Intersecting Risks: Food Insecurity, Cigarette Smoking, Rurality and Colorectal Cancer Diagnosis in the U.S

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Introduction

- Colorectal cancer (CRC) is a leading cause of cancer-related death in the U.S., with disparities driven by behavioral, structural, and socioeconomic factors.[1]
- In 2023, food insecurity affected 13.5% of U.S. households and was linked to lower cancer screening rates, delayed diagnoses, and worse health outcomes due to poor diet and limited preventive care. Food-insecure individuals often consume ultra-processed, low-nutrient foods that heighten biological risk for CRC. [2,3,4,9]
- One in four cancer patients experiences food insecurity. Food-insecure adults are also more likely to use tobacco, often as a coping mechanism for stress and hunger. [3,7,10]
- Tobacco use, especially cigarettes, increases CRC risk and remains more common in rural areas, where limited healthcare access and fewer cessation and nutrition resources further compound these risks.[2,3,11]
- While food insecurity and tobacco use are known individual risk factors for CRC, their combined effect remains poorly understood, particularly in underserved rural communities. [5,6,7]
- **Objective**: Examine how food insecurity and cigarette smoking intersect to influence CRC diagnosis, with a focus on geographic variation. Understanding these interactions can guide prevention strategies and reduce CRC disparities in high-risk populations. [11]

Methods

Study Design

- We used a Cross-Sectional study design with data from the 2020-2023 National Health Interview Survey (NHIS) N=147,430

Sample

- The survey included a representative sample of the U.S population.
- The sample included respondents who indicated current smoking status, responded yes to having ever had a diagnosis of colorectal cancer, and responded to the food security prompts.

Definition of Variables

- Food insecurity defined by a validated 10-item food insecurity scale from the National Center for Health Statistics. A score of 0-2 is food secure and a score of 3-10 is food insecure. [8]
- Tobacco use is defined as an individual who indicated they had smoked at least 100 cigarettes in their lifetime and smoke cigarettes every day or some days. [8]
- Colorectal Cancer is defined as someone who indicated they had ever been diagnosis with colon, rectal, or colorectal cancer. [8]
- Urban defined as someone who lives in a large central metro, large fringe metro, or medium and small metro. Rural defined as someone who lives in a nonmetropolitan. [8]

Data Analysis

- Data Analysis included
  - descriptive statistics and a Chi-square test to determine differences between groups
  - logistic regression model assessing the independent and combined associations of food insecurity, tobacco use, and rurality with CRC diagnosis.

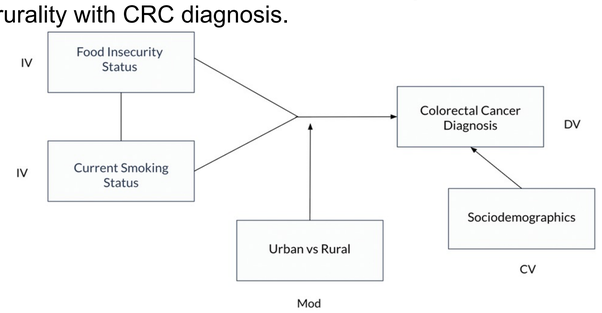

Figure 1: Conceptual Model

Main Finding: Food insecure nonsmokers in rural areas are over twice as likely to be diagnosed with colorectal cancer compared to food secure nonsmokers in urban areas.

