|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Indicator | Description | Data |
| Density | Building density | The ratio of total building footprint area to the neighborhood area. | Building data with footprint area |
| Floor area ratio | The ratio of a building's total floor area (gross floor area) to the size of the piece of land upon which it is built. | Building data with footprint area and floor number |
| Functional density | The total amount of the types of all facilities divided by the neighborhood area. | POI data |
| Convenience store density/Bus station density/Fast food density/Restaurant density/Gym density/Health related facility density (including pharmacy, clinic, etc.) | The amount of the specific type of facilities divided by the neighborhood area. | POI data with the specific type of facility  |
| Diversity | Land-use diversity (Building or Lot level) | Diversity = −∑ (Pi \*lnPi); where n denotes the number of land use types, and Pi is the proportion of land use type i among all land uses within the neighborhood. | Land-use data/Building data with the type of use |
| Functional diversity | Functional diversity= −∑ (Pi \*lnPi); where n denotes the number of types, and Pi is the proportion of facility type i among all POIs within the neighborhood. | POI data with the specific type of facility  |
| Design | Spatial quality(neighborhood scale/around neighborhood scale) | Step1: Evaluating the spatial quality through the indicator obtained by panel auditing system, a platform for people to manually grade the degree of spatial disorder.Step2: Calculating the mean value of four directions as the value for that point.Step3: Summing up the value of the whole points at neighborhood scale and around neighborhood scale. | Street view images |
| Cross-sectional proportion (neighborhood scale/around neighborhood scale) | Definition: The ratio of averageheight to street width, which could be calculated directly for both sides.Step1: Methods are borrowed from Harvey (2014) to calculate cross-sectional proportion.Step2: Summing up the value of the whole points within the both scales. |
| Street wall continuity(neighborhood scale/around neighborhood scale) | Definition: The proportionof street edge intersecting with buildings.Step1: Methods are borrowed from Harvey (2014) to calculate Street wall continuity.Step2: Calculating the mean value of both sides as the value for that point.Step3: Summing up the value of the whole points within the both scales. |
| Greenery(neighborhood scale/around neighborhood scale) | Definition: The percentage of trees in the picture is defined as greenery.Step 1: Calculating the proportion of trees in the pictures.Step2: Calculating the mean value of four directions as the value for that point.Step3: Summing up the value of the whole points within the both scales. |
| Tree(neighborhood scale/around neighborhood scale) | Step1: Extracting the trees from high resolution remote imagery.Step2: The trees measured under neighborhood scale and around neighborhood scale divided by neighborhood area and around neighborhood area. | High resolution remote imagery |
| Green space(neighborhood scale/around neighborhood scale) | Step1: Extracting the green land from the land-use data.Step2: The area of the green land measured at neighborhood scale and around neighborhood scale divided by neighborhood area and around neighborhood area. | Land-use data |
|  | Fast food/Tobacco /alcohol advertisement density(neighborhood scale/around neighborhood scale) | Step1: Extracting the specific advertisement from the street view pictures.Step2: The appearance number of the specific advertisement divided by neighborhood area and around neighborhood area. | Street view images |
|  | Busy traffic road density(neighborhood scale/around neighborhood scale) | Step1: Extracting the busy traffic road from the street view pictures.Step2: The appearance number of the busy traffic roads divided by neighborhood area and around neighborhood area. |
| Destination accessibility | Fast food density/Gym densityRestaurant density/Tobacco and alcohol retailer density/Shopping mall density/Bus station density | Total amount of the specific facilities divided by the area of around neighborhood scale. | POI data with the specific type of facility  |
| Excellent restaurant proportion | The good/excellent restaurants divided by all the restaurants within the around neighborhood area. | POI data with the review information of the restaurant |
| Street intersection density | Total amount of the street intersections divided by the area of around neighborhood scale. | Road network data |
| Distance | Distance to city center/Distance to CBD/Average distance to city subcenter(s)/Average distance to famous park(s)/Distance to the nearest subway station/Distance to the nearest park/Distance to the major road/Distance to the nearest prime health care/Distance to the nearest emergence center | Calculating Euclidean distance from the centroid of neighborhood to the specific site. | POI data with the location of the specific site |

