## Supplemental Table 1A. Cardiopulmonary Effects in the Community

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [[Brink et al. 2014](https://hawcproject.org/study/130937/)](https://hawcproject.org/study/130937/) [4] | Residents of WV (BRFSS),  2005-2009  N=1,236,841 | County coal production (tons total, surface, and underground), 2005 | Respiratory disease hospitalization rates | Surface coal production makes a small but significant contribution to respiratory disease hospitalization rates. | ARIES (states that authors are independent researchers)/Authors report they have no COI |
| [Hendryx et al. 2007](https://hawcproject.org/study/130908/) [9] | Health Care Utilization Project National In Patient Sample, regional (WV, KY, PA)  2001  N=93,952 | County coal production, 2001 | Hospitalization for ischemic heart disease, congestive heart failure, hypertension  COPD, asthma | Coal mining volume was associated with increased risk of hospitalization for hypertension and COPD. | NR/NR |
| [Hendryx and Ahern 2008](https://hawcproject.org/study/130909/) [11] | WV adults  2000-2004  N=16,493 | Coal production (tons), 2001 | Angina or coronary heart disease, stroke, cardiovascular disease, arteriosclerosis, congestive heart failure, hypertension, all heart diseases, black lung, asthma, COPD, all lung diseases, cardiopulmonary diseases | High coal production levels were associated with higher rates of cardiopulmonary disease, COPD, hypertension, and lung disease. | NR/NR |
| [Hendryx and Zullig 2009](https://hawcproject.org/study/130913/) [12] | National (BRFSS)  2006  N=235,783 | Coal mining (yes/no) and Appalachia (yes/no), 1996–2006 | Self-reported angina or coronary heart disease, stroke, heart attack, cardiovascular disease | Residents of Appalachian coal mining areas reported higher rates of cardiovascular disease. | NR/Authors report they have no COI |
| [Hendryx 2013](https://hawcproject.org/study/130929/) [18] | Adult residents of 3 rural eastern counties in KY  2012  N=952 | County of residence (MTR mining – Floyd /No coal mining – Elliott and Rowan), 2012 | Heart attack, stroke, angina or coronary heart disease, hypertension, cardiovascular symptoms, COPD, asthma (current/lifetime), respiratory symptoms | The MTR mining community reported significantly poorer health conditions for: lifetime and current asthma, COPD, hypertension, and more cardiovascular symptoms. | NR/NR |
| [[Hendryx and Luo. 2015](https://hawcproject.org/study/130933/)](https://hawcproject.org/study/130933/) [20] | Adult residents of 3 rural western counties in VA  2013  N=682 | County of residence (MTR mining – Lee and Wise/No coal mining – Smyth), 2013 | COPD, respiratory symptoms | Residents of MTR mining counties had an elevated prevalence of respiratory symptoms and COPD. | NR/NR |
| [[Hendryx and Entwhistle 2015](https://hawcproject.org/study/132960/)](https://hawcproject.org/study/132960/) [21] | 2 communities in WV and IN  2014  N=48 | Residence and active surface coal mine (>or ≤ 3 miles),  Indoor and outdoor particle counts.  2014 | Cardiopulmonary conditions, high-sensitivity C-reactive Protein (HsCRP) | Residents who lived near mining had higher HsCRP levels and reported more cardiopulmonary conditions.  Particle counts were higher in mining locations, and were most disparate for outdoor counts of particles in a respirable range (0.5-5.0μm). | NR/NR |
| [Talbott et al. 2015](https://hawcproject.org/study/130940/) [25] | Residents of WV (WV Health Care Authority)  2005-2009  N= 1,236,841 | Coal production, 2005 | circulatory hospitalization rates | Coal production was not related to rate of hospitalization for circulatory disease, after adjustment. | ARIES (states that authors are independent researchers)/Authors report they have no COI |

ARIES - Appalachian Research Initiative for Environmental Science

BRFSS - Behavioral Risk Factor Surveillance System

COI - conflict of interest

COPD - chronic obstructive pulmonary disease

MTR - mountaintop removal

NR - not reported

## Supplemental Table 1B. Cancer in the Community

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [Christian et al. 2011](https://hawcproject.org/study/130923/) [7] | Residents of KY (US Census and BRFSS),  1995-2007  N=total NR | County coal production (tons) | Lung cancer (3 regional clusters identified) | Coal-mining exposures could contribute to the high incidence of lung cancer in SE KY. | Kentucky Lung Cancer Research Program/NR |
| [Hendryx et al. 2007](https://hawcproject.org/study/130908/) [9] | Health Care Utilization Project National In Patient Sample, regional (WV, KY, PA)  2001  N=93,952 | County coal production, 2001 | Hospitalization for lung cancer | Coal mining volume was not associated with increased risk of hospitalization for lung cancer. | NR/NR |
| [Hendryx and Ahern 2008](https://hawcproject.org/study/130909/) [11] | WV adults  2000-2004  N=16,493 | Coal production (tons), 2001 | Cancer | High coal production levels were not associated with self-reported cancer. | NR/NR |
| [Hendryx et al. 2012c](https://hawcproject.org/study/130921/) [16] | Adult residents of 3 rural southern counties in WV  2011  N=769 | County of residence (MTR mining – Coal River/No coal mining – Pocahontas), 2011 | Self-reported cancer | Self-reported cancer rates were higher in the MTR mining area. | NR/NR |
| [Hendryx 2013](https://hawcproject.org/study/130929/) [18] | Adult residents of 3 rural eastern counties in KY  2012  N=952 | County of residence (MTR mining – Floyd /No coal mining – Elliott and Rowan), 2012 | cancer | No differences were observed between MTR and non-mining communities for self-reported cancer, although differences in household cancer were reported | NR/NR |

ARIES - Appalachian Research Initiative for Environmental Science

BRFSS - Behavioral Risk Factor Surveillance System

COI - conflict of interest

MTR - mountaintop removal

NR - not reported

## Supplemental Table 1C. Reproductive Effects in the Community

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [Ahern, M et al. 2011](https://hawcproject.org/study/130914/) [1] | WV Birthscore Dataset  2005-2007  N=42,770 | Residence county total coal production (high, moderate, no), 2005–2007 | Low birth weight | Compared to no coal mining, living in high or moderate areas elevates the odds of a low-birth-weight infant. | NR/NR |
| [[Ahern, MM et al. 2011](https://hawcproject.org/study/130920/)](https://hawcproject.org/study/130920/) [2] | National Center for Health Statistics natality data, regional (WV, VA, TN, KY)  1996-2003  N=1,889,071 | Residence county surface mining (none, non-MTR, MTR), 1996-2003 | Congenital anomalies (any and 8 categories of defects) | Rate ratios were higher in MTR mining areas compared to non-mining areas, an effect more pronounced in 2000-2003 period. | NR/NR |
| [[Lamm et al. 2015](https://hawcproject.org/study/130938/)](https://hawcproject.org/study/130938/) [24] | WV birth certificates,  1990-2009  N=418,385 | MTR mining by hospital, 1990-2009 | Birth defects by hospital (also analyses 1996 to 2003 subset to compare to [2]) | MTR mining was not associated with increased risk of birth defects after accounting for hospital of birth. | ARIES (states that authors are independent researchers)/Authors report they have no COI |

