RELATIONSHIP OF COMMUNITY LEVEL SOCIOECONOMIC STATUS ON STAGE AT DIAGNOSIS OF COLORECTAL CANCER

by

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TABLE OF CONTENTS

i. List of Figures and Tables

Tables:

Figures:

ii. Acknowledgments

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ii. Abstract

Colorectal cancer (CRC) is a common cancer in industrialized countries and the second leading cause of cancer-related deaths in Florida and the United States. Prognosis is dependent upon stage of cancer at diagnosis, and effective screening can identify CRC both in precancerous and early stages of the disease. Cancers diagnosed at an early stage are nearly always curable, so effective screening can reduce mortality. Cancers identified in a precancerous stage can be treated before progression to cancer, so effective screening can also reduce morbidity due to CRC.

Some of the largest differences in overall cancer survival among social classes occur in cancers with an effective screening test, such as CRC. Lower socioeconomic status (SES) groups may have lower screening rates, resulting in more cases diagnosed at a late stage. Lower SES groups may also have other risk factors or exposures, such as diet or smoking, resulting in increased risk of late stage CRC.

This is an ecological study examining the relationship between SES and stage at diagnosis of CRC in Florida. Incidence data from the cancer registry were combined with census demographic data aggregated to the block group level. Block groups were then combined into four levels of SES. Stratified analysis by sex, race, ethnicity, and urban/rural status was conducted.

Overall incidence of invasive CRC varied by SES level (but the pattern was inconsistent among races, ethnicities, and urban/rural status). In general, the incidence of total CRC increased with increasing poverty (except for Blacks,

Hispanics, and rural residents where the risk decreased with increasing economic deprivation). To account for the variation in CRC risk by SES level, the ratio of the age-adjusted incidence rate of late to early stage diagnosis was evaluated. Consistent patterns were found of an increasing relative rate ratio for late to early stage, indicating increasing risk of a late stage diagnosis, for Whites and Non-Hispanic Whites with increasing poverty (with the exception of rural residents).

Additional analysis aimed at eliminating residual confounding due to increased poverty among Blacks and Hispanics resulted in the same patterns seen among Blacks but not Hispanics. This study suggests that lower community level SES is related to an increase risk of late stage CRC, with the exception of rural residents and Hispanics.

While all groups would benefit from increased screening, poor communities may potentially benefit the most. The identification of individuals at risk based on the SES of the community in which they reside is easy and can be achieved using free and readily available census data. Targeting such communities for enhancing screening efforts should be incorporated in public health policy.

I. INTRODUCTION

A. Colorectal Cancer

Colorectal cancer (CRC) is a common cancer in industrialized countries and the second leading cause of cancer-related deaths in Florida and the United States.[1,2] According to the Florida Cancer Data System (FCDS), Florida's statewide, population-based cancer registry, CRC is the fourth most common cancer among Floridians (after lung and bronchus, breast, and prostate cancers) with an age-adjusted incidence rate of 46.6 cases per 100,000 Floridians in 2003.[3] Cancer of the colon and rectum comprise the second most common cause of death due to cancer, after lung and bronchus cancers, with an age-adjusted mortality rate of 15.5 deaths per 100,000 Floridians in 2003.[3] Because, like many cancers, the exact cause of CRC is unknown, screening and early detection are the most important factors for survival.[1,2]

i. Colorectal Cancer Screening

Because effective screening by colonoscopy can lead to the identification and removal of precancerous lesions, CRC is potentially eradicable through secondary prevention. And, like many cancers, diagnosing CRC at an early stage is an important prognostic factor for the ability to treat and cure the disease. Therefore, a diagnosis of a CRC at a late stage should be viewed as a preventable, adverse health outcome. Hence, characterization and identification of populations needing enhanced screening efforts is supported by a number of national initiatives.

The Institute of Medicine considers CRC screening, along with cervical cancer screening, to be a priority area for national action because routine screening for these cancers has demonstrated a reduction in mortality.[4] Colorectal cancer screening is also a

national health priority reflected in Healthy People 2010 objectives 3-12 and 3-5 to increase screening and reduce mortality.[5]

Because prognosis is largely dependent upon the stage of cancer at diagnosis, routine screening can reduce mortality due to CRC through early detection.[6] All major health organizations support the concept of routine screening for CRC, although a national consensus is lacking on which screening test is best and what the optimal time is between screenings. Routine screening with a Fecal Occult Blood Test (FOBT, a chemical test for blood in stool), sigmoidoscopy (visual examination of the lower one-third of the bowel using a flexible fiber optic endoscope) or both, is recommended for all individuals over the age of 50 by the US Preventive Services Taskforce.[7] Additionally, all the key national public health organizations (i.e., ACS (American Cancer Society), the CDC (Centers for Disease Control) and the NCI (National Cancer Institute)) recommend double-contrast barium enema (a series of x-rays), digital rectal exam (a physical exam performed by a clinician), and/or colonoscopy (visual examination of the entire colon with a flexible scope) for routine screening.[1] The American Gastroenterological Association has the most specific guidelines for CRC screening, which includes screening recommendations stratified by CRC risk.[8]

Screening with colonoscopy can reduce the overall burden of CRC by identifying and removing precancerous polyps.[6] Colonoscopy is not as used as much as other screening methods even though it is perceived to be the most effective screening test by primary care physicians.[9] During a colonoscopy, the provider can remove any polyps found during the procedure, contributing to the prevention of CRC which generally begins from adenomatous polyps.[6,7,8] Colonoscopy is more expensive, inconvenient, and

risky than other screening methods, but a colonoscopy can evaluate the entire colon, including the proximal colon, which is an area beyond the reach of a sigmoidoscope.[6,7,8] While published studies to date have evaluated screening colonoscopy as a stand-alone procedure, sufficient evidence exists to indicate screening colonoscopy reduces both mortality and incidence.[8,10]

Despite national agreement that routine CRC screening can save lives, reported CRC screening is much lower in the United States than other cancer screenings such as mammography and pap tests. Fewer than half of persons over age 50 receive any type of routine CRC screening[11] compared to 86% of women who receive recommended cervical cancer screening and 75% who receive recommended breast cancer screening.[12] For screening programs to be successfully implemented, a series of events must occur: screening must be offered; it must be paid for; and it must be accepted by patients. Acceptance of CRC screening is further complicated by the complexity of screening guidelines, which recommend multiple tests, and guidelines vary based on individual's CRC risk.[8] The Centers for Disease Control and Prevention (CDC) Adult Behavior Risk Factor Surveillance Survey (BRFSS) data show that only 56% of Floridians over 50 years of age reported ever having received endoscopy (either sigmoidoscopy or colonoscopy) and only 32% reported having had an FOBT within the past two years in 2004.[12]

As seen in Table 1, routine screening rates vary by sex, age, race, education, and income both in Florida and the United States as a whole. In general, the reported overall screening rates were higher in Florida than nationally. Blacks and Hispanics, persons under 60, persons of low income, and persons of low education have lower reported routine screening rates in Florida and nationally.

Table 1. Reported Colorectal Cancer Screening; U.S. and Florida, 2004

	Percent Ever Received Endoscopy			Percent Received FOBT In Last 2 Years		
	U.S.	Florida	Florida C.I.	U.S.	Florida	Florida C.I.
Total	52.9	56.1	53.9-58.4	26.4	31.5	29.5-33.6
Sex						
Male	52.5	56.5	53.0-60.2	27.4	31.7	28.4-35.0
Female	53.2	55.8	53.0-58.5	25.6	31.4	28.9-34.0
Age						
50-59	42.2	38.8	34.9-42.8	21.5	20.4	17.3-23.6
60-64	55.7	61.4	55.9-67.0	29.8	33.9	28.3-39.5
65+	63.1	66.4	63.6-69.1	30.4	38.5	35.6-41.4
Race/ Hispanic Origin						
White	54.3	59.2	56.8-61.5	27.4	34.7	32.5-37.0
Black	~	46.0	37.2-54.8	21.0	24.8	15.9-33.7
Hispanic	~	46.4	38.9-54.0	~	17.8	12.2-23.4
Income						
<$15,000	46.1	44.6	37.8-51.5	23.2	22.9	16.6-29.2
$15,000-24,999	48.4	54.5	49.2-59.7	25.5	34.1	29.1-39.1
$25,000-34,999	53.0	58.2	51.7-64.7	26.9	34.0	27.9-40.1
$35,999-49,999	55.3	55.8	50.1-61.6	28.4	33.8	28.4-39.2
$50,000+	55.6	60.9	56.6-65.1	27.6	30.7	26.9-34.5
Education						
< HS	43.0	43.7	36.5-50.9	22.4	21.4	14.8-28.0
HS or GED	50.6	54.8	50.9-58.7	25.5	32.3	28.7-35.9
Some Post HS	54.0	55.8	51.4-60.3	28.1	35.3	31.1-39.6
College Graduate	58.6	62.0	58.2-65.8	29.0	31.0	27.6-34.5

Source: CDC BRFSS 2004 available at http://www.cdc.gov/brfss/; ~ data unavailable due to sample size

ii. Socioeconomic Status (SES) and Health

Socioeconomic status (SES) is an integral and complex determinant of individual health and the health of populations. Health disparities between the rich and poor were documented even in ancient civilizations, and contemporary research continues to show disparities even after adjusting for genetic and behavior driven risks.[13] Recent renewed interest has been spurred by the publication of a number of studies demonstrating excess mortality among the lower SES class. For instance, The Black Report identified SES influences on individual health by showing increased mortality among lower class workers in England compared to higher SES workers.[14] Although the trend plateaus in

the upper social classes, in general, the health of a population improves with rising average per capita income.[15] In addition to overall health, differences specifically in cancer rates and survival between the rich and poor are consistently shown in the literature.[16]

