AQLI Air Quality Life Index® | China Fact Sheet

China's fine particulate air pollution ($PM_{2.5}$) has been decreasing since the country announced a "war against pollution" in 2014. This decline has continued through 2021, with pollution levels down by 42 percent compared to 2013.[1] Due to these improvements, the average Chinese citizen can expect to live 2.2 years longer, provided the reductions are sustained. Nevertheless, work remains. While China's overall particulate pollution average is in compliance with its national standard of 35 µg/m³, pollution levels still significantly exceed the World Health Organization (WHO) guideline of 5 µg/m³. As a result, particulate pollution shortens an average Chinese resident's life expectancy by 2.5 years, relative to what it would be if the WHO guideline was met.

KEY TAKEAWAYS

- Despite tremendous progress over the past few years, China is still the 13th most polluted country in the world. As a comparison, particulate pollution in Beijing is still 40 percent higher than the most polluted county in the United States (Plumas county in California).
- Practically all, 99.9 percent, of China's 1.4 billion people still live in areas where the annual average particulate pollution level exceeds the WHO guideline. If the current pollution levels persists, China stands to lose 3.6 billion total life years.
- Even though China's overall particulate pollution average is in compliance with the national standard, 30.9 percent of the population still lives in areas that exceed the national standard of 35 µg/m³. If these areas were to comply with the national standard, it would result in a gain of 216.7 million total life years. An individual living in these areas would gain 6 months of life expectancy on average if the pollution was brought down to the levels prescribed by the national standard.
- Measured in terms of life expectancy, particulate pollution is among the five greatest threats to human health in China, taking 2.5 years off the life of the average Chinese resident. In comparison, tobacco use reduces life expectancy by 3 years.
- In China's most polluted prefecture—Shijiazhuang in Hebei Province—the average person is on track to lose 4.3 years of life expectancy on average relative to the WHO guideline.
- The Beijing-Tianjin-Hebei (BTH) region continues to be the most polluted region in Mainland China, a record that it has held since 1998.[2] Yet, the region's pollution has improved markedly, with particulate pollution dropping by 53 percent from 2013 to 2021.

Figure 1 · Potential gain in life expectancy from permanently reducing $PM_{2.5}$ from 2021 concentration to the WHO guideline

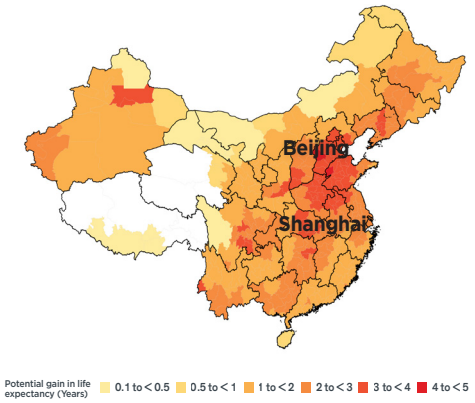
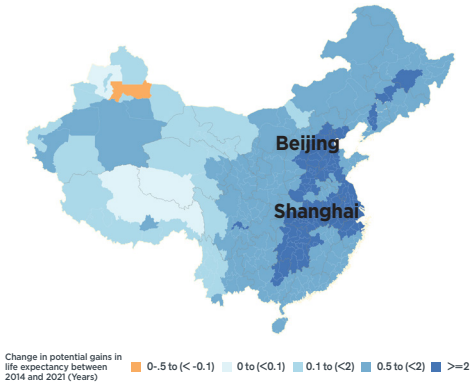


Figure 2 · Improvements in life expectancy due to reduced pollution between 2014 and 2021



Note: Most Chinese residents will see their life expectancy improve (blue) due to recent reductions in particulate pollution, if those reductions persist. Residents living in just two prefectures (orange) are losing years off their life expectancy due to higher particulate pollution in 2021 compared to 2014.

1 This data is based on the AQLI 2021 dataset. All annual average $PM_{2.5}$ values (measured in micrograms per cubic meter: µg/m³) are population weighted.

2 PRD stands for Pearl River Delta and it includes the dense network of cities that covers nine prefectures of the province of Guangdong, namely Dongguan, Foshan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaoqing, Zhongshan and Zhuhai and the Special Administrative Regions of Hong Kong and Macau. YRD stands for Yangtze River Delta and it includes Shanghai, Jiangsu and Zhejiang. BTH stands for Beijing-Tianjin-Hebei. It is important to note that our definition of the YRD region includes all regions in the Jiangsu and Zhejiang provinces. Others may define the YRD region differently than how we have defined it in this report.

