

Walkability in Flanders (Belgium): Developing a tool to support healthy spatial planning

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Abstract: Insufficient physical activity is a key factor for noncommunicable diseases such as cardiovascular diseases, different cancers and diabetes type II. According to the World Health Organisation more than half of the European population does not meet physical activity recommendations. International studies have shown that living in high-walkable neighbourhoods is associated with higher physical activity levels. A clear understanding of the geographical variation of the walkability within a region is necessary for effective spatial interventions promoting physical activity. However to date in Europe no analytical spatial tool at a regional scale exists to provide such an evidence base. Our research mapped walkability at a high resolution for the entire region of Flanders. Analysis of the spatial distribution at a regional scale reveals only a few distinct areas showing a higher walkability score in comparison to other Flemish neighbourhoods. At a local scale differences between neighbourhoods or districts are apparent and can be addressed. The tool provides support in making more evidence-based healthy spatial policy decisions. Based on the resulting map an easy accessible open-source online tool was developed which can be used to assess the walkability and to compare neighbourhoods within a municipality or in reference to other towns and cities.

Keywords: Walkability, Physical activity, Analytical spatial tools, Urban environment and health

Introduction

Insufficient physical activity is a key factor for noncommunicable diseases such as cardiovascular diseases, different kinds of cancer and diabetes type II. Evidence shows, in Europe more than half of the population is not active enough to meet health recommendations. (World Health Organisation, 2018) Therefore increasing the average amount of physical activity is paramount to ensure a healthy population. According to The Lancet (Das and Horton, 2016) only raising awareness to the issue is not sufficient to ensure a significant long-term health outcome. Only a limited group of people will feel addressed and accordingly respond by doing more physical exercise. Moreover the effects are most of the time not long lasting and people tend to soon return to their old habits.

To profoundly embed physical activity in our daily routines, other policy fields such as spatial planning, housing and mobility should also incorporate health concerns policy initiatives or interventions. A structural way to ensure more physical activity is to shift from a motorised means of

transportation to walking or riding bicycles where possible. At some locations this is of course easier to achieve than at other locations, depending on several parameters (e.g. availability of high quality public transport, cycle or pedestrian infrastructure, proximity of jobs, schools or commercial facilities) This article focuses on exploring the geographical variation of spatial characteristics associated with high levels of physical activity, applied to the Flemish region in Belgium, situated in the centre of Western Europe.

The recently adopted strategic vision document of the ‘Spatial Policy Plan for Flanders’ (Flemish Government, 2018) expresses the ambition to develop healthy urban places as an overall policy goal, and stresses the importance of enhancing environmental conditions that favour active mobility. The aim of our research is to develop an analytical tool to assess the geographical variation in walkability in Flanders in order to support the expressed ambition to incorporate health concerns in spatial policy, and planning practice.

Walkability

Intuitively what is meant by ‘walkability’ is clear. However in literature, research and planning practice different definitions are being used, mostly based on related yet sometimes divergent spatial concepts, assumptions or empirical evidence. (Forsyth, 2015) The term is for instance often associated or intertwined with concepts of liveable and sociable placemaking at a human scale (Jacobs, 1961, Gehl, 2010, Montgomery, 2013). These concepts link walkability to other positive outcomes regarding the quality of life for people living in these neighbourhoods, not only improving their physical health but also their mental and social well-being. Still not all neighbourhoods with a large amount of people going on foot is necessarily liveable or is designed to foster pedestrians. Furthermore not every neighbourhood providing a sound, safe and pleasant pedestrian infrastructure will therefore always induce a higher rate of active mobility or be able to grow into vibrant living environments.

