Supplementary Material

Development and reliability testing of an audit toolbox for the assessment of the physical activity friendliness of urban and rural environments in Germany

Christina Müller\*, Bruno Domokos, Tanja Amersbach, Eva-Maria Hausmayer, Christin Roßmann, Birgit Wallmann-Sperlich, Jens Bucksch

**\* Correspondence:** Christina Müller: christina.mueller@stud-mail.uni-wuerzburg.de

# Supplementary Data

**Search-terms for the identification of existing audit tools**

"physical activity"[TIAB] OR "physical activities"[TIAB] OR "physical inactivity"[TIAB] OR "mobility"[TIAB] OR "walk\*"[TIAB] OR "cycle"[TIAB] OR "cycling"[TIAB] OR "biking"[TIAB] OR “bicycle”[TIAB] OR "transport\*"[TIAB] OR "commute"[TIAB] OR "commuting"[TIAB] OR “travel”[TIAB] OR “pedestrian”[TIAB] OR “active play”[TIAB] OR “sport\*”[TIAB] OR “exercise”[TIAB]

AND

“audit\*”[TIAB] OR “observational instrument\*”[TIAB] OR "observation instrument\*"[TIAB] OR “observational measure\*”[TIAB] OR "assessment tool\*"[TIAB] OR "checklist\*"[TIAB]

AND

"environment\*"[TIAB] OR “physical attributes”[TIAB] OR “physical characteristics”[TIAB] OR "socio-ecological"[TIAB] OR "traffic"[TIAB] OR "facilities"[TIAB] OR "walkability"[TIAB] OR “bikeability”[TIAB] OR “aesthetics”[TIAB] OR “safety”[TIAB]

AND

"neighbourhood\*"[TIAB] OR "neighborhood\*"[TIAB] OR "community"[TIAB] OR "communities"[TIAB] OR "community-based"[TIAB] OR "park\*"[TIAB] OR "urban"[TIAB] OR "rural"[TIAB] OR “greenspace\*”[TIAB] OR “open space\*”[TIAB] OR “street\*”[TIAB] OR “public space\*”[TIAB] OR “playground\*”[TIAB] OR “path\*”[TIAB] OR “trail\*”[TIAB] OR “recreation area\*”[TIAB]

