

Characteristics of elemental carbon (EC) exposure of household waste collectors

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BACKGROUNDS

- Major health hazards for household waste collectors → bio-aerosols and vehicle exhaust engine emissions
- The carcinogenicity of diesel engine exhaust emissions(DE)
- No study on exposures to DE generated during household waste collection.

DIESEL ENGINE EXHAUST EMISSIONS (DE)



- The fine carbonaceous particles in DE formed by incomplete combustion.
- Carbonaceous particles divided into elemental (EC) and organic carbon(OC)
- $OC + EC = \text{total carbon}(TC)$.
- EC as surrogate for DE exposure

OBJECTIVES

- To assess exposure to EC of household waste collectors
- To examine the relationship between EC and TC
- To identify factors influencing TC
- To examine whether EC can be used as surrogate for DE

HOUSEHOLD WASTE COLLECTION IN KOREA



- Recyclable and biodegradable wastes from households collected separately at designated points on specific dates
- Short distance between the collection points within an apartment complex
- Diesel vehicle commonly used to collect household wastes

STUDY SUBJECTS

- A total of 72 household waste collectors
- Sampling from June through September

SAMPLING & ANALYTICAL METHODS



- Airborne EC from the breathing zone collected on pre-fired quartz filters equipped with personal respirable sampler
- The thermal optical reflectance (TOR) method recommended by NIOSH

