Individual- and contextual-level predictors of participant retention in the American Cancer Society Nutrition and Physical Activity Study

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Behavior Modification Interventions

- Cost- and time-intensive[1]
- Consistently of moderate strength and limited duration[2]
  - Physical activity: 10-100 min/wk[3]
  - Fruit and vegetable consumption: 1.2 srv/day of f/v[4]
  - Duration: 6-9 months[3,4]
- Lack of compliance
- Significant losses
  - Drop out/Loss to follow-up: 9-87%[3]

1. Eakin EG, Lawler SP, Vandelanotte C, Owen N. "Telephone interventions for physical activity and dietary behavior change: A systematic Review." *AJPM*. 2007, 32(5): 419-434.
2. Marcus BH, et al. "Physical Activity Intervention Studies: What we know and what we need to know". *Circulation*. 2006,114: 2739-2752.
3. Hillsdon M, Foster C, Thorogood M. "Intervention for promoting physical activity". *Cochrane Database of Systematic Reviews.* 2005, 1:CD003180.
4. Brunner EJ, Thorogood M, Rees K, Hewitt G. "Dietary advice for reducing cardiovascular risk." *Cochrane Database of Systematic Reviews*. 2005, 4:CD002128.

Telephone Interventions

- Less cost-intensive to conduct
- Adequate intervention effects
- However:
  - High non-response for sensitive questions
  - Re-contacting individuals → lower retention

Eakin EG, Lawler SP, Vandelanotte C, Owen N. "Telephone interventions for physical activity and dietary behavior change: A systematic Review." *AJPM*. 2007, 32(5): 419-434.

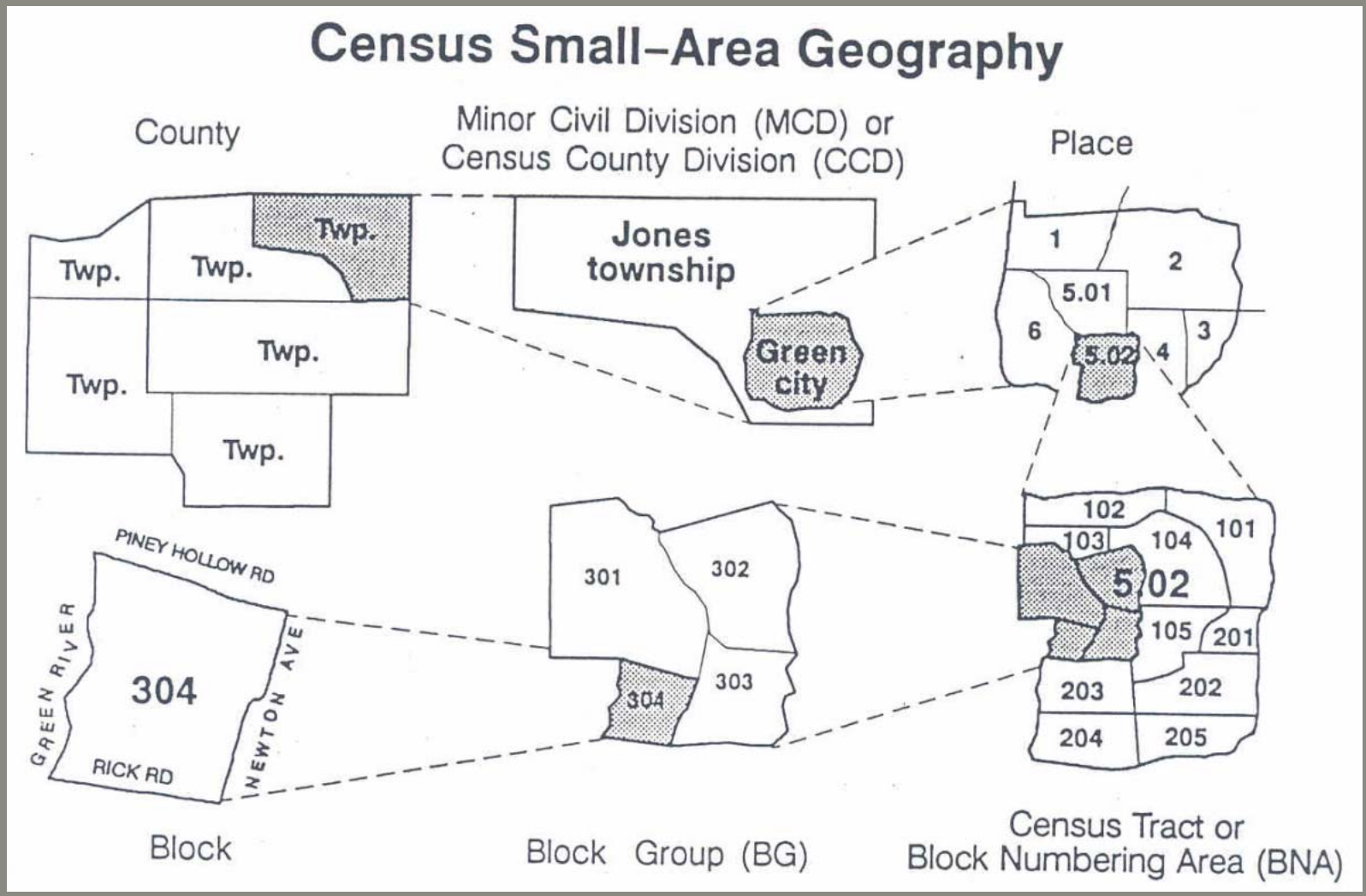
Retention and Loss to Follow-up

- Loss of Power
- Potential for biased estimates
- Studies of retention and loss to follow-up
  - Populations
    - HIV/AIDS, illicit drug users, homeless, run-away youth
  - Individual-level risk factors
    - Race/ethnicity, gender, health, age
    - *Factors associated with epidemiologic outcomes*
  - Contextual/Environmental variables

