

Purpose

Conduct cross-sectional secondary analyses of spatial data and clinical measures of health to explore associations between environmental characteristics and metabolic risk.

Background

- Obesity, dyslipidemia, elevated blood pressure or blood glucose are known risk factors for type 2 diabetes or cardiovascular diseases that are partially preventable or modifiable through physical activity, nutrition
- Built environment refers to:
 - Physical form of communities, including pattern of land use
 - Design of man-made features and landscaping
 - Transportation system of roadways and public transit
- Residential neighborhood characteristics are associated with physical activity, access to healthy foods, and obesity in middle-aged/older adults
- Residential environmental characteristics are associated with metabolic risk in younger populations (Deng 2011)
- Sedentary behavior is associated with dyslipidemia, obesity, metabolic syndrome, diabetes, and heart disease (Thorpe 2011)
- Few built environment studies on metabolic risk in middle-aged adults

Study Design

- Cross-sectional
- Linked archival spatial and health data

Methods: Spatial Data

- 12-county area in Dallas-Fort Worth and Austin, TX
- Data sources:
 - North Central Texas Council of Governments (land use, other)
 - City of Austin (land use, other)
 - Dun and Bradstreet (private exercise facilities)
 - ESRI 2005 street file (street connectivity)
 - National Agriculture Imagery Program imagery (vegetation)
- Calculations made in ArcGIS 10.0
- Distance to city center: Euclidean distance from residence to city hall of Dallas, Fort Worth, or Austin, whichever was nearest (proxy for urban sprawl, increased driving time)
- Buffers:
 - 800-meter network (a walkable distance)
 - 1600-meter Euclidean (recreational facilities, e.g. parks, gyms)
 - Buffer size comparison analyses: 400- to 8000-meter Euclidean
- Private exercise facilities: number of gyms, YMCAs, or other types
- Recreational activity friendliness index: sum of z-scores of
 - Park area
 - Private exercise facilities (count)
 - Vegetation coverage (% per infrared imagery and calculated index)
 - Average traffic speed (reverse coded)

