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Research Article

Race/Ethnicity, Gender, Weight Status, and Colorectal Cancer Screening

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Background. The literature on colorectal cancer (CRC) screening is contradictory regarding the impact of weight status on CRC screening. This study was intended to determine if CRC screening rates among 2005 National Health Interview Survey (NHIS) respondent racial/ethnic and gender subgroups were influenced by weight status. *Methods*. Univariable and multivariable logistic regression analyses were performed to determine if CRC screening use differed significantly among obese, overweight, and normal-weight individuals in race/ethnic and gender subgroups. *Results*. Multivariable analyses showed that CRC screening rates did not differ significantly for individuals within these subgroups who were obese or overweight as compared to their normal-weight peers. *Conclusion*. Weight status does not contribute to disparities in CRC screening in race/ethnicity and gender subgroups.

1. Introduction

Colorectal cancer (CRC) is highly preventable with screening, yet it remains the third leading cause of cancer death in both men and women [1]. CRC screening is uniformly recommended in men and women as well as blacks and whites over the age of 50. However, almost half of eligible individuals do not complete CRC screening within the recommended interval [2]. Compared to non-Hispanic whites, Hispanics and blacks are less likely to have had a CRC screening test [3]. Gender and weight status have also been reported to affect CRC screening. Obese individuals have higher morbidity and mortality for many cancers including colorectal cancer (CRC) [4, 5]. Currently, there is controversy about the contributions of weight status, race/ethnicity, and gender to observed CRC screening rates.

The literature on CRC screening and weight status in large, nationally representative samples is contradictory. In the 1997 Cancer Prevention Nutrition cohort, Chao et al. observed lower rates of CRC screening in overweight men, overweight women, obese men, and obese women in comparison to their normal weight peers [6]. In an analysis of the 1999 Behavioral Risk Factor Surveillance Survey (BRFSS) data, Rosen and Schneider found no difference in overall CRC screening, endoscopy screening, or FOBT screening among men regardless of weight status, but these authors observed that morbidly obese women had a lower rate of overall screening, endoscopy, and FOBT [7]. In 2001, another study using BRFSS data reported that men who were overweight or obese (class I) were more likely to have undergone endoscopic screening, while obese women (class I and II) were less likely to have screened endoscopically [8]. Obesity had no effect on fecal occult blood testing (FOBT) in either gender [8].

In the 2000 National Health Interview survey (NHIS) data, Wee et al. found a trend towards increased screening in the overweight population compared to their normal weight counterparts, but this analysis did not examine obesity and overweight separately in relation to CRC screening, nor did the analysis address the relationship of race/ethnicity and gender with screening [9]. Using the 2005 NHIS data set, Leone et al. reported lower screening in obese white women compared to survey respondents who were not obese (overweight and normal weight). However, they did not find a similar association among black women [10]. That analysis did not report on men or Hispanics and did not assess the independent effects of overweight and normal weight status on screening. In a recent report that used Medicare claims data and Veterans Health Administration data, Chang et al. reported that obesity and overweight status had no statistically significant impact on CRC screening [11]. Although that study provided insight into the impact of weight status, the analysis did not separately examine the effects of race/ethnicity and gender. Many smaller studies have examined this relationship but did control for other variables known to influence CRC screening, such as socioeconomic status, physician recommendation, and access to care.

This paper seeks to address limitations of prior analyses by examining race/ethnicity and gender, along with weight status, in CRC screening. This analysis uniquely includes Hispanics and reports weight status in terms of normal, overweight, and obese. Thus, findings presented here provide a more comprehensive view of factors which may impact CRC screening use than has been reported in the literature to date [7–10].

2. Materials and Methods

This study analyzed the data from the 2005 National Health Interview Survey, a nationally representative, cross-sectional, household survey of the civilian noninstitutionalized population of the United States [12].

2.1. Participants. NHIS respondents in this study were individuals aged 50 to 80 years old [13]. We excluded individuals who had missing data on weight status and covariates (n = 6392) as well as underweight (BMI ≤ 18.5) individuals (n = 108). Based on an NHIS recoded variable, we selected those individuals who self-identified as white (non-Hispanic), black, or Hispanic.

