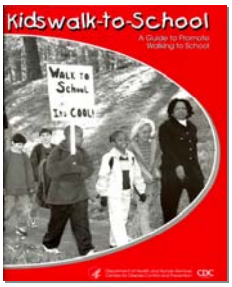
ENVIRONMENTAL DETERMINANTS OF PHYSICAL ACTIVITY: A VIEW FROM PUBLIC HEALTH

- Tom Schmid, PhD
  - Centers for Disease Control and Prevention
  - tls4@cdc.gov
  - Magglengen, Switzerland 2005

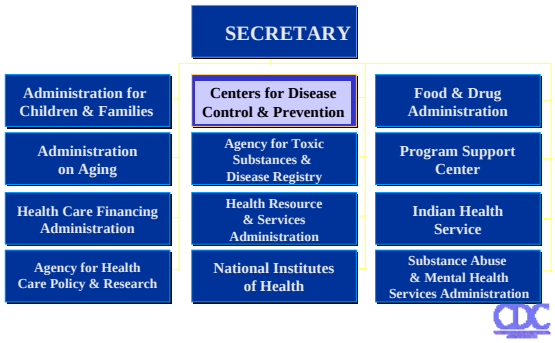
Public Health has many views



CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Healthy People in a Healthy World, Through Prevention

U.S. Department of Health and Human Services



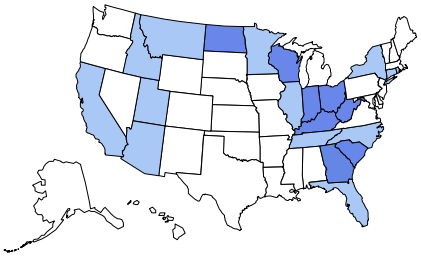
Centers for Disease Control and Prevention

Physical Activity and Health Branch

- Vision
  - Active People in an Activity-Friendly World
- Mission
  - Understand and Promote Physical Activity to Enhance Health and Quality of Life
- Guiding Principles
  - We are a science-driven organization.
  - We Focus on population-based public health research and programs.
  - We are accountable to our public health constituents.
  - We conduct our work with integrity and follow ethical standards.

Obesity* Trends Among U.S. Adults
BRFSS, 1985

(*BMI ≥ 30, or ~ 30 lbs overweight for 5'4" person)



No Data | <10% | 10%-14% | 15-19% | ≥20%

Source: BRFSS, CDC.

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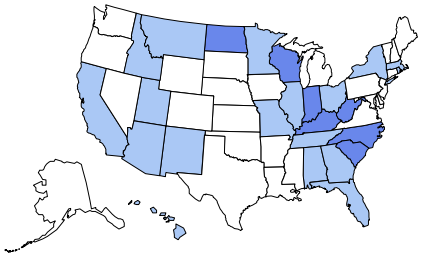

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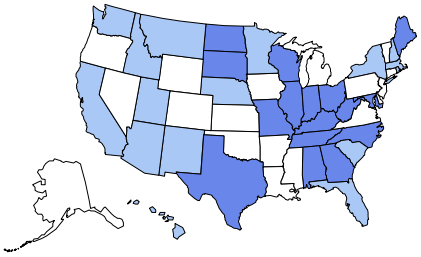

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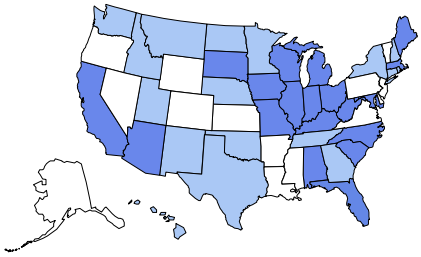

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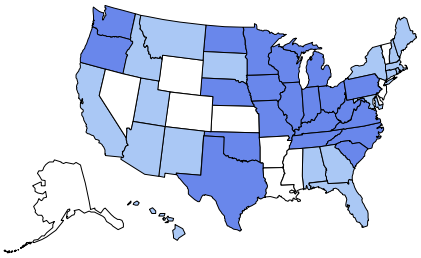

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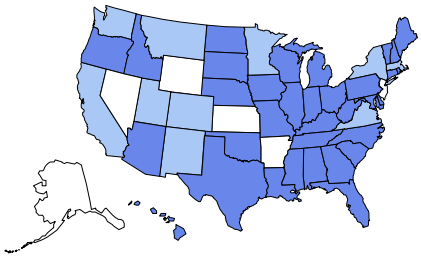

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Source: BRFSS, CDC.