SAMPLING & ANALYTICAL METHODS



SELECTION OF VARIABLES

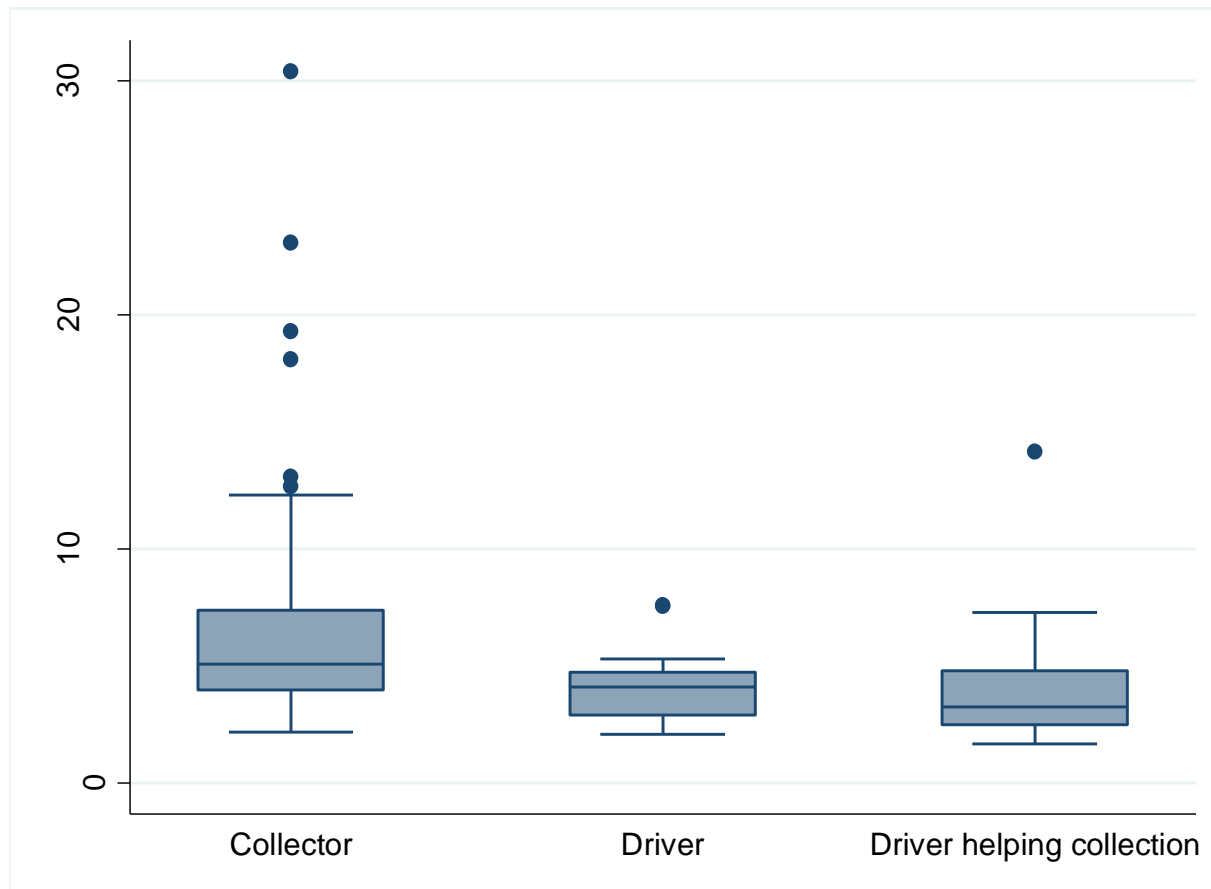


- Characteristics related to job, household waste collected and vehicle
 - Job title (driver vs. collector)
 - Type of household waste collected was categorized (food vs. solid)
 - Truck vehicle age (<10 years old vs. ≥ 10)
 - Truck vehicle load volume (<5 ton vs. $5 \geq$ ton)
 - Status of diesel particulate filter (originally installed vs retrofitted)

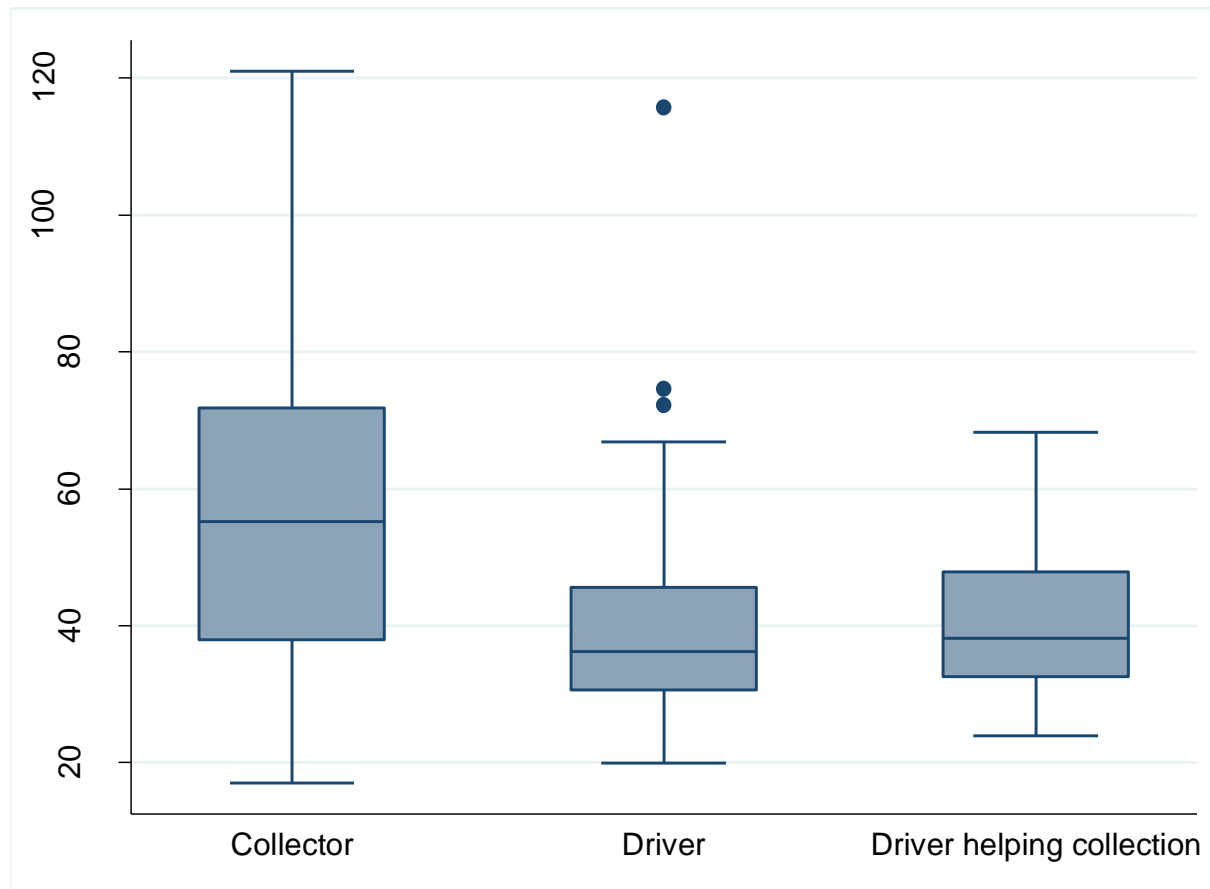
DATA ANALYSIS

- Analysis of variance
- Univariate analysis
- Multiple regression analysis

EXPOSURE TO RESPIRABLE ELEMENTAL CARBON(EC)



