

**Supplemental Table 1.** Sample repeated measures data for particle exposures (P)

Participant ID	PFT date	P <sub>0.25</sub> date	P <sub>0.25</sub>	P <sub>1</sub> date	P <sub>1</sub>	P <sub>5</sub> date	P <sub>5</sub>	P <sub>cumulative</sub> date	P <sub>cumulative</sub>
1	1/4/2011	10/5/2010	30	1/4/2010	167	1/1/2010	167	1/1/2010	167
1	5/6/2012	2/5/2012	226	5/7/2011	439	1/1/2010	679	1/1/2010	679
1	6/6/2013	3/7/2013	199	6/6/2012	419	1/1/2010	1406	1/1/2010	1406
1	8/19/2014	5/20/2014	453	8/19/2013	1029	1/1/2010	2234	1/1/2010	2234
1	2/8/2015	11/9/2014	303	2/8/2014	2138	2/9/2010	4346	1/1/2010	4346
1	3/26/2016	12/26/2015	139	3/27/2015	991	3/28/2011	5038	1/1/2010	5205
1	5/11/2017	2/9/2017	36	5/11/2016	263	5/12/2012	4906	1/1/2010	5455
1	12/9/2018	9/9/2018	81	12/9/2017	375	12/10/2013	4642	1/1/2010	5847
1	5/5/2019	2/3/2019	63	5/5/2018	395	5/6/2014	4023	1/1/2010	6229
2	5/29/2010	2/27/2010	1382	5/29/2009	1566	1/1/2010	1566	1/1/2010	1566
2	1/8/2011	10/9/2010	48	1/8/2010	1338	1/1/2010	3525	1/1/2010	3525
2	12/30/2012	9/30/2012	13	12/31/2011	118	1/1/2010	3560	1/1/2010	3560
2	7/19/2013	4/19/2013	46	7/19/2012	125	1/1/2010	3684	1/1/2010	3684
2	3/3/2014	12/2/2013	75	3/3/2013	429	1/1/2010	4114	1/1/2010	4114
2	9/1/2014	6/2/2014	178	9/1/2013	602	1/1/2010	4292	1/1/2010	4292
2	4/4/2015	1/3/2015	332	4/4/2014	707	4/5/2010	2428	1/1/2010	4998