The majority of the literature investigating the associations between SES and health has been generated outside of the United States. This is partly because SES data are not collected by most health information systems, including cancer registries, in the United States. However, a number of studies have combined individual health data, based on location of incident or place of residence, with community-level SES from the US Census Bureau data to evaluate demographic risk factors. The validity of this area-based methodology has been tested and verified.[17]

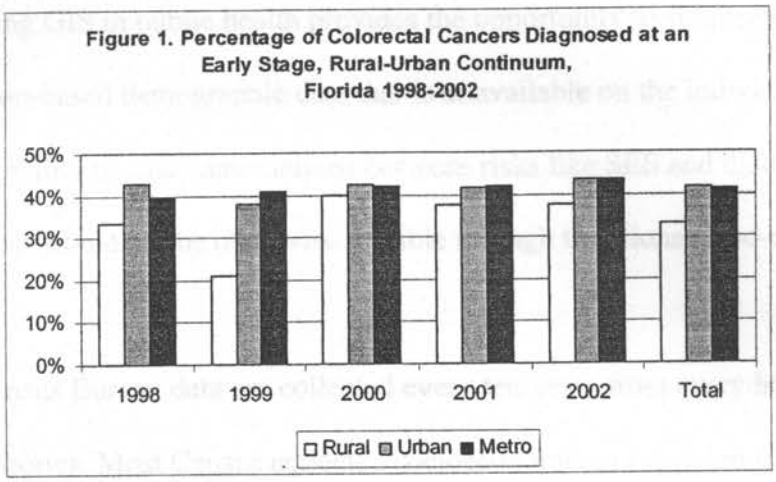
Some of the largest differences in cancer survival among social classes occur in those cancers that have a fairly good prognosis if detected at an early stage, such as CRC.[18] Plausible explanations for the discrepancies include inferior medical care and/or preventive services. Lower screening rates leading to more late stage diagnoses may also partially explain poorer survival among lower SES groups. For CRC specifically, studies have indicated that the risk of late stage diagnosis is higher among lower SES groups.[19,20] According to the Census, which follows the federal government's official poverty definitions, 13% of Florida's nearly 16 million residents are living below the poverty line.[21] The relationship between community-level SES and late stage at diagnosis in Florida has not yet been described.

iii. Urban and Rural Differences

Numerous studies have indicated cancer rates and survival may be different for urban and rural residents. Historically, these geographic differences were larger for men than women.[22] Rural residents generally are less educated and more likely to be impoverished and uninsured,[23] which are all characteristics that reduce the likelihood of an individual to seek preventive medical care, such as CRC screening.[24] Rural residents also have longer travel time for medical care[23] and report fewer annual health care visits, which may result in fewer preventive exams.[24] For CRC specifically, screening rates have been shown to be lower among rural residents than metropolitan residents.[25] And rural residency has been associated with increased risk of late stage cancers, including CRC.[26] However, the urban/rural disparities may be more than differences in routine screening rates based on availability of services to include different attitudes or awareness about screening and medical care or increased risk factors related to stage.[27] Although Florida is a densely populated state, according to the state Office of Rural Health, 33 of Florida's 67 counties are considered rural. Florida State Statute 381.0406 defines rural as "an area with a population density of less than 100 individuals per square mile or an area defined by the most recent United States Census as rural."

Using Rural-Urban Continuum County Codes defined by the United States Department of Agriculture (USDA), Figure 1 shows rural counties in Florida consistently have a lower percentage of CRC diagnosed at an early stage while urban and metropolitan counties have similar, higher percentages of cases diagnosed at an early stage. It is not known if these urban-rural differences in stage are related to differences in access to services (i.e. fewer medical services in rural areas) or demographic differences

in the underlying population (i.e. lower SES for rural residents or differences in attitudes towards screening).



B. Area-based Demographic Data

The use of geographic information systems (GIS) is recognized as a powerful tool in the field of public health. GIS technology can be used to produce easily understood maps to demonstrate complicated data as well as perform spatial analysis to identify potential associations. Traditionally, GIS has been used in the tracking of environmentally-linked diseases, i.e. vector-borne or communicable illnesses. But GIS is also a useful tool in chronic disease predictor models, surveillance, and resource allocation. GIS is also particularly useful in public health because of the ability to link data from disparate sources using advanced relational database management, such as supplementing risk factor data, such as area based socioeconomic data collected by the US Census Bureau, with public health surveillance data, such as cancer incidence data collected by central cancer registries.

Incorporating GIS into health research is a national priority as indicated by Healthy People 2010 objective 23-3 to incorporate the use of GIS into all levels of health

data.[5] Additionally, the National Cancer Institute encourages the use of geocoded cancer data through grant funding for geographic based research in cancer control and epidemiology. Using GIS in public health provides the opportunity to supplement disease data with population-based demographic data that is unavailable on the individual-level. This results in the ability to study associations between risks like SES and disease on a population basis that would not be otherwise feasible through traditional case-control studies.

The US Census Bureau data are collected every ten years from every household in the US and its territories. Most Census collected socioeconomic information (i.e median income, education, and language spoken) is available for many levels of geography, including states, counties, cities and towns, ZIP codes, Census tracts and block groups. The block group is the lowest level at which the US Census Bureau tabulates socio-economic data. The average size of a block group is 1,000 people whereas the average size of a Census tract is 4,000 people. Block group populations, being smaller, are slightly more homogenous population than Census tracts.[13,28]

The area-based socioeconomic data are easily linked to public health data based on the geography (i.e. residence at diagnosis or death for cancer data). There are two main ways to use these linked data: 1) assign the area-based SES measure to the cases residing in the block group or Census tract for analysis; or, 2) conduct analysis of aggregated data for both the disease and the risk factor. The second technique examines the relationship of a community-based risk on the health of a population; not on individual outcomes.

C. Objective

Due to both the high incidence and high mortality, CRC is a public health priority. Early detection, identifying a cancer in the earliest, most treatable stage, through routine screening is the most effective method for reducing the public health burden of CRC. Early detection is achieved through appropriate, routine CRC screening. Community-level SES likely impacts the accessibility and uptake of routine screening in the population. Therefore, this study examines the relationship between community-level SES and the stage at diagnosis of CRC in Florida by merging individual-level CRC data from a cancer registry with area-level SES data from the US Census based on geography.

D. Hypothesis

The study hypothesis is that community-level poverty is an effective marker for the complex variable of social class; specifically, as community-level poverty increases, the risk of a CRC being diagnosed at a late stage also increases. This relationship holds true regardless of sex, race, ethnicity, or population density of residence. Further, it is feasible to use GIS-based SES markers from the US Census for small areas to identify and target high risk communities for late stage CRC. Block group measures of SES from available US Census data are effective predictors of late stage diagnosis of CRC among Floridians, when controlling for the effects of age, sex, race, ethnicity and urban/rural status.

II. MATERIALS AND METHODS

The research protocol was reviewed by an OHSU MPH Thesis Committee and the Florida Cancer Data System. The University of Miami Human Subjects Research Office determined this study (HSRO # 20057486) qualified for "exemption" from Institutional

Review Board (IRB) review pursuant to category 45 CFR 46.101(b)(4). Since this was a study performed to complete the thesis requirements at Oregon Health & Sciences University (OHSU), IRB review from OHSU was also sought. But oversight was ultimately deferred to the University of Miami, and this study protocol was not required to be submitted for review by OHSU Human Subjects Committee.

A. Colorectal Cancer Data

CRC incidence data were obtained from Florida's statewide cancer registry. The variables included were age, sex, race, ethnicity, cancer site, cancer histology, stage at diagnosis, tumor sequence, cause of death, and block group of addresses at diagnosis.

The Florida registry, FCDS (Florida Cancer Data System), is housed in the Sylvester Comprehensive Cancer Center of the University of Miami, Miller School of Medicine. FCDS was contracted by the State of Florida Department of Health in 1978 to design and implement the Florida central cancer registry. FCDS has been collecting information on all reportable cancers diagnosed or treated in Florida as of January 1, 1981. The FCDS is supported by the University of Miami's Sylvester Comprehensive Cancer Center, Florida Department of Health, and the Centers for Disease Control and Prevention's (CDC) National Program of Cancer Registries (NPCR).

Physicians, pathology laboratories, licensed medical facilities (civilian), and free-standing radiation facilities are legally required to report cancers diagnosed or treated in the state. Reportable cancers include all malignant neoplasms that are invasive or in situ (International Classification of Disease-Oncology behavior codes 2 and 3) with the exception of basal and squamous cell carcinomas of the skin and in situ cervical cancers. The North American Association of Central Cancer Registries (NAACCR) has certified

the Florida registry data for meeting or exceeding the standards of quality and completeness for all years of data included in this study. The Florida cancer data are geocoded, enabling assignment of Census tract, block group, longitude and latitude to the individual cancer records, thus allowing the incorporation of information from disparate sources, including the US Census data.

i. Case Selection

Cases of primary CRC reported to FCDS (Florida Cancer Data System) diagnosed among Floridians from 1998-2002 were analyzed. Because medical screening guidelines recommend that screening for CRC begin at age 50, cases diagnosed before age 50 were excluded from the analysis. The analysis was conducted on adenocarcinomas only. To account for changes in routine screening practices after a diagnosis, cases of second primaries of CRC were excluded; however, a prior diagnosis of a cancer other than CRC was not grounds for exclusion. Cases diagnosed by autopsy for which the cause of death was not CRC were also excluded.

ii. Stage at Diagnosis

To classify cases as either "early" or "late" stage at diagnosis, the Surveillance Epidemiology and End Results (SEER) Summary Staging system was used (SEER 1977 for cases prior to 2001, SEER 2000 for cases 2001 and forward). SEER is a program within the National Cancer Institute. SEER works with other national and international organizations to standardize the collection of cancer data. Cases diagnosed at an *in situ* or localized stage were classified as "early", and cases diagnosed at a regional or distant stage were classified as "late".

