Appendix. Summary of key study characteristics, GIS data and methods used, and key findings of the 121 included studies (ranked by the alphabetical order of the first authors’ last name)†

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Reference # | Author  [year] | Study aim(s) | Study design†† [period] | Study area††† [scale] | Sample size [age] | GIS data | GIS data processing & analysis methods | GIS-based variables & indicators | Key findings |
| [1](#_ENREF_1) | Abbott [2014] | Examine the extent to which characteristics of the neighborhood built environment explain the association between adiposity and educational qualifications in Australian women | CS [2004] | Melbourne, Australia [C] | 1,819 [16-88 yrs] | ● Road network ● Address ● Crime ● Open space  ● FF outlet ● Supermarket ● Greengrocer ● Sport facility | ● Geocoding  ● Overlay ● Network ● Buffer | ● Distance to open space, supermarkets, greengrocers, and FF outlets ● Density of open space, supermarkets, greengrocers, FF outlets, and sport facilities ● Total length of walking paths ● Street connectivity ● Number of crimes ● Presence of coastlines  (2-km network buffer) | ● Compared with women with a high school degree or above, women who did not complete high school had higher average BMI, which was partially explained by lower density of sports facilities and living less proximally to the coastline and to supermarkets. ● Number of sports facilities and presence of the coastlines within 2 km of participants' homes were significant mediators of the observed socioeconomic disparity in BMI. |
| [2](#_ENREF_2) | Adams [2015] | Examine whether patterns of GIS-derived BE features explained objective and self-reported PA, sedentary behavior, and BMI | CS [2001-2005] | Seattle, Baltimore, US [C2] | 2,199 [20-65 yrs] | ● Address ● Park ● Parcel  ● Census ● Road network ● Land use | ● Geocoding ● Overlay ● Buffer ● Network | ● Residential density ● Intersection density ● Land-use mix ● Ratio of retail floor areas ● Density of transit stops ● Density of recreation facilities | ● In Seattle, PA, active transportation, and BMI were higher in high walkability/transit/recreation population than low walkability/transit/recreation population.  ● In Baltimore, PA and active transportation were higher in high land use mix, transit, and recreation population than low walkability/transit/recreation population. |
| [3](#_ENREF_3) | Adlakha [2014] | Assess differences in outdoor PA by neighborhood SES using public web data feeds | CS [2012] | St. Louis, US [C] | N/A | ● Exercise route  ● Park  ● Census | N/A | Presence of exercise routes | ● A majority of running and walking routes occur in or traverse through a park.  ● The odds of running in a park in a low-SES neighborhood were 54% lower than running in a park in a higher-SES neighborhood.  ● The odds of walking in a park in a low-SES neighborhood were 17% lower than walking in a park in a higher-SES neighborhood. |
| [4](#_ENREF_4) | Bader [2010] | Illustrate the effects on the measurement of disparities in food environments | EC | New York City, US [C] | N/A | ● Census  ● Supermarket  ● Road network  ● Bus and subway stop  ● Homicide  ● Automobile accident  ● Highway | ● Geocoding  ● Overlay  ● Buffer  ● Network  ● Kernel density | ● Number of supermarkets (1.6-km buffer)  ● Presence of bus/subway stops (400-m buffer)  ● Presence of supermarkets (800-m network buffer)  ● Intensity of homicides, automobiles accidents, and highways | Adjusting for vehicle ownership and crime tended to increase measured disparities in access to supermarkets by neighborhood race/ethnicity and income, while adjusting for public transit and traffic safety tended to narrow these disparities. |
| [5](#_ENREF_5) | Barnes [2015] | ● Examine agreement between objective and perceived presence of retail food outlets within a 1.6-km buffer around individuals  ● Examine agreement between perceived 1.6-km buffer and GIS-based buffers with different radii | CS [2010] | 8 counties in South Carolina, US [CT8] | 939 [>18 yrs] | ● Address  ● Road network  ● Retail food store | ● Geocoding  ● Network  ● Buffer  ● Overlay | Presence of retail food stores (1.6-/3.2-/4.8-/8-km road network buffer) | Individuals’ perceived neighborhood food environment was moderately correlated with the geographic-based presence of food outlets. |
| [6](#_ENREF_6) | Berge [2014] | Investigate individual and joint associations of the home environment and the neighborhood built environment with adolescent dietary patterns and BMI z-score | CS [2010] | Minneapolis/St. Paul, US [C] | 2,682 [6-12 grade] | ● Address  ● Food outlet  ● Road network | ● Geocoding  ● Overlay  ● Network  ● Buffer | ● Presence to FF, convenience stores, and supermarkets (1.2-km network buffer)  ● Density of FF stores (1.6-km network buffer) | ● Presence of convenience stores was positively associated with BMI z-score among girls.  ● The relationship between a supportive family environment and adolescent fruit and vegetable intake and BMI was enhanced when the neighborhood was supportive of healthful behavior. |
| [7](#_ENREF_7) | Berry [2010] | Investigate the longitudinal relationship between the built environment and changes in BMI | LO [2002-2008] | Edmonton, Canada [C] | 500 [18-90 yrs] | N/A | ● Overlay  ● Network | ● Residential density  ● Land-use mix  ● Intersection density | ● Age, neighborhood SES and perceived traffic were significantly related to increased BMI over the 6 years.  ● Walkability was not associated with BMI change. |
| [8](#_ENREF_8) | Bird [2015] | ● Describe development of a youth-oriented direct-observation park audit tool (PARK)  ● Compare reliability estimates of items between tools | CS | Montreal, Canada [C] | 512 [children] | ● Land use  ● Residential address | ● Geocoding  ● Buffer  ● Overlay | Presence of parks | PARK tool is generally reliable and can be used to assess park characteristics that may be associated with youth PA. |
| [9](#_ENREF_9) | Björk [2009] | Investigate associations between recreational values of the close natural environment and neighborhood satisfaction, PA, obesity, and wellbeing | CS [2004] | Scanioa, Sweden [C] | 24,819 [18-80 yrs] | ● Address ● Land and vegetation cover | ● Geocoding ● Overlay ● Buffer | Presence of recreational values  (300-m buffer) | ● Number of recreational values near the residence was strongly associated with neighborhood satisfaction and PA. ● Presence of recreational values was associated with low or normal BMI. |
| [10](#_ENREF_10) | Boone-Heinonen [2013] | Examine joint, interactive, and cumulative impacts of neighborhood food retail and PA environment characteristics on BMI | LO [1992-2011] | Birmingham, Chicago, Minneapolis, Oakland, US [C4] | 4,092 [24-42 yrs] | ● FF restaurant ● Supermarket ● Convenience store ● Commercial PA facility ● Public PA facility ● Facility supporting sedentary activities ● Road network | ● Geocoding ● Overlay ● Buffer | ● Number of FF restaurants, supermarkets, convenience stores, commercial PA facilities, and public PA facilities  ● Development intensity (3-km buffer) | ● Increasing supermarket density (from 25th to 75th percentile) predicted inter-exam reduction in BMI of 0.09 kg/m2. ● Increasing commercial PA facility density predicted BMI reductions up to 0.22 kg/m2 in men. ● Increases in supermarket and commercial PA facility density predicted inter-exam BMI reductions up to 0.31 kg/ m2 in men, but not women. ● Reduced FF restaurant and convenience store density and increased public PA facility density and neighborhood development intensity did not predict reductions in BMI. |
| [11](#_ENREF_11) | Browning [2014] | Examine healthy eating programs, healthy eating education, and the food retail environments of schools | EC | Canada [N] | N/A | ● School  ● Food retailer | ● Overlay  ● Buffer | Number of chain FF restaurants, chain cafés/coffee shops, and convenience stores (1-km buffer) | 50% of schools had a chain FF restaurant; 33% had a chain café/coffee shop; and 41% had a convenience store within 1 km. |
| [12](#_ENREF_12) | Burd [2013] | Use gene-environment interaction model to test for differences in children’s food acceptance and body weights | CS [2005-2010] | New York City, US [C] | 120 [4-6 yrs] | ● Address  ● Retail food store | Geocoding | Number of healthy and unhealthy food stores (0.8-km buffer) | ● Food environment did not have a main effect on children’s liking/disliking of fruits, vegetables, or unhealthy food.  ● Children who are not sensitive to taste bitter thiourea compounds from unhealthy food environment had higher BMI z-scores than all other groups (p≤0.005). |
| [13](#_ENREF_13) | Burdette [2004] | Examine the relationship between overweight in preschool children and environmental factors | CS [1998-2001] | Cincinnati, US [C] | 7,020 [36-59 months] | ● Address ● Public playground ● FF restaurant | ● Geocoding ● Overlay | ● Distance to public playgrounds and FF restaurants | There was no association between child overweight and proximity to playgrounds, proximity to FF restaurants, or level of neighborhood crime. |
| [14](#_ENREF_14) | Burgoine [2015] | ● Examine whether objective measures of food, PA, and built environment exposures contribute to children's body weight ● Test for evidence of selective daily mobility bias when using GPS data | CS [2011] | Mebane, North Carolina, US [C] | 94 [5-11 yrs] | ● Food outlet ● PA facility ● Green space ● Fatal traffic accident ● Road network ● Land use ● Address ● GPS | ● Geocoding ● Overlay ● Buffer ● Network | ● Access to FF, all food outlets, and PA facilities (6-km network buffer) ● Area of Green space ● Density of fatal traffic accidents ● Proportion of major roads ● Land-use mix ● Ratio of junctions to junctions and cul-de-sacs ● Effective walkable area and route length ratio (800-m network buffer) | ● Greater home walkability was associated with increased BMI, as was greater school access to green space. ● There was no associations between BMI and route exposure characteristics . |
| [15](#_ENREF_15) | Burgoine [2016] | Test whether observed differences in FF consumption and obesity by FF outlet exposure are moderated by educational attainment | CS [2005-2013] | Cambridgeshire County, UK [CT] | 5,958 [29-62 yrs] | ● Address ● Workplace ● Food outlet | ● Geocoding ● Buffer ● Overlay | Number of FF outlets and supermarkets (1.6-km buffer) | ● Greater FF consumption, BMI, and odds of obesity were associated with greater FF outlet exposure and a lower educational level. ● High FF outlet exposure amplified differences in FF consumption across levels of education.  ● The relation between FF outlet exposure and obesity was only significant among those who were least educated. |
| [16](#_ENREF_16) | Carlson [2016] | Examine associations between built environment and WS in middle- and older-aged women | CS | San Diego, US [C] | 5,085 [50-79 yrs] | ● Address  ● Census | ● Geocoding  ● Network  ● Buffer  ● Overlay | ● Residential density  ● Number of parks  ● Land-use mix  ● Intersection density  (0.8-km road network buffer) | BMI was 0.22 units higher and the odds ratio for being obese (vs. normal or overweight) was 8% higher for every standard deviation decrease in neighborhood activity supportiveness. |
