Media Briefing: WHO Air Quality Guidelines

Since the inception of the World Health Organization's (WHO) Air Quality Guidelines in 1987, scientific understanding of the health risks of polluted air has expanded. Evidence has mounted that even low-level exposure to air pollution is harmful to humans, especially with chronic exposure. It is increasingly evident that there is no safe level of air pollution. The WHO renews its guidelines to reflect developments in our understanding of the threats and risks from air pollution. The last update was in 2005 (Table 1).

WHO Air Quality Guidelines revisions[1]

- 1987: Inception
- 1997: First update
- 2005: Second update
- 2021: Third update (expected)

Table 1: 2005 WHO Air Quality Guidelines

Pollutant	Averaging Period	Guideline 2005
PM_{10} (coarse particulate matter)	1 year	20 µg/m^3
	24 hours	50 µg/m^3
$PM_{2.5}$ (fine particulate matter)	1 year	10 µg/m^3
	24 hours	25 µg/m^3
O_3 (ozone)	8 hours	100 µg/m^3
NO_2 (nitrogen dioxide)	1 year	40 µg/m^3
	1 hour	200 µg/m^3
SO_2 (sulfur dioxide)	24 hours	20 µg/m^3
	10 minutes	500 µg/m^3

[1] According to: *World Health Organization: WHO Air Quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005; Preface.* Retrieved from http://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf on 2021-09-15 (pdf).

State of the Air

Cities around the world are suffering from polluted air. In 2020, at least 79 of the world's 100 most populous cities had annual mean $PM_{2.5}$ air pollution levels that breached the 2005 WHO Air Quality Guidelines, according to data published by IQAir (Table 2). This statistic is based on city-wide averages; hotspots within all 100 cities likely exceeded the guideline locally, for example in locations close to busy roads or industry.
In 8 of the 100 most populous cities worldwide no $PM_{2.5}$ air pollution data is available, underlining the need for installment of ground sensors.

Moreover, last year $PM_{2.5}$ air pollution breached the 2021 annual mean guideline in all of the world's biggest 100 cities where data was available, in some cases by more than fifteen-fold.

Table 2: Assessment of air quality in the 100 most populous cities in the world: 2020 average $PM_{2.5}$ concentration. AQG: 2005-2021 WHO Air Quality Guideline for $PM_{2.5}$ annual average concentration (10 µg/m^3). The full list is shown in Table 3.

2020 average $PM_{2.5}$ concentration in the 100 most populous cities*	
Total number of cities	100
Number of cities **exceeding the 2005 Air Quality Guideline**	**79**
Number of cities **exceeding the 2021 Air Quality Guideline**	**92**
Number of cities **without available air quality data**	8

*This statistic is based on city-wide averages; hotspots within all 100 cities likely exceeded the 2005 and 2021 guideline locally, for example in locations close to busy roads or industry.

Table 3 *(next page)***:** Annual mean $PM_{2.5}$ near-surface concentration in 2020 in the 100 most populous cities worldwide. The data shows city-wide averages based on sensor data aggregated by IQAir. In 8 cities, no $PM_{2.5}$ data is available. The missing cities are located in Brazil (3), Egypt (2), Bangladesh, India and Tanzania (each 1). Pollution values are to be taken as indicative only as data quality may vary substantially across cities (e. g. number, location, surrounding, quality and temporal data reporting of the sensors). Air pollution data: IQAir[2], population data: Urban agglomeration, United Nations Habitat (2021)[3].

[2] Data provided by IQAir in upon request https://www.iqair.com/. Data can be queried manually at https://www.iqair.com/world-most-polluted-cities (last accessed 2021-09-16).
[3] UN Habitat: *Population in Urban Agglomerations 2000 - 2035 (Thousands)*, retrieved from https://data.unhabitat.org/pages/urban-population-and-demographic-trends on 2021-09-14.

