Meta-Analysis of the Fine Particulate Matters-Associated Occupational Health Risks

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Motivation

Fine particulate matter (PM) is the recognized risk factor that can cause respiratory and other diseases. Some environmental regulations have been established to protect public people from health concerns. However, it still needs more criterion to understand the fine PM-induced health effects for each occupational population and to further conduct the health protection strategy. This study aims to provide a quantitative summary the fine PM-associated health risk for workers in workplaces.

Methods

Literature search. Relevant studies were identified in several stages, beginning with a systematic search using the keywords of fine particulate matter, workplace, and occupational in the abstract, with the results restricted to studies of occupational population. An initial search was conducted in July 2015 and updated automatically through December 2015. **Inclusion and exclusion criteria.** studies were included in the current meta-analysis if they provided quantitative risk estimates of hazard ratio, risk ratio, or odds ratio. **Statistical analyses.** All study estimates were converted to risk ratio to represent the change under fine PM exposure. Estimates from the studies were combined using both fixed- and random-effects model, which allowed between-study heterogeneity to contribute to the variance.

Review of Workplace Fine PM and Occupational Mortality

Reference	Cohort	Exposure	Cause	CaseNo.
Sjogren et al. 1987	234 welder	Hexavalent chromium	Ischaemic heart disease (IHD)	10
Steenland et al. 1998	92 control dockworkers	Diesel fume	Lung cancer (LC)	70
	604 control long-haul drivers			609
	134 control short-haul drivers			121
	50 control truck mechanics			37
	143 control other potentially exposed			99
Randem et al. 2003	8,610 male asphalt workers	Bitumen fume and PAH	Cerebrovascular disease (CBD)/IHD	73/214
Finkelstein et al. 2004	1,009 Heavy equipment operators	Diesel fume	CBD/IHD	38/259
	271 boilermakers			9/59
	1,533 electricians			61/332
	201 insulators			5/34
	220 painters			5/40
	3,561 plumbers			190/876
	505 sheet metal			22/92
Laden et al. 2007	54,319 male in the trucking industry	Diesel fume	CBD/IHD	167/1,133
Toren et al. 2007	248,087 male construction workers	Diesel fume	CBD/IHD	423/1,720
		Asphalt fume		45/171
		Metal fume		205/831
Garshick et al. 2012	29,324 male workers in trucking industry	Diesel fume in diffewrent levels	LC	179
				202
				248
Silverman et al. 2012	228 control male miners	Diesel fume	LC	50
	157 control male miners			49
	123 control male miners			50
Costello et al. 2013	39,412 autoworkers	Metal fume in different levels	IHD	67
				68
				68
				67
Mohner et al. 2013	5,862 potash miners	Diesel fume	LC	68