Contextual/Environmental Data

- Census and USDA data
  - Pro: Public data that is accessible to all researchers
  - Con: Not usually directly related to outcomes
- Marketing Data
  - Pro: Can be estimated down to census block group level
  - Con: Uses modeling approach for estimation at lower geographic levels, not available to all researchers

Census Geography



From http://www.lib.washington.edu/subject/geography/geog100/

The NuPA Study: Methods

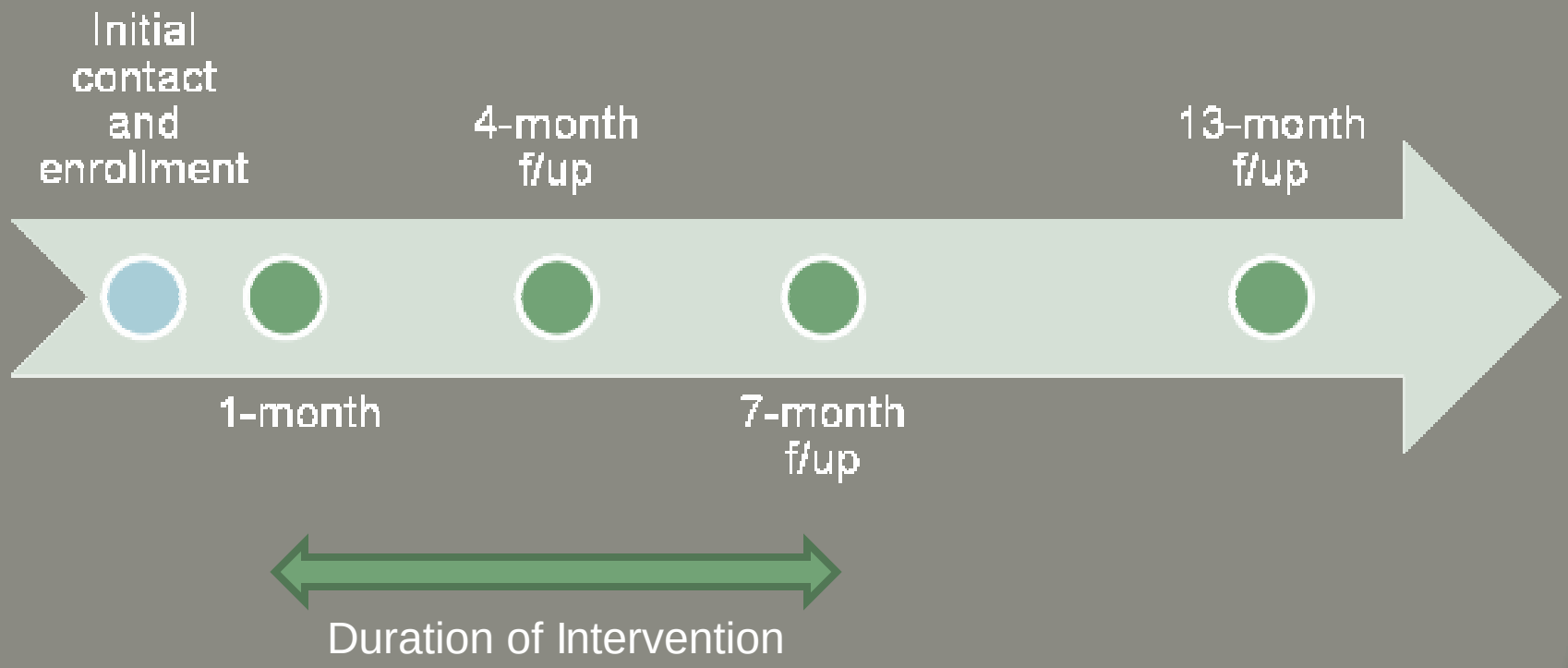
- Purpose: Improve diet and physical activity behaviors
- Modeled after the ACS Quitline for tobacco cessation
- Interested individuals phone into the call center
- Recruited through:
  - Work
  - School
  - Community, Direct Advertisement
  - Health care providers