ARIES - Appalachian Research Initiative for Environmental Science

COI - conflict of interest

MTR - mountaintop removal

NR - not reported

## Supplemental Table 1D. Mortality in the Community

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [[Borak et al. 2012](https://hawcproject.org/study/130924/)](https://hawcproject.org/study/130924/) [3]\* | Residents of Appalachia (CDC), regional  2000-2004  N=NR | County coal production (yes/no), 2000-2004 | All-cause mortality | Coal mining  is not an independent risk factor for increased mortality. | National Mining Association (states that funder had no role in work)/NR |
| [[Buchanich et al. 2014](https://hawcproject.org/study/130936/)](https://hawcproject.org/study/130936/) [5] | Regional (counties in WV, VA, TN, KY, NC)  1950-2009  N=NR | County coal production (tons total, surface, and underground), 1950-2009 | All-cause, external cause and cancer mortality | All forms of coal were associated with excess cancer mortality, while total and all external mortalities do not seem to be related. | ARIES (states that authors are independent researchers)/Authors report they have no COI |
| [Esch and Hendryx 2011](https://hawcproject.org/study/130922/) [8] | Residents (US Census), regional (WV, VA, TN, KY)  1999-2006  N=NR | County coal production (none, non-MTR, and MTR) 1994-2006 | Chronic cardiovascular disease mortality rates | MTR mining is associated with increased chronic cardiovascular disease mortality rates. | NR/NR |
| [Hendryx et al. 2008](https://hawcproject.org/study/130910/) [10] | National (CDC)  2000-2004  N=NR | Coal production (tons/area/per capita, high level/type of Appalachian coal-mining), 2000-2004 | Lung cancer mortality rate | Lung cancer mortality was higher in areas with heavy Appalachian coal mining. | Regional Research Institute, West Virginia University (states that funder had no role in work)/ Authors report they have no COI |
| [Hendryx and Ahern 2009](https://hawcproject.org/study/130912/) [13] | National (CDC)  1979-2005  N=NR | County coal mining (yes/no) and Appalachia (yes/no), 1996–2006 | Mortality rates | Mortality rates were higher in Appalachian coal mining areas with the highest rates in areas with the highest levels of mining. | Regional Research Institute, West Virginia University/NR |
| [Hendryx 2009](https://hawcproject.org/study/130911/) [14] | National (CDC)  2000-2004  N=287,786,522 | Coal production (Appalachian mining > 4 million tons, Appalachian mining ≤ 4 million tons, non-Appalachian mining, non-mining), 2000-2004 | Mortality rates (total/acute/chronic heart disease, total/acute/chronic respiratory disease, chronic kidney disease) | In Appalachian counties with high coal mining, mortality rates were higher for chronic heart, respiratory and kidney disease, but not for acute disease. For non-Appalachian coal mining counties acute heart and respiratory mortality were higher. | Regional Research Institute, West Virginia University/NR |
| [Hendryx et al. 2010](https://hawcproject.org/study/130916/) [15] | Residents of WV (CDC)  1979-2004  N>1.8 million | Coal mining (tonnage and GIS distance), 1979-2004 | Cancer mortality (total, breast, digestive system, genital, oral, respiratory, urinary, and all other) | Total, respiratory and other cancer mortality rates were associated with the GIS-exposure measure more than the tonnage measure. | NR/NR |
| [Hendryx 2013](https://hawcproject.org/study/130929/) [18] | Adult residents of 3 rural eastern counties in KY  2012  N=952 | County of residence (MTR mining – Floyd /No coal mining – Elliott and Rowan), 2012 | household member died (any cause in last year, cancer in last 5 years) | MTR mining community residents were more likely to report that in the past 5 years a household member had died from cancer, but not died of any cause in the last year. | NR/NR |
| [Hendryx and Holland 2016](https://hawcproject.org/study/205805/) [22] | Residents (US Census), regional (KY, TN, VA, WV)  1968-2014 | County of residence (any MTR, Appalachia without MTR, non-Appalachia), before and after the 1990 Clean Air Act (CAA) | Mortality rates (age-adjusted all-cause, respiratory cancer, and non-cancer respiratory disease) | Mortality rates for all regions declined from 1968-2014, but the MTR region in the post-CAA years experienced an excess of deaths compared to non-MTR regions. | NR/NR |
| [Hitt and Hendryx 2010](https://hawcproject.org/study/130915/) [23] | Residents of WV (CDC and BRFSS),  1979-2005  N=NR | County coal production and ecological integrity, 1979-2005 | Cancer mortality rates (total and 8 subtypes) | Coal mining was associated with both increased cancer mortality rates and ecological disintegrity. | Dept. Fisheries and Wildlife Sciences at Virginia Tech/NR |
| [Woolley et al. 2015a](https://hawcproject.org/study/130939/) [27] | Residents of 76 counties in WV, VA, TN, KY, and NC  1960-2009  N=NR | WV and VA coal producing counties, 1983-2009 | Mortality rates by time period (all-cause, external, respiratory, and nonmalignant respiratory disease) | Mortality and poverty rates were elevated in coal-mining compared with non-coal-mining areas. | ARIES (states that authors are independent researchers)/Authors report they have no COI |

ARIES - Appalachian Research Initiative for Environmental Science

BRFSS - Behavioral Risk Factor Surveillance System

CAA – Clean Air Act, 1990

CDC – Centers for Disease Control and Prevention

COI - conflict of interest

GIS – geographic information system

MTR - mountaintop removal

NR - not reported

\* Borak (2012)[3] stated that they undertook a re-analysis of 3 papers,[10, 13, 14] but the authors of those papers dispute this claim noting model errors and inconsistencies with their work.[30]