# Supplementary Figures and Tables

Supplementary table : Identified audit instruments

|  |  |  |  |  |  |  |  |
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| **No.** | **Name of the audit** | **Type** | **Urban/ Rural** | **Population group** | **Continent, country** | **Quality criteria** | **Ref.** |
| 1 | Active Neighborhood Checklist | Community/ Streetscape | Unspecific | Unspecific | North America, USA | **Inter-rater reliability**  Mean observed agreement: 0.87 (range 0.61-1.00).  Mean Cohen‘s kappa: 0.68 (range: 0.21-1.00 | (1) |
| 2 | African American Health | Community/ Streetscape | Urban | Seniors | North America, USA | **Discriminant and concurrent validity**  Strong and consistent differences in ratings between the inner city and suburb neighborhoods  **Convergent validity**  Association between overall scale and global neighborhood rating by residents | (2) |
| 3 | Assessment of the local outdoor environment for falling over | Community/ Streetscape | Urban | Seniors | Europe, UK | None reported | (3) |
| 4 | Bikeability and Walkability Evaluation Table (BiWET) | Community/ Streetscape | Urban | Unspecific | Europe, Austria | **Intra-rater reliability**  Mean observed agreement: 0.95 (range 0.89-0.98)  **Inter-rater reliability**  Mean observed agreement: 0.89 (range 0.79-0.97) | (4) |
| 5 | Bridging the Gap Community Obesity Measures Project (BTG-COMP) - Street Segment Observation Form | Community/ Streetscape | Urban | Children/ Adolescents | North America, USA | **Inter-rater reliability**  All items included in the index with almost perfect or substantial agreement (ICCs 0.61-1.00) or >90% observed agreement | (5) |
| 6 | CDC-Healthy Aging Research Network Environmental Audit Tool (CDC-HAN HEAT) | Community/ Streetscape | Urban | Seniors | North America, USA | **Inter-rater reliability**  Cohen’s kappa ≥ 0.4 | (6, 7) |
| 7 | Children’s Environmental Health Initiative - Community Assessment Project (CEHIs CAP) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Mean observed agreement: 0.95; agreement across all items > 0.70 | (8) |
| 8 | Checklist for Pedestrians’ Crossing areas | Community/ Streetscape | Urban | Unspecific | North America, Mexico | None reported | (9) |
| 9 | Community Health Environment Scan Survey (CHESS) | Community/ Streetscape | Urban | Unspecific | North America, Mexico | **Inter-rater reliability**  Consistently high agreement for the main variables (kappa and AC1 close to 1.0) | (10) |
| 10 | China Urban Built Environment Scan Tool (CUBEST) | Community/ Streetscape | Urban | Unspecific | Asia, China | **Intra-rater reliability**  ICCs for dimensions between 0.360 and 0.758  **Inter-rater reliability**  ICCs for dimensions between 0.766 and 0.912  **Construct validity**  Almost perfect matching between 6 components and the corresponding items | (11) |
| 11 | Community Street Review (CSR) | Community/ Streetscape | Urban | Unspecific | New Zealand | None reported | (12) |
| 12 | Cyprus Neighbourhood Observation Tool for auditing community environment (CY-NOTes) | Community/ Streetscape | Urban | Unspecific | Europe, Cyprus | **Content validity**  assessed by reviewing Facebook posts related to the neighborhood environment | (13) |
| 13 | Environment in Asia Scan Tool – Hong Kong (EAST-HK) | Community/ Streetscape | Urban | Unspecific | Asia, Hong Kong | **Intra-rater reliability**  59 items with substantial to perfect reliability  **Inter-rater reliability**  46 items with substantial to perfect reliability | (14) |
| 14 | Environmental Profile of a Community’s Health- Photos-Neighbourhood Evaluation Tool (EP-NET / EPOCH I) | Community/ Streetscape | Unspecific | Unspecific | Unspecific, Brazil, Canada, China, Colombia, India | **Inter-rater reliability**  77% (46 of 60) items had an ICC of ≥0.75, 17% (10 of 60) had an ICC between 0.60 and 0.74, 0% had an ICC between 0.4 and 0.59 and 5% (3 of 60) items had an ICC ≤0.40 | (15) |
| 15 | Inventories for Community Health Assessment in Rural Towns (ICHART) | Community/ Streetscape | Rural | Unspecific | North America, USA | **Intra-rater reliability**  Mean Cohen’s kappa: 0.72.  **Inter-rater reliability**  Mean observed agreement: 0.84 | (16) |
| 16 | Instrument to assess health-affecting aspects of neighborhood in Tehran | Community/ Streetscape | Urban | Unspecific | Asia, Iran | **Inter-rater reliability**  Median kappa of the final checklist: 0.78 (range 0.63-1.00)  **Content validity**  Confirmed by experts | (17) |
| 17 | Inventory for Pedestrian Safety Infrastructure (IPSI) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Cohen’s kappa between 0.05 and 1.0  ICCs between 0.192 and 1.0  **Internal consistency**  Intersection scale: Cronbach’s Alpha 0.86  Roadway scale: Cronbach’s Alpha 0.60 | (18) |
| 18 | Irvine Minnesota Inventory (IMI) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  68% of the items had >70% agreement among three observers | (19) |
| 19 | Microscale Audit of Pedestrian Streetscapes (MAPS) / Full / Abbreviated / Mini / Global / Global-SN | Community/ Streetscape | Urban | Unspecific | North America, USA | MAPS Full  **Inter-rater reliability**  84.9% of items with moderate to excellent reliability (ICC or Cohen’s Kappa)  MAPS Abbreviated  **Validity**  Destinations and land use, streetscape and walking path characteristics, and overall total scores are related to active transport in all age groups.  MAPS Mini  **Validity**  Total scores are related to active transportation in all age groups.  MAPS Global  **Inter-rater reliability**  Median ICC: 0.92 (range 0.50-1.0)  MAPS Global-SN  **Inter-rater reliability**  ICCs between 0.60 and 0.99 | (20–24) |
| 20 | Measure of Accessibility to Urban Infrastructures for Adults with Physical Disabilities (MAUAP) | Community/ Streetscape | Urban | People with disabilities | North America, Canada | **Inter-rater reliability**  Gwet’s AC1 between 0.63 and 1.00  Observed agreement between 0.804 and 1.00 | (25) |
| 21 | Measure of environmental characteristics | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  ICC > 0.85 for all measures | (26) |
| 22 | Measuring Urban Design Qualities | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  ICCs between 0.344 and 0.584 | (27) |
| 23 | Neighbourhood Design Characteristics Checklist (NeDeCC) | Community/ Streetscape | Unspecific | Seniors | Europe, England | **Inter-rater reliability**  Kappa ≥ 0.6 for all categorical items | (28) |
| 24 | Neighbourhood Brief Observation Tool (NBOT) | Community/ Streetscape | Urban | Children/ Adolescents | North America, USA | **Neighborhood-level reliability** between 0.93 and 0.96  **Construct validity**  Correlations between physical incivilities scale and neighborhood poverty, crime density and residents’ perceptions of neighborhood conditions | (29) |
| 25 | Neighbourhood Active Living Potential (NALP) | Community/ Streetscape | Urban | Unspecific | North America, Canada | **Inter-rater reliability**  Mean of activity-friendliness items: 0.78  Mean of safety items: 0.76  Mean of density of destinations items: 0.83  **Internal consistency**  Activity-friendliness: 0.80 / 0.84  Safety: 0.77 / 0.82  Density of destinations: 0.87 / 0.91  **Convergent validity**  Safety of the environment was positively associated with neighborhood affluence, density of destinations was negatively associated with affluence and positively associated with higher proportions of persons in the neighborhood walking to work | (30, 31) |
| 26 | Neighbourhood Attribute Inventory (NAI) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  83% agreement  **Internal consistency**  Physical incivility scale: Cronbach’s Alpha = 0.81  Social spaces scale: Cronbach’s Alpha = 0.61  Territoriality scale: Cronbach’s Alpha = 0.56  Correlations between scales and Census variables like poverty and low education | (32) |
| 27 | Neighbourhood Observational Checklist (NOC) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Intra-rater reliability**  61% of items with substantial to almost perfect reliability (kappa 0.60-1.00); 29% moderate (0.40-0.59).  **Inter-rater reliability**  43% of items with substantial to almost perfect reliability (kappa 0.60-1.00); 25% moderate (0.40-0.59). | (33, 34) |
| 28 | Neighborhood Walkability Assessment (NWA) | Community/ Streetscape | Urban | Children/ Adolescents | North America, USA | None reported | (35) |
| 29 | Neighborhood Sidewalk Assessment Tool (NSAT) | Community/ Streetscape | Urban | Unspecific | Asia, Malaysia | **Internal consistency**  Cronbach’s Alpha ≥ 0.7 for all scales | (36) |
| 30 | Older People’s Environments and CVD Risk (OPECR) | Community/ Streetscape | Urban | Seniors | Europe, UK | **Inter-rater reliability**  ICCs between 0.58 and 0.99  Cohen’s Kappa between 0.56 and 0.96  **Criterion validity**  Good agreement between foot-based and virtual data collection | (37) |
| 31 | Older People’s External Residential Assessment Tool (OPERAT) | Community/ Streetscape | Urban | Seniors | Europe, Wales | **Construct validity**  Correlation between OPERAT items and corresponding questionnaire items; significant associations between 21 of 40 items  **Convergent validity**  Correlation between OPERAT domains, residents’ perceptions of the area and deprivation at postcode level  **Inter-rater reliability**  Krippendorff’s Alpha > 0.8 for all items | (38) |