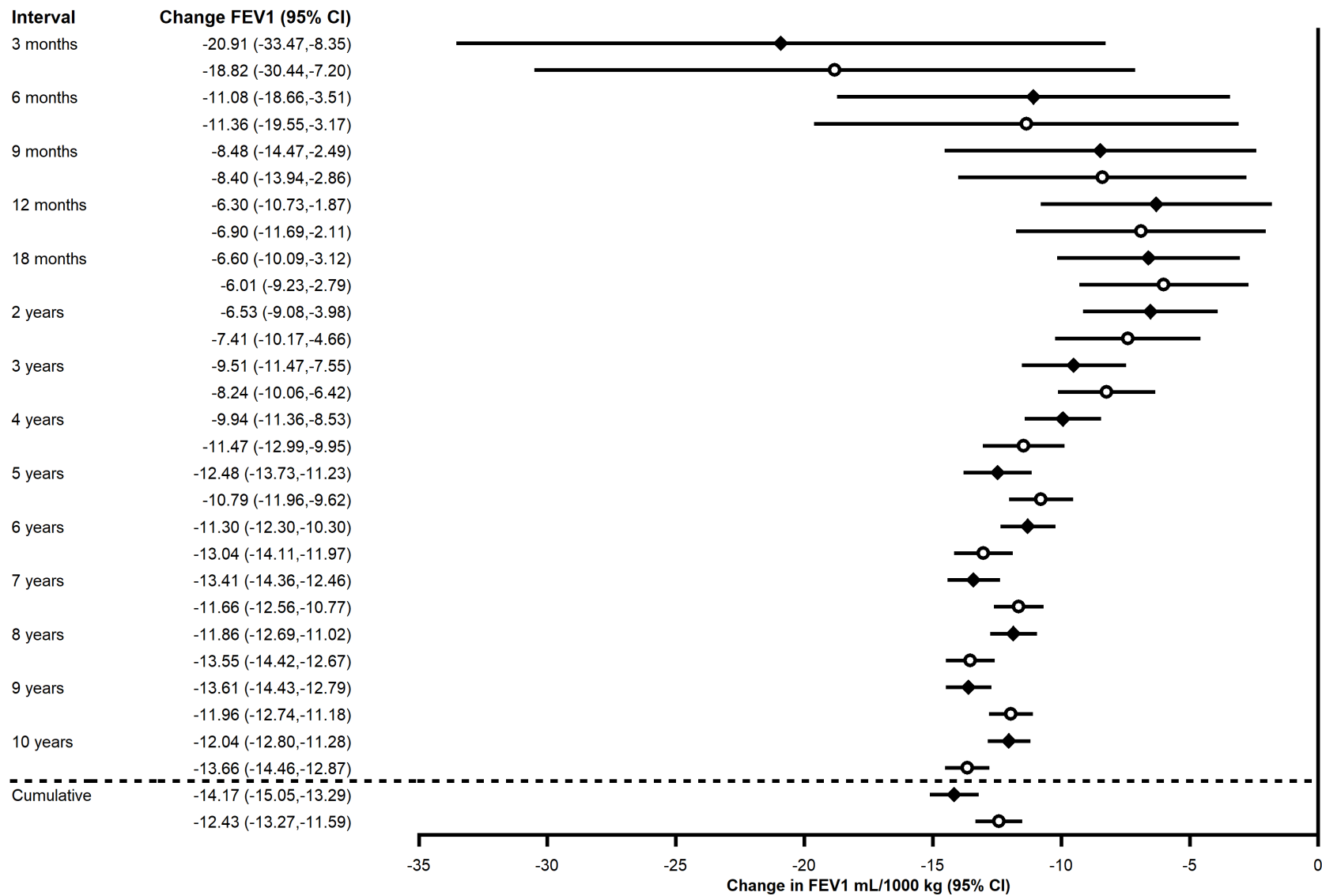
Abbreviations: PFT=Pulmonary Function Test; P=particle exposure; P<sub>0.25</sub>=Particle exposure in previous 0.25 years (3 months); P<sub>1</sub>=Particle exposure in previous 1 year; P<sub>5</sub>=Particle exposure in previous 5 years; P<sub>cumulative</sub>=Cumulative particle exposure during entire study period

Legend: Table above displays sample data for 2 participants with repeated spirometry measurements. Sample participant 1 has 9 pulmonary function tests (PFTs) and retired on 12/16/2020. Sample participant 2 has 7 PFTs and retired on 5/6/2015. P<sub>0.25</sub>, P<sub>1</sub>, P<sub>5</sub>, and P<sub>cumulative</sub> dates correspond with the beginning of the period for which exposure was estimated until the observed exam date for the previous 0.25 (3 months), 1 and 5, and 12 years (cumulative) before the PFT, respectively.

**Supplemental Table 2.** Descriptive characteristics among excluded participants that retired between 2001 through 2009.

<b>Retirement period</b>	<b>2001-2009</b>
n	4,132
Age on 9/11 mean, SD	44.4 (6.8)
Race/ethnicity n, %	
White	3875 (93.8)
African American/Black	136 (3.3)
Hispanic	121 (2.9)
Arrival at WTC disaster site n, %	
9/11 AM	728 (17.6)
9/11 PM	2146 (51.9)
9/12	690 (16.7)
9/13 or later	568 (13.8)
Follow-up mean, SD	
Overall years of service	20.8 (6.9)
Active years pre-9/11/2001	17.2 (7.5)
Active years 9/11/2001-12/31/2009	3.7 (2.4)
Active years post-2010	0.0 (0.0)
Years retired - end of follow-up	16.3 (2.4)
Pulmonary Function Tests mean, SD	
Total	11.4 (4.3)
9/11/2001-12/31/2009	3.8 (1.4)
1/1/2010-retire	0.0 (0.0)
Years retire - end of follow-up	9.3 (4.2)
Months at WTC disaster site mean, SD	3.1 (2.7)
Height (cm) mean, SD	177.0 (6.5)
Weight (kg) mean, SD	
First post-9/11 exam	91.6 (13.1)
Smoking n, %	
Ever	1662 (40.2)
Current (as of most recent exam)	181 (4.4)
Former (as of most recent exam)	1481 (35.8)