| [17](#_ENREF_17) | Casey [2012] | Determine whether individual and environmental SES characteristics modulated the relationships between youth overweight and spatial accessibility to PA facilities and food outlets | CS [2001] | Bas-Rhin Department, France [S] | 3,293  [12±0.6 yrs] | ● PA facility  ● Food outlet  ● Census  ● Urbanization | ● Geocoding  ● Overlay  ● Kernel density | ● Distance to PA facilities and food outlets  ● Number of food outlets (1-km buffer) | ● For children of blue-collar-workers, the likelihood of overweight was negatively associated with spatial accessibility to urban PA facilities and food outlets.  ● Individual SES modulated relationships between overweight and spatial accessibility to PA facilities and food outlets. |
| [18](#_ENREF_18) | Cerin [2011] | Examine associations of accessibility, availability, price, and quality of food choices and neighborhood urban design with WS and utilitarian walking | CS [2001-2005] | Atlanta, US [C] | 274 [18-65 yrs] | ● Food outlet  ● Parcel  ● Census  ● Road network | ● Overlay  ● Network | ● Number of and distance to grocery, convenience, and FF stores, and restaurants  ● Number of diverse types of food outlets  ● Net residential density  ● Retail density  ● Land-use mix  Intersection density  (1-km network buffer) | ● The numbers of convenience stores and in-store healthful food choices were positively related to walking for errands.  ● Intersection density was positively related to walking for eating purposes in men, not in women.  ● Negative associations with overweight/obesity unexplained by walking were found for the numbers of grocery stores and healthful food choices in sit-down restaurants. |
| [19](#_ENREF_19) | Cetateanu [2014] | Assess the association between WS in children, food environment, and area deprivation | CS [2007-2010] | England, UK [S] | 3,003,258 [4-5 & 10-11 yrs] | ● Commercial facility  ● Census | Overlay | Number of FF outlets, other unhealthy food outlets, and mixed food outlets | ● The prevalence of overweight and obesity in children was positively associated with the density of unhealthy food outlets, and was negatively associated with other types of food outlets.  ● Food environment explained only a small proportion of the observed associations between WS and socioeconomic deprivation. |
| [20](#_ENREF_20) | Christian [2011] | Examine the individual, behavioral, social and built environment correlates of BMI | CS [2003-2005] | Perth, Australia [C] | 1,151 [mean=40 yrs] | ● Road network ● Census ● Land use ● Food outlet ● PA facility | ● Geocoding ● Overlay ● Network ● Buffer | ● Walkability score ● Food outlet index ● PA index | BMI was not associated with any objective measures of the built environment but was independently associated with one perceived environment measure (perceived safety from crime). |
| [21](#_ENREF_21) | Coakley [2014] | ● Determine how to use ground-truthing and tablet personal computer technologies to create a visual database of food environment  ● Determine whether accuracy of food sources recalled by children has improved with the use of the Baltimore Food Source Software (BFSS) and its visual database | CS | Baltimore, US [C] | 12 [10-14 yrs] | Food source | GIS visualization | N/A | BFSS program correctly identified 84% of food sources described by children. |
| [22](#_ENREF_22) | Cohen [2015] | ● Compare five common measures of rurality  ● Assess patterns in the correlations between prevalence of obesity in the population aged 60+ and each of the five measures of rurality | EC | US [N] | N/A | ● Rural–urban continuum code  ● Urban influence code  ● Population density  ● Urban population %  ● Index of Relative Rurality | N/A | ● Rural–urban continuum code  ● Urban influence code  ● Population density  ● % of urban population  ● Index of Relative Rurality | The associations between measures of rurality and obesity in the 60+ population varied by rurality measure used and by region |
| [23](#_ENREF_23) | Colabianchi [2014] | ● Examine the degree to which the self-defined neighborhood where adolescent are physical active overlay common neighborhood ● Examine the relationship between neighborhood environment and PA/obesity | CS | Cuyahoga County, Ohio, US [CT] | 145 [14-17 yrs] | ● Address ● Road network ● Restaurant ● Recreation center ● Food store ● Park ● Commercial PA facility | ● Geocoding  ● Overlay ● Network ● Buffer ● Minimum convex polygon | Number of restaurants, recreation centers, food stores, parks, and commercial PA facilities (census tract, 1.2-km network buffer, and self-defined neighborhood) | ● Limited spatial overlap was observed across census tract/buffer and self-defined neighborhood. ● No statistically significant associations were found between the number of facilities in self-defined neighborhood and PA/obesity. ● Number of parks was inversely associated with obesity, and the numbers of restaurants and food stores were positively associated with PA in 0.75 mile buffer neighborhood. ● Absence of commercial PA facilities was positively associated with overweight ● Number of recreation centers was positively associated with PA in census neighborhood. |
| [24](#_ENREF_24) | Coombes [2010] | Provide new evidence on associations between overweight and obesity and objectively measured access to green space, frequency of green space use, and PA level | CS [2005] | Bristol, UK [C] | 6,821 [>16 yrs] | ● Address  ● Green space  ● Road network  ● Land use  ● Census | ● Geocoding  ● Network  ● Buffer  ● Overlay | ● Distance to green space  ● Density of roads, intersections, and buildings  ● Ratio of junctions to cul-de-sacs  ● Ratio of actual neighborhood to potential neighborhood areas  ● Land-use mix  ● % of residential and commercial buildings (800-m road network buffer) | ● The reported frequency of green space use declined with distance increasing.  ● The respondents living closest to formal park were more likely to achieve recommended PA levels, and less likely to be overweight or obese.  ● Road density was correlated positively with PA and negatively with obesity status; the former association remained after adjustment for covariates. |
| [25](#_ENREF_25) | Corsino [2013] | ● Identify factors affecting obesity-related lifestyle behaviors  ● Assess policies, resources, and population's perception of obesity  ● Develop plans to improve obesity-related health outcomes | FG [2009-  2011] | Durham, US [C] | N/A | ● Health care facility  ● PA facility  ● Food resource | Overlay | N/A | PA and nutrition resources were not evenly distributed throughout Durham, North Carolina of the US. |
| [26](#_ENREF_26) | Crider [2014] | Identify those counties with the highest proportion of at-risk workers *per capita* | EC [2012] | Alabama, US [S] | N/A | ● Census  ● Leisure time physical inactivity prevalence | GIS visualization | N/A | Proportion of employees in the MET 3–5.99 category were marginally positively correlated to work-related heat-related illness (*p* = 0.08). |
| [27](#_ENREF_27) | Crawford [2010] | Determine the independent contributions of family and neighborhood environments to changes in youth PA and BMI z-score over 5 years | LO [2001-2006] | Melbourne, Australia [C] | 301 [10-12 yrs] | ● Address ● Road network ● Public open space | ● Geocoding  ● Overlay ● Buffer | ● Number of freely accessible public open space, and sport/recreation open space ● Total length of walking/cycling tracks, access paths, local roads, and busy roads ● Number of intersections, cul-de-sacs  ● Proportion of >3-way intersections (2-km buffer) | ● Presence of dead-end roads were positively associated with PA among boys. ● Other neighborhood environment factors were not associated with PA or BMI z-score. |
| [28](#_ENREF_28) | Crawford [2015] | Identify longitudinal individual, social and environmental predictors of adiposity, and of resilience to unhealthy weight gain, in healthy weight children and adolescents | LO [2007-2011] | Australia [N] | 200 [5-12 yrs] | ● Address ● FF outlet ● Supermarket ● Greengrocer ● Public swimming pool ● Playground | ● Geocoding  ● Overlay ● Buffer | ● Availability of FF outlets, supermarkets, greengrocers, and public swimming pools  (2-km buffer) ● Availability of playgrounds (800-m buffer) | Objectively measured neighborhood environment factors were not associated with BMI z-score and resilience to unhealthy weight gain. |
| [29](#_ENREF_29) | Cutts [2009] | Evaluate relationships between populations vulnerable to obesity and proximity to parks and walkable street networks | EC | Phoenix, US [C] | N/A | ● Census data  ● Road network  ● Land parcel  ● Park | ● Overlay  ● Buffer | ● Land-use mix  ● Density of households and intersections  ● Distance to parks (0.64-km buffer) | Subpopulations generally considered vulnerable to obesity and environmental injustices were more likely to live in walkable neighborhoods and have better walking access to neighborhood parks than other groups in Phoenix, Arizona of the US. |
| [30](#_ENREF_30) | Day [2011] | ● Determine whether food outlets were clustered around schools  ● Evaluate the extent of food outlet clustering by school and school neighborhood sociodemographic characteristics | EC [2008] | North Shore, Waitakere, Lower Hutt, Wellington, Christchurch, New Zealand [C5] | N/A | ● School address  ● FF outlet and convenience store  ● Census  ● Land use  ● Road network | ● Geocoding  ● Buffer  ● Network  ● Overlay  ● Spatial statistics | ● Number of food outlets  ● Proportion of food outlets per 1000 students (400-/800-m buffer around school) | ● The most socially deprived quintile of schools had 3 times the number and proportion of food outlets compared to the least-deprived quintile.  ● There was a high degree of clustering of food outlets around schools, with up to 5.5 times more than expected.  ● Outlets were most clustered up to 800-m from schools and around secondary schools, socially deprived schools, and schools in densely populated and commercially zoned areas. |
| [31](#_ENREF_31) | Drewnowski [2014] | Compare associations between food environment, SES and obesity rates in two cities | CS [2007-2009] | Seattle, US & Paris, France [C2] | ● 1,340 in the US  ● 7,173 in France | ● Address  ● Parcel  ● Residential dwelling value  ● Food establishment  ● Supermarket | ● Geocoding  ● Overlay  ● Network  ● Buffer | Distance to primary supermarkets | No association was observed between distance to the primary supermarkets and obesity risk. |
| [32](#_ENREF_32) | Drewnowski [2016] | Examine geographic distribution of the Healthy Eating Index in relation to residential property values | CS | King County, US [CT] | 1,116 [>18 yrs] | ● Address  ● Parcel  ● Residential property value | ● GIS visualization  ● Geocoding  ● Overlay | N/A | Higher residential property values, education, and incomes were associated with healthier eating behavior. |
