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Title: Using individual activity spaces derived from survey data to assess relationships between built environment exposures and active transportation.

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Abstract (492 words)

Background

Studies utilising objective measures to assess relationships between built environment exposures and physical activity behaviour during transportation have tended to use administratively-defined or residence-centred exposure areas. As daily travel routes and destinations can exceed the boundaries of these areas they may not adequately reflect one's proximal environment (activity space) during daily transportation. This work aimed to create a methodology for representing individual activity spaces using large-scale transportation survey data, and apply it to assessment of the relationship between built environment exposures and active transportation.

Methods

Data on individual transportation behaviours were drawn from the 1998 Montreal Origin-Destination (MO-D) survey, a computer-assisted telephone interview of a representative sample (n=164,076) of the Census Montreal Metropolitan Area population. Respondents provided self-report data about the origin, destination and mode of all transportation activities (trips) undertaken by members of their household over the preceding 24-hour period. Reported home locations, trip origins and destinations were geocoded. This analysis was restricted to participants residing on Montreal Island (n=37,165).

Trip origins and destinations were mapped to the Montreal Island street network using ArcGIS 9.3. The shortest network-constrained path between origin and destination was calculated for each trip using ArcGIS Network Analyst according to reported transportation mode(s). 1.6 km network-constrained buffers were created around each trip origin and destination to cover an area within walking distance. 200-m straight-line buffers were created around calculated paths to cover an area proximal to the path. Built environment variables were extracted within each buffer using data from a geographic information system, including: Land use mix; greenness (NDVI); and density of intersections, destinations, bus lines, and highways. Metabolic equivalents (MET) were estimated to express physical activity accrued during walking and cycling. Respondents were categorised as physically active (≥ 7 MET.mins reported) or sedentary.

Four models were developed representing the activity space or components thereof for each individual: All components together (origins, destinations and paths); paths only; origins and destinations only; and origins at place of residence only. Built environment exposures were expressed for each model as averaged values for all components included in that model. In all models, respondent data for origins and destinations located less than a 1 km straight-line distance from a previously reported origin or destination were excluded.

Relationships between built environment predictors and physical activity as the outcome variable were tested using generalised linear regression models for the activity space and component models. All models included participant age, gender, employment status, driver's license status, ratio of driver's licenses to cars owned by household, family status of household, total distance travelled, access to subway, and SES measures representing area-level education, household income, and crime. Spatial clustering by census tracts was accounted for using generalised estimating equations estimators.

Results and conclusions

Preliminary results show that relationships between built environment variables and physical activity can vary substantially for different expressions of the activity space, and suggest that measurement using the activity space can capture relationships that are missed by models using individual components only.