City	Population (millions)	$PM_{2.5}$ ($\mu g/m^3$) in 2020	Comparison to 2021 guidelines		City	Population (millions)	$PM_{2.5}$ ($\mu g/m^3$) in 2020	Comparison to 2021 guidelines	
Tokyo	37.3	10	Exceeded	2-fold	Surat	7.5	No data		
Delhi	31.2	84	Exceeded	16.8-fold	Foshan	7.4	22	Exceeded	4.4-fold
Shanghai	27.7	32	Exceeded	6.4-fold	Riyadh	7.4	23	Exceeded	4.6-fold
São Paulo	22.2	14	Exceeded	2.8-fold	Suzhou	7.4	47	Exceeded	9.4-fold
Mexico City	22.0	19	Exceeded	3.8-fold	Shenyang	7.4	41	Exceeded	8.2-fold
Dhaka	21.7	77	Exceeded	15.4-fold	Baghdad	7.3	32	Exceeded	6.4-fold
Al-Qahirah (Cairo)	21.3	No data			Dar es Salaam	7.1	No data		
Beijing	20.9	38	Exceeded	7.6-fold	Santiago	6.8	24	Exceeded	4.8-fold
Mumbai (Bombay)	20.7	41	Exceeded	8.2-fold	Pune (Poona)	6.8	40	Exceeded	8-fold
Osaka	19.1	11	Exceeded	2.2-fold	Madrid	6.7	9	Exceeded	1.8-fold
New York	18.9	7	Exceeded	1.4-fold	Haerbin	6.5	44	Exceeded	8.8-fold
Karachi	16.5	44	Exceeded	8.8-fold	Houston	6.5	10	Exceeded	2-fold
Chongqing	16.3	32	Exceeded	6.4-fold	Dallas	6.4	10	Exceeded	2-fold
Istanbul	15.4	17	Exceeded	3.4-fold	Toronto	6.3	7	Exceeded	1.4-fold
Buenos Aires	15.3	14	Exceeded	2.8-fold	Miami	6.2	8	Exceeded	1.6-fold
Kolkata (Calcutta)	15.0	47	Exceeded	9.4-fold	Belo Horizonte	6.1	No data		
Kinshasa	15.0	35	Exceeded	7-fold	Khartoum	6.0	24	Exceeded	4.8-fold
Lagos	14.9	24	Exceeded	4.8-fold	Singapore	6.0	12	Exceeded	2.4-fold
Manila	14.2	13	Exceeded	2.6-fold	Johannesburg	5.9	22	Exceeded	4.4-fold
Tianjin	13.8	49	Exceeded	9.8-fold	Atlanta	5.9	10	Exceeded	2-fold
Guangzhou	13.6	23	Exceeded	4.6-fold	Dalian	5.8	30	Exceeded	6-fold
Rio de Janeiro	13.6	No data			Philadelphia	5.7	10	Exceeded	2-fold
Lahore	13.1	79	Exceeded	15.8-fold	Qingdao	5.7	32	Exceeded	6.4-fold
Bangalore	12.7	28	Exceeded	5.6-fold	Barcelona	5.6	13	Exceeded	2.6-fold
Shenzhen	12.6	19	Exceeded	3.8-fold	Fukuoka	5.5	11	Exceeded	2.2-fold
Moskva (Moscow)	12.6	11	Exceeded	2.2-fold	Ji'nan	5.5	49	Exceeded	9.8-fold
Los Angeles	12.5	15	Exceeded	3-fold	Saint Petersburg	5.5	6	Exceeded	1.2-fold
Chennai (Madras)	11.2	27	Exceeded	5.4-fold	Zhengzhou	5.5	51	Exceeded	10.2-fold
Bogotá	11.1	14	Exceeded	2.8-fold	Yangon	5.4	29	Exceeded	5.8-fold
Paris	11.1	12	Exceeded	2.4-fold	Alexandria	5.4	No data		
Jakarta	10.9	40	Exceeded	8-fold	Washington, D.C.	5.4	7	Exceeded	1.4-fold
Lima	10.9	18	Exceeded	3.6-fold	Abidjan	5.4	22	Exceeded	4.4-fold
Bangkok	10.7	21	Exceeded	4.2-fold	Guadalajara	5.3	25	Exceeded	5-fold
Hyderabad	10.3	35	Exceeded	7-fold	Ankara	5.2	19	Exceeded	3.8-fold
Seoul	10.0	21	Exceeded	4.2-fold	Chittagong	5.1	No data		
Nagoya	9.5	9	Exceeded	1.8-fold	Melbourne	5.1	8	Exceeded	1.6-fold
London	9.4	10	Exceeded	2-fold	Addis Ababa	5.0	15	Exceeded	3-fold
Chengdu	9.3	41	Exceeded	8.2-fold	Sydney	5.0	7	Exceeded	1.4-fold
Tehran	9.3	29	Exceeded	5.8-fold	Monterrey	5.0	15	Exceeded	3-fold
Nanjing	9.1	31	Exceeded	6.2-fold	Nairobi	4.9	15	Exceeded	3-fold