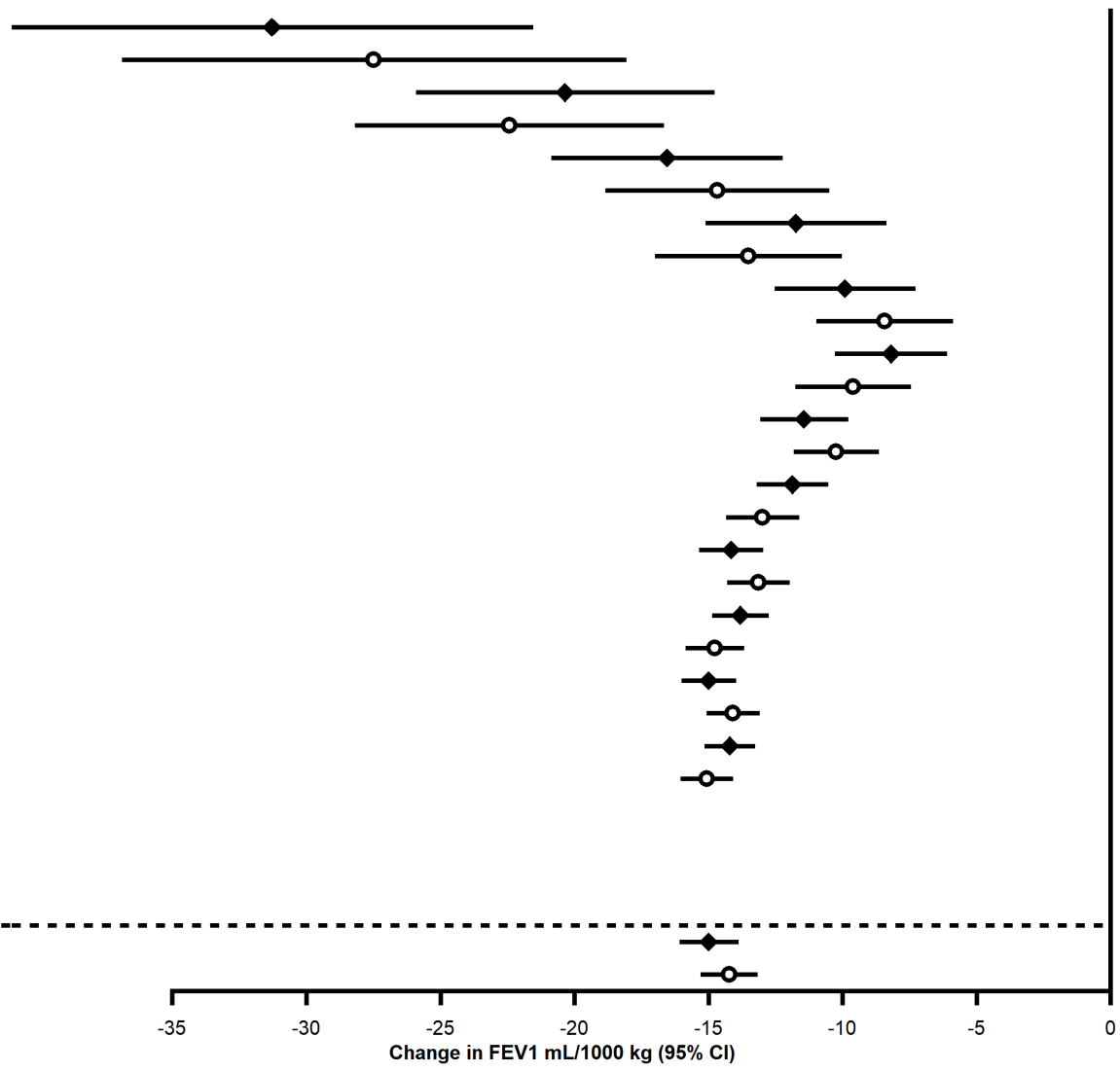
(a)



(b)