Since the purpose of this analysis was to study the effects of SES on the stage of the disease, this analysis was restricted to the cases with a known stage at diagnosis. Cases of unknown stage were cases for which information is missing from the medical record or unobtainable from the medical record (i.e. an out of state diagnosis or an archived medical record). Cases of unknown stage were also cases that were never medically staged. A case may be unstaged due to decisions made by providers and patients to limit the invasiveness of procedures (i.e. due to advanced age or other co-morbidity) or by lack of follow-up visits due to insurance or lack of patient compliance. Unstaged cases and cases of unknown stage were excluded from analysis. Cases lacking stage at diagnosis information were also "death certificate only" (DCO) cases. Due to lack of information, these cases were coded with an unknown stage at diagnosis and, subsequently, excluded from the analysis.

B. US Census Demographic Data

The most current decennial US Census, conducted in April 2000, was used for the purposes of this study. Prior research has determined that both Census tract and block group level analysis of community-level social data is valid for health outcome research.[29] Therefore, all analysis was done on aggregated block group data since the block group data are more homogenous.

Poverty status was estimated based on a sample of individuals that were administered the Census long form. Unlike the short form data that is collected from every adult individual, the long form data contains supplemental social and economic questions from a representative sample of the population. The poverty status variable was from the US Census 2000 Table P87 Poverty Status in 1999 by Age (Summary File 3).

Urban and rural residency was based on the Census short form, total population data, which classified a person's residence as urban or rural. The Urban/Rural Status variable was from the US Census 2000 Table P5 Urban and Rural (Summary File 3).

i. Socioeconomic Status (SES) Level

A single variable, percent of people living below the poverty line, was used to assign an SES level. For this analysis, each Census block group where the patient resided at the time of diagnosis was assigned a level of SES using the poverty status information, the percentage of individuals living below the poverty line, from the US 2000 Census. *A priori* cut-points previously validated for area-level SES were used to create four levels of SES based on the percentage of persons living below the poverty line.[29,30]

- SES 4 = < 5% of population living in poverty (highest SES level)
- SES 3 = between 5% and <10% of population living in poverty
- SES 2 = between 10% and <20% of population living in poverty
- SES 1 = > 20% living below poverty line (lowest SES level).

The poverty threshold is the same throughout the country and is not adjusted for local or regional differences in cost of living, and the percentage of persons living below poverty varies by geography and, particularly, by race. The cut-points were based on work conducted extensively on data from New England, where the percentage of persons living below the poverty line is considerably less than Florida (percentage living in poverty from 2002 US Census estimates: US 12%, CT 8%, MA 9% and FL 13%). Table 2 demonstrates Florida follows national patterns with the percentage of Blacks and Hispanics living below the poverty line appreciably higher than for Whites and Non-Hispanic Whites.

Table 2. Percent of Florida Residents Living at or Below the Federal Poverty Level, By Race and Ethnicity; US Census 2000

	Percent of Florida Population	Percent of Population Living in Poverty
Florida Total	100%	13%
Blacks	15%	26%
Whites	78%	10%
Hispanics	17%	18%
White, Non-Hispanics	65%	8%
Data from US Census 2000; based on single race reporting only		

Therefore, additional analysis was conducted using quartiles to determine SES level, instead of the *a priori* cut-points, to avoid potential residual confounding caused by amplified effects of poverty due to race.[31,32] The cut-points for the race and ethnicity specific quartiles SES levels are listed in Appendix A.

ii. Urban or Rural Residency

According to the Census, about 2 million (11%) Florida's nearly 16 million residents live in rural areas. Urban is defined by the US Census Bureau as 1) a cluster of one or more block groups or Census blocks, each of which has a population density of at least 1,000 people per square mile at the time; 2) surrounding block groups and Census blocks each of which has a population density of at least 500 people per square mile at the time; or 3) less densely settled blocks that form enclaves or indentations, or are used to connect non-contiguous areas with qualifying densities.

For each Census block group, the percentage of the population living in urban areas was calculated. National standards for Census tract based urban/rural codes classify tracts as urban if 30% or more of the residents live in urban areas or urban clusters.[33] Therefore, a block group with 30% or more of the population defined as urban residents by the US Census Bureau was designated as "urban"; the remainder were designated as "rural". This urban/rural designation was used instead of national

urban/rural codes (Beale Codes or Rural Urban Commuting Area Codes) or the Florida Office of Rural Health designations because the analysis was conducted at the block group level. Of note, this is a method that is easily replicated outside the state of Florida.

C. Data Analysis

Individual-level CRC data were linked, using place of residence at diagnosis, with area-based poverty data at the block group level. Each block group was assigned an SES level and an urban/rural status. The block groups were then combined by SES level to calculate age-adjusted rates. To account for known risk factors (and for those risk factors for which data were available), analysis was stratified by sex, race, ethnicity, and urban/rural status.

Following guidelines from the Washington State Department of Health and the National Center for Health Statistics,[34] age-adjusted rates were calculated for CRC cases using the direct method and the Year 2000 US Population Standard (See Appendix B). Population counts and cases were aggregated to the block group level by sex, race, ethnicity, urban/rural status and socioeconomic level, and age-adjusted incidence rates were calculated for early stage (*in situ* or localized), late stage (regional and distant), as well as unstaged and DCO cases, using five year age-groups (50-54, 55-59, ...80-84, 85+). The formula used was $IR_{st} = \sum_j w_j IR_j$ where IR was the age-adjusted rate; IRj was the age-specific rate within each age-category j, and w_j as the proportion of the standard million population for the age-group. The variance for each age-specific rate was calculated using this formula $\mathrm{Var}(IR_{st}) = \sum_j w_j^2 \left(\frac{cases_j}{pop_j^2} \right)$.[34] Following guidelines from the National Center for Health Statistics,[35] 95% confidence intervals were calculated for each age-adjusted rate based on the gamma distribution.[36] Any confidence interval lower

bound less than zero was set to zero. The rates were calculated in SAS using an algorithm modeled on one publicly available from the Public Health Disparities Geocoding Project.[37]

This study evaluated the relationship of late stage diagnosis of CRC by community-level SES, not the risk of CRC in general. Because the rate of total invasive colorectal cancer varies by sex, race/ethnicity and other variables, such as modifiable risk factors like diet, a comparison between early and late stage cases was necessary to evaluate a group's propensity for late stage diagnosis relative to early stage. Therefore, the ratio of the age-adjusted rates of late stage to early stage incidence (L:E stage) for CRC was evaluated. The Delta Method estimate of variance was used to obtain confidence intervals for the ratio of the L:E stage incidence rates. The Delta Method accounts for the dependence between early and late stage rates and includes a covariance term to account for this statistical dependency.[38]

Relative rate ratios for the rates were calculated in Excel to evaluate differences among the SES groups. The highest, most affluent SES group was the referent category for each relative rate ratio. To test for statistical significance, 95% confidence intervals were computed using the standard formula L CI = exp[ln(Rate Ratio) - (1.96*SQRT(Variance)] ; U CI = exp[ln(Rate Ratio) + (1.96*SQRT(Variance)].[37] The formula used for variance for the age-adjusted incidence rates was $Var[\log(IRR_s)] = \frac{Var(IR_{s1})}{IR_{s1}^2} + \frac{Var(IR_{s0})}{IR_{s0}^2}$.[37] The variance calculated using the Delta method was used to calculate the confidence intervals for the relative rate ratio of L:E stage rates.

III. RESULTS

The study population consisted of 41,679 cases of CRC: 17,588 early stage (42%) and 24,091 (58%) late stage. Table 3 shows the number of cases excluded with each case selection criteria. Of cases that met the case selection criteria, 14% were excluded due to lack of staging information.

Table 3. Colorectal Cancer Cases Among Florida Residents, 1998-2002; Count and Percent of Cases Excluded From Analysis Based on Study Selection Criteria

Variable	Count	Percent	Notes
1. Diagnosis Years 1998-2002	60,789	100.0%	Florida resident; address geocoded to block group
2. First CRC diagnosis	56,204	92.5%	8% excluded, not 1st CRC diagnosis based on FL incidence data from 1981 forward
3. Age = 50+	52,652	86.6%	6% excluded; age known
4. Cause of Death	52,643	86.6%	<1% excluded as autopsy cases
5. Sex Male or Female	52,628	86.6%	<1% excluded as Sex Unknown or Other
6. Tumors of mucus membrane lining only	50,544	83.1%	4% excluded as tumors of other tissues
7. Existing FIPS Code; geocoded to street	48,412	79.6%	4% excluded because geocoded to zipcode or higher or invalid FIPS Code
8. Reported by hospital or physician	47,195	77.6%	2% excluded (1,217 DCO)
9. Stage known	41,679	68.6%	9% excluded (5,516 stage unknown)

Table 4 shows the distribution of cases by stage and race/ethnicity. Due to the small number of cases and low population for American Indians, Asians, and Pacific Islanders in Florida, this study was restricted to Black and White race-specific analysis. Since analysis was conducted on aggregated block groups, analysis was restricted to Hispanic and Non-Hispanic White ethnicity-specific analysis because White Hispanic and Black Hispanic population data were not released below the Census tract level by the US Census Bureau for 2000 data. Race and ethnicity were not mutually exclusive categories, specifically; the Hispanic category includes all races, not just White Hispanics.

Table 4. Colorectal Cancer, Florida 1998-2002; Count and Percent of Cases Meeting Study Criteria by Stage and Race/Ethnicity

	Early		Late	
Race	Count	Percent	Count	Percent
Black	1,175	39%	1,806	61%
White	16,193	42%	21,996	58%
Ethnicity				
Hispanic	1,655	40%	2,516	60%
Non-Hispanic White	14,514	43%	19,440	57%

The distribution of the Florida population in each SES and Urban/Rural category is described in Appendix C. The distribution of the cases in each SES and Urban/Rural category is described in Appendix D. Table 5 shows the distribution of cases by SES level and race, ethnicity, and Urban/Rural status.