Obesity* Trends Among U.S. Adults
BRFSS, 1991

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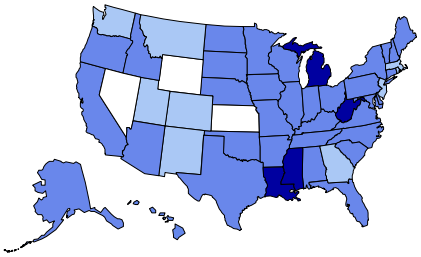

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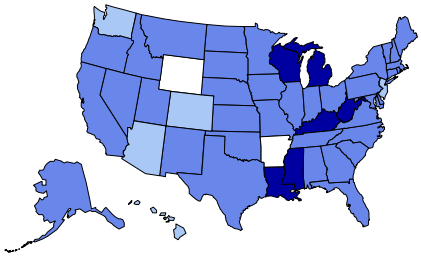

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Source: BRFSS, CDC.

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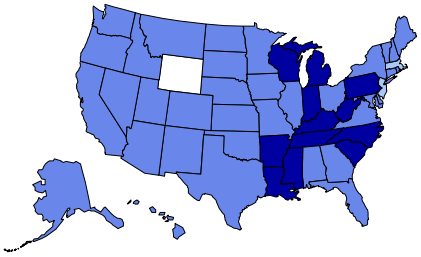

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Obesity* Trends Among U.S. Adults
BRFSS, 1994

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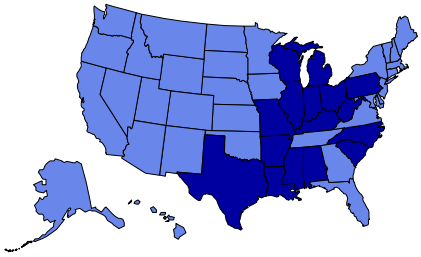

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Source: BRFSS, CDC.

Obesity* Trends Among U.S. Adults
BRFSS, 1995

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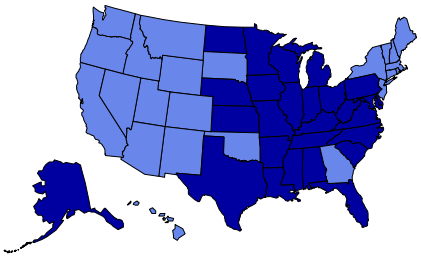

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Obesity* Trends Among U.S. Adults
BRFSS, 1996

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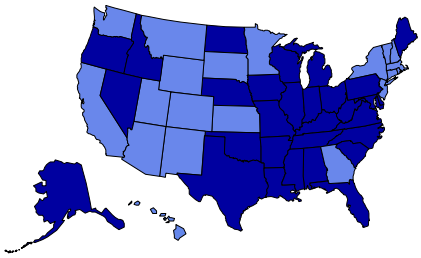

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Source: BRFSS, CDC.

Obesity* Trends Among U.S. Adults
BRFSS, 1997

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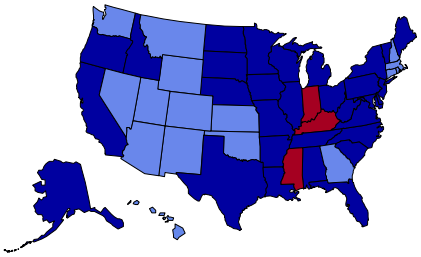

No Data | <10% | 10%-14% | 15-19% | ≥20%

Source: BRFSS, CDC.