## Supplemental Table 1E. General health status in the Community

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [Hendryx (2008b)](https://hawcproject.org/study/130909/)[11] | WV adults  2000-2004  N=16,493 | Coal production (tons), 2001 | Self-reported health status (6-point scale) | High coal production levels were associated with worse adjusted health status. | NR/NR |
| [Hendryx (2013a)](https://hawcproject.org/study/130929/)[18] | Adult residents of 3 rural eastern counties in KY  2012  N=952 | County of residence (MTR mining – Floyd /No coal mining – Elliott and Rowan), 2012 | Self-reported health status, serious household illness in the last year | The MTR mining community reported significantly poorer health conditions for self-rated health status. | NR/NR |
| [[Woolley et al. 2015b](https://hawcproject.org/study/130942/)](https://hawcproject.org/study/130942/) [26] | Residents of 10 counties in WV, TN, and NC  (year NR)  N=415 | Self-reported number of coal mining facilities near residence | Self-reported health status (5-point Likert scale) | Self-rated health does not seem to be associated with living near coal mining. | ARIES (states that authors are independent researchers)/Authors report they have no COI |
| [Zullig and Hendryx 2010](https://hawcproject.org/study/130917/) [28] | National survey of adults (BRFSS)  2006  N=349,287 | Coal mining (yes/no) and Appalachia (yes/no), 1996–2005 | Self-reported health (5-point scale, Healthy Days Index, days poor physical, days poor mental, and activity limitation) | Residents of coal-mining counties reported fewer healthy days and poorer self-rated health; and disparities were greatest in Appalachian coal-mining areas. | NR/NR |
| [[Zullig and Hendryx 2011](https://hawcproject.org/study/130919/)](https://hawcproject.org/study/130919/) [29] | Regional survey of adults (BRFSS) (WV, VA, TN, KY)  2006  N=10,234 | Coal mining in Appalachia (MTR, other coal, and no mining) | Self-reported health (5-point scale, Healthy Days Index, days poor physical, days poor mental, and activity limitation) | Residents of MTR mining areas report the greatest reductions in health-related quality of life compared to counties with other forms of coal mining and no coal mining. | NR/NR |

ARIES - Appalachian Research Initiative for Environmental Science

BRFSS - Behavioral Risk Factor Surveillance System

COI - conflict of interest

MTR - mountaintop removal

NR - not reported

## Supplemental Table 1F. Other Effects in the Community

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [[Cain and Hendryx 2010](https://hawcproject.org/study/132958/)](https://hawcproject.org/study/132958/) [6] | WV Public School students  2004-2008  N=1,812 | Counties with and without coal production, 2004-2008 | Standardized school performance tests pass rates (4 subjects) | Proficiency rates were lower in all subject areas for schools in coal-mining counties. | NR/Authors report they have no COI |
| [Hendryx et al. 2007](https://hawcproject.org/epi/outcome/20883/) [9] | Health Care Utilization Project National In Patient Sample, regional (WV, KY, PA)  2001  N=93,952 | County coal production, 2001 | Hospitalization for kidney disease, organic psychoses, musculoskeletal and connective tissue symptoms, diabetes | Coal mining volume was not associated with increased risk of hospitalization for these conditions. | NR/NR |
| [Hendryx and Ahern 2008](https://hawcproject.org/study/130909/) [11] | WV adults  2000-2004  N=16,493 | Coal production (tons), 2001 | Arthritis or osteoporosis, kidney disease, diabetes | High coal production levels were associated higher rates of kidney disease. | NR/NR |
| [Hendryx et al. 2012a](https://hawcproject.org/study/130925/) [17] | National (BRFSS)  2006  N=NR | County coal mining (yes/no) and Appalachia (yes/no), 1994-2006 | Adult tooth loss (any/ordinal) | Appalachian coal-mining county residents showed elevated odds for tooth loss, with the Appalachia main effect significant but not the coal mining main effect. | NR/NR |
| [Hendryx 2013](https://hawcproject.org/study/130929/) [18] | Adult residents of 3 rural eastern counties in KY  2012  N=952 | County of residence (MTR mining – Floyd /No coal mining – Elliott and Rowan), 2012 | Symptoms (dermal; eye, ear, nose and throat; gastrointestinal; muscle, joint, and bone; neurological; 5+; and other) | The mountaintop mining community reported more illness symptoms across multiple organ systems. | NR/NR |
| [Hendryx and Innes-Wimsatt 2013](https://hawcproject.org/study/132959/) [19] | National (BRFSS)  2006  N= 8,591 | Coal producing counties (MTR, other coal, no coal mining), 1994-2006 | Self-reported depression (mild, moderate, severe) | Major depression was reported more in MTR mining areas than in non-mining areas. | NR/Authors report they have no COI |
| [[Hendryx and Entwhistle 2015](https://hawcproject.org/study/132960/)](https://hawcproject.org/study/132960/) [21] | 2 communities in WV and IN  2014  N=48 | Residence and active surface coal mine (>or ≤ 3 miles),  Indoor and outdoor particle counts.  2014 | Number of symptoms (32 recorded across 7 areas) | Residents who lived near mining had higher HsCRP levels and reported more illness symptoms.  Particle counts were higher in mining locations, and were most disparate for outdoor counts of particles in a respirable range (0.5-5.0μm). | NR/NR |

ARIES - Appalachian Research Initiative for Environmental Science

BRFSS - Behavioral Risk Factor Surveillance System

COI - conflict of interest

MTR - mountaintop removal

NR - not reported

## Supplemental Table 2 – Occupational Effects

| **Study** | **Population** | **Exposure** | **Outcome** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [CDC 2000](https://hawcproject.org/study/130893/) [31] | Surface coal miners in PA  1996-1997  N=1,236 | Coal mining by location, coal type (bituminous/anthracite), and estimated exposure | Silicosis (radiograph ILO profusion category >2) | The screening indicated an increased prevalence of and risk for silicosis associated with age and years of drilling experience. | CDC MMWR Report/NR |
| [CDC 2012](https://hawcproject.org/study/130926/) [32] | Surface coal miners in 16 states  2010-2011  N=2,328 | Coal mining by tenure in surface or underground and location (Central Appalachia = KY, VA, WV) | Progressive massive fibrosis and pneumoconiosis | Central Appalachian surface miners had an increased prevalence ratio of pneumoconiosis, but not fibrosis, compared to other surface miners. | CDC MMWR Report/NR |
| [[Hendryx et al. 2012c](https://hawcproject.org/study/130921/)](https://hawcproject.org/study/130921/) [16] | Adult residents of 3 rural southern counties in WV  2011  N=769 | Ever worked as a coal miner | Self-reported cancer | Occupation exposure as a coal miner was not associated with self-reported cancer rates. | NR/NR |
| [Prince and Frank 1996](https://hawcproject.org/study/130970/) [33] | Coal mining disability claimants in KY  1989-1992  N=374 | Year of mining activity by type (underground/surface) | Forced expiratory volume, forced vital capacity, and ratio | Pulmonary function declined in association with years mining, even after controlling for roentgenograph status and smoking, particularly among underground miners. | Univ. KY Department of Preventive Medicine and Environmental Health funding/NR |
| [[Woolley et al. 2015b](https://hawcproject.org/study/130942/)](https://hawcproject.org/study/130942/) [26] | Residents of 10 counties in WV, TN, and NC  (year NR)  N=415 | Self-reported occupational coal mining | Self-reported health status (5-point Likert scale) | Poor self-rated health does not seem to be associated working in the coal industry. | ARIES (states that authors are independent researchers)/Authors report they have no COI |
| [Young and Rachal 1996](https://hawcproject.org/study/130968/) [34] | Former coal miners who were claimants for "black lung" benefits in TN  (year NR)  N=133 | Self-reported occupational lifetime coal mine dust exposure, type of mine (surface/underground), and location | Pneumoconiosis, pulmonary insufficiency, and respiratory disability | Disability from occupational injuries and comorbidities occurred with greater frequency in miners with coal workers' pneumoconiosis than in controls. | Supported in part by the Medical Effectiveness Treatment Program/NR |