Research in human movement sciences (Frank et al., 2006, Owen et al., 2007, Sallis et al., 2016, Van Dyck et al., 2010) indicate a significant positive correlation between the observed amount of people’s physical activity and specific objective spatial characteristics. The evidence shows people will more likely choose for an active mode of transportation (going on foot or by bike) for functional travel in neighbourhoods characterised by a high residential density, a high amount of different destinations and a high street connectivity. Other possible determinants such as a high amount of motorised traffic, a higher risk of injuries for pedestrians, or a lack of high-quality pedestrian infrastructure or urban greenery seem to have less influence on the amount of active mobility in a neighbourhood (Van Holle *et al.*, 2012). This insight clarifies why urban design efforts will not necessarily increase the average amount of physical activity in a neighbourhood, but also why some environments which intuitively are not considered to be walkable still attract a fair amount of pedestrians.

In this article ‘walkability’ is used to indicate spatial characteristics of a neighbourhood associated with high levels of physical activity.

Methodology

Walkability is operationalised and computed by making use of the following formula: $\text{Walkability} = 2 \cdot (\text{z-connectivity}) + (\text{z-residential-density}) + (\text{z-land-use-mix})$. The calculation method is based on

earlier research by Frank *et al.* (2010), which has been modified and tested by Van Dyck *et al.* (2010) to suit the specific Belgian spatial context.

In our research walkability is computed for every neighbourhood in Flanders and visualised on a high density grid (100 by 100 meters) . ‘Neighbourhood’ is defined as an area consisting of adjacent hectare-cells reachable on foot within a 1 km radius from a cell over the road network. This method is preferred over a Euclid buffer to determine the neighbourhood size because it takes physical barriers (for instance railways, highways or canals) into account. Unreachable cells are not considered to be part of the cells neighbourhood. However using this methodology the walkability index is not computed for cells not accessible by the road network, although these cells could be part of a larger adjoining area (for instance the core of a public park) which in some occasions could be reached on foot.

Connectivity for active mobility (pedestrians and cyclists) refers to the directness, or the ease, to walk from one location to another (Saelens *et al.*, 2003). Pedestrians tend to switch to other modes of transportation if the detour to their destination is too large. A high density of intersections provides pedestrians the opportunity to choose for short walking distances. Connectivity is calculated for every neighbourhood by the ratio of the number of true intersections (by 3 or more streets) to the neighbourhood size. Only those true intersections that can be crossed by pedestrians were selected from the Flemish road network register. (<https://overheid.vlaanderen.be/producten-diensten/wegenregister>, accessed on 30/05/2019)

In the prior research by Van Dyck *et al.* (2010) residential density is computed by the ratio of dwellings to the area designated for housing in zoning plans. Unfortunately this data is not available for the entire territory of Flanders. As a proxy our research made use of the population density (for the year 2017), being the ratio of the total amount of people living in the considered neighbourhood to the neighbourhood size.

Land use mix indicates the diversity of different kinds of land uses in the considered neighbourhood. To assess this feature an entropy index is computed which represents how homogenous or heterogenous the usage of a neighbourhood is. The higher the entropy index, the higher the diversity of land use. Following Frank *et al.* (2010) and Van Dyck *et al.* (2010) the entropy index is calculated by using following formula:

$$\text{Land use mix} = \frac{-\sum_{i=1}^k [(p_i) \cdot (\ln p_i)]}{\ln k}$$

p_i = area of a considered land use
 k = total amount of different land uses

A selection of the land use data (for retail, offices, public services, leisure) collected in the research of Verachtert *et al.* (2016) provided a solid basis for the calculation of the land use mix in Flanders.

The eventual walkability index consists of z-scores for each cell, normalised in regard to other cells of the grid.

Results

Figure 1 shows the resulting map indicating the walkability index for every cell accessible on foot by the road network. The map also includes cells that are part of agricultural or natural areas. Considering the three spatial characteristics associated to active mobility, it is more interesting only visualising cells that are part of the built environment or for which urban development is made possible in zoning plans (figure 2).

As to be expected the map (figure 2) clearly shows the neighbourhoods with the highest walkability (indicated in dark blue) in Flanders are located in the urban centres of the most important cities. The historic centres have both a high street connectivity and population density. Also the land use mix in these neighbourhoods is high, due to an abundance of retail, offices, leisure accommodation and public services (schools for instance) serving not only the local neighbourhood but the larger city agglomeration. The map also shows the effects of *urban sprawl* on walkability. Overall neighbourhoods in the centres of smaller cities or villages (indicated in light orange) score better on the walkability index than neighbourhoods characterised by scattered spatial patterns or ribbon development (in brown). The latter more peripheral locations are very monofunctional (designated residential areas, retail ribbons or industrial areas), which also have a low population density and a very car-oriented street pattern resulting in less connectivity.

