Air quality and mental health: evidence, challenges and future directions

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Background

Poor air quality is associated with poor health. Little attention is given to the complex array of environmental exposures and air pollutants that affect mental health during the life course.

Aims

We gather interdisciplinary expertise and knowledge across the air pollution and mental health fields. We seek to propose future research priorities and how to address them.

Method

Through a rapid narrative review, we summarise the key scientific findings, knowledge gaps and methodological challenges.

Results

There is emerging evidence of associations between poor air quality, both indoors and outdoors, and poor mental health more generally, as well as specific mental disorders. Furthermore, pre-existing long-term conditions appear to deteriorate, requiring more healthcare. Evidence of critical periods for exposure among children and adolescents highlights the need for more longitudinal data as the basis of early preventive actions and policies. Particulate matter, including bioaerosols, are implicated, but form part of a complex exposome influenced by geography, deprivation, socioeconomic conditions and biological and individual vulnerabilities. Critical knowledge gaps need to be addressed to design interventions for mitigation and prevention, reflecting ever-changing sources of air pollution. The evidence base can inform and motivate multi-sector and inter-disciplinary efforts of researchers, practitioners, policy makers, industry, community groups and campaigners to take informed action.
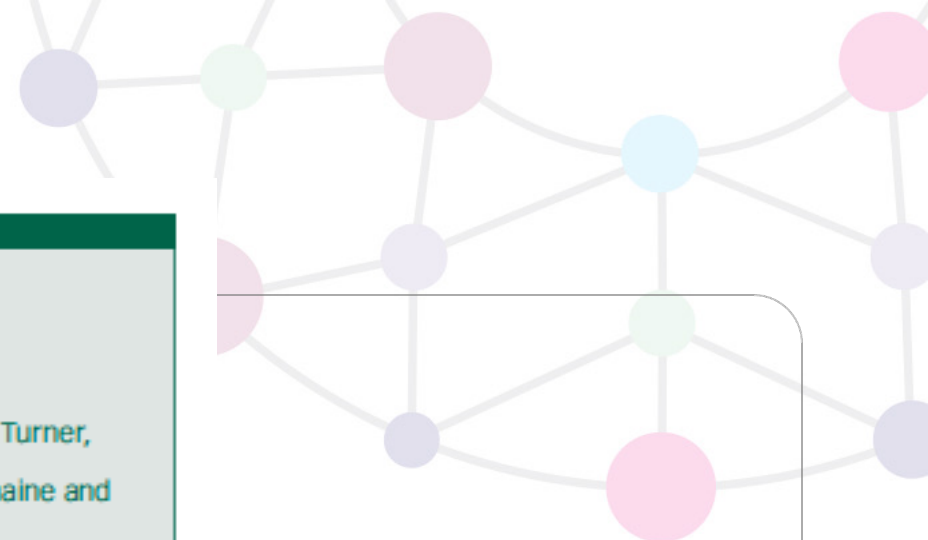
Conclusions

There are knowledge gaps and a need for more research, for example, around bioaerosols exposure, indoor and outdoor pollution, urban design and impact on mental health over the life course.

Keywords

Air quality; pollution; research; policy; mental health.

Aims

- Interdisciplinary expertise and knowledge: air pollution and mental health/health