Methods

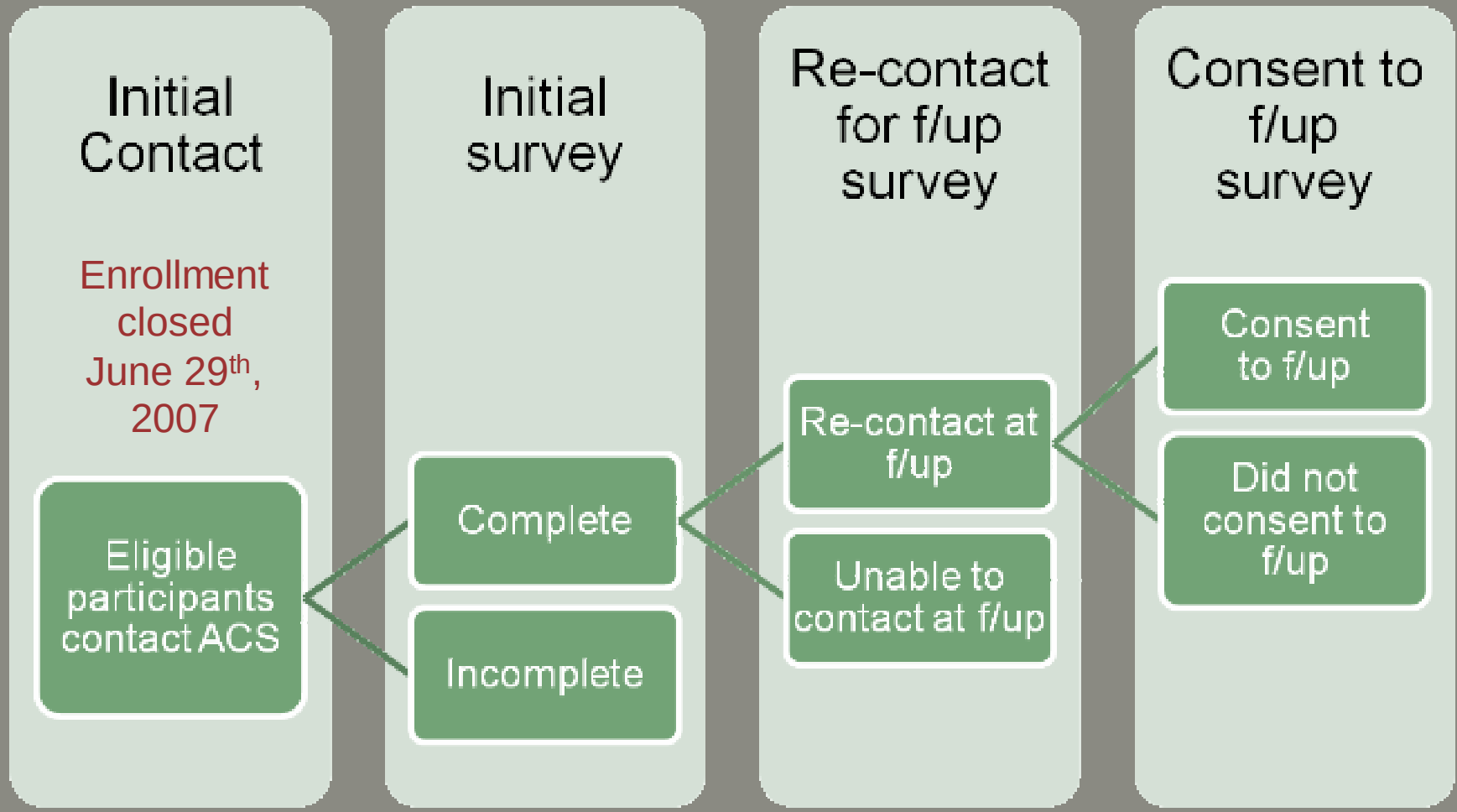
- Assessed for eligibility and randomized
  - Over 18
  - Not pregnant, no eating disorder
- Trial Arms
  - Control group receives self-help materials
  - Intervention group receives self-help materials and:
    - 6 counseling sessions with 3 additional booster sessions possible over a period of 6 months
    - Specific material covered during each session
  - Intervention delivered over the phone

Methods: Follow-up (cont'd)