| 32 | Pedestrian Environment Data Scan (PEDS) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Cohen’s kappa between 0.085 and 1.0  Observed agreement between 0.5 and 1.0.  **Intra-rater reliability**  Cohen’s kappa between 0.022 and 1.0  Percent agreement between 0.529 and 1.0 | (39) |
| 33 | Pedestrian Environment Quality Index (PEQI) | Community/ Streetscape | Urban | Unspecific | North America, USA | None reported | (40) |
| 34 | Pittsburgh Hill/Homewood Research on Neighborhood Change and Health (PHRESH Audit Tool) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Between 83.5% and 93.8% of items with excellent or good agreement | (41) |
| 35 | Physical Activity and Nutrition Features audit tool | Community/ Streetscape | Unspecific | Unspecific | North America, Canada | None reported | (42) |
| 36 | Pregnancy Infection and Nutrition (PIN3) Neighborhood Audit Instrument | Community/ Streetscape | Unspecific | Unspecific | North America, USA | **Intra-rater reliability**  Arterial or thoroughfare: Spearman correlation coefficient = 0.96 in urban and 0.96 in rural areas  Walkable neighborhood: Spearman correlation coefficient = 0.79 in urban and 0.82 in rural areas  Physical incivilities: Spearman correlation coefficient = 0.78 in urban and 0.77 in rural areas  Decoration: Spearman correlation coefficient = 0.50 in urban and 0.39 in rural areas  **Internal consistency**  Physical incivilities: Cronbach’s Alpha = 0.57 in urban and 0.59 in rural areas  Territoriality: Cronbach’s Alpha = 0.22 in urban and 0.34 in rural areas  Social spaces: Cronbach’s Alpha = 0.31 in urban and 0.24 in rural areas  Safety: Cronbach’s Alpha = 0.39 in urban and 0.41 in rural areas  Aesthetics/Streetscape: Cronbach’s Alpha = 0.29 in urban and 0.27 in rural areas  Functionality: Cronbach’s Alpha = 0.18 in urban and 0.11 in rural areas  Destinations: Cronbach’s Alpha = 0.27 in urban and 0.11 in rural areas | (43) |
| 37 | Rural Active Living Assessment (RALA) | Community/ Streetscape | Rural | Unspecific | North America, USA | Street Segment Assessment  **Inter-rater reliability**  Mean observed agreement: 0.919.  Mean Cohen’s kappa: 0.78 | (44) |
| 38 | Revised Residential Environment Assessment Tool (REAT) | Community/ Streetscape | Unspecific | Unspecific | Europe, Wales | **Inter-rater reliability**  Cohen’s kappa between 0.77 and 1.00  **Convergent validity**  Strong correlation between the street level neighborhood condition component and the PIN3 neighborhood condition scale  **Construct validity**  Associations with residents’ perceptions, e.g., residents living in neighborhoods with better street-level neighborhood condition perceived fewer incivilities and maintenance issues in their neighborhood.  **Predictive validity**  Associations between the overall REAT score and neighborhood attachment | (45) |
| 39 | Rural Pedestrian Environmental Audit Tool | Community/ Streetscape | Rural | Unspecific | North America, USA | **Inter-rater reliability**  > 80% agreement for each domain  Mean Cohen’s Kappa:  Destinations: 0.90  Street characteristics: 0.80  Quality of pedestrian facility: 0.45  Aesthetics/Quality of environment: 0.53  Social/dynamic environment: 0.50 | (46) |
| 40 | Sidewalk Assessment Tool | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Cohen’s Kappa between 0.41 and 0.72 | (47) |
| 41 | Systematic Pedestrian and Cycling Environmental Scan (SPACES) / Madrid-SPACES / New Zealand-SPACES | Community/ Streetscape | Urban | Unspecific | Australia/ New Zealand/ Europe, Spain | SPACES  **Intra-rater reliability**  69 of 71 items with ≥ 70% agreement; 17 items with excellent (Kappa > 0.75), 47 with fair to good (0.4-0.75), and 7 with poor (< 0.4) reliability  **Inter-rater reliability**  45 of 67 items with ≥ 70% agreement; 21 items with excellent (Kappa > 0.75), 27 with fair to good (0.4-0.75), and 19 with poor (< 0.4) reliability  M-SPACES  **Intra-rater reliability**  ICCs between 0.00 and 0.92  **Inter-rater reliability**  ICCs between 0.02 and 0.79  NZ-SPACES  Acceptable level of agreement (ICC ≥ 0.70) between in-person and virtual audits | (48–50) |
| 42 | SPACES for Alleys | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  58 of 72 items with at least substantial agreement | (51) |
| 43 | Chicaco Community Adult Health Study (CCAHS) Systematic Social Observation Coding Sheet | Community/ Streetscape | Urban | Unspecific | North America, USA | Agreement between Systematic Social Observation and publicly available data from aerial photography: between 59% (Kappa = 0.19) and 90% (Kappa = 0.60) | (52, 53) |
| 44 | St. Louis Audit Tools (Analytic Audit Tool, Checklist Audit Tool) | Community/ Streetscape | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Analytic: observed agreement between 0.42 and 0.92; ICC between 0.19 and 0.77  Checklist: observed agreement between 0.53 and 0.94; Cohen’s Kappa between 0.07 and 0.69 | (54) |
| 45 | Street Design Environmental Audit | Community/ Streetscape | Urban | Children/ Adolescents | North America, USA | None reported | (55) |
| 46 | SPOTLIGHT field audit tool and SPOTLIGHT virtual audit tool (S-VAT) | Community/ Streetscape | Urban | Unspecific | Europe | S-VAT  Intra-rater reliability  Between 91.7% (Kappa = 0.654) and 100% (Kappa = 1.0) agreement  **Inter-rater reliability**  Between substantial (78.6%; Kappa = 0.440) and high (99.2%; Kappa = 0.579) agreement  **Criterion validity**  Agreement between in-person and virtual audits between 87.3 and 99.9% | (56) |
| 47 | Stakeholders Walkability/Wheelability Audit in Neighbourhood for People with Disabilities (SWAN/SWAN-PWD) | Community/ Streetscape | Urban | People with disabilities | North America, Canada | None reported | (57) |
| 48 | Scottish Walkability Assessment Tool (SWAT) | Community/ Streetscape | Urban | Unspecific | Europe, Scotland | **Intra-rater reliability**  17 items with very good reliability (kappa ≥ 0.7), 9 with fair to good reliability (kappa = 0.4-0.7), 3 items with poor reliability (kappa < 0.4)  **Inter-rater reliability**  15 items with very good reliability (kappa ≥ 0.7), 18 with fair to good reliability (kappa = 0.4-0.7), 15 items with poor reliability (kappa < 0.4) | (58) |
| 49 | Senior Walking Environmental Assessment Tool (SWEAT) / SWEAT-R (modified) | Community/ Streetscape | Urban | Seniors | North America, USA | SWEAT-R  **Intra-rater reliability**  75% of items with good or excellent reliability (kappa > 0.60)  **Inter-rater reliability**  88% of items with good or excellent reliability (kappa > 0.60) | (59) |
| 50 | The Walking Suitability Index of the Territory (T-WSI) | Community/ Streetscape | Urban | Unspecific | Europe, Italy | **Inter-rater reliability**  Overall ICC = 0.89 | (60) |
| 51 | WABSA (Walking Suitability Assessment Form / Bicycle Suitability Assessment Form) | Community/ Streetscape | Urban | Unspecific | North America, USA | Walking Suitability Assessment Form  **Inter-rater reliability**  Overall score: ICC = 0.79  **Criterion-related validity** between r = 0.15 and r = 0.84  Bicycle Suitability Assessment Form  **Inter-rater reliability**  Overall score: ICC = 0.90  **Criterion-related validity**  Overall score: r = 0.62 | (61) |
| 52 | Wisconsin Assessment of the Social and Built Environment (WASABE) | Community/ Streetscape | Unspecific | Unspecific | North America, USA | **Inter-rater reliability**  Percent agreement between 54% and 100%; 70% of items with more than 90% agreement | (62) |
| 53 | WalkBoston Walk Audit Form | Community/ Streetscape | Urban | Unspecific | North America, USA | None reported | (63, 64) |
| 54 | Walking Environment Audit Tool-Diabetes (WEAT-D) | Community/ Streetscape | Unspecific | People with diabetes | North America, USA | None reported | (65) |
| 55 | Walking Route Audit Tool (WRATS) | Community/ Streetscape | Urban | Seniors | North America, USA | **Inter-rater reliability**  Kappa between 0.13 and 1.0; 27 of 44 items with Kappa ≥ 0.60 or ≥ 75% agreement | (66) |
| 56 | BRAT Direct Observation | Parks/Trails/ Public open spaces | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Average agreement within domains between 83.7% and 91.9%  **Validity**  Agreement with “gold standard” assessment by consensus of two investigators involved in the tool development: average between 63.3% and 88.3% | (67) |
| 57 | Bridging the Gap Community Obesity Measures Project (BTG-COMP) - Park Observation Form | Parks/Trails/ Public open spaces | Urban | Children/ Adolescents | North America, USA | **Inter-rater reliability**  57% of items with almost perfect or substantial reliability, 35% with moderate or fair reliability, 8% with poor reliability | (68, 69) |
| 58 | Community Park Audit Tool (CPAT) | Parks/Trails/ Public open spaces | Urban | Unspecific | North America, USA | **Inter-rater reliability**  126 of 130 items with > 70% agreement  66 of 74 items with at least moderate reliability (kappa ≥ 0.4) | (70) |