Table 5. Colorectal Cancer, Florida 1998-2002; Percent and Count of Cases Meeting Study Selection Criteria by Race/Ethnicity, Urban/Rural Status, and Designated SES Level

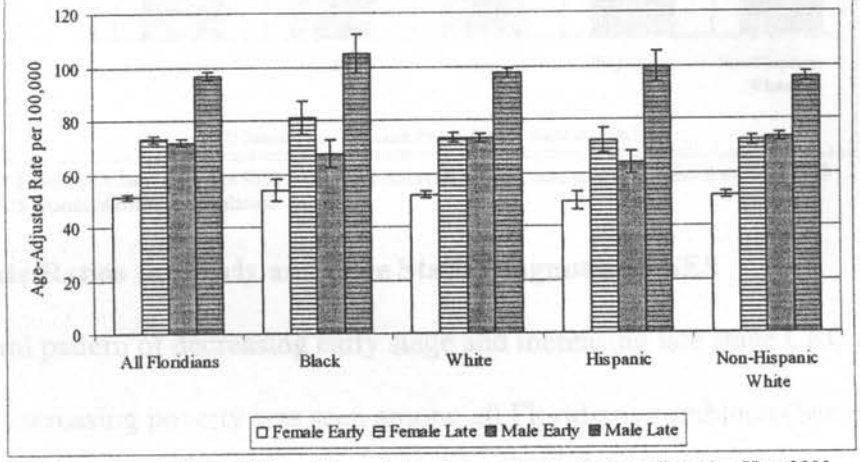
URBAN/RURAL STATUS AND SES LEVEL		RACE		ETHNICITY	
		White	Black	Hispanic	NH White
Urban	SES 4 (Highest)	27%	12%	16%	29%
	SES 3	35%	19%	23%	37%
	SES 2	25%	27%	31%	24%
	SES 1 (Lowest)	12%	42%	30%	10%
Total Case Count		40,210	3,145	4,671	35,501
Rural	SES 4 (Highest)	13%	10%	10%	14%
	SES 3	32%	26%	22%	32%
	SES 2	38%	42%	32%	38%
	SES 1 (Lowest)	17%	22%	36%	16%
Total Case Count		3,070	189	130	2,926

A. Stage-Specific Age-Adjusted Incidence Rates

Compared to early stage, the incidence of late stage CRC was higher for all sex, race and ethnicity categories (See Figure 2). Female rates for both early and late stage CRC incidence were lower than male rates. This held true for all race and ethnicity categories. Early stage incidence was higher for White men than Black men, and women of both races had similar rates of early stage incidence. Early stage incidence was also

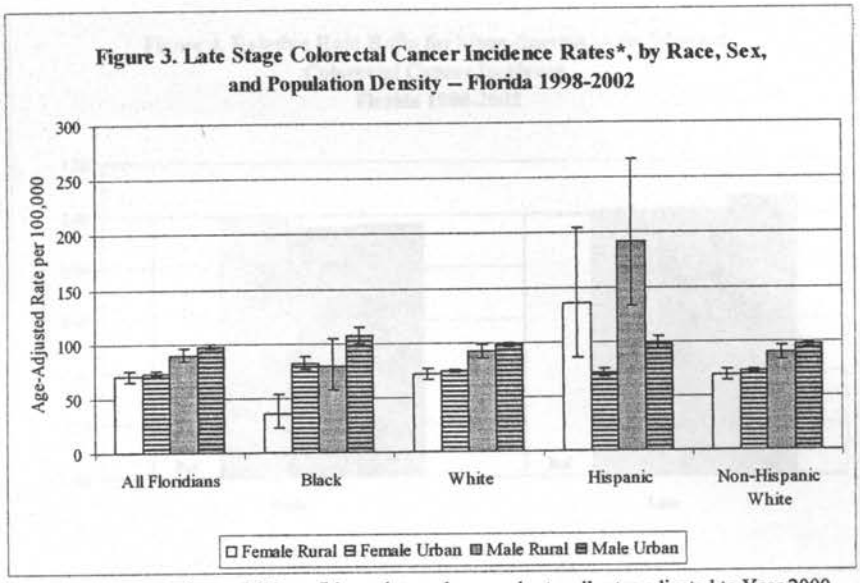
higher for Non-Hispanic Whites than Hispanics. However, late stage incidence rates for Whites were slightly lower than for Blacks, regardless of sex. The rates for Non-Hispanic Whites were slightly lower than Hispanics. This reversal indicates Blacks and Hispanics are at higher risk for a late stage CRC diagnosis than Whites and Non-Hispanic Whites.

Figure 2. Stage-Specific Colorectal Cancer Incidence Rates*, by Race and Sex – Florida 1998-2002



* Black error bars indicates 95% confidence intervals around rate, all rates adjusted to Year 2000 US Standard Million Population

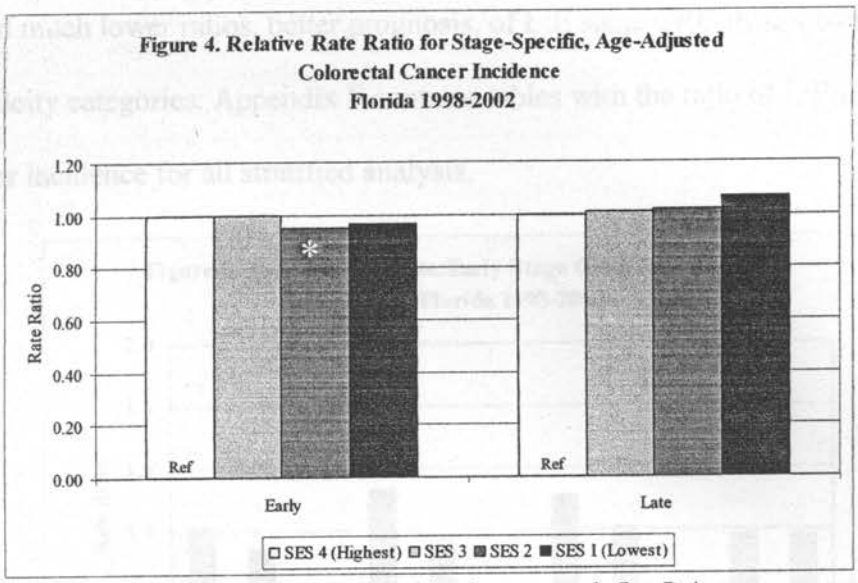
With the exception of Hispanic residents, the rates for rural residents were lower than for urban residents for late stage CRC (See Figure 3). The overall patterns by sex were the same for both urban and rural residents; men had higher rates of late stage cancers than women. These patterns by Urban/Rural status mirrored the early stage at diagnosis incidence rate patterns, although the early stage rates were lower than late stage rates for every category.



* Black error bars indicates 95% confidence intervals around rate, all rates adjusted to Year 2000 US Standard Million Population

B. Relative Rate Ratios for Early and Late Stage Diagnosis by SES

A general pattern of decreasing early stage and increasing late stage CRC incidence with increasing poverty was seen among all Floridians combined (See Figure 4). The two highest SES categories had similar rates of early stage diagnoses, which were slightly higher than the two lower SES categories. Although the differences between groups were small, the second poorest SES group had a statistically significantly higher relative rate ratio for early stage CRC compared to the wealthiest SES group. The relative rate ratio for late stage CRC increased marginally at each level of increasing poverty. The lowest SES group, compared to the highest SES group, had a statistically significant higher relative rate ratio of late stage CRC.



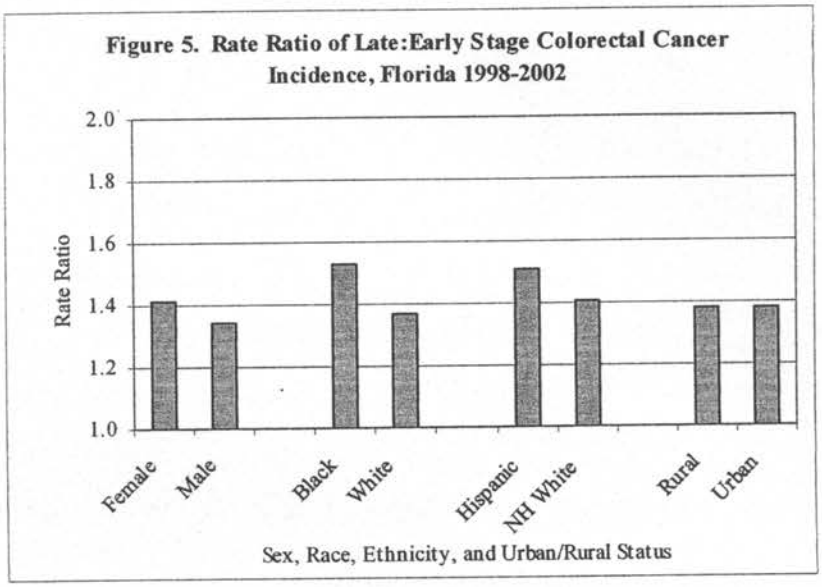
* Denotes statistical significance, SES 4 (Highest) is reference group for Rate Ratio

The incidence of early and late stage CRC varied by SES level and patterns differed by sex, race, ethnicity, and urban/rural status (See Appendix E for complete tables of relative rate ratios for all stratified analysis). In general, the rate of early stage cases decreased slightly with increasing poverty. For Urban White and Non-Hispanic White women, however, the highest rates of early stage CRC were in the poorest SES category. With the exception of rural residents, which demonstrated the reverse, late stage incidence rates increased slightly with increasing poverty. The increase in late stage rates with increasing poverty was greatest for urban residents and males. The lower SES categories for urban residents and males had slightly higher rates of late stage CRC that were statistically significant compared to the most affluent.

