guideline ($5 \mu\text{g}/\text{m}^3$). Summer 2024 was the cleanest period, with PM_{2.5} near $11.5 \mu\text{g}/\text{m}^3$; thus May-August can be deemed the “cleanest” months, and November-February the “dirtiest.”

Health Outcomes: Asthma and Respiratory Problems

When looking at the general impacts of air pollution on population health, several main diseases are highlighted in the literature, among which asthma, COPD, bronchial hyperresponsiveness, and lung cancer. For example, a [2021 study](#) from Tulane University analyzed Louisiana's severe air pollution linked to dozens of cancer cases each year, and found that high levels of toxic air pollution are estimated to cause 85 cancer cases every year in Louisiana (Terrell & St Julien, 2022). This is a direct connection between cancer and air pollution. In turns of respiratory diseases and infections, the researchers found that higher exposure to NO₂, PM₁₀, and PM_{2.5} was associated with a higher incidence of all-cause, respiratory, and infectious hospital admissions both before adjusting for the area of residence and in fully adjusted models when considering cumulative exposure across time. Furthermore, exposure to evaluated levels of NO₂, PM_{2.5} or PM₁₀ (except O₃) showed approximately 50% rising in hospital admissions in men, however in women it was about 3% higher.

One of the often-cited consequences of air pollution is asthma. Asthma [is](#) one of known chronic respiratory diseases classified by different airflow obstruction, bronchial hyperresponsiveness, and airway inflammation.

Within the air pollution-related cases of asthma, one of the most concerning ones is with children. It is supposed that [13%](#) of all global diseases of asthma in children could be related to traffic-related air pollution (Tiotiu et al., 2020). According to data, air pollution has a harmful impact on asthma consequences both in adult and infant cases. A [meta-analysis](#) of published birth cohort studies provided

crucial associations amongst poor air quality and the numbers of asthma disease. Children are at the highest [danger](#) of air pollution which can worsen their situation at times or even increase risks for more serious respiratory illnesses such as wheezing, bronchitis, and pneumonia. Additionally, poor air quality may lead to problems in the immune system, cardiovascular effects, and neurodevelopmental impacts. In terms of prenatal exposure to poor air quality, it can be apparent with preterm birth, low birth weight, and stillbirth.

Perception & Behaviour of Residents

One of the key measurements that is usually underlooked in air pollution studies is public perception of air pollution. Perceived air pollution is people's subjective perception of air quality, which differs from objective scientific measurements and is shaped by personal experience, knowledge, social environment, and emotions.

Multiple studies have been done to measure perceived air pollution. For example, in 2025, [Rahman et al.](#), surveyed 398 adults who had been living at least 3 years in their current location, about how they perceived air pollution and how it related to self-reported health-related concerns. That self-reporting of health problems was analyzed using 13 specific air-pollution related illnesses. As a result, the authors found that the most of the surveyed responded adults noticed in their area air polluted environment, and concluded that construction activities are the prevalent reason of their concerns. As for age-related vulnerability, older people (46-55 and >55 years) reported greatly higher health diseases due to the poor air quality in contrast with the youth. Location plays a crucial role, for instance, Mirpur's citizens faced fewer health illnesses that clearly shows how urbanization affects public health. Discrepancy between knowledge and action: Even though residents are aware of the risks, many fail to consistently adopt protective measures such as wearing masks. Seasonal trends: Winter was identified as the most polluted season, while the monsoon season provided some relief.