Obesity* Trends Among U.S. Adults
BRFSS, 1998

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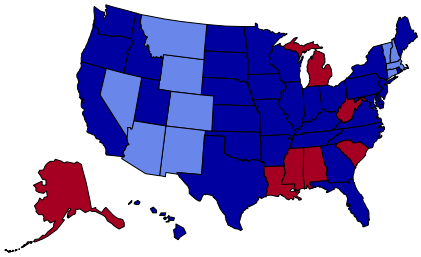

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Obesity* Trends Among U.S. Adults
BRFSS, 1999

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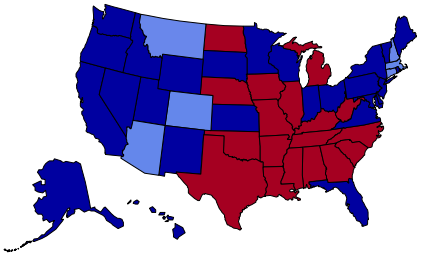

No Data | <10% | 10%-14% | 15-19% | ≥20%

Source: BRFSS, CDC.

Obesity* Trends Among U.S. Adults
BRFSS, 2000

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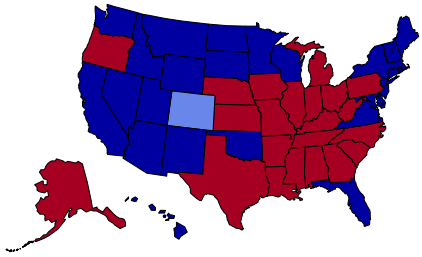


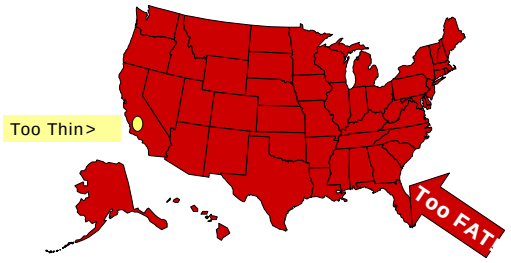
No Data | <10% | 10%-14% | 15-19% | ≥20%

Source: Mokdad A H, et al. *JAMA* 2001;286:10

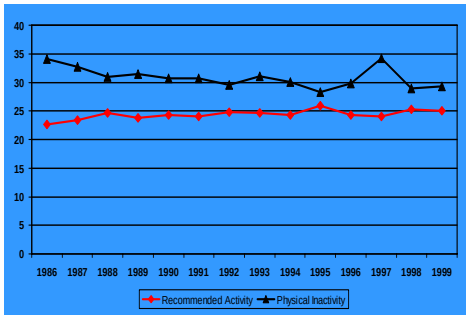
Obesity Trends* Among U.S. Adults

BRFSS, 200?

(*BMI ≥30, or ~ 30 lbs overweight for 5'4" woman)



Leisure Time Physical Activity Trends 1986-1999



S. Ham, CDC, 2000.

Recommended Activity = Moderate or Vigorous Activity

Morbidity Associated with Inactivity

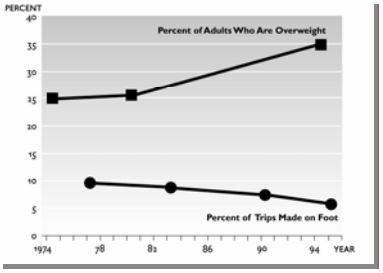
- Coronary Heart Disease
- Obesity
- Diabetes
- Stroke
- Colorectal Cancer

Therapeutic Effects of Physical Activity

Clinical practice guidelines exist for physical activity in many diseases:

- high blood pressure
- chronic lung disease
- cholesterol management
- cardiovascular disease
- diabetes
- osteoporosis
- arthritis
- obesity

Walking Is Declining, While the Number of Overweight Adults Is Climbing



Based on data from the Nationwide Personal Transportation Survey and the Centers for Disease Control and Prevention.

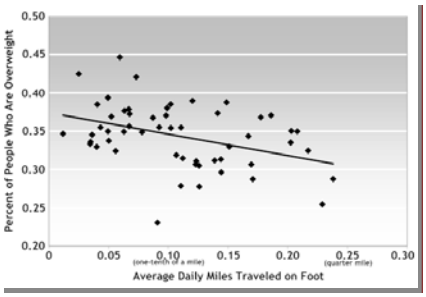
Modal Travel in Urban Areas:

Europe and North America Percent of Trips by Mode

Country	Bicycle	Walking	Public Transport	Car
Netherlands	30	18	5	45
Germany	12	22	16	49
England	8	12	14	62
Italy	5	28	16	42
Canada	1	10	14	74
USA	1	9	3	84

Transportation Quarterly 1997; 51:31

More People Are Overweight in Places Where People Walk Less



What are Active Community Environments - ACES?