ARIES - Appalachian Research Initiative for Environmental Science

CDC MMWR - Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report

COI - conflict of interest

MTR - mountaintop removal

NR - not reported

## Supplemental Table 3 – Experimental Studies

| **Study** | **Model System** | **Exposure** | **Outcomes** | **Author’s Conclusion** | **Funding/COI** |
| --- | --- | --- | --- | --- | --- |
| [Knuckles et al. 2013](https://hawcproject.org/study/130927/) [35] | Male Sprague–Dawley rats (6–11 weeks old)  N=8 or 13 exposed, 11 or 17 unexposed | Intratracheal instilled with 300µg re-suspended PM collected from air for 2–4 weeks at 2 sites ≤ 1 mile of MTR mining site | Isolated arteriole and intravital microscopy studies  Acute (<24 hr) | Exposure to PM from MTR mining sites impairs microvascular function through alterations in NO-mediated dilation and sympathetic nerve influences. | NIH and NSF/NR |
| [Luanpitpong et al. 2014](https://hawcproject.org/study/130935/) [36] | Human bronchial cell line (epithelial BEAS-2B) | PM collected from air for 2–4 weeks at 2 sites ≤ 1 mile of MTR mining site in Edwight, WV and from areas in Green Bank, WV (no coal mining) | Cytotoxicity, proliferation, cell cycle analysis, cell migration  Chronic (3 months) | Chronic exposure to noncytotoxic, physiological relevant concentration of MTR mining PM induced neoplastic transformation, accelerated cell proliferation, and enhanced cell migration. | NIH/Authors report they have no COI |
|  | Immunodeficient NOD/SCID gamma mice | Subcutaneously injection with luciferase-labeled lung cancer H460 cells MTR mining PM-exposed cells | Tumor growth of luciferase-labeled cells | Xenograft transplantation of the MTR mining PM-exposed cells in mice caused no apparent tumor formation, but promoted tumor growth of human lung carcinoma H460 cells. |  |
| [Nichols et al. 2015](https://hawcproject.org/study/130943/) [37] | Male Sprague–Dawley rats  N=6 exposed, 6 unexposed | Intratracheal instilled with 300µg re-suspended PM collected from air for 2–4 weeks at 2 sites ≤ 1 mile of MTR mining site | Cardiac function, apoptotic indices, and mitochondrial function  Acute (<24 hr) | Exposure to PM from MTR mining sites increases cardiac mitochondrial-associated apoptotic signaling and decreases mitochondrial function concomitant with decreased cardiac function. | NIH, NSF, and American Heart Association/Authors report they have no COI |
| [Turner et al. 2013](https://hawcproject.org/study/130930/) [38] | 8 strains of C. elegans (wildtype; GFP-tagged metallothionein; and sensitivities to osmotic stress, heavy metals, metalloids, and manganese) | Stream water and sediment from 13 sites on the Upper Mud River WV and its tributaries - some impacted by MTR mining (collected 2010-2012) | Size (growth) and fluorescence (metallothionein GFP reporter strain) | Samples from mine-  impacted streams inhibited growth; in general, the toxicity of streamwater was due to osmotic stress, while the toxicity of sediments was from metals or metalloids. | Foundation for the Carolinas (funders had no role)/ Authors report they have no COI |