- Both arms, follow-up occur 3 times



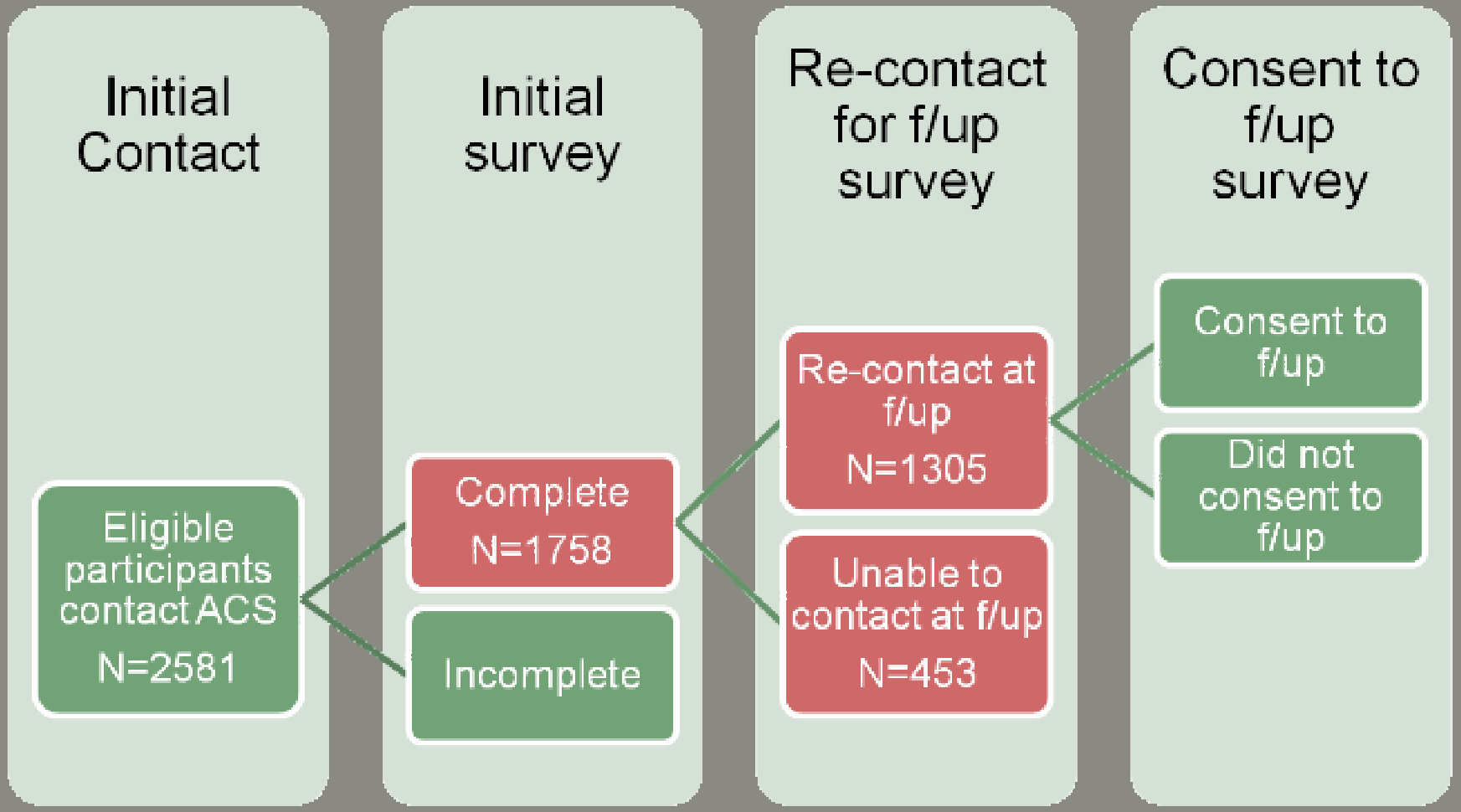
Methods: Follow-Up (cont'd)