- ACES are places that support and promote physical activity for people of all ages and abilities
  - Places that make it easy to "choose" to be active
- Predominant features include sidewalks, bikeways, trails, parks and other recreational facilities
- They are close to where people live and work and are easily accessible
- What is Active Living?
  - A way of life that integrates Physical Activity into daily routines
    - Transportaiton Leisure Occupation Household

ACES Research Agenda

- Long Standing Interest in Policy and Environmental Interventions
  - Panel Discussion on Policy and Environmental Actions to Promote Physical Activity
    - Participants: urban planning, transportation, architecture, criminology, social ecology, environmental health
    - Recommendations
      - » ***Develop tools, find data, determine relationships- collaborate***
      - » Advocate: Ped Friendly design, infill/density. limit parking, job housing mix, developer incentives, zoning standards…

ACES
Active Community Environments

Research Practice and Policy

GUIDE TO
COMMUNITY
Preventive Services
SYSTEMATIC REVIEWS AND EVIDENCE-BASED RECOMMENDATIONS

Physical Activity

Informational
- Community-wide campaigns
- Point-of-decision prompts

Behavioral and social
- School-based PE
- Social support in community settings
- Individually adapted behavior change

Environmental and policy
- Enhanced access with outreach

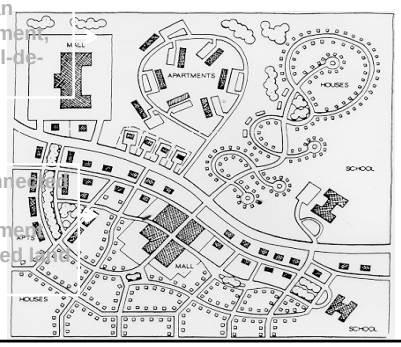
Community-scale urban design and land use policies and practices

- Defined as: Urban design and land use policies and practices that support physical activity in geographic areas, generally several square kilometers in area or more.
- Examples of interventions include
  - Infrastructure projects to improve **continuity** and **connectivity** of streets, sidewalks, and bike lanes
  - Local zoning regulations and roadway design standards that promote **destination walking** and co-location of residential, commercial, and school properties

Community Developments

Suburban development, many cul-de-sacs

Well-connected urban development with mixed land uses



Community Guide Recommendation: Community-scale urban design and land use policies

- The Task Force *recommends* community-scale urban design and land use policies and practices to promote physical activity based on sufficient evidence of effectiveness.
- Evidence was considered sufficient based on:
  - Sufficient effect size
  - Consistency of results: ↑ levels of PA associated with improved continuity and connectivity of streets and sidewalks; ↑ levels of PA associated with local mixed-use zoning and roadway design that promotes destination walking
- Other supporting evidence
  - Dose-response across levels of exposure
  - Face validity
  - Other potential benefits include ↑: air quality, social capital, consumer choice, and green space

Street-scale urban design and land use policies and practices

- Defined as: Urban design and land use policies that support physical activity in small geographic areas, generally limited to a few blocks.
- Intervention Characteristics: policy instruments and practices such as:
  - Implementation of improved street lighting
  - Infrastructure projects to:
    - Increase ease and safety of street crossing
    - Ensure sidewalk continuity
    - Introduce or enhance traffic calming
    - Enhance aesthetics of the streetscape

Community Guide recommendation:

- The Task Force *recommends* use of street-scale urban design to increase physical activity based on sufficient evidence of effectiveness.
- Evidence was considered sufficient to make a recommendation based on sufficient effect size and consistency of results.
- Other supporting evidence
  - Face validity
  - Other potential benefits such as: ↑ social capital, ↓ stress, ↑ green space, and ↓ crime

ACES Active Community Environments

Research Practice and Policy

Socio-Ecologic Model

Source: Adapted from McLeroy, et al., An ecological perspective on health promotion programs. Health Education Quarterly 1988; 15:351-77.