| 59 | CLAN Public Open Space Audit Tool (C-POST) | Parks/Trails/ Public open spaces | Urban | Children/ Adolescents | Australia | All items showed at least adequate intra- and inter-rater reliability | (71) |
| 60 | Environmental Assessment of Public Recreation Spaces (EAPRS) / Abbreviated / Mini | Parks/Trails/ Public open spaces | Urban | Unspecific | North America, USA | **Inter-rater reliability**  69.6% of items with good-excellent range or high percent agreement | (72) |
| 61 | Natural Environment Scoring Tool (NEST) | Parks/Trails/ Public open spaces | Urban | Unspecific | Europe, England, Lithuania, Nether-lands, Spain | **Inter-rater reliability**  R-values between 0.76 and 0.96; percent agreement between 80% and 83% | (73) |
| 62 | Neighbourhod Green Space Tool (NGST) | Parks/Trails/ Public open spaces | Urban | Unspecific | Europe, England | **Inter-rater reliability**  ICC for overall score: 0.727  ICCs for domains between 0.575 and 0.948 | (74) |
| 63 | Parks and Play Spaces Audit | Parks/Trails/ Public open spaces | Urban | Children/ Adolescents | North America, USA | None reported | (75) |
| 64 | Path Environment Audit Tool (PEAT) | Parks/Trails/ Public open spaces | Unspecific | Unspecific | North America, USA | **Inter-rater reliability**  Percent agreement between 34% and 100%  ICCs between -0.04 and 0.84  Kappa between -0.03 and 1.0 | (76) |
| 65 | Public Open Space Tool (POST) / NZ-POST / New Remote POST | Parks/Trails/ Public open spaces | Urban | Unspecific | Australia/ New Zealand | POST  **Inter-rater reliability**  Kappa between 0.6 and 1.0  **Content validity** assessed by a panel of six experts.  **Agreement between remote and in-person assessment:**  17 items with substantial agreement (kappa > 0.6), 15 items with moderate agreement (0.6 > kappa > 0.4), 9 items with poor agreement  NZ-POST  Adequate reliability | (77–80) |
| 66 | READI Park Audit Tool | Parks/Trails/ Public open spaces | Unspecific | Unspecific | Australia | **Intra-rater reliability**  Percent agreement between 70% and 100%  **Inter-rater reliability**  Percent agreement between 82% and 100% | (81) |
| 67 | Systematic Audit of Green-Space Environments (SAGE) | Parks/Trails/ Public open spaces | Urban | Unspecific | North America, USA | None reported | (82) |
| 68 | Woods in and Around Towns (WIAT) | Parks/Trails/ Public open spaces | Urban | Unspecific | Europe, Scotland | None reported | (83) |
| 69 | Americas Playgrounds Safety Report Card | Playgrounds/ Recreation Facilities | Urban | Children/ Adolescents | North America, USA | **Inter-rater reliability**  was found to be acceptable (ICC = 0.77) | (84) |
| 70 | Bridging the Gap Community Obesity Measures Project (BTG-COMP) PA Facility Observation Form | Playgrounds/ Recreation Facilities | Urban | Children/ Adolescents | North America, USA | None reported | (85) |
| 71 | Physical Activity Resource Assessment Tool (PARA) | Playgrounds/ Recreation Facilities | Urban | Unspecific | North America, USA | Reliability tests of a 10% overlap showed good reliability (r s > .77) | (86) |
| 72 | The Parks, Activity and Recreation among Kids (PARK) Tool | Playgrounds/ Recreation Facilities | Urban | Children/ Adolescents | North America, Canada | **Intra-rater reliability**  Kappa > 0.4 for all but 4 items  **Inter-rater reliability**  86% of items with ≥ 75% agreement  85% of items with kappa > 0.4 (28% moderate, 27% substantial, 30% almost perfect) | (87) |
| 73 | Play Space Audit Tool (PSAT) | Playgrounds/ Recreation Facilities | Urban | Children/ Adolescents | North America, USA | **Inter-rater reliability**  Percent agreement between 67% and 100%  Kappa between 0.09 and 1.00 | (88) |
| 74 | Recreational Facility Audit Tool (RecFAT) | Playgrounds/ Recreation Facilities | Urban | Unspecific | Asia, Hong Kong | **Intra-rater reliability**  Mean percent agreement: 96.9% (range 91.0% - 100%)  76% of items with good kappa values, 4 items with moderate, 5 with poor  **Inter-rater reliability**  Mean percent agreement: 90.6% (range 80.0% - 100%)  51% of items with good kappa values, 12 items with moderate, 12 with poor  **Internal consistency**  Cronbach’s Alpha between 0.45 and 0.85 | (89) |
| 75 | Recreation Facility Evaluation Tool (RFET) | Playgrounds/ Recreation Facilities | Urban | Unspecific | North America, USA | **Inter-rater reliability**  Overall, the items were reliable | (90) |
| 76 | Computer Assisted Neighborhood Visual Assessment (CANVAS)/ “Drop-and-Spin Neighborhood Auditing” | Online-Tool/ Software | Urban | Unspecific | North America, USA | **Inter-rater reliability**  64 of 187 items with kappa or ICC scores above 0.80 and an additional 33 with scores above 0.60 | (91) |
| 77 | Complete Streets Assessment Tool (CSAT) | Online-Tool/ Software | Urban | Unspecific | North America, USA | None reported | (92) |
| 78 | Environmental Google Street View based Cycling (EGA-Cycling) | Online-Tool/ Software | Urban | Children/ Adolescents | Europe, Belgium | **Intra-rater reliability**  Cohen’s kappa between 0.47 and 1.00.  Observed agreement between 0.80 and 1.00.  **Inter-rater reliability**  Cohen’s kappa between -0.03 and 1.00.  Observed agreement between 0.367 and 1.00.  **Criterion validity**  Kappa values between virtually assessed and on-site assessed items between -0.06 and 1.00.  Observed agreement between 0.30 and 1.00. | (93) |
| 79 | ESRI Survey Audit Tool (ArcGIS) | Online-Tool/ Software | Unspecific | Seniors | Australia | None reported | (94) |
| 80 | Pedestrian Environment Review System (PERS) / Cycling Environment Review System (CERS) / Forty Area Study Street View (FASTVIEW) | Online-Tool/ Software | Urban | Unspecific | Europe, UK | **Intra-rater reliability**  Mean observed agreement: 0.81 (Kappa = 0.4)  **Inter-rater reliability**  Mean observed agreement: 0.717.  **Criterion reliability**  Mean observed agreement between in-person and desk-based audits: 0.84 (range 0.75-0.97; Kappa = 0.5-0.9) | (95) |
| 81 | Neighborhood Disorder Observational Scale | Online-Tool/ Software | Urban | Unspecific | Europe, Spain | **Inter-rater reliability**  Average of all items: fair agreement (0.21-0.40)  Mean of each subscale: moderate agreement (0.41-0.60)  **Criterion validity**  Correlation between physical and virtual audits | (96) |
| 82 | Public Open Space Desktop Auditing Tool (POSDAT) | Online-Tool/ Software | Urban | Unspecific | Australia | **Inter-rater reliability**  24 items with substantial reliability (kappa ≥ 0.6), 8 with moderate reliability (0.4 ≥ kappa < 0.6), and 11 with poor reliability (kappa < 0.4)  **Criterion validity**  39 items with substantial agreement (kappa ≥ 0.6) and one with moderate agreement (0.4 ≥ kappa < 0.6) between in-person and virtual audit | (97) |
| 83 | Systematic Social Observation Instrument (SSOI) | Online-Tool/ Software | Urban | Unspecific | North America, Canada | **Inter-rater reliability**  Average ICC across all items in 2011 was r = 0.85, in 2012, r = 0.72 and in 2013, r = 0.71  **Internal consistency**  2011: Cronbach’s alpha = 0.73; 2012: 0.64; 2013: 0.72 | (98) |
| 84 | Stanford Healthy Neighborhood Discovery Tool | Online-Tool/ Software | Urban | Seniors | North America, USA | **Inter-rater reliability** of coding schema: observed agreement > 90%; PABAK > 0.80.  Coding schema reviewed for construct validity | (99) |
| 85 | Virtual Audits of Streetscapes by Crowdworkers | Online-Tool/ Software | Urban | Unspecific | Asia, Japan | **Inter-rater reliability**  Kappa/ICC between 0.06 and 0.97; observed agreement between 0.73 and 0.988.  **Agreement between in-person and virtual audits**  Kappa/ICC between 0.30 and 0.99; observed agreement between 0.807 and 0.995. | (100) |
| 86 | Virtual-Systematic Tool for Evaluating Pedestrian Streetscapes (Virtual-STEPS) | Online-Tool/ Software | Urban | Unspecific | North America, Canada | **Inter-rater reliability**  75% of items with an observed agreement above 80%.  42.5% of items with almost perfect reliability (Kappa or ICC > 0.80), 27.5% of items with substantial reliability (Kappa or ICC 0.61-0.80), 15% of items with moderate reliability (Kappa or ICC 0.41-0.60)  **Criterion validity**  80% of items with an observed agreement above 80% between in-person and virtual audits.  50.0% of items with almost perfect agreement (Kappa or ICC > 0.80), 32.5% of items with substantial agreement (Kappa or ICC 0.61–0.80), 15.0% of items with moderate agreement (Kappa or ICC 0.41–0.60) | (101) |
| 87 | Space for children’s play inventory of the living environment [Raum für Kinderspiel Wohnumfeldinventar] | Community/ Streetscape | Urban | Children/ Adolescents | Europe, Germany | None reported | (102) |
| 88 | Integrated Microscale Walk Audit [Integriertes Walk-Audit auf Mikroebene (IWAM)] | Community/ Streetscape | Urban | Unspecific | Europe, Germany | None reported | (103) |
| 89 | Walkability Checklist [Checkliste/Prüfliste für Fußgängerfreundlichkeit] | Community/ Streetscape | Urban | Unspecific | Europe, Germany | None reported | (104, 105) |
| 90 | Playground Check [Spielplatz-Check] | Playgrounds/ Recreation Facilities | Unspecific | Children/ Adolescents | Europe, Germany | None reported | (106) |