ARIES - Appalachian Research Initiative for Environmental Science

COI - conflict of interest

MTR - mountaintop removal

NO-nitric oxide

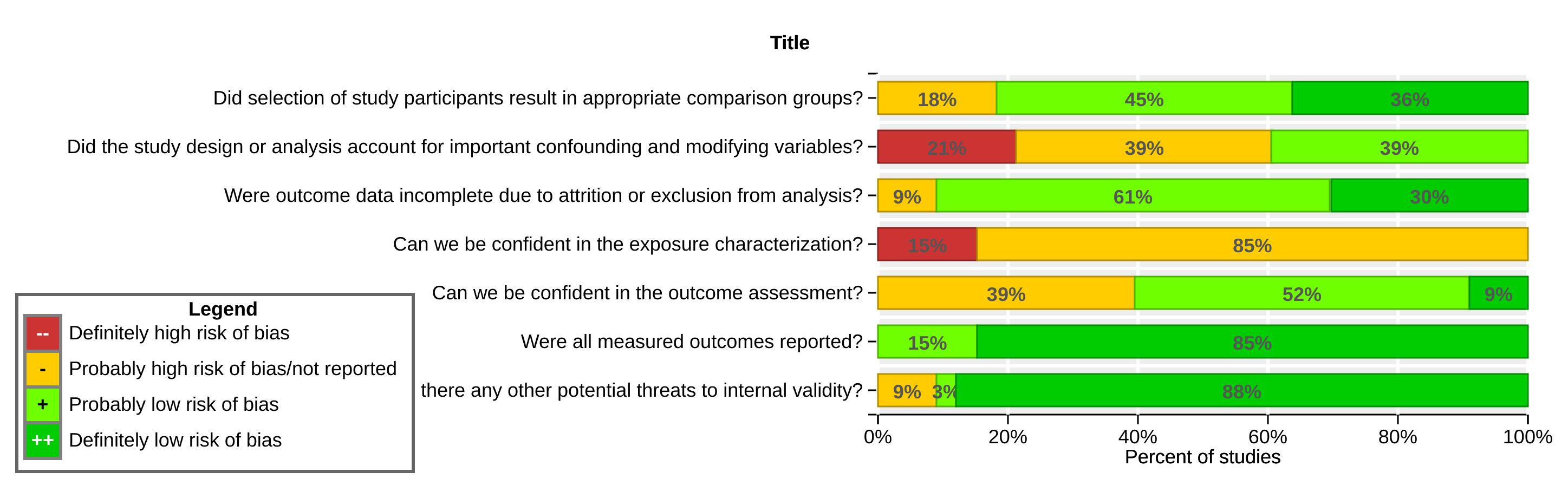
NR - not reported

PM – particulate matter

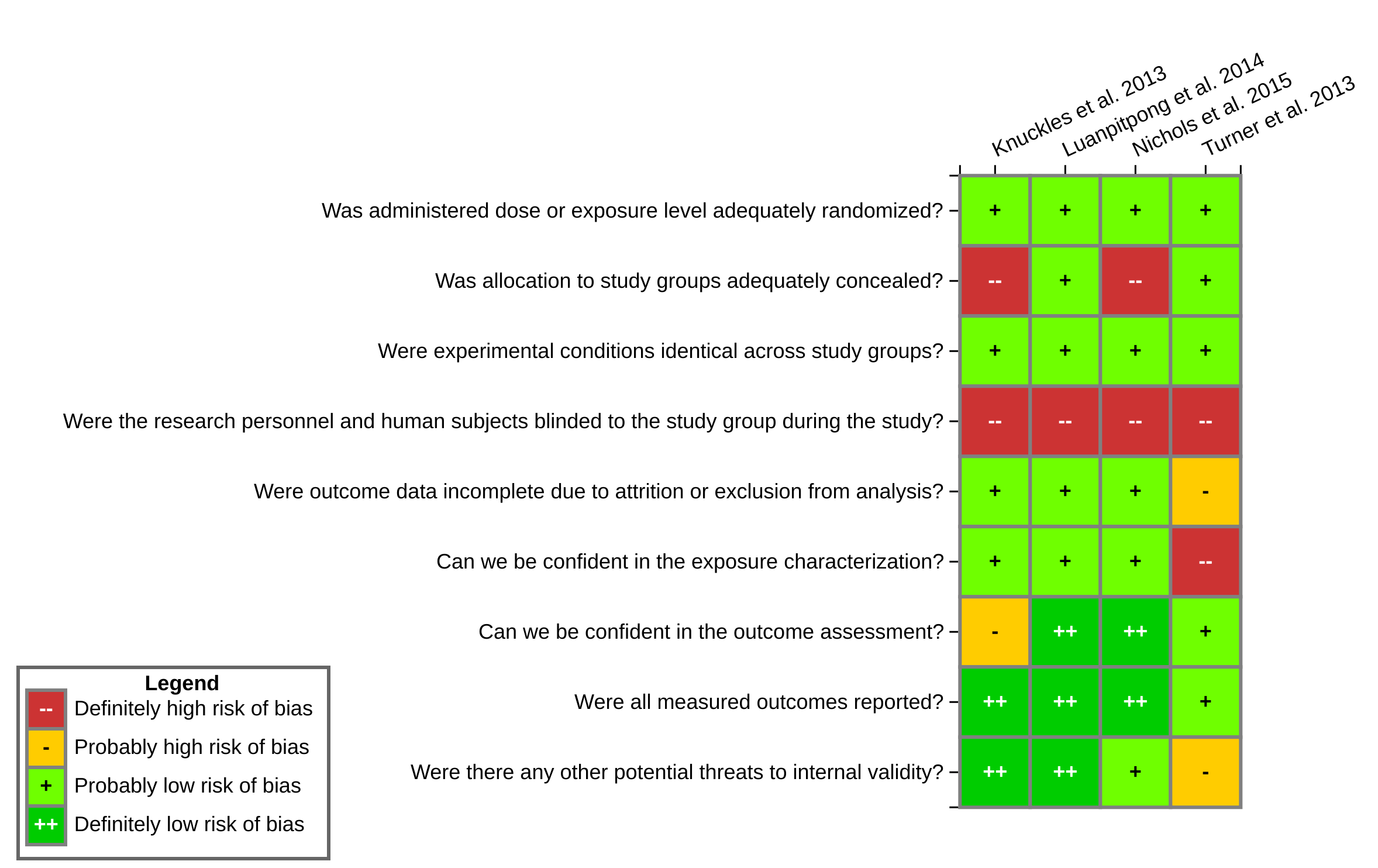
**Supplemental Tables References**

1. Ahern M, Mullett M, Mackay K, Hamilton C. 2011. Residence in coal-mining areas and low-birth-weight outcomes. Maternal and child health journal 15:974-979.
2. Ahern MM, Hendryx M, Conley J, Fedorko E, Ducatman A, Zullig KJ. 2011. The association between mountaintop mining and birth defects among live births in central appalachia, 1996-2003. Environmental research 111:838-846.
3. Borak J, Salipante-Zaidel C, Slade MD, Fields CA. 2012. Mortality disparities in appalachia: Reassessment of major risk factors. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 54:146-156.
4. Brink LL, Talbott EO, Stacy S, Marshall LP, Sharma RK, Buchanich J. 2014. The association of respiratory hospitalization rates in wv counties, total, underground, and surface coal production and sociodemographic covariates. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 56:1179-1188.
5. Buchanich JM, Balmert LC, Youk AO, Woolley SM, Talbott EO. 2014. General mortality patterns in appalachian coal-mining and non-coal-mining counties. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 56:1169-1178.
6. Cain LR, Hendryx M. 2010. Learning outcomes among students in relation to west virginia coal mining: An environmental riskscape approach. Environmental Justice 3:71-77.
7. Christian WJ, Huang B, Rinehart J, Hopenhayn C. 2011. Exploring geographic variation in lung cancer incidence in kentucky using a spatial scan statistic: Elevated risk in the appalachian coal-mining region. Public health reports (Washington, DC : 1974) 126:789-796.
8. Esch L, Hendryx M. 2011. Chronic cardiovascular disease mortality in mountaintop mining areas of central appalachian states. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association 27:350-357.
9. Hendryx M, Ahern MM, Nurkiewicz TR. 2007. Hospitalization patterns associated with appalachian coal mining. Journal of toxicology and environmental health Part A 70:2064-2070.
10. Hendryx M, O'Donnell K, Horn K. 2008. Lung cancer mortality is elevated in coal-mining areas of appalachia. Lung cancer (Amsterdam, Netherlands) 62:1-7.
11. Hendryx M, Ahern MM. 2008. Relations between health indicators and residential proximity to coal mining in west virginia. American journal of public health 98:669-671.
12. Hendryx M, Zullig KJ. 2009. Higher coronary heart disease and heart attack morbidity in appalachian coal mining regions. Preventive medicine 49:355-359.
13. Hendryx M, Ahern MM. 2009. Mortality in appalachian coal mining regions: The value of statistical life lost. Public health reports (Washington, DC : 1974) 124:541-550.
14. Hendryx M. 2009. Mortality from heart, respiratory, and kidney disease in coal mining areas of appalachia. International archives of occupational and environmental health 82:243-249.
15. Hendryx M, Fedorko E, Anesetti-Rothermel A. 2010. A geographical information system-based analysis of cancer mortality and population exposure to coal mining activities in west virginia, united states of america. Geospatial health 4:243-256.
16. Hendryx M, Wolfe L, Luo J, Webb B. 2012c. Self-reported cancer rates in two rural areas of west virginia with and without mountaintop coal mining. Journal of community health 37:320-327.
17. Hendryx M, Ducatman AM, Zullig KJ, Ahern MM, Crout R. 2012a. Adult tooth loss for residents of us coal mining and appalachian counties. Community dentistry and oral epidemiology 40:488-497.
18. Hendryx M. 2013. Personal and family health in rural areas of kentucky with and without mountaintop coal mining. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association 29 Suppl 1:s79-88.
19. Hendryx M, Innes-Wimsatt KA. 2013. Increased risk of depression for people living in coal mining areas of central appalachia. Ecopsychology 5:179-187.
20. Hendryx M, Luo J. 2015. An examination of the effects of mountaintop removal coal mining on respiratory symptoms and copd using propensity scores. International journal of environmental health research 25:265-276.
21. Hendryx M, Entwhistle J. 2015. Association between residence near surface coal mining and blood inflammation. Extractive Industries and Society 2:246-251.
22. Hendryx M, Holland B. 2016. Unintended consequences of the clean air act: Mortality rates in appalachian coal mining communities. Environmental Science & Policy 63:1-6.