- Propose future research priorities and how to address them
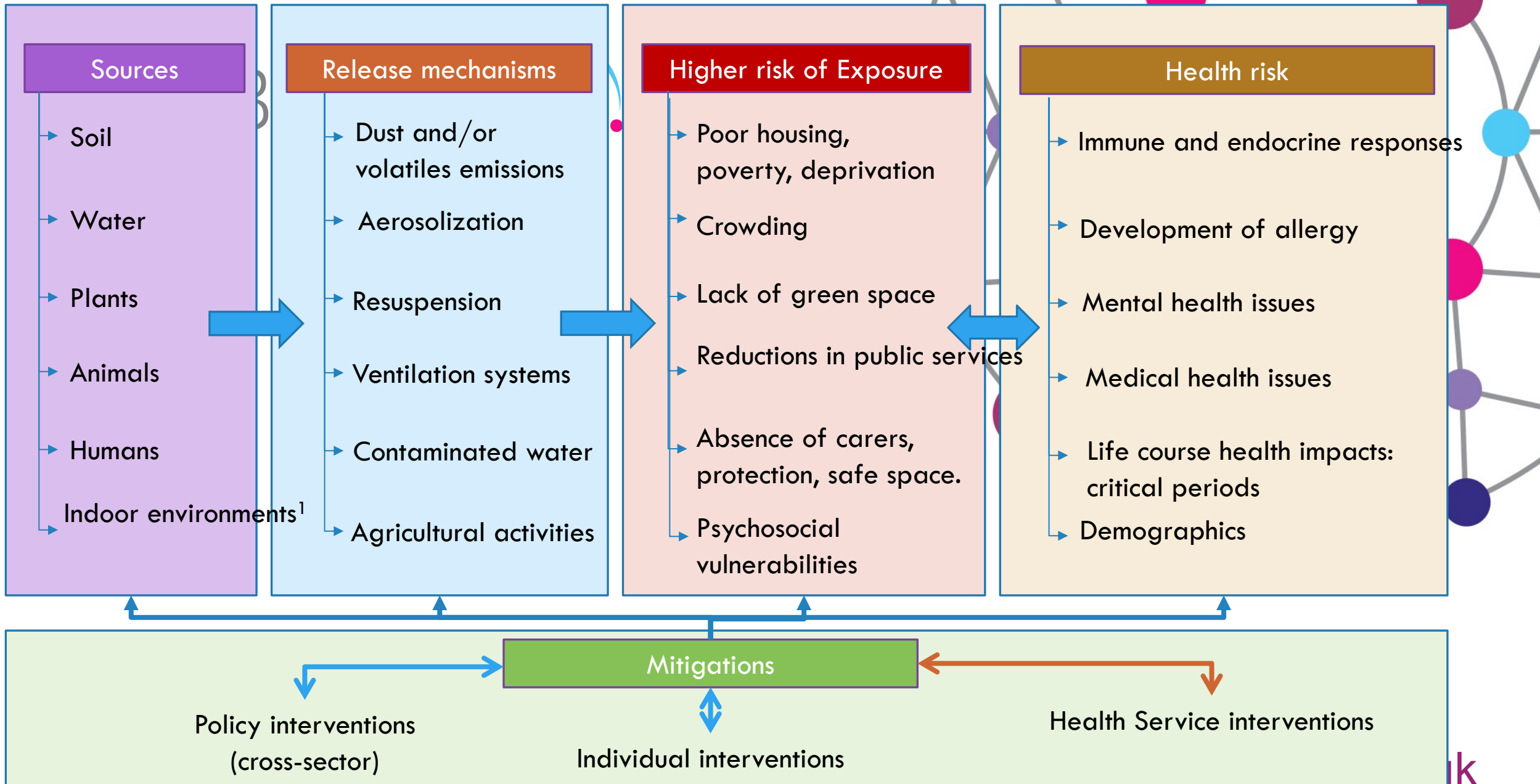
Method

A rapid narrative review: summarise key findings, knowledge gaps, and methodological challenges.

Outline

- Exposome and risks

- Pathways and mechanisms

- Indoor – outdoor

- Life-course

- Methodologies

- Ambition

Sources	Release mechanisms	Higher risk of Exposure	Health risk
Soil	Dust and/or volatiles emissions	Poor housing, poverty, deprivation	Immune and endocrine responses
Water	Aerosolization	Crowding	Development of allergy
Plants	Resuspension	Lack of green space	Mental health issues
Animals	Ventilation systems	Reductions in public services	Medical health issues
Humans	Contaminated water	Absence of carers, protection, safe space.	Life course health impacts: critical periods
Indoor environments[1]	Agricultural activities	Psychosocial vulnerabilities	Demographics

Mitigations

Policy interventions (cross-sector)

Individual interventions

Health Service interventions

[1](e.g. schools, workplaces, hospitals, shopping malls)

Exposome and risks for poor mental health

- Exposome: air quality, geographical and built environment, social variables such as housing, adversity, stigma, discrimination, crime, violence, poverty, access to education and employment, access to green-blue-brown space, noise, building design and sick buildings.

