Food Deserts and Obesity

Is poor access to grocery stores associated with an increased risk of obesity?

Outline

- What is a food desert?
- What factors influence the food environment and food access in Kansas?
- What is the food environment for WIC mothers in Kansas?
- Are food environments linked with obesity?
- Public health implications (group discussion)?

What is a food desert?

- A geographic area with:
  - Limited access to grocery stores
  - Limited access to low-cost foods
  - Limited access to healthy foods
- Store characteristics
  - Number
  - Size
  - Quality
  - Convenience:Grocery

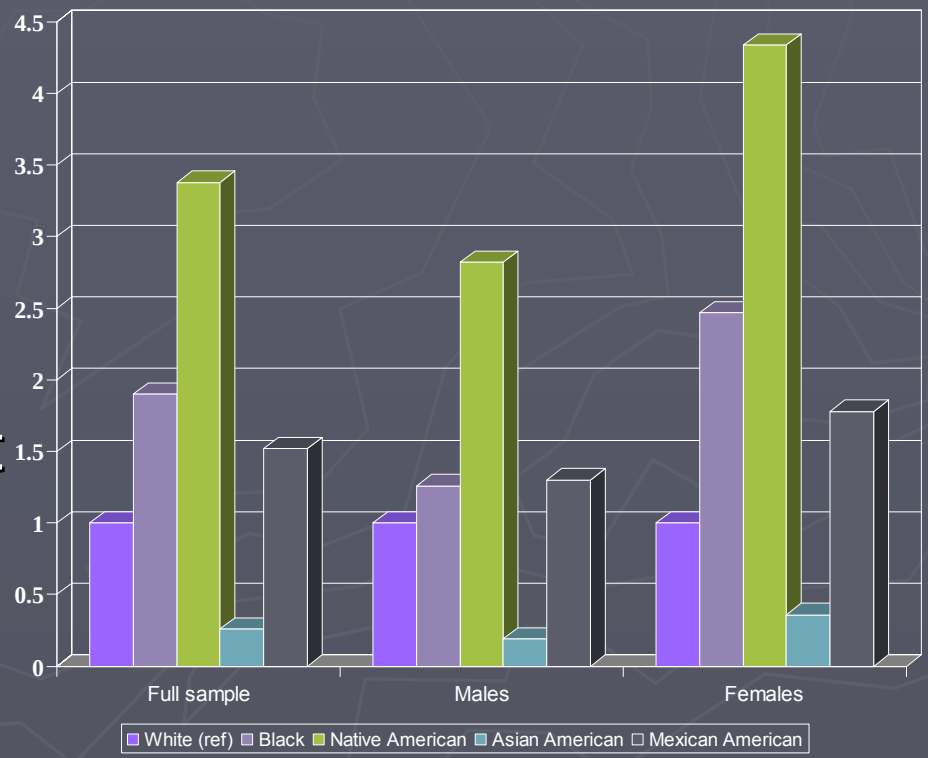
Food desert formation

- Consolidation in the supermarket industry and growth of supercenters
- Loss of population in rural areas
- Suburban sprawl
- Urban blight and disinvestment

Why care about food deserts?

- AA living in tract with supermarket 32% more likely to meet FV recommendation (Morland, 2004).
- Increased OV and OB in tracts with no supermarket (Morland, 2006).
- Shopping distance >1.76 miles associated with 0.78 unit increase in BMI (Inagami, 2006).

Disparities in obesity rates, 2002

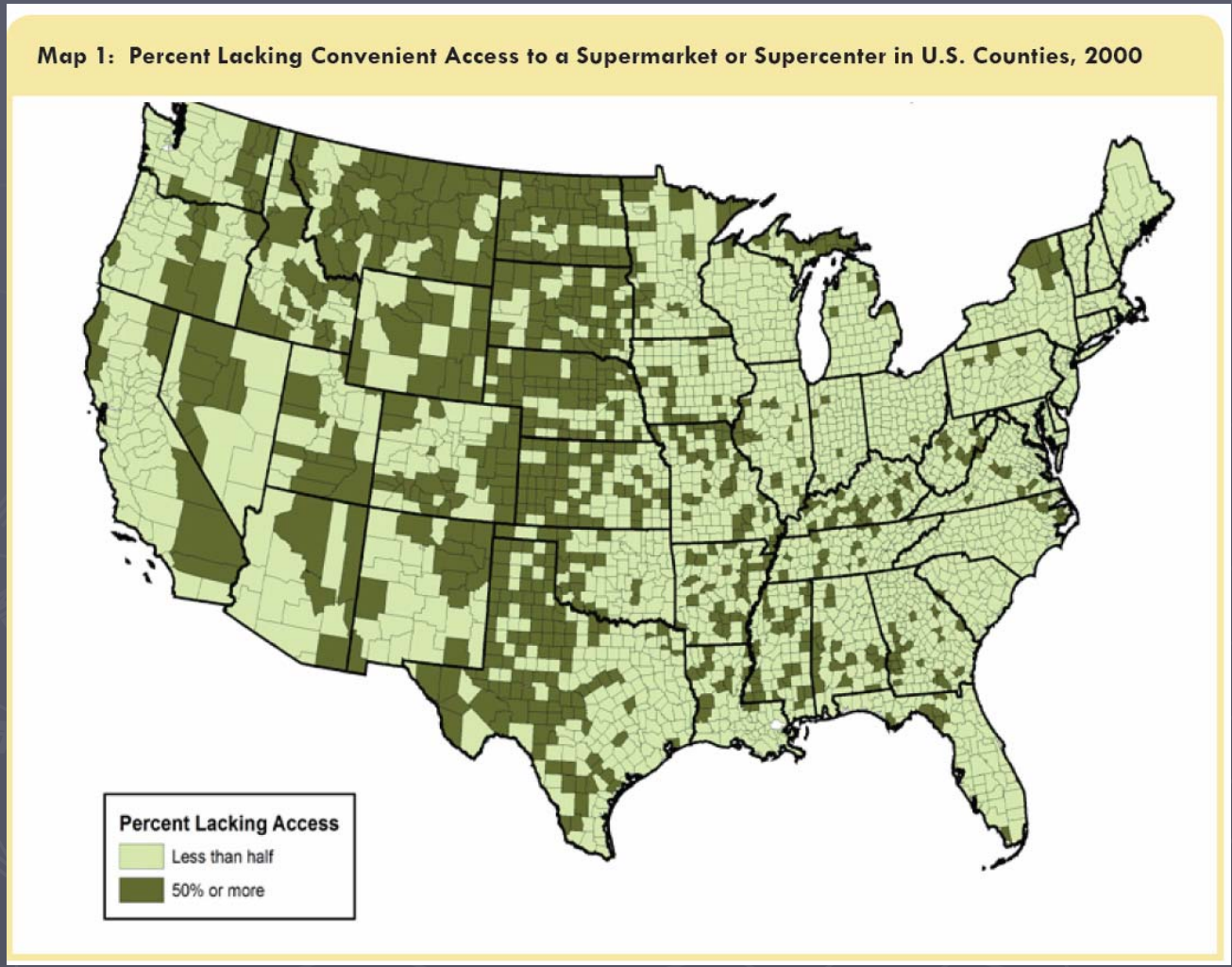


Model controls for age, marital status, region, income, education, employment, smoking, and physical activity. (Denney, 2004)

Food deserts in urban areas

- Low SES neighborhoods 50% as many supermarkets as higher SES neighborhoods (Morland, 2006).
- Low SES, high minority neighborhoods in Detroit were 1.1 miles further from supermarket compared to same SES, white neighborhoods (Zenk, 2004).
- Low SES minority neighborhoods had 48% as many supermarkets as compared to same SES white neighborhoods (Powell, 2006).