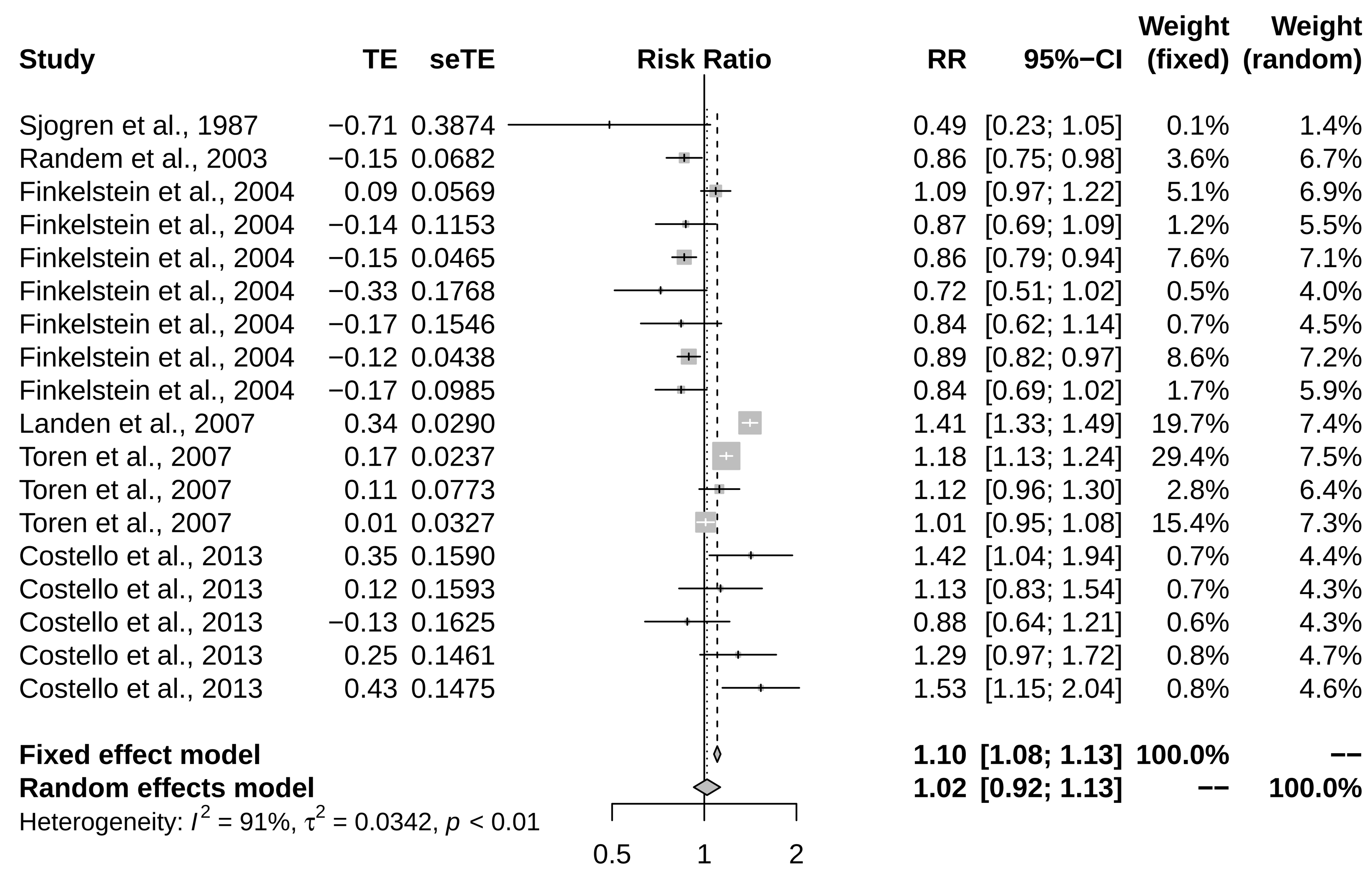
Review of Ambient Fine PM and Occupational Mortality

Reference	Cohort	Cause	CaseNo.
Puett et al. 2009	66,250 women from the Nurses' Health study	Coronary heart disease	1,348
Hart et al. 2011	53,814 men in the U.S. trucking industry	All-causes	4,806
		Cardiovascular disease	1,682
		Ischemic heart disease	1,109
Lipsett et al. 2011	73,489 women from the California Teachers Study	Cardiovascular disease	1,630
Puett et al. 2011	17,545 male from Health Professionals Follow-Up Study prospective cohort	All-cause	2,813
		Cardiovascular disease	1,661
		IHD	746
Weichenthal et al. 2014	83,378 subjects included farmers, their spouses, and commercial pesticide applicators.	All-cause	3,961
		Cardiovascular disease	1,055
Ostro et al. 2015	133,479 current and former female teachers and administrators	All-cause	6,285
		Cardiovascular disease	2,400
		IHD	1,085
Hart et al. 2015	108,767 members of the Nurses' Health Study 2000-2006	All-cause	8,617