The sampling plan follows a multistage area probability design that permits the representative sampling of households and noninstitutional group quarters (e.g., college dormitories) and oversamples of blacks, Hispanics, and Asians. This complex survey design allows for population estimates of the United States [12].

2.2. Dependent Variables

2.2.1. Colorectal Cancer Screening. We examined the self-reported variables related to endoscopy and stool blood testing and test date. The outcome variable of overall CRC screening status (up to date or not) was defined as up to date in individuals who had one of the following screening tests: colonoscopy within the last 10 years, sigmoidoscopy in last 5 years, or FOBT within the last year [13]. We required a person to have complete answers to at least one of the aforementioned screening test questions.

2.3. Independent Variables

2.3.1. Weight Status. Obesity was defined according to BMI which was calculated as weight in kilograms divided by the square of height in meters. BMI was categorized as underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9), and obesity (≥30) [14]. When possible, obese weight status was subdivided into BMI 30–34.9 (Class I), BMI 35–39.9 (Class II), and BMI ≥ 40 (Class III).

2.4. Covariates. We examined the potential confounding variables of age (50–59, 60–69, 70–79), marital status (married, unmarried), education (<12 y, high school graduate, some college, college graduate), annual income (<20 K, >20 K), regular source of medical care (yes/no), insurance status (yes/no), office visits in the last year (none, 1, 2–5, ≥6), personal history of cancer (yes/no), alcohol consumption (heavy, light, none), health status (fair/poor, excellent/good), smoking status (current, former, never), physician recommendation (yes/no), number of comorbidities (0, 1, 2-3, 4-5, 6 or more), and physical recreational activity as metabolic equivalents per week (none, <675 mets, ≥675 mets).

2.5. Statistical Analysis. In univariable analyses, we computed the proportion of subjects who had CRC screening across levels of each of the variables listed above (and shown in Table 1), as well as associated unadjusted odds ratios. We then fit two multivariable logistic regression models. The first model included main effects for all the variables shown in Table 1 and yielded adjusted odds ratios. The second model included the same main effects, as well as interaction terms for gender by race/ethnicity, gender by weight status, and race/ethnicity by weight status, which allowed us to assess whether either gender or race/ethnicity modified the association between weight status and CRC screening. All logistic regression models accounted for the complex sampling design of the NHIS via appropriate weighting (Proc Surveylogistic in SAS 9.2).

3. Results and Discussion

3.1. Results. The final sample included 7,088 individuals. Overall, CRC screening was up to date in approximately 56% of respondents. Weighted CRC screening rates among NHIS respondents were as follows: white males (58%), white females (58%), black males (44%), black females (48%), Hispanic males (39%), and Hispanic females (37%).

Table 1 presents several known predictors of CRC screening including both the unadjusted analysis and the analysis adjusted for main effects only. In the adjusted analyses, demographic variables significantly associated with

Table 1: Colorectal cancer screening according to selected covariates (n = 7088).

