

Environmental Issues

Motorcycles as high-noise emitters, air pollutants and cardiovascular threats: time to regulate the risks

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Motorcycles are extremely polluting, but are not regulated

Motorcycles often escape scrutiny in the conversation about urban air pollution and its toll on human health. Compact, convenient, and fuel-efficient, they are seen by many as an efficient solution to congestion and mobility in fast-growing cities. But their environmental and health impacts tell a more troubling story, especially concerning the cardiovascular system.^{1,2}

Motorcycles, particularly older two-stroke models, emit disproportionately high levels of ultrafine particles (UFPs). These particles are <100 nm in diameter and can easily penetrate deep into the lungs, pass through the alveolar barrier, and enter the bloodstream. Once inside the circulatory system, UFPs trigger systemic inflammation, oxidative stress, and endothelial dysfunction.³ These processes are well-established precursors to hypertension, atherosclerosis, heart attacks, and strokes (Figure 1).⁴

Studies show that motorcycles can emit up to 10 times more particulate matter per kilometre than modern passenger cars. Even newer four-stroke motorcycles, although cleaner, often lack the advanced filtration technologies like diesel particulate filters and catalytic converters found in cars and buses. As a result, motorcycle traffic contributes significantly to urban PM_{2.5} and UFP concentrations—particularly in cities across Asia, Africa, and Latin America where motorcycles dominate.⁴

Air pollution is not the only concern. Environmental noise—particularly chronic exposure to levels above 65 dB(A)—is increasingly recognized as a significant cardiovascular risk factor.⁵ Noise-induced stress activates the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system, leading to the release of cortisol and catecholamines. These hormonal responses raise blood pressure, increase heart rate variability, and promote vascular inflammation.

Motorcycles, especially those with modified or unregulated exhaust systems, are among the most significant high-noise emitters in urban environments. Sound levels frequently exceed 90 to 100 decibels, especially under acceleration. In densely populated areas, the cumulative noise exposure from frequent motorcycle traffic can lead to substantial sleep disturbances, annoyance, and chronic stress—all of which have been linked to cardiovascular morbidity and mortality.⁶

Several countries are now responding to the dual threat of particulate and noise emissions from motorcycles with targeted policies. Austria, for example, implemented a seasonal ban on loud motorcycles in the Tyrolean Alps after residents voiced concerns. This measure resulted in a 36% reduction in affected traffic and a measurable 2 dB(A) decrease in average noise levels—small in decibel terms, but epidemiologically meaningful.⁷

In France, authorities are piloting noise radar systems capable of identifying and penalizing excessively noisy vehicles. These systems automatically detect decibel levels as cars pass and match them to license plates. Similarly, in Geneva, Switzerland, a noise radar project has shown that over 70% of noise violations are attributable to motorized two-wheelers, while cars, vans, and trucks account for <30%.⁶

Regulatory action is needed urgently

Despite these advances, motorcycles remain under-regulated in many regions. Whereas cars and heavy vehicles have been subjected to progressively stricter Euro emission norms, motorcycles often follow outdated or poorly enforced standards. In many low- and middle-income countries, motorcycles are the primary means of transport but receive minimal environmental oversight. The combination of high ambient exposure, weak healthcare infrastructure, and limited noise control makes these populations especially vulnerable.⁸ Furthermore, imported second-hand motorcycles—often with removed or degraded emission systems—continue circulating in these regions. Lack of vehicle

