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Chemical characterization and sources of personal exposure to fine particulate matter in the general population of Guangzhou, China

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Fine particulate matter pollution severely deteriorates the environmental conditions and negatively impacts human health in the Chinese megacity Guangzhou. Concurrent ambient and personal measurements of fine particulate matter (PM2.5) were conducted in Guangzhou, China. Personal-to-ambient (P-C) relationships of PM2.5 chemical components were determined and sources of personal PM2.5 exposure were evaluated using principal component analysis along with a mixed-effects model. Water-soluble inorganic ions (mainly secondary inorganic ions) and anhydrosugars exhibited median personal-to-ambient (P/C) ratios < 1 accompanied by strong P-C correlations, indicating that these constituents in personal PM2.5 were significantly affected by ambient sources. Conversely, elemental carbon (EC) and calcium (Ca2+) showed median P/C ratios greater than unity, which indicated that among subjects who spent a great amount of time indoors, aside from particles of ambient origin, individual's total exposure to PM2.5 includes contributions of non-ambient exposure while indoors and outdoors (e.g., local traffic, indoor sources, personal activities). SO42- displayed very low coefficient of divergence (COD) values coupled with strong P-C correlations, implying a uniform distribution of SO42- in the urban area of Guangzhou. EC, Ca2+, and levoglucosan were otherwise heterogeneously distributed across individuals in different districts. Regional air pollution (50.4 $\pm$ 0.9%), traffic-related particles (8.6 $\pm$ 0.7%), dust-related particles (5.8 $\pm$ 0.7%), and biomass burning emissions (2.0 $\pm$ 0.2%) were moderate to high positive sources of personal PM2.5 exposure in Guangzhou. The observed positive and significant contribution of Ca2+ to personal PM2.5 exposure, highlighting indoor sources and/or personal activities, were driving factors determining personal exposure to dust-related particles. Considerable discrepancies (COD values ranging from 0.42 to 0.50) were shown between ambient concentrations and personal exposure, indicating caution should be taken when using ambient concentrations as proxies for personal exposure in epidemiological studies.