Table 1: Characteristics of participants

Variable	Nonsmoker and Food Secure (n=99,085)	Nonsmoker and Food Insecure (n=5,856)	Smoker and Food Secure (n=11,128)	Smoker and Food Insecure (n=2,154)	p value (p < 0.05)
Age					p < 0.001
<45	35,327 (35.7%)	2,599 (44.4%)	3,708 (33.3%)	857 (39.8%)	
45-55	13,484 (13.6%)	927 (15.8%)	1,991 (17.9%)	429 (19.9%)	
55-65	16,936 (17.1%)	2,076 (18.6%)	2,692 (24.2%)	548 (25.4%)	
65-75	18,038 (18.2%)	832 (14.2%)	2,076 (18.7%)	261 (12.1%)	
75+	15,300 (15.4%)	407 (7.0%)	661 (5.9%)	59 (2.7%)	
Sex					p < 0.001
Male	44,905 (45.3%)	2,157 (36.8%)	5,919 (53.2%)	973 (45.2%)	
Female	54,169 (54.7%)	3,697 (63.1%)	5,209 (46.8%)	1,181 (54.8%)	
Missing	11 (0.0%)	2 (0.0%)	0 (0.0%	0 (0.0%)	
Sexuality					p < 0.001
Straight	89,959 (90.8%)	5,223 (89.2%)	10,290 (92.5%)	1,931 (89.6%)	
Gay/Lesbian	1,896 (1.9%)	134 (2.3%)	258 (2.3%)	52 (2.4%)	
Bisexual	1,541 (1.6%)	256 (4.4%)	231 (2.1%)	109 (5.1%)	
Missing	5,689 (5.7%)	243 (4.1%)	349 (3.1%)	62 (2.9%)	
Race					p < 0.001
White	75,086 (75.8%)	3,311 (56.5%)	8,677 (78.0%)	1,495 (69.4%)	
Black	10,077 (10.2%)	1,385 (23.7%)	1,286 (11.6%)	418 (19.4%)	
American Indian or Alaskan Native	1,435 (1.4%)	215 (3.7%)	287 (2.6%)	101 (4.7%)	
Asian	6,319 (6.4%)	225 (3.8%)	344 (3.1%)	29 (1.3%)	
Multi-racial	1,270 (1.3%)	106 (1.8%)	138 (1.2%)	30 (1.4%)	
Missing	4,898 (4.9%)	614 (10.5%)	396 (3.6%)	81 (3.8%)	
Ethnicity					p < 0.001
Hispanic	13,232 (13.4%)	1,518 (25.9%)	1,055 (9.5%)	1,899 (88.2%)	
Not Hispanic	85,683 (86.5%)	4,321 (73.8%)	10,052 (90.3%)	251 (11.7%	
Missing	170 (0.2%)	17 (0.3%)	21 (0.2%)	212 (0.2%)	
Education					p < 0.001
12th grade or less, no diploma	6,804 (6.9%)	1,126 (19.2%)	1,436 (12.9%)	523 (24.3%)	
High school Diploma or GED	22,578 (22.8%)	1,855 (31.7%)	4,042 (36.3%)	759 (35.2%)	
Some college, no degree	14,394 (14.5%)	1,089 (18.6%)	1,952 (17.5%)	440 (20.4%)	
Associate degree	12,561 (12.7%)	787 (13.4%)	1,646 (14.8%)	269 (12.5%)	
Bachelor's degree	25,252 (25.5%)	685 (11.7%)	1,422 (12.8%)	114 (5.3%)	
Professional school degree	16,351 (16.5%)	270 (4.6%)	532 (4.8%)	24 (1.1%)	
Doctoral degree	683 (0.7%)	6 (0.1%)	28 (0.3%)	1 (0.0%)	
Missing	462 (0.5%)	38 (0.6%)	70 (0.6%)	24 (1.1%)	
Insurance Type					p < 0.001
Uninsured	6,131 (6.2%)	912 (15.6%)	1,431 (12.9%)	370 (17.2%)	
Private	50,064 (50.7%)	1,637 (28.1%)	4,536 (40.9%)	411 (19.2%)	
Medicaid/CHIP	8,867 (9.0%)	1,964 (33.7%)	2,114 (19.1%)	951 (44.3%)	
Medicare	31,094 (31.5%)	1,157 (19.8%)	2,612 (23.5%)	340 (15.8%)	
Military	1,993 (2.0%)	88 (1.5%)	300 (2.7%)	46 (2.1%)	
Other Government	657 (0.7%)	78 (1.3%)	104 (0.9%)	28 (1.3%)	
Rurality					p < 0.001
Urban	85,125 (85.9%)	4,933 (84.2%)	8,670 (77.9%)	1,638 (76.0%)	
Rural	13,960 (14.1%)	923 (15.8%)	2458 (22.1%)	516 (24.0%)	
Region					p <0.001
South	34,939 (35.3%)	2,511 (42.9%)	4,338 (39.0%)	976 (45.3%)	
Northeast	16,777 (16.9%)	813 (13.9%)	1,742 (15.7%)	282 (13.1%)	
North Central/ Midwest	21,474 (21.7%)	1,063 (18.2%)	2,921 (26.2%)	546 (25.3%)	
West	25,895 (26.1%)	1,469 (25.1%)	2,127 (19.1%)	350 (16.2%)	
Income					p <0.001
Low (<$50k)	8,946 (9.0%)	1,159 (19.8%)	1,626 (14.6%)	479 (22.2%)	
Middle ($50k-$99k)	8,575 (8.7%)	218 (3.7%)	951 (8.5%)	50 (2.3%)	
High ($100k+)	9,022 (9.1%)	39 (0.7%)	497 (4.5%)	6 (0.3%)	
Missing	72,542 (73.2%)	4,440 (75.8%)	8,054 (72.4%)	1,619 (75.2%)	