Supplementary table : Summary of the results of systematic reviews on associations between the built environment and physical activity (children and adolescents)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nordbo et al. 2020: Promoting activity participation and well-being among children and adolescents: a systematic review of neighborhood built-environment determinants (107) (age: 5-18 years)** | | | | | | | | |
| **Unspecified PA** | **MVPA** | **Leisure-time PA** | **Leisure-time walking/ cycling** | **Active travel** | **Outdoor play/activity** | **Organized sports** | **Wellbeing** | **Use of public open spaces** |
| Road/street pattern and connectivity (+) |  | Facility and amenity index (+) |  | Less traffic and/or higher safety (+) | Less traffic and/or higher safety (+) |  | Increased count/ proportion of green/open space (+) |  |
| Facility and amenity index (+) |  |  |  | Increased traffic exposure and/or safety concerns (-) | Increased count/ proportion of facilities/ amenities (+) |  | Less favorable esthetics (-) |  |
|  |  |  |  | Pedestrian infrastructure (+) |  |  |  |  |
|  |  |  |  | Walkability (+) |  |  |  |  |
|  |  |  |  | Shorter Distance to facilities/ amenities (+) |  |  |  |  |
| **Lambert et al. 2019: What Is the Relationship between the Neighbourhood Built Environment and Time Spent in Outdoor Play? A Systematic Review (108) (age: 0-18 years)** | | | | | | | | |
|  |  |  |  |  | Lower traffic volumes (+) (6-11 years) |  |  |  |
|  |  |  |  |  | Yard access (+) (3-10 years) |  |  |  |
|  |  |  |  |  | Increased neighborhood greenness (+) (2-15 years) |  |  |  |
|  |  |  |  |  | Traffic-calming street features (+) (limited evidence) |  |  |  |
|  |  |  |  |  | Low traffic speeds (+) (limited evidence) |  |  |  |
|  |  |  |  |  | Neighborhood disorder (+) (limited evidence) |  |  |  |
|  |  |  |  |  | Residential density (+) (limited evidence) |  |  |  |
| **Timperio et al. 2015: Playability: Built and Social Environment Features That Promote Physical Activity Within Children (109) (age: 5-13 years)** | | | | | | | | |
| Seeing others exercise in the neighborhood (+) |  |  |  | Proximity to school (+) |  |  |  |  |
|  |  |  |  | Neighborhood walking and cycling infrastructure (e.g. presence and quality of sidewalks) (+) |  |  |  |  |
|  |  |  |  | Pedestrian safety/crossing infrastructure (+) |  |  |  |  |
| **Larouche 2015: Built Environment Features that Promote Cycling in School-Aged Children (110) (age: 5-17 years)** | | | | | | | | |
|  |  |  |  | Increased distance between home and school (-) |  |  |  |  |
| **D'Haese et al. 2015: Cross-continental comparison of the association between the physical environment and active transportation in children: a systematic review (111) (age: 6-12 years)** | | | | | | | | |
|  |  |  |  | Walkability (+) (walking or cycling to school) |  |  |  |  |
|  |  |  |  | Density (+) (walking to school) |  |  |  |  |
|  |  |  |  | Accessibility (+) (walking to school) |  |  |  |  |
|  |  |  |  | Traffic safety (+) (possible association with all forms of active transportation to school) |  |  |  |  |
| **McGrath et al. 2015: Associations of Objectively Measured Built-Environment Attributes with Youth Moderate–Vigorous Physical Activity: A Systematic Review and Meta-Analysis (112) (age: 5-17 years)** | | | | | | | | |
|  | Play facilities, parks, playgrounds, and features that facilitate walking (+) (15 years) |  |  |  |  |  |  |  |
|  | Play facilities, parks, playgrounds, and features that facilitate walking (-) (9 years) |  |  |  |  |  |  |  |
| **Ding et al. 2011: Neighborhood Environment and Physical Activity Among Youth: A Review (113) (age: 3-18 years)** | | | | | | | | |
| Access to recreation facilities (children 5-12) |  |  |  |  |  |  |  |  |
| Land-use mix (children and adolescents) |  |  |  |  |  |  |  |  |
| Residential density (children + adolescents) |  |  |  |  |  |  |  |  |
| Walkability (children 5-12) |  |  |  |  |  |  |  |  |
| Walking/ biking facilities (children 5-12) |  |  |  |  |  |  |  |  |
| Traffic speed/volume (children 5-12) |  |  |  |  |  |  |  |  |
| Pedestrian safety structures (children 5-12) |  |  |  |  |  |  |  |  |
| Incivilities/ disorders (children 5-12) |  |  |  |  |  |  |  |  |
| Vegetation (children 5-12) |  |  |  |  |  |  |  |  |
| **Van Hecke et al. 2018: Public open space characteristics influencing adolescents’ use and physical activity: A systematic literature review of qualitative and quantitative studies (114) (age: 12-16 years)** | | | | | | | | |
|  |  |  |  |  |  |  |  | Lack of age-appropriate features (e.g., small swings and slides) (-) |
|  |  |  |  |  |  |  |  | sport- and adventurous playgrounds (+) |
|  |  |  |  |  |  |  |  | Presence of trails/walking paths (+) |
| **Ikeda et al. 2018: Associations of children's active school travel with perceptions of the physical environment and characteristics of the social environment: A systematic review (115) (age: 5-13 years)** | | | | | | | | |
|  |  |  |  | Safety (+) |  |  |  |  |
|  |  |  |  | Walkability (+) |  |  |  |  |
|  |  |  |  | Neighborhood social interactions (+) |  |  |  |  |
|  |  |  |  | Travel distance (-) |  |  |  |  |
|  |  |  |  | Car ownership (-) |  |  |  |  |
| **Marzi et al. 2018: Social and physical environmental correlates of independent mobility in children: a systematic review taking sex/gender differences into account (116) (age: 3-12 years)** | | | | | | | | |
|  |  |  |  | Neighborhood safety (+) |  |  |  |  |
|  |  |  |  | Perception of traffic |  |  |  |  |
|  |  |  |  | Car ownership (-) |  |  |  |  |
|  |  |  |  | Distance |  |  |  |  |
|  |  |  |  | Neighborhood design |  |  |  |  |