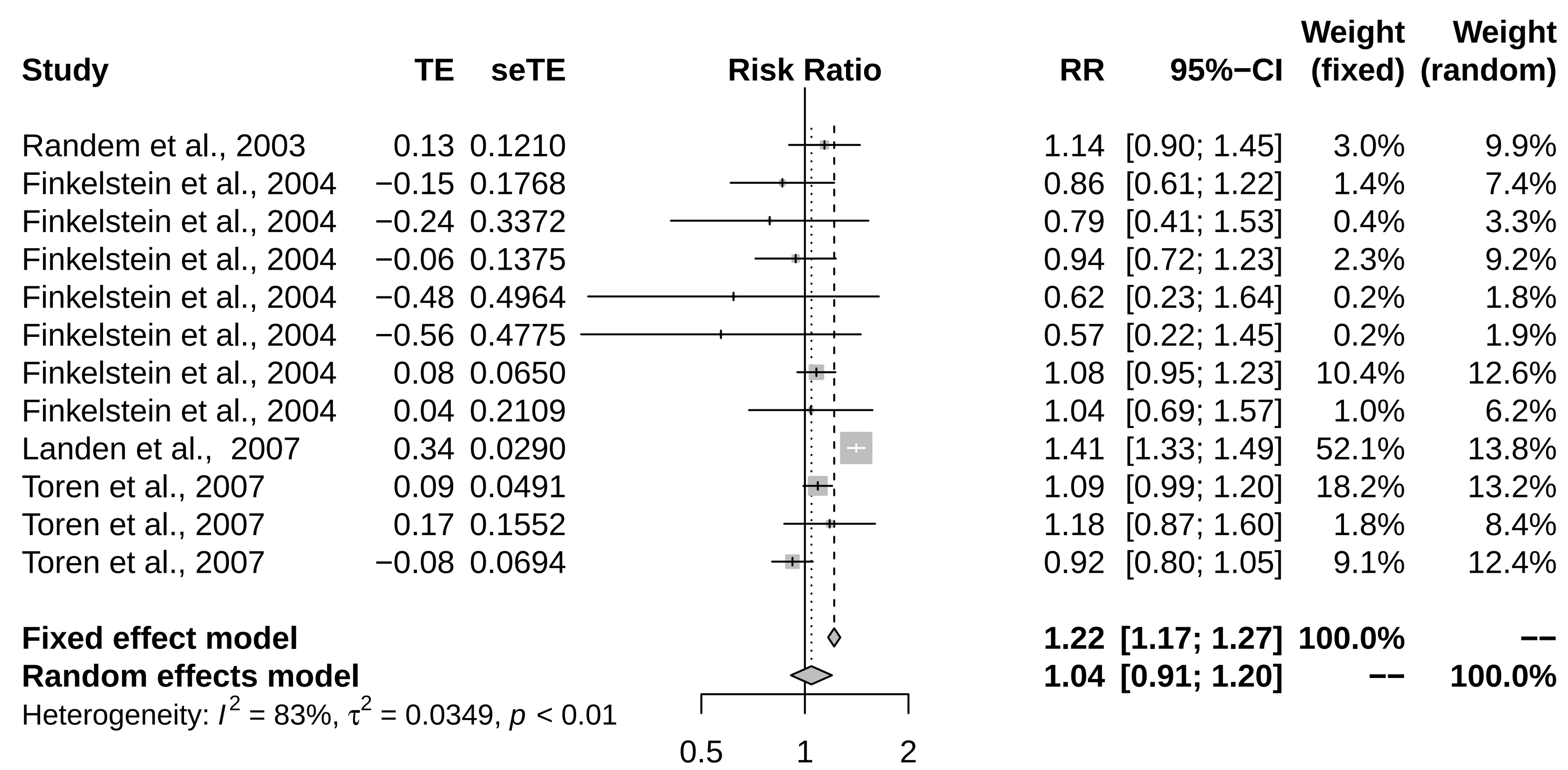
Workplace Fine PM-associated occupational mortality

We summarized the result of the fine PM-associated mortality of respiratory and other diseases, which include lung cancer, ischemic heart disease, and cerebrovascular disease. The result shows that lung cancer has the highest risk ratio with insignificant heterogeneity. Random-effects estimation also indicated the consistencies between studies.

