

Spotlight: University of California Berkeley study finds that failure to consider the healthy worker survivor bias can lead to highly misleading conclusions when analyzing the health impacts of hazardous exposures.

Alpha Foundation Grant AFC113-08: Ischemic Heart Disease and Lung Cancer Mortality in Relation to Respirable Particulate Matter and Diesel Exhaust in Non-metal Miners

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Investigating exposure-response relationships in observational studies can be very challenging because of all of the potential confounding variables and biases. This study by the University of California Berkley examined Ischemic Heart Disease (IHD) mortality in relation to diesel exhaust and respirable particulate matter (RPM). A previous study, jointly conducted by NCI and NIOSH, had reported excess lung cancer risk, but no evidence that miners in the Diesel Exhaust in Miners Study (DEMS) were at increased risk for IHD.

Results of many occupational epidemiology studies of chronic diseases are likely attenuated by the healthy worker effect. The healthy worker effect consists of two parts: (1) the healthy hire effect, in which people who are hired into jobs are healthier than those who are not, and (2) the healthy worker survivor effect (HWSE), in which workers reduce their exposures by transferring to a lower exposure job, taking time off work, or leaving employment altogether for health-related reasons. This leads to more accumulated exposure among the (remaining) healthiest workers.

The study found evidence that the healthy worker survivor effect was in fact operating in this study -- workers with higher exposure to Respirable Elemental Carbon (REC) were more likely to terminate employment sooner. By applying statistical methods designed to address this bias, they found that there was increased risk of heart disease with exposure to increased levels of respirable dust. The study also examined the influence of the healthy worker survivor effect on the risk of developing lung cancer and found failure to consider it also attenuated the real risk of developing lung disease. The results of study are shown in the table below for various hypothetical levels exposure control.

Risk of IHD mortality under the natural course and under hypothetical interventions on REC and RPM					
Intervention	IHD mortality %	RR	95% CI	Risk Diff.	95% CI
Natural course (no intervention)	19.4
Interventions on REC only					
REC≤106 µg/m ³	17.9	0.92	0.84, 1.00	-1.5	-3.0, 0.0
REC=25 µg/m ³	16.9	0.87	0.72, 1.06	-2.5	-6.0, 1.0
REC≤0 µg/m ³	16.5	0.85	0.65, 1.11	-2.9	-7.6, 1.7
Interventions on RPM					
RPM≤5 mg/m ³	19.4	1.00	1.00, 1.00	0.0	0.0, 0.0
RPM≤3 mg/m ³	19.3	0.99	0.98, 1.00	-0.1	-0.4, 0.2
RPM≤0.5 mg/m ³	18.8	0.97	0.84, 1.11	-0.6	-3.9, 2.0
Joint interventions on REC & RPM					
REC≤106 µg/m ³ RPM≤5 mg/m ³	17.9	0.92	0.84, 1.02	-1.5	(-2.9, 0.2)
REC=25 µg/m ³ RPM≤3 mg/m ³	16.8	0.87	0.73, 1.03	-2.6	(-5.7, 0.5)
REC≤0 µg/m ³ RPM≤0.5 mg/m ³	15.8	0.81	0.69, 0.96	-3.6	(-6.3, -0.9)