Proceedings of the 3rd International Conference on Modern Medicine and Global Health
DOI: 10.54254/2753-8818/68/2025.20026

A Review of Air Pollution Research in Panzhihua City from 2018 to 2023

Boyuan Zheng[1,a,*]

[1]*Nanjing University, No. 1520, Taihu Avenue, Suzhou, China*
a. 2398411221@qq.com
**corresponding author*

Abstract: Air pollution is a critical issue of concern to society, and researches on this topic has notably increased in recent years. Panzhihua City, a key resource-consuming and heavy industrial city in the southwestern region of China, places air pollution prevention and control at the top of its priorities. However, there is currently a lack of comprehensive reviews on air pollution studies specific to Panzhihua. This paper reviews the research conducted on air pollution and its control methods in Panzhihua City between 2018 and 2023. Ten relevant studies were included, the pollution levels of heavy metals and mineral particles in atmospheric dustfall, $PM_{2.5}$, PM_{10}, SO_2, CO, NO_2, and O_3 were summarized. The paper also outlined the trends, potential causes of air pollution in Panzhihua, and suggested control measures, aiming to provide a reference for future research and offer a scientific basis for local government policy-making regarding air pollution control.

Keywords: Air pollution, influencing factors, control measures, Panzhihua City, 2018-2023.

1. Introduction

Panzhihua City, an important industrial city in Sichuan Province, has experienced rapid economic development closely tied to resource exploitation [1]. However, this growth has also brought significant air pollution challenges [2]. Air pollution not only severely impacts the health of local residents [3] but also restricts the region's sustainable economic development [4] and environmental protection efforts [5]. Therefore, in-depth research on the characteristics of air pollution in Panzhihua and the development of effective prevention and control measures is critical for formulating sound environmental protection policies and advancing ecological civilization.

To combat air pollution, the State Council of China has issued several key policies, including the Air Pollution Prevention and Control Action Plan and the Three-Year Action Plan to Win the Battle for Blue Skies. Panzhihua City has responded actively by publishing several local plans, such as the Panzhihua Renhe District Three-Year Plan for Resolute Air Pollution Control (2022–2024). In recent years, the number of studies focused on air pollution in Panzhihua and its surrounding areas has significantly increased. For instance, Yang Jiu et al. [6] found that between 2014 and 2020, the concentrations of air pollutants such as $PM_{2.5}$, PM_{10}, CO, and SO_2 in Panzhihua showed a downward trend, while NO_2 concentrations increased, albeit not significantly. However, $O_{3\text{-}8h}$ concentrations showed a significant upward trend. Zhang Jiao et al. [7] discovered that mineral particles in Panzhihua's dustfall contained high concentrations of hematite, and coal combustion and mobile sources contributed significantly to the dustfall's mineral particles. These studies have enriched the

© 2025 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/68/2025.20026

knowledge on recent air pollution and dustfall characteristics in Panzhihua, but there has been no comprehensive review of the recent researches on air pollution in the city. Thus, this paper provides an overview of the research conducted on Panzhihua's air pollution from 2018 to 2023, helping readers better understand the current status of air pollution researches in the area.

2. Materials and Methods

2.1. Literature Search Scope

The databases used for this study included Chinese-language databases: Wanfang Data Knowledge Service Platform, CNKI (China National Knowledge Infrastructure), and VIP Chinese Journal Service Platform. English-language databases included PubMed, Web of Science, and Medline. The search timeframe was from January 1, 2018, to August 1, 2024, and publications were limited to Chinese and English.

2.2. Inclusion and Exclusion Criteria

The inclusion criteria were: (1)The study location must be Panzhihua City or its surrounding areas, and the research topic must focus on air pollution. (2)The study must reflect the spatial and temporal distribution characteristics of air pollution in Panzhihua City.

The exclusion criteria were: (1)Duplicate publications. (2)Studies with a scope that was either too narrow or too broad. (3)Studies with a research direction unrelated to air pollution.

