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Healthy Urban Living

Children's active school commuting and environmental exposures: A GPS-based study in the Netherlands

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1. Background

Dutch schoolchildren are insufficiently physical activity, and overweight and obesity among them are on the rise (Hildebrandt et al. 2013). A way to integrate higher levels of physical activity in children's daily lives is through active transport to school, namely walking and cycling there (Sallis et al. 2015). While the correlates of active transport to school around the residential and school location are frequently studied (Mitra 2013), much less is known about how natural and built environments en route influence children's transport behavior.

2. Aim

This study examined how natural environments (e.g., green space, hourly weather conditions) and horizontal and vertical built environmental features (e.g., street layout, morphology) en route influence transport mode choice among school children in the Netherlands.

3. Study area, data and research design

97 children aged 6–11 years in six elementary schools located in mid- to large-sized Dutch cities (i.e., Amersfoort, Haarlem, Hengelo, Rotterdam, and Vlaardingen; Figure 1) were tracked with Global Positioning Systems (GPS) for a 7-day period.

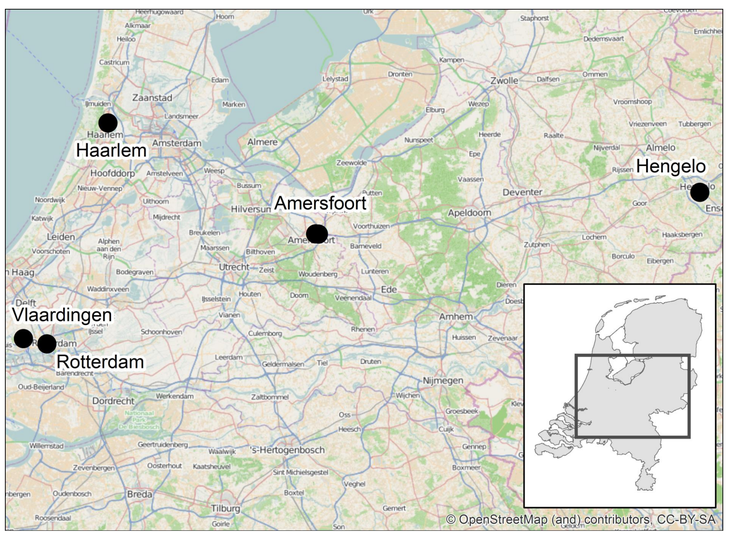

Figure 1: Study areas.

In accordance to our conceptual model (Figure 2), we assumed that the selected mode of transport for each trip is influenced by means of the following indicators:

- Personal characteristics (age, gender, BMI)
- Trip characteristics (distance, time, direction)
- Weather conditions (wind speed, precipitation, temperature, global radiation)
- Transport safety (fatal and non-fatal accidents, bike paths, major roads)
- Natural environment (green space, land-use diversity)
- Built environment (street density, intersection types, building-roughness , accessibility)

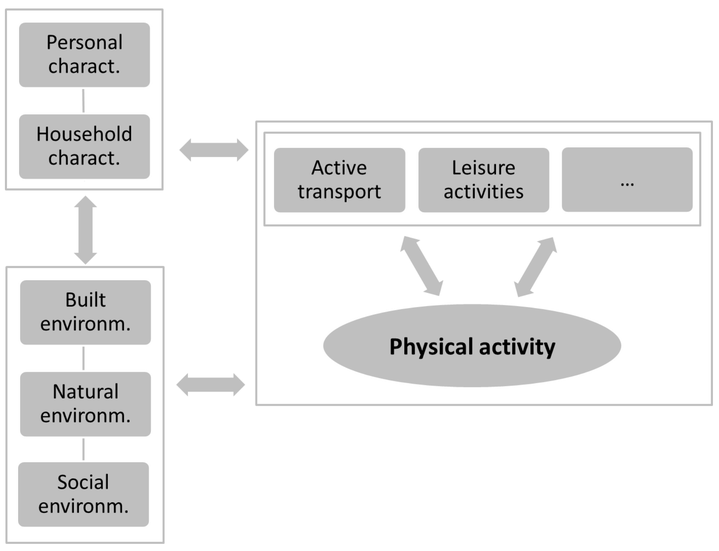

Figure 2: Conceptual model.

4. Methods

Step 1: The mode of transport for each trip (n=623) by the 97 children from/to home and school was determined by a rule-based algorithm. GPS-based information was utilized to classify the mode of transport of each trip in an active mode (walking, cycling) or a passive mode (public transport, automobile) (Figure 3).

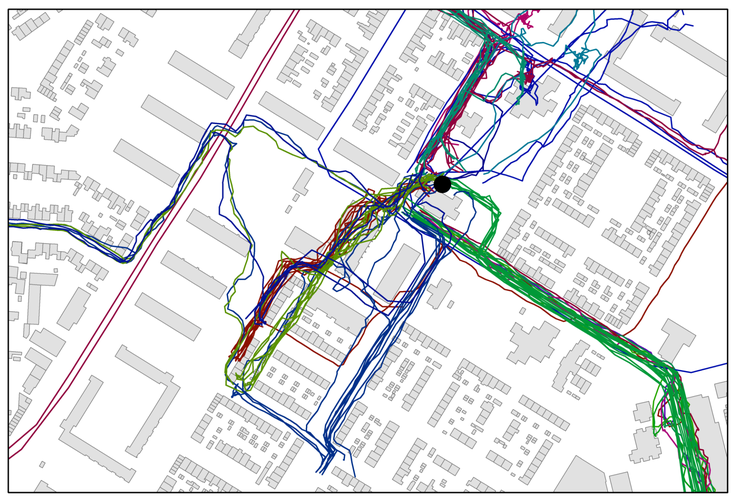

Figure 3: School trips classified by transport mode (The black dot refers to the school location, gray areas refer to buildings. BAG 2013).