Comparing the scores of all neighbourhoods in Flanders (figure 3) it is notable that only a distinct number of locations score high on the walkability index. The majority of neighbourhoods in Flanders score very low in comparison to the city centres of Ghent and Antwerp (highest scores). Using the classification introduced by Pisman, Vanacker, Willems, Engelen, and Poelmans (2018) the differences in walkability in urban, suburban and rural areas in Flanders can be assessed (figure 3).

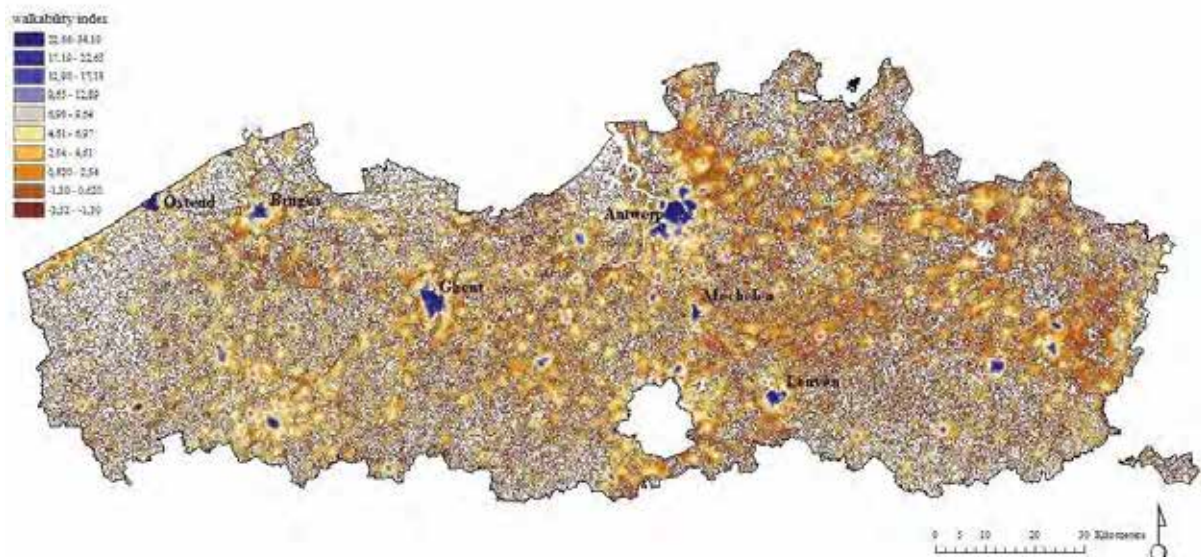


Figure 1: Walkability in Flanders, natural breaks (Jenks)