Food deserts in rural areas



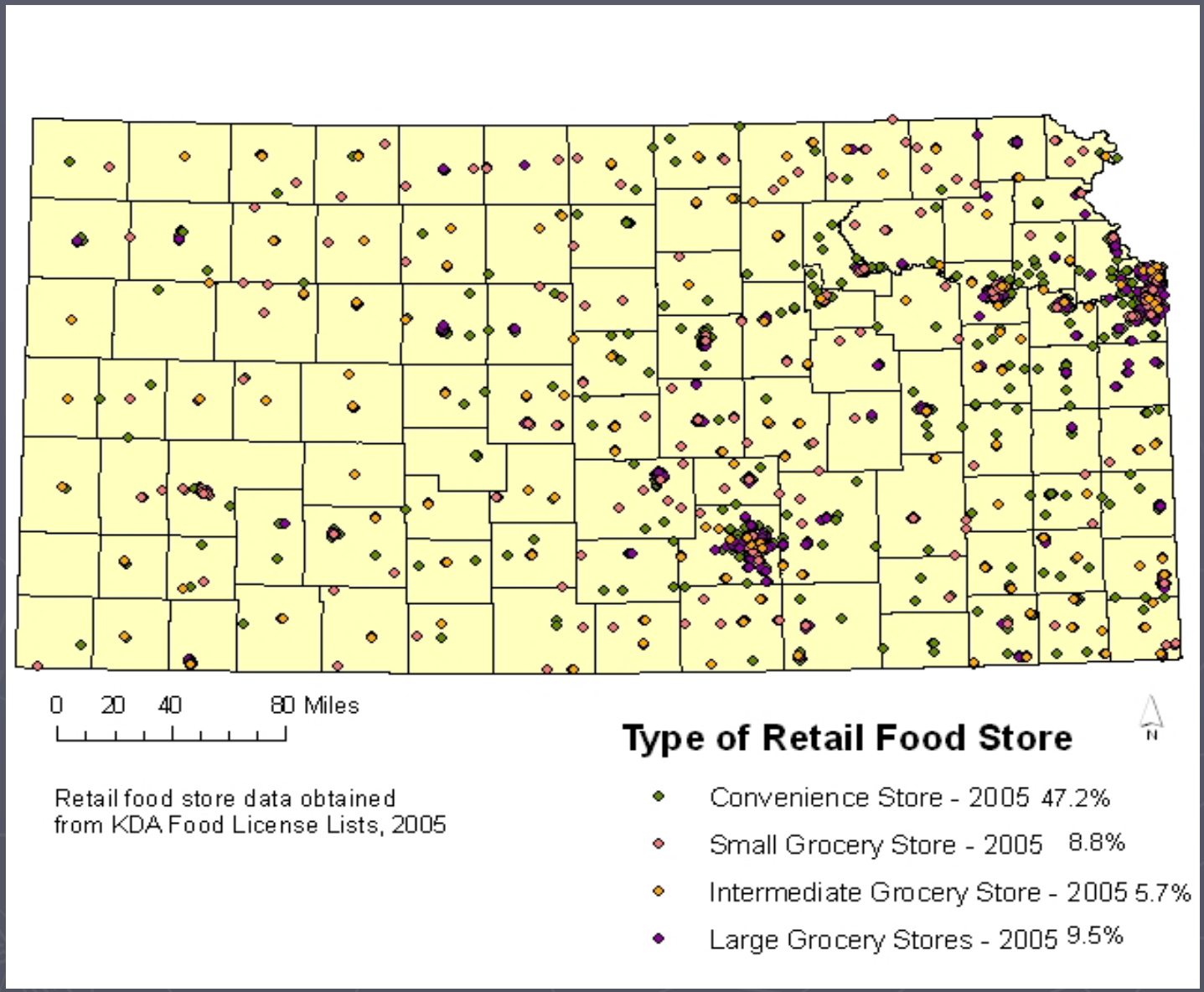
Morton and Blanchard, 2002

Kansas Food Environments and Obesity Study

- What factors are associated with access to food stores at the tract level in Kansas? (Part I)
- What factors are associated with access to food stores for WIC mothers in Kansas? (Part II)
- Is limited access to grocery stores associated with an increased risk of obesity among WIC mothers in Kansas? (Part III)