Methods: Study Population

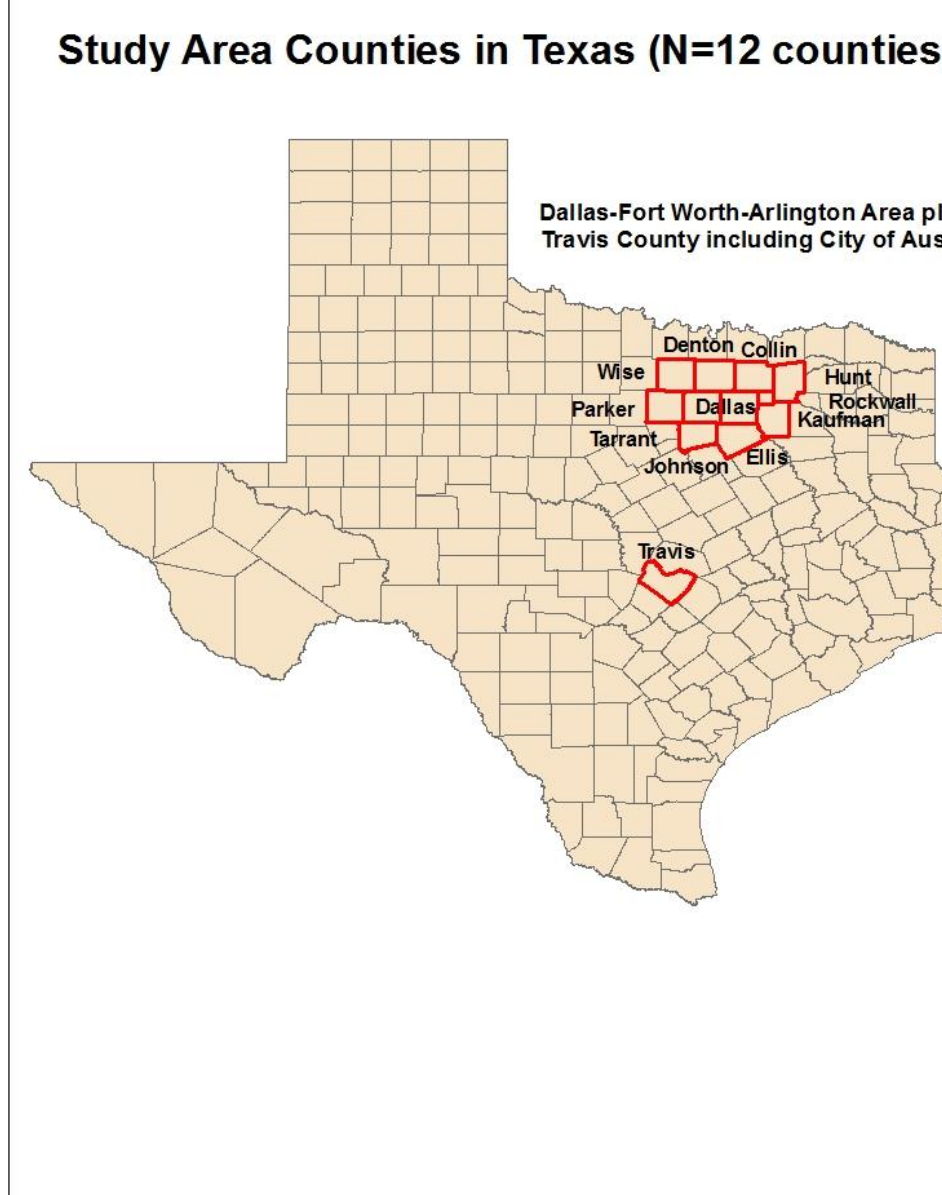
Cooper Center Longitudinal Study

Inclusion Criteria

- Aged ≥ 50 years
- Completed preventive medicine exam at Cooper Clinic in Dallas, TX in 2000-2007
- Lived in one of 12 counties in Dallas-Fort Worth or Austin, TX area
- Geocoded residential address

Exclusion Criteria

- Self-reported history of diabetes, stroke, or heart disease
- Missing data on variables
 - Exception: Imputed missing waist circumference modeled on body mass index (BMI), age, sex, lipids, glucose, and blood pressure



Methods: Health Data

Table 1. Metabolic syndrome criteria (Alberti 2009)

Metabolic Syndrome	3 or more of the following:
Waist circumference	Men: ≥ 102 cm, Women: ≥ 88 cm
Fasting blood glucose	≥ 100 mg/dL
Blood pressure	Systolic ≥ 130 mm Hg or diastolic ≥ 85 mm Hg
Triglycerides	≥ 150 mg/dL
High-density lipoprotein (HDL)	Men: < 40 mg/dL, Women: < 50 mg/dL

Methods: Data Analyses

- All analyses conducted in SAS 9.2
- Generalized estimating equations (GEE), logistic distribution with robust standard errors, to adjust for nuisance clustering by census block group
- Separate bivariate adjusted models, adjusted for age, sex, alcohol intake, current smoking, and comorbidity

Results: Demographic Characteristics

Table 2. Demographic Characteristics

Characteristic	Overall (N=3547)
Age, mean ± SD range	57.2 ± 6.3 50 to 88 years old
Male	74.4%
Employed full- or part-time	77.8%
College graduate	84.6%
Non-Hispanic white	95.8%

Results: Health Characteristics

Table 3. Health characteristics

Clinical Measures of Health	Overall (N=3547)
Met metabolic syndrome criteria	21.3%
Elevated waist circumference	25.2%
Elevated fasting blood glucose	34.8 %
Elevated blood pressure (single clinic visit)	50.7%
Elevated triglycerides	23.8%
Low HDL	16.9%
Obese (BMI ≥ 30 kg/m ²)	21.4%

Results: Built Environment and Metabolic Syndrome

Table 4. Metabolic syndrome proportion and odds ratio (95% CI) by built environment IV, bivariate adjusted GEE models, logistic