**Interval**      **Change FEV1 (95% CI)**

3 months	-31.28 (-40.92,-21.63)
6 months	-27.49 (-36.81,-18.16)
9 months	-22.43 (-28.12,-16.75)
12 months	-16.55 (-20.78,-12.32)
18 months	-14.67 (-18.77,-10.58)
2 years	-11.75 (-15.04,-8.45)
3 years	-13.51 (-16.91,-10.12)
4 years	-9.91 (-12.46,-7.37)
5 years	-8.43 (-10.90,-5.96)
6 years	-9.61 (-11.69,-7.54)
7 years	-11.44 (-13.00,-9.88)
8 years	-10.24 (-11.75,-8.73)
9 years	-11.88 (-13.13,-10.63)
10 years	-12.99 (-14.27,-11.70)
Cumulative	-14.16 (-15.27,-13.05)
	-13.14 (-14.22,-12.07)
	-13.82 (-14.79,-12.85)
	-14.77 (-15.77,-13.77)
	-14.99 (-15.92,-14.06)
	-14.09 (-14.99,-13.18)
	-14.21 (-15.07,-13.35)
	-15.07 (-15.97,-14.18)



**Supplemental Figure 1.** Differences in absolute FEV<sub>1</sub> for exposures within 3-months to 10-years prior to pulmonary function tests Unadjusted (◆) and adjusted (○) for age, race/ethnicity, height, smoking, and weight; Change is presented in mL FEV<sub>1</sub> per 1000 kg of particle exposure (P) stratified by retirement period.

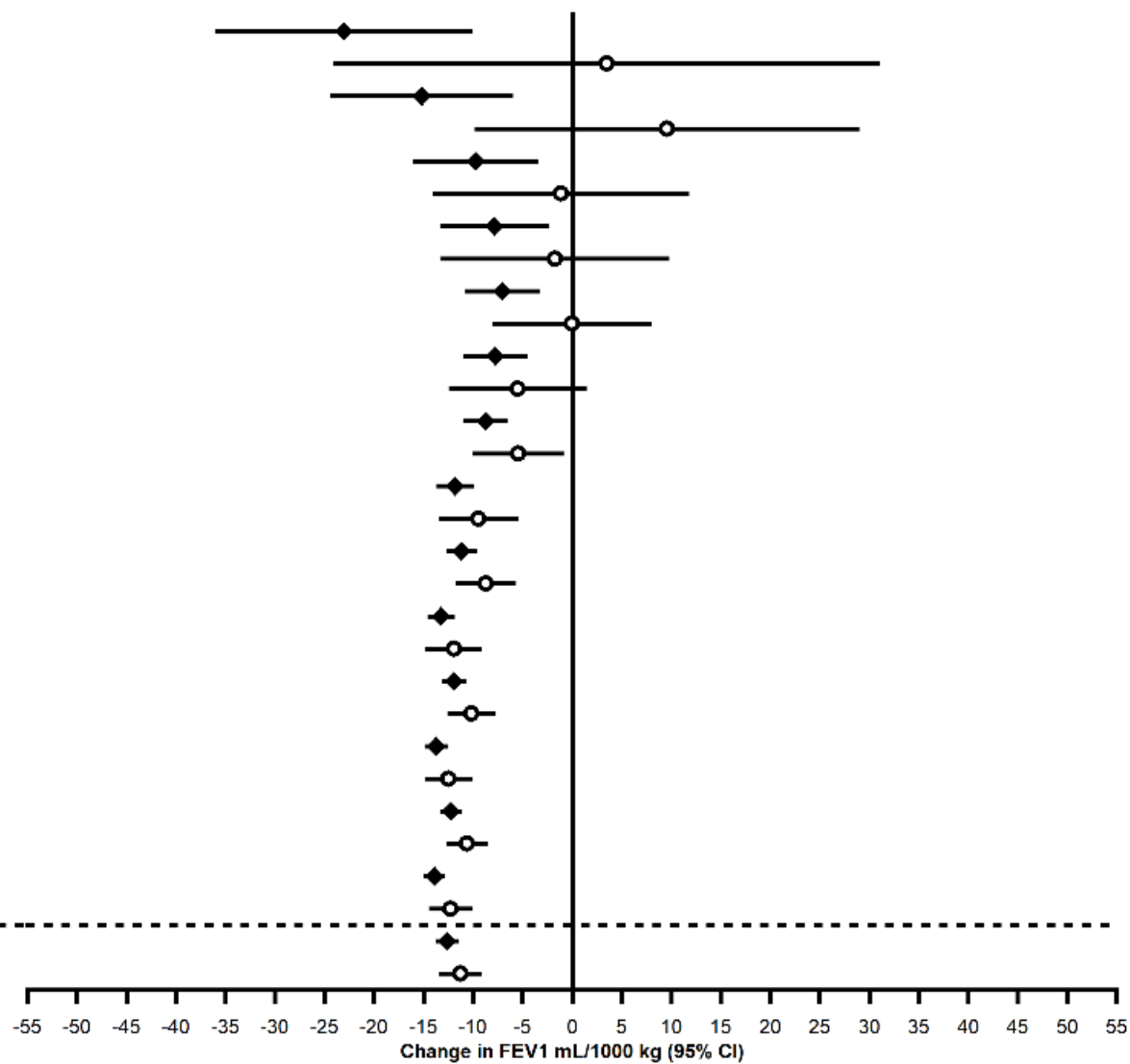
(a) Group a retired between 2019 and 2021 or (b) Group b retired between 2010-2018.