Methods- Food Stores

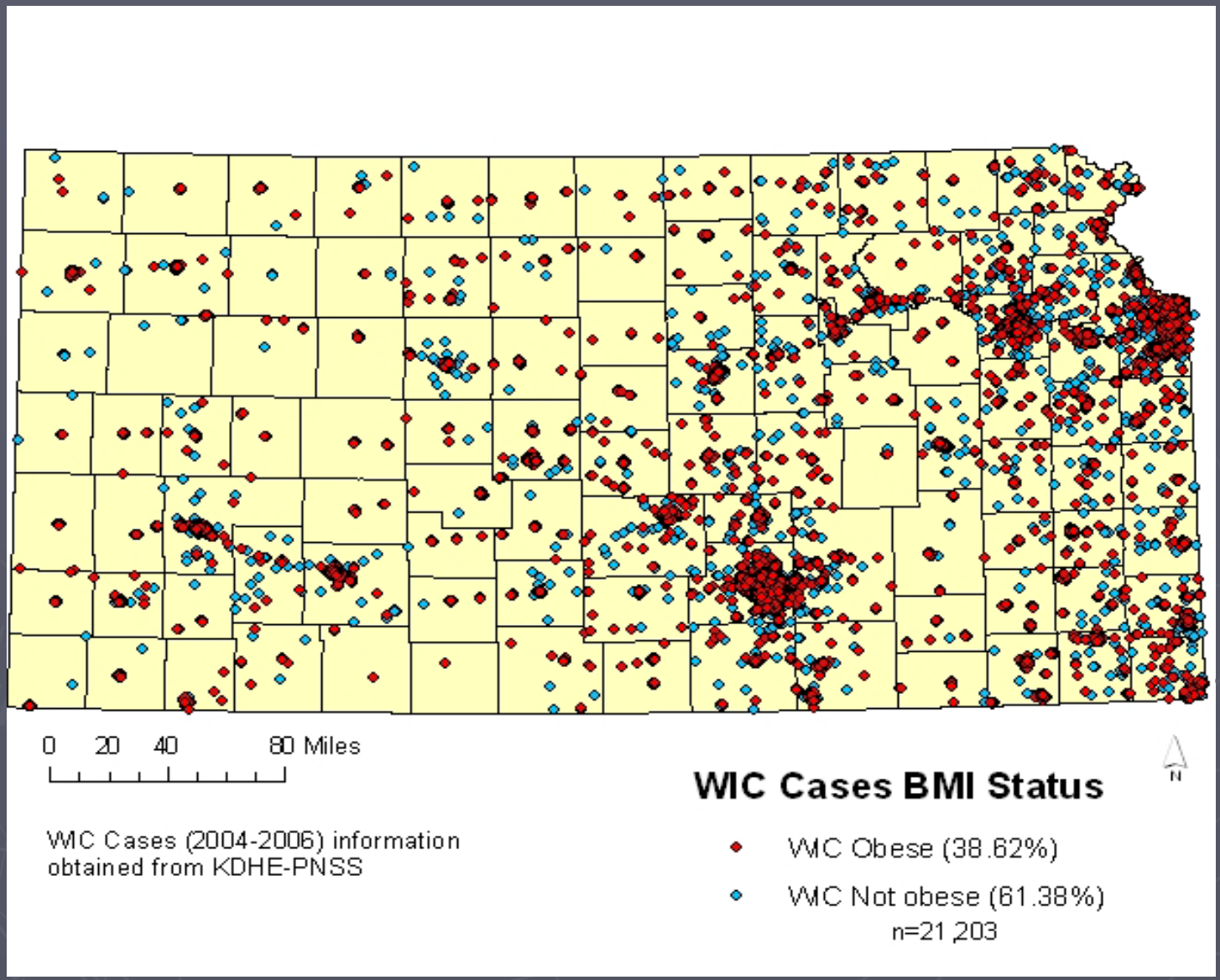
- KS Dept of Ag. Food retail license list from 2005
- Store categories:
  - Convenience store
  - Small grocery store = < 5,000 ft^2
  - Intermediate grocery store = 5,000-15,000 ft^2
  - Large grocery store = > 15,000 ft^2
  - Specialty store (bakery, butcher, etc.)
  - Variety store (drugstore, regular Wal-Mart, etc.)
- Store listing geocoded within ArcGIS v 9.1 (Redlands, CA)



Complete listing of 2005 KDA Licensed stores = 2,680. Total of 2,520 stores were successfully geocoded (94.9%) to street address.

Methods – WIC Cases

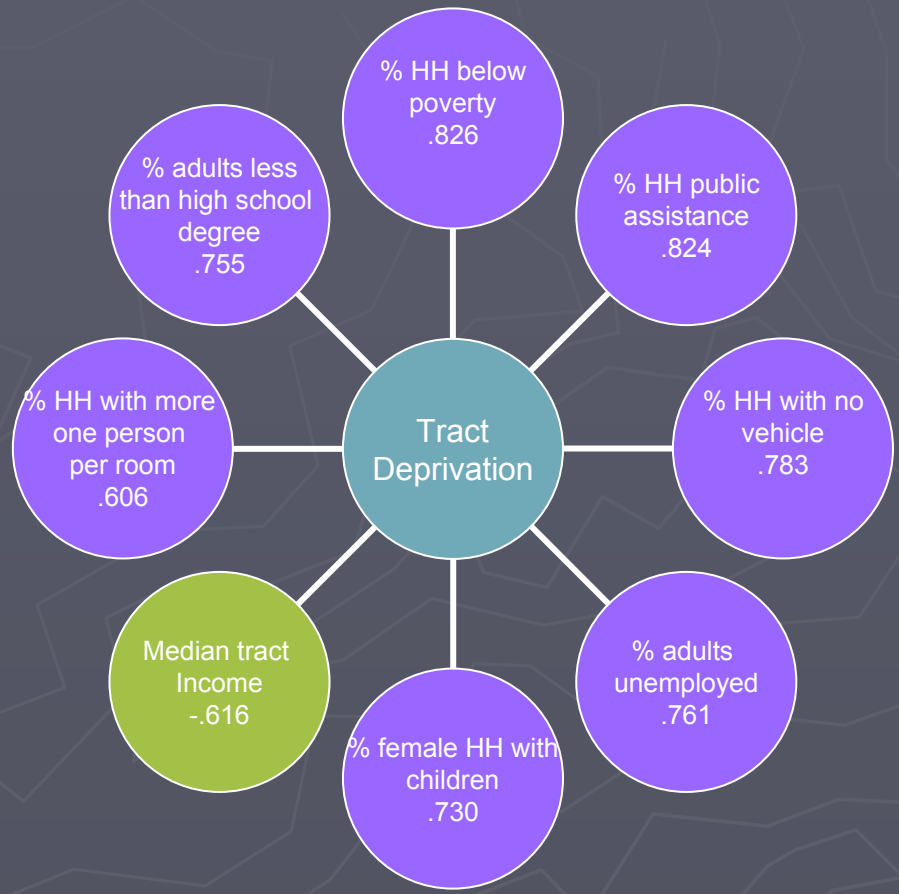
- Women enrolled in Special Supplemental Nutrition Program for Women, Infants and Children (WIC) from 9/2004-12/2006.
- Individual level data: age, race, ethnicity, marital status, parity, education, income, and pre-partum BMI (reported) and post-partum BMI (measured).
- Total sample n=23,351 of which 21,203 were geocoded to street address level (90.8%).
- Buffers created around each WIC cases of 1,3,5 and 10 mile radius and stores of each type were counted within each buffer.