C. Rate Ratio of Age-Adjusted Rates for Late:Early Stage Colorectal Cancer

Women had a higher rate ratio of L:E stage CRC than men, indicating women had more late stage CRC diagnoses (See Figure 5). Blacks and Hispanics had a higher L:E stage ratio, and, therefore, poorer prognosis, compared to Whites and Non-Hispanic Whites. Rural and urban residents had a comparable ratio of L:E stage at diagnosis for CRC. This was driven by rural

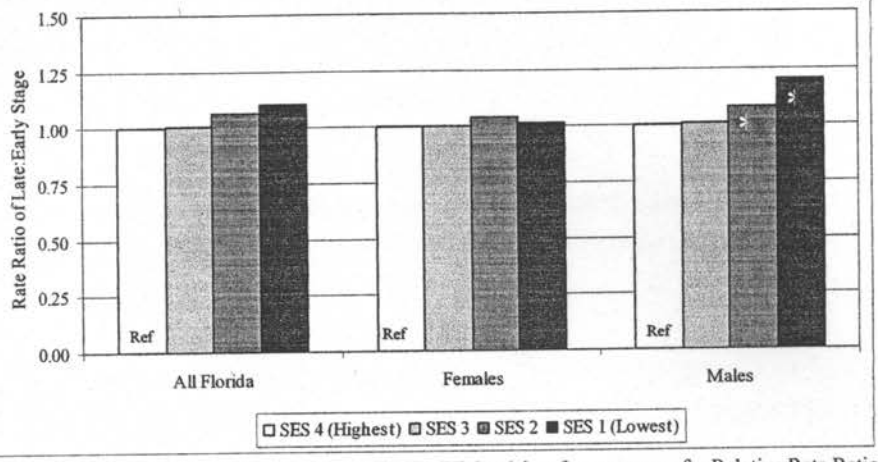
women who had much lower ratios, better prognosis, of L:E stage CRC than urban women for all race/ethnicity categories. Appendix F contains tables with the ratio of L:E stage colorectal cancer incidence for all stratified analysis.



D. Relative Rate Ratios for Ratio of Late to Early Stage Colorectal Cancer

For all Floridians combined, the risk of a late stage CRC diagnosis increased marginally with increasing poverty (See Figure 6). The lowest two SES groups for all Floridians combined had a statistically significantly higher relative rate ratio of L:E stage CRC incidence, signifying greater risk for late stage diagnosis, compared to the richest SES group. This was clearest for the men. There was no difference among the two highest SES group for women, and the second lowest SES group had a higher relative rate ratio for L:E stage than the poorest SES group. None of relative rate ratios for women were statistically significant compared to the highest, most affluent SES group. The poorest two SES groups for men had a statistically significantly higher relative rate ratio of L:E stage diagnoses than the upper SES group, indicating elevated risk of late stage CRC diagnosis compared to the wealthiest.

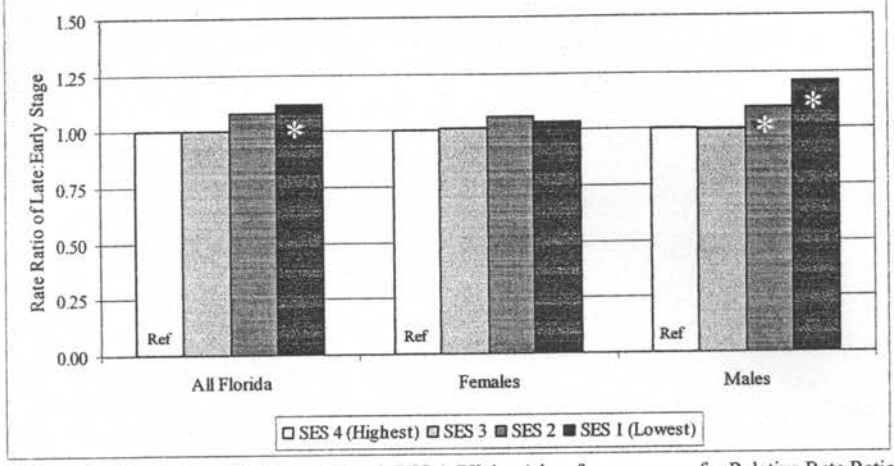
Figure 6. Relative Rate Ratio of Late:Early Stage Colorectal Cancer Incidence Rates by SES, Florida 1998-2002



* Denotes statistical significance at .05 level, SES 4 (Highest) is reference group for Relative Rate Ratios

The same patterns in relative rate ratios were seen among urban residents (See Figure 7). The two lowest SES categories for males and females combined had statistically significantly higher relative rate ratios for L:E stage CRC incidence compared to the highest SES group. The range of relative rate ratios was again smallest for women for all categories, and the second poorest SES category again had the highest relative rate ratio of L:E stage diagnoses compared to the richest SES group. No relative rate ratios for women in any of these categories were statistically significant. The range of rates for men was again larger than for women, and the poorest two SES categories had a statistically significantly higher relative rate ratio for L:E stage rates compared to the wealthiest SES group for men.

Figure 7. Relative Rate Ratio of Late:Early Stage Colorectal Cancer Incidence Rates by SES, Urban Residents, Florida 1998-2002



* Denotes statistical significance at .05 level, SES 4 (Highest) is reference group for Relative Rate Ratios

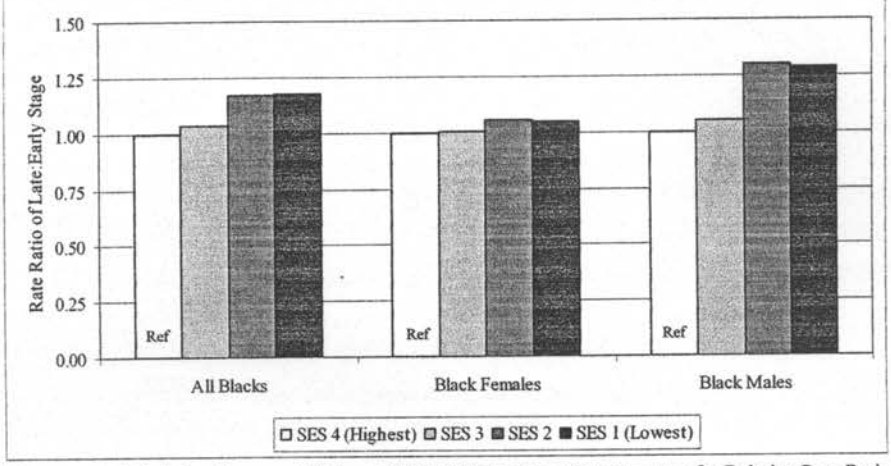
Similar patterns were seen for Whites, Non-Hispanic Whites and Urban Whites, and Urban Non-Hispanic Whites. The two lowest SES groups had a higher relative rate ratio of L:E stage diagnoses, representing an increase in risk of late stage diagnosis for the poorer SES groups. The difference in relative rate ratios between the SES groups was small for all categories but greater among urban residents and men. The relative rate ratios for rural residents, Blacks, and Hispanics did not follow these or any discernible patterns. Appendix F contains tables with relative rate ratios of L:E stage colorectal cancer incidence for all stratified analysis.

i. Relative Rate Ratios for Ratio of Late:Early Stage by Quartile SES

The *a priori* cut-points for establishing SES levels for Blacks showed inconsistent patterns. Driven by the low ratio for Black women, the second most affluent SES group had a statistically significantly lower relative rate ratio of L:E stage diagnosis, indicating a lower risk among those in second to highest SES group compared to the wealthiest SES group. However, the relative rate ratios of L:E stage CRC incidence calculated using SES levels based on quartiles of Black poverty percentages showed the same general patterns

seen among Whites and Non-Hispanic Whites. As seen for Whites and Non-Hispanic Whites, the range of difference was greater among men than women. The two lowest SES groups had a higher relative rate ratio of L:E stage CRC incidence, suggesting an increase

Figure 8. Incidence Rate Ratio of Late:Early Stage Colorectal Cancer, Urban Blacks, Quartile SES Groups, Florida 1998-2002



* Denotes statistical significance at .05 level, SES 4 (Highest) is reference group for Relative Rate Ratios

in risk of late stage diagnosis among the lower SES groups. The relative rate ratios among Black women were more similar by SES than for men. As seen with Whites and Non-Hispanic Whites, the differences in relative rate ratios were larger among urban residents and men (See Figure 8). However, even after adjustment of the greater burden of poverty among Blacks, none of the relative rate ratios of L:E stage were statistically significant. After adjustment, no pattern was distinguishable for rural Blacks.

Similar patterns were seen for Whites and Non-Hispanic Whites using both methods of creating SES levels, including the inconsistent pattern seen with rural residents. Unlike Blacks, Hispanics showed inconsistent patterns regardless of method used to create the SES levels. In general, the lower SES groups had higher relative rate ratios of L:E stage at diagnosis compared to the highest SES group for men. This broad pattern was reversed for women, the lower SES groups had lower relative rate ratios of

L:E stage at diagnosis. None of the relative rate ratios by SES were statistically significant for the Hispanic data. Patterns for the rural Hispanics could not be compared age-adjusted rates by SES could not be calculated using the *a priori* method due to small populations. Appendix G contains complete tables of the relative rate ratios of L:E stage CRC incidence using the quartile SES levels for Blacks and Hispanics.