| [33](#_ENREF_33) | Duncan [2011] | Evaluate validity of Walk Score for assessing neighborhood walkability based on GIS indicators of neighborhood walkability | CS [2006-  2007] | 4 metropolitan areas, US [C4] | 733 [5-11 yrs] | ● Address  ● Road network  ● Census  ● Walking destination  ● Park  ● Median pedestrian route directness  ● Walk Score | ● Geocoding  ● Overlay  ● Buffer  ● Spatial Statistics | ● Density of retail walking destinations, service walking destinations, cultural/ educational walking destinations, intersections, highways, population, and parks  ● Median pedestrian route directness  ● Number of cul-de-sacs  ● Average speed limit (400-, 800-, 1600-m buffer) | ● There were many significant moderate correlations between Walk Scores and the GIS neighborhood walkability indicators. Correlations became stronger with a larger spatial scale, and there were some geographic differences.  ● Walk Score was a valid measure of estimating certain aspects of neighborhood walkability, particularly at the 1600-m buffer. |
| [34](#_ENREF_34) | Duncan [2012] | ● Investigate spatial relationships between various built environment features and BMI z-score among adolescents  ● Examine whether the relationships above was modified by race/ethnicity  ● Evaluate the sensitivity of findings to the spatial scale of analysis | CS [2008] | Boston, US [C] | 1,034 [9-12 grade] | ● Address  ● Recreational open space and public transit  ● Park  ● Retail, service and cultural/ educational walking destination  ● Road network  ● Sidewalk | ● Geocoding  ● Overlay  ● Buffer  ● Spatial statistics | ● Density of recreational open space, parks, bus stops, subway stops, retailing walking destinations, service walking destinations, cultural/education walking destinations, intersections, and highways  ● Sidewalk completeness  ● Average sidewalk width  ● Average speed limit  ● Residential density  (400-, 800-m buffer) | ● There was significant positive spatial autocorrelation in the examined built environment features, but not in BMI z-score.  ● Most built environment features were not associated with BMI z-score.  ● Density of bus stops was associated with a higher BMI z-score among whites. Sidewalk completeness was significantly associated with a higher BMI z-score for the total sample. These significant associations were found for the 800-m buffer. |
| [35](#_ENREF_35) | Duncan [2014] | Examine associations of walkable built environment characteristics with BMI z-score among children and adolescents | LO [2008-  2012] | Massachusetts, US [S] | 46,813 [4-19 yrs] | ● Recreational open space  ● Census  ● Road network  ● Traffic  ● Business point  ● Address | ● Network  ● Overlay  ● Buffer  ● Geocoding | ● Distance to the nearest recreational open space  ● Number of recreational open space  ● Density of traffics and intersections  ● Residential density  ● Average speed limit  ● Sidewalk completeness (census tract) | ● Distance to the nearest recreational open space was negatively associated with BMI z-score, but was not significantly associated with BMI z-score changes over time.  ● Living in neighborhoods with fewer recreational open spaces and less residential density, traffic density, sidewalk completeness, and intersection density were associated with higher cross-sectional BMI z-score and with an increase in BMI z-score over time.  ● Average speed limit was not significantly associated with BMI z-score or BMI z-score changes over time. |
| [36](#_ENREF_36) | Dunton [2012] | Determine whether participation in organized outdoor team sports and structured indoor nonschool activity programs  predicted subsequent change in BMI during the adiposity rebound period of childhood. | LO [2002-2006] | Southern California, US [C] | 4,550 [mean=6.6 yrs] | ● Address ● FF restaurant ● Census | ● Geocoding ● Overlay | Number of FF restaurants  (500-m buffer) | ● BMI increased at a rate 0.05 unit/year slower for children who participated in outdoor organized team sports at least twice per week compared with children who did not.  ● For participation in each additional indoor nonschool structured activity class, lesson, and program, BMI increased at a rate 0.05 unit/year slower, and the attained BMI level at age 10 years was 0.48 units lower. |
| [37](#_ENREF_37) | Ferguson [2013] | Explore distribution of access to PA facilities by car and bus by income deprivation | EC | Scotland, UK [S] | N/A | ● Population density  ● Scottish Index of Multiple Deprivation income domain score  ●Urban-rural classification  ● Recreational PA facility  ● Car and bus network | ● Network  ● Spatial statistics | Number of PA facilities (10-, 20- ,30-minutes travel time buffer) | ● Access to PA facilities by car was significantly higher for the most affluent quintile of income deprivation than for most other quintiles in small towns and all other quintiles in rural areas.  ● Accessibility by bus was significantly lower for the most affluent quintile than for other quintiles in urban areas and small towns, but not in rural areas  ● The most disadvantaged groups were those without access to a car and living in the most affluent areas or in rural areas. |
| [38](#_ENREF_38) | Fiechtner [2013] | Examine associations of proximity to food establishments with BMI among preschool-age children | CS [2006-2009] | Massachusetts, US [S] | 438 [2-6.9 yrs] | ● Road network ● Food establishment ● Address | ● Geocoding ● Overlay ● Network | Distance to convenience stores, bakeries, coffee shops, candy stores, restaurants, supermarkets, and FF restaurants | ● Compared to children living >3.2km from a large supermarket, those who lived within 1 mile had a BMI 1.06 kg/m2 higher. ● Adjustment for SES and distance to FF restaurants attenuated this estimate to 0.77 kg/m2. ● Living in any other distance category from a large supermarket and proximity to other food establishments were not associated with child BMI. |
| [39](#_ENREF_39) | Frank [2012] | Describe development of GIS-based multi-component PA and nutrition environment indicators of child obesogenic environments | EC | San Diego, Seattle, US [C2] | N/A | ● Census  ● Road network  ● Land use  ● Park  ● Parcel  ● FF outlet | ● Buffer  ● Overlay | ● Walkability (net residential density, intersection density, land-use mix, retail floor area ratio) (0.4-km buffer around block group)  ● Presence of parks  ● Distance to parks and supermarkets  ● Density of FF outlets (block group) | ● High PA environment block groups had at least one high-quality park within 0.4 km and were above median walkability  ● Whereas low PA environment block groups had no parks and were below median walkability.  ● High nutrition environment block groups had a supermarket within 0.8 km, and fewer than 16 (Seattle) and 31 (San Diego) FF restaurants within 0.8 km.  ● Low nutrition environments had either no supermarket, or a supermarket and more than 16 (Seattle) and 31 (San Diego) FF restaurants within 0.8 km. |
| [40](#_ENREF_40) | Fraser [2010] | Examine the association between childhood overweight and obesity and the density and proximity of FF outlets | CS [2004-05] | Leeds, UK [C] | 33,594 [3-14 yrs] | ● FF outlet  ● Address  ● Super-output area boundary | Overlay | ● Number of FF outlets  ● Distance to FF outlets | ● A higher density of FF outlets was significantly associated (*p*=0.02) with the child being obese (or overweight/obese).  ● No significant association between the distance to the nearest FF outlets and overweight or obese status was found. |
| [41](#_ENREF_41) | Fraser [2012] | Explore associations between food outlet location, deprivation, WS and ethnicity | CS [2007-  2010] | Bradford, UK [C] | 1,198 pregnant women | Food outlet | ● Geocoding  ● Overlay  ● Buffer | ● Distance to the nearest food outlets  ● Number of food outlets (250-, 500-, and 1000-m buffer) | ● The numbers of specialist food outlets, grocery stores and convenience stores were positively associated with BMI among non-South Asian group.  ● There was a negative association between BMI and FF outlet density/ proximity in the South Asian group.  ● Women in areas of high deprivation had greater access to food outlets. |
| [42](#_ENREF_42) | Gebel [2011] | Examine whether persons who perceive their objectively measured high walkable environment as low walkable decrease their walking more and gain more weight than those with matched perceptions | LO [2004-2007] | Adelaide, Australia [C] | 1,027 [20-65 yrs] | N/A | N/A | ● Walkability ● Dwelling density ● Street connectivity ● Land-use mix ● Retail density | ● Those who perceived high walkability, dwelling density or land use mix as low decreased their walking for transport significantly more than those with matched perceptions. ● Those who perceived high walkability, land use mix or retail density as low increased their BMI significantly more than those with concordant perceptions. |
| [43](#_ENREF_43) | Ghirardelli [2010] | ● Examine conditions that affect obesity to inform program planning, nutrition education, community participation, investment of resources, and involvement of stakeholders in low-income neighborhoods | EC [2007-2009] | California, US [S] | N/A | Retail food store | ● Geocoding  ● Overlay | ● % of residents  within walking distance to healthy food (0.8-km buffer)  ● Number of small markets  and convenience stores (0.8-km network buffer) | ● 31% of neighborhoods had no supermarket within any of their census tract boundaries, but health department estimated that 74.2% of residents had access to a large grocery store within 1.6 km.  ● 81% of small markets sold produce, and 67.6% offered 4 or more types of fresh vegetables. |
| [44](#_ENREF_44) | Ghosh [2013] | ● Determine how topic modeling can be used to identify relevant public health topics such as obesity on Twitter.com  ● Determine common obesity-related themes, spatial pattern of themes, and research challenges of using large conversational datasets from social networking sites | CS [2011-2012] | US [N] | 455,981 tweets | Tweets data | ● Geocoding  ● Spatial statistics | N/A | ● Obesity-related tweets terms show distinct spatial pattern between rural and urban areas, northern and southern states, and between coasts and inland states. |
| [45](#_ENREF_45) | Glicksman [2013] | ● Test whether residents will exercise more, eat healthier, and suffer from less obesity in a walkable neighborhood  ● Test whether the relationships above will be stronger for elderly | CS [2008] | Philadelphia, US [C] | 4,394 [3,051 aged 18-59 yrs & 1,343 aged >60 yrs] | ● Vacant property  ● Bus stop  ● Corner store  ● Restaurant  ● Pharmacy  ● Fitness center  ● Dwellings data | N/A | ● Density of murders, corner stores, coffee shops, book stores, bus stops, murals, restaurants, pharmacies, groceries, and fitness centers  ● Proportion of vacant properties | ● No statistically significant relation between walkability score and PA, fruits and vegetable intake, and BMI  ● Age did not affect all relations between the 3 environmental factors we created and PA, fruits and vegetable intake, and BMI. |