Variable	CRC screening rate (weighted)	Unadjusted odds ratio [CI_{95}]	Adjusted odds ratio [CI_{95}][1]
Overall	55.8		
Weight status			
[a]Normal weight	56.3		
Overweight	55.7	0.97 [0.86–1.11]	1.00 [0.84–1.21]
Obese	55.5	0.98 [0.85–1.12]	0.91 [0.75–1.12]
Gender			
[a]Female	55.7	0.99 [0.89–1.10]	0.86 [0.73–1.02]
Male	56.0		
Race			
[a]Hispanic	38.2		
Black	46.1	1.38 [1.06–1.81]	1.26 [0.87–1.82]
White	58.5	2.28 [1.85–2.80]	1.25 [0.96–1.63]
Age			
[a]50–59	47.2		
60–69	62.7	1.87 [1.67–2.11]	1.69 [1.41–2.02]
70–79	65.0	2.08 [1.79–2.41]	1.71 [1.39–2.10]
Marital status			
[a]Unmarried	51.6		
Married	57.5	1.27 [1.15–1.41]	1.02 [0.86–1.20]
Education			
[a]<12 years	44.6		
High school graduate	53.3	1.41 [1.21–1.70]	1.03 [0.83–1.28]
Some college	55.6	1.56 [1.32–1.84]	1.01 [0.79–1.29]
College graduate	65.3	2.33 [1.96–2.78]	1.42 [1.09–1.85]
Annual income			
[a]<20 K	45.0		
>20 K	58.0	1.69 [1.48–1.93]	1.31 [1.05–1.63]
Regular source of medical care[2]			
[a]No	28.5		
Yes	57.4	3.38 [2.57–4.44]	1.11 [0.78–1.57]
Insured			
[a]No	22.7		
Yes	57.9	3.78 [3.02–4.73]	1.57 [1.16–2.14]
Office visits in last year			
[a]None	24.4		
One	43.3	2.37 [1.78–3.16]	1.21 [0.83–1.77]
2–5 visits	58.4	4.35 [3.39–5.59]	1.60 [1.14–2.27]
≥6 visits	64.9	5.74 [4.44–7.42]	2.05 [1.42–2.96]
Physician recommendation[3]			
Yes	81.9	43.49 [36.82–51.36]	36.97 [31.18–43.84]
[a]No	9.4		
Health status			
[a]Fair/Poor	56.5		
Excellent/Good	52.8	1.16 [1.01–1.33]	1.12 [0.91–1.38]
Comorbidities			
[a]0	43.7		
1	55.3	1.60 [1.38–1.85]	1.18 [0.94–1.48]
2-3	62.4	2.14 [1.85–2.48]	1.28 [0.99–1.65]
4-5	62.3	2.13 [1.73–2.62]	1.20 [0.85–1.70]
6 or more	73.4	3.55 [2.29–5.53]	2.28 [1.14–4.56]

Table 1: Continued.

Variable	CRC screening rate (weighted)	Unadjusted odds ratio [CI_{95}]	Adjusted odds ratio [CI_{95}][1]
Personal history cancer ever			
[a]No	69.3		
Yes	53.5	1.96 [1.67–2.30]	1.15 [0.92–1.43]
Alcohol consumption[4]			
[a]Heavy	51.6		
Light	59.1	1.23 [0.93–1.63]	1.01 [0.72–1.41]
None	54.0	0.91 [0.69–1.20]	1.03 [0.73–1.45]
Smoke			
[a]Current	55.0		
Former	62.6	2.28 [1.93–2.70]	1.27 [1.03–1.58]
Never	42.4	1.67 [1.43–1.94]	1.26 [1.03–1.54]
Recreational physical activity (METS)			
[a]None/unable to exercise	48.1		
<675	59.4	1.58 [1.39–1.79]	0.97 [0.81–1.17]
≥675	69.9	1.84 [1.61–2.09]	1.19 [0.98–1.44]

[a]Reference category
[1]Adjusted for all covariates listed in first column
[2]Recoded from NHIS data, has a usual place of care which is not the emergency room
[3]Saw physician in last 12 months and received a recommendation for either colonoscopy or endoscopy
[4]Heavy ≥14 drinks/week, light = 1–14 drinks/week

increased screening included age greater than 60, college education, and higher income. Access variables positively associated with CRC screening included being insured and increasing number of doctor visits in the last year. A strong association between physician recommendation and a CRC screening was observed (OR 36.97, $P < 0.001$).

Obesity was categorized further as obesity class I, II, and III, and there was no effect (data not shown). This classification could not be carried through in subgroups due to sample size. We also examined endoscopy and FOBT as separate outcomes and found no differences (data not shown).

Table 2 addresses the hypothesis of this study and shows the multivariable model for the relationship of weight status and CRC which adjusted for the covariates in Table 1 as well as interactions between weight status with gender and race/ethnicity. There were no significant associations between weight status and CRC screening in Hispanic men, Hispanic women, black men, black women, white men, and white women, with the gender by weight status and race/ethnicity by weight status interactions not significant (P = 0.512 and 0.654, resp.).

3.2. Discussion. Obese and overweight individuals are as likely to receive CRC screening as their normal weight peers regardless of gender, race, or Hispanic ethnicity. This finding contradicts other literature which suggests a relationship between weight status and CRC screening. This study agrees with the recent analysis of Chang et al., who found no evidence that obese or overweight patients were less likely to receive recommended care, including CRC screening, when compared with their normal weight peers [11]. Our model isolates the relationship of weight and CRC screening from multiple known predictors and examines this relationship more comprehensively by incorporating race, gender, and ethnicity. Other work using smaller datasets may have been unable to account for all potential covariates, and only very large datasets could accommodate a subgroup analysis such as this. Access to care is strongly associated with CRC screening. The strength of the association of physician recommendation and CRC screening is striking and may indicate that physician recommendation is necessary for screening. The literature indicates that this effect appears to persist regardless of race and gender [9]. More work is needed to understand barriers and predictors of physician recommendation in subgroups who are at risk for not being screened.

