Supplementary Table 1 Characteristics of Male Participants Enrolled between 2001 to 2014

Characteristics	All Participants	Participants with Semen Assessment	*P* for comparison
Number	158,542	6,938	
Age [year: mean (SD)][a]	36.0(7.4)	32.0(4.3)	<0.05
Educational level (%)			<0.05
High school or lower	19.5%	12.1%	
College or university	56.9%	59.8%	
Postgraduate	19.4%	25.5%	
Missing	4.2%	2.5%	
Cigarette smoking (%)			<0.05
Never	55.6%	62.5%	
Former	8.3%	8.5%	
Current	31.7%	26.3%	
Missing	4.4%	2.7%	
Body mass index [kg/m^2: mean (SD)]	24.2(3.5)	23.9(3.3)	<0.05
Missing	0.15%	0.01%	

[a] Age was available for all participants.

Supplementary Table 2 Associations between Exposure to $PM_{2.5}$ and Semen Quality in Participants with Normal Semen Parameters

Semen Parameters (N=4951)	Crude Model [a]		Model 1 [a]		Model 2 [a]		Model 3 [a]	
	Coef/OR (95%CI) [b]	*P*	Coef/OR (95%CI) [b]	*P*	Coef/OR (95%CI) [b]	*P*	Coef/OR (95%CI) [b]	*P*
Short-term Exposure (3-month average $PM_{2.5}$)								
Continuous								
Concentration (10^6/ml) [c]	1.03 (1.02,1.04)	<0.001	1.03 (1.02,1.04)	<0.001	1.03 (1.02,1.04)	<0.001	1.02 (1.01,1.04)	<0.001
Total motility (%)	0.16 (-0.01,0.34)	0.07	0.12 (-0.06,0.29)	0.19	0.11 (-0.06,0.29)	0.20	0.20 (0.01,0.38)	0.03
Progressive motility (%)	-0.13 (-0.33,0.08)	0.23	-0.14 (-0.35,0.07)	0.18	-0.12 (-0.33,0.08)	0.24	-0.01 (-0.22,0.20)	0.93
Normal morphology (%)	-0.64 (-0.86,-0.43)	<0.001	-0.71 (-0.92,-0.49)	<0.001	-0.72 (-0.94,-0.50)	<0.001	-0.83 (-1.06,-0.61)	<0.001
Dichotomous (< 10^{th} percentile as decreased)								
Decreased concentration	0.91 (0.86,0.97)	0.003	0.92 (0.87,0.98)	0.009	0.92 (0.87,0.98)	0.009	0.93 (0.87,0.98)	0.02
Decreased total motility	0.87 (0.81,0.93)	<0.001	0.88 (0.81,0.94)	<0.001	0.88 (0.81,0.94)	<0.001	0.87 (0.80,0.94)	<0.001
Decreased progressive motility	0.98 (0.92,1.03)	0.43	0.98 (0.93,1.04)	0.53	0.98 (0.92,1.04)	0.48	0.97 (0.91,1.03)	0.33
Decreased normal morphology	1.24 (1.18,1.30)	<0.001	1.25 (1.19,1.31)	<0.001	1.25 (1.19,1.31)	<0.001	1.29 (1.22,1.35)	<0.001
Long-term Exposure (2-year average $PM_{2.5}$)								
Continuous								
Concentration (10^6/ml) [c]	1.02 (1.01,1.03)	<0.001	1.02 (1.01,1.03)	<0.001	1.02 (1.01,1.03)	<0.001	1.02 (1.01,1.03)	<0.001
Total motility (%)	0.28 (0.08,0.49)	0.006	0.21 (0.01,0.42)	0.04	0.21 (0.01,0.42)	0.04	0.24 (0.04,0.44)	0.02
Progressive motility (%)	0.01 (-0.23,0.24)	0.96	-0.02 (-0.26,0.22)	0.88	0.00 (-0.24,0.23)	0.97	0.05 (-0.18,0.29)	0.67
Normal morphology (%)	-1.15 (-1.40,-0.90)	<0.001	-1.25 (-1.50,-1.00)	<0.001	-1.27 (-1.52,-1.02)	<0.001	-1.27 (-1.52,-1.02)	<0.001
Dichotomous (< 10^{th} percentile as decreased)								
Decreased concentration	0.95 (0.88,1.01)	0.10	0.96 (0.90,1.02)	0.22	0.96 (0.90,1.02)	0.21	0.96 (0.89,1.02)	0.18
Decreased total motility	0.81 (0.74,0.88)	<0.001	0.83 (0.76,0.90)	<0.001	0.83 (0.76,0.90)	<0.001	0.83 (0.76,0.90)	<0.001
Decreased progressive motility	0.96 (0.90,1.03)	0.25	0.97 (0.90,1.03)	0.32	0.96 (0.90,1.03)	0.27	0.96 (0.90,1.03)	0.23
Decreased normal morphology	1.40 (1.33,1.48)	<0.001	1.42 (1.34,1.50)	<0.001	1.42 (1.35,1.51)	<0.001	1.43 (1.35,1.51)	<0.001

Effect estimates were calculated for an increment of 5 $\mu g/m^3$ in $PM_{2.5}$ concentrations.

[a] Crude model had no adjustment; Model 1 was adjusted for age, educational level, smoking status, alcohol drinking, exercise, and occupational exposure to asbestos & organic solvent; Model 2 was further adjusted for Body Mass index, systolic blood pressure, fasting blood glucose and total cholesterol levels; Model 3 was further adjusted for season and year of medical examination.