2.3. Data Extraction

The study first screened Chinese and English literature that met the inclusion criteria. From the selected literature, data such as the author, publication year, research area, study period, pollutants, and research findings were extracted and summarized. A comparative analysis was then conducted to examine both horizontal and vertical trends, allowing for a comprehensive summary of the air pollution situation in Panzhihua City in recent years. The analysis also integrated local conditions to propose feasible solutions for air pollution prevention in Panzhihua City.

3. Results

3.1. Literature Search Results

A total of 27 articles were retrieved from the databases, including 13 Chinese-language papers and 14 English-language papers. After removing duplicates, 12 Chinese-language papers and 12 English-language papers were selected based on their titles and abstracts. Two Chinese papers were excluded due to overly broad research scopes, and nine English papers were excluded due to deviations in research focus from air pollution. After thoroughly reading the remaining 13 papers, 9 Chinese-language papers and 1 English-language paper were included in the final analysis, for a total of 10 papers.

3.2. Characteristics of Included Studies

The basic characteristics of the 10 included papers were shown in Table 1. The earliest paper was published in 2017, and the most recent in 2023. Two papers were published between 2017 and 2020, while eight papers were published between 2021 and 2023. Geographically, two papers covered the southern part of Sichuan Province, and eight papers focused solely on Panzhihua City. In terms of research topics, three papers studied atmospheric dust characteristics, three papers examined the

DOI: 10.54254/2753-8818/68/2025.20026

spatial and temporal distribution of air pollution in Panzhihua, two papers investigated the causes of air pollution, one paper focused on remote sensing monitoring of atmospheric pollution, and one paper addressed air pollution prevention and control. Regarding research methods, four papers used spatio-temporal land-use regression models, two employed the Spearman's rank coefficient of correlation method, and two utilized correlation analysis. Additional methods used in individual papers included radar plots, divergence coefficient methods, inverse distance weighting, least significant difference tests, and comprehensive contribution index algorithms. For pollutant data sources, three papers collected data from field samples, all focusing on atmospheric dust-related characteristics. Six papers used air pollution monitoring data and high-resolution meteorological data from Panzhihua City, and one paper used remote sensing data from the European Space Agency's TROPOMI satellite. The research findings of these studies were presented in Table 2.

Table 1: Characteristics of relevant literatures on air pollution research in Panzhihua City.

No.	Author	Publication Year	Research Area	Research Subject	Research Methodology	Pollutant Data Source
1[8]	Su Ting	2017	Panzhihua City	Geochemical characteristics of atmospheric dust	Spatiotemporal land-use regression model	Field sampling
2[9]	Liu Rui et al.	2019	Southern Sichuan Province	Characteristics of heavy metal pollution in near-surface atmospheric dust	Spatiotemporal land-use regression model	Field sampling
3[10]	Cao Xueying et al.	2021	Panzhihua City	Spatiotemporal variation of air pollutants	Radar plot, divergence coefficient method, Spearman's rank coefficient of correlation method	Ground-level air pollution monitoring data and high-resolution meteorological fields
4[11]	Xie Nan et al.	2021	Panzhihua City	Impact of economic development on ambient air quality	Spearman's rank coefficient of correlation method	Ground-level air pollution monitoring data and high-resolution meteorological fields
5[12]	Liu Xinyu et al.	2022	Panzhihua City	Influence of meteorological factors on air pollution	Correlation analysis, inverse distance weighting	Ground-level air pollution monitoring data and high-resolution meteorological fields
6[13]	Zhou Li et al.	2022	Panzhihua City	Remote sensing monitoring of atmospheric pollution	Spatiotemporal land-use regression model	Satellite remote sensing

DOI: 10.54254/2753-8818/68/2025.20026

Table 1: (continued).

