

PREFINAL VERSION, to be published right after publication of the WHO AQG – missing information highlighted in yellow will be added on September 22<sup>nd</sup> (also further endorsements will be added)

### **2021 WHO Air Quality Guidelines 2021 – Aiming for healthier air for all**

A joint statement by medical, public health and scientific societies

After years of intensive research and deliberations with experts across the globe, the World Health Organization (WHO) updated its 2005 Global Air Quality Guidelines (AQG) in September 2021 (WHO 2021; WHO 2017). The new air quality guidelines (WHO AQG) are ambitious and reflect the large impact that air pollution has on global health. They recommend aiming for annual mean concentrations of PM<sub>2.5</sub> not exceeding  $x \mu\text{g}/\text{m}^3$  and NO<sub>2</sub> not exceeding  $y \mu\text{g}/\text{m}^3$ , and the peak season mean 8-hr ozone concentration not exceeding  $z \mu\text{g}/\text{m}^3$  (WHO 2021). For reference, the corresponding 2005 WHO guideline values for PM<sub>2.5</sub> and NO<sub>2</sub> were, respectively, 10  $\mu\text{g}/\text{m}^3$  and 40  $\mu\text{g}/\text{m}^3$  with no recommendation issued for long-term ozone concentrations (WHO 2006). While the guidelines are not legally binding, we hope they will influence air quality policy across the globe for many years to come.

The updated WHO AQGs have become so necessary as an overwhelming body of evidence has accumulated over the past two decades, demonstrating that health

effects of air pollution are serious and can affect nearly all organ systems of the human body (Thurston et al. 2017). Importantly, recent studies and large research programmes consistently show that the adverse effects of air pollution are not only limited to high exposures; harmful health effects can be observed all the way down to very low concentration levels, with no observable thresholds below which exposure can be considered safe (Brauer et al. 2019; Brunekreef et al. 2021; Dominici et al. 2019).

There is now broad expert consensus that air pollution is a major global public health risk factor and puts an enormous financial burden on societies. Outdoor and household air pollution together accounted for approximately 12% of all deaths in 2019. Air pollution currently ranks fourth among major risk factors for global disease and mortality, only behind hypertension, smoking and dietary factors (Murray et al. 2020). In terms of economic burden, the estimated global health-related external costs (i.e., those borne by society as a whole) were US\$ 5 trillion in 2013 with an additional US\$ 225 billion in lost labour productivity (World Bank Group 2016). For the WHO European Region, the overall annual economic cost of health impacts and mortality from air pollution, including estimates for morbidity costs, stood at US\$ 1.575 trillion (WHO Regional Office for Europe, OECD 2015).

The most important message of the updated WHO AQG is that each reduction in the outdoor concentrations of key air pollutants brings health benefits to the surrounding population, even in places which already have low pollution concentrations. Moreover, linear exposure-response relationships down to the lowest observable concentrations

show that every individual will benefit from cleaner air (Huangfu and Atkinson 2020; Lee et al. 2020; Chen and Hoek 2020; Orellano et al. 2020; Zheng et al. 2021). These findings provide critical input into clean air policies and regulation around the world. They also are key to estimating the potential health and economic benefits from policies that reduce exposure to air pollution.

Recognising that the adverse health effects of pollution exposure can be seen at all, even the lowest, observed levels of pollution concentrations, is a milestone for cleaner air and better health policies and offers a wake-up call, to reconsider current air quality legislation and regulations. To maximise health benefits, we now understand better the importance of implementing measures to reduce average exposures of all people. Such an approach must complement reductions in exposure at “hotspots” with high levels of air pollution, in particular to address known inequities owing to socioeconomic conditions, increased vulnerability of the residential population, and economic activities (Hooper and Kaufman, 2018). To tackle the health effects of air pollution, bold air quality actions are needed at all levels – international, national, local – and across all sectors such as transport, energy, industry, agriculture, and residential.

Most jurisdictions with clean air regulations have relied on fixed limit values with little incentive to further reduce air pollution levels once compliance with the limit value is achieved (Kutlar Joss et al. 2017). Given the evidence that health effects occur all the way down to very low concentration levels, future clean air policies must include incentives for progressive lowering of exposures of the entire population, thereby improving health for all. What is needed is a paradigm change from relying solely on

fixed limit values, with a shift towards the concept of combining fixed limit values with a continuous reduction of the average exposure. For example, the current European Union (EU) Ambient Air Quality Directive already contains a non-binding average exposure reduction target (European Commission 2008). The upcoming 2022 revision of the EU Ambient Air Quality Directive will offer the chance to lead the way and implement binding average exposure reduction goals for air pollutants in combination with lowered fixed limit values.

