European Heart Journal (2025) 46 (Suppl 1)
Preventive Cardiology – Risk Factors and Prevention, Environmental and Occupational Aspects of Heart Disease, Environmental Aspects of Heart Disease

Individual, socio-economic and environmental vulnerabilities to the effects of air pollution on STEMI hospital admissions: results from a Belgian nationwide 9-year case-crossover study

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Funding Acknowledgements: Type of funding sources: Public grant(s) – EU funding. Main funding source(s): - HORIZON-HLTH 2024 as part of the ENACT project
- Joseph Oscar Waldmann-Berteau & Walckiers-Van Dessel Funds, managed by the King Baudouin Foundation.
- Department of Care of the Flemish Government through the Partnerorganisatie Milieugezondheidszorg (a consortium of VITO, PIH, and Gezond Leven).

Background: Short-term exposure to air pollution is a well-known trigger for STEMI, but it remains poorly understood whether this association is influenced by patient-specific, socio-economic, and environmental determinants.

Purpose: To investigate the short-term impact of air pollution on STEMI admissions using a holistic approach, exploring how personal, socio-economic, and environmental factors influence this association.

Methods: We collected from Belgian national health-insurance data all STEMI hospitalizations in 2012-2014 and 2016–2021. We linked individual-level socio-economic data and environmental exposures modelled at patients' addresses. Adopting a case-crossover design, conditional logistic regression compared within each person PM2.5, PM10 (particles with diameter ≤2.5 and 10 µm), NO_2 and O3 exposure on the day of admission to control days matched by temperature and calendar month. Lag models assessed immediate (same day, lag 0) and delayed (lag 1, lag 2, lag 3) effects. Subgroup analyses tested interactions with patient-specific, socioeconomic and environmental factors.

Results: We counted 51,544 STEMI admissions (mean age 68 years, 71% male), equating 50,8 annual admissions per 100,000 population. A daily interquartile range (IQR) increase in PM2.5, PM10, and NO_2 was associated with 2.4% (95% CI: 1.0–3.7%), 2.4% (95% CI: 0.9–4.0%), and 4.4% (95% CI: 2.5–6.3%) more same-day STEMI admissions. The lag model revealed a delayed effect of NO_2 with, per IQR increase, 2.3% (95% CI: 0.5–4.0%) more STEMI admissions the following day (lag 1), while PM2.5 and PM10 showed no delayed effects. Stronger associations between PM2.5 and admissions were observed in older, male, and non-diabetic patients. Additionally, higher associations were found during cold seasons (winter and autumn) and in 2012-2014 and 2015-2017 compared to 2019-2021. Patients living in a less green environment and at medium distance from main road experienced higher PM2.5 impacts. Marital and work state also influenced association strength, with married and retired individuals showing higher impacts, while no differences were observed across salary categories.

Conclusion: From a large-scale study, we performed a holistic approach to STEMI epidemiology. Our findings underscores the acute impact of air pollution on STEMI admissions, particularly NO_2, and identify vulnerable groups across three holistic pillars: personal factors—older age, male gender, and non-diabetic status; socio-economic factors—being married or retired; and environmental factors—colder seasons and living in less green areas. Such holistic approach may help to target preventive interventions to mitigate disparities in air pollution related cardiovascular diseases.