| [46](#_ENREF_46) | Gordon-Larsen [2006] | Assess the geographic and social distribution of PA facilities and how disparity in access might underlie population-level PA and overweight patterns | CS [1994-1995] | US [N] | 20,475 [7-12 yrs] | ● Address  ● Census  ● PA Facility | ● Geocoding  ● Buffer  ● Overlay | Number of PA facilities  (8.05-km buffer) | ● Higher-SES block groups had asignificantly greater relative odds of having 1 or more facilities; Low-SES and high-minority block groups were less likely to have facilities.  ● Relative to zero facilities per block group, an increasing number of facilities was associated with decreased overweight and increased relative odds of achieving ≥ 5 bouts per week of moderate-vigorous PA. |
| [47](#_ENREF_47) | Gose [2013] | Examine longitudinal 4-year-relationships between neighborhood social environment and children’s BMI-standard deviation score (BMI-SDS) taking into account the built environment. | LO [2006-2012] | Kiel, Germany [C] | 485 [4.8-6.4 yrs] | ● Address ● Food outlet ● Traffic ● Walkability | ● Geocoding ● Overlay ● Buffer | ● Street length ● Number of FF outlets ● Distance to playgrounds and park/green space (800-m buffer) ● Traffic density ● Walkability | ● Walkability, street type, SES of the district and perceived frequency of passing trucks/busses were associated with BMI-SDS over 4 years, but only neighborhood SES had an effect on change in BMI-SDS. ● Familial/social factors rather than neighborhood environment (especially social environment) had an impact on children’s BMI-SDS over 4 years. |
| [48](#_ENREF_48) | [Gutiérrez-Zornoza](http://www.ncbi.nlm.nih.gov/pubmed/?term=Guti%C3%A9rrez-Zornoza%20M%5BAuthor%5D&cauthor=true&cauthor_uid=25228370) [2015] | ● Examine whether distance from home to school is a determinant of active commuting ● Examine the relationship between distance from home to school, green spaces, and sports facilities and the WS and cardiometabolic risk categories ● Examine whether active commuting has a positive impact on schoolchildren's health | CS [2006] | Cuenca Province, Spain [CT] | 956 [10-12 yrs] | Aerial photograph | N/A | Distance from home to school, green space, and sports facilities | ● Children living closer to school commuted actively more frequently than children living further away. ● Normoweight boys lived further away from sports facilities than overweight /obese peers, and children presenting higher cardiometabolic risk levels lived closer to school than those who did not. ● No differences were found between children who daily active commuting to school and those commuting actively less frequently in BMI, metabolic syndrome index, fitness, and PA. |
| [49](#_ENREF_49) | Hanibuchi [2011] | Examine associations of local food environment with BMI of older individuals | CS [2006-  2007] | 9 municipalities, Japan [C9] | 12,595 [> 65 yrs] | ● Address  ● Food outlet  ● Census  ● Topographic Map of Japan  Digital Map | ● Geocoding  ● Buffer  ● Network  ● Overlay | ● Density of supermarkets, convenience stores, and FF outlets  ● Distance to supermarkets, convenience stores, and FF outlets (500-m buffer) | ● Better access to supermarkets was related to higher BMI, and overweight or obesity, but not related to being underweight.  ● Better access to FF outlets or convenience stores was also associated with higher BMI, but only among those living alone. |
| [50](#_ENREF_50) | Hansen [2009] | Examine extent and quality of sidewalks using walkability assessment | EC [2004-  2005] | Campbell County, US [CT] | N/A | ● Sidewalk  ● Census | ● Digitalization  ● Overlay | Sidewalk score | ● Higher overall sidewalk scores for older urban areas adjacent to the Ohio River and Cincinnati.  ● Housing built in the 1970s and 1980s showed the lowest scores while more recent housing showed improvement over earlier decades.  ● Age of housing was determined to be a useful predictor while economic and population density attributes showed no correlation with walkability factors. |
| [51](#_ENREF_51) | Hemphill [2008] | Explore the relationship between the placement of FF outlets and neighborhood-level socioeconomic variables by determining if indicators of lower SES were predictive of exposure to FF | EC [2001] | Edmonton, Canada [C] | N/A | ● Census  ● FF outlet | ● Geocoding  ● Overlay | Number of FF outlets | Significant differences were found between the three levels of FF accessibility across the socioeconomic variables, with successively greater % of unemployment, low income, and renters in neighborhoods with increasingly greater access to FF restaurants. |
| [52](#_ENREF_52) | Hill [2012] | ● Test whether lower income and racially diverse block groups had fewer food outlets and fewer PA outlets  ● Test whether walkability was lower in lower income block groups | EC | Pittsylvania and Henry County, Virginia & Caswell County, North Carolina, US [CT3] | N/A | ● Census  ● Retail food outlet and restaurant  ● Land use  ● PA facility | ● Geocoding  ● Overlay  ● Spatial Statistics | ● Intersection density  ● Residential density  ● Land-use mix  ● Number of food outlets and PA resources (block group) | ● There were no differences in the number of PA/food outlets by block group income/race.  ● Spatial analyses suggested that distribution of PA/food outlets was dispersed across all block groups. |
| [53](#_ENREF_53) | Hinckson [2014] | Investigate the association between the distance to school and children's sedentary behavior during weekdays | CS [2008-2010] | North Shore, Waitakere, Wellington, Christchurch, New Zealand [C4] | 295 [5-13 yrs] | Address | ● Overlay  ● Network | ● Intersection density  ● Dwelling density  ● Retail floor area ratio  ● Land-use mix  ● Distance to schools | ● Children living in the 2nd tertile of distance from school were the least sedentary during the school traveling periods compared to those living in the 1st or 3rd distance tertiles.  ● Children who traveled by motorized transport were more sedentary for each of the distance tertiles. |
| [54](#_ENREF_54) | Hirsch [2014] | Examine longitudinal associations of the neighborhood built environment with BMI and waist circumference | LO [2000-2012] | Baltimore, Chicago, Forsyth County, Los Angeles, New York City, St. Paul, US [C6] | 5,506 [45-84 yrs] | ● Address ● Census ● Land use ● Destination ● Transportation stop ● Road network | ● Geocoding ● Network ● Overlay ● Buffer | ● % of retail and residential areas ● Density of walking destinations ● Distance to buses ● Network ratio ● Street connectivity | ● Increases in the intensity of development (higher density of walking destinations and population density, and lower percent residential) were associated with less pronounced increases or decreases over time in BMI and waist circumference. ● Changes in connected retail centers (higher percent retail, higher street connectivity) and public transportation (distance to buses) were not associated with changes in BMI or waist circumference. |
| [55](#_ENREF_55) | Hoehner [2013] | Examine the associations of built environment features around the home and workplace with cardiorespiratory fitness (CRF) based on a treadmill test and BMI | CS [2000-07] | 12 counties in Texas, US [CT12] | 4,734 [20-88 yrs] | ● Address  ● Recreational facility  ● Road network | ● Geocoding  ● Overlay  ● Network  ● Buffer | ● Household density  ● Land-use mix  ● Intersection density  ● Area of vegetation  ● Sidewalk coverage  ● Average speed limit (800-m network buffer)  ● Number of parks and exercise facilities  ● Average number of features in parks (1.6-km network buffer)  ● Distance to city centers and parks with trails | CRF and BMI were associated with higher intersection density, higher numbers of private exercise facilities around the home and workplace, larger area of vegetation around the home, and shorter distance to the closest city centers. |
| [56](#_ENREF_56) | Hosler [2009] | ● Assess the availability of selected retail foods and cigarettes  ● Explore ecologic relationships of the availability with obesity and smoking in rural communities. | EC [2003] | Columbia and Greene County, New York, US [CT2] | N/A | ● Census ● Food store | Spatial statistics | Number of supermarkets, grocery stores, farm stores, convenience stores, gas station stores | ● Nutritionally important foods were most available in the semi-urbanized region, followed by the rural heartland, the remote mountains region, and the most urbanized inner-town. ● No signiﬁcant difference was found in the availability of general food items and cigarettes. ● Overweight/obesity was inversely associated with the availability of fresh fruit, vegetables, and low-fat milk. ● Smoking was positively associated with the availability of cigarettes, white bread, whole milk, and eggs. |
| [57](#_ENREF_57) | Huang [2015] | ● Locate obesity clusters  ● Analyze obesity clusters in relation to the neighborhood built environment | CS [2008-2009] | King County, Washington, US [CT] | 1,602 [>18 yrs] | Address | ● Geocoding  ● Overlay  ● Spatial Statistics | ● Residential density  ● Residential property value  ● Density of supermarkets and grocery stores  ● % of park land  ● Trafﬁc volume  ● Intersection density | ● Both the *Local Moran's I* and spatial scan statistic identified similar spatial concentrations of obesity.  ● High and low obesity clusters were attenuated after adjusting for age, gender, race, education and income. |
| [58](#_ENREF_58) | Jeffery [2006] | Examine whether living or working near FF restaurants was associated with body weight | CS | Minnesota, US [S] | 1,033 [> 18 yrs] | ● Food outlet  ● Home and work address | ● Geocoding  ● Buffer  ● Overlay | Density of FF restaurants and other restaurants (0.8-, 1.6-, 3.2-km buffer) | ● Eating at FF restaurants was positively associated with having a high fat diet and BMI.  ● It was negatively associated with vegetable consumption and PA.  ● Proximity of FF restaurants to home or work was not associated with eating at FF restaurants or with BMI.  ● Proximity of non-FF restaurants was not associated with BMI, but was associated with frequency of eating at those restaurants. For men only, there was a significant inverse relationship between BMI and restaurant proximity from work place. |
| [59](#_ENREF_59) | Jennings [2011] | Examine how WS and dietary intake were associated with neighborhood food outlets among children | CS [2007] | Norfolk, UK [C] | 1,669 [9-10 yrs] | ● Food outlet  ● Address  ● Road network | ● Geocoding  ● Buffer  ● Network  ● Overlay | Density of supermarkets, grocery stores, FF outlets, restaurants, food outlets, and convenience stores (800-m buffer) | ● Availability of BMI-healthy outlets (supermarkets and grocery stores) in neighborhoods was associated with lower body weight, BMI, BMI z-score, waist circumference, and % of body fat compared to no availability.  ● Neighborhood availability of BMI-unhealthy outlets (convenience stores and FF) was inversely associated with body weight, BMI, BMI z-score, waist circumference, and % of body fat.  ● Unhealthy food intake was also associated with availability of BMI-unhealthy food outlets. |