Supplementary table : Summary of the results of systematic reviews on associations between the built environment and physical activity (adults)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **McCormack & Shiell 2011: In search of causality: a systematic review of the relationship between the built environment and physical activity among adults (117)** | | | | | | |
| **Unspecified PA** | **Leisure-time PA** | **Total walking/cycling** | **Leisure-time walking/cycling** | **Active travel** | **Walking for transportation** | **Cycling for transportation** |
| Land-use mix (+) |  |  |  |  |  |  |
| Connectivity (+) |  |  |  |  |  |  |
| Population density (+) |  |  |  |  |  |  |
| Overall neighborhood design (+) |  |  |  |  |  |  |
| **Van Holle et al. 2012: Relationship between the physical environment and different domains of physical activity in European adults: a systematic review (118) (age: 18-65 years)** | | | | | | |
| Walkability (+) | Quality of the environment (+) (possible evidence) | Urbanization degree (+) (possible evidence) | Traffic-related safety (+) | Access to shops/services/ work (+) | Walkability (+) | Walkability (+) |
| Quality of the environment (+) |  |  |  | Walking/cycling facilities (+) (possible evidence) |  | Access to shops/services/ work (+) |
| Urbanization degree (-) |  |  |  |  |  | Urbanization degree (+) |
| Access to recreation facilities (+) (possible evidence) |  |  |  |  |  | Walking/cycling facilities (+) (possible evidence) |
|  |  |  |  |  |  | Hilliness (-) (possible evidence) |
| **Wang & Wen 2017: The Relationship between the Neighborhood Built Environment and Active Transportation among Adults: A Systematic Literature Review (119)** | | | | | | |
|  |  |  |  |  | Residential density (+) | Street connectivity (+) |
|  |  |  |  |  | Land use mix (+) | Bike lane (+) |
|  |  |  |  |  | Street connectivity (+) | Neighborhood aesthetics (-) |
|  |  |  |  |  | Retail land use (+) | Access to destinations (-) |
|  |  |  |  |  | Walkability (+) |  |
|  |  |  |  |  | Sidewalk (+) |  |
|  |  |  |  |  | Assess to destinations (+) |  |
| **Carlin et al. 2017: A life course examination of the physical environmental determinants of physical activity behaviour: A "Determinants of Diet and Physical Activity" (DEDIPAC) umbrella systematic literature review (120)** | | | | | | |
| Negative street characteristics (-) |  | Street connectivity (+) |  | Street connectivity (+) |  |  |
| Walkability (+) (limited evidence) |  | Land use diversity (+) |  | Land use diversity (+) |  |  |
| Level of urbanization (+) |  | Availability/access/ proximity of public transport system (+) |  |  |  |  |