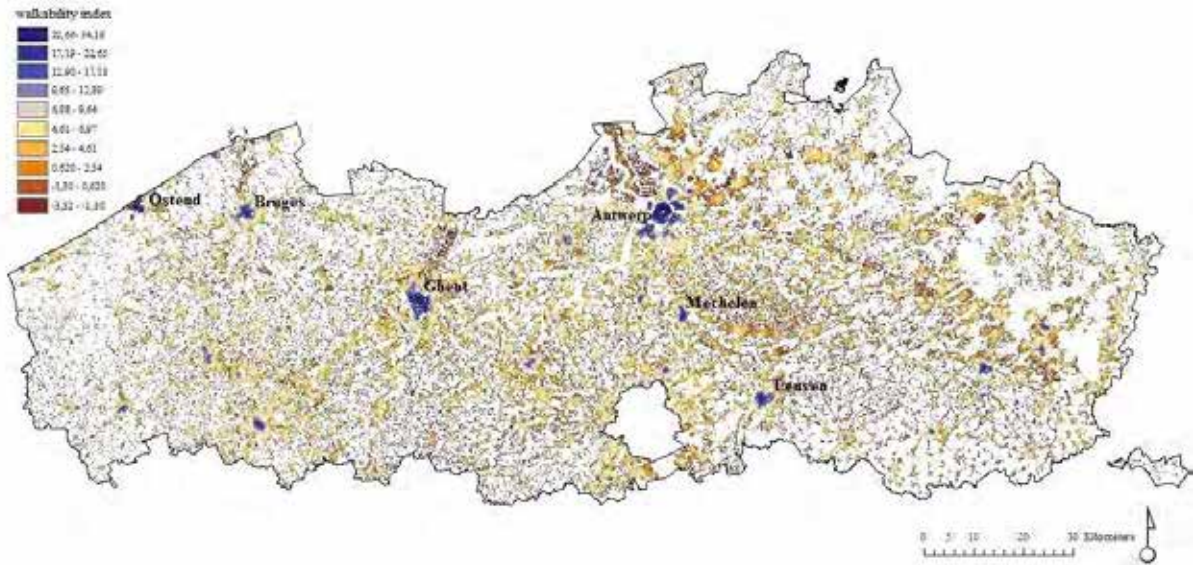


Figure 2: Walkability built environment in Flanders, natural breaks (Jenks)

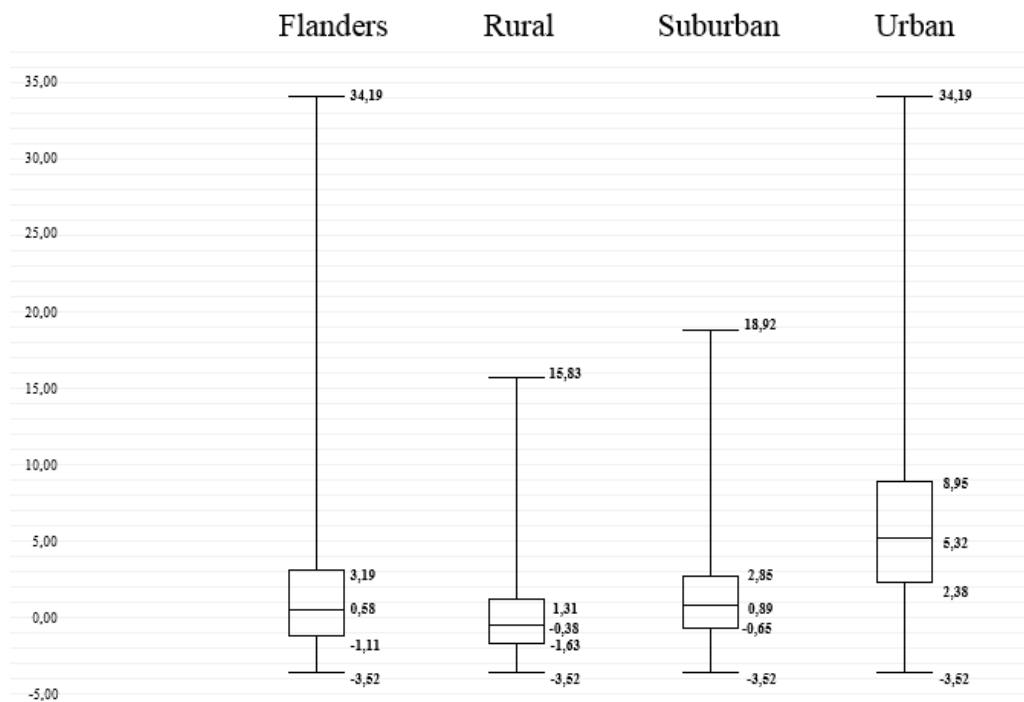


Figure 3: Box-Whisker-plots walkability index built environment in Flanders

In particular the urban areas score high on walkability. Although suburbs seem to score slightly better than rural neighbourhoods, the walkability in both categories is rather low. Nevertheless, there are also urban locations that remain below the Flemish median. Furthermore also some rural or suburban locations score as high as the most walkable neighbourhoods in the urban category (third quartile, walkability index above 8.95). Most of these high scoring suburban or rural neighbourhoods are actually situated in the centre of small historic towns and villages developed from a medieval dense spatial pattern which to date still have a local importance in terms of retail, jobs and public services.