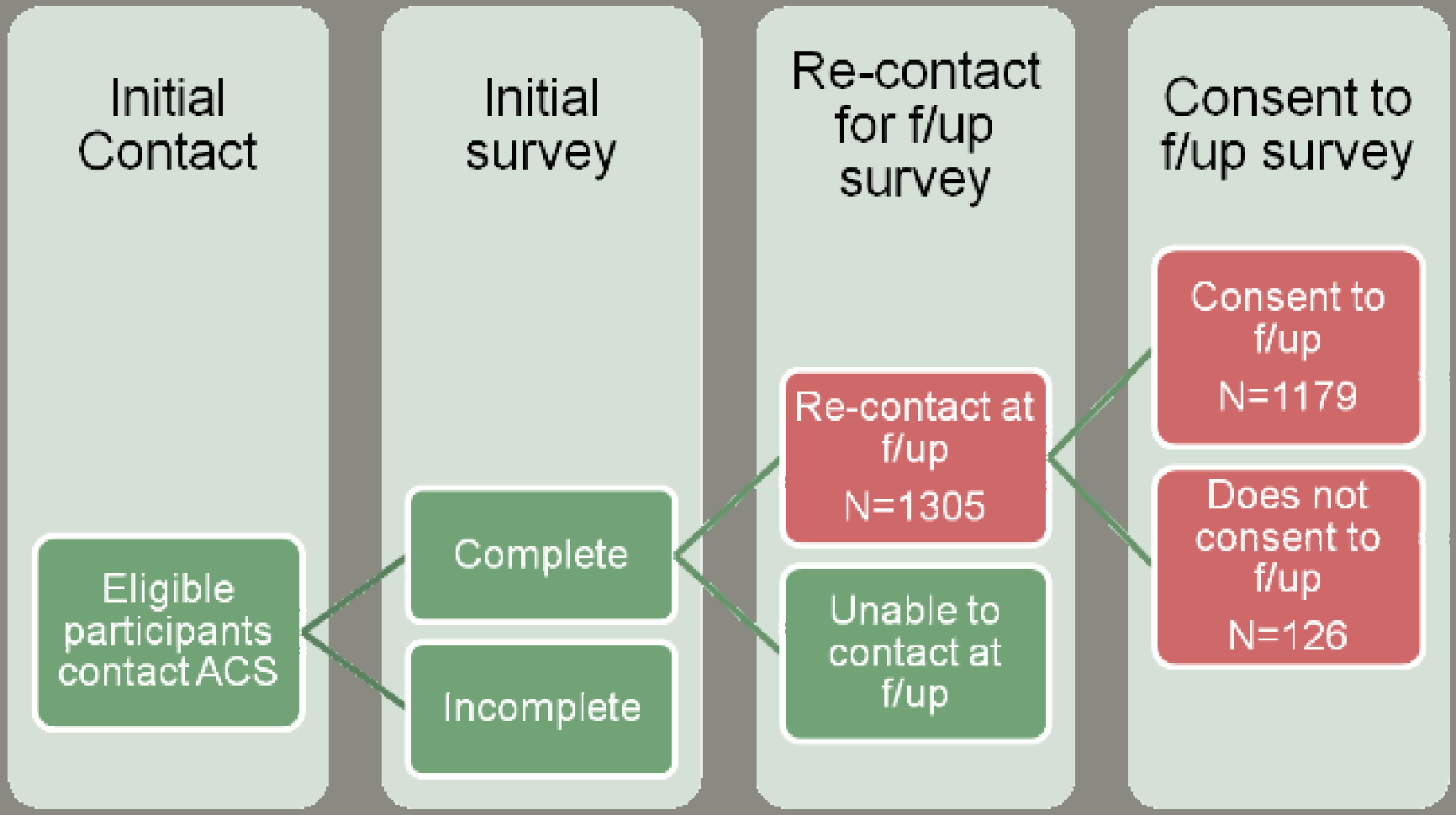
Analytic Approach

- Unadjusted associations
- Adjusted associations
- Logistic Regression
  - Among everyone completing the intake survey
    - Event: Non-contact by 4-month follow-up
  - Among those who were contacted for 4-month
    - Event: Refusal to participate in f/up evaluation

Re-Contacted Individuals



Refusal to Participate



Modeling Approach

- Modeling approach
  - First, individual-level variables
  - Then, contextual-level variables
- Ordinary Logistic Regression
- Correlated Logistic Regression
  - SAS: proc genmod, ALR
  - County-level

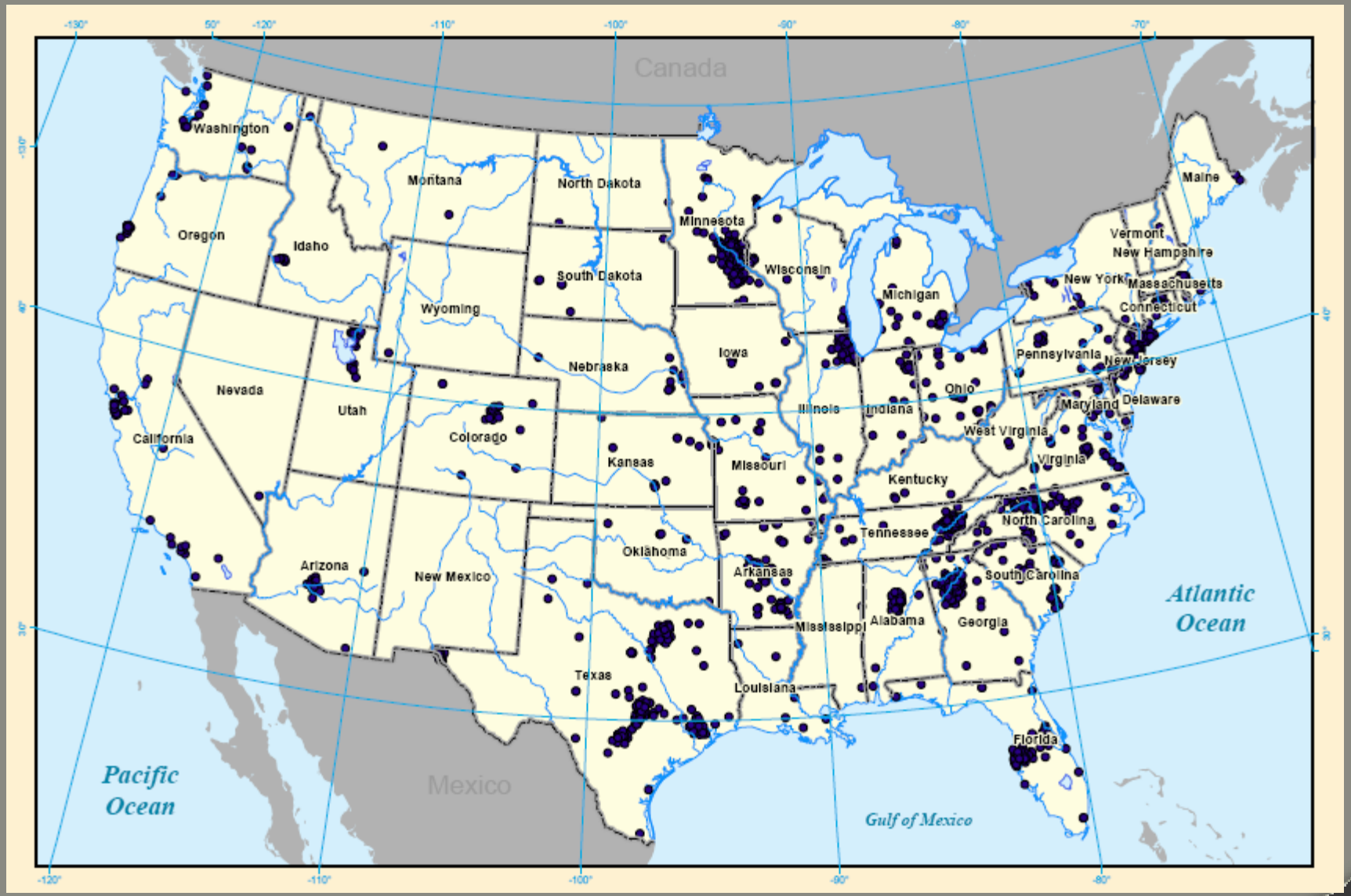
Study Variables

- Identification of covariates guided by PA and FVC literature
- Individual-level covariates
  - Age
  - Gender
  - Race/ethnicity
  - Education
  - Baseline BMI category
  - Motivation to be in the study
  - Feeling sad/blue
  - Satisfaction with life