Supplementary table : Summary of the results of systematic reviews on associations between the built environment and physical activity (older adults)

|  |  |  |  |
| --- | --- | --- | --- |
| **Bonaccorsi et al. 2020: Impact of the Built Environment and the Neighborhood in Promoting the Physical Activity and the Healthy Aging in Older People: An Umbrella Review (121) (age: > 65 years)** | | | |
| **Unspecified PA** | **Leisure-time PA** | **Walking** | **Active travel** |
| Walkability (+) | Walkability (+) | Walkability (+) | Walkability (+) |
| Land-use mix (+) | Land-use mix - access (+) | Residential density/urbanization - density of physical activity facilities (+) | Residential density/urbanization (+) |
| Street connectivity (+) | Aesthetically pleasing scenery (+) | Street connectivity (+) | Overall access to facilities, destinations, and services (+) |
| Overall access to facilities (+) | Access to public transit (+) | Access to shops/commercial (+) | Land use-mix - destination diversity (+) |
| Access to shops/commercial (+) | Access to recreational facilities (+) | Access to public transport (+) | Access to shops/commercial (+) |
| Poor pedestrian access to shopping centers (-) | Access to park/open space (+) | Access to nature/parks/open space (+) | Access to food outlets (+) |
| Access to public transport (+) | Barriers to walking/cycling (-) | Pedestrian-friendly infrastructure (+) | Access to business/ institutional/industrial destinations (+) |
| Access to nature/parks/open space (+) |  | Greenery/aesthetically pleasing scenery (+) | Access to public transport (+) |
| Access to recreational facilities (+) |  | Crime-related safety (+) | Access to parks/open space/ recreation (+) |
| Acces to places for social interaction (+) |  |  | Pedestrian-friendly infrastructure - footpath quality, pedestrian crossing (+) |
| Access to exercise opportunities (senior oriented group activities) (+) |  |  | Pedestrian/cycling facilities (+) |
| Access to rest areas - seating, benches, public washrooms |  |  | Availability of benches/sitting facilities (+) |
| Pedestrian-friendly infrastructure - footpath quality, lack of hills, sidewalk characteristics (presence and continuity, quality and maintenance, slopes and curbs, temporary obstacles on sidewalks), separation between pedestrians and other nonmotorized transport (+) |  |  | Street lighting (+) |
| Poor pedestrian-friendly infrastructure/footpath quality (-) |  |  | Easy access to building entrance, whelchair access, walking access (+) |
| Pedestrian/cycling facilities (+) |  |  | Human and motorized traffic volume (+) |
| Aesthetics - Greenery/Aesthetically pleasing scenery, buildings, and streetscape/natural scenery (+) |  |  | Littering/vandalism/decay (-) |
| Lack of aesthetically pleasing scenery (-) |  |  |  |
| Crime-related safety - street lighting (+) |  |  |  |
| Crime-related safety - unattended dogs, inadequate lighting, lack of street lighting and upkeep (-) |  |  |  |
| Traffic-related safety - zebra-crossing characteristics, signaled crosswalks (+) |  |  |  |
| Traffic (-) |  |  |  |
| High environmental quality (+) |  |  |  |
| Pollution (-) |  |  |  |
| Noise (-) |  |  |  |