|  |
| --- |
| **A simplified method to explore the basic association between neighborhood built environment and health outcome** |
|  | Search Term | Number  |
| 1 | Neighborhood/ or community |  |
| 2 | Built environment/ or Building density/ or floor area ratio / or Functional density/ facility density/ or amenities density/ or facility index/ or amenities indexLand use/ or land-use mix /or land-use diversity/ or diversity of land-use/ or Facility density/ or tobacco and alcohol retailor density/ or convenient store density/ or shopping mall density/ or supermarket density/ or gym density/ or fast food density/ or restaurant density/ or full service restaurant density/ or grocery density/ or pharmacy density/ or recreation density/ or Facility accessibility/ or tobacco and alcohol retailor accessibility/ or convenient store accessibility/ or shopping mall accessibility/ or supermarket accessibility/ or gym accessibility/ or fast food accessibility/ or restaurant accessibility/ or full service restaurant accessibility/ or grocery accessibility/ or pharmacy accessibility/ or recreation accessibility/or Intersection density/ or junction density/ or street density/ or connectivity density/ or road pattern/ or street pattern/ or bus station density/ or transit density/ traffic facility density/or Distance to station/ distance to subway station/ distance to transit/ distance to traffic facility/or Distance to health care/ or proximity to health care/ or health care accessibility/ or distance to hospital/ or hospital accessibility/ or proximity to hospital/ or distance to emergence center/ or proximity to emergence center/ or emergence center accessibility/or distance to the major road/ or traffic exposure/ or adjacent to major road/or proximity to the major road/or distance to the greenness/ or adjacent to the greenness/ proximity to the greenness/ or distance to the green space/ or adjacent to the green space/or proximity to the green space/or distance to the green park/ or adjacent to the green park/ proximity to the green park/ or greenness density/or park density/or tree density/ exposure to greenness/ or tree canopy area/ or patches of trees/ or patches of forests/ or NDVI/ or greenery proportion/ or greenery density/or spatial quality/ or spatial disorder/ or cross-sectional proportion/ or urban design/ or street wall continuity/ or advertisement density/ or aesthetic/or walkability/ or playability |  |
| 3 | 1 and 2 |  |
| 4 | exp health/ or exp adolescent health/ or exp child health/ or exp family health/ or exp global health/ or exp holistic health/ or exp infant health/ or exp men's health/ or exp mental health/ or exp minority health/ or exp oral health/ or exp population health/ or exp rural health/ or exp suburban health/ or exp urban health/ or exp public health/ or exp reproductive health/ or exp sexual health/ or exp veterans health/ or exp women's health/or exp "bacterial infections and mycoses"/ or exp virus diseases/ or exp parasitic diseases/ or exp neoplasms/ or exp musculoskeletal diseases/ or exp digestive system diseases/ or exp stomatognathic diseases/ or exp respiratory tract diseases/ or exp otorhinolaryngologic diseases/ or exp nervous system diseases/ or exp eye diseases/ or exp male urogenital diseases/ or exp "female urogenital diseases and pregnancy complications"/ or exp cardiovascular diseases/ or exp "hemic and lymphatic diseases"/ or exp "congenital, hereditary, and neonatal diseases and abnormalities"/ or exp "skin and connective tissue diseases"/ or exp "nutritional and metabolic diseases"/ or exp endocrine system diseases/ or exp immune system diseases/ or exp "disorders of environmental origin"/ or exp animal diseases/ or exp "pathological conditions, signs and symptoms"/ or exp occupational diseases/ or exp chemically-induced disorders/ or exp "wounds and injuries"/ or obesity/ or blood pressure/ or BMI(health or health outcome\*).ab,ti. |  |
| 5 | Review |  |
| 6 | GIS/or ArcGIS/or geographical information science/or remote sensing/or satellite/or spatial measure/or subjective measure |  |
| 7 | 3 and 4 and 5 and 6 | 77 |
| 8 | After the exclusion, there are 17 reviews that exploring the association between neighborhoods’ built environment with health outcomes. | 17 |

|  |  |
| --- | --- |
| Issue | Key health effects |
| Longer distance to prime care | More late stage cancer |
| Higher convenience store density | Higher BMI |
| More park/playground access | Lower BMI |
| More swimming pool access | Lower BMI |
| More park density | Worse breast cancer-specific survival |
| More green space | Better overall health/Decreased acute respiratory illness/Better mental health/Better self-perceived health/Lower stress/Lower BMI/Lower depression/Lower anxiety/Lower cardio-vascular risk/Better birth and development outcome/Decreased T2DM/Decreased cancer/Decreased mortality/Decreased migraine/Decreased acute urinary tract infection/Decreased infectious disease of intestinal canal/Decreased vertigo |
| More recreational function density | Lower BMI |
| More land-use mix | Decreased metabolic syndrome/ |
| Higher walkability | Lower blood pressure/Lower BMI/ Decreased obesity/ Decreased T2DM/Lower cardio-metabolic risk |
| Higher functional density | Lower blood pressure |
| Higher sports facility density | Lower BMI |
| Higher Fast food restaurant density | Higher BMI/Increased stroke/Increased T1DM/ Increased T2DM |
| Higher grocery/supermarket density | Decreased obesity |
| Higher bar/pub density | Increased stroke |
| Higher traffic density | Increased CHD |
| More number of residential units | Worse self-perceived health |

