A Review of Built Environment Measures in Older Adult Physical Activity and Health Studies

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Purpose of the Review

- Describe 3 types of built environment measures used in physical activity and health studies among older adults:

  archival, perceived, direct observation
- Identify measurement gaps
- Inform future research methodology

Photos of Austin , TX courtesy of Pedestrian and Biking Information Center.

Background

- Reviews of older adult studies found repeated associations of proximity to retail destinations with walking, and proximity to recreational facilities and perceived safety from crime with both walking and total PA
- However, many BE elements had inconsistent findings: some studies no associations, others weak associations (Van Cauwenberg 2011)
- Difficulty walking or climbing stairs is common in older adults but rarely addressed in BE studies, with results varying by functional ability

Methods: Literature Search

Inclusion Criteria

- Original empiric research that quantitatively tested relationships of BE measures with PA, function, or health
- Average age ≥ 55 years
- Peer-reviewed journal articles only
- Published January 2000 - December 2011
- English-language
- Community-dwelling adults

Exclusion Criteria

- Qualitative studies
- Reviews
- Studies in senior housing, assisted living, or long-term care facilities

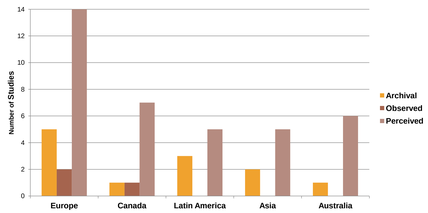
Databases Searched

- Academic Search Premier, Active Living Research, CINAHL, PsychInfo, PubMed, SocIndex, Web of Science
- Manual search of bibliographies of studies found
- Cross-checked with review article bibliographies

Results: Study Characteristics

- 125 studies met inclusion criteria
- Archival measures used in 52 studies
- 11 environmental audit instruments found in 16 studies
- Perceived BE measures found in 83 studies
  - Neighborhood Environment Walkability Survey (NEWS, 6 versions)
  - 12 non-NEWS survey instruments with reported reliability
- Archival measures increasingly used in recent years
- Most conducted in urban centers (Bogotá, Columbia; Portland, Oregon, USA)
- 52 of 125 studies conducted outside of the United States

Figure 1 . Study locations outside the United States



Results: Archival BE Measures

- Counts and density (counts/spatial area) measures were more common than measures of distance to, area, pattern, or characteristics of BE elements
- Common spatial units: census tracts or circular residential buffers (100-8,000m)
- Some studies included archival measures of area economic and social contexts

Table 1 Studies reporting verifying archival data

Study	BE Domain	Verification Procedures
Auchincloss 2008, Diez Roux 2007	Recreational facilities	Verified facility requirement of fee for use through Web search and telephone calls
Hanibuchi 2011	Residential density	Verified population density data against an historical topographical map of Japan from the same time period
Satariano 2010	Block length	Assessed temporal reliability of block length values

Table 2. Studies reporting consensus categorizing of archival data

Study	BE Domain	Consensus Coding Procedures
Kubzansky 2005	Recreational facilities, food stores, retail	Two investigators independently categorized Yellow Page data by type of business or service. A third compared lists. Categories with <85% agreement were reconciled by the three.
Rodriguez 2009	Land use	One investigator recoded detailed land use codes into fewer classifications for measures creation. A second investigator condirmed clasifications and recoded disagreements.

Results: Environmental Audits for Direct Observation

- The 11 audits ranged from 5 – 162 items for observers to rate
- Inter-rater agreement ranged from <.40 to .94 for specific items or scales with highest agreement for retail destinations and lowest for aesthetics
- Several emphasized conditions of home exterior, yard, street on immediate block
- 4 audits developed specifically for older adults or those with difficulty walking:
  - Burton 2011, 25 items, used in the United Kingdom
  - Clarke 2008, 3 scales, used in Chicago, Illinois, USA
  - Cunningham 2005, Michael 2009, 92 items, used in Portland, Oregon, USA
  - King 2008, 60 items, used in Denver, Colorado, USA