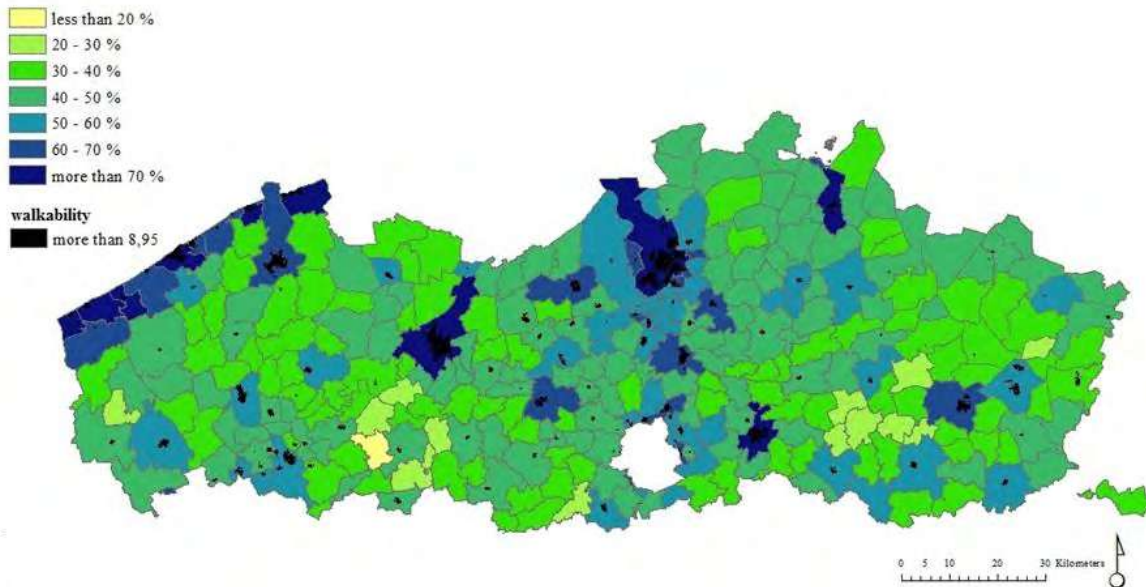


Figure 4: Neighbourhoods scoring more than 8.95 on the walkability index versus percentage of inhabitants per municipality reporting going on foot at least once a week, based on survey data retrieved from Agentschap Binnenlands Bestuur (2018).

Figure 4 shows the highly walkable neighbourhoods (walkability index over 8.95) compared to the reported active mobility in the municipality based on survey data retrieved from the Flemish Agency for Domestic Administration (Agentschap Binnenlands Bestuur, 2018). The largest clusters of highly walkable neighbourhoods are located in municipalities with a high percentage of inhabitants reporting going on foot at least once a week. For smaller clusters the relationship is less clear. In some municipalities there appears to be a higher rate of active mobility than expected based on the walkability index, at other locations the opposite is noticeable. More in-depth research can provide more insight into this. There may be other (spatial) characteristics influencing active mobility such as the urban design, the condition of pedestrian infrastructure or proximity of public transport. Also the different resolution (i.e. a survey aggregated at municipal level versus a walkability index based on a 1 km radius) can explain differences. Furthermore it is not inconceivable that a minimum size of "high walkability clusters" is required to effectively convince people to walk. Finally, it is probable that also non-functional journeys (i.e. walking for leisure) were reported in the survey, since all coastal municipalities (West on Figure 4) score high.