EXPOSURE TO RESPIRABLE TOTAL CARBON(TC)

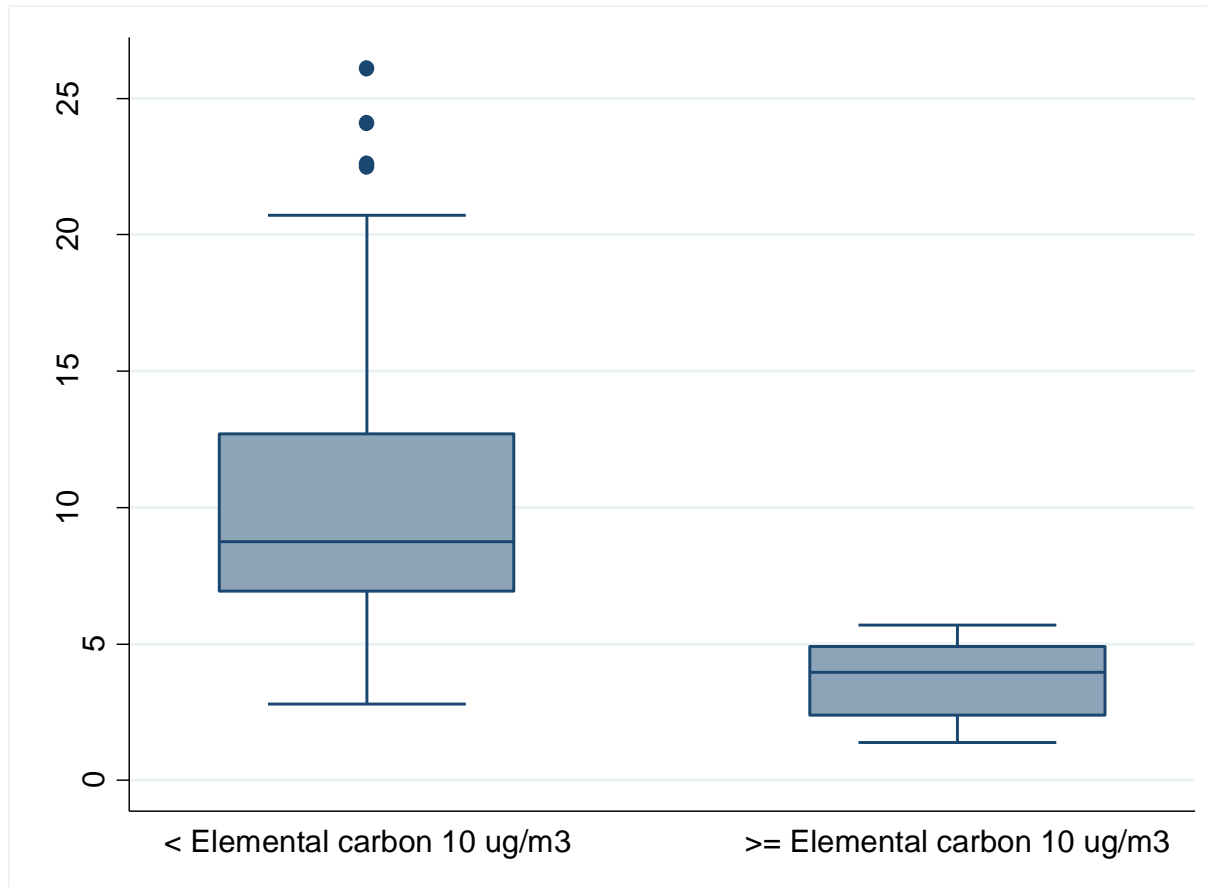


EXPOSURE TO RESPIRABLE ELEMENTAL CARBON(EC)



- EC exposure levels (mean=7.2 ug/m³, range=2.0-30.4 ug/m³) lower than
 - Moderate DE exp jobs → mechanics in a shop, emergency workers in fire stations, and workers loading or unloading inside a ferry
 - High DE exposure jobs → working in underground mine, railway repair, vehicle testing, fork-lift truck, bus repair, toll booth and tunnel

