Effects of Pollution on Child and Adolescent Mental Health: A Protocol for a Systematic Review

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Abstract

Background

Whilst there is little uncertainty about the deleterious impact of pollution on human and planetary health, pollution's impact on child and adolescent mental health is less well understood. This is particularly true for young people in underdeveloped and developing world contexts, about whom research is generally lacking. Furthermore, although child and adolescent resilience continues to be a research priority, little attention has been paid to child and adolescent pathways of resilience in the face or aftermath of pollution exposure.

Methods

We will conduct a systematic review that adheres to PRISMA guidelines. Its purpose is to document what is known about how pollution affects child and adolescent mental health, along with what protects children and adolescents against these effects and associations across diverse contexts.

Discussion

Systematic insights are likely to support psychologists and other mental health practitioners to better support child and adolescent wellbeing globally regardless of exposure to pollution. Systematic review registration We have registered the review protocol in PROSPERO (registration: CRD42020176664).

Background

Across the globe, human activity has resulted in widespread emissions that are harmful to the earth and its inhabitants[1]. In the past century, there have been dramatic increases in chemical pollutants—including plastics, heavy metals, pesticides, building materials, antibiotics, and synthetic hormones—in our air, water, and soil[2], as well as increases in the noise to which we are exposed[3]. The harmful physical health sequalae of these emissions are well-recognised[4–5]. In comparison, understanding of the mental health effects of pollution is emergent[6–8], particularly when it comes to impacts on children and adolescents[9–10]. The under-attention to pollution's potential mental health effects is problematic, not least because much of the global burden of disease is attributable to mental illness[11].

Similarly concerning is the fact that half of all mental disorders are thought to have commenced by the time children reach early adolescence[12]. Onset in childhood or adolescence is associated with 10 times the expense of disorders with later onset[13]. Moreover, poor child and adolescent mental health predicts constrained child and adolescent development along with long-term diminished cognitive, psychological and behavioural capacities[14–15]. These concerns beg systematic attention to the mental health of children and adolescents, with specific consideration of those who are exposed to pollution. This attention must be inclusive of children and adolescents in low- and middle-income countries (LMICs), given that 85% of the world's children and adolescents reside in LMICs[16] and the understanding that they

may be disproportionately impacted by exposure to pollution[1]. To understand the cellular and molecular mechanisms underlying effects of pollution, it is also important to consider the state of the evidence for both animal and human models, rather than solely focusing on humans[17]. Causal pathways of the impacts of different pollutants can be established through animal experimental work. Without such a comprehensive understanding, it would be difficult to pinpoint knowledge gaps or effect implementation science aimed at meaningfully supporting the mental health of children and adolescents exposed to pollution.

Further, consideration of child and adolescent mental health should not omit the factors and processes that enable or sustain mental health[18], including when young people are exposed to adverse life experiences or circumstances[19]. Whilst young people's capacity to maintain positive mental health despite exposure to risk is well-researched[20], there is limited understanding of the resilience processes that protect child and adolescent mental health specifically during and/or following exposure to environmental pollution[21]. Because resilience processes are multi-systemic and sensitive to developmental, situational, and cultural determinants[22], it will be important to ascertain what facilitates child and adolescent resilience to pollution exposure across diverse contexts and highlight contextually relevant resilience-enablers.

Objectives

Taken together, the abovementioned concerns prompt our interest in what is currently known about the associations between pollution and child and adolescent mental health worldwide. This interest is framed by a social ecological perspective of resilience (i.e., the understanding that positive human adaptation to significant risk, such as pollution, is a dynamic and contextually responsive process)[23]. Accordingly, the purpose of the proposed review is to systematically synthesize what is known about how pollution impacts child and adolescent mental health, along with what protects children and adolescents against these effects across diverse contexts. To this end, the following questions guide the proposed systematic review:

- What is the global extent and focus of published and indexed empirical research on pollution and child and adolescent mental health, including which pollutants and associated mental health outcomes are most frequently investigated?
- What does empirical research on pollution and child and adolescent mental health reveal about factors or processes that enable child and adolescent mental health despite exposure to pollution?

The key terms in our guiding questions include:

Pollution

Following the European Union's[24] definition, pollution is understood as "the direct or indirect introduction, as a result of human activity, of substances, vibrations, heat or noise into air, water or land which may be harmful to human health or the quality of the environment" (p. 6).

Child and adolescent

The term "child and adolescent" includes young people from conception to 24 years of age[25].

Child and adolescent mental health

For children and adolescents, mental health implies no or limited indication of: (i) neurodevelopmental disorders (e.g., intellectual disability, communication disorders, autism spectrum disorder, attention-deficit and/or hyperactivity disorder, or specific learning disorders); (ii) disruptive, impulse-control, and conduct disorders; (iii) depressive disorders; (iv) anxiety disorders; or (v) substance disorders[26] (Rey, 2015). Lee et al.[13] also include schizophrenia in typical adolescent-onset disorders. All these disorders are recognized by the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM−5TR)[27]. The DSM−5TR guides practitioner support of mental health.