| [60](#_ENREF_60) | Jilcott Pitts [2011] | Examine associations between various measures of the food environment and BMI percentile among youth | CS [2007-2008] | Pitt County, North Carolina, US [CT] | 744 [mean=12.9 yrs] | ● Address ● Food venue ● Road network | ● Geocoding ● Overlay ● Buffer ● Network | Distance to and density of grocery, convenience, FF/pizza, and dollar stores, restaurants, supercenters, supermarkets, and farmers markets (0.4-, 0.8-, 1.6-, and 8-km Euclidean and network buffer) | ● The network distance to convenience stores was negatively associated with BMI percentile  ● Proximity to farmers' markets was positively associated with BMI percentile. |
| [61](#_ENREF_61) | Jilcott Pitts [2012] | Examine associations between BMI and the food environment among adult female | CS [2009-2010] | Pitt County, North Carolina, US [CT] | 197 [20-64 yrs] | ● Address ● Food venue ● Road network | ● Geocoding ● Overlay | ● Distance to food venues ● Walk score | ● Frequency of supercenter use was significantly inversely associated with distance to supercenters. ● Walk Score was significantly inversely associated with BMI.  ● BMI was not associated with distance to or use of any particular food venue. |
| [62](#_ENREF_62) | Jilcott Pitts [2015] | Examine cross-sectional associations among neighborhood- and individual-level factors related to a healthful lifestyle and dietary intake, PA, and support for obesity prevention polices | CS [2011-  2012] | Lenoir County, North Carolina, US [CT] | 366 [> 18yrs] | ● Address  ● Food outlet ● PA facility | ● Buffer  ● Overlay  ● Network  ● Geocoding | ● Density of FF outlets, supermarkets, farmers' markets, parks, trails, and gyms (1.6-km buffer) | ● There was an inverse association between better diet quality and perceived neighborhood nutrition barriers and GIS nutrition distance.  ● There were no significant associations between PA, BMI, and perceived or GIS-measured neighborhood factors. |
| [63](#_ENREF_63) | Kelishadi [2014] | Assess distribution of growth disorders in terms of BMI and height in 6-year-old Iranian children using GIS | CS [2009] | Iran [N] | 955,388 [6 yrs] | N/A | GIS visualization | N/A | ● The growth disorders were not equally distributed across various provinces. |
| [64](#_ENREF_64) | Kestens [2010] | Evaluate relationships among food sources around schools, neighborhood income, and commercial density | EC [2005] | Montreal, Canada [C] | N/A | ● Primary and secondary school  ● Road network  ● Business and service  ● Census | ● Geocoding  ● Network  ● Buffer  ● Overlay | ● Density of and distance to FF outlets, fruit and vegetable stores, hairdressing salons, and restaurants (750-m buffer) | ● Compare to the highest income-quartile schools, the odds ratio of a FF outlet being located within 750-m of a low income-  quartile school was 30.9.  ● Similar relationships were observed for full-service restaurants and fruit and vegetable stores. |
| [65](#_ENREF_65) | Kim [2014] | Examine the association between landscape spatial patterns and obesity in Hispanic children | CS | Houston, US [C] | 61 [4-5 grade] | ● Aerial photo image  ● Address | ● Buffer  ● Overlay  ● Image classification | ● Number of patches  ● Patch density  ● Mean patch size  ● Fragmentation Measurement Index  ● Total area  ● % of landscape  ● Total edge  ● Landscape Shape Index  ● Mean Shape Index  ● Mean nearest neighborhood distance  ● Patch Cohesion Index  (0.8-km buffer) | ● More tree patches and well-connected landscape patterns were negatively correlated with BMI z-scores.  ● Larger sizes of urban forests and tree patches were negatively associated with children's BMI z-scores. |
| [66](#_ENREF_66) | Kim [2016] | Examine associations between urban natural environment and obesity and health-related quality of life (HRQOL) among Hispanic children | CS | Houston, US [C] | 92 [9-11 yrs] | High-resolution Digital Orthophoto Quarter Quadrangle (DOQQ) image | ● Buffer | ● % of landscape  ● Number of patches  ● Mean patch size  ● Mean Shape Index  ● Mean nearest neighbor distance (0.4-, 0.8-km buffer)  ● Patch Cohesion Index | ● Children’s BMI showed a significantly negative association with their HRQOL.  ● Larger and more tree areas were positively correlated with children’s HRQOL.  ● Children living in areas with tree patches further apart from each other showed higher HRQOL. |
| [67](#_ENREF_67) | King [2011] | Examine the relations among objectively measured neighborhood design, mobility impairment, and PA and body weight | LO [2005-2008] | Seattle, Baltimore, US [C2] | 719 [≥66 yrs] | ● Census  ● Road network  ● Parcel  building square footage | ● Overlay  ● Network | ● Net residential density  ● Retail floor area ratio  ● Land-use mix  ● Intersection density | ● Older adults living in more walkable neighborhoods had more transport activity and moderate-to-vigorous PA and lower BMI relative to those living in less walkable neighborhoods.  ● The most mobility-impaired adults living in more walkable neighborhoods reported transport activity levels that were similar to less mobility-impaired adults living in less walkable neighborhoods. |
| [68](#_ENREF_68) | Kowaleski-Jones [2013] | Examine the influence of neighborhood characteristics on child risk for overweight | CS [2003-2004] | US [N] | 1,753 [2-11 yrs] | ● Census  ● Rural–urban commuting area codes  ● Tree canopy  ● Park | ● Overlay  ● Image classification | ● % of areas covered by tree canopy within each 30-m pixel  ● Distance from neighborhood centroids to the nearest seven parks  ● % of individuals commuting at least 1 hour per day to work | ● Longer commuting time within the census tract was associated with higher overweight risk.  ● Boys' risk of overweight was associated with living in rural areas. |
| [69](#_ENREF_69) | Kyttä [2012] | ● Determine the relationship between urban structure characteristics ● Determine the relationship between children's environmental experiences and active behavioral patterns ● Determine the relationship between perceived health and BMI | CS [2008] | Turku, Finland [C] | 1,837 [10-15 yrs] | ● Address ● Census ● Cartographic map | ● Geocoding ● Overlay ● Buffer | ● Residential density ● Proportion of green structure  (500-m buffer) | ● Residential density was significantly associated with active travel mode to school and short distances to the meaningful places of children.  ● The proportions of green structure and children had an association with nonactive transport, long distance to meaningful places, and small territorial range. ● There were negative association between likability index and daily symptoms and positive association with perceived health. |
| [70](#_ENREF_70) | Lahti-Koski [2008] | Investigate and visualize the geographical differences in general obesity (BMI) and in abdominal obesity (waist circumference and waist-to-hip ratio) in Finland | CS [1997-2000] | Finland [N] | 17,816 [30-64 yrs] | Geographical coordinates of participants | N/A | N/A | ● Both in men and women, the prevalence of obesity varied little across geographical areas, but it was smaller in cities compared with other areas across the country.  ● The prevalence of abdominal obesity was higher in western Finland compared with southern and northern Finland. |
| [71](#_ENREF_71) | Larson [2013] | ● Identify the most important home/family, peer, school, and neighborhood environmental characteristics associated with WS ● Determine the overall contribution of these contexts to explaining WS | CS [2009-2010] | Minneapolis/St. Paul, US [C] | 2,793 [6-12 grade] | ● Address ● School ● FF restaurant ● Convenience store ● Land use ● Road network ● Police report ● Recreation center ● Gym/fitness center ● Walking/biking trail ● Park | ● Geocoding ● Overlay ● Network ● Buffer | ● Presence of FF restaurants and convenience stores in school and home neighborhood (800-/1.2-km buffer) ● Distance to recreation centers, gym/fitness centers, and walking/biking trails ● Park and recreation space | ● Presence of FF restaurants around school was associated with higher BMI among boys. ● Presence of convenience stores around school was associated with lower BMI among boys and girls. However, presence of convenience stores in residential neighborhood was associated with higher BMI. ● Distance to recreation centers was positively associated with BMI among boys. ● Larger recreation space was associated with lower BMI. |
| [72](#_ENREF_72) | Laska [2010] | Examine neighborhood food environments, adolescent nutrition, and WS | CS [2006-2007] | Minneapolis/St. Paul, US [C] | 349 [11-18 yrs] | ● Address ● Census ● Road network ● Food outlet | ● Geocoding ● Overlay ● Buffer ● Network | ● Distance to and density of restaurants, convenience stores, grocery stores, retail facilities (0.8-, 1.6-, 3-km buffer) | ● Adolescents' sugar-sweetened beverage intake was associated with residential proximity to restaurants, convenience stores, grocery stores and other retail facilities within the 0.8 and/or 1.6km residential buffers. ● BMI Z-score and percentage body fat were positively associated with the presence of a convenience store within a 1.6km buffer.  ● Other individual-level factors, such as energy, fruit and vegetable intake, as well as convenience store and FF purchasing, were not significantly associated with features of the residential neighborhood food environment. |
| [73](#_ENREF_73) | Leslie [2014] | Assess associations between type and location of food sources and chronic liver disease (CLD) using GIS | CS | Washington D.C., US [C] | 267 [55.6±12 yrs] | ● Address  ● FF outlet | ● Geocoding  ● Overlay | Distance to food outlets | ● Hepatitis B (HBV) patients had significantly less distance to grocery stores, restaurants, and FF than Hepatitis C patients  ● HBV patients lived closer to grocery stores than nonalcoholic fatty liver disease patients |
| [74](#_ENREF_74) | Li [2008] | Investigated built environment and its associations with health and PA in the immediate pre-Baby Boom/early-Baby Boom generations | CS [2006-  2007] | Portland, US [C] | 1,221 [50-75 yrs] | ● FF restaurant  ● Land use  ● Public transit  ● Park | ● Geocoding  ● Overlay | ● Land-use mix  ● Density of FF outlets, public transit stations, and intersections  ● Area of green and open space for recreation  ● Residential density  (block group) | ● Each 10% increase in land-use mix was associated with a 25% reduction in the prevalence of overweight and obesity.  ● A 1-SD increase in the density of FF outlets was associated with a 7% increase in overweight/ obesity.  ● Higher mixed-use land was positively associated with all three types of walking activities and the meeting of PA recommendations.  ● Neighborhoods with high street connectivity, high density of public transit stations, and green and open spaces were related in varying degrees to walking and the meeting of PA recommendations. |