7[6]	Yang Jiu et al.	2022	Panzhihua City	Characteristics of atmospheric pollutants	Least significant difference test	Ground-level air pollution monitoring data and high-resolution meteorological fields
8[14]	Li et al.	2022	Panzhihua City	Impact of air pollution on health	Correlation analysis	Ground-level air pollution monitoring data and high-resolution meteorological fields
9[7]	Zhang Jiao et al.	2023	Southern Sichuan Province	Mineral particle characteristics in atmospheric dust	Spatiotemporal land-use regression model	Field sampling
10[15]	Dai Jiao et al.	2023	Panzhihua City	Characteristics of air pollution	Comprehensive contribution index algorithm	Ground-level air pollution monitoring data and high-resolution meteorological fields

Table 2: The results of various studies.

No.	Pollutants Studied	Research Results
1[8]	Water-soluble ions, heavy metals (As, Cd, Cr, Cu, Pb, V, Zn, Ni, etc.)	The atmospheric dust in Panzhihua City is characterized by fine particle sizes and poor sorting. The dust is slightly acidic and can have certain impacts on soil and water bodies. The content of some heavy metals in the dust far exceeds the background levels of Sichuan soil. The mineral particles in the dust have complex morphologies. Industrial activities, mining, coal combustion, and traffic are the main contributors to the unique attributes of Panzhihua's atmospheric dust.
2[9]	Heavy metals (Cd, Cr, Cu, Zn, Ni, V, etc.)	Panzhihua City faces severe heavy metal pollution, especially in the Baoding coal mining area and the Panzhihua Iron and Steel industrial area. The soil ecology in Panzhihua is under significant threat, possibly related to steel production.
3[10]	SO_2、NO_2、CO、O_3、$PM_{2.5}$ and coarse particles ($PM_{2.5}$-PM_{10})	From 2016 to 2019, air quality in Panzhihua City showed an overall improvement. CO and O_3 levels exhibited a V-shaped trend, while SO_2 followed an M-shaped trend. The concentrations of pollutants varied significantly across seasons. SO_2, CO, and NO_2 concentrations were highest in the He Menkou, Nonnongping, and Bingcaogang areas, while O_3, $PM_{2.5}$, and PM10 concentrations were more evenly distributed. Key meteorological factors affecting pollution varied by season.

DOI: 10.54254/2753-8818/68/2025.20026

Table 2: (continued).

4[11]	SO_2、NO_2、PM_{10}、CO、O_3-8h、$PM_{2.5}$	Socioeconomic development had the most significant impact on $PM_{2.5}$, O_3, and NO_2 concentrations. Corporate investment in environmental protection played a significant role in improving air quality. The increase in the added value of the primary and tertiary sectors had an effect on air quality in Panzhihua City.
5[12]	AQI, $PM_{2.5}$, PM_{10}, CO, NO_2, SO_2, O_3	The primary pollutant in Panzhihua City is PM_{10}. PM_{10} and NO_2 dominate in autumn and winter, while PM10 and O_3 dominate in spring and summer. Various meteorological elements affect air quality differently. The six air pollutants vary significantly in their spatial distribution.
6[13]	O_3, CO	The changes in O_3 concentrations in Panzhihua City were not caused by point-source emissions but by a broader, systemic change. The urban area is a CO high-concentration zone, and CO spreads throughout the city, raising overall CO levels.
7[6]	SO_2, NO_2, PM_{10}, CO, O_3-8h, $PM_{2.5}$	From 2016 to 2020, the concentrations of $PM_{2.5}$, PM_{10}, CO, and SO_2 decreased, while NO_2 increased, and O_3-8h showed a significant upward trend. Air quality was poorer in the central urban area and better in the surrounding areas. The six air pollutants varied significantly across seasons, with different patterns of change. Meteorological factors were correlated with air pollutants, with temperature and relative humidity being the primary factors affecting air pollution.
8[14]	$PM_{2.5}$, PM_{10}, SO_2, NO_2, CO	$PM_{2.5}$、PM_{10}、SO_2、NO_2 and CO were associated with increased hospitalization rates, length of hospital stays, and medical costs for RD-DM patients.
9[7]	Hematite, calcite, quartz, muscovite, gypsum, albite, dolomite, kaolinite, chlorite, cordierite, etc.	The atmospheric dust particles in Panzhihua are relatively fine. There are columnar and plate-shaped particles, ooids, and spherical particles in the dust. Mineral particles such as calcite, quartz, muscovite, gypsum, albite, dolomite, kaolinite, chlorite, and cordierite, as well as a high mass fraction of hematite, were found in the dust. The air masses affecting Panzhihua are less influenced by those from the Sichuan Basin and are primarily impacted by air masses from the Yunnan-Guizhou Plateau.
10[15]	SO_2, NO_2, PM_{10}, CO, O_3-8h, $PM_{2.5}$	The concentrations of the six air pollutants show significant and different changes annually, seasonally, and daily. The changes in O_3 concentrations in Panzhihua align with trends in most cities in China, indicating that O_3 pollution is a national issue.