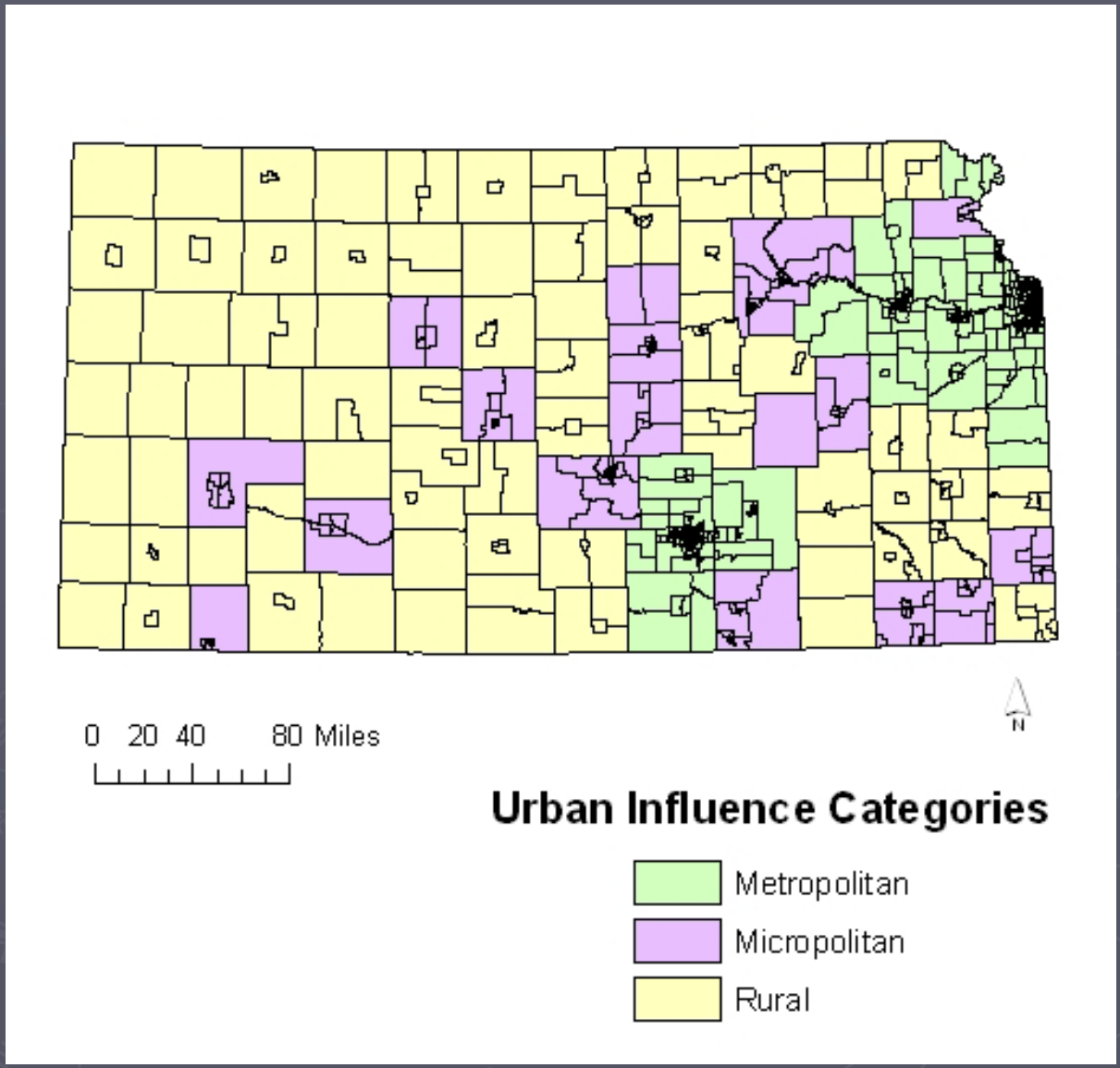


WIC Cases certified between 9/2004-12/2006. Total WIC Cases =23,351, Final geocoded WIC cases = 21,203 (91%).

Methods – Tract Sociodemographics

- 2000 U.S. Census Bureau
- Based on 8 tract-level factors
- Used to reduce colinearity and better capture complexities of deprivation
- % Black
- % Hispanic





Urban influence categories based on USDA-ERS urban influence codes. Categories developed based on population density, proximity to urban area, and economic influences.

Methods – Statistical analyses

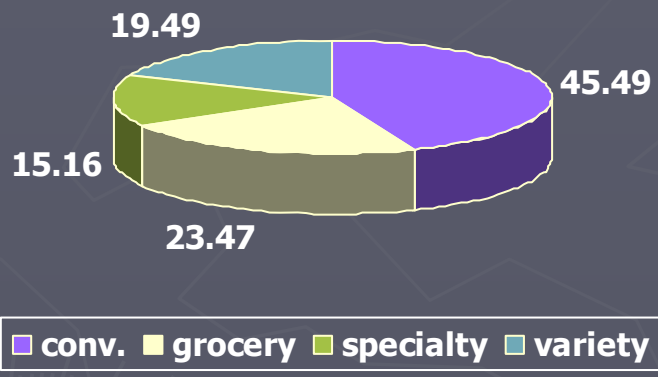
- Analyses were run on both full data set, and data stratified by urban influence code (metropolitan, micropolitan, and rural).
- Univariate and multivariate (Poisson) analysis examining association between store availability, tract demographics, and store access for individuals. All analyses included controls for population density (stores) and age (obesity).
- Logistic regression used to determine effect of key variables on risk of obesity at individual level.
- Means followed by different letter are significantly different at $p < 0.05$. Regression coefficients followed by *, **, and ** are significantly different at the 0.05, 0.01, and 0.001 level, respectively.

What factors are associated with food access in Kansas? (Part I)

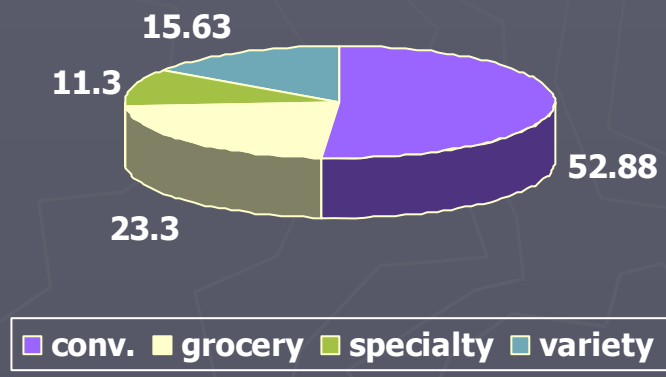
- Food access
  - Number and types of stores in census tracts
- Urban influence
  - Metropolitan
  - Micropolitan
  - Rural
- Community demographics
  - Tract deprivation
  - % Black
  - % Hispanic