Walkability and spatial policy

It is probably for the first time in Europe that walkability is being mapped for a large region. Previous exercises were limited to a city or city region. Nevertheless, mapping on a regional scale also provides added value for *regional spatial policy*. It indicates places that already favour active mobility today. Our research proves the number of locations in Flanders scoring high on walkability is rather limited. Furthermore except for highly urbanised city centres the existing locations are also very limited in terms of size. The strategic vision document of the Spatial Policy Plan for Flanders (Flemish Government, 2018) focuses on public transit oriented development. Furthermore it emphasises future spatial developments have to enhance liveability, reduce health hazards, ensure more social inclusiveness, *favour active mobility* and provide a higher amount and quality of urban green spaces.

Recent research (Verachtert *et al.*, 2016) indicated high potential locations for future transit oriented development (TOD) in Flanders. These locations are close to high quality public transport hubs and have a high level of facilities in the vicinity, figure 5 shows a clear overlap with locations of high walkability. Nevertheless most of the indicated high potential locations for transit oriented development lack a high score on the walkability index.

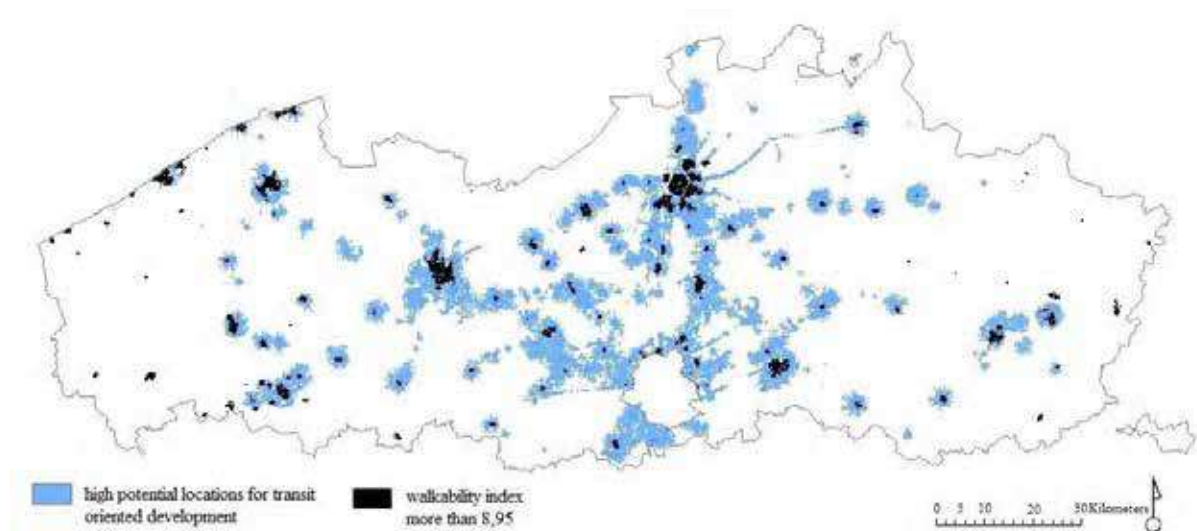


Figure 5: High potential locations for transit oriented development in terms of proximity of high public quality public transport and a high level of facilities – ‘A-Quadrant locations’ in Verachtert *et al.* (2016) versus highly walkable neighbourhoods.

For sustainable and healthy urban policy in Flanders walkability evidence is an added value to guide strategic development. Within the high potential locations for transit oriented development a focus on locations with a decent walkability score, or locations of which the score could be significant enhanced, will result in more active mobility. As mentioned before a walkable neighbourhood is not necessarily a liveable or sociable neighbourhood. It is however an excellent spatial condition for further spatial developments at a human scale. Moreover it will decrease car dependence, which will also have a positive effect on the use of public transport for the longer distances. At the regional scale (Flanders) this means the transformation of the urban sprawl pattern to a more dense and concentrated development at specific strategic locations must be placed central and high on the future spatial policy agenda.