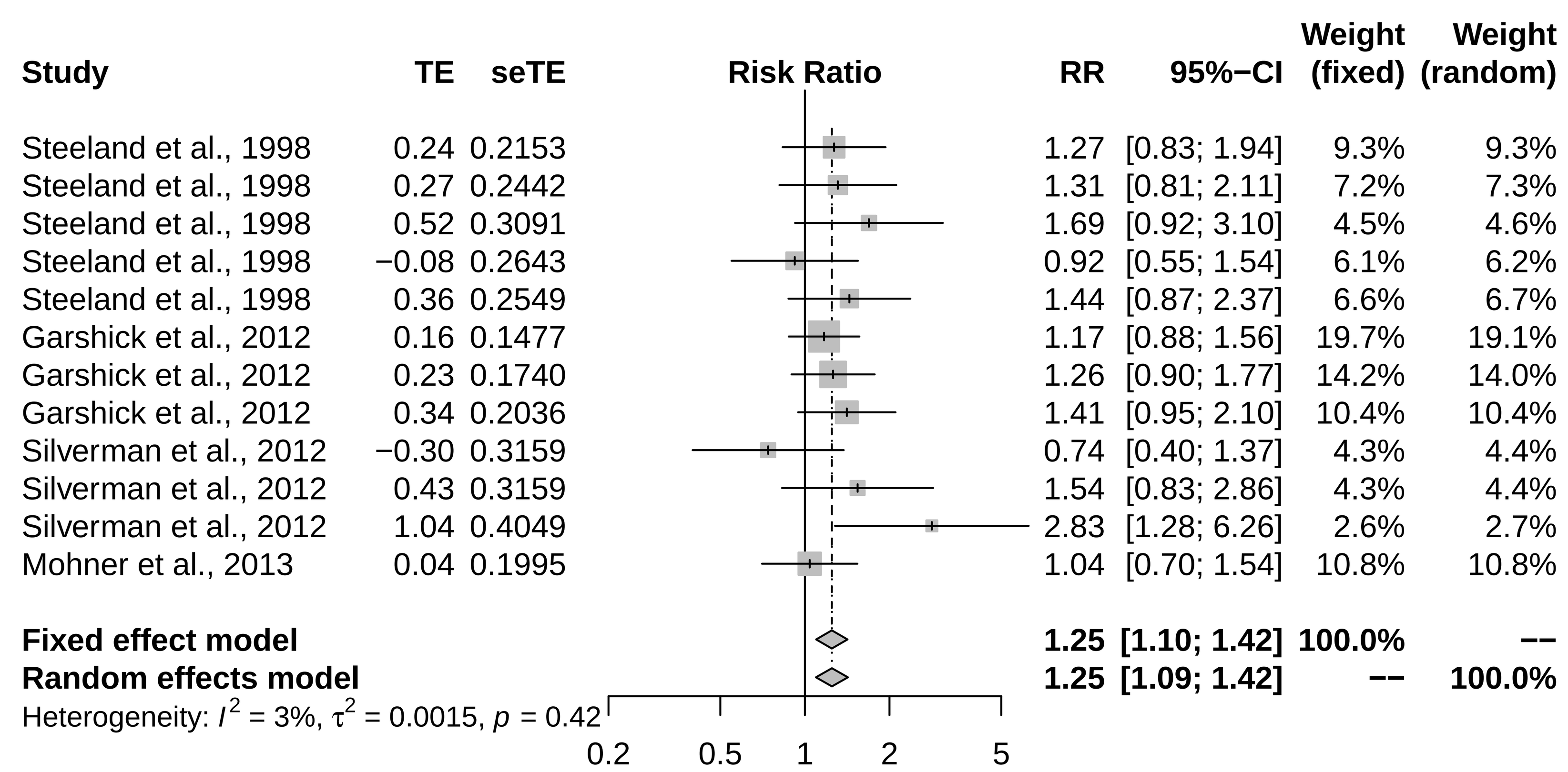
A) Ischemic Heart Disease Mortality



B) Cerebrovascular Disease Mortality



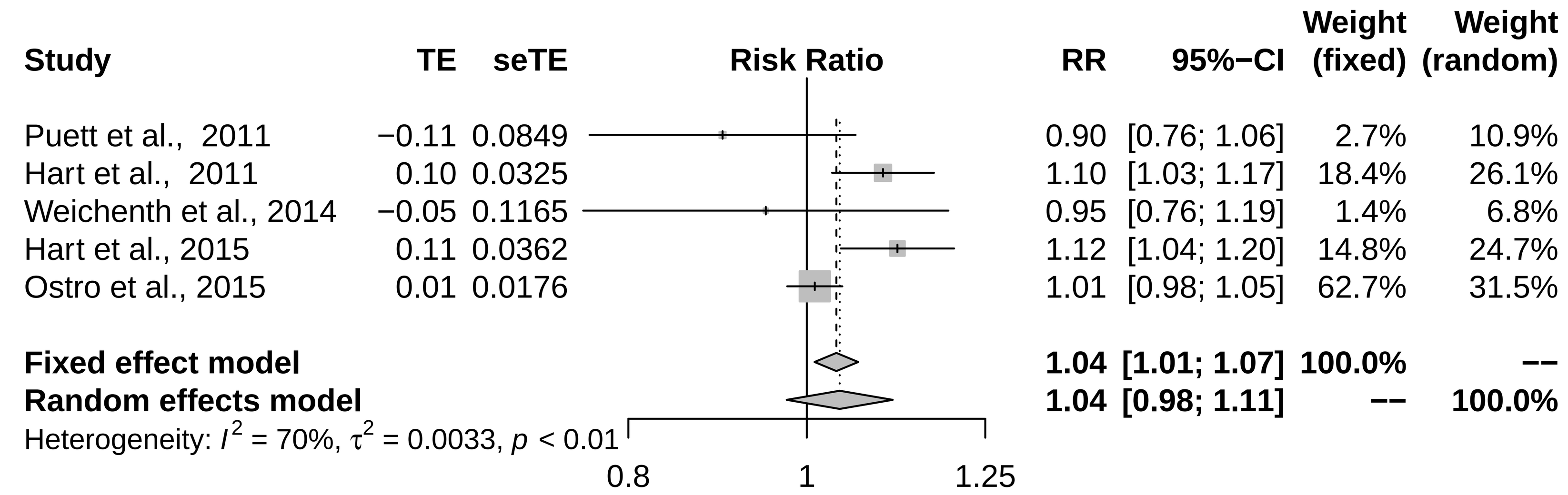