	Private Exercise Facilities	Recreational Activity Friendliness Index	Distance to City Center	Intersection Density
Lowest BE quartile	23.2% OR 1.0 (Ref)	24.5% 1.0 (Ref)	18.1% 1.0 (Ref)	22.2% 1.0 (Ref)
Second BE quartile	23.0% OR 1.02 (.79, 1.32)	20.8% .81 (.65, 1.03)	21.3% 1.17 (.94, 1.45)	21.1% .98 (.78, 1.23)
Third BE quartile	20.8% OR .86 (.68, 1.10)	21.1% .79 (.64, .99)	21.3% 1.09 (.89, 1.34)	22.4% 1.02 (.82, 1.27)
Highest BE quartile	18.8% OR .78 (.62, .98)	18.8% .74 (.60, .92)	24.6% 1.37 (1.13, 1.67)	19.6% .87 (.70, 1.07)
P-value for trend	.037	.048	.028	.48
Model Fit QIC	3604.2	3601.7	3601.6	3608.2

Results: Other

Dependent Variable: Met Criteria for Metabolic Syndrome

- Other BE elements tested were unrelated to metabolic syndrome
- Private exercise facility associations robust across multiple buffer sizes
- Distance to city center relationship held when additionally adjusted for employment status, education, and self-reported physical activity
- Longer distances to city center in this region imply increased driving time to get to retail, service, healthcare, and entertainment destinations and many workplaces, thereby likely increasing total sedentary time

Strengths

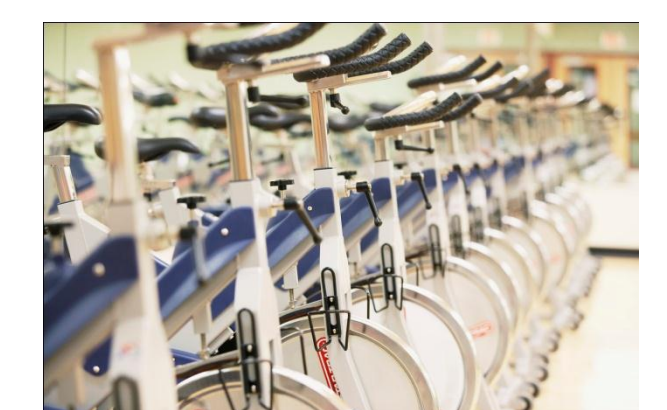
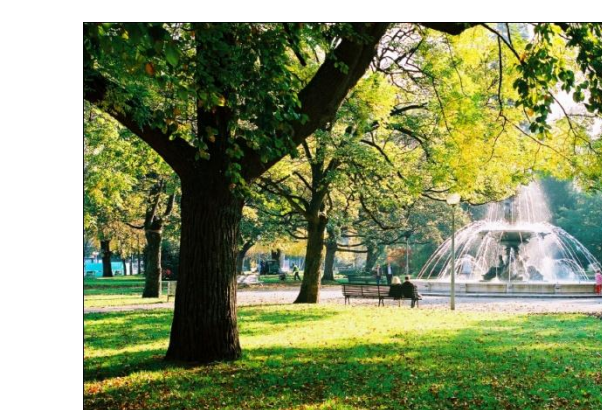
- Comprehensive set of GIS-based measures
- Clinical measures of health
- Residential buffers instead of census tracts
- Included middle-aged adults, who are likely to reduce physical activity participation pre-retirement



Limitations

- Non-representative sample
- Cross-sectional study design
- Unmeasured self-selection of neighborhoods to support healthy living
- Waist circumference imputed by single value modeling
- Did not test for associations by functional ability or age cohort
- Pedestrian infrastructure under-addressed

Conclusions



- Previous research has shown built environment associations with physical activity or obesity in middle-aged and older adults
- This exploratory study shows:
 - Living in a neighborhood with private exercise facilities, vegetation coverage, park area, and/or low traffic speed is associated with lower proportion of metabolic syndrome in this sample of well-educated middle-aged and older adults
 - Living far from a city center is associated with higher sample proportion of metabolic syndrome
 - Intriguing findings worthy of further investigation in diverse samples
- If replicated in representative samples with additional environmental characteristics associated, could motivate action, including:
 - Provision of parks in residential areas
 - Placement of fitness facilities in residential areas
 - Promotion of active transport

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