[Another study in Hong Kong](#) involved 210 participants who wore portable PM2.5 sensors and GPS devices for two days, using real-time mobility-based (MB) measurements. The research compared residence-based (RB) versus mobility-based measurements of environmental factors to tackle the Uncertain Geographic Context Problem (UGCoP). There is a notable gap between actual exposure to air pollution and people's perceptions of it. Individuals with lower incomes are more likely to experience higher levels of poor air quality. In contrast, unemployed individuals and those experiencing more severe mental health issues are more adept at accurately gauging air pollution levels. Older adults and those living in areas with dense MB access to open spaces tend to underestimate air pollution, while students often view air quality favorable. Environmental conditions are influential: Residents in areas with high MB transportation and green space density generally perceive the air quality is poor. No significant correlation was detected between actual PM2.5 concentrations and perceptions of air quality based on mobility measurement, likely due to the relatively low pollution levels in Hong Kong.

Last but not the least is [a study on Estonian residents](#): A population-based study of 1,000 Estonian residents utilized questionnaires on health risk perception along with modeled PM10 levels at a 1x1 km resolution. Path analysis was employed to explore the connections among actual air pollution, perceived pollution, health risk perception, symptoms, and diseases. Actual PM10 exposure did not have a direct impact on perceived pollution or health outcomes. However, perceived exposure notably affected health risk perception, which subsequently influenced health symptoms and diseases. In terms of regional differences, the link between perceived pollution and symptoms was stronger in large urban areas than in

rural settings. A negative correlation was found between health risk perception and disease, suggesting that higher perceptions of risk may lead to healthier protective behaviours. Even at pollution levels that fall below official safety thresholds, when perceived as harmful by the community, air pollution can present significant health risks through psychological mechanisms.

Data and Methodology

The following study will analyze how Almaty citizens perceive air pollution health impacts. This study is oriented on closing the gap in the literature and adding to the conversation of perceived health impacts. The research questions this study is concerned about are as follows: **How do Almaty residents perceive the health impacts of air pollution? Do Almaty residents feel the impacts of air pollution at all? Do Almaty residents notice the difference in pollution in different areas of the city?**

I have interviewed 11 Almaty citizens. I chose every respondent based on their availability to respond and their own interest about the poor quality of air in Almaty City and how it influences citizens' health. Mainly, interviews were conducted online, where respondents recorded their answers after I sent them a list of questions. Some interviews were conducted face-to-face in my current school, these interviews were recorded.

I tried to choose respondents from various regions in Almaty, different age, gender, and area of expertise. Thus, I wanted to cover diverse views from different individuals on this topic. The main criteria was that every respondent should be older than 18.

The interview format was fully structured, since all questions were clear and did not require additional explanations. All interviews were conducted based on respondents availability and with different options on how it will be conducted (online or face-to-face). At the beginning of every interview session I gave the introduction where I mentioned that the interview is anonymous and took permission to record an audio.

6 out of 11 interviews were audio-recorded with participant consent. Recordings were transcribed verbatim using the Whisper speech-to-text model and then manually reviewed for accuracy and anonymization.

Transcripts were coded in Excel/Google Sheets using a codebook aligned with the interview guide (e.g., perceived air quality, seasonality/hotspots, health symptoms, adaptation behaviors, information sources, policy suggestions), with room for emergent themes. A two-pass process (initial coding → consolidation) was used to ensure consistent labels and to enable cross-case comparison. For transparency, we kept an audit trail (versioned codebook, dated notes) and summarized results with simple frequency counts (e.g., how many participants mentioned traffic, the main issue that influences air quality in Almaty is the excessive amount of cars mentioned by 10/11 participants).

Results

Demographics

The average age of participants was from 22 to 54. The interview involved 5 males and 6 females. Most of the respondents live in the most polluted areas in Almaty such as Almalinskiy, Alatauskiy and Bostandykskiy districts.

Perceived Quality of Air

Most respondents report poor air quality. Absolutely everyone noticed the difference in air depending on the area and time of day. The majority of respondents claimed that the air is much cleaner in the upper

areas of the city closer to the mountains. As for the lower part of the city and the center, the air there is noticeably dustier. In contrast, some respondents do not see a significant difference in the air depending on the areas of Almaty, and believe that the entire city is covered to one extent or another. However, they all claimed that the air is pretty cleaner in the upper areas of the city closer to the mountains and it's still better than in other parts of the city:

“It's dirty everywhere, it doesn't seem to depend on the area. But apart from the fact that there is cleanest air in the mountains.”