Methods And Analysis

If the 2020 PRISMA guidelines[28] are not available shortly, then the 2009 PRISMA guidelines[29] will inform our systematic review. The development of this protocol was informed by Moher et al.[30] and Shamseer et al.[31] This review protocol has been registered in PROSPERO (CRD42020176664).

Eligibility criteria

Regarding study characteristics, only original studies (human or animal) will be included. The human studies are inclusive of foetuses (i.e., conception to birth), children (i.e., new-born to nine years of age), and adolescents (i.e., 10 to 24 years; see Sawyer et al.[25]) from any country. The animal studies are inclusive of animals exposed to pollutants at the same developmental stages. In instances where the same data set is reported in multiple articles, the article that provides the clearest evidence of pollution impacts on/associations with child and adolescent mental health will be included. Studies will be excluded if:

- reference to pollution or mental health is tangential (e.g., only in the introduction or recommendations);
- mental health was not formally measured (e.g., through a clinical interview, scale/checklist, self- or caregiver-report, animal behaviour task, or biomarker [animal studies only]);
- intervention is the focus (e.g., interventions designed to reduce pollution); or

- solvents or pesticides are reported in relation to using these for suicide or substance-abuse.

Regarding report characteristics, only peer-reviewed, indexed journal articles (published and pre-print, on-line) will be included. To fit the profile of the reviewer team, publications in languages other than Cantonese, English, Mandarin, Portuguese, or Spanish will be excluded.

Information sources

Peer-reviewed articles, published on or before 10 April 2020, will be retrieved using the following databases: Africa-Wide, CINAHL, PsycARTICLES, PsycINFO (all via EBSCOhost platform); Medline (via Web of Science Clarivate Analytics); PubMed; Scopus (which includes contents of Embase); Web of Science Core Collection; SciELO Citation Index; and ERIC. The database search will be supplemented by a manual search of the reference lists of well-cited articles identified in the database search. The reviewer team (of which researchers from the Global South comprise the majority) will be sensitive to the inclusion of indexed Global South studies given their historic under-representation in scholarly literature[32].

Search strategy

In order to identify relevant article publications, the search strategy listed in Table 1 will be followed. It was developed by author LS1, a librarian working in South Africa, and tested by LS2, a research assistant working in the United Kingdom. The search will be limited to the title, abstract, and topic fields for the databases that allow this limiting.

Study records

Data management

Articles meeting the search strategy will be populated into EndNote and then exported to Zotero to annotate (i.e., to formulate as citations that include the title and abstract).

Selection process

Annotated citations containing the search terms in the title and/or abstract will be independently screened for eligibility by 11 reviewers (LT, YAV, CB, MECL, GPA, MAO, LG, LL, IM, AT, KH). Initially, the first 50 titles and abstracts will be independently screened by all 11 reviewers to determine the clarity of the inclusion/exclusion criteria. Once the criteria have been refined (if/as necessary), the remaining annotated citations will be randomly divided into five sets. Each set will be independently reviewed by groups of 2 reviewers (with one group of 3, due to the odd number). Each of these groups includes at least one reviewer from the Global South. Those articles that meet the inclusion criteria and to which the

exclusion criteria do not apply—as well as those where this information is not clear from the title or abstract—will be selected for a full text review. Consensus discussions (see Saldana[33]) will be used to resolve any disagreements regarding article selection for full assessment. Should consensus not be reached, LT or KH will evaluate the disputed citation.

Data collection process

The same 11 reviewers will extract relevant data from the identified articles. Reviewers will again work as five groups. Identified articles will be divided between the groups. Within groups, reviewers will independently extract data from the articles assigned to that group. Data extraction will be guided by a data-charting form that will be developed by LT and KH and calibrated by all reviewers (using 10 of the identified articles). The data-charting form will correspond to the items for which data will be sought (see data items). Once a reviewer group has reached consensus on the accuracy of the extracted information, another reviewer group will verify the data extracted from 10% of the completed group's articles.

Data items

We will extract data for the following categories of information: study descriptors [country context; design/methods (including how mental health was measured); sample (size, age range of human participants or animal subjects, sex of participants/subjects); study limitations]; pollution factors [type, level/intensity, duration of exposure]; and factors/processes that enable/sustain child and adolescent mental health despite exposure to pollution.