Types of stores by urban influence

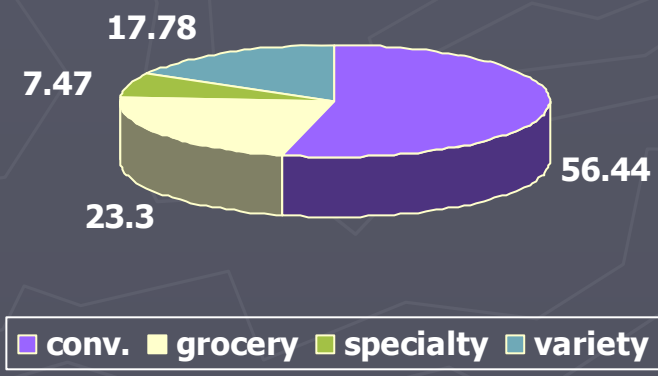
Metropolitan



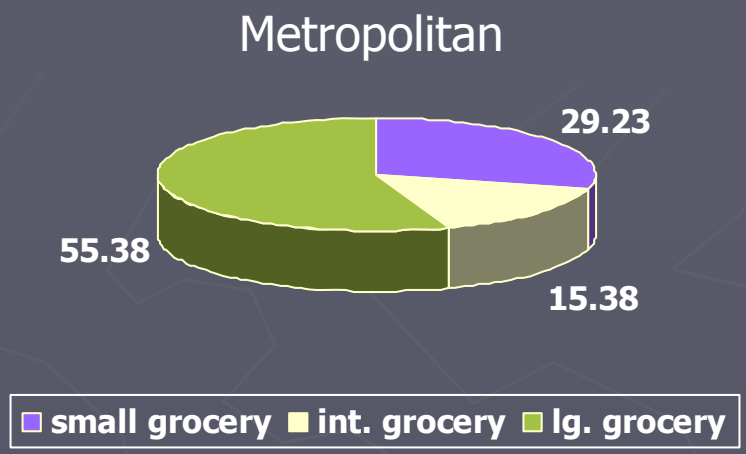
Micropolitan

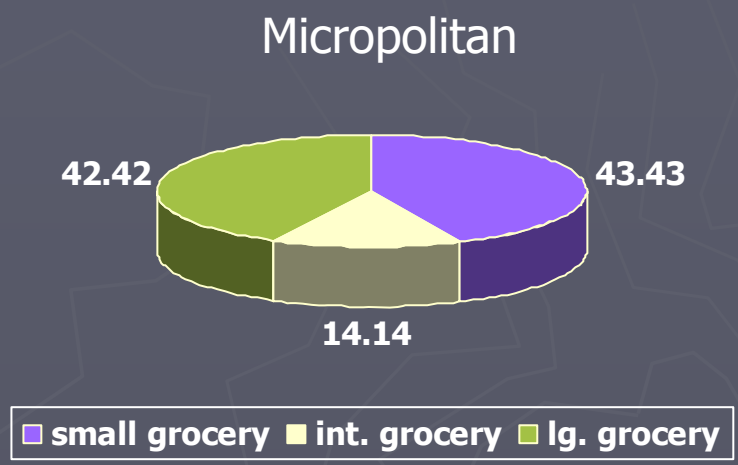


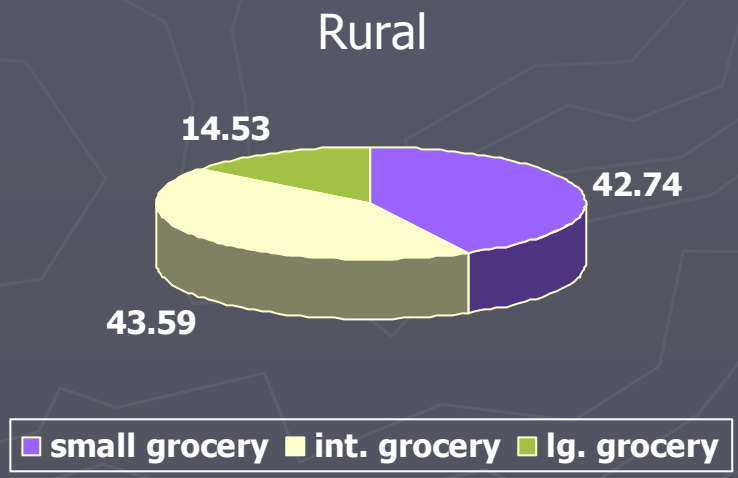
Rural



Size of grocery store by urban influence







Store availability at tract level by urban influence

	Conv. Store Mean (SD)	Sm. grocery Mean (SD)	Int. grocery Mean (SD)	Lg. grocery Mean (SD)	Tracts without grocery # (%)	RFEI Mean (SD)
Metropolitan (n=422)	1.26a (1.29)	0.19a (0.50)	0.10a (0.33)	0.36a (0.61)	221 (52.4%)	1.61a (1.48)
Micropolitan (n=148)	2.20b (1.64)	0.43b (0.91)	0.14a (0.35)	0.42a (0.60)	57 (38.5%)	2.62b (1.79)
Rural (n=150)	2.19b (1.52)	0.50b (0.78)	0.51b (0.41)	0.17b (0.41)	34 (22.7%0	1.44a (1.44)

Notes: Retail Food Environment (RFEI) =Convenience stores/Total grocery stores. Means followed by different letters are significantly different at the $p < 0.05$ level.

Mean store availability at tract level by deprivation, % Hispanic, and % Black

Metropolitan Sample	Convenience Store Mean ± SD	Sm. Grocery Mean ± SD	Lg. grocery Mean ± SD	Total grocery Mean ± SD
Tract deprivation				
Low deprivation (n=187)	1.04a ± 1.26	0.12a ± 0.42	0.43a ± 0.69	0.64a ± 0.88
Intermediate deprivation (n=90)	1.70b ± 1.43	0.20a ± 0.46	0.31a ± 0.55	0.64a ± 0.75
High deprivation (n=145)	1.26a ± 1.18	0.29b ± 0.59	1.29a ± 0.51	0.68a ± 0.79
Tract Hispanic				
< 15% Hispanic (n=385)	1.28a ± 1.32	0.17a ± 0.47	0.37a ± 0.62	0.64a ± 0.83
15-40% Hispanic (n=26)	1.15a ± 0.93	0.31ab ± 0.55	0.27a ± 0.53	0.65a ± 0.80
> 40% Hispanic (n=11)	0.82a ± 0.75	0.82b ± 0.75	0.18a ± 0.41	1.00b ± 0.77
Tract Black				
< 15% Black (n=351)	1.32a ± 1.34	0.18a ± 0.47	0.38a ± 0.62	0.66a ± 0.82
15-40% Black (n=43)	1.19a ± 1.03	0.30a ± 0.64	0.37a ± 0.62	0.79a ± 0.91
> 40 % Black (n=28)	0.57b ± 0.69	0.18a ± 0.55	0.07b ± 0.61	0.32b ± 0.61

Association between store count and tract sociodemographics

Full sample = 720	Conv store Exp**β** (SE)	Sm. Grocery Exp**β** (SE)	Total grocery Exp**β** (SE)	Total stores Exp**β** (SE)
Low tract Deprivation	0.71*** (0.08)	0.82 (0.19)	0.94 (0.11)	0.83*** (0.06)
High tract deprivation	1.22*** (0.07)	0.89 (0.20)	1.02 (0.11)	1.20** (0.05)
15-40% Hispanic	0.85 (.012)	1.64 (0.25)	1.19 (0.16	0.95 (0.08)
>40% Hispanic	1.27 (0.17)	6.01*** (0.24)	2.32*** (0.20)	1.49*** (0.11)
15-40%Black	0.75* (0.13)	1.06 (0.48)	1.00 (0.18)	0.85 (0.09)
> 40% Black	0.36*** (0.25)	0.97 (0.29)	0.45* (0.21)	0.37*** (0.17)
Likelihood X^2 ratio	153.17	95.14	68.54	179.33