23. Hitt NP, Hendryx M. 2010. Ecological integrity of streams related to human cancer mortality rates. EcoHealth 7:91-104.
24. Lamm SH, Li J, Robbins SA, Dissen E, Chen R, Feinleib M. 2015. Are residents of mountain-top mining counties more likely to have infants with birth defects? The west virginia experience. Birth Defects Research Part A - Clinical and Molecular Teratology 103:76-84.
25. Talbott EO, Sharma RK, Buchanich J, Stacy SL. 2015. Is there an association of circulatory hospitalizations independent of mining employment in coal-mining and non-coal-mining counties in west virginia? Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 57:e30-36.
26. Woolley SM, Youk AO, Bear TM, Balmert LC, Talbott EO, Buchanich JM. 2015b. Impact of coal mining on self-rated health among appalachian residents. Journal of environmental and public health 2015:501837.
27. Woolley SM, Meacham SL, Balmert LC, Talbott EO, Buchanich JM. 2015a. Comparison of mortality disparities in central appalachian coal- and non-coal-mining counties. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 57:687-694.
28. Zullig KJ, Hendryx M. 2010. A comparative analysis of health-related quality of life for residents of u.S. Counties with and without coal mining. Public health reports (Washington, DC : 1974) 125:548-555.
29. Zullig KJ, Hendryx M. 2011. Health-related quality of life among central appalachian residents in mountaintop mining counties. American journal of public health 101:848-853.
30. Hendryx M, Ahern M. 2012. Reply to Borak et al "mortality disparities in appalachia: Reassessment of major risk factors". Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 54:768-769; author reply 770-763.
31. CDC. 2000. Silicosis screening in surface coal miners--pennsylvania, 1996-1997. MMWR Morbidity and mortality weekly report 49:612-615.
32. CDC. 2012. Pneumoconiosis and advanced occupational lung disease among surface coal miners--16 states, 2010-2011. MMWR Morbidity and mortality weekly report 61:431-434.
33. Prince TS, Frank AL. 1996. Causation, impairment, disability: An analysis of coal workers' pneumoconiosis evaluations. Journal of occupational and environmental medicine / American College of Occupational and Environmental Medicine 38:77-82.
34. Young RC, Jr., Rachal RE. 1996. Pulmonary disability in former appalachian coal miners. Journal of the National Medical Association 88:517-522.
35. Knuckles TL, Stapleton PA, Minarchick VC, Esch L, McCawley M, Hendryx M, et al. 2013. Air pollution particulate matter collected from an appalachian mountaintop mining site induces microvascular dysfunction. Microcirculation (New York, NY : 1994) 20:158-169.
36. Luanpitpong S, Chen M, Knuckles T, Wen S, Luo J, Ellis E, et al. 2014. Appalachian mountaintop mining particulate matter induces neoplastic transformation of human bronchial epithelial cells and promotes tumor formation. Environmental science & technology 48:12912-12919.
37. Nichols CE, Shepherd DL, Knuckles TL, Thapa D, Stricker JC, Stapleton PA, et al. 2015. Cardiac and mitochondrial dysfunction following acute pulmonary exposure to mountaintop removal mining particulate matter. American journal of physiology Heart and circulatory physiology 309:H2017-2030.
38. Turner EA, Kroeger GL, Arnold MC, Thornton BL, Di Giulio RT, Meyer JN. 2013. Assessing different mechanisms of toxicity in mountaintop removal/valley fill coal mining-affected watershed samples using caenorhabditis elegans. PloS one 8:e75329.

## Supplemental Figure 1. Risk-of-bias bar chart, observational Studies (n=33)



## Supplemental Figure 2. Risk of Bias heat map, experimental studies (n=4)



# Supplemental Reference Lists

## Impact on water chemistry/quality (n=43)

Arnold MC, Lindberg TT, Liu YT, Porter KA, Hsu-Kim H, Hinton DE, et al. 2014. Bioaccumulation and speciation of selenium in fish and insects collected from a mountaintop removal coal mining-impacted stream in west virginia. Ecotoxicology (London, England) 23:929-938.

Arnold MC, Friedrich LA, Lindberg TT, Ross M, Halden NM, Bernhardt E, et al. 2015. Microchemical analysis of selenium in otoliths of two west virginia fishes captured near mountaintop removal coal mining operations. Environmental toxicology and chemistry / SETAC 34:1039-1044.

Bernhardt ES, Lutz BD, King RS, Fay JP, Carter CE, Helton AM, et al. 2012. How many mountains can we mine? Assessing the regional degradation of central appalachian rivers by surface coal mining. Environmental science & technology 46:8115-8122.