| [75](#_ENREF_75) | Li [2009] | Examine variation in obesity among older adults relative to the joint influences of density of neighborhood FF outlets and residents' behavioral, psychosocial, and sociodemographic characteristics | CS [2006-2007] | Portland, US [C] | 1,221 [50-75 yrs] | ● FF restaurant ● Land use ● Census | ● Geocoding ● Overlay | ● Land-use mix ● Density of FF restaurants ● Residential density | Significant associations were found between resident-level individual characteristics and the likelihood of being obese for neighborhoods with a high density of FF restaurants in comparison with those with a low density. |
| [76](#_ENREF_76) | Li [2014] | ● Investigate the association between neighborhood racial composition and adult obesity risks by race and gender ● Explore whether neighborhood social and built environment mediates the observed protective or detrimental effects of racial composition on obesity risks | CS [2006-2008] | Bucks, Chester, Delaware, Montgomery, and Philadelphia County, Pennsylvania, US [CT5] | 12,730 [>18 yrs] | ● Road network  ● Parks | ● Overlay ● Network | ● Intersection density ● Distance to parks | After controlling for neighborhood SES, black concentration and street connectivity are associated with lower obesity risks for white men. |
| [77](#_ENREF_77) | Li [2015] | ● Assess community food environment  ● Examine associations between food environment and childhood obesity | CS [2013] | Macon County, Alabama, US [CT] | 613 [4-13 yrs] | ● Food outlet  ● Address  ● Census | Geocoding | Probability of children visiting a food outlet | Supermarket was negatively associated with percentile of BMI, and FF outlet was not related to percentile of BMI. |
| [78](#_ENREF_78) | Lin [2007] | Examine the relationship between BMI and climate amenable for PA at the county level in the U.S. | CS [1990-2002] | US [N] | 182,946 | ● Weather  ● Census  ● Road network | ● Overlay  ● Network  ● Spatial interpolation | ● % of amenable hours  ● Road density | There was an inverse relationship between climate amenable to PA and BMI at the county level. |
| [79](#_ENREF_79) | Liu [2002] | Explore environmental and social predictors of obesity in children | CS [2000] | Indianapolis, US [C] | 2,554 [4-18 yrs] | ● Address  ● Playspace | Geocoding | Proximity to playspace | Low SES at the census tract level correlate with both overweight and obese outcomes in the study population. |
| [80](#_ENREF_80) | Liu [2007] | Examine relationships between overweight in children and environmental factors | CS [2000] | Indianapolis, US [C] | 7,334 [3-18 yrs] | ● Address ● Census ● Road network ● Satellite image ● Food outlet | ● Geocoding ● Overlay ● Buffer ● Network | ● Normalized Difference Vegetation Index ● Distance to food retails, grocery stores, convenience stores, FF restaurants, and supermarkets | ● Increased neighborhood vegetation was associated with decreased risk for overweight, but only for subjects residing in higher population density regions. ● Increased distance to large brand name supermarkets was associated with increased risk of overweight, but only for subjects residing in lower population density regions. |
| [81](#_ENREF_81) | Littenberg [2016] | Report experience obtaining the current state of driver's license data as an epidemiological resource | EC | Illinois, Maine, Michigan, Oregon, Texas, Vermont, Washington, US [S7] | N/A | Driver's license | Geocoding | N/A | Obesity is more prevalent among males and those living in less urbanized areas, based on a total of 52.6 million unique analyzable records from seven states. |
| [82](#_ENREF_82) | Lovasi [2012] | ● Evaluate whether potentially attractive neighborhood features are associated with lower BMI ● Evaluate whether safety hazards are associated with higher BMI ● Evaluate whether environment-environment interactions are present such that associations for a particular characteristic are stronger in an otherwise supportive environment | CS [2000-2002] | New York City, US [C] | 13,102 [>18 yrs] | ● Census ● Road network ● Bus stop ● Subway stop ● Homicide report ● pedestrian–auto collision ● street tree census ● Landmark building ● Sidewalk café | ● Geocoding ● Overlay ● Network ● Buffer | ● Walkability index ● Presence of sidewalk cafés ● Presence of landmark buildings ● Street tree density ● Percentage of streets rated acceptably clean ● Homicide prevalence ● Pedestrian–auto fatality prevalence (1-km network buffer) | ● Presence of sidewalk cafés, density of landmark buildings, and density of street trees were associated with lower BMI, whereas the proportion of streets rated as clean was associated with higher BMI. ● Safety hazard indicators were not independently associated with BMI. |
| [83](#_ENREF_83) | Lovasi [2013] | Investigate neighborhood safety, green space, walkability, and SES in association with PA and childhood obesity | CS [2004] | New York City, US [C] | 11,562 [3-5 yrs] | ● Address  ● Census  ● Land use  ● Road network  ● Subway stop  ● Street tree  ● Park  ● Homicide report | ● Geocoding  ● Buffer  ● Overlay | ● Land-use mix  ● Residential density  ● Ratio of retail floor areas  ● Density of intersections, subway stops, and street trees  ● Park areas | ● A higher homicide rate (75th *vs* 25th percentile) was associated with a 22% higher obesity prevalence.  ● A higher density of street trees (75th *vs* 25th percentile) was associated with 12% lower prevalence of obesity.  ● Other neighborhood characteristics did not have significant associations with childhood obesity. |
| [84](#_ENREF_84) | Miller [2014] | Examine whether individual-level childhood obesity was related to residential availability of FF and healthy food outlets | CS [2005-  2010] | Perth, Australia [C] | 1,850 [5-15 yrs] | ● Address  ● Food premise | ● Geocoding  ● Buffer  ● Overlay | ● Presence of, distance to, and density of FF and healthy food outlets  ● % of healthy food outlets (800- and 3000-m buffer) | An increasing number of healthy food outlets within 800 m of a child's home was associated with a significantly reduced risk of being overweight/obese |
| [85](#_ENREF_85) | Maroko [2009] | Test whether access to park space was associated with neighborhood race/ethnic composition and SES in New York City | EC | New York City, US [C] | N/A | ● Park  ● PA site | ● Overlay  ● Kernel density  ● Spatial statistics  ● Geographically- weighted regression | Density of park acreage and PA sites | ● Racial/ethnic minorities and lower SES populations had higher access to parks and PA sites.  ● The inequity was inconsistently correlated with specific sociodemographic variables. |
| [86](#_ENREF_86) | Mena [2015] | Examine the association between access to urban green spaces and markets with anthropometric measurements, biological markers, sociodemographic, and healthy lifestyle | CS | Talca, Chile [C] | 832 [18-74 yrs] | ● Address ● Park ● Market | ● Geocoding ● Overlay | Distance to parks and markets | ● BMI was significantly and positively related to the distance to parks, but negatively related to the distance to markets. ● Waist circumference was similar and positively related to distance to parks and negatively related to distance to markets. |
| [87](#_ENREF_87) | Mitchell [2015] | ● Determine the reach of a low-cost, nationally-available weight loss program in Health Resources and Services Administration medically underserved areas (MUAs)  ● Describe the demographics of the communities with program locations | CS | US [N] | N/A | ● Census  ● Take Off Pounds Sensibly (TOPS) chapter location | Overlay | Presence of TOPS | TOPS was available in 30% of MUAs. The typical TOPS chapter was in a Census Tract that was predominantly white, urban, with a median annual income between $25 000 and $50 000. |
| [88](#_ENREF_88) | Morris [2015] | Estimate average BMI at census tract and block group levels using state-issued identification cards | EC [2003-2010] | Oregon, US [S] | N/A | Address | Geocoding | ● Distance to grocery, convenience, and FF stores, restaurants, and produce stands  ● % of residents living within 1.6 km of grocery, convenience, and FF stores, restaurants, and produce stands  ● Intersection density | ● Annual obesity prevalence estimates from identification cards averaged 18% lower than the BRFSS for men and 31% lower for women.  ● BMI estimates averaged 2% lower than the BRFSS for men and 5% lower for women. |
| [89](#_ENREF_89) | Norman [2010] | Examine if neighborhood recreation environment was associated with adolescent PA, sedentary time, and obesity | CS | San Diego County, US [C] | 871 [11-15 yrs] | ● Address  ● Road network  ● Park  ● Land use | ● Geocoding  ● Overlay  ● Network  ● Buffer | ● Acreage of land use  ● Residential density  ● Number of road ends and recreational facilities  ● Land-use mix  ● Land-use density  ● Ratio of retail floor areas  ● Intersection density  (1.6-km network buffer) | ● Boys were less sedentary in open space (OS) neighborhoods and residential with cul-de-sacs (RWC) neighborhoods, compared with the housing & facility dense (HFD) neighborhoods.  ● Boys were more likely to be obese in the HFD neighborhoods (55%) compared with the OS group (24%).  ● Girls in the RWC neighborhoods had lower exercise levels and were more likely to be obese (31%) than those in the OS neighborhoods.  ● No differences were found for boys' exercise level or girls' sedentary time by neighborhood types. |
| [90](#_ENREF_90) | Norman [2013] | Investigate whether self-selection moderated the effects of walkability on walking in overweight and obese men. | CS | San Diego County, US [C] | 240 [mean=44.9 yrs] | ● Address  ● Land use ● Road network | ● Geocoding ● Overlay ● Buffer ● Network | Walkability score | ● Walkability was associated with walking for transportation and neighborhood selection was associated with walking for transportation and total walking.  ● Preference was associated with leisure walking and preference moderated the relationship between walkability and total walking. |
| [91](#_ENREF_91) | O'Connor [2014] | Examine the independent contributions of sociodemographic, cultural, parent perceived environmental, and objectively measured environmental factors, to PA parenting practices | CS [2011-  2012] | Harris County, Texas, US [C] | 232 | ● Traffic related injury  ● Crime  ● Address | ● Geocoding  ● Overlay | ● Crime risk  ● Traffic safety (census block)  ● Distance to the nearest parks | Objectively measured environmental attributes did not significantly correlate with PA parenting practices. |