Respondents commonly reported that air quality is highest in the early morning. A majority indicated that the cold seasons – autumn and winter – are most polluted, attributing this to the heating period and increased vehicle use, which together make breathing more difficult. Others emphasized that summer can be comparably burdensome due to intense heat and stagnant air; as one participant noted,

“It is most difficult to breathe in summer, when it is unbearably hot and the air becomes even heavier.”

A minority reported no clear seasonal pattern in breathing difficulty.

“Personally, I don't feel it seasonally, I actually feel it in the regions and mountains, that is, it's probably always hard to breathe, but when you change the terrain, you feel the difference.”

Another respondent believes that it is difficult to breathe at any season in Almaty.

Almaty residents list a number of reasons for air pollution in the city. They arrange them in the following order: 1. A large number of cars and vehicles, especially old ones. 2. Construction sites for new buildings 3. Industry in the city (factories, enterprises, heating stations) and finally, the factor that is most likely seasonal is heating. Indeed, this aligns with the actual statistics. Of the total number of registered cars as of January 1, 2025 (5.74 million units), more than half are cars older than 20 years. In the past 10 years, there has been an increase in vehicles from 27 thousands to 695 thousands. When it comes to construction sites, too, we have seen that now the government wants to build [a new ski resort in Almaty](#), however the ecological society "green salvation" reports that the development of a natural area can lead to negative consequences for residents of the metropolis (Tajibayeva, 2025). Experts believe that the implementation of the project will lead to further destruction of mountain ecosystems, deterioration of the ecological situation in Almaty and the Almaty region.

Nine out of eleven respondents reported having allergic symptoms (sneezing, runny nose, fatigue), which they associate with especially “contaminated days”, which usually occur from the beginning of autumn to the end of winter as well as headaches, the second most common symptom, which many have noticed a sore throat and cough, and even dirty nasal discharge, which can signal the penetration of dust into the respiratory tract:

“I often noticed that with a runny nose, the snot comes out "dirty". It's like dust is gathering in the respiratory tract.”

In addition, Almaty residents note that children are now more likely to suffer from ENT diseases than before, which also indicates the impact of polluted air on the health of residents. This [finding](#) is in line with the literature that shows a direct connection between air pollution and respiratory diseases. The observation that Almaty residents made about children's respiratory diseases possibly indicates an increase in the perceived level of pollution.

All respondents replied that there is a significant difference between Almaty and other countries and cities. Upon arrival in Almaty, they start experiencing allergy symptoms, nasal congestion, and rashes on their face that do not go away. Also, in other cities and countries, in addition to free breathing, the respondents

noticed better sleepiness and felt it for their health.

“I lived in another city before moving to Almaty, and I can confirm that the difference in air quality is noticeable. According to friends, in other cities of Kazakhstan and abroad, the air is much cleaner, and this is felt by health.” - said one of the respondents.

“If you come from another city or country, that's the difference, it's immediately felt. Just last week, my colleagues and I were on a business trip to Borovoye. And there, firstly, there is no such pollution. The sky is so clear. There's a lot of oxygen in the air. And for comparison, I didn't have nasal congestion and constant sneezing there. And so, literally on Friday evening, we arrived. And today is Monday, I have a stuffy nose and a constant sneeze.”

The difference is especially noticeable with the resort countries. A large number of Kazakhstanis like to relax on the shores of the Mediterranean Sea, especially in the Antalya region. And, indeed, according to the website iQAIR.com, the air quality in Antalya remains good, but it fluctuates depending on seasons. - write the difference on index in almaty and antalya

Air Quality Monitoring and Related Habits in Daily Life

Most of the respondents monitor air quality extremely rarely using apps. Respondents mentioned apps such as AirVisual and IQAir. With the AirVisual app, users can follow real-time updates on indoor and outdoor air pollution, as well as air quality forecasts. Some people learn about air quality through news channels. They also replied that they only monitor the air quality when they feel that the air is really contaminated, just to make sure they are not mistaken.