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Chicago	8.9	11	Exceeded	2.2-fold	Hà Noi	4.9	38	Exceeded	7.6-fold
Ho Chi Minh City	8.8	22	Exceeded	4.4-fold	Brasília	4.7	No data		
Luanda	8.7	13	Exceeded	2.6-fold	Cape Town	4.7	8	Exceeded	1.6-fold
Wuhan	8.5	37	Exceeded	7.4-fold	Jiddah	4.7	30	Exceeded	6-fold
Ahmadabad	8.3	49	Exceeded	9.8-fold	Changsha	4.7	41	Exceeded	8.2-fold
Xi'an	8.2	49	Exceeded	9.8-fold	Phoenix-Mesa	4.6	15	Exceeded	3-fold
Kuala Lumpur	8.2	17	Exceeded	3.4-fold	Kunming	4.5	22	Exceeded	4.4-fold
Hangzhou	7.8	29	Exceeded	5.8-fold	Urumqi	4.5	51	Exceeded	10.2-fold
Hong Kong	7.6	15	Exceeded	3-fold	Changchun	4.5	40	Exceeded	8-fold
Dongguan	7.5	24	Exceeded	4.8-fold	New Taipei	4.4	13	Exceeded	2.6-fold

The Cost of Air Pollution

Air pollution increases the likelihood of premature death and many medical conditions including asthma, preterm birth, low birth weight, depression, schizophrenia, diabetes, stroke and lung cancer. This is the case even in places where air pollution levels meet the 2005 WHO Air Quality Guidelines.

The health impact also takes a financial toll. Work absences due to sickness and lost life years due to premature death are accompanied by a substantial financial cost to society of up to 14% of total GDP in some locations (Table 4).

Table 4: Premature deaths and financial loss due to air pollution in ten global cities in 2020. Death numbers and cost are computed by combining long-term air pollution data from ground-based sensors with empirical risk factors (which are functions of air pollution exposure). The methodology is explained in detail in *Estimating the cost of air pollution in world cities* (Greenpeace Southeast Asia, 2020).[4] Population data here are adopted from IQAir. The population numbers differ from Table 3 because of different population data sources and underlying definitions of "city".

City		Estimated Air Pollution Impact in 2020				
Name	Population	Deaths from Air Pollution Exposure	Deaths per million	Financial Cost of Air Pollution Exposure (USD)	Cost (% of GDP)	Cost per capita (USD)
Tokyo	37,000,000	53,000	1,400	57,000,000,000	3.9	1,500
Delhi	30,000,000	57,000	1,900	8,600,000,000	14.0	280
Shanghai	26,000,000	49,000	1,900	23,000,000,000	9.0	880

[4] Available at: https://www.greenpeace.org/static/planet4-southeastasia-stateless/2021/02/ef76f49b-methodology_-revealing-the-cost-of-air-pollution-in-world-cities-annual-results-for-2020.pdf [Accessed September 15, 2021]

Mexico City	22,000,000	20,000	900	10,000,000,000	4.8	460
São Paulo	22,000,000	16,000	740	7,800,000,000	3.9	350
New York	19,000,000	11,000	560	25,000,000,000	2.1	1,300
Istanbul	15,000,000	15,000	980	6,600,000,000	4.6	440
Bangkok	11,000,000	9,700	920	3,800,000,000	4.9	360
London	9,300,000	9,800	1,100	14,000,000,000	3.4	1,500
Johannesburg	5,800,000	4,400	750	1,800,000,000	4.9	310

The Way Forward

The WHO's updated Air Quality Guidelines are a firm warning about the severity of our air pollution crisis. Governments around the world must take bold action to ensure their cities and communities turn from sources of air pollution-related health risks to safe places for billions of humans to reside.

Recommendations: Actions Needed to Address the Air Pollution Crisis

• Encourage national governments to adopt WHO Air Quality Guidelines, which are based on the latest scientific understanding – the situation at present is a series of global nations with no globally coherent clean air policy. Some national governments have not set any standards at all.

• Encourage national governments to urgently seek alternatives to burning fossil fuels for power, transport and industry because burning coal, oil and gas are major sources of the global burden of disease and mortality from air pollution.

• Encourage national governments to prioritise provision of transport infrastructure that revolves around walking and cycling – or for longer distances and people with additional needs, electric buses, trams and trains – and stop using fossil fuelled modes of transport.

• Establish private vehicle-free days or zones in urban areas to (i) alleviate pollution (ii) encourage people to enjoy the streets safely and (iii) illustrate that it is possible to travel about the city without private vehicles.

• Create green spaces in urban areas and encourage biodiversity by planting trees and encouraging wildflowers to grow.

• Communicate with local residents: describe the health and financial problems of air pollution in their region (whether urban or rural) and present solutions. Governments must lead with policy and system-wide changes, while supporting residents to make personal steps that benefit air quality.

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