| [92](#_ENREF_92) | Oka [2013] | Examine the area-based variations in obesity | CS [2002-2005] | Boston, US [C] | 5,485 [30-79 yrs] | ● Food market ● Convenience store ● Grocer ● Restaurant ● Pizza store ● Gym Transportation system Green space ● Urban amenity ● Forest ● Impervious surface ● Land use ● Satellite image | ● Geocoding ● Overlay | ● Density of bus stops, commercial trail stations, highway exits, train stations, convenience stores, food markets, restaurants, grocers, pizza stores, gyms, and vegetable coverage ● % of commercial, conservational, industrial, and residential land use | ● The area-based variations was insufficient in explaining the body weight of residents. ● The concept of area-based variations in obesity will have to consider how residents behave differently within a given environment. |
| [93](#_ENREF_93) | Oreskovic [2009] | Examine associations between BMI and density of and distance to nearest built environment features | CS [2006] | Massachusetts, US [S] | 21,008 [2-18 yrs] | ● Address  ● FF outlet  ● Road network  ● Sidewalk  ● School  ● Subway station  ● Bicycle path  ● Open space | ● Geocoding  ● Overlay  ● Network  ● Buffer | ● Density of schools (1.6-km buffer), subway stations, bicycle trails, and FF outlets (400-m buffer)  ● Distance to schools, subway stations, and FF outlets  ● Area of open space and sidewalk | ● Distance to nearest FF restaurants was inversely associated with BMI, whereas density of FF restaurants was positively associated with BMI.  ● Distance to schools and subway stations, amounts of open space, and density of subway stations were inversely associated with BMI.  ● Living near a greater density of subway stations was inversely associated with overweight and obesity |
| [94](#_ENREF_94) | Oreskovic [2009] | Assess differences in built environment and child weight, and associations between them in high- and low-income communities | CS [2006] | Massachusetts, US [S] | 6,680 [2-18 yrs] | ● Address  ● School  ● Subway station  ● Bicycle trail  ● Open space  ● FF outlet  ● Road network | ● Geocoding  ● Overlay  ● Network  ● Buffer | ● Density of FF outlets, subway stations, and bicycle trails  ● Area of sidewalk and open space (400-m buffer)  ● Distance to FF outlets and schools | ● Low-income towns had more sidewalks, less open space, a greater density of FF restaurants, and higher rates of overweight/obesity.  ● Among low-income-town children, density of FF restaurants was positively associated with overweight and obesity, whereas distance to nearest age-appropriate school and FF restaurant were inversely associated with obesity. |
| [95](#_ENREF_95) | Ortega Hinojosa [2014] | Generate prevalence estimates of smoking and obesity rates over small areas for the United States | EC [1990- 2010] | US [N] | N/A | ● Census data  ● Prevalence of obesity and smoking | GIS visualization | Prevalence of smoking and obesity | ● The two-level random effects model produced improved estimates compared to the fixed effects-only models.  ● Estimates were particularly improved for the two-thirds of the conterminous U.S. where BRFSS data were available to estimate the county level random effects. |
| [96](#_ENREF_96) | Pearce [2007] | ● Determine whether geographic access to FF outlets varied by neighborhood deprivation and school socioeconomic ranking  ● Determine whether any such associations differed to those for access to healthier food outlets | EC [2005] | New Zealand [N] | N/A | ● Food outlet  ● Road network  ● Census  ● School | ● Geocoding  ● Overlay  ● Network | Distance to FF outlets | ● Negative associations were found between neighborhood access to the nearest FF outlet and neighborhood deprivation for both multinational FF outlets and locally operated outlets.  ● Travel distances to both types of FF outlet were at least twice as far in the least socially deprived neighborhoods compared to the most deprived neighborhoods. A similar pattern was found for outlets selling healthy food such as supermarkets and smaller food outlets. |
| [97](#_ENREF_97) | Penney [2014] | Examine the spatial variation of overweight and obesity using community geographic boundaries | CS [2000-2005] | Nova Scotia Province, Canada [S] | 5,681 [15-64 yrs] | Census | Spatial statistics | N/A | ● Maps illustrating local cluster analysis showed a significant degree of similarity between neighboring communities in urban areas more than rural communities.  ● Hot spot analysis maps showed communities clustering together in the urban center tended to have lower incidence of overweight and obesity, whereas clustered communities in a more rural area had a higher incidence of overweight and obesity. |
| [98](#_ENREF_98) | Potestio [2009] | Examine associations between parks/green space and childhood overweight/obesity | CS [2005-2006] | Calgary, Canada [C] | 6,772 [3-8 yrs] | ● Parks/green space  ● Address  ● Road network | ● Geocoding  ● Overlay  ● Network | ● Number of parks/green space per 10,000 population  ● Proportion of parks/green space  ● Distance to the nearest park/green space | Parks/green space at the community level was not associated with overweight and obesity, with the exception of a marginally significant effect whereby a moderate number of parks/green spaces per 10,000 residents was associated with lower odds of overweight and obesity. |
| [99](#_ENREF_99) | Pouliou [2010] | Identify potential associations between overweight/obesity and individual and socio-environmental determinants | CS [2003] | Toronto, Vancouver, Canada [C2] | 5,418,218 [≥20 yrs] | ● Land use  ● Residential dwelling  ● Food outlet | ● Geocoding  ● Overlay  ● Network  ● Buffer | ● Proportion of the residential land use  ● Intersection density  ● Density of food outlets  ● Residential density  ● Land-use mix  (1-km buffer) | ● Residential density was negatively associated with BMI.  ● Intersection density and land-use mix were negatively associated with BMI for residents in Vancouver only. |
| [100](#_ENREF_100) | Richardson [2015] | Examine longitudinal pathways from multiple types of neighborhood restaurants and food stores to BMI, through dietary behaviors | LO [1985-2006] | Birmingham, Chicago, Minneapolis, Oakland, US [C4] | 5,114 [18-30 yrs] | ● Address ● Food outlet ● Census | ● Geocoding ● Overlay ● Buffer | ● Densities of FF and sit-down restaurants, supermarkets, and convenience stores  ● Population density ● Roadway length  (3-, 8-km buffer) | ● Higher number of neighborhood FF restaurants and lower number of sit-down restaurants were associated with higher consumption of an obesogenic FF-type diet.  ● The pathways from food stores to BMI through diet were inconsistent in magnitude and statistical significance. |
| [101](#_ENREF_101) | Sadler [2011] | Determine distances between every residence and different types of food retailers | EC | Middlesex County, Canada [CT] | N/A | ● Retail food establishment  ● Local food producer  ● High resolution orthophotography  ● Road network  ● Residence address | ● Geocoding  ● Air Photo Verification  ● Network | Distance to the top three nearest FF sources | ● Residents in the most distressed neighborhoods tended to have better accessibility to all types of food retailers. In the most distressed neighborhoods, 79% of residences were within walking distance of a grocery store, compared to only 10% in the least distressed neighborhoods. |
| [102](#_ENREF_102) | Saelens [2012] | Evaluate child and parent WS across neighborhoods differing in GIS-defined PA environment and nutrition environment characteristics | CS [2007-  2009] | San Diego, Seattle, US [C2] | 681 [6-11 yrs] | ● Census  ● Environmental assessment of public recreation spaces  ● Supermarket and FF outlet | ● Buffer  ● Overlay | ● Residential density  ● Ratio of retail floor areas  ● Land-use mix  ● Street connectivity  ● Density of supermarkets and FF outlets (0.8-km buffer around block group) | ● Children from high PA and health eating neighborhoods were less likely to be obese and marginally less likely to be overweight than children from low PA and health eating neighborhoods.  ● Parents in high PA and health eating neighborhoods were marginally less likely to be obese , although parent overweight did not differ by neighborhood environment. |
| [103](#_ENREF_103) | Sage [2010] | Identify contributory factors of childhood obesity | CS [2008-  2009] | Austin, US [C] | 12,284 [6-8 grades] | N/A | GIS visualization | N/A | ● Two neighborhoods outside downtown Austin have particularly high concentrations of overweight and obese students.  ● Maps also showed that the neighborhoods have different proportions of FF outlets, grocery stores selling fresh produce, green recreation space, and students failing cardiovascular testing. |
| [104](#_ENREF_104) | Schlundt [2006] | Study the clustering of health outcomes, health behaviors, and environmental characteristics | EC [2001] | Nashville, US [C] | N/A | ● Address ● Census | Geocoding | Crowding index | Pearson correlations across the 129 census tracts were in the 0.20 to 0.60 range and provided evidence for spatial clustering of health outcomes, health behaviors, and neighborhood characteristics. |
| [105](#_ENREF_105) | Sheldon [2010] | Evaluate the availability and costs of foods that fulfill the USDA's Thrifty Food Plan (TFP) guidelines | CS [2007-2008] | Central Falls, Rhode Island, US [C] | N/A | ● Retail food store  ● Bus route and stop | ● Geocoding  ● Overlay | Presence of bus stops | ● Only two stores in Central Falls and the discount supermarket in an adjacent city, Pawtucket, carried enough variety of foods to fill the TFP basket.  ● At the two stores, costs were up to 40% higher, and at the discount store, costs were up to 18% cheaper, than the national average.  ● Each of the stores was accessible by public transportation. |
| [106](#_ENREF_106) | Smith [2008] | Examine relationships between neighborhood walkability and residents’ excess weight | CS [2006] | Salt Lake County, Utah, US [CT] | 453,927 [25-64 yrs] | ● Address  ● Census  ● Street centerline | ● Buffer  ● Overlay | ● Median house age (census tract)  ● Intersection density (0.4-km buffer) | ● Increasing levels of walkability decreased the risks of excess weight.  ● Doubling the proportion of neighborhood residents walking to work decreased an individual's risk of obesity by almost 10%.  ● Adding a decade to the average age of neighborhood housing decreased women's risk of obesity by about 8% and men's by 13%. |
| [107](#_ENREF_107) | Tilt [2007] | Examine the influence of destinations within walking distance of a residence and vegetation on walking trips and BMI | CS | Seattle, US [C] | 529 | ● Parcel ● Road network ● Public destination ● Satellite image | ● Overlay ● Network | ● Normalized difference vegetation index (NDVI) ● Number of types of destinations  (0.64-km network buffer) | ● Objective accessibility were related to walking trips per month, as was subjective greenness, although objective measures of actual greenness were not.  ● In areas with high accessibility, BMI was lower in areas that had high NDVI, or more greenness.  ● Low NDVI areas were associated with overestimation of the number of destinations within walking distance. |