C) Lung Cancer Mortality



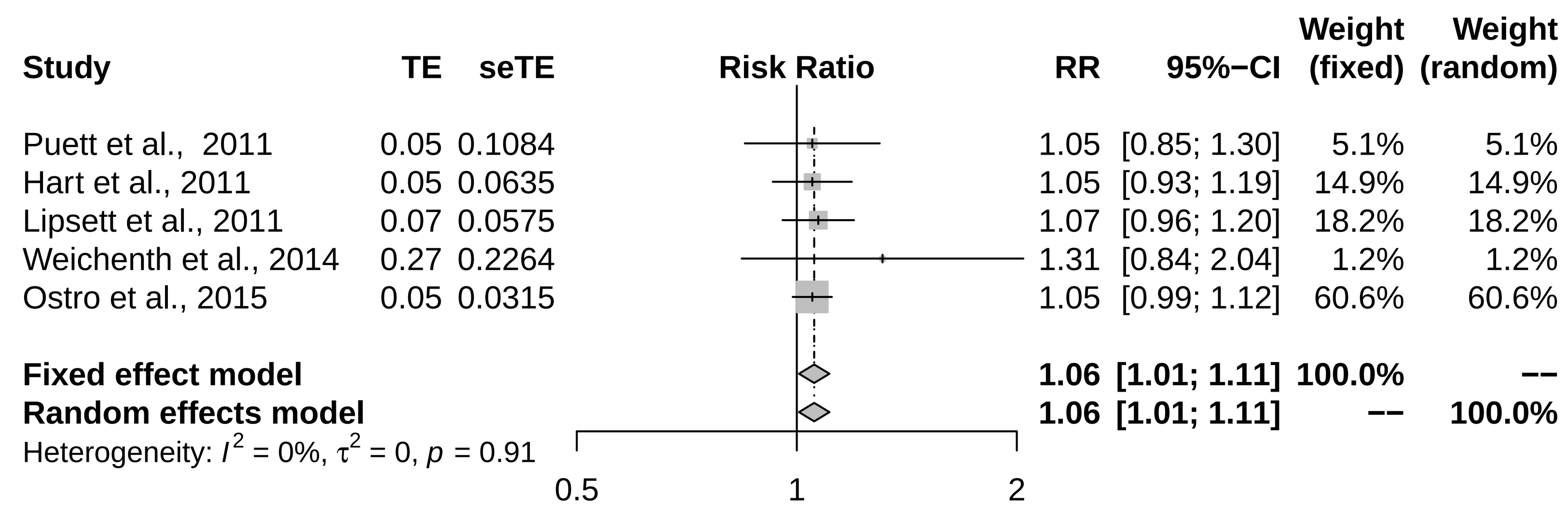
Environmental Fine PM-associated occupational mortality

