**Background** Oxidant and inflammatory mechanisms have been proposed to explain associations between exposure to PM2.5 air pollution and cardiovascular, cardiopulmonary and other pathologies in those exposed.

**Objective** To assess the effects of a daily antioxidant and anti-inflammatory dietary supplement on declines in pulmonary function and increases in airway and systemic inflammation when exposed to variations in ambient PM2.5

**Methods** We conducted a randomized placebo-controlled parallel-arm study in male and female participants in the age range of 45-80 years. The interventions consisted of daily consumption for 18 weeks of a vitamin, mineral, antioxidant and anti-inflammatory dietary supplement pack (n=27) or a matched placebo control (n=30). The primary endpoints were forced vital capacity (FVC), exhaled nitric oxide (FeNO) and plasma C-reactive protein (CRP) assessed on 6 occasions during the final 6 weeks of the study. Secondary endpoints included forced expiratory volume at 1 (FEV1) and 6 (FEV6) seconds. Serum chemistries and adverse events were monitored for safety.

**Results** Variations in ambient PM2.5 levels between 1.1 and 14.6 µg/m3 were associated with significant acute declines in pulmonary function measured by FVC, FEV6 and FEV1, and significant increases in airway and systemic inflammation quantified by FeNO and plasma CRP, though the latter association was weaker and not consistently observed between different statistical models. Effects on lung function were most strongly associated with PM2.5 levels on the day prior to testing while FeNO levels were most strongly associated with PM2.5 levels three days prior to testing The vitamin, mineral, antioxidant and anti-inflammatory dietary supplement pack did not provide protection against the adverse effects of PM2.5 air pollution. Rather, there was evidence of a greater adverse effect of PM2.5 air pollution on some indices of lung function in the active treatment group.

**Conclusion** Within the concentration range consistent with a “good” to low “moderate” Air Quality Index, elevations in PM2.5 air pollution were associated with adverse effects on lung function and inflammation indicating that the current U.S. Environmental Protection Agency National Air Quality Standard for PM2.5 may be insufficiently protective. Further, the data do not support a role for dietary anti-inflammatory and antioxidant supplements for mitigating the adverse effects of PM2.5 air pollution.