Physical Activity and the Environment Major Issues for Public Health

- Define/measure
  - Independent Variables, Dependent Variables
- Determine Associations
- Determine "Causation"
- Determine Solutions
- Determine Benefit (Is it HEPA, for Whom?)

ACEs Research: Research, Practice and Policy

- Evidence
  - Harvard — Youth
  - North Carolina — Youth
  - South Carolina — Community
  - Ga Tech — Community
  - Washington — Seniors
  - Western Australia — Community
  - Rutgers — Health Outcomes

Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity

Reid Ewing, Tom Schmid, Rich Killingsworth, Amy Zlot, Stephen Raudenbush

American Journal of Health Promotion (2003) Vol. 18, No. 1, pages 47-57

Purpose

- To determine the relationship between urban sprawl, health, and health-related behaviors using a cross-sectional analysis

Hypotheses

Residents of sprawling places:

(1) walk less

(2) weigh more

(3) have a higher prevalence of health problems linked to physical inactivity

Health Measures:

Behavioral Risk Factor Surveillance System (BRFSS) 1998-2000[1]

- Leisure time physical activity (any amount, recommended levels, minutes walked in past month)
- Obesity
- Body mass index (BMI)
- Hypertension
- Diabetes
- Coronary heart disease (CHD)

Control Measures:

- Gender
- Age
- Race or ethnicity
- Education
- Smoking
- Diet (fruit or vegetable consumption)

County Sprawl Index:

- County-level indices based on[1]:
  - Residential density
  - Street accessibility
- Scores ranged from **352** for compact Manhattan to **63** for sprawling Geauga County (outside of Cleveland, OH)

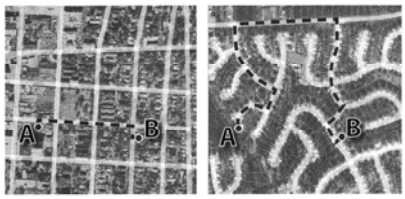
1. Data from US census, USDA Natural Resource Inventory, and Census TIGER files. Estimated for 448 metropolitan counties in the U.S.

Density

- Persons per square mile
- Percentage of county population living at low suburban densities (i.e. less than one housing unit per acre)
- Percentage of county population living at moderate to high suburban densities (i.e. 8 housing units per acre)

Street Accessibility

- Average block size
- Percentage of typical traditional urban block (i.e., less than 1/100 square mile)



Sprawl in the United States

County	Sprawl Index Score
Geauga (Cleveland, OH)	63.12
Isanti (Minnesota)	70.12
Hanover (Richmond, VA)	74.97
McHenry (Illinois)	100.08
Delaware (Philadelphia, PA)	125.34
Cook (Illinois)	150.15
Suffolk (New York)	179.37
San Francisco (California)	209.27
Manhattan (New York)	352.07

Results

People living in sprawling counties:

- Have higher body mass indexes
- Are more likely to be obese
- Are more likely to have high blood pressure
- Walk less in their leisure time

Results

	County Sprawl Index		
Outcome	**Coefficient**	**t**	**p**
Minutes walked*	0.275	2.95	0.004
BMI	-0.00344	-2.84	0.005
Obesity	-0.00212	-4.24	<0.001
Hypertension	-0.00119	-2.37	0.018
*only outcome also significantly related to the metropolitan index			

Results: Minutes Walked

- Every 50-point increase in the sprawl index is associated with **14 minutes less** leisure walking per month

Results: BMI

- Every 50-point increase in the sprawl index is linked to a **0.17 increase** in BMI
- This increase translates into approximately **one pound** for an average person

Results: Obesity

- Every 50-point increase in the sprawl index is associated with a **10% increase** in the odds a county resident will be obese

Results: Hypertension

- Every 50-point increase in the sprawl index is linked to a **6% increase** in the odds a county resident will have high blood pressure

The influence of sprawl on weight[1]:

County	Sprawl score	Expected BMI	Expected weight in lbs. for a 5'7" person
Geauga (Cleveland, OH)	63.12	26.23	167.5
Isanti (Minnesota)	70.12	26.20	167.3
Hanover (Richmond, VA)	74.97	26.19	167.2
McHenry (Illinois)	100.08	26.10	166.6
Delaware (Philadelphia, PA)	125.34	26.01	166.1
Cook (Illinois)	150.15	25.93	165.5
Suffolk (New York)	179.37	25.83	164.9
San Francisco (California)	209.27	25.72	164.2
Manhattan (New York)	352.07	25.23	161.1

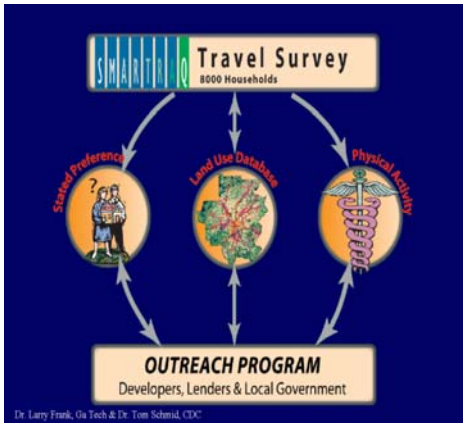
1. McCann, B. and Ewing, R. Measuring the Health Effects of Sprawl. Smart Growth America, 2003.

Conclusion

- Urban form could be significantly associated with some forms of physical activity and some pertinent health outcomes

Some study limitations
(and hence, future work)

- Study shows association, not causality (cross sectional study)
- Leisure time activity is only one source of physical activity
- Statistical analysis could not account for BRFSS' complex sampling design
- Relationship between sprawl and health outcomes probably not linear
- Need better, more microscale, environmental variables



SMARTRAQ SURVEY PLAN

ACTIVITY BASED TRAVEL SURVEY
8000 Households

- **Across land use type, household size, and income**
- **Engaging Traditionally Under-served Households via Translation, Active Recruitment, and Community Outreach**

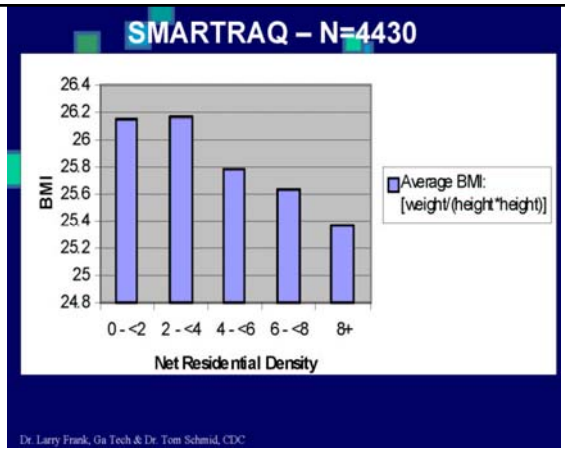
1500 households
Residential Preference Survey: *Defining the Market for Smart Growth*