Abbreviation: FEV<sub>1</sub>=One-second Forced Expiratory Volume

(a)

**Interval**                      **Change FEV1 (95% CI)**

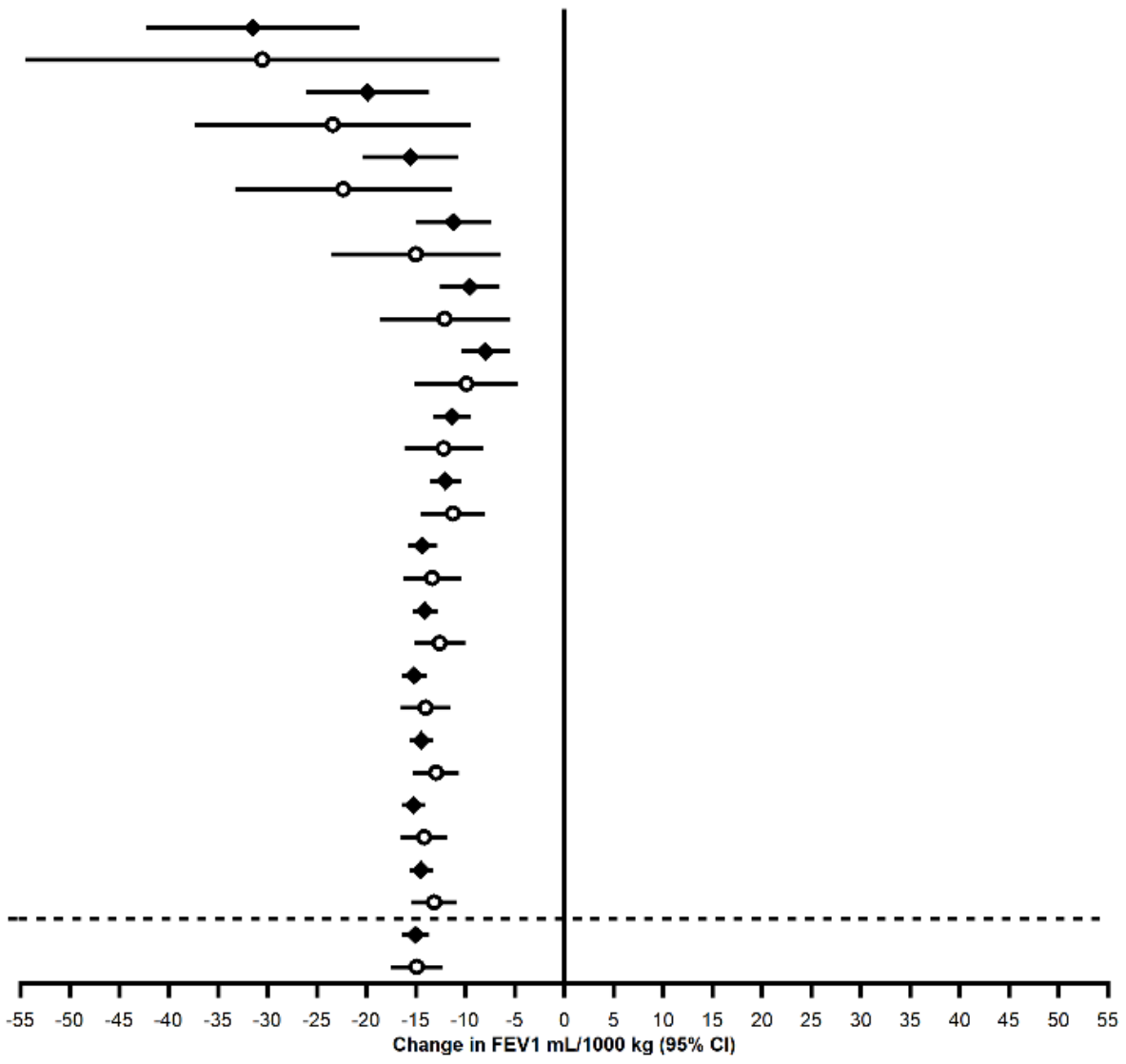
3 months	-23.05 (-35.83,-10.26)
	3.47 (-23.90,30.83)
6 months	-15.19 (-24.20,-6.18)
	9.58 (-9.60,28.75)
9 months	-9.73 (-15.85,-3.62)
	-1.11 (-13.82,11.60)
12 months	-7.88 (-13.15,-2.61)
	-1.72 (-13.01,9.57)
18 months	-7.08 (-10.60,-3.55)
	-0.04 (-7.85,7.76)
2 years	-7.75 (-10.77,-4.74)
	-5.52 (-12.25,1.21)
3 years	-8.73 (-10.72,-6.74)
	-5.46 (-9.86,-1.06)
4 years	-11.83 (-13.50,-10.17)
	-9.47 (-13.24,-5.69)
5 years	-11.16 (-12.44,-9.88)
	-8.71 (-11.53,-5.88)
6 years	-13.23 (-14.40,-12.06)
	-11.95 (-14.59,-9.30)
7 years	-11.93 (-12.91,-10.95)
	-10.17 (-12.37,-7.98)
8 years	-13.73 (-14.69,-12.78)
	-12.49 (-14.65,-10.33)
9 years	-12.21 (-13.07,-11.35)
	-10.61 (-12.5,-8.72)
10 years	-13.91 (-14.78,-13.05)
	-12.27 (-14.23,-10.31)
Cumulative	-12.63 (-13.55,-11.70)
	-11.30 (-13.3,-9.31)



