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GRADE guidelines for environmental and occupational health: A new series of articles in *Environment International*

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The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group started in 2000 as a collaboration of epidemiologists, public and other health professionals, scientists with different backgrounds (e.g. health economics, social science, toxicology, etc.), clinicians, and guideline developers with the goal to create a unifying, transparent and sensible system for grading the certainty of a body of evidence and making recommendations to support decisions for health related questions (Schünemann et al., 2003;

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Schünemann et al., 2008). Since 2010, following the establishment of the inaugural GRADE Centre at McMaster University, members of the GRADE Working Group have created 16 centres and networks globally (<http://www.gradeworkinggroup.org/>). GRADE has also supported over 20 topic-specific project groups for further methods development and has seen growing interest in application of the GRADE methodology in contexts outside of healthcare, such as for preclinical animal studies, test accuracy, public health and coverage decisions (Schünemann et al., 2019; Hooijmans et al., 2018; Schünemann et al., 2016).

In 2014, early in the GRADE Working Group's initiative of expanding evidence assessment and guideline development to address specific topic areas, the working group created the Environmental and Occupational Health Project Group. The project group began by developing a research agenda to advance the rigor and transparency of systematic reviews and guideline development in this field by adapting GRADE to support decision-making in environmental health. In a commentary for *Environment International*, we first introduced GRADE, examined steps of the guideline development process currently used for decision-making, and outlined suggestions for a research agenda to address decision-making in the environmental and occupational health field (Morgan et al., 2016). We identified the following priorities: 1) develop approaches to evaluate and integrate the evidence across different evidence streams (e.g., observational human, animal, in vitro, and in silico); 2) apply GRADE to evaluations of exposure risk and interventions to mitigate exposure or reduce risk; and 3) gain experience with environmental health decision-making by applying the GRADE evidence-to-decision framework to environmental and occupational health topics.

Since then, we have addressed several pressing needs in environmental and occupational health. Members of the GRADE Working Group described how one may adopt GRADE in situations of emergency or urgency, when rapid evidence assessments and guidance are needed (Thayer and Schünemann, 2016). We outlined several scenarios to guide readers through the development of a clearly formulated research question: PECO (Population, Exposure, Comparator, Outcome) (Morgan et al., 2018a). Most recently, a publication piloted and modified a newly released instrument to assess the risk of bias within studies of environmental exposures (Morgan et al., 2018b). Papers by third parties applying the GRADE framework or various interpretations of it to environmental health research questions include systematic reviews by the Navigation Guide, the National Toxicology Program's Office of Health Assessment and Translation, the SYRINA framework for identification of endocrine disrupting chemicals, and a set of systematic reviews by the World Health Organization and International Labor Office to contribute to determining global burden of disease from occupational environmental exposures (Johnson et al., 2016; NTP, 2016; Vandenberg et al., 2016; Mandrioli et al., 2018).

Given the broad application of methods and GRADE guidance to environmental and occupational health, we are now pleased to announce a Special Series within *Environment International* to highlight the ongoing development of methods as GRADE becomes more integrated into studies of environmental exposures. In this Series, we expand on the published literature of GRADE guidance in the *Journal of Clinical Epidemiology* (JCE) and current developments to provide guidance for the application of GRADE for

environmental and occupational decision-making (Guyatt et al., 2011). In addition, to further development of methods, this series will serve as a forum for providing explicit guidance and tailored examples for challenges identified when applying GRADE to environmental and occupational health research.

The first article outlines a proposal for integrating a novel instrument for rating the risk of bias of non-randomized studies of exposure into the GRADE certainty of evidence assessment (Morgan et al., 2019). Subsequent articles will allow for deeper exploration into topics of interest within the environmental and occupational fields, for example, addressing adaptations for the GRADEpro Guideline Development Tool (GDT) for environmental health questions. In partnership with JCE, we will describe how the GRADE domains of assessing certainty in evidence apply to modeling (e.g., in the fields of environmental and public health, health economics, clinical practice, and health policy).

The intent of this series is to provide guidance and concepts for use of the GRADE approach in environmental and occupational health systematic reviews and decision-making. Environment International will ensure accessibility by making all eligible publications within the series open access to researchers and decision-makers globally. This allows for transparency in current methodological approaches, as well as inevitable advances from future development, testing, and refinement. Further, the foremost principle of the GRADE Working Group is to enable participation and discussion of ideas. GRADE meetings, usually held biannually, are centered around a topic-focused discussion format open to suggestions and agenda items from the scientific community, and many of us believe that the progress in GRADE has been fundamentally influenced by this open approach (Schünemann, 2016). Most guidance for the application of GRADE is based on decades of careful consideration and reflection from GRADE members involved in systematic review, health technology assessment, biostatistics and guideline development methodology and use. We encourage members of the community to take advantage of these existing opportunities. They will inform thinking of other members of the GRADE Working Group and the community at large. Finally, as demonstrated by the GRADE guidance series in JCE with currently over 10,000 citations, this guidance will have a high impact in the field of environmental and occupational health.

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