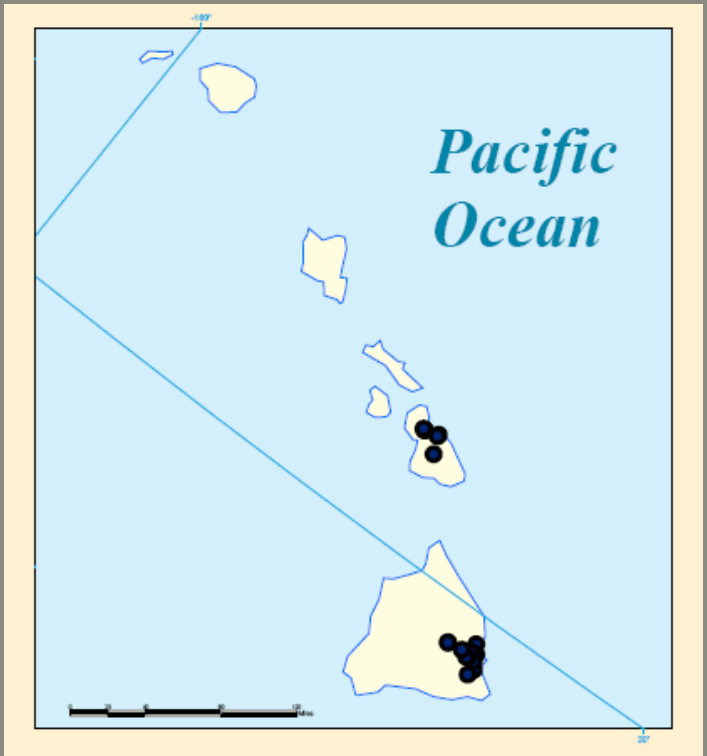
Study Variables(cont'd)

- Contextual-level covariates
  - From Census (block group level)
    - Racial composition
    - Median income
    - Housing density
    - Average commute time
    - Urbanicity (census tract level)
  - From Marketing Data (census tract level)
    - Try to exercise more
    - Consider their diet very healthy
    - Try to eat healthier/more balanced

Geographic Location



Geographic Location



Intervention Effect

- The Use of Technology to Improve Public Health: "Effectiveness of a Telephone Counseling Intervention for Improving Healthy Lifestyles: American Cancer Society's Nutrition and Physical Activity Research Study". KJ Pike, H Adams, Y Kim, D He. November 5th Poster Session.
  - Significant weight loss and increase in FVC across all participants (ps < 0.0001)
  - Significantly greater improvement in FVC in counseling group than in self-help group among those not consuming at least 5 a day at intake (p=0.0271)

Results: Individual-Level

	Participants (N=1758)	US Population
Male	20.1%	49.2%
Ethnicity		
Black	13.6%	12.1%
Hispanic[1]	4.3%	14.5%
Other	4.1%	13.1%
White	78.0%	74.7%
Education	Over 18	Population over 25
High School graduate or more	98.9%	84.2%
Bachelors degree or more	55.4%	27.2%
Married[2]	62.6%	50.4%

US Census Bureau, American FactFinder
http://factfinder.census.gov/servlet/ACSSAFFFacts?_submenuId=factsheet_1&_sse=on
1.Mutually exclusive categories in NuPA
2.Among those over 15 in census

Results: Individual-Level

	NuPA	US NHANES (1999-2000)[1]
BMI Category		
Normal/Underweight	21.3%	35.5%
Overweight	33.9%	33.6%
Obese	44.8%	30.9%
Sad/Blue	7.2%	--
Satisfied with Life	73.0%	--
Other like me better when I am in shape	26.7%	--
I would feel bad about myself if I didn't	65.9%	--
It is personally important to me	98.7%	--
I simply enjoy living a healthier lifestyle	92.8%	--

1. Aged 20 and over. Flegal KM, Carroll MD, Ogden CL, Johnson CL. "Prevalence and trends in obesity among US adults, 1999-2000." JAMA 2002 Oct 9;288(14):1723-7.

Results: Individual-Level

	Median	IQR
Participant Characteristics		
Age (years)	44	[35, 52]
Height at intake(inches)	66	[64, 68]
Weight at intake (lbs)	181.5	[155, 218]
BMI at Intake (kg/m^2)	29.26	[25.61, 34.17]

Results: Contextual-Level

Census Bureau Data – by Block Group	Median	IQR
Block Group Area (mi^2)	1.16	[0.4, 5.35]
Business (count/mi^2)	39.16	[10.29, 108.01]
Average Commute Time (min)	26	[23, 31]
Median Age (years)	37.3	[34, 41]
Median Home Value	173895	[118333, 241883]
Median Income	57717.5	[43333, 75313]
Per capita income	26954.5	[20947, 34362]
Housing Density (units/mi^2)	755.28	[174.34, 1496.45]