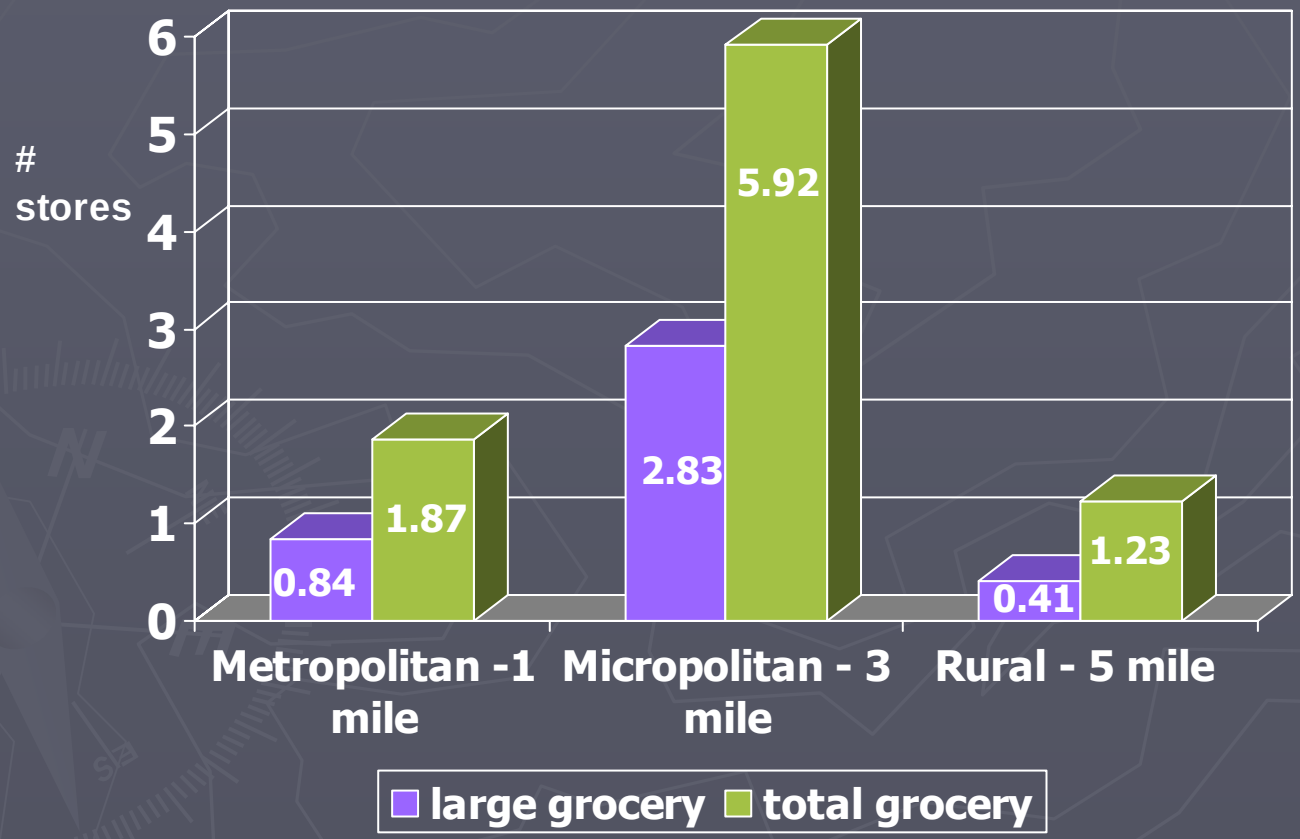
Conclusions – Factors associated with food access at the tract level in Kansas

- Urban influence
  - Metropolitan – 52% no grocery stores
  - Micropolitan – 39% no grocery stores
  - Rural – 23% no grocery
- Tract demographics
  - > 40% black – less than half of grocery stores
  - High tract deprivation – 2% more grocery stores
  - > 40% Hispanic –2X as many grocery stores
- Demographic factors are associated more strongly with food store availability in urbanized areas

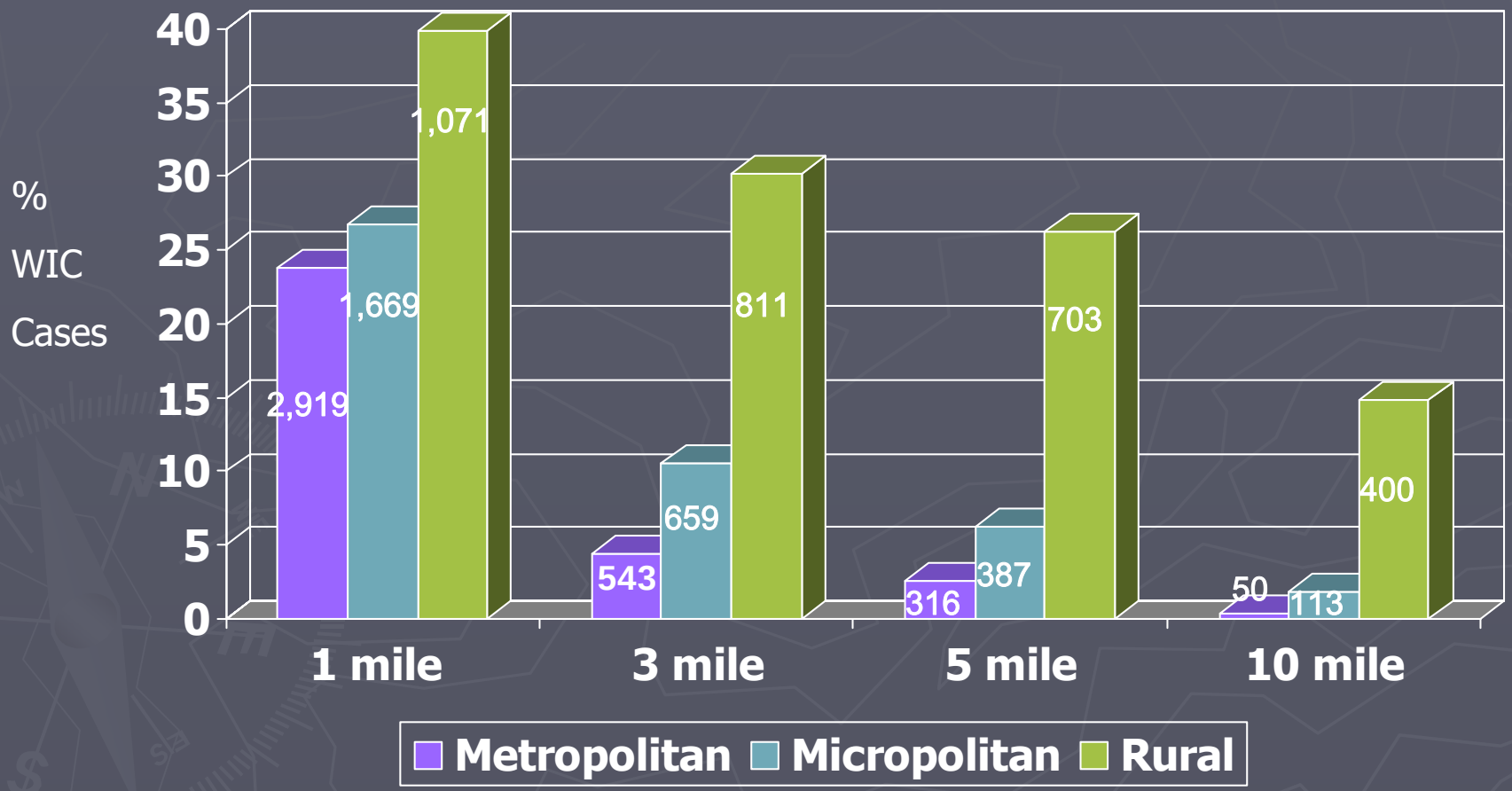
What is the food environment for WIC mothers in Kansas? (Part II)