Bier RL, Voss KA, Bernhardt ES. 2015. Bacterial community responses to a gradient of alkaline mountaintop mine drainage in central appalachian streams. The ISME journal 9:1378-1390.

Bogner JE, Sobek AA. 1985. Distribution of selected metals in clastic overburden units of the appalachian and interior coal basins: Water quality implications. 9e congres international de stratigraphie et de geologie du Carbonifere, Washington et Champaign-Urbana, 1979 Compte rendu vol 4:479-490.

Borchers JW, Ehlke TA, Mathes MV, Downs SC. 1991. Effects of coal mining on the hydrologic environment of selected stream basins in southern west virginia. Govt Reports Announcements & Index:130.

Brenner FJ, Helm J. 1991. Macroinvertebrate recolonization and water quality characteristics of a reconstructed stream after surface coal mining in northwestern pennsylvania, USA. International journal of surface mining & reclamation 5:11-15.

Burke RA, Fritz KM, Barton CD, Johnson BR, Fulton S, Hardy D, et al. 2014. Impacts of mountaintop removal and valley fill coal mining on c and n processing in terrestrial soils and headwater streams. Water, Air, & Soil Pollution 225.

Clark EV, Greer BM, Zipper CE, Hester ET. 2016. Specific conductance-stage relationships in appalachian valley fill streams. Environmental Earth Sciences 75:13.

Cravotta CA, Brady KBC. 2015. Priority pollutants and associated constituents in untreated and treated discharges from coal mining or processing facilities in pennsylvania, USA. Applied Geochemistry.

Daniel WM, Kaller MD, Jack J. 2015. Nitrogen stable isotopes as an alternative for assessing mountaintop removal mining's impact on headwater streams. Fundamental and Applied Limnology 186:193-202.

Daniels WL, Zipper CE, Orndorff ZW, Skousen J, Barton CD, McDonald LM, et al. 2016. Predicting total dissolved solids release from central appalachian coal mine spoils. Environmental pollution (Barking, Essex : 1987) 216:371-379.

Dinger JS, Wunsch DR, Haney DC. 1991. Determination of aquifer characteristics in spoil generated by mountaintop removal: Valley fill coal-mining process. Govt Reports Announcements & Index:262.

Duckson DW. 1989. Land-use and water-quality relationships in the georges creek basin, maryland. Water Resources Bulletin 25:801-807.

Evans DM, Zipper CE, Donovan PF, Daniels WL. 2014. Long-term trends of specific conductance in waters discharged by coal-mine valley fills in central appalachia, USA. Journal of the American Water Resources Association 50:1449-1460.

Fox JF. 2009. Identification of sediment sources in forested watersheds with surface coal mining disturbance using carbon and nitrogen isotopes. Journal of the American Water Resources Association 45:1273-1289.

Gangloff MM, Perkins M, Blum PW, Walker C. 2015. Effects of coal mining, forestry, and road construction on southern appalachian stream invertebrates and habitats. Environmental management 55:702-714.

Gottfried PK. 1985. Geochemical changes of streams associated with surface mining of coal on the cumberland plateau. Southeastern Geology 26:53-66.

Hitt NP, Chambers DB. 2014. Temporal changes in taxonomic and functional diversity of fish assemblages downstream from mountaintop mining. Freshwater Science 33:915-926.

Hopkins RL, Roush JC. 2013. Effects of mountaintop mining on fish distributions in central appalachia. Ecology of Freshwater Fish 22:578-586.

Jaeger KL. 2015. Reach-scale geomorphic differences between headwater streams draining mountaintop mined and unmined catchments. Geomorphology 236:25-33.

Johnson BR, Fritz KM, Price R. 2013. Estimating benthic secondary production from aquatic insect emergence in streams affected by mountaintop removal coal mining, west virginia, USA. Fundamental and Applied Limnology 182:191-204.

McGarvey DJ, Johnston JM. 2013. 'Fishing' for alternatives to mountaintop mining in southern west virginia. Ambio 42:298-308.

Merriam ER, Petty JT, Merovich GT, Fulton JB, Strager MP. 2011. Additive effects of mining and residential development on stream conditions in a central appalachian watershed. Journal of the North American Benthological Society 30:399-418.

Merriam ER, Petty JT, Strager MP, Maxwell AE, Ziemkiewicz PF. 2013. Scenario analysis predicts context-dependent stream response to landuse change in a heavily mined central appalachian watershed. Freshwater Science 32:1246-1259.

Merriam ER, Petty JT, Strager MP, Maxwell AE, Ziemkiewicz PF. 2015a. Complex contaminant mixtures in multistressor appalachian riverscapes. Environmental toxicology and chemistry / SETAC 34:2603-2610.

Merriam ER, Petty JT, Strager MP, Maxwell AE, Ziemkiewicz PF. 2015b. Landscape-based cumulative effects models for predicting stream response to mountaintop mining in multistressor appalachian watersheds. Freshwater Science 34:1006-1019.

Merriam ER, Petty JT. 2016. Under siege: Isolated tributaries are threatened by regionally impaired metacommunities. The Science of the total environment 560-561:170-178.

Messinger T. 2004. Polycyclic aromatic hydrocarbons in bottom sediment and bioavailability in streams in the new river gorge national river and gauley river national recreation area, west virginia, 2002. Govt Reports Announcements & Index:36.

Minear RA, Tschantz BA. 1976. The effect of coal surface mining on the water quality of mountain drainage basin streams. Journal of the Water Pollution Control Federation 48:2549-2569.

Mitsch WJ, Taylor JR, Benson KB, Hill PL. 1983. Wetlands and coal surface mining in western kentucky - a regional impact assessment. Wetlands 3:161-179.

Muncy BL, Price SJ, Bonner SJ, Barton CD. 2014. Mountaintop removal mining reduces stream salamander occupancy and richness in southeastern kentucky (USA). Biological Conservation 180:115-121.

Paybins KS, Messinger T, Eychaner JH, Chambers DB, Kozar MD. 1998. Water quality in the kanawha-new river basin west virginia, virginia, and north carolina, 1996-98. Govt Reports Announcements & Index:398.

Plass WT. 1975. Changes in water chemistry resulting from surface-mining of coal on four west virginia watersheds.152-169.

Powell JD. 1988. Origin and influence of coal mine drainage on streams of the usa. Environ Geol Water Sci 11:141-152.

Pumure I, Renton JJ, Smart RB. 2009. Accelerated aqueous leaching of selenium and arsenic from coal associated rock samples with selenium speciation using ultrasound extraction. Environmental Geology 56:985-991.