Reference:

Aimone, A. M., Perumal, N., & Cole, D. C. (2013). A systematic review of the application and utility of geographical information systems for exploring disease-disease relationships in paediatric global health research: the case of anaemia and malaria. International journal of health geographics, 12(1), 1.

An, R., Shen, J., Yang, Q., & Yang, Y. (2018). Impact of built environment on physical activity and obesity among children and adolescents in China: a narrative systematic review. Journal of sport and health science.

Browning, M., & Lee, K. (2017). Within what distance does “greenness” best predict physical health? A systematic review of articles with GIS buffer analyses across the lifespan. International journal of environmental research and public health, 14(7), 675.

Christian, H., Zubrick, S. R., Foster, S., Giles-Corti, B., Bull, F., Wood, L., ... & Boruff, B. (2015). The influence of the neighborhood physical environment on early child health and development: A review and call for research. Health & place, 33, 25-36.

Den Braver, N. R., Lakerveld, J., Rutters, F., Schoonmade, L. J., Brug, J., & Beulens, J. W. J. (2018). Built environmental characteristics and diabetes: a systematic review and meta-analysis. BMC medicine, 16(1), 12.

Ding, D., & Gebel, K. (2012). Built environment, physical activity, and obesity: what have we learned from reviewing the literature?. Health & place, 18(1), 100-105.

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forns, J., Plasència, A., & Nieuwenhuijsen, M. (2015). Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. International journal of environmental research and public health, 12(4), 4354-4379.

Gomez, S. L., Shariff‐Marco, S., DeRouen, M., Keegan, T. H., Yen, I. H., Mujahid, M., ... & Glaser, S. L. (2015). The impact of neighborhood social and built environment factors across the cancer continuum: current research, methodological considerations, and future directions. Cancer, 121(14), 2314-2330.

Gong, Y., Palmer, S., Gallacher, J., Marsden, T., & Fone, D. (2016). A systematic review of the relationship between objective measurements of the urban environment and psychological distress. Environment international, 96, 48-57.

Grasser, G., Van Dyck, D., Titze, S., & Stronegger, W. (2013). Objectively measured walkability and active transport and weight-related outcomes in adults: a systematic review. International journal of public health, 58(4), 615-625.

Harvey, C. W. (2014). Measuring streetscape design for livability using spatial data and methods.

Johnson, K. A., Showell, N. N., Flessa, S., Janssen, M., Reid, N., Cheskin, L. J., & Thornton, R. L. (2019). Do neighborhoods matter? A systematic review of modifiable risk factors for obesity among low socio-economic status Black and Hispanic children. Childhood obesity, 15(2), 71-86.

Malambo, P. , Kengne, A. P. , Villiers, A. D. , Lambert, E. V. , & Puoane, T. . (2016). Built environment, selected risk factors and major cardiovascular disease outcomes: a systematic review. Plos one, 11(11), e0166846.

Nordbø, E. C. A., Nordh, H., Raanaas, R. K., & Aamodt, G. (2018). GIS-derived measures of the built environment determinants of mental health and activity participation in childhood and adolescence: A systematic review. Landscape and urban planning, 177, 19-37.

Schulz, M., Romppel, M., & Grande, G. (2016). Built environment and health: a systematic review of studies in Germany. Journal of public health, 40(1), 8-15.

Schulz, M., Romppel, M., & Grande, G. (2018). Is the built environment associated with morbidity and mortality? A systematic review of evidence from Germany. International journal of environmental health research, 28(6), 697-706.

Wilkins, E., Radley, D., Morris, M., Hobbs, M., Christensen, A., Marwa, W. L., ... & Griffiths, C. (2019). A systematic review employing the GeoFERN framework to examine methods, reporting quality and associations between the retail food environment and obesity. Health & place, 57, 186-199.

Won, J., Lee, C., Forjuoh, S. N., & Ory, M. G. (2016). Neighborhood safety factors associated with older adults' health-related outcomes: a systematic literature review. Social science & medicine, 165, 177-186.