3.3. Main Research Findings

3.3.1. Heavy Metals and Mineral Particles

Three studies [7-9] reported on the heavy metals and mineral particles in atmospheric dust in Panzhihua City, with two of them focusing on heavy metals[8, 9] and one on mineral particles [7]. All three studies relied on data from field sampling. The findings indicated that Panzhihua City suffered from severe pollution by heavy metals and mineral particles [7-9], with most areas classified as experiencing moderate to high levels of heavy metal pollution [9]. Furthermore, the composition of heavy metals and the morphology of mineral particles in atmospheric dust were complex, displaying spherical, block, layered, flaky, and columnar structures [7]. The Baoding coal mine area

DOI: 10.54254/2753-8818/68/2025.20026

and the Panzhihua Iron and Steel industrial area were the most heavily polluted by heavy metals and mineral particles [7-9], both being key heavy industrial zones in Panzhihua. Comparative studies across Sichuan Province showed that the content of some heavy metals in atmospheric dust in Panzhihua far exceeded the background levels of Sichuan soil [8, 9]. For instance, the As content was more than four times the background value, Cd was more than 21 times higher, and Cr was more than seven times the background value [9]. Additionally, Panzhihua's atmospheric dust contained a relatively high mass fraction of hematite, reaching 7.7% [7], which was significantly higher compared to other regions in Sichuan. Researchers concluded that the characteristics of Panzhihua's atmospheric dust were closely related to local heavy industrial and mining activities [8, 9]. Due to the city's unique geographical factors, air masses in Panzhihua were less influenced by those from the Sichuan Basin and were primarily affected by air masses from the Yunnan-Guizhou Plateau [7].

3.3.2. $PM_{2.5}$ and PM_{10}

Six studies examined the $PM_{2.5}$ and PM_{10} pollution in Panzhihua City [6, 10-12, 14, 15]. PM_{10} was identified as the primary pollutant, with days dominated by PM_{10} accounting for 51% of the year, while days with $PM_{2.5}$ as the main pollutant accounted for 3% [12]. From an annual concentration perspective, both $PM_{2.5}$ and PM_{10} concentrations showed a downward trend over the years [6, 10, 15]. On a monthly basis, their concentrations exhibited clear variations, with lower levels in summer and higher levels in winter [6, 10, 15]. Daily concentration changed follow a "double peak" pattern, with higher peaks in the morning and evening [10, 15]. Additionally, the daytime peak was approximately 1.5 times higher than the nighttime peak [10, 15]. In terms of spatial distribution, the concentrations of $PM_{2.5}$ and PM_{10} tended to be evenly distributed across Panzhihua City. Moreover, the differences in their distribution have been gradually decreasing in recent years [10, 12].

3.3.3. SO_2 and CO

Seven studies reported on SO_2 and CO pollution in Panzhihua City [6, 10-15]. The studies found that the days when SO_2 and CO were the primary pollutants accounted for 3% and 5% of the year, respectively [12]. From the perspective of annual concentration changes, the levels of SO_2 and CO have been steadily decreasing [6, 10, 15]. On a monthly basis, SO_2 and CO concentrations showed a pattern of being lower in summer and higher in winter [6, 10, 15]. On a daily basis, SO_2 and CO concentrations exhibited a single-peak variation [10, 15]. In terms of spatial distribution, areas with high concentrations of SO_2 and CO were concentrated in He Menkou, Nonnongping, and Bingcaogang, with significant differences in concentration across monitoring sites [10, 12, 13]. Regarding the relationship between air pollutant concentrations and meteorological factors, CO concentration was found to have a significant positive correlation with relative humidity, while no significant correlation was observed between SO_2 concentration and meteorological factors [6].