For many respondents, life hacks with measures taken to reduce the impact of polluted air on themselves and their families almost completely coincide, they include morning walks, air purifiers, wearing masks, closing windows, and so on. There were unique life hacks to feel better on polluted days; exercise and proper nutrition. Some people don't have any life hacks because they believe that air pollution is stable and they don't notice it in their routine.

As for the statistics of the presence of chronic diseases in Almaty residents, the indicators are encouraging, since most of the respondents do not have chronic diseases related to respiratory functions, for example (asthma, bronchitis, pneumonia and others). The proportion of Almaty residents with chronic diseases really begins to worsen during the "dirty days", their relatives notice that this period is very difficult to endure.

Policy Signals

Respondents converged on a set of policy priorities for municipal authorities. First, they emphasized expanding and improving public transportation, alongside stricter enforcement of emissions standards for heavy-duty vehicles and industrial sources. Second, they favored incentives that nudge modal shifts toward lower-emission options – bicycles, electric vehicles, and scooters – paired with disincentives for high-emitting cars (e.g., restrictions on registering older vehicles entering the city and substantial penalties for violations). Several participants also proposed periodic car-free interventions; one suggestion was, “one week without cars, restrict entry only by passes.”

Participants underscored that environmental quality should be elevated within urban planning and investment decisions, given air pollution's documented physical and psychological harms. A recurrent infrastructure request was the extension of the metro and related mass transit to peripheral areas (e.g., Kaskelen and Talgar): “develop public transport – the same metro to Kaskelen, to Talgar... and correspondingly expand metro and bus service (and trams).” Civic responsibilities identified by residents

included adopting cleaner travel habits, staying informed about air conditions, sharing information within communities, and participating in tree-planting and other environmental initiatives

Conclusion

This study examined how Almaty residents perceive the health, well-being, and everyday consequences of poor air quality, and how these perceptions intersect with seasonal patterns and emerging regulatory changes. Understanding lived experience is essential in a city where ambient pollution routinely exceeds international guidelines and where policy choices over the next several years may reshape exposure.

Three findings stand out. First, participants consistently associated polluted air with acute respiratory symptoms such as nasal congestion, allergic reactions, skin irritation and reported noticeable relief when outside Almaty, suggesting strong perceived links between local air conditions and health. Second, respondents identified clear temporal patterns: winter and late-evening hours were viewed as the most burdensome periods, while mornings and summer months were comparatively cleaner; nonetheless, several noted that extreme summer heat can also exacerbate breathing difficulty. Third, residents articulated convergent policy preferences: strengthen and enforce emissions standards (especially for heavy vehicles and industrial sources), expand and electrify public transport (including metro extensions to peripheral areas), deploy demand-management measures (e.g., restrictions on older vehicles or periodic car-free weeks), and mobilize civic action (information sharing, tree planting, eco-initiatives).

These insights have practical use. They can inform targeted interventions during the heating season and evening peaks; guide communication strategies that align with residents' felt risks; and help prioritize investments in mass transit, clean fleets, and industrial controls. They also suggest near-term pilots (car-free days, low-emission zones) that could build public support and generate measurable air-quality gains. Two caveats apply. The evidence here is perceptual and self-reported; it should be complemented with clinical and high-resolution exposure data. Moreover, our sample cannot claim citywide representativeness. Future work should integrate mixed methods of personal exposure monitoring, health records, and longitudinal interviews to evaluate policy impacts over time. Even with these limitations, the convergence of residents' experiences and policy suggestions offers an actionable agenda for improving air quality and, with it, the physical and psychological well-being of Almaty's population.

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