1100 Vehicles
In-Vehicle (GPS) Global Positioning Systems: *capturing actual travel vs reported*

1000 Persons Physical Activity Survey

500 Persons
GPS / Palm Pilots

500 Persons
Activity monitors



Statistical Significance -- BMI

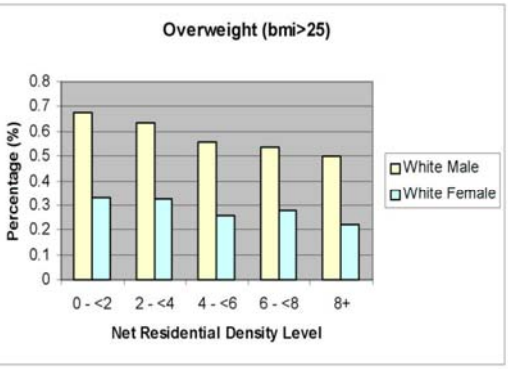
- - -
- - -

ntrolling for.. AGE ETHNICITY GENDER TRANSIT SERVICE

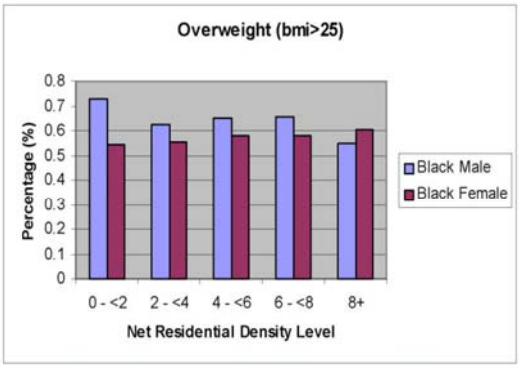
	LogBMI	NRDLOG	INTDENLG
LogBMI	1.0000 (0) P= .	-.1249 (4430) P= .000	-.1038 (4430) P= .000
NRDLOG	-.1249 (4430) P= .000	1.0000 (0) P= .	.5591 (4430) P= .000
INTDENLG	-.1038 (4430)	.5591 (4430)	1.0000 (0)

Mixed Use = -.1298
Int. Density = -.1
Composite = -.12

Dr. Larry Frank, Ga Tech & Dr. Tom Schmid, CDC



Dr. Lawrence Frank and Dr. Tom Schmid



Dr. Lawrence Frank and Dr. Tom Schmid

Analysis

Black	Statistic	Value	df	p-value	White	Statistic	Value	df	p-value
Male	Pearson Chi-Square	11.5101	4	0.021	Male	Pearson Chi-Square	34.507	4	5.86E-07
Female	Pearson Chi-Square	8.1284	4	0.087	Female	Pearson Chi-Square	17.703	4	0.0014

Based on the bar charts and chi-square tests, the following conclusions can be reached:

- For **black male**, the probabilities of being obese are significantly different for different NRDL's.
- For **black female**, there is some evidence that the probabilities of being obese are significantly different for different NRDL's, but the evidence is not very strong.
- For **white male**, the probabilities of being obese are significantly different for different NRDL's. The bar chart shows that the probability of being obese decrease as net residential density increases. That is, the less dense, the higher probability of being obese.
- For **white female**, the probabilities of being obese are significantly different for different NRDL's.

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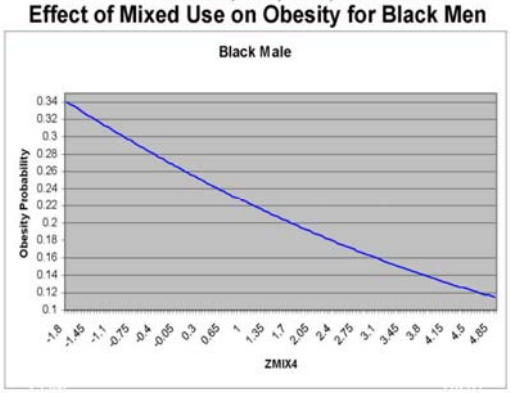
ZMIX4 = Residential, retail, office, and institutional

Effect of Mixed Use on Obesity for Black Men



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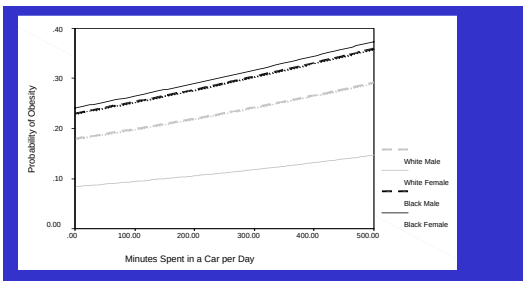
Probability of Obesity and Time Spent in Car



Correlations between PA and Residential Density, Land Use Mix and Intersection Density

	» Res.Density	Mix	Inter Dens
PA	.179**	.145**	.111**
Res Dens		.496**	.586**
Mix			.356**

Logistic Regression to Explain 30 Minutes of Moderate of PA

• Construct	p	odds	
• Gender	.42	.82	
• Age	.04	.98	
• Ed	.57	1.17	
• Ethnic	.17	1.57	
• Walkability quartile			
– 2	.19	1.63	
– 3	.05	2.02	
– 4	.01	2.40	