- Access to grocery stores in 1,3,5, and 10 mile radius
- Does access vary by:
  - Urban influence
  - Tract level characteristics
  - Individual level characteristics

Average number of grocery stores in 1,3, and 5 mile radius of WIC cases



% of WIC cases without any grocery stores within 3,5, and 10 mile radius



Numbers within graph indicate # of WIC cases without grocery store in buffer.

Individual and tract factors associated with store availability in 3 mile radius

Metropolitan Sample n=11,889	Conv store Exp**β** (SE)	Sm. Grocery Exp**β** (SE)	Total grocery Exp**β** (SE)	Total stores Exp**β** (SE)
Black N=2045	1.01*** (.01)	1.16*** (0.01)	1.14*** (0.01)	1.14*** (0.01)
Hispanic N=3544	1.14*** (0.01)	1.19*** (0.01)	1.19*** (0.01)	1.16*** (0.01)
< 12 yrs education N=4076	1.02*** (0.01)	1.05*** (0.01)	1.03*** (0.01)	1.02*** (0.004)
< $10,000 annual income N=5,789	1.04*** (0.01)	1.00 (0.01)	1.01 (0.01)	1.03*** (0.004)
High Tract Dep. N=6,897	1.18*** (0.01)	1.38*** (0.01)	1.16*** (0.01)	1.08 *** (0.01)
Likelihood X^2 ratio	2593	21566	30032	54828

Individual and tract factors associated with store availability in 5 mile radius

Micropolitan Sample n=6,254	Conv store Exp**β** (SE)	Sm. Grocery Exp**β** (SE)	Total grocery Exp**β** (SE)	Total stores Exp**β** (SE)
Black N=350	1.09*** (0.01)	1.18*** (0.04)	1.14*** (0.02)	1.11*** (0.02)
Hispanic N=1,872	1.08*** (0.01)	1.11*** (0.02)	1.10*** (0.01)	1.10*** (0.01)
< 12 yrs education N=2,131	1.05*** (0.01)	1.01 (0.02)	1.03* (0.01)	1.04*** (0.01)
< $10,000 annual income N=1,991	1.00 (0.01)	0.97 (0.02)	1.00 (0.01)	1.01 (0.01)
High Tract Dep. N=4,062	1.08*** (0.01)	1.25*** (0.02)	0.97 (0.01)	1.08*** (0.01)
Likelihood X^2 ratio	6639	6803	6803	11096

Individual and tract factors associated with store availability in 10 mile radius

Rural N=2,686	Conv store Exp**β** (SE)	Int. Grocery Exp**β** (SE)	Total grocery Exp**β** (SE)	Total stores Exp**β** (SE)
Black N=36	.98 (0.07)	0.82 (0.20)	0.82 (0.14)	0.98 (0.08)
Hispanic N=316	1.14*** (0.03)	1.36*** (0.06)	1.19*** (0.05)	1.13*** (0.03)
< 12 yrs education N=734	.944** (0.02)	1.04 (0.05)	0.98 (0.04)	0.96 (0.02)
< $10,000 annual income N=980	1.08*** (0.02)	0.99 (0.05)	1.04 (0.03)	1.06** (0.02)
High Tract Dep. N=1,057	1.14*** (0.02)	1.13** (0.05)	1.10** (0.03)	1.27*** (0.02)
Likelihood X^2 ratio	827	82	130	651

Odds of WIC case living near a grocery store

	Metropolitan – 1 mile Expβ 95% CI	Micropolitan – 3 mile Expβ 95% CI	Rural – 5 mile Expβ 95% CI
Black	1.82*** (1.61,2.05)	2.27*** (1.45, 3.57)	NS
Hispanic	2.74*** (2.44, 3.07)	2.88*** (2.27, 3.65)	1.44* (1.07, 1.93)
< 12 years	1.26*** (1.13, 1.40)	NS	NS
< $10,000 annual income	NS	1.56*** (1.29, 1.89)	NS
$ 10,000-$ 15,000 Annual income	1.20** (1.06, 1.35)	1.67*** (1.28, 2.18)	1.30** (1.07, 1.58)

Reference categories: Not Black, Not Hispanic, HS education, > $15,000 annual income

Odds of WIC case living near a large grocery store

	Metropolitan – 1 mile Expβ 95% CI	Micropolitan – 3 mile Expβ 95% CI	Rural – 5 mile Expβ 95% CI
Black	NS	2.00*** (1.45, 2.75)	NS
Hispanic	2.05*** (1.87, 2.24)	3.81*** (3.15, 4.61)	NS
< 12 years	1.11* (1.02, 1.22)	1.35*** (1.14, 1.59)	NS
< $10,000 annual income	NS	2.10*** (1.59, 2.14)	NS
$ 10,000-$ 15,000 Annual income	NS	1.92*** (1.69, 2.59)	NS

Reference categories: Not Black, Not Hispanic, HS education, > $15,000 annual income

Odds of WIC case living in a low quality retail food environment (RFEI>2.0)

	Metropolitan – 1 mile Expβ 95% CI	Micropolitan – 3 mile Expβ 95% CI	Rural – 5 mile Expβ 95% CI
Black	NS	0.07*** (0.02, 0.05)	NS
Hispanic	0.73*** (0.65, 0.82)	0.34*** (0.20,0.50)	0.30*** (0.21,0.44)
< 12 years	NS	NS	NS
< $10,000 annual income	NS	NS	NS
$ 10,000-$ 15,000 Annual income	NS	NS	NS

Reference categories: Not Black, Not Hispanic, HS education, > $15,000 annual income

Conclusions– Factors associated with access to grocery stores among WIC mothers in Kansas

- 76% metropolitan WIC cases within 1 mile
- 90% micropolitan WIC cases within 3 miles
- 75% rural WIC cases within 5 miles
- Access to grocery stores higher among Black, Hispanic, and lower income WIC participants
- Association of individual characteristics on store access more pronounced in urbanized areas

Is limited access to grocery stores associated with increased risk of obesity among WIC mothers in Kansas?