IV. DISCUSSION

This study evaluated the relationship between community-level poverty and late stage at diagnosis of CRC in Florida. Because the rate of total invasive colorectal cancer varied by SES level, the relative rate ratio of L:E stage incidence was examined rather than the rate of late stage CRC alone. With the exception of rural residents, consistent patterns were found of an increasing relative rate ratio of L:E stage CRC for Whites and Non-Hispanic Whites with increasing poverty. The two poorest SES groups had a higher relative rate ratio of L:E stage diagnoses, indicating an increase in risk of late stage diagnosis among the lower SES groups. The differences in relative rate ratios were greater for urban residents and men. Additional analysis aimed at eliminating potential residual confounding caused by the amplified effects of poverty due to race showed similar patterns among Blacks as were seen among Whites and Non-Hispanics Whites. Yet even after adjusting for the higher percentage of Hispanics living in poverty than Non-Hispanic Whites, the Hispanic data did not demonstrate any relationship between SES and risk of late stage CRC. The data for rural residents also did not show any identifiable pattern for any of the stratified analysis. This study suggests that lower community-level SES is correlated with a marginal increased risk of late stage CRC diagnosis in Florida, with the exception of rural residents and Hispanics. This finding is

fairly consistent with the literature. This study confirms previous findings from published studies conducted in the Europe and the United States.[19,20,39,40] However, at least one European study found no correlation between impoverished communities and CRC diagnosed at a late stage.[41]

Consistent with other studies, women had a higher ratio of L:E stage at diagnosis for CRC than men.[18] However, the relationship between community-level poverty and late stage diagnosis was less clear for women than for men. None of the relative rate ratios for the L:E stage diagnoses by SES were statistically significant for women. The second lowest SES group, not the poorest, consistently had the highest relative rate ratio compared to the highest SES group for women. This is a pattern potentially driven by access to services. Poorest persons with access to welfare medical services have the opportunity to receive routine health screening. But the near poor, those just above the poverty line and still by most definitions highly deprived, are likely ineligible for Medicaid or other welfare medical services. Better access to screening may explain why the most poverty-stricken SES group for women fares better than the second poorest SES group.

The same pattern is not seen among men, which may be due to poor women being more likely to seek available care than poor men. In addition to Medicaid, there are a number of health services directed specifically towards low-income women, including family planning services and breast and cervical cancer screening services. Women already in the health care system for these services perhaps are more likely to seek health care than men living in similar communities.[42]

The literature on CRC and rural residents is inconsistent. Contrary to previously published studies which indicate rural residents are at increased risk of late stage diagnosis,[26] this study found that rural residents had a similar ratio of L:E stage at diagnosis for CRC compared to urban residents. Numerous studies have focused on distance from services and quality of services as a cause of the increased late stage diagnoses and decreased survival in rural areas.[26,43] Long or difficult distances to services or a shortage of providers are significant risk factors for late stage cancers, including CRC.[44] These, and other rural specific characteristics, may not be as relevant for such a densely populated state as Florida. These results are consistent with a recent study in California which indicated that rural residents were not at increased risk of a late stage CRC diagnosis.[45] The same study also did not show a relationship between community SES and stage at diagnosis for CRC for rural residents.[45]

Although this study was consistent with prior research indicating Hispanics are at a greater risk of late stage CRC,[46] a relationship between community SES and stage at diagnosis for CRC for Hispanics was not seen. Although the smallest level of Census geography was used to achieve greatest community uniformity, grouping together the diverse ethnic group of Hispanics may have limited the utility for this population. Hispanics, particularly in South Florida where the majority reside, are a heterogeneous group with numerous countries of origin and a wide range of educational achievement, average income, and percent living below the poverty level. Level of acculturation, language isolation, and other immigrant issues may be more important than the SES level in the health outcomes observed for some of these groups. Additional stratified analysis by Hispanic Whites, Hispanic Blacks, and Non-Hispanic Blacks may provide insight into

the relationship between community-level poverty and late stage at diagnosis for CRC, but that is beyond the scope of this study. Rates can not be calculated for these groups at the block group level due to the unavailability of US Census socioeconomic data at that level.

This study looked at a single measure of SES, percentage living below the poverty level. Although this is an easily accessible variable that has been tested for validity for community-level SES and health outcome studies, particularly over education level or occupational status,[47] the scale of inequality among population groups is another significant factor in health outcomes.[15,48] Findings have suggested that mortality rates increase not only with increasing poverty but also as the gap between the rich and the poor increases.[48,49] The Southeastern United States, including Florida, is an area of high income inequality.[48] Due to such heterogeneity of income and other variables, area-based measures of SES tend to underestimate associations.[13,17] Therefore, it is likely that the association between SES and the ratio of L:E stage CRC is underestimated in this study.

There were a number of risks for late stage CRC for which adjustment was not possible. These include access to medical care, pre-existing medical conditions, and modifiable risk behaviors. Although analysis was conducted separately based on population density, sex, and race/ethnicity, the study did not focus on other predictors, such as screening behavior and type of screening test. Risks such as lifestyle and diet were not considered in this analysis because the data were not available at either the individual or community level. There were also a number of disease- and screening-related factors for which adjustment was not possible. Although the analysis focused on

the ratio of L:E stage within each SES level, to account for unequal CRC risk by SES, some of these risk factors could have influenced the results.

For instance, diabetes has been associated with increased CRC risk in many studies.[50] Diabetes prevalence is higher in the poorer SES groups and higher among Blacks than Whites and higher among Hispanics than non-Hispanic Whites.[50,51,52] Lower income is associated more strongly with higher diabetes rates than other SES variables, such as education level and occupation.[53,54] Persons who are already in the medical system for diabetes may be more likely to receive additional medical services, such as CRC screening.[42] One study reported a slightly higher prevalence of co-morbidities for patients diagnosed with an early stage than a late stage CRC.[55] Because lower income persons are at increased risk of diabetes they are, therefore, potentially offered more routine screening. Since routine screening will increase the percentage of early stage diagnosis through early detection, it is likely that the association between SES and the ratio of L:E stage CRC is underestimated in this study.

Familial risk that is not genetic but modifiable due to environmental exposures or other modifiable factors, such as diet, may be associated with SES. Some behaviors, such as tobacco and alcohol use, increase risk for CRC incidence while some, such as daily aspirin use[56,57] and vitamin D[58] uptake, are potential protective factors. While tobacco use increases with increasing poverty,[12] other dietary factors and alcohol use do not follow the same gradient. Alcohol use is high at both ends of the economic scale (highest among the wealthy and second highest among the poor)[12] which increases the risk of CRC for both these groups. Other dietary factors, such as high vegetable consumption, favor the upper class.[12] But since these factors influence risk of total CRC not late stage CRC, it is

likely the omission of tobacco and alcohol use and diet as risk factors did not significantly alter the results.

Vitamin D is a supplement of interest for CRC. Potentially because higher vitamin D levels promote apoptosis, or "cell suicide", in the colorectal mucosa, higher vitamin D levels may reduce CRC risk.[58] Vitamin D may also delay the progression of disease.[58] Sun exposure is the most common method of obtaining vitamin D, so individuals who have high sun exposure may be at a lower risk of CRC and late stage CRC. Those who have outdoor occupations, like groundskeepers, gardeners, agricultural workers, or forestry workers, will likely have high sun exposures. These jobs are often low paying and have a lower SES ranking than most indoor office workers.[59] So, the lower income groups may have higher sun exposures, and subsequently higher vitamin D uptake, than higher income groups. Since vitamin D may delay the progression of CRC, populations with increased sun exposure may have a decreased risk of late stage CRC. Therefore, increased sun exposure among the lower SES groups may have lessened the relationship of community-level SES and late stage CRC.

Additionally, CRC rates for particular sub-sites along the colon and rectum have different geographic, demographic and other risk factors.[60] A recent study indicated a strong correlation between county-level poverty and a late stage at diagnosis for proximal (right colon) CRC but not distal (left colon) or rectal cancers for Whites.[39] Colonoscopy and barium enema are the only exams likely to identify disease in the right colon. Insurance status and type may also impact the type of test used, for instance Medicare now covers colonoscopy. In recent years, CRC screening has been increasing due to increased public awareness; President Ronald Reagan's diagnosis may have prompted the

faster national rise in colonoscopy among men from 1987 to 2000 and Katie Couric's campaign likely prompted the recent rise in colonoscopy among women and younger individuals from 2000 forward.[61] Women, the elderly, and minorities are at increased risk of CRC in the proximal colon,[62,63,64] and right-sided CRC is more likely to be diagnosed at a late stage.[39,65] Patients with left-sided CRC become symptomatic sooner, i.e. cramping or bowl obstruction occurs earlier in proximal CRC than distal, prompting patients to seek medical care earlier and leading to earlier diagnoses.[66,67] The ratio of distal to proximal (left to right colon) CRC changes with age with the likelihood of a proximal colon cancer diagnosis increasing with increasing age. This would limit the utility of flexible sigmoidoscopy for older adults as well as Blacks of all ages.[64] The stronger relationship between community-level poverty and L:E CRC incidence for White men may be reflecting the appropriateness of screening modalities used based on sex, race and age.

A. Study Limitations

There are a number of limitations that need to be considered when interpreting the results of this study. Because of a lack of staging information, nearly 7,000 cases (14% of total) had to be excluded from the analysis. The exclusion was not evenly distributed by SES, and the lack of staging information also affected the Hispanics and rural residents disproportionately. This may have reduced the SES effect for the following reasons.

For cases of unknown stage, the variations in rates follow most of the patterns seen for invasive CRC rates by sex and rural/urban status; i.e. males higher than females and urban higher than rural populations (See Appendix I). However, while Hispanics have the lowest overall rate of invasive CRC, Hispanics have the highest percentage of

cases diagnosed at an unknown stage and a higher rate of unstaged cases than other race/ethnicity groups. DCO cases, those incident cancer cases with the only information supplied to the registry from the death certificate, are an additional source of cases lacking staging information. Rural residents have higher rates of DCO cases than urban residents; yet rural residents have lower rates of total invasive CRC than urban residents. Since early stage CRC is generally treatable, it is likely that many of these DCO deaths represent individuals who were diagnosed at a later stage. The rates of DCO cases were statistically higher in the lower SES groups compared to the highest SES group (See Appendix J) and potentially more likely to be a late stage cancer. The percentage of cases of unknown stage that are still alive is similar to the percentage of cases of late stage that are still alive (See Table 6), so it is plausible that the majority of the cases of unknown stage were diagnosed at a late stage.