Results: Contextual-Level

Census Bureau Data – by Block Group	Median	IQR
Population Density (pop/mi^2)	1871.1	[454.53, 3741.82]
Nonhispanic White (%)	87.0%	[0.69, 0.94]
Nonhispanic Black (%)	3.0%	[0.01, 0.09]
Nonhispanic Asian (%)	2.0%	[0.01, 0.04]
Owner-occupied Housing (%)	76.0%	[0.57, 0.89]
Renter-occupied Housing (%)	16.0%	[0.07, 0.34]
Vacant Housing (%)	5.0%	[0.03, 0.08]

Results: Contextual-Level

Marketing Data – By Census Tract	Median	IQR
Consider diet health (%)	38.5%	[0.3179, 0.4435]
Currently dieting (%)	23.7%	[0.2007, 0.2757]
Try to eat healthy/balanced (%)	51.1%	[0.4489, 0.5779]
Try to eat healthier (%)	64.0%	[0.5579, 0.6974]
Exercise at home (%)	27.6%	[0.2401, 0.3043]
Should exercise more (%)	70.3%	[0.6199, 0.7508]
Participate in regular exercise program (%)	46.9%	[0.4022, 0.5219]
Make sure exercise regularly (%)	34.4%	[0.2879, 0.3932]

Unadjusted Associations: Individual-Level

	% Uncontacted	p
Overall	25.8	
Intervention Arm		0.8852
Counseling	25.6	
Self-Help	25.9	
Ethnicity		**0.0005**
White	23.6	
Black	33.1	
Other	34.0	
Marital Status		**0.0004**
No	30.6	
Yes	22.9	

Unadjusted Associations: Individual-Level

	% Uncontacted	p
Sad/Blue		0.3380
No	25.5	
Yes	29.4	
Satisfied Life		**0.0114**
No	30.1	
Yes	24.2	
Age		**<0.0001**
Q1 [18, 36)	35.4	
Q2 [36, 44)	26.7	
Q3 [44, 52)	23.2	
Q4 [52, 80]	18.0	

Unadjusted Associations: Contextual-Level

	% Uncontacted	p
Median Age (years)		**0.0299**
Q1 [15.4, 34.0)	30.3	
Q2 [34.0, 37.3)	25.0	
Q3 [37.3, 41.0)	26.3	
Q4 [41.0, 80.2]	21.5	
Grad HS		0.2694
Q1 [0, 12.00)	25.0	
Q2 [12.00, 17.77)	24.4	
Q3 [17.77, 22.95)	29.3	
Q4 [22.95, 42.17]	24.4	
Non-Hispanic White (%)		**0.0030**
Q1 [0.00, 68.83)	31.9	
Q2 [68.83, 87.50)	24.6	
Q3 [87.50, 93.83)	21.1	
Q4 [93.83, 100.0]	25.5	

Unadjusted Associations: Contextual-Level

	% Uncontacted	p
Consider diet health (%)		**0.0109**
Q1 [0.0, 32.0)	31.4	
Q2 [32.0, 38.5)	24.6	
Q3 [38.5, 44.0)	22.0	
Q4 [44.0, 63.2]	24.6	
Currently dieting (%)		**0.0308**
Q1 [10.6, 20.0)	30.9	
Q2 [20.0, 23.8)	22.8	
Q3 [23.8, 27.5)	24.0	
Q4 [27.5, 38.5]	25.5	
Try to eat healthier (%)		**0.0088**
Q1 [26.6, 55.0)	31.9	
Q2 [55.5, 64.0)	22.9	
Q3 [64.0, 70.0)	25.1	
Q4 [70.0, 83.1]	23.5	

Unadjusted Associations: Contextual-Level

- Metropolitan vs. Non-Metropolitan

	% Uncontacted	p
Metropolitan Area		0.7591
Yes	25.9	
No	25.0	

From: USDA RUCA 2000 codes
http://www.ers.usda.gov/briefing/Rurality/RuralUrbanCommutingAreas/

Unadjusted Associations: Individual-Level

	% Refused	p
Overall	9.7	
Intervention Arm		**0.0053**
Counseling	11.82	
Self-Help	7.26	
Ethnicity		0.7920
White	9.64	
Black	8.75	
Other	11.34	
Marital Status		0.4463
No	10.5	
Yes	9.2	

Unadjusted Associations: Individual-Level

	% Refused	p
Sad/Blue		0.1013
No	9.29	
Yes	14.61	
Satisfied Life		0.6756
No	10.24	
Yes	9.46	
Age		0.0913
Q1 [18, 36)	6.23	
Q2 [36, 44)	12.16	
Q3 [44, 52)	10.66	
Q4 [52, 80]	9.38	

Unadjusted Associations: Contextual-Level

	% Refused	p
Median Age (years)		0.3400
Q1 [15.4, 34.0)	8.55	
Q2 [34.0, 37.3)	8.93	
Q3 [37.3, 41.0)	8.78	
Q4 [41.0, 80.2]	12.14	
Grad HS		**0.0489**
Q1 [0, 12.00)	7.58	
Q2 [12.00, 17.77)	7.83	
Q3 [17.77, 22.95)	9.97	
Q4 [22.95, 42.17]	13.25	
Non-Hispanic White (%)		0.4806
Q1 [0.00, 68.83)	10.03	
Q2 [68.83, 87.50)	8.43	
Q3 [87.50, 93.83)	8.65	
Q4 [93.83, 100.0]	11.62	