- NIH definition of obesity - BMI > 30 kg/m^2
- After controlling for individual traits, do tract characteristics influence risk of obesity ?
- Does access to grocery stores provide a protective effect against obesity among WIC mothers?

BMI among WIC cases in Kansas by individual level characteristics

Full Sample = 21,203	N	BMI ± SD
Race/ethnicity		
Not Black (White and other)	18,698	29.16a ± 6.36
Black	2,505	30.34b ± 6.36
Not Hispanic	15,278	29.44a ± 7.47
Hispanic	5,925	28.94b ± 6.83
Education		
< 12 grade	7,134	28.81a ± 6.06
12 years	8,713	29.85b± 6.73
> 12 years	5,356	29.37b ±6.73
Income		
< $ 10,000	7,190	29.39a ± 6.84
$10,000-$15,000	3,305	29.19a ± 6.47
>$15,000	10,708	29.27a ± 6.32

BMI among WIC cases in Kansas by tract level characteristics

Full Sample = 21,203	N	BMI ± SD
Urban influence category		
Metropolitan	12,263	29.30a ± 6.59
Micropolitan	6,254	29.22a ± 6.28
Rural	2,686	29.48a ± 6.75
Tract deprivation category		
Lowest tract deprivation	2,954	28.85a ± 6.31
Intermediate tract deprivation	5,859	29.08a ± 6.42
Highest tract deprivation	12,388	29.51b ± 6.62
Tract % Hispanic		
< 15% Hispanic	16,154	29.31a ± 6.62
15-40% Hispanic	2,825	29.33a ± 6.24
> 40% Hispanic	1,981	29.15a ± 6.06
Tract % Black		
< 15% Black	17,361	29.21a ± 6.44
15-40% Black	2,630	29.59a ± 6.69
> 40% Black	1,083	30.09b ± 7.37

Odds of post-partum obesity by individual and tract characteristics

Full Sample = 21,203	Model 1 Expβ (95% CI)	Model 2 Expβ (95% CI)	Model 3 Expβ (95% CI)
Race/ethnicity			
Black	1.26*** (1.15,1.37)	1.29*** (1.18,1.41)	1.23*** (1.13,1.35)
Hispanic	0.85*** (0.79,0.91)	0.86***(0.80,0.92)	0.83*** (0.78, 0.89)
Education			
< 12 years	0.87*** (0.82,0.94)	0.87***(0.82, 0.93)	0.86*** (0.81.0.92)
> 12 years	NS	NS	NS
Urban Influence			
Micropolitan		0.90* (0.83, 0.99)	0.89* (0.81,0.98)
Rural		NS	0.91* (0.82,0.99)
Tract Deprivation			
Low deprivation			NS
High deprivation			1.19*** (1.11, 1.272)

Models control for age. Referent categories: Not Black, Not Hispanic, 12 yrs. education, > $15,000 annual income, metropolitan, and intermediate deprivation.

Odds of post-partum obesity by individual, tract characteristics, and tract grocery stores

	Model 1 stores Expβ (95% CI)	Model 2 Expβ (95% CI)
Race/ethnicity		
Black	1.22*** (1.11, 1.33)	1.22*** (1.11, 1.33)
Hispanic	0.92* (0.86, 0.99)	0.91** (0.85, 0.97)
Education		
< 12 years	0.86*** (0.81, 0.92)	0.86*** (0.81, 0.92)
Urban Influence		
Micropolitan	1.10* (1.01, 1.21)	NS
Rural	NS	NS
Tract Deprivation		
High deprivation	1.18*** (1.11, 1.27)	1.18*** (1.10, 1.26)
Tract large grocery stores	NS	NS
Tract total grocery stores		1.04** (1.01, 1.07)

Odds of post-partum obesity by individual, tract characteristics, and tract grocery stores

Full Sample = 21,203	Model 1 Expβ (95% CI)	Model 2 Expβ (95% CI)	Model 3 Expβ (95% CI)
Race/ethnicity			
Black	1.22 (1.12, 1.34)	1.23*** (1.12, 1.35)	1.23*** (1.13, 1.35)
Hispanic	0.93* (0.87, 1.00)	NS	NS
Education			
< 12 yrs	0.87*** (0.81, 0.93)	0.87*** (0.81, 0.93)	0.87*** (0.81, 0.93)
> 12 yrs	1.14*** (1.07, 1.23)	1.14*** (1.07, 1.23)	1.14*** (1.07, 1.22)
Tract Deprivation			
High deprivation	1.19*** (1.11, 1.27)	1.20*** (1.12, 1.28)	1.20*** (1.12, 1.29)
3 mile lg. grocery		NS	
3 mile any grocery			0.994* (0.989, 1.00)

Odds of post-partum obesity by individual, tract characteristics, and grocery stores within 3 miles

Metropolitan Sample = 12,261	Model 1 Expβ (95% CI)	Model 2 Expβ (95% CI)	Model 3 Expβ (95% CI)
Race/ethnicity			
Black	1.21*** (1.10, 1.34)	1.23*** (1.11, 1.36)	1.23*** (1.12,1.37)
Hispanic	0.88** (0.81, 0.96)	0.90* (0.82,0.98)	0.91* (0.83, 0.99)
Education			
< 12 yrs	0.86** (0.79, 0.94)	0.86** (0.79,0.95)	0.87** (0.80,0.95)
> 12 yrs	1.25*** (1.14, 1.38)	1.26*** (1.14,1.38)	1.26*** (1.14,1.38)
Tract Deprivation			
Low deprivation	0.74*** (0.67, 0.82)	0.74*** (0.67,0.82)	0.72*** (0.65, 0.80)
High deprivation	0.87 (0.79, 0.955)	0.87*** (0.79,0.95)	0.85** (0.77, 0.93)
3 mile lg. grocery		0.99* (0.98,0.99)	
3 mile any grocery			0.99* (0.98, 0.99)

Conclusions – Is limited access to grocery stores associated with increased risk of obesity?

- Tract level differences in supermarkets not associated with increased risk of obesity; slightly negative effect associated with overall stores in tract.
- For metropolitan tracts, grocery stores within a 3-mile radius provide a protective (albeit small) effect against obesity
- The protective effect of grocery stores does not extend to micropolitan or rural areas

Are there food deserts in Kansas?

- Tract level disparities
- Increased access to grocery stores for Black, Hispanic, and low income WIC cases
- Most WIC cases live within "reasonable" distance to grocery store
- "Food Desert" probably not an appropriate metaphor for food environment in Kansas

Do food environments matter?

- Slight protective effect of living near a grocery store
- Food environments as forces that shape tastes (esp. children) as well as constrain choices
- Food pricing critical
- Differences in store quality?
- Where and why do people shop at different stores?
- Multi-level approaches

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Public Health Issues (group discussion)

- Grocery store development?
- Other (non-grocery store) routes to increase access to healthy foods?
- Multi-level approaches that target both individual behaviors and community characteristics?
- Other groups vulnerable to poor quality food environments (esp. elderly and children)?