| [108](#_ENREF_108) | Timperio [2010] | Examine associations between environmental characteristics of neighborhoods and adiposity cross-sectionally and longitudinally  in children and their female carers | LO [2001-2004] | Melbourne, Australia [C] | ● 140 [5-6 yrs] ● 269 [10-12 yrs] ● 369 female carers | ● Address ● Road network ● Walking/cycling path ● Access path ● Public open space ● Sport/recreation center | ● Geocoding ● Buffer ● Overlay ● Network | ● Density of public open space ● Presence of sports/recreation centers ● Total length of access paths, walking/cycling tracks, and local roads ● Number of cul-de-sacs ● Intersection density ● Proportion of intersections (at least 4-way) | ● Cross-sectionally, BMI z-score was inversely associated with length of access paths among youngers, and with number of sport/recreation public open space and, length of access paths, and local roads among older children. ● Among female carers, BMI was associated with length of walking/cycling tracks and busy roads. ● Longitudinally, the proportion of intersections that were 4-way was negatively associated with change in BMI z-score among younger children, while length of access paths was significant among older children.  ● Among female carers, presence of sports/recreation centers were associated with change in BMI. |
| [109](#_ENREF_109) | Van Hulst [2013] | Examine associations between characteristics of neighborhood built and social environments and likelihood of obesity among family triads | CS | Quebec, Canada [C] | 630 [8-10 yrs] | ● Address ● Road network  ● Land use | ● Geocoding ● Overlay ● Network ● Buffer | ● Residential density ● Presence of parks ● % of park coverage ● Number of intersections ● Total length of streets with normal traffic at rush hours ● % and length of streets with high traffic at rush hours | Residing in low traffic neighborhood was associated with less obesity. |
| [110](#_ENREF_110) | Wall [2012] | ● Identify patterns among neighborhood food, PA, street/transportation, and SES characteristics  ● Examine their associations with adolescent WS | CS [2009-  2010] | Minneapolis/St. Paul, US [C] | 2,682 [6-12 grade] | ● Address  ● Census  ● Land use  ● Transit route  ● Food resource | ● Geocoding  ● Buffer  ● Overlay  ● Spatial Latent Class | ● Density of and distance to FF and convenience stores, supermarkets, restaurants, and public transit stops  ● Distance to walking/biking trails, recreation centers, and gym/fitness centers  ● Proportion of land used for parks/recreation and commercial buildings, and “busy” streets  ● Number of street access points (400-, 800-, 1200-, and 1600-m buffer) | ● A low % of parks/ recreation, and low perceived safety were associated with higher BMI z-scores.  ● Presence of convenience stores, restaurants, recreation accessibility, and access points (intersection density) was associated with higher BMI z-score in girls but not in boys.  ● In boys, the cluster with highest obesity (29.8%) included low SES, parks/recreation, and safety; high restaurant and convenience store density; and nearby access to gyms, supermarkets, and many transit stops. |
| [111](#_ENREF_111) | Weiss [2011] | Estimate the relationships between neighborhood compositional characteristics and measures of park facilities | EC | New York City, US [C] | N/A | ● Census  ● Park  ● Auto-  mobile accident  ● Land use  ● Homicides report | ● Geocoding  ● Buffer  ● Overlay  ● Air photo verification  ● Kernel Density | ● Number of parks, facilities in the parks, and unique facility types (0.4-km buffer around tract)  ● Area of parkland | ● Neighborhoods with higher concentrations of traditionally disadvantaged social groups had access to more parks with a greater number of facility types and facilities. |
| [112](#_ENREF_112) | Wen [2011] | ● Examine how Latino-white spatial segregation was associated with risk of obesity for Latinos and whites  ● Examine whether neighborhood SES resources, the built environment, and subcultural orientation served as the underlying mechanisms  ● Examine whether neighborhood context helped explain obesity disparities across ethnic and immigrant groups | CS [1998-2008] | Utah, US [S] | ● 376,192 men  ● 359,783 women [25-64 yrs] | ● Utah Population Database  ● Census  ● Tree canopy  ● 2009 Public Park | Overlay | ● Distance to the nearest seven parks  ● % of area covered by tree canopy (census tract) | ● Latino residential isolation is significantly and positively linked to the risk of obesity  ● The segregation effect is partly attributable to neighborhood SES and the built environment; and only for women is it partly attributable to obesity prevalence in the neighborhood.  ● Place matters for individual risk of obesity for both men and women and there are multifarious pathways linking residence to obesity. |
| [113](#_ENREF_113) | Wen [2012] | Explore whether neighborhood built environment attributes were significant correlates of obesity risk and mediators of obesity disparities by race/ethnicity | LO [2003-  2008] | US [N] | 9,739 [20-64 yrs] | ● Census  ● Road network  ● Park | ● Overlay  ● Network | ● Average distance to the nearest seven parks  ● Density of population and intersections (census tract) | ● Intersection density and distance to parks were negatively and positively correlated with obesity risk, respectively.  ● Population density was negatively correlated with obesity risk for men but positively for women. |
| [114](#_ENREF_114) | Williams [2015] | Examine associations between food retailing and BMI among primary school students | CS [2010-2011] | Berkshire, England, UK [C] | 16,956 [8,745 aged 4-5 yrs & 8,211 aged 10-11 yrs] | ● Address  ● Census  ● Children well-being index  ● Food outlet  ● Road network  ● Administrative boundary | ● Geocoding  ● Network  ● Buffer  ● Overlay | ● Density of FF outlets and food stores (800-m road network buffer) | ●There were no significant associations between retailing near schools and student BMI, but positive associations between FF outlets in home neighborhood and BMI z-scores  ●Year 6 students living in areas with the highest density of FF outlets had an average higher BMI z-score than those living in areas with none. |
| [115](#_ENREF_115) | Witten [2008] | Examine the relationship between travel time access to parks and beaches, BMI and PA | CS [2002-2003] | New Zealand [N] | 12,529 [>15 yrs] | ● Census ● Park ● Beach ● Road network | ● Overlay ● Network | Travel time to parks and beaches | ● Neighborhood access to parks was not associated with BMI, sedentary behavior or PA. ● Respondents living in neighborhoods with best access to the beach had lower normalized BMI. |
| [116](#_ENREF_116) | Yang [2012] | Explore relationships between multiple built environment factors and individual characteristics on leisure time PA (LTPA) | CS [2006-2007] | Nevada, US [S] | 6,311 [>18 yrs] | ● Census  ● Air quality  ● Recreational facility  ● Crime | ● Geocoding  ● Overlay  ● Buffer | ● Presence of recreational facilities  ● Density of recreational facilities (0.8-, 1.6-, and 4.8-km)  ● Population density  ● Land-use mix  ● Crime rate  ● Urbanicity | ● No engagement in LTPA was significantly associated with older age, less education, lower income, being obesity, low life satisfaction, more commute time, higher crime rate, urban residence, and higher population density. |
| [117](#_ENREF_117) | Yin [2012] | ● Examine race and sex differences in adiposity measured by dual-energy x-ray absorptiometry (DXA) in a large sample of young children ● Identify both micro- and macro-level correlates of adiposity | CS [2003] | Augusta, Georgia, US [C] | 495 [mean=8.7 yrs] | ● Address ● PA facility ● Census | ● Geocoding ● Overlay ● Buffer | ● Number of PA facilities (0.8-/4.8-km buffer)  ● Population density ● Street length (school neighborhood) | Percentage body fat was higher in children who had lower athletic competence and lived in neighborhoods with higher percentages of minority residents. |
| [118](#_ENREF_118) | Ying [2015] | Examine the relationship between built environment and PA, weight, and health outcome in meso- and microscales | CS [2010] | Shanghai, China [C] | 819 [46-80 yrs] | ● Road network ● Address ● Land use ● Recreational space | ● Overlay ● Geocoding | ● Street connectivity ● *Per capita* road area ● *Per capita* green and open space ● Distance to rivers, parks, and squares ● Land-use mix (500-m buffer) | ● Street connectivity and land-use mix were positively associated with PA, land-use mix was inversely associated with BMI and WS. ● Park and square proximity were positively associated with PA, BMI, and WS. ● Green and open space were positively related with BMI and health status. ● River proximity was inversely related with WS. |
| [119](#_ENREF_119) | Zhang [2006] | Identify contrastive and comparable school neighborhoods for pilot studies on child overweight and PA and school social and built environments | EC | Chicago, US [C] | N/A | ● School attendance boundary  ● Land use  ● Traffic  ● Park  ● Crime | Overlay | ● Land-use mix, composition, and fragmentation  ● Density of blocks  ● Distance to parks  ● Number of arterial streets  ● Maximum average of annual daily traffic | ● The combination of GIS and cluster analysis allowed us to identify eight school neighborhoods that were contrastive and comparable on land use and safety for a childhood obesity and PA study. |
| [120](#_ENREF_120) | Zhang [2016] | Examine the influence of food establishments on children’s BMI | LO | 9 provinces in China [S9] | 348 [6-17 yrs] | ● Address  ● Food outlet | ● Geocoding  ● Overlay | Distance to the nearest grocery stores, free markets, restaurants, and food stalls | ● Boys in the 2nd quartile of proximity to the nearest grocery store had higher BMI compared to those in the 1st quartile.  ● Girls in higher quartiles had lower BMI.  ● Boys and girls in the 2nd quartile of proximity to the nearest Chinese restaurant had lower BMI compared to those in the 1st quartile. |
| [121](#_ENREF_121) | Zhu [2008] | Examine disparities in environmental support for walking around public elementary schools | CS | Austin, US [C] | N/A | ● Land use  ● Traffic crash  ● Crime  ● Road network  ● Census  ● Sidewalk  ● Traffic signal | ● Geocoding  ● Overlay  ● Network  ● Spatial Statistics | ● % of students living within 0.8 km from school  ● Sidewalk completeness  ● Density of traffic-signals, streets, and intersections  ● Residential density  ● Land-use mix | ● For the top-quartile schools with higher poverty or % of Hispanic students, the surroundings showed higher walkability with shorter distances to schools, more sidewalks, higher crash and crime rates, and lower walkability, compared with the bottom quartile. |

†BMI– body mass index; FF– fast food; MET– metabolic equivalent; PA– physical activity; SES– socioeconomic status; WS– weight status

††Study design – CS: cross-sectional, CO: cohort, LO: longitudinal, EC: ecological, FG: focus group

†††Study scale –N: national, S: state (US) or equivalent unit (e.g., province in China), S*n*: *n* states or equivalent units, CT: county or equivalent unit, CT*n*: *n* counties or equivalent units, C: city, C*n*: *n* cities

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