Also at a *supra-local or local policy* level (e.g. a city-region, city or municipality) insights in the geographical variation of walkability provides a basis for a differentiated spatial policy for sustainable and healthy urban development of neighbourhoods. Locations characterised by a sufficiently high residential density, street connectivity and land use mix are less car dependent. Densification should therefore in the first place be considered in neighbourhoods that already have a substantial level of walkability while ensuring the improvement of other important conditions for liveability (e.g. high quality public space, safety, urban green space, absence of environmental nuisance,...). In addition these neighbourhoods are the best locations for investments in pedestrian friendly infrastructure as more active mobility is to be expected.

For example examining the walkability within the municipality of Mechelen, (a medium sized city located in the centre of Flanders, South of Antwerp, North of Brussels – figure 6) clear differences

between the city centre (dark blue) and the surrounding villages are visible. The city centre, but also the neighbourhood Spreeuwenhoek, score high on walkability. But there are also differences in walkability between the surrounding villages. Muizen, Hombeek and Walem have a larger central more walkable cluster than Heffen or Leest. Very low walkability scores are noticeable in the residential ribbons surrounding Heffen, Leest and Hombeek. Urban policy promoting active mobility should be well aware of these differences, concentrating developments foremost in the central blue or light orange areas and to a lesser extent in the more walkable centres of the surrounding villages. Also investments in pedestrian friendly public spaces should in the first place be considered in these distinct areas. High quality public transport or bicycle connections from the villages to the city centre could be introduced or enhanced. In the darker brown areas, which have a very low walkability, a cautious assessment of the desirable spatial development perspective is appropriate.