Figure 3 · Potential gain in life expectancy from reducing $PM_{2.5}$ concentrations from 2021 levels to the WHO guideline in the 10 most populous prefectures of China

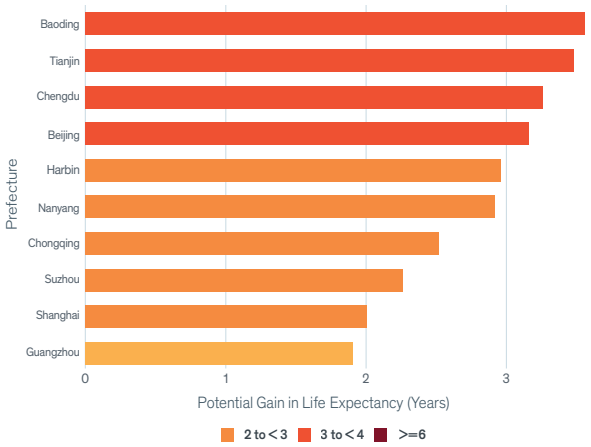
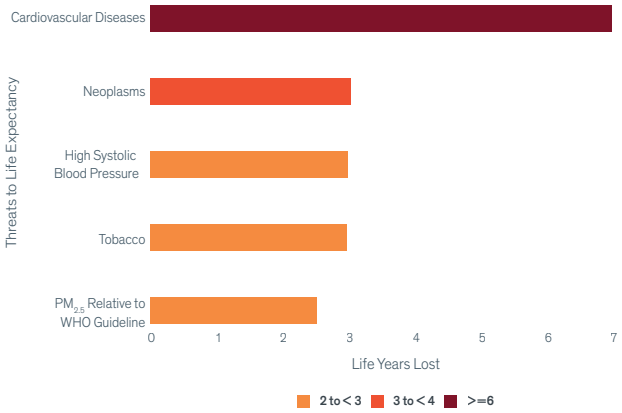
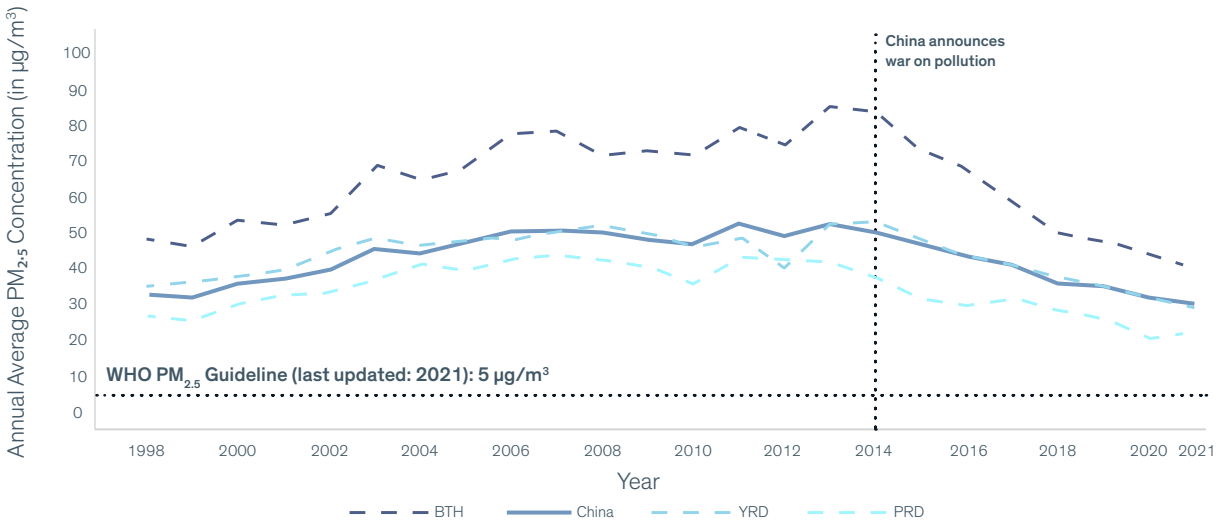


Figure 4 · Top 5 threats to life expectancy in China



Sources: Global Burden of Disease (https://vizhub.healthdata.org/gbd-results/) level-2 causes and risks data and WHO Life Tables (https://apps.who.int/gho/data/node.main.LIFECOUNTRY?lang=en) were combined with the Life table method to arrive at these results. "$PM_{2.5}$ relative to WHO Guideline" bar displays the reduction in life expectancy relative to the WHO guideline as calculated by latest AQLI (2021) data.