- Personal demographic, biological, and social variables
  - immune function and epigenetic and genetic risks of mental illness

- Proximal exposome: housing, damp, fungi/mold, cockroaches, control over immediate environment

- Poor physical health = poor mental health
  - Risk factors for onset
  - Interactions over time including quality of life and mortality
  - Self-care, exercise/activity, health risk behaviours

Bio pathways implicated for specific PMs, bioaerosol

- Inhalation and pathways to cross blood brain barrier for inflammation in the brain
- Inhalation and peripheral effects leading to poor health, asthma, and heart disease.
- Inflammation: bacterial endotoxins and fungi implicated in hypersensitivity models
- Oxidative stress
- PM (especially PM$_{2.5}$)
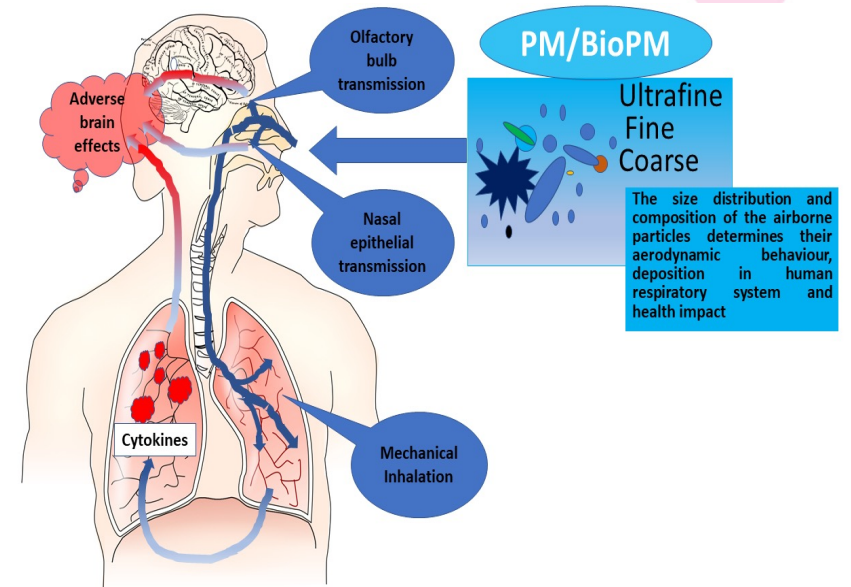
Bio-social pathways

- Psychological and social adversity, lack of social support, drivers of health inequalities and histories of adversity (e.g. ACEs also associated with poor adult MH)

- Poor physical health associated with poor mental health and vice versa

- Neurodevelopment (ND) impacted at critical periods (in utero, early childhood, adolescence)

- Drivers of ND problems may also lead to neurodegenerative conditions. Children exposed to air pollution already showing hallmarks of degenerative conditions of old age.

- Autism and ND disorders in those exposed to AP in pregnancy

Indoor and outdoor

- Higher indoor concentrations rising where ventilation is inadequate
  - PM, NO, CO2, open fires, cooking contaminants, detergents, flame retardants, plasticisers, and VOC.

- Associations with climate change
  - heat; poor air quality and poor mental health; indirect and direct effects

- Energy efficient tech with poor ventilation → poorer AQ

- Drift of those with poor health into poorer areas and inability to escape those areas

Life Course evidence

- Perinatal
  - $PM_{10, 2.5}$. NO_2, NOx 29-76% greater chance of mental disorders that complicate pregnancy
- Adolescents
  - NO_2 and benzene exposure; NOx associated with 1.4 great risk
- USA/Denmark Study
  - PM 2.5, PM10, NO2, organic substances->psychiatric disorders: bipolar, Sx, PD
  - Confirmed by a recent meta-analysis: depression, anxiety, bipolar, psychosis and suicide
- Effect on new incidents, admissions, worsening of existing conditions
- Distance from roads/noise, smog, all suggestive evidence
- Implications for degenerative conditions is fascinating:
  - dementia known to be worse in areas of poverty and deprivation, by ethnicity, and in those experiencing childhood adversity (!)

Methodologies and future actions

- Data
  - Linked
  - Mixed methods
  - Longitudinal

- Exposures
  - Existing stations for measuring exposures
  - Personal experience sampling

- Proposed Systematic Reviews

- Health outcomes of interest-multiple approaches

Conclusion

- There are associations between poor air quality, both *indoors and outdoors*, and poor mental health/specific mental disorders.

- Incidence, admissions, pre-existing conditions deterioriate

- Critical periods: children and adolescents, need longitudinal data, early preventive actions

  - ND, Dementia, Mental Illnesses

- Particulate matter in a complex exposome: geography, deprivation, socio-economic conditions, and biological and individual vulnerabilities.

Implications

- Critical knowledge gaps: <u>bioaerosols exposure</u>, indoor and outdoor pollution, urban design, and mental health impacts over the life course.

- The evidence base to motivate multi-sector and interdisciplinary efforts of researchers, practitioners, policy-makers, industry, community groups, and campaigners to take informed action.