Programmes that reduce air pollutant emissions provide enormous air quality and health benefits which increase over time. The estimated health benefits of improved air quality outweigh by far the implementation costs of air quality actions. For the US, it has been estimated that the benefits from decreased mortality, lower medical expenditures for air pollution-related diseases, and higher productivity of workers are around 30 times greater than the costs of the Clean Air Act, resulting in net improvements of economic growth and population welfare (U.S. EPA. 2015). In China, public health benefits were 50% greater than the costs for air quality improvement measures (Zhang et al. 2019). Similarly, for the EU, additional clean air and climate policies beyond the current obligations will lead to net benefits with positive macro-economic implications (Amann et al. 2017). Indeed, the cost effectiveness of air quality actions is enhanced by the close link between air pollution and greenhouse gas emissions. A reduction of air pollution emissions will also feed into efforts for climate neutrality and vice versa, making benefits from investments in one area count twice (Amann et al. 2014, IPCC 2021).

## Conclusions

Air pollution is a major global public health threat that causes a range of adverse health effects, even at the lowest observable concentrations. There is ample evidence to strongly support government action to reduce air pollution and address climate change simultaneously. The updated WHO AQG are bold and stress the importance of lowering air pollution concentrations at every level. The benefits are clear: lowering air pollution levels will lead to enormous improvements in public health for people of all ages breathing cleaner air. We support the recommendations of the new WHO AQG, and urge nations to use the WHO AQG as a guide for ambitious air quality and emission reduction policies around the world.

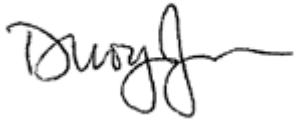
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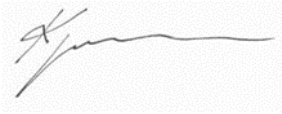
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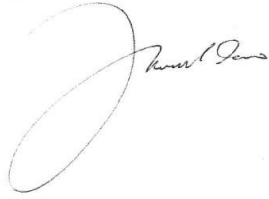
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Dr Riccardo Asero, President, the Italian Association of Allergologists and Immunologists



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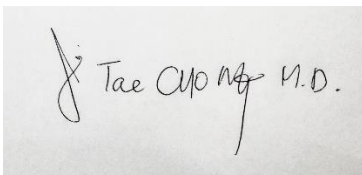
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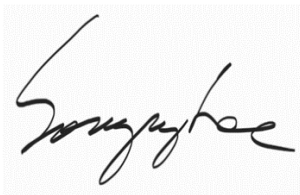


Prof. Ji Tae Choung, President, Korean Academy of Medical Sciences



Prof. Hae-Kwan Cheong, President; Prof. Sin Kam, Chair of the Board,

The Korean Society for Preventive Medicine



Professor, Soon Young Lee, President, Korean Society of Epidemiology





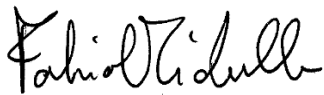
Professor, Jung-Wan Koo, President, Korean Society of Occupational and Environmental Medicine



Prof. Susana I. García, President, Ibero-American Society for Environmental Health



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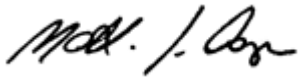
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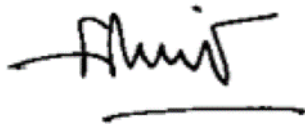
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Prof. Stylianos Loukides, President, Hellenic Thoracic Society



Dr. Jukka Takala, President, International Commission on Occupational Health



Dr. Catia Cilloniz Campos, President, the Association for the Support of Patients with Pneumonia and their Families



Natalia Maeva, President, Bulgarian Society of the patients with PH

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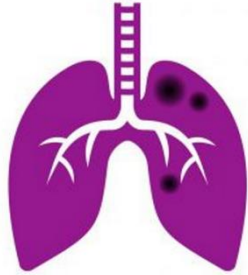


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Members of the writing group: Barbara Hoffmann, Hanna Boogaard, Audrey de Nazelle, Zorana Andersen, Michael Abramson, Michael Brauer, Bert Brunekreef, Francesco Forastiere, Wei Huang, Haidong Kan, Joel Kaufman, Klea Katsouyanni, Michal Krzyzanowski, Nino Künzli, Francine Laden, Mark Nieuwenhuijsen, Adetoun Mustapha, Pippa Powell, Mary Rice, Agnes Soares, Kurt Straif, George Thurston

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