Table 6. Stage at Diagnosis for Colorectal Cancer and Vital Status; Florida Cases Diagnosed 1998-2002

	Status*	
Stage at Diagnosis	**Alive**	**Dead**
Early	91%	9%
Late	76%	24%
Unknown	78%	22%

*Vital Status as of December 31, 2005;
Cases diagnosed through death certificate only are excluded

The exclusion of these unstaged cases may have artificially inflated the proportion of L:E stage diagnoses, resulting in a higher ratio of early stage for rural residents and Hispanics. This may have contributed to the lack of pattern seen among the rural resident and Hispanic data resulting in a lower association seen between SES and stage at diagnosis of CRC.

Additional limitations lie with the design of the study. For instance, the accuracy of the geocoded cases, potential differences in the ungeocoded cases, and the reliability

of the address at diagnosis to represent a person's lifetime history of SES are study limitations. However, this type of ecological approach, and the selection of SES variable, has been demonstrated to be a valid design by a number of studies.[13,29,30]

Finally, ecological fallacy, due to community-level characteristics failing to represent individual-level characteristics, is generally a limitation for ecological studies. However, this method does not use the block group variables as a proxy for individual-level health; rather it describes community-level risks and community-level outcomes. So, ecological fallacy may be a limited issue.[68] A related problem is MAUP (Modifiable Arial Unit Problem). MAUP is a two-fold problem with aggregated data sets—that the analysis results may change with aggregation. One is the scale effect—different results can be obtained at different levels of aggregation, i.e., Census tracts versus block groups.[69] But since this study used the smallest, most homogenous, level of Census geography possible, it is likely that the results of block groups, compared to Census tracts, more accurately reflects the health status of the underlying population. Another is the zoning effect—different results can be obtained based on the arbitrary boundaries of aggregation.[69] However, this problem is likely small because geographically adjunct areas were not necessarily combined—analysis was done on groupings of block groups based on SES level and not geographic proximity.

V. CONCLUSION

Excluding rural residents, for Whites, Non-Hispanic Whites, and Blacks (after adjusting for the higher percentage of poverty among Blacks), the two poorer SES groups consistently showed a lower ratio of L:E stage CRC, i.e. were at higher risk of a late stage CRC diagnosis, than the two richer SES groups. A slight increase in risk of late stage

CRC with each SES level was seen most clearly with the male and urban resident data where the rate ratios of the poorer SES groups were statistically significantly lower than the richest SES group.

The general pattern of increasing ratio of L:E stage CRC diagnosis with increasing poverty was replicated in multiple groups using multiple cut-points which strengthens the association. Excluding the Hispanic and rural resident results, the overall pattern seen in the data was the two highest SES groups consistently had lower ratios of L:E stage CRC diagnoses than the two lower SES groups regardless of race or gender.

Neighborhood poverty is a biologically plausible risk factor for both individual and population based health. Community-level poverty represents a composite relationship that is interdependent with other risks such as environmental, economic, medical access, psychosocial, historic, and political systems.[13,17] Poverty is generally related to education level and may impede access to screening and other medical services. Poverty also represents a host of multifaceted interactions that influence medical access, screening attitudes, and environmental and modifiable risk factors that contribute to the health of these communities.

Although the strength of the association between community-level poverty and late stage CRC in Florida was low, this is still a potentially important result because it was a population-based study of a common cancer. Due to a number of factors, including income heterogeneity of a population and temporal change, area-based measures of SES tend to underestimate associations.[13] Yet even small increases in risk can result in a large number of cases for common diseases, such as CRC.

Because this was a population based study, there were a number of individual-level factors that likely affected the results. However, those effects more likely diminished the strength of the association rather than accentuated it. While all groups would benefit from increased screening, poor urban communities may potentially benefit the most. The identification of individuals at risk based on the SES of the community in which they reside is easy and can be achieved using free and readily available Census data. Combining these data with additional freely available data such as the Consumer Health Profiles from the Cancer Information Service program at the National Cancer Institute can guide appropriate targeting strategies for these populations. Targeting such communities for enhancing screening efforts should be incorporated in public health policy.

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VII. Appendices

Appendix A – Quartiles for Additional Race Analysis

Blacks	Percent Living in Poverty
SES 4 (Highest)	0%
SES 3	0-13.9%
SES 2	14-34.9%
SES 1 (Lowest)	>35%

Whites	Percent Living in Poverty
SES 4 (Highest)	<3.9%
SES 3	4-8.9%
SES 2	9-14.9%
SES 1 (Lowest)	>15%

Hispanics	Percent Living in Poverty
SES 4 (Highest)	0%
SES 3	0-9.9%
SES 2	10-26.9%
SES 1 (Lowest)	>27%

Non-Hispanic Whites	Percent Living in Poverty
SES 4 (Highest)	<3.9%
SES 3	4-7.9%
SES 2	8-13.9%
SES 1 (Lowest)	>14%

Appendix B – Year 2000 US Population Standard Million and Age-Adjusted Rates

Age-standardization, or age-adjustment, is a method for adjusting a rate for age. The age-adjusted rates are calculated to allow comparisons between two different populations whose age distributions differ. This is particularly important when calculating cancer rates since increasing age is the most important risk factor for most cancers. The age-adjusted rate is a hypothetical rate that would have been observed in the population studied had the same age-distribution as a pre-defined standard population. Since in 1999, all United States vital statistics data are required to be calculated using the Year 2000 US Standard Million for age-adjusting rates to allow national comparisons.

In the direct method of age-adjusting, each age-specific rate (a crude rate for each age-group) is multiplied by weights from the Year 2000 US Standard Million population, the percentage of the population within each age group (See Table AB1). Rates age-adjusted to the same standard can be compared and any potential differences would be irrespective of age.

Table AB1. US Year 2000 Standard Million Population and Weights for Age-adjusting

Age Group	Year 2000 US Standard Million	Weight For Direct Standardization	Weight for 50+ Age-Group Standardization
00 years	13,818	1.4%	
01-04 years	55,317	5.5%	
05-09 years	72,533	7.3%	
10-14 years	73,032	7.3%	
15-19 years	72,169	7.2%	
20-24 years	66,478	6.6%	
25-29 years	64,529	6.5%	
30-34 years	71,044	7.1%	
35-39 years	80,762	8.1%	
40-44 years	81,851	8.2%	
45-49 years	72,118	7.2%	
50-54 years	62,716	6.3%	22.7%
55-59 years	48,454	4.8%	17.5%
60-64 years	38,793	3.9%	14.0%
65-69 years	34,264	3.4%	12.4%
70-74 years	31,773	3.2%	11.5%
75-79 years	26,999	2.7%	9.8%
80-84 years	17,842	1.8%	6.5%
85+ years	15,508	1.6%	5.6%

Appendix C – Distribution of Florida Population by SES and Urban/Rural Status

Table AC1 shows the distribution of the Florida population in each SES and Urban/Rural category for the total Florida population as well as for those aged 50 and above. Some block groups could not be assigned an SES level (60 of 9112) due to information lacking from the Census. These 60 block groups are located in the sparsely populated Everglades and Lake Okeechokee areas and no poverty determination could be made. However, there were no cases in these block groups, and the population was negligible.

Table AC1. Distribution of Florida Population by SES and Urban/Rural Status

	Urban		Rural	
Total Florida Population	**Count**	**Percent**	**Count**	**Percent**
SES 4 (Highest)	3,537,264	25%	160,242	13%
SES 3	4,331,172	30%	322,561	26%
SES 2	3,719,696	26%	531,118	43%
SES 1 (Lowest)	2,767,987	19%	235,327	19%
	Urban		**Rural**	
Persons Aged 50+	**Count**	**Percent**	**Count**	**Percent**
SES 4 (Highest)	12,1181	29%	6,230	14%
SES 3	12,9966	31%	11,955	26%
SES 2	10,2821	24%	19,263	43%
SES 1 (Lowest)	6,8324	16%	7,864	17%

Appendix D – Distribution of CRC Cases by SES and Urban/Rural Status

Because poverty status is derived from data from the Census long form which was administered to a sample of the US population, it was not determined for all residents included in the Census. For rural Hispanics, one block group contained incidence data but no population data from the Census for a specific age-group. This could have also occurred if the case was incorrectly geocoded or incorrectly coded by race or ethnicity. Or this could occur if a resident recently moved into an area after the Census was conducted but before their diagnosis of CRC. This resulted in the removal of one Rural Hispanic case from the analysis.

Quartile cut-points for the race/ethnicity specific SES levels are listed in Appendix A. Because the quartile method was race and ethnicity specific, sometimes Census data were unavailable for block groups sparsely populated by the race or ethnicity of interest. This resulted in some block groups containing case level data but SES level could not be determined. These cases were removed from the analysis (21 cases of 43,280 for Whites (>1%), 211 cases of 3,334 for Blacks (6%), 62 cases of 4,801 for Hispanics (1%), and 62 cases of 38,427 for Non-Hispanic Whites (<1%). Of the excluded cases, a higher percentage were early stage cases than the cases with a designated race/ethnicity SES level (10% more early stage for Whites; 4% more for Blacks and Hispanics) except for Non-Hispanic Whites which had a 4% increase in cases diagnosed at an unknown stage.

Table AD1 shows the distribution of the Florida population into the SES levels comparing *a priori* cut points and race/ethnicity specific quartiles. The general affect was

to move population from the middle SES categories to the highest SES category for urban residents and to the highest and lowest SES categories for the rural residents.

Because block groups with no persons living below poverty were classified as SES Level 4, the quartiles do not each equal 25%. Additionally, the quartiles were based on the number of block groups not population. So the actual population did not reflect the block group distribution, particularly for rural residents and Hispanics.