3.3.4. NO_2 and O_3

Seven studies also reported on NO_2 and O_3 pollution in Panzhihua City [6, 10-15]. The studies found that NO_2 was the primary pollutant on 26% of the days in a year, while O_3 was the primary pollutant on 11% of the days[12]. A clear negative correlation was observed between NO_2 and O_3 concentrations[6]. From an annual concentration perspective, both NO_2 and O_3 concentrations showed an upward trend, but the increase in O_3 was more pronounced than that of NO_2 [6, 10, 15]. On a monthly basis, O_3 concentration exhibited a pattern of "high in spring and low in winter," while NO_2 concentration followed a "low in summer and high in winter" trend [6, 10, 15]. On a daily basis, NO_2 concentrations displayed a "double peak" pattern in the morning and evening, while O_3 concentrations showed a "single peak" in the afternoon [10, 15]. In terms of spatial distribution, high

DOI: 10.54254/2753-8818/68/2025.20026

concentrations of NO_2 were concentrated in He Menkou, Nonnongping, and Bingcaogang, while O_3 concentrations tended to be more evenly distributed [10, 13].

4. Discussion

4.1. Air Pollution Status and Trends in Panzhihua City

From the results of the 10 reviewed studies, it can be observed that the air pollution situation in Panzhihua City has generally improved from 2018 to 2023. The annual average concentrations of $PM_{2.5}$, PM_{10}, SO_2, CO, and NO_2 have shown a clear downward trend [6, 10, 15], and their comprehensive index contribution rates have also gradually decreased [15], indicating that air pollution in Panzhihua has been effectively controlled in recent years. However, the annual average concentration of O_3 has exhibited an abnormal upward trend [6, 10, 13, 15], which should raise concerns for the relevant authorities. In addition, the city still faces issues related to heavy metal and mineral particle pollution in atmospheric dust[7-9], which also warrants the attention of relevant departments.

4.2. Possible Causes of Air Pollution in Panzhihua City

Regarding the possible causes of air pollution in Panzhihua City, research indicated that natural factors such as temperature, wind speed, and relative humidity were the primary meteorological factors influencing air pollution in the city [6]. The city was less affected by air masses from the Sichuan Basin and was mainly influenced by air masses from the Yunnan-Guizhou Plateau [7], which has a certain impact on atmospheric pollution and dust in Panzhihua. From the perspective of urban development, Panzhihua has been expanding its urban scale in recent years, with increasing real estate projects, a growing number of vehicles, and numerous large-scale engineering projects. The resulting industrial dust emissions and vehicle exhaust have had a significant effect on the concentrations of $PM_{2.5}$, O_3, and NO_2 [11]. In terms of the city's industrial structure, the steel and mining industries are its main economic pillars, and the local steel production and mining activities were the primary causes of air pollution and atmospheric dust [6, 8, 9, 12, 15]. The improvement in air quality in Panzhihua in recent years can be largely attributed to the environmental protection reforms implemented in heavy industry enterprises following the "13th Five-Year Plan" [10].

4.3. Air Pollution Control Measures in Panzhihua City

As for measures to control air pollution in Panzhihua City, researches suggested that pollution source management should be targeted by month and time period, with specific control plans for industrial sources, mobile sources, and area sources. The city should also enhance its emergency response capabilities under unfavorable meteorological conditions to further improve air quality [15]. Regarding ozone pollution, research indicateed that Panzhihua has shifted from experiencing O_3-type pollution from March to June and no significant pollution from July to October, to a complex pollution pattern dominated by $PM_{2.5}$ and other pollutants from November to February. The period from March to June is the most severe for O_3 pollution [6, 10], which should receive special attention from relevant authorities. In addition, heavy metal and mineral particle pollution in atmospheric dust remains a serious issue [7-9], and effective control measures should be implemented by authorities to address these pollution sources.