To understand the ambient fine PM-associated the health risk of mortality, this study finds that the cardiovascular disease mortality and heart disease mortality are related to fine PM exposure for workers who have no occupational exposure to fine PM in the workplaces. However, we can only find few reference that focuses on the relationship between fine PM and occupational population.

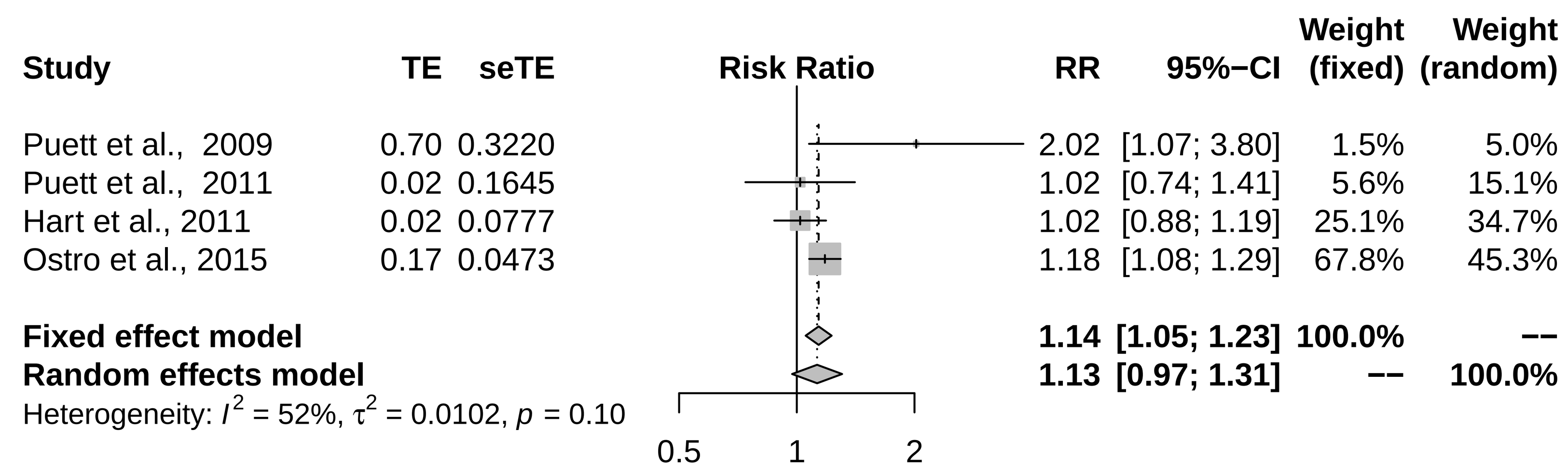
A) All-Cause Mortality



B) Cardiovascular Mortality



C) Heart Disease Mortality



Discussion

- In this analysis, we focused attention on fine PM, which is prominent component of the air pollution. We divided the two different scenarios to quantify and understand the exposure risk for the occupational population. Current result shows that most studies had investigated the exposure risk of fine PM in the workplace. However, we also need to pay more attention to the occupational population who may have potential exposure risk to fine PM from ambient environment.
- Most of the data were obtained from cohort studies; We did not place any restrictions based on whether or not a study adjusted for specific confounders. Therefore, homogeneity tests found the difference in estimates between exposure assessment techniques.
- A large number of hypothetical studies would be required to construct a symmetrical analysis and change the results of our meta-analyses.Results for mortality risk of lung cancer from fine PM was robust to influence analyses in occupational exposure, where the meta-estimate was recalculated with the systematic exclusion of each study.

Acknowledgements

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Source code

The R source code of this study were put on the github `https://github.com/nanhung/MetaPM`. We appreciate your valuable comments to improve this study.