Figure 5 · Annual average $PM_{2.5}$ concentrations in major regions in Mainland China, 1998-2021



Note: PRD stands for Pearl River Delta and it includes the dense network of cities that covers nine prefectures of the province of Guangdong, namely Dongguan, Foshan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaoqing, Zhongshan and Zhuhai and the Special Administrative Regions of Hong Kong and Macau. YRD stands for Yangtze River Delta and it includes Shanghai, Jiangsu and Zhejiang. BTH stands for Beijing-Tianjin-Hebei. It is important to note that our definition of the YRD region includes all regions in the Jiangsu and Zhejiang provinces. Others may define the YRD region differently than how we have defined it in this report.

Potential life expectancy impacts of particulate pollution reductions in the 25 most populous prefectures of China

Prefectures	Population (millions)	$PM_{2.5}$ concentration 2021 (μg/m³)	Life expectancy gains from reducing $PM_{2.5}$ from 2014 concentrations to 2021 concentrations (years)	Life expectancy gains from reducing $PM_{2.5}$ concentrations from 2021 concentration to the WHO guideline of 5 μg/m³ (years)	Life expectancy gains from reducing $PM_{2.5}$ concentrations from 2021 concentration to the national standard of 35 μg/m³ (years)
Chongqing	30.2	30.7	1.9	2.5	0
Shanghai	24.2	25.5	2	2	0
Beijing	20.6	37.2	4.2	3.2	0.2
Chengdu	14	38.2	1.9	3.3	0.3
Tianjin	13.6	40.5	3.8	3.5	0.5
Guangzhou	13.2	24.5	1.8	1.9	0
Baoding	11.7	41.3	5.9	3.6	0.6
Harbin	11.2	35.2	2.5	3	0
Suzhou	10.9	28	2.8	2.3	0
Nanyang	10.8	34.8	2.2	2.9	0
Shijiazhuang	10.7	49	5.5	4.3	1.4
Shenzhen	10.7	20.1	1.3	1.5	0
Linyi	10.5	39.2	2.1	3.4	0.4
Wuhan	10.2	36.9	3.6	3.1	0.2
Handan	9.6	42.8	4.1	3.7	0.8
Weifang	9.6	37.9	1.8	3.2	0.3
Zhoukou	9.4	40.2	2	3.5	0.5
Wenzhou	9.4	25	1.5	2	0
Hangzhou	9.3	27.6	3	2.2	0
Xi'an	9.1	39	1.8	3.3	0.4
Zhengzhou	9	39.6	3.3	3.4	0.4
Xuzhou	9	44.3	1.8	3.9	0.9
Qingdao	9	30.5	1.8	2.5	0
Ganzhou	8.8	22.7	1.6	1.7	0
Heze	8.7	44.5	2	3.9	0.9

ABOUT THE AIR QUALITY LIFE INDEX (AQLI)

The AQLI is a pollution index that translates particulate air pollution into perhaps the most important metric that exists: its impact on life expectancy. Developed by the University of Chicago's Milton Friedman Distinguished Service Professor in Economics Michael Greenstone and his team at the Energy Policy Institute at the University of Chicago (EPIC), the AQLI is rooted in research that quantifies the causal relationship between long-term human exposure to air pollution and life expectancy. The Index then combines this research with hyper-localized, satellite measurements of global particulate matter ($PM_{2.5}$), yielding unprecedented insight into the true cost of pollution in communities around the world. The Index also illustrates how air pollution policies can increase life expectancy when they meet the World Health Organization's guideline for what is considered a safe level of exposure, existing national air quality standards, or user-defined air quality levels. This information can help to inform local communities and policymakers about the importance of air pollution policies in concrete terms.

Methodology: The life expectancy calculations made by the AQLI are based on a pair of peer-reviewed studies, Chen et al. (2013) and Ebenstein et al. (2017), co-authored by Michael Greenstone, that exploit a unique natural experiment in China. By comparing two subgroups of the population that experienced prolonged exposure to different levels of particulate air pollution, the studies were able to plausibly isolate the effect of particulate air pollution from other factors that affect health. Ebenstein et al. (2017) found that sustained exposure to an additional 10 μg/m³ of PM_{10} reduces life expectancy by 0.64 years. In terms of $PM_{2.5}$, this translates to the relationship that an additional 10 μg/m³ of $PM_{2.5}$ reduces life expectancy by 0.98 years. This metric is then combined with sea-salt and mineral dust removed satellite-derived $PM_{2.5}$ data. All 2021 annual average $PM_{2.5}$ values are population-weighted and AQLI's source of population data is https://landscan.ornl.gov/. We are grateful to the Atmospheric Composition Analysis Group, based at the Washington University in St. Louis for providing us with the satellite data. The original dataset can be found here: https://sites.wustl.edu/acag/datasets/surface-pm2-5/. To learn more deeply about the methodology used by the AQLI, visit: aqli.epic.uchicago.edu/about/methodology.