Improving the evidence on the impact of ambient air pollution exposure during pregnancy on the risk of preterm birth

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Background

- Numerous systematic reviews (SRs) and meta-analyses (MAs) have suggested that there is an association between exposure to ambient air pollution and an elevated risk of preterm birth, the birth of an infant with fewer than 37 weeks of gestation[1].

- Few studies have examined differences in their quality and if the summary estimates provided can help derive a robust concentration-response function (CRF) for informing policy-making.

Objective

- To **understand the practices and shortcomings of published SR/MAs** in the area, and **determine if a new SR/MA of the area is needed**

Methods

A literature search using major English and Chinese databases was performed to find relevant peer reviewed, published SR/MAs. Information regarding publication dates, methods of quality assessment, and primary studies used were extracted and compared.

Results

After literature screening, **23 SR/MAs were retrieved**, all published in English apart from 1 that was published in Chinese. They were conducted between January 2004 and September 2021, and on average searched for 4 databases. 9 publications were SR with MAs, 9 were just SRs, and 5 that were just MAs.

Quality assessment

Various quality assessment (QA) tools are used in these SR/MAs. Newcastle-Ottawa Scale (NOS)[2] is most commonly used as the sole quality assessment tool. 7 did not mention the methodology or if QA was conducted. 2 issues are highlighted from this observation.

1. **NOS was not particularly developed for birth outcomes studies**. Questions such as 'did the study adjust for the most important confounder' is based on the assumption that there is a consensus regarding it, but it is unclear in the case for studies of air pollution and birth outcomes. Disagreements were also observed between how primary studies was graded among some SR/MAs that used NOS.

2. **Improvement in transparency in reporting** is needed, as some SR/MAs either did not publish the QA assessment results, or the QA framework used. This hinders reproducibility of the results.
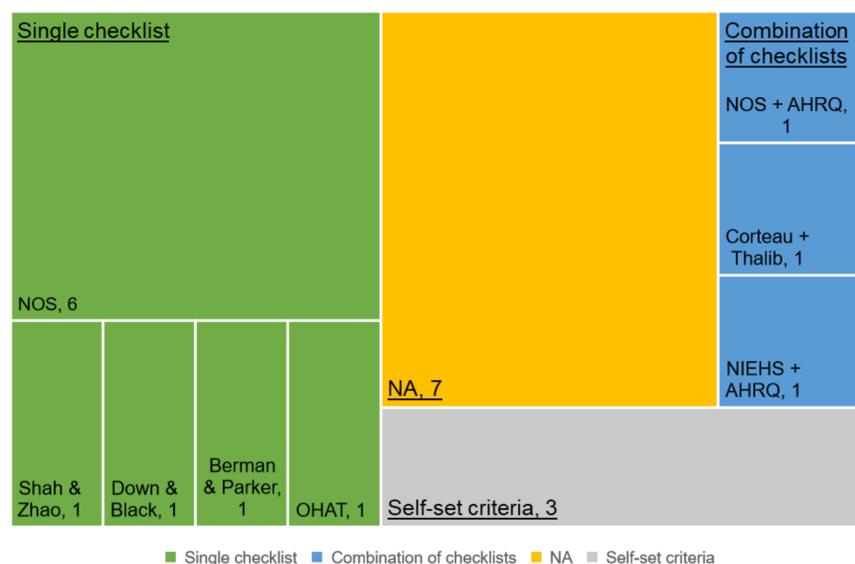

Figure 1. A treemap showing the types of QA tools used in the SR/MAs retrieved, and how often they were used .

Inclusion and exclusion criteria

The SR/MAs identified have similar inclusion and exclusion criteria overall. However, **newer MAs often exclude primary studies that were included in older MAs**. It could be caused by the studies not being retrieved at all, or due to issues such as population overlap, which occurs when studies with population from the same location, setting and time period were used. An example is shown below.

Primary studies	Time period	Location	Zhu 2015[3] 01/03/2014	Sun 2015[4] 31/12/2014	Li 2017[5] 31/07/2016
Wilhelm & Ritz 2005	1994 - 2000	LA, CA, US	green	green	
Huynh 2006	1999 - 2000	CA, US	green	green	
Ritz 2007	2003	LA, CA, US	green	green	
Jalaudin 2007	1998 - 2000	SYD, AU	green	green	
Brauer 2008	1999 - 2002	VBC, CAN	green	green	
Wu 2009	1997 - 2006	LA+OC, CA, US	green	green	
Gehring 2011	1996 - 1997	NL	green	green	
Rudra 2011	1996 - 2006	WA, US	green	green	
Kloog 2012	2000 - 2008	MA, US	green	green	
Lee 2013	1997 - 2002	AC, PA, US	green	green	
Hyder 2014	2000 - 2006	CT+MA, US	green	green	
Fleischer 2014	2004 - 2008	Global	dashed	green	
Pereria 2014a	2000 - 2006	CT, US	dashed	green	
Pereria 2014b	1997 - 2007	PER, AU	dashed	green	
Ha 2014	2004 - 2005	FL, US	dashed	green	
Gray 2014	2002 - 2006	NC, US	green	green	
Hannam 2014	2004 - 2008	NW, ENG	green	green	
Stieb 2016	1999 - 2008	CAN	dashed	dashed	green
Lavigne 2016	2005 - 2012	ON, CAN	dashed	dashed	green

Table 1. The primary studies included in 3 MAs of the association between $PM_{2.5}$ and risk of PTB. Green coloured blocks indicate included studies. Yellow and blue highlights indicate the two potential population overlaps present. Dashed line indicates a primary study that was published after the SR/MA's literature cut-off date.

Meta-analysis is conducted based on the assumption of independent effects of included studies[6]. However, as shown above all 3 MAs have included studies with populations potentially overlapping each other. It is unclear what the extent of overlap is, and how it may affect the summary estimate presented, but it indicates that effect estimates derived from currently published MAs could be less robust than expected.

Conclusions

i) Current SR/MAs suffer from issues such as lack of appropriate quality assessment tool, in-depth consideration of population overlap, replicability of findings, and transparency in reporting.

ii) A new SR/MA with improvements in these areas is therefore needed. The protocol of this SR/MA is registered on PROSPERO and is in the stage of literature screening (CRD4202301743)[7].

Reference

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