Step 2: While the personal and trip characteristics were available through our survey and GPS-data, the natural and built environments were operationalized using a Geographic Information System. The indicators were derived on a 100 m grid superimposed on the study areas. The indicators are computed for each grid cell. Figure 4, for example, shows the probability for a road accident. Green cells refer to a low accident risk and red cells to a high risk.

Figure 4: Accident risk around two schools (large dots, small dots show the road accidents for the year 2009, BAG 2013).

Natural and built environmental exposures were determined by means of a Geographic Information System. Exposures were computed through buffer and overlay analyses around each school trip (Figure 5).

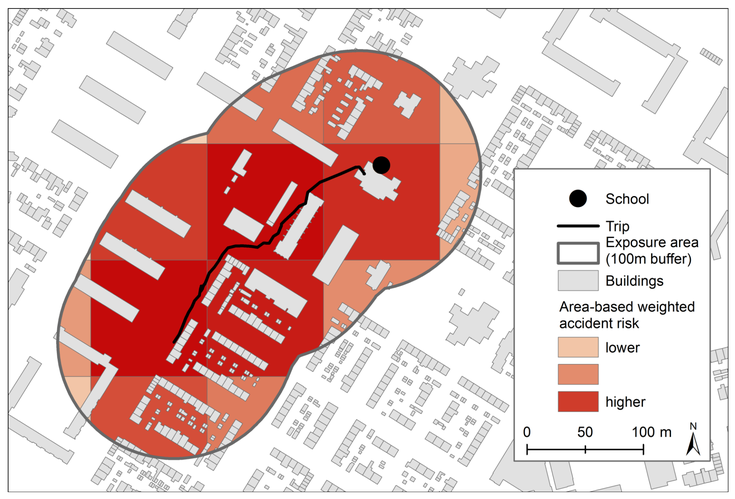

Figure 5: Accident risk along a school trip (BAG 2013).

Step 3: To analyze associations between children's active/passive mode choice and the personal, trip, weather, safety, natural and built environmental variables, we estimated elastic nets and generalized linear mixed models.

5. Results

The joint consideration of multiple environmental variables provoked problems with high correlations. Dark red (+) and dark blue cells (-) in Figure 6 refer to problematic associations. Therefore, we used elastic nets to pre-screen the multivariate relationships and remove variables not related with children's mode choice (i.e., trip direction, precipitation, green space, land-use diversity) before estimating generalized linear mixed models.

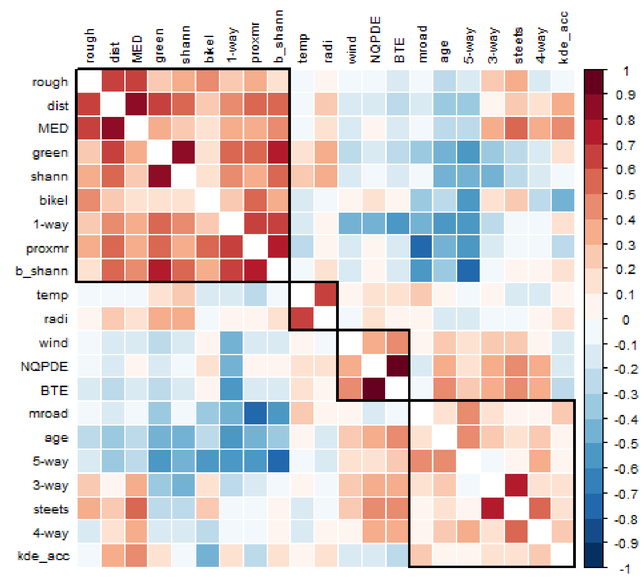

Figure 6: Correlations between variables.

The actual commuted distance is inversely associated with active transport mode choice when only personal, traffic safety, and weather characteristics are considered. When the model is adjusted for traversed urban environments, the results are reversed and distance is no longer significant, whereas well-connected streets and cycling lanes are positively associated with active travel. Table 1 shows the results of the final mixed model. The reported variables are significant at the 0.05 level, the remaining variables were not significant. Neither green space nor weather is associated with active travel.

Table 1: Results of the regression.

	Beta	P-value
Age	0.652	0.029
Bike path	0.046	0.053
Closeness index	-0.118	0.001
Betweenness index	0.116	0.092

6. Conclusion

This study examined the impact of dynamic natural and built environmental exposures on Dutch children's mode choice when travelling to/from school. Whereas distance is inversely associated with active transport to school when only personal, trip, and weather characteristics are considered, the opposite is true when the models are adjusted for traversed urban environments. As distance is not apparent as a constraining travel determinant when moving through urban landscapes, it is important that planning authorities support children's active school travel by providing well-designed cities. This could have profound health implications for both children and the general population.

References

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