Findings presented here may be directly compared to a recent analysis which also examined the relationship of obesity and CRC screening in the NHIS 2005 data set [10]. In contrast to our findings, these authors found that obese white women were less likely to screen. Our analysis is distinct in several ways. First, we included any individual who had complete data for either the set of questions for FOBT or for endoscopy. So, for example, individuals who were up to date on endoscopy were counted as up to date for colorectal cancer screening, regardless of missing data on FOBT and vice versa. While this is not the convention in handling of missing data, the population that would have been excluded from our analysis (if we required complete data for both sets of questions) was distinct in screening behavior and several known predictors of screening. Second, we separated Hispanics from the white and black subgroups. We believed that this group warranted separate consideration because of the low rate of screening in Hispanics and the relative lack

Table 2: Adjusted model for colorectal cancer screening according to race/gender and ethnicity ($n = 7088$).

Weight status	CRC screening rate	Adjusted odds ratios[1]	95% confidence interval
Stratum specific for race/gender			
White males ($n = 2491$)	58.6		
Normal	59.7	1.00	
Overweight	57.9	0.90	0.68–1.18
Obese	59.0	0.83	0.61–1.13
Black males ($n = 392$)	43.8		
Normal	45.5	1.00	
Overweight	44.2	1.07	0.62–1.85
Obese	42.1	1.06	0.56–2.02
Hispanic males ($n = 323$)	39.4		
Normal	37.6	1.00	
Overweight	35.0	0.71	0.37–1.37
Obese	52.1	0.97	0.47–2.03
White females ($n = 2955$)	58.3		
Normal	58.3	1.00	
Overweight	59.9	1.11	0.84–1.46
Obese	56.5	0.91	0.68–1.21
Black females ($n = 496$)	48.0		
Normal	36.2	1.00	
Overweight	53.6	1.32	0.75–2.31
Obese	48.1	1.16	0.64–2.10
Hispanic females ($n = 431$)	37.1		
Normal	32.6	1.00	
Overweight	34.6	0.88	0.47–1.64
Obese	43.3	1.06	0.54–2.10

[1]Adjusted for all variables in Table 1, as well as interaction terms of race, gender, and Hispanic ethnicity.

of literature on barriers to screening in this group. Also, our analysis reports on men. Finally, this analysis is distinct in that it isolates the overweight group from the normal weight group. Table 2 supports this decision and shows that the rate of CRC screening in overweight individuals is distinct from both the normal weight group and the obese group in several of our subgroups. For example, the rate of screening in overweight black females is 54%, compared to 36% in normal weight black females and 48% in obese black females. Black females do not see themselves as overweight until a higher BMI, compared to their white counterparts, and this may explain the difference between overweight and obese [15].

The cross-sectional design of our study precludes determination of cause. BMI and CRC screening are self-reported and therefore may be distorted. Sample size is a challenge in analysis of our subgroups. Although all cells met the NHIS suggested requirements (less than 30% standard error), the wide confidence intervals suggest that sample size may have been a restriction in groups such as Hispanics. Additionally, we could not examine subclasses of obesity (i.e., obesity I, II, III) in our groups of interest due to sample size.

CRC screening reduces mortality and prevents colorectal cancer. However, rates of screening are unacceptably low overall and in minority subgroups. The rising prevalence of obesity and the higher burden of cancer risk in obese individuals make this an especially important population subgroup in terms of race/ethnicity, gender, and other characteristics.

4. Conclusions

There is no relationship between increasing weight and CRC screening in this nationally representative sample. Regardless of the lack of association of obesity and CRC screening, obesity remains a risk factor for increased morbidity/mortality related to CRC. Therefore, future work is needed to understand and mitigate risk in the obese population especially as this group comes to represent an ever-increasing percentage of the US population.

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