[b] Beta coefficients (Coef) were presented for continuous variables and odd ratios (OR) were presented for dichotomous variables

[c] Concentration was log-transformed to achieve approximate normality for the data analysis and then the geometric coefficients were transformed back for presentation.

Abbreviations: particulate matter with an aerodynamic diameter less than 2.5 μm ($PM_{2.5}$).

Supplementary Table 3 Associations between Exposure to $PM_{2.5}$ and Semen Quality in Participants with Abnormal Semen Parameters

Semen Parameters (N=1524)	Crude Model [a]		Model 1 [a]		Model 2 [a]		Model 3 [a]	
	Coef/OR (95%CI) [b]	*P*	Coef/OR (95%CI) [b]	*P*	Coef/OR (95%CI) [b]	*P*	Coef/OR (95%CI) [b]	*P*
Short-term Exposure (3-month average $PM_{2.5}$)								
Continuous								
Concentration (10^6/ml) [c]	1.05 (1.02,1.09)	0.004	1.05 (1.02,1.09)	0.003	1.06 (1.02,1.09)	0.002	1.05 (1.01,1.08)	0.009
Total motility (%)	0.10 (-0.35,0.56)	0.66	0.03 (-0.42,0.48)	0.90	0.02 (-0.43,0.48)	0.92	0.08 (-0.39,0.55)	0.75
Progressive motility (%)	-0.37 (-0.74,0.00)	0.05	-0.39 (-0.76,-0.01)	0.04	-0.39 (-0.76,-0.02)	0.04	-0.36 (-0.74,0.03)	0.07
Normal morphology (%)	-1.1 8(-1.67,-0.69)	<0.001	-1.21 (-1.70,-0.72)	<0.001	-1.20 (-1.70,-0.71)	<0.001	-1.19 (-1.7,-0.68)	<0.001
Dichotomous (< 10^{th} percentile as decreased)								
Decreased concentration	0.87 (0.78,0.97)	0.02	0.88 (0.78,0.98)	0.03	0.87 (0.78,0.98)	0.02	0.87 (0.77,0.98)	0.03
Decreased total motility	1.01 (0.91,1.13)	0.79	1.02 (0.91,1.14)	0.67	1.02 (0.91,1.14)	0.66	1.02 (0.91,1.14)	0.68
Decreased progressive motility	0.95 (0.84,1.05)	0.33	0.95 (0.84,1.06)	0.34	0.95 (0.84,1.06)	0.34	0.93 (0.82,1.05)	0.28
Decreased normal morphology	1.30 (1.20,1.41)	<0.001	1.31 (1.21,1.42)	<0.001	1.31 (1.21,1.42)	<0.001	1.32 (1.21,1.43)	<0.001
Long-term Exposure (2-year average $PM_{2.5}$)								
Continuous								
Concentration (10^6/ml) [c]	1.04 (1.00,1.09)	0.04	1.05 (1.00,1.09)	0.03	1.05 (1.01,1.09)	0.02	1.05 (1.01,1.09)	0.02
Total motility (%)	0.4(-0.15,0.95)	0.15	0.36 (-0.19,0.9)	0.20	0.36 (-0.18,0.91)	0.19	0.39 (-0.16,0.94)	0.17
Progressive motility (%)	-0.21(-0.66,0.23)	0.35	-0.20 (-0.65,0.25)	0.38	-0.20 (-0.65,0.25)	0.39	-0.18 (-0.63,0.28)	0.45
Normal morphology (%)	-1.56(-2.14,-0.97)	<0.001	-1.58 (-2.18,-0.98)	<0.001	-1.56 (-2.16,-0.97)	<0.001	-1.52 (-2.11,-0.92)	<0.001
Dichotomous (< 10^{th} percentile as decreased)								
Decreased concentration	0.81 (0.70,0.93)	0.004	0.82 (0.71,0.94)	0.005	0.81 (0.70,0.93)	0.004	0.81 (0.70,0.93)	0.004
Decreased total motility	0.97 (0.84,1.11)	0.66	0.97 (0.84,1.11)	0.72	0.98 (0.84,1.12)	0.73	0.97 (0.84,1.12)	0.72
Decreased progressive motility	0.89 (0.77,1.02)	0.12	0.89 (0.76,1.02)	0.10	0.89 (0.76,1.02)	0.10	0.89 (0.76,1.02)	0.10
Decreased normal morphology	1.46 (1.32,1.62)	<0.001	1.48 (1.33,1.64)	<0.001	1.49 (1.34,1.65)	<0.001	1.50 (1.35,1.67)	<0.001

Effect estimates were calculated for an increment of 5 $\mu g/m^3$ in $PM_{2.5}$ concentrations.

[a] Crude model had no adjustment; Model 1 was adjusted for age, educational level, smoking status, alcohol drinking, exercise, and occupational exposure to asbestos & organic solvent; Model 2 was further adjusted for Body Mass index, systolic blood pressure, fasting blood glucose and total cholesterol levels; Model 3 was further adjusted for season and year of medical examination.

[b] Beta coefficients (Coef) were presented for continuous variables and odd ratios (OR) were presented for dichotomous variables

[c] Concentration was log-transformed to achieve approximate normality for the data analysis and then the geometric coefficients were transformed back for presentation.

Abbreviations: particulate matter with an aerodynamic diameter less than 2.5 μm ($PM_{2.5}$).