Ramsey DL, Brannon DG. 1988. Predicted acid mine drainage impacts to the buckhannon river, wv, u.S.A. Water, Air, and Soil Pollution 39:1-14.

Ross MR, McGlynn BL, Bernhardt ES. 2016. Deep impact: Effects of mountaintop mining on surface topography, bedrock structure, and downstream waters. Environmental science & technology 50:2064-2074.

Siskind DE, Kopp JW. Blasting effects on appalachian water wells. 1987, 96-102.

Vengosh A, Lindberg TT, Merola BR, Ruhl L, Warner NR, White A, et al. 2013. Isotopic imprints of mountaintop mining contaminants. Environmental science & technology 47:10041-10048.

Welsh SA, Loughman ZJ. 2014. Physical habitat and water quality correlates of crayfish distributions in a mined watershed. Hydrobiologia 745:85-96.

Wood PB, Williams JM. 2013. Impact of valley fills on streamside salamanders in southern west virginia. Journal of Herpetology 47:119-125.

Zipper CE, Donovan PF, Jones JW, Li J, Price JE, Stewart RE. 2016. Spatial and temporal relationships among watershed mining, water quality, and freshwater mussel status in an eastern USA river. The Science of the total environment 541:603-615.

## Impact on the aquatic ecosystem (n=25)

Arnold MC, Lindberg TT, Liu YT, Porter KA, Hsu-Kim H, Hinton DE, et al. 2014. Bioaccumulation and speciation of selenium in fish and insects collected from a mountaintop removal coal mining-impacted stream in west virginia. Ecotoxicology (London, England) 23:929-938.

Arnold MC, Friedrich LA, Lindberg TT, Ross M, Halden NM, Bernhardt E, et al. 2015. Microchemical analysis of selenium in otoliths of two west virginia fishes captured near mountaintop removal coal mining operations. Environmental toxicology and chemistry / SETAC 34:1039-1044.

Becker DA, Wood PB, Strager MP, Mazzarella C. 2014. Impacts of mountaintop mining on terrestrial ecosystem integrity: Identifying landscape thresholds for avian species in the central appalachians, united states. Landscape Ecology 30:339-356.

Bernhardt ES, Lutz BD, King RS, Fay JP, Carter CE, Helton AM, et al. 2012. How many mountains can we mine? Assessing the regional degradation of central appalachian rivers by surface coal mining. Environmental science & technology 46:8115-8122.

Bier RL, Voss KA, Bernhardt ES. 2015. Bacterial community responses to a gradient of alkaline mountaintop mine drainage in central appalachian streams. The ISME journal 9:1378-1390.

Borchers JW, Ehlke TA, Mathes MV, Downs SC. 1991. Effects of coal mining on the hydrologic environment of selected stream basins in southern west virginia. Govt Reports Announcements & Index:130.

Brenner FJ, Helm J. 1991. Macroinvertebrate recolonization and water quality characteristics of a reconstructed stream after surface coal mining in northwestern pennsylvania, USA. International journal of surface mining & reclamation 5:11-15.

Cravotta CA, Brady KBC. 2015. Priority pollutants and associated constituents in untreated and treated discharges from coal mining or processing facilities in pennsylvania, USA. Applied Geochemistry.

Daniel WM, Kaller MD, Jack J. 2015. Nitrogen stable isotopes as an alternative for assessing mountaintop removal mining's impact on headwater streams. Fundamental and Applied Limnology 186:193-202.

Evans DM, Zipper CE, Donovan PF, Daniels WL. 2014. Long-term trends of specific conductance in waters discharged by coal-mine valley fills in central appalachia, USA. Journal of the American Water Resources Association 50:1449-1460.

Gangloff MM, Perkins M, Blum PW, Walker C. 2015. Effects of coal mining, forestry, and road construction on southern appalachian stream invertebrates and habitats. Environmental management 55:702-714.

Hitt NP, Chambers DB. 2014. Temporal changes in taxonomic and functional diversity of fish assemblages downstream from mountaintop mining. Freshwater Science 33:915-926.

Hopkins RL, Roush JC. 2013. Effects of mountaintop mining on fish distributions in central appalachia. Ecology of Freshwater Fish 22:578-586.

Johnson BR, Fritz KM, Price R. 2013. Estimating benthic secondary production from aquatic insect emergence in streams affected by mountaintop removal coal mining, west virginia, USA. Fundamental and Applied Limnology 182:191-204.

McGarvey DJ, Johnston JM. 2013. 'Fishing' for alternatives to mountaintop mining in southern west virginia. Ambio 42:298-308.

Merriam ER, Petty JT, Merovich GT, Fulton JB, Strager MP. 2011. Additive effects of mining and residential development on stream conditions in a central appalachian watershed. Journal of the North American Benthological Society 30:399-418.

Merriam ER, Petty JT, Strager MP, Maxwell AE, Ziemkiewicz PF. 2015. Landscape-based cumulative effects models for predicting stream response to mountaintop mining in multistressor appalachian watersheds. Freshwater Science 34:1006-1019.

Merriam ER, Petty JT. 2016. Under siege: Isolated tributaries are threatened by regionally impaired metacommunities. The Science of the total environment 560-561:170-178.

Messinger T. 2004. Polycyclic aromatic hydrocarbons in bottom sediment and bioavailability in streams in the new river gorge national river and gauley river national recreation area, west virginia, 2002. Govt Reports Announcements & Index:36.

Muncy BL, Price SJ, Bonner SJ, Barton CD. 2014. Mountaintop removal mining reduces stream salamander occupancy and richness in southeastern kentucky (USA). Biological Conservation 180:115-121.

Paybins KS, Messinger T, Eychaner JH, Chambers DB, Kozar MD. 1998. Water quality in the kanawha-new river basin west virginia, virginia, and north carolina, 1996-98. Govt Reports Announcements & Index:398.

Pond GJ, Passmore ME, Borsuk FA, Reynolds L, Rose CJ. 2008. Downstream effects of mountaintop coal mining: Comparing biological conditions using family- and genus-level macroinvertebrate bioassessment tools. Journal of the North American Benthological Society 27:717-737.

Welsh SA, Loughman ZJ. 2014. Physical habitat and water quality correlates of crayfish distributions in a mined watershed. Hydrobiologia 745:85-96.

Wood PB, Williams JM. 2013. Impact of valley fills on streamside salamanders in southern west virginia. Journal of Herpetology 47:119-125.

Zipper CE, Donovan PF, Jones JW, Li J, Price JE, Stewart RE. 2016. Spatial and temporal relationships among watershed mining, water quality, and freshwater mussel status in an eastern USA river. The Science of the total environment 541:603-615.