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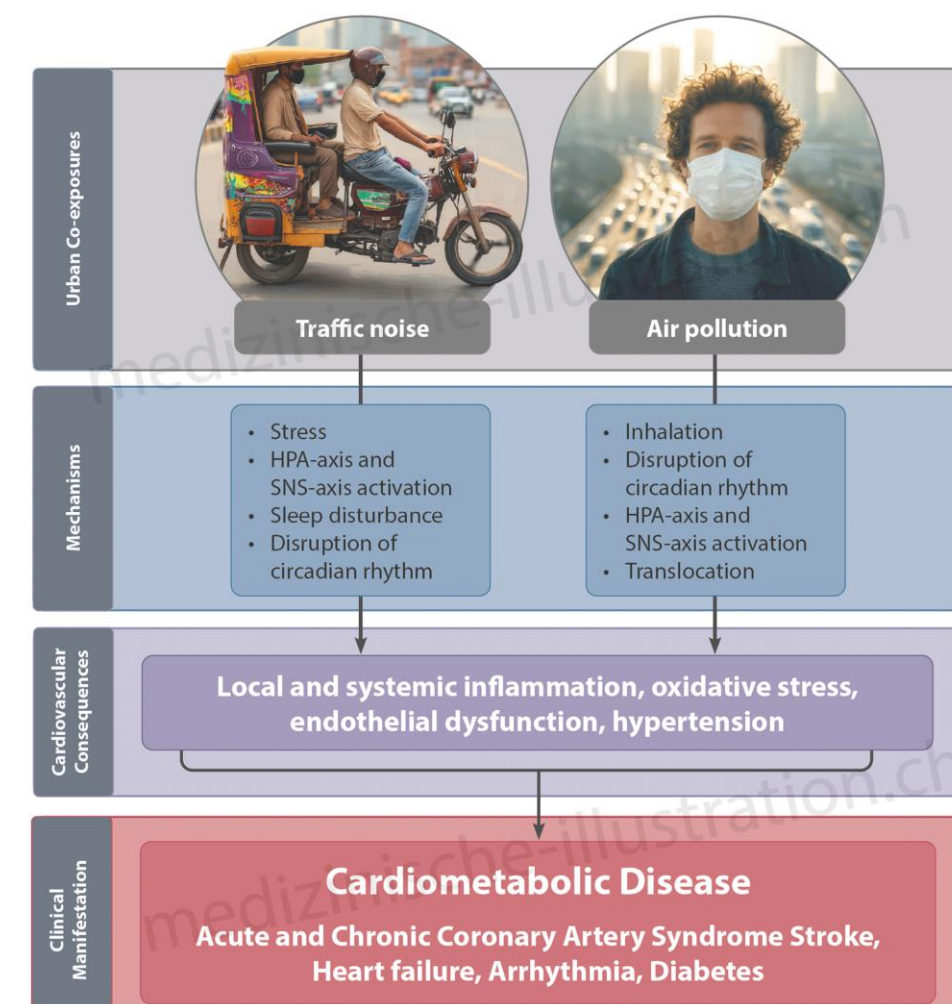


Figure 1 Co-exposure to traffic noise and air pollution from motorcycles: pathways to cardiometabolic disease. This figure depicts how combined exposure to traffic noise and air pollution—particularly from motorcycles and motorbike taxis—activates stress pathways (HPA axis, SNS), disrupts sleep and circadian rhythm, and induces pulmonary and systemic inflammation. The resulting oxidative stress and endothelial dysfunction promote hypertension, atherosclerosis, and metabolic disturbances, increasing the risk of ischemic heart disease, stroke, arrhythmias, heart failure, and diabetes. Motorbike drivers face an elevated risk due to prolonged, close-range exposure. SNS, sympathetic nervous system

inspections and the popularity of modified exhausts contribute to a worsening environmental burden. Urban residents, particularly those living near busy roads, face chronic exposure to air and noise pollution, heightening their cardiovascular risk over time. The epidemiological evidence is mounting. Studies have shown that long-term motorcycle commuters face higher risks of ischemic heart disease and stroke compared with non-commuters.⁹ Research from West Africa and Southeast Asia indicates that motorcycle taxi drivers suffer disproportionately from hypertension and early signs of vascular disease.¹⁰ These findings are not anomalies—they reflect broader trends in environmental cardiology.

Motorcycles combine noise and air pollution

Moreover, the overlap between noise and air pollution exposure creates a cumulative burden. Both pathways—through stress hormone activation and systemic inflammation—converge on the cardiovascular system. This underscores the importance of addressing motorcycles

not only as transportation assets but as public health challenges. Policy solutions are within reach. First, adopting Euro 5-equivalent emission standards for two-wheelers would significantly reduce particulate emissions. Second, banning or strictly regulating modified exhaust systems is essential for noise control. Third, investing in noise-monitoring infrastructure—such as radar systems—can help enforce compliance. Fourth, cities should promote electric alternatives like e-bikes and electric motorcycles, along with expanding public transit and cycling infrastructure.¹¹

Towards healthier cities: let's go for healthy mobility

Public awareness campaigns are crucial. Many users are unaware of the health implications of motorcycle emissions, both for themselves and those around them. Education, incentives for clean technology, and urban design that discourages high-noise traffic in residential zones will be critical components of a sustainable urban mobility strategy.

The rise of motorcycles in urban transport was initially seen as a success story—cheap, mobile, and fuel-efficient. But that story may become a cautionary tale unless we reckon with their hidden costs, particularly their status as high-noise and UFP emitters. The cardiovascular system is often the first to bear the brunt of environmental exposures, but policy is the lever that can prevent long-term harm. It's time for urban planners, policymakers, and public health officials to confront the real risks on two wheels—with courage, data, and regulatory resolve.

Acknowledgements

T.M. is supported by the Foundation Heart of Mainz and by the Mainzer Wissenschaftsstiftung. He is also P.I. of the German Cardiovascular Research Centre (Partner Site Rhine_Main).

Declarations

Disclosure of Interest

All authors declare no disclosure of interest for this contribution.

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