Results

- Analyses revealed significant sociodemographic differences across all four groups ($p < 0.001$ for all comparisons).
- Within the sample (n=118,223) most identified as straight (90.4%), female (52.6%), white (74.8%), and not Hispanic (85.3%).
- Individuals who smoked and were food insecure were more likely to be younger, female, straight, white or Hispanic, have lower educational attainment, enrolled in Medicaid/CHIP, reside in an urban area and in the South.
- This group also had the highest proportion of individuals with low income (<$50k) across all four groups.
- Adjusted odds ratios revealed that compared to nonsmokers who were food secure and lived in urban areas (reference group), individuals in all other cigarette smoking/food security/rurality combinations had significantly higher odds of CRC diagnosis.
- The highest odds were observed among nonsmokers who were food insecure and lived in a rural area (OR=2.391, 95% CI: 2.328–2.456), followed by smokers who were food insecure living in an urban area (OR=2.063, 95% CI: 2.009–2.118).
- Smokers who were food secure and lived in rural areas had significantly lower odds of CRC diagnosis (OR=0.791, 95% CI: 0.769–0.812).

Table 2: Interaction between smoking status, food security, geography, and CRC

Variable	OR	95% (CI)
Nonsmoker & Food Secure & Urban	Ref	
Nonsmoker & Food Secure & Rural	1.969	(1.919-2.021)
Nonsmoker & Food Insecure & Urban	1.529	(1.490-1.570)
Nonsmoker & Food Insecure & Rural	2.391	(2.328-2.456)
Smoker & Food Secure & Urban	1.035	(1.009-1.063)
Smoker & Food Secure & Rural	0.791	(.769-.812)
Smoker & Food Insecure & Urban	2.063	(2.009-2.118)
Smoker & Food Insecure & Rural	1.040	(1.010-1.071)

Discussion/Conclusion

- This study examined the intersection of smoking status, food security, and rurality as it relates to CRC diagnosis.
- Smoking, food insecurity, and rurality compound risk for CRC diagnosis.
- Individuals experiencing food insecurity, particularly in rural areas, face significantly greater odds of CRC diagnosis, regardless of smoking status.
- These findings highlight the influence of structural inequalities in CRC diagnosis, and that food insecurity alone may be a stronger predictor of health vulnerability than smoking status or rurality when examined independently.
- Study limitations included (1) cross-sectional design, (2) self-reported and (3) missing data, (4) limited measurement of rurality, and (5) use of only the SAMPWEIGHT variable without accounting for the NHIS's complex survey design (i.e., more advanced software is needed to corroborate findings).
- Strengths of the study included (1) using a large, nationally representative sample, (2) intersectional and multivariable logistic regression analyses, (3), and consideration of comprehensive sociodemographic data for thorough characterization of subgroups and adjustment for potential confounders.
- **Conclusion**: The confluence of smoking, food insecurity, and rurality creates a greater risk of CRC diagnosis. Thus, it is crucial to address these interrelated determinants by developing and expanding integrated, geographically tailored tobacco cessation and food assistance programs in rural areas.

References available upon request. Please email tpeterson3@Tulane.edu.

This research project was supported by the Stanley S. Scott Cancer Center.