5. Conclusion

The air pollution situation in Panzhihua City has generally improved, with noticeable reductions in the concentrations of PM2.5, PM10, SO2, CO, and NO2 in recent years, indicating that air pollution

DOI: 10.54254/2753-8818/68/2025.20026

has been effectively controlled. However, heavy metal and mineral particle pollution in atmospheric dust remains a significant issue, and ozone (O3) pollution has worsened compared to the past, which requires attention and further management by relevant authorities. Panzhihua should develop control plans for industrial, mobile, and area pollution sources based on specific months and time periods, and enhance emergency response capabilities for unfavorable meteorological conditions to further improve air quality. With effective control measures, Panzhihua's "Iron-Handed Air Pollution Control" action is expected to achieve positive results.

References

[1] *Zhong, X. (2024). The current status and development ideas of Panzhihua Iron and Steel's vanadium and titanium export trade. Northern Economy and Trade, 2024(02), 43-46.*

[2] *Shao, B., et al. (2022). Analysis of ozone pollution characteristics and impacts in Panzhihua from 2015 to 2020. Green Technology, 24(12), 8-11.*

[3] *Tu, P., et al. (2023). Spatiotemporal distribution characteristics of air pollution and health risks in key cities in China. Environmental Science, 44(11), 5954-5963.*

[4] *Zeng, S. (2021). The spatial spillover effects of environmental pollution on regional economic development levels. Modern Business, 2021(17), 127-129.*

[5] *Wang, Z. (2023). Environmental impact assessment analysis of air pollution in the urbanization process. Resource Conservation and Environmental Protection, 2023(03), 110-113.*

[6] *Yang, J., et al. (2022). Analysis of the characteristics of air pollutants and their relationship with meteorological factors in Panzhihua. Environmental Science & Technology, 45(S1), 205-214.*

[7] *Zhang, J., et al. (2023). Characteristics of mineral particles in atmospheric dust in the special topographic area of Southwest China. Chemical Minerals and Processing, 52(03), 1-9.*

[8] *Su, T. (2017). Geochemical characteristics of atmospheric dust in Panzhihua City. [Unpublished doctoral dissertation].*

[9] *Liu, R., et al. (2019). Characteristics and evaluation of heavy metal pollution in soil and near-surface atmospheric dust in a typical mining city in Southwest China: A case study of Panzhihua City. Mineralogy and Petrology, 39(03), 111-119.*

[10] *Cao, X., & Ye, Z. (2021). Analysis of the spatiotemporal variation characteristics of air pollutants in Panzhihua from 2015 to 2019. In Proceedings of the 2021 Annual Scientific and Technological Conference of the Chinese Society for Environmental Sciences: Environmental Engineering Technology Innovation and Application. Tianjin, China.*

[11] *Xie, N., et al. (2021). The impact of economic development on ambient air quality in Panzhihua. Journal of Environmental Science Guide, 40(05), 52-59.*

[12] *Liu, X., et al. (2022). A brief analysis of the impact of meteorological elements on air pollution in Panzhihua from 2015 to 2017. Sichuan Environment, 41(01), 86-95.*

[13] *Zhou, L., Hu, H., & Wang, X. (2022). Preliminary exploration of atmospheric remote sensing monitoring in Panzhihua City using Sentinel-5P satellite data. Environmental Protection Technology, 28(02), 40-44.*

[14] *Li, X., et al. (2022). Health and economic impacts of ambient air pollution on hospital admissions for overall and specific cardiovascular diseases in Panzhihua, Southwestern China. Journal of Global Health, 12, 11012.*

[15] *Dai, J., et al. (2023). Analysis of air pollution characteristics in Panzhihua based on the contribution rate of the comprehensive index at different time scales. China Environmental Monitoring, 39(S1), 52-58.*