RATIO OF OC/EC BETWEEN < EC 10 ug/m³ & >=10 ug/m³



Around the engine tailpipe while collecting household waste

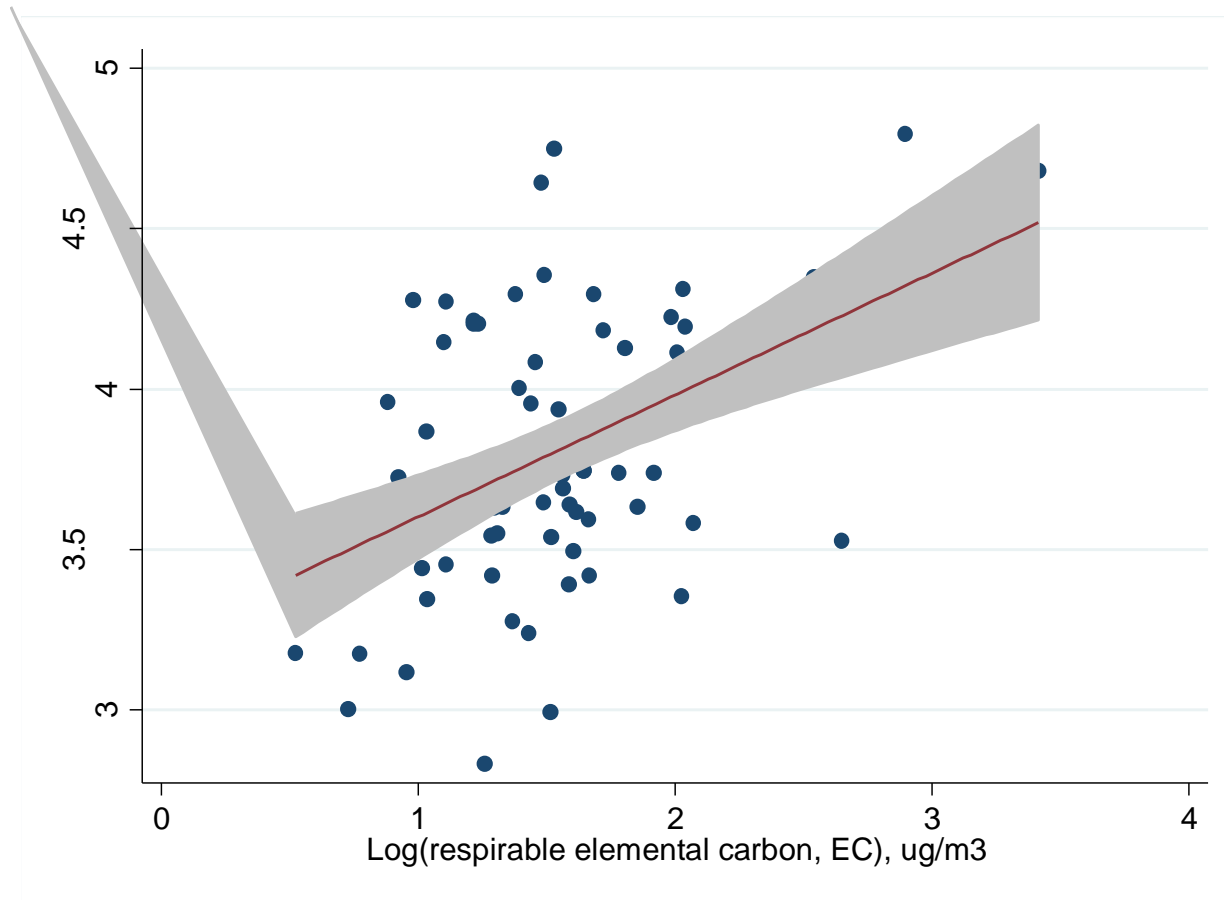


RELATIONSHIP BETWEEN EC & TC



- Significant relationship between EC and TC
- $\text{Log (TC)} = 0.38 \times \text{log EC} + 3.22$ (n=72, p<0.0001, adjusted R² = 0.23)

RELATIONSHIP BETWEEN EC & TC



FACTORS ASSOCIATED WITH TOTAL CARBON(TC)



- Elemental carbon(EC), average vehicle speed(km/hr), truck age (<10 year-old vs \geq 10 year-old), smoking significantly influencing the level of TC exposure (n=53, model $p < 0.0001$, adjusted $R^2 = 0.45$)

CONCLUSIONS

- EC exposure of household waste collectors can be categorized into the relatively low occupational exposure group
- EC exposure associated with vehicle characteristics such as vehicle age and vehicle drive speed
- EC as a surrogate for DE in household waste collecting environments.