Supplementary table : Summary of the results of systematic reviews on associations between the built environment and physical activity (no specific age group)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Schulz et al. 2016: Built environment and health: a systematic review of studies in Germany (122)** | | | | | | |
| **Unspecified PA** | **MVPA** | **Leisure-time PA** | **Walking** | **Cycling** | **Active travel** | **Cycling for transportation** |
| Better street connectivity/walkability (+) | Close distance to activity-related destinations (playgrounds and sports facilities) (+) |  | Better street connectivity/walkability (+) |  | Close distance to sports-unrelated destinations (i.e. transit) (+) |  |
| **Yang et al. 2019: Towards a cycling-friendly city: An updated review of the associations between built environment and cycling behaviors (2007–2017) (123)** | | | | | | |
|  |  |  |  | Presence of cycling routes/paths (+) |  | Street connectivity (+) |
|  |  |  |  | Open space and green space (+) |  | Availability of non-residential destinations (+) |
|  |  |  |  | Aesthetics and attractiveness (+) |  | Presence of cycling routes/paths (+) |
|  |  |  |  | Terrain slope (emerging) |  | Land use mix (+) (emerging) |
|  |  |  |  | Cycling safety design features (emerging) |  | Availability of green spaces (+) (emerging) |
|  |  |  |  |  |  |  |
| **Kärmeniemi et al. 2018: The Built Environment as a Determinant of Physical Activity: A Systematic Review of Longitudinal Studies and Natural Experiments (124)** | | | | | | |
| Accessibility (+) |  |  |  |  | Accessibility (+) |  |
| Infrastructure for walking/cycling (+) |  |  |  |  | Infrastructure for walking/cycling (+) |  |
| Public transport (+) |  |  |  |  | Public transport (+) |  |
| Aesthetics (+) |  |  |  |  |  |  |
| Safety (+) |  |  |  |  |  |  |

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