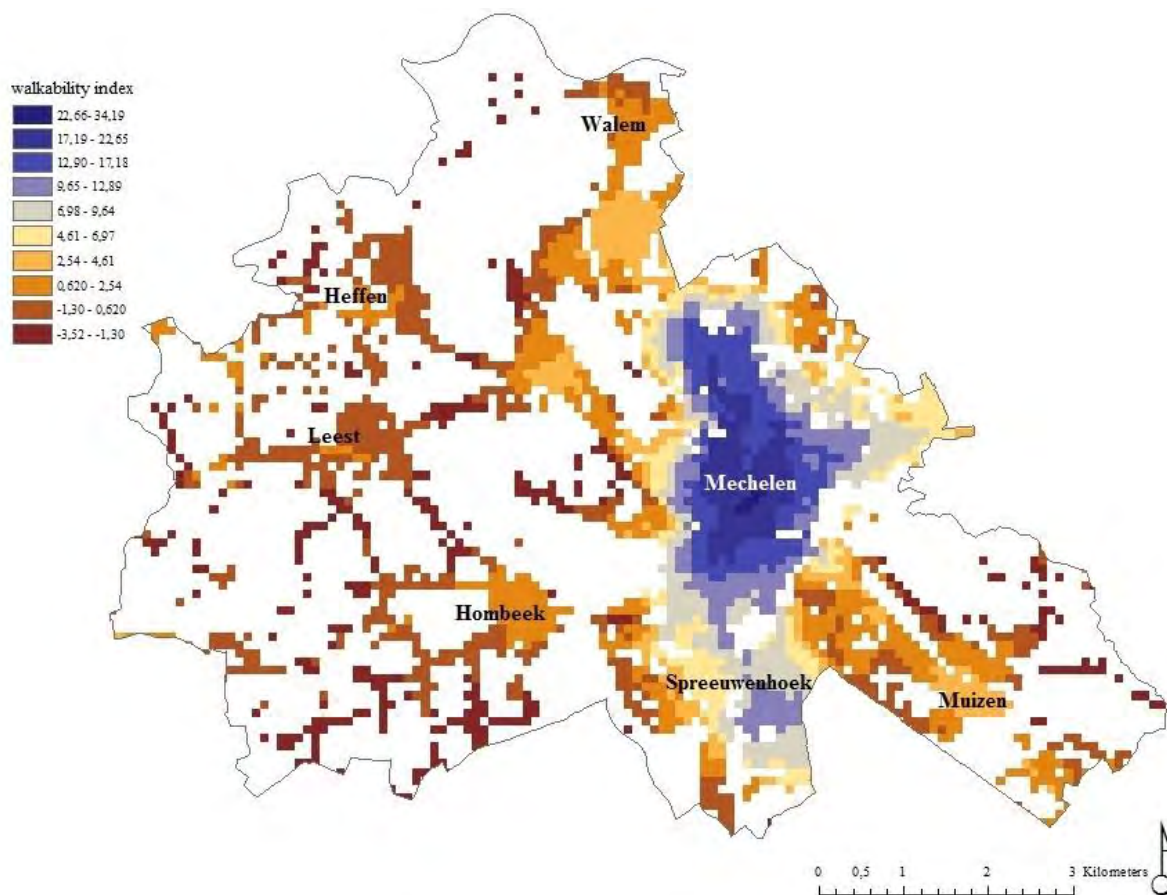


Figure 6: Walkability index for the built environment in the municipality of Mechelen, natural breaks (Jenks)

Another consideration from a health perspective to guide local spatial planning initiatives improving walkability is an assessment of the socio-economic status (SES) in different neighbourhoods. People of lower socio-economic status are more vulnerable to several health hazards (i.e. because of budget restraints which affect their diet, housing quality or access to drugs and medical advice) (Pampel et al., 2010). Increasing the walkability in low SES neighbourhoods will increase possibilities for active mobility, thus effectively improving health conditions for a vulnerable group.

Governance and dissemination

Achieving the policy goal to develop healthy urban places (i.e. neighbourhoods with increased levels of physical activity) in Flanders relies very much on the capacity of the local policy level to address the issue. The Flemish policy level outlines guidelines for spatial planning, is responsible for policy interventions in areas of regional importance and supports the local institutional level achieving policy goals, but the lot of planning initiatives and spatial projects in Flanders are carried out at the municipal level. There are 300 municipalities in Flanders: larger cities like Antwerp (over 515.000 inhabitants) and Ghent (over 255.000 inhabitants), but mostly smaller towns and cities. The administrative capacity and resources of these municipalities are unevenly distributed. To enable all local governments to access the walkability data for their municipality an easy accessible open-source online tool was developed based on the resulting maps (<https://walkability.marvin.vito.be>). The tool can be used to assess the walkability and to compare neighbourhoods within a municipality or in reference to other towns and cities. It gives insight in the underlying three environmental features (connectivity, residential density, land use mix) of a neighbourhood providing evidence to improve the local walkability. The data is also made available enabling municipalities with more technical resources a more thorough analysis possibilities using their own GIS-system. The tool was tested and adjusted in cooperation with civil servants in five municipalities of different scales.

The walkability evidence and the online-tool is actively disseminated and promoted by the Flemish Institute for Healthy Living, the Department of Environment and Spatial Development Flanders and the Flemish Agency for Public Healthcare to policy makers, civil servants, private organisations and citizens as part of a larger project on healthy public spaces.

Conclusion

Based on prior evidence (Frank et al., 2010, Van Dyck et al., 2010) linking neighbourhood characteristics to increased levels of physical activity our research succeeded in mapping a walkability index for the entire region of Flanders (Belgium). Overall the research reveals walkability throughout the region is rather low. Nevertheless clear contrasts between more walkable centres of small villages and towns and peripheral scattered spatial patterns or ribbon development with a very low walkability level is noticeable. Neighbourhoods scoring best in terms of walkability are mainly located in urban city centres. The number of neighbourhoods in Flanders scoring very high on walkability index however is limited. Except for highly urbanised city centres these highly walkable neighbourhoods are also very limited in terms of size. The high resolution map also enables analysis of walkability at a municipal level, as a basis for a differentiated spatial policy for sustainable and healthy urban development. Urban policy promoting active mobility should be well aware of the spatial differences throughout the territory, concentrating developments foremost in the more walkable neighbourhoods or actively enhancing walkability conditions at locations selected for densification.

Acknowledgements

The authors would like to thank Tomas Crols, Guy Engelen, Wim Peelaerts, Lien Poelmans and Els Verachtert at the Flemish Institute for Technological Research (VITO) for their technical help computing the walkability index and developing the online walkability tool. This research is funded by the Government of Flanders.

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