Barriers to pedestrians in a growing African city
How to quantify them using minimal data

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Community severance (barrier effect of roads)

Existing methods

Video surveys
Street audits
Participatory mapping
Spatial analysis
Travel vs. health/wellbeing survey
Stated preference surveys

https://www.ucl.ac.uk/street-mobility/toolkit

Community severance in African cities

Community severance (barrier effect of roads)

Contributions of this study

To literature on barrier effects in African cities
Quantify the barrier effect of roads for the first time in an African city (Praia, capital of Cabo Verde)
Analyze the equity dimensions of the barrier effect

To literature on barrier effects
Map the effect at the city level
Indicators that account for land use (what is on the other side of the road)
- Houses of others
- Food shops

Praia

- 132,000 people (2010) → 188,000 (2023 est.)
- 75% of buildings in informal settlements, 15% of population in poverty
- 81% of households do not own a car, insufficient public transport
- 9%/year increase in number of vehicles. New roads planned.

Lack of crossing facilities associated with less physical activity among children (Marboe et al. 2016)
Only 19% of drivers stopped for pedestrians at a crossing (Masato 2017)

30% of older pedestrians could not finish crossing the road within the green phase (Amosun et al. 2007)
50% of pedestrians never use footbridges to cross motorways (Sinclair and Zuidgeest 2016)

After construction of motorway, % of non-motor users dropped from 67% to 7% (Ndiaye 2018)
Propensity to walk decreases 50% in places without traffic calming (Zago et al. 2017)

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Buildings

Provided by local government

Food shops

Manual mapping

Markets: local knowledge and information in municipal master plan

Supermarkets and minimarkets

List of private companies (provided by local government)

Full address Incomplete or missing address

See store name in OpenStreet Maps or Google Maps

Geocode (manually)

Full address Shop name in OpenStreet Map or Google Maps

Incomplete or missing address

Compare unlocated shops in each neighborhood with (image) maps in Nascimento (2003)

Data

Roads

Shapefile provided by local government (image) map in municipal master plan

Georeferenced satellite image

Road hierarchy (Levels 1-2)

Number of lanes, median strip (in Roads Levels 1-2)

Demographics

At building level

Shapefile provided by local government (image) map in municipal master plan

Add (manually) as attributes

Type of zone: formal, old (consolidated) informal, new informal, isolated

At neighborhood level

Shapefile provided by local government

Excel data files from National Statistics Office

Add (manually) as attributes

Age group

Sex of household head

Level of material comfort (indicator combining 10 variables)

Demographics

At building level

Shapefile provided by local government (image) map in municipal master plan

Add (manually) as attributes

Type of zone: formal, old (consolidated) informal, new informal, isolated

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Age group

Sex of household head

Level of material comfort (indicator combining 10 variables)

Barrier effect of a road segment

Use Anciés and Jones (2020) scale (based on pedestrian preferences): 0-100

<table>
<thead>
<tr>
<th>Number of lanes</th>
<th>Median strip</th>
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<tbody>
<tr>
<td>High-speed</td>
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</table>

Assumed to be

Roads with 3 lanes

Volume=medium-high, speed=30-40mph

Roads with 2 lanes

Volume=low, speed=20-30mph

Barrier effect for residents in a given building $j$

Barrier to homes of others (within 600m)

$\sum_{k} \text{Barrier effect of all roads from building } j \text{ to building } k \cdot \text{Proportion of area of } k \text{ in area of all buildings within 600m of } j$

Barriers to food shops (within 600m)

$\sum_{k} \text{Barrier effect of all roads from building } j \text{ to shop } k \cdot \text{Proportion of area of } k \text{ in area of all shops within 600m of } j$
Further (regression) analysis confirmed that older informal areas have higher than average barrier effects and newer informal areas have lower barrier effects.

Further (regression) analysis confirmed that populations with very low and very high comfort levels have lower than average barrier effects.

Further (regression) analysis confirmed that individuals aged 65+ have higher than average barrier effects.

Alternative assumptions for same indicators:
- Only Level 1 roads
- Destinations within 400m
- Inversely weight destinations by distance

Alternative indicators:
- Distance to nearest Level 1 road
- Distance to nearest Level 1 or 2 road
- Length of Level 1 roads within 600m
- Length of Level 1/2 roads within 600m

Indicators are more variable
Most socio-economic patterns still apply
Indicators are less variable
Some socio-economic patterns do not apply anymore
Conclusions

1. Roads reduce walking accessibility, affecting most of the city but with higher incidence in older informal zones and affecting older people.

2. Households with very high and very low comfort levels are least affected.

3. Policy implication: barrier effect already high in many areas. New roads will increase this effect, so mitigation measures are needed.

4. Indicators capture differences between areas near roads with many destinations on one side and areas near similar roads with no reason to cross the road. Simpler indicators would not capture those differences.

5. Possible to build this indicator with minimal data (but tedious manual mapping...)

Thank you!

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