Outcomes and prioritization

We will extract data that relate to mental health outcomes in the face or aftermath of exposure to pollution. This includes data relating to symptoms of: (i) neurodevelopmental disorders (e.g., intellectual disability, communication disorders, autism spectrum disorder, attention-deficit and/or hyperactivity disorder, or specific learning disorders); (ii) disruptive, impulse-control, and conduct disorders; (iii) depressive disorders; (iv) anxiety or post-traumatic stress disorders; (v) substance disorders; or schizophrenia. Where possible, the extent of symptoms (e.g., no, limited/mild, severe) will be noted too.

Rigour and risk of bias in individual studies

Three review authors will independently assess the risk of bias in the included quantitative studies by considering the following characteristics[34]: 1. Completeness of data: were participant exclusions, attrition, and incomplete data adequately addressed in the published report? 2. Selective reporting: is there evidence of selective reporting of analyses (quantitative studies) and might this have affected the published results? 3. Reliability and validity: do the included measures have internal consistency? Have

measures used been validated for use in the populations or languages in which they were administered? 4. Participant selection: were the participants sampled in such a way that the results of the study can be generalized to the population? To assess risk of bias in animal studies, SYRCLE's risk of bias tool for animal studies[35] will be applied by three review authors with animal study expertise. SYRCLE's tool is similar to the Cochrane risk of bias tool specific to randomized control trials.

There is little consensus on which quality appraisal tool is preferred for judging the rigour of qualitative studies and so the decision is generally informed by the objective of the systematic review and reviewer experience with qualitative methodologies[36]. Given that the author team includes experienced qualitative researchers and that the eligible qualitative studies are likely to include a broad range of qualitative methodologies, the Standards for Reporting Qualitative Research (SRQR[37]) is preferable[36]. The SRQR is a 21-item checklist that evaluates all aspects of qualitative studies, including problem formulation, research design, findings and interpretation of findings.

Disagreements between the review authors over the risk of bias and quality limitations in individual studies will be resolved by discussion, with involvement of two additional review authors where necessary. Following Hughes-Morley et al.[38], we will not omit any studies that demonstrate bias or limited quality. Instead we will de-emphasise the results of these studies in the conclusions of our synthesis.

Data Synthesis

Because we anticipate that studies will not be sufficiently homogenous to accommodate meta-analyses, the results will be tabulated and narratively synthesized. An advantage of narrative syntheses is their juxtaposition of quantitative and qualitative evidence in order to provide a detailed response to the question directing the review[39]. This juxtaposition will yield a detailed account of what is currently known about how pollution impacts on, or relates to, child and adolescent mental health worldwide, as well as what facilitates child and adolescent mental health resilience in the face or aftermath of pollution exposure. This will be used to signpost limitations and silences in current understandings of child and adolescent mental health during/following exposure to pollution and to advocate for specific research and practice agendas. To ensure replicability of the narrative synthesis, we will make public the completed data-charting forms that informed the synthesis (e.g., as supplemental, on-line files when the review is published). LT and KH will lead the synthesis, with input from the remaining reviewers.

Meta-biases

Meta-bias includes both the selective reporting of outcomes due to their significance, magnitude, or direction and publication bias[31]. To asses meta-biases due to selective outcome reporting, we will: 1) evaluate whether studies have associated protocols, and whether those protocols were published prior to the recruitment of participants; 2) look for discrepancies between the published article and protocol (for

those studies with a protocol); and 3) contact authors of the study, where additional information is needed. We do not plan any assessment of meta-biases due to publication bias.

Confidence in cumulative evidence

To assess confidence, we will apply the Grading of Recommendations Assessment, Development and Evaluation (GRADE[40]) and GRADE-CERQual[41–42].

Conclusion

Children and adolescents comprise at least 25% of the world's population[16]. Pollution effects are threatening the wellbeing of this sizeable population[1]. To better protect the wellbeing of the world's current and future children and adolescents, a thorough understanding is needed of how child and adolescent mental health is affected by pollution and what might enable resilience to pollution effects. The review that we propose is a first step in gaining that thorough understanding.

Abbreviations

DSM−5[TR]: Diagnostic and Statistical Manual of Mental Disorders

GRADE: Grading of Recommendations Assessment, Development and Evaluation

GRADE-CERQual: Confidence in the Evidence from Reviews of Qualitative research

LMIC: low- and middle-income countries

Declarations

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Tables

Table 1: EBSCOhost Search strategy, modified as needed for other electronic databases

pollut* or pesticid* or platicizer* or metal* or DDT or solvent*

AND

mental health or mental illness or mental disorder* or psychiatric illness or psychiatric disorder* or psychiatric condition* or mood disorder* or anxiety-like or depressive-like

AND

foetus* or fetus or child* or adolescen* or youth* or teenager* or juvenil* or neonat* or young or gestation*or prenatal or larva* or embryonic

NOT

Heavy metal music

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- PRISMAP2015checklist.docx