Results: Perceived BE Measures

Neighborhood Environment Walkability Survey (NEWS)

- 25.3% (21 of 83) studies used all or part of any of six versions of NEWS
- Test-retest reliability: range .41 – 1.0, most scales ≥ .75
- Validity well-tested by Cerin and colleagues
- NEWS-Chinese Seniors used in Hong Kong (Cerin 2010)
- Other versions: Original, Abbreviated, Modified, Brazilian, Flemish

Table 3. Non-NEWS survey instruments with reported reliability developed for older adults or those with difficulty walking

Name of Instrument	Author (Year)	Test-Retest Reliability	Number of Citations
Environmental Analysis of Mobility	Shumway-Cook 2003	Median .92	65
Home and Community Environment	Keysor 2005	.47-1.0	21
Measure of the Quality of the Environment	Fourgeyrollas 1999	.60-.83	17
Multi-Ethnic Study of Atherosclerosis Neighborhood Study	Bild 2002	.60-.88	640

Results: Coverage of BE Domains

Table 4. Common BE elements measured in older adult studies

BE Domains	Archival Measures N=52 studies %	Observed Measures N=16 studies %	Perceived Measures N=83 studies %
Land use			
Retail destinations	21.2	6.2	28.9
Land use pattern	15.4	75.0	3.6
Street connectivity			
Block length	5.8	6.2	16.9
Intersections	15.4	12.5	16.9
Pedestrian Infrastructure			
Sidewalk coverage	3.8	56.2	38.6
Sidewalk quality	0	68.8	25.3
Crosswalks	0	31.2	0
Urbanization/Density			
Urban vs. rural	7.7	0	3.6
Population density	21.2	6.2	14.5
Vegetation	1.9	31.2	1.2
Recreational facilities			
Parks and trails	23.1	12.5	15.7
Gyms/recreation centers	7.7	6.2	6.0
Comfort			
Aesthetics	0	37.5	21.7
Benches present	0	25.0	2.4
Safety from crime	5.8	37.5	28.9
Safety from traffic	3.8	25.0	22.9
Safety, general	0	0	15.7
Slope of terrain	5.8	6.2	6.0
Public transit stops or stations	5.8	18.8	3.6
Composite measures			
Walkability (Frank 2005)	11.5	0	1.2
LTPA conduciveness	3.8	12.5	12.0
Economic/social context	21.2	12.5	20.5

Discussion

Variability in Measures

- BE characteristics defined many ways
- Within studies, those with multiple dependent variables typically used same BE measures regardless of type of PA or health being studied
- Variety of measures may explain a portion of the inconsistent findings

Target Populations of Instrument Design

- Most instruments created for studies with adults of any age
- Few instruments took varied gait speed and functional abilities into account in micro-scale measures, e.g. crosswalk signal timing

Measurement Gaps

- Pedestrian infrastructure addressed in NEWS but rarely measured in studies with archival measures, esp. crosswalks, sidewalks, traffic
- Dual influences of built and social environment partially addressed
- Characteristics of features (stairways into public transit) may matter more with older adults yet assessed little
- Life course perspective lacking re influence of earlier environments
- Incompleteness or temporal unreliability of archival data acknowledged in the literature earlier but few studies report verification procedures

Limitations of the Review

- EMBASE database not searched, Transportation Research Information Services database not systematically searched in all years
- Social environment measures are incomplete since inclusion criteria and search terms based on BE

Recommendations for Future Research

- Collaborate with mobility researchers, older adults, and others to develop conceptual frameworks and pertinent street-scale measures
  - Adapt well-tested measures for use with older adults
  - Address modifiable pedestrian infrastructure, including cross-walk and intersection safety per qualitative studies (Dumbaugh 2008)
- Address neighborhood deprivation, assess social environment
- Include perceived measures in studies with objective measures since perceptions important in behavior, and discordant findings (Gebel 2011)
- Address neighborhood deprivation and poverty, otherwise early onset of functional limitations in low income populations likely to continue
- Measure what can be changed to generate actionable data

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