(b)

**Interval**                      **Change FEV1 (95% CI)**

3 months	-31.47 (-42.03,-20.91)
6 months	-19.88 (-25.87,-13.89)
9 months	-15.54 (-20.14,-10.94)
12 months	-11.20 (-14.78,-7.62)
18 months	-9.54 (-12.31,-6.77)
2 years	-7.94 (-10.13,-5.74)
3 years	-11.31 (-13.02,-9.61)
4 years	-12.02 (-13.38,-10.65)
5 years	-12.17 (-15.94,-8.40)
6 years	-12.57 (-14.94,-10.21)
7 years	-15.17 (-16.19,-14.16)
8 years	-14.45 (-15.4,-13.51)
9 years	-12.95 (-15.05,-10.85)
10 years	-14.48 (-15.4,-13.56)
Cumulative	-15.02 (-16.13,-13.9)



**Supplemental Figure 2.** Differences in absolute FEV<sub>1</sub> for exposures within 3-month to 10-years prior to pulmonary function tests by time of arrival at WTC disaster site stratified by retirement period.

Arrived at the World Trade Center site between 9/11/2001-9/12/2001 (◆) Arrived at WTC site after 9/12 (○) All models control for age, race/ethnicity, height, smoking, and weight.

Change is presented in mL FEV<sub>1</sub> per 1000 kg of particle exposure (P); (a) Group a: WTC-exposed firefighters who retired between 2019 and 2021 (b) Group b: WTC-exposed firefighters who retired between 2010-2018

Abbreviation: FEV<sub>1</sub>=One-second Forced Expiratory Volume