Unadjusted Associations: Contextual-Level

	% Refused	p
Consider diet health (%)		0.8632
Q1 [0.0, 32.0)	8.71	
Q2 [32.0, 38.5)	9.46	
Q3 [38.5, 44.0)	9.71	
Q4 [44.0, 63.2]	10.68	
Currently dieting (%)		0.7140
Q1 [10.6, 20.0)	8.28	
Q2 [20.0, 23.8)	10.46	
Q3 [23.8, 27.5)	10.65	
Q4 [27.5, 38.5]	9.14	
Try to eat healthier (%)		**0.0296**
Q1 [26.6, 55.0)	7.29	
Q2 [55.5, 64.0)	12.97	
Q3 [64.0, 70.0)	7.19	
Q4 [70.0, 83.1]	10.71	

Unadjusted Associations: Contextual-Level

- Metropolitan vs. Non-Metropolitan

	% Refused	p
Metropolitan Area		**0.0075**
Yes	8.7	
No	14.9	

From: USDA RUCA 2000 codes
http://www.ers.usda.gov/briefing/Rurality/RuralUrbanCommutingAreas/

Unadjusted Associations: Summary

Variable	Uncontacted	Refusal
Individual-Level		
Intervention	0	x
Ethnicity	x	0
Marital Status	x	0
Satisfied with Life	x	0
Age	x	0
Contextual-Level		
Median Age	x	0
Grad HS	0	x
Non-hispanic White	x	0
Consider diet healthy	x	0
Currently dieting	x	0
Try to eat healthier/more balanced	x	x
Metropolitan area	0	x

Adjusted Associations

- Modeling approach
  - First, individual-level variables
  - Then, contextual-level variables
- Ordinary Logistic Regression

Adjusted Associations: Uncontacted

	β	SE	OR	p
Counseling	-0.035	0.1113	0.97	0.7529
Male	0.0016	0.1417	1.00	0.9908
Ethnicity				**0.0246**
Black	0.3562	0.1568	1.43	
Other	0.3457	0.19	1.41	
Marital Status	-0.271	0.1156	0.76	**0.0190**
Age				**<0.0001**
Q1 [18, 36)	0.8529	0.1598	2.35	
Q2 [36, 44)	0.4468	0.1677	1.56	
Q3 [44, 52)	0.2964	0.1663	1.35	
Satisfied Life	0.2987	0.1225	1.35	**0.0147**

Adjusted Associations: Uncontacted

	β	SE	OR	p
Exercise at Home				**0.0098**
Q1 [10.0, 24.0)	-0.3449	0.1242	0.7	
Q2 [24.0, 27.5)	0.1388	0.1012	1.1	
Q3 [27.5, 30.2)	-0.0759	0.1009	0.9	
Q4 [30.2, 40.5]	0	--	1	
Try to eat healthy/balanced				**0.0468**
Q1 [20.00, 44.50)	0.9132	0.3432	2.5	
Q2 [44.50, 51.00)	0.7258	0.3199	2.1	
Q3 [51.00, 58.00)	0.6184	0.2509	1.9	
Q4 [58.00, 74.31]	0	--	1	
Consider diet healthy				**0.0285**
Q1 [0, 32)	0.081	0.1366	1.1	
Q2 [32, 38.5)	-0.282	0.1394	0.8	
Q3 [38.5, 44)	-0.1951	0.1357	0.8	
Q4 [44, 63.1925]	0	--	1	

Adjusted Associations: Refusal

	β	SE	OR	p
Counseling	0.5268	0.1966	1.69	**0.0074**
Male	0.2483	0.2286	1.28	0.2776
Ethnicity			1.00	
Black	-0.0786	0.3092	0.92	0.8309
Other	0.1791	0.3437	1.20	
Married	-0.2372	0.1995	0.79	0.2346
Age				
Q1 [18, 36)	-0.4550	0.3065	0.63	0.0651
Q2 [36, 44)	0.3450	0.2556	1.41	
Q3 [44, 52)	0.1705	0.2515	1.19	
Satisfied with Life	-0.0269	0.2154	0.97	0.9007
Metropolitan Area	-0.6181	0.2335	0.54	**0.0081**

Results: Summary

- Replicated individual-level associations
- Contextual-level associations
  - Re-contact associated with greater proportion of community reporting trying to eat a healthier or more balanced diet
  - Participants living in metropolitan areas less likely to refusal follow-up
- Correlated analysis did not result in different conclusions

Discussion

- Estimated variables associated with retention
  - True also after adjusting for census variables (not shown)
- Re-contacted vs. Refusal
  - Associated with different participant -and contextual-/environment-level characteristics
  - Two distinct selection processes?

Limitations

- Contextual-level variables functioning as proxies of individual-level characteristics
- Contextual vs. compositional effects of environmental data
- Limited granularity of some data
- Missing data
  - Economic Census

Future directions

- Further study to gain better understanding of and decrease occurrence of losses
  - Examine other environmental exposures
    - Access to grocery stores, restaurants, exercise facilities, parks
- Assessment of direction and magnitudes of potential biases
  - Statistical adjustment

Implications

- Learn about participants without adding to participant burden
  - Data is freely available, ready to use
- Ultimate goal: predict and prevent loss to follow-up and/or refusal

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  - Joseph Hunter, ACS, National Cancer Information Center
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