Table AD1. Distribution of Florida Population by *a priori* and Quartile SES Levels

		RACE				ETHNICITY			
		White		Black		Hispanic		Non-Hispanic White	
		A Priori	Quartiles	*A Priori*	Quartiles	*A Priori*	Quartiles	*A Priori*	Quartiles
Urban	SES 4 (Highest)	23%	26%	23%	35%	23%	36%	23%	26%
	SES 3	26%	25%	26%	15%	26%	14%	26%	26%
	SES 2	26%	24%	26%	25%	26%	26%	26%	24%
	SES 1 (Lowest)	25%	25%	25%	25%	25%	24%	25%	24%
Total Population Count		11,126,409		2,104,779		2,556,652		9,198,660	
Rural	SES 4 (Highest)	18%	20%	18%	34%	18%	49%	18%	19%
	SES 3	21%	21%	21%	11%	21%	6%	21%	20%
	SES 2	40%	32%	40%	27%	40%	12%	40%	31%
	SES 1 (Lowest)	21%	26%	21%	27%	21%	32%	21%	30%
Total Population Count		1,090,757		99,259		77,339		1,043,528	

Table AD2. Distribution of Colorectal Cases by *a priori* and Quartile SES Levels

		RACE				ETHNICITY			
		White		Black		Hispanic		Non-Hispanic White	
		A Priori	Quartiles	*A Priori*	Quartiles	*A Priori*	Quartiles	*A Priori*	Quartiles
Urban	SES 4 (Highest)	27%	27%	12%	17%	16%	8%	29%	24%
	SES 3	35%	33%	19%	20%	23%	25%	37%	35%
	SES 2	25%	25%	27%	38%	31%	48%	24%	27%
	SES 1 (Lowest)	12%	15%	42%	25%	30%	19%	10%	14%
	Total Case Count	40,210	40,189	3,145	2,966	4,671	3,120	35,501	35,444
Rural	SES 4 (Highest)	13%	15%	10%	20%	10%	14%	14%	13%
	SES 3	32%	28%	26%	17%	22%	17%	32%	25%
	SES 2	38%	35%	42%	38%	32%	24%	38%	38%
	SES 1 (Lowest)	17%	22%	22%	24%	36%	45%	16%	24%
	Total Case Count	3,070	3,070	189	157	130	88	2,926	2,921

Appendix E – Relative Rate Ratios Early and Late Stage CRC Incidence

Table AE1. Relative Rate Ratios for Early and Late Stage Colorectal Cancer: All Floridians

	SES	Early Stage	95% CI Lower	95% CI Upper	Late Stage	95% CI Lower	95% CI Upper
All Floridians	4 (High)	1.00			1.00		
	3	1.00	0.96	1.04	1.01	0.98	1.04
	2	0.95*	0.92	0.98	1.02	0.98	1.05
	1 (Low)	0.97	0.92	1.01	1.07*	1.03	1.11
Females	4 (High)	1.00			1.00		
	3	1.00	0.94	1.06	1.00	0.95	1.05
	2	0.97	0.93	1.01	1.01	0.96	1.06
	1 (Low)	1.04	0.97	1.11	1.05	0.99	1.12
Males	4 (High)	1.00			1.00		
	3	1.02	0.96	1.07	1.03	0.98	1.08
	2	0.96*	0.92	1.00	1.03	0.98	1.08
	1 (Low)	0.93	0.87	1.00	1.12*	1.06	1.19
Rural	4 (High)	1.00			1.00		
	3	1.01	0.84	1.22	1.07	0.91	1.26
	2	0.84*	0.72	0.99	0.82*	0.70	0.96
	1 (Low)	0.86	0.70	1.06	0.83*	0.69	0.99
Rural Females	4 (High)	1.00			1.00		
	3	1.16	0.87	1.53	1.03	0.81	1.30
	2	0.90	0.71	1.13	0.84	0.67	1.05
	1 (Low)	0.98	0.72	1.32	0.78	0.60	1.02
Rural Males	4 (High)	1.00			1.00		
	3	0.88	0.68	1.15	1.09	0.87	1.36
	2	0.81	0.65	1.00	0.79*	0.63	0.99
	1 (Low)	0.75*	0.56	1.00	0.87	0.67	1.12
Urban	4 (High)	1.00			1.00		
	3	1.00	0.96	1.04	1.00	0.97	1.04
	2	0.96*	0.93	0.99	1.04*	1.01	1.08
	1 (Low)	0.98	0.93	1.03	1.09*	1.05	1.14
Urban Females	4 (High)	1.00			1.00		
	3	0.99	0.93	1.05	1.00	0.95	1.05
	2	0.98	0.93	1.02	1.03	0.98	1.09
	1 (Low)	1.05	0.97	1.12	1.08*	1.02	1.15
Urban Males	4 (High)	1.00			1.00		
	3	1.03	0.97	1.08	1.02	0.97	1.07
	2	0.98	0.94	1.02	1.07*	1.01	1.12
	1 (Low)	0.95	0.88	1.02	1.15*	1.08	1.22

* Denotes statistical significance

Table AE2. Relative Rate Ratios for Early and Late Stage Colorectal Cancer: Blacks

	SES	Early Stage	95% CI Lower	95% CI Upper	Late Stage	95% CI Lower	95% CI Upper
Blacks	4 (High)	1.00			1.00		
	3	0.94	0.75	1.17	0.62*	0.52	0.75
	2	0.53*	0.44	0.63	0.56*	0.47	0.66
	1 (Low)	0.39*	0.32	0.48	0.36*	0.31	0.43
Black Females	4 (High)	1.00			1.00		
	3	1.14	0.84	1.56	0.60*	0.47	0.77
	2	0.61*	0.47	0.79	0.56*	0.45	0.70
	1 (Low)	0.45*	0.34	0.61	0.36*	0.29	0.44
Black Males	4 (High)	1.00			1.00		
	3	0.76	0.55	1.06	0.63*	0.48	0.83
	2	0.47*	0.36	0.61	0.53*	0.41	0.68
	1 (Low)	0.33*	0.25	0.45	0.36*	0.29	0.46
Rural Blacks	4 (High)	1.00			1.00		
	3	1.70	0.72	4.02	0.80*	0.37	1.72
	2	0.85	0.41	1.79	0.63*	0.31	1.28
	1 (Low)	0.61	0.25	1.47	0.40*	0.18	0.86
Rural Black Females	4 (High)	1.00			1.00		
	3	1.26	0.23	6.74	0.52	0.13	2.03
	2	0.45	0.11	1.86	0.21*	0.06	0.78
	1 (Low)	0.67	0.14	3.25	0.31	0.09	1.12
Rural Black Males	4 (High)	1.00			1.00		
	3	0.92	0.29	2.96	1.03	0.32	3.27
	2	0.64	0.26	1.60	0.70	0.24	2.09
	1 (Low)	0.50	0.16	1.58	0.74	0.24	2.26
Urban Blacks	4 (High)	1.00			1.00		
	3	0.90	0.72	1.13	0.62*	0.51	0.74
	2	0.51*	0.43	0.62	0.57*	0.48	0.67
	1 (Low)	0.38*	0.31	0.47	0.36*	0.31	0.42
Urban Black Females	4 (High)	1.00			1.00		
	3	1.07	0.77	1.47	0.60*	0.46	0.77
	2	0.57*	0.44	0.75	0.56*	0.45	0.71
	1 (Low)	0.44*	0.33	0.59	0.36*	0.29	0.45
Urban Black Males	4 (High)	1.00			1.00		
	3	0.76	0.54	1.07	0.62*	0.46	0.82
	2	0.47*	0.36	0.61	0.54*	0.41	0.70
	1 (Low)	0.33*	0.24	0.44	0.35*	0.27	0.45

* Denotes statistical significance

Table AE3. Relative Rate Ratios for Early and Late Stage Colorectal Cancer: Whites

	SES	Early Stage	95% CI Lower	95% CI Upper	Late Stage	95% CI Lower	95% CI Upper
Whites	4 (High)	1.00			1.00		
	3	1.00	0.96	1.04	1.02	0.99	1.06
	2	0.98	0.95	1.01	1.04*	1.00	1.07
	1 (Low)	1.11*	1.05	1.17	1.22*	1.17	1.28
White Females	4 (High)	1.00			1.00		
	3	0.99	0.94	1.05	1.02	0.97	1.07
	2	0.99	0.94	1.03	1.03	0.98	1.09
	1 (Low)	1.19*	1.10	1.29	1.21*	1.13	1.29
White Males	4 (High)	1.00			1.00		
	3	1.03	0.97	1.08	1.04	0.99	1.09
	2	0.99	0.95	1.03	1.05*	1.00	1.11
	1 (Low)	1.07	0.99	1.15	1.27*	1.19	1.35
Rural Whites	4 (High)	1.00			1.00		
	3	1.00	0.82	1.21	1.08	0.92	1.27
	2	0.86	0.73	1.00	0.82	0.70	0.96
	1 (Low)	0.92	0.74	1.14	0.87	0.72	1.05
Rural White Females	4 (High)	1.00			1.00		
	3	1.10	0.83	1.47	1.05*	0.82	1.33
	2	0.89	0.70	1.13	0.83	0.66	1.06
	1 (Low)	1.03	0.75	1.41	0.86	0.65	1.13
Rural White Males	4 (High)	1.00			1.00		
	3	0.90	0.68	1.18	1.09	0.86	1.37
	2	0.83	0.66	1.04	0.79	0.63	1.00
	1 (Low)	0.78	0.58	1.06	0.89	0.68	1.16
Urban Whites	4 (High)	1.00			1.00		
	3	1.00	0.96	1.05	1.02	0.98	1.06
	2	0.99	0.96	1.02	1.06*	1.02	1.11
	1 (Low)	1.13*	1.07	1.20	1.27*	1.21	1.33
Urban White Females	4 (High)	1.00			1.00		
	3	0.99	0.93	1.05	1.02	0.97	1.07
	2	1.00	0.95	1.04	1.06	1.00	1.12
	1 (Low)	1.22*	1.12	1.32	1.26	1.18	1.35
Urban White Males	4 (High)	1.00			1.00		
	3	1.03	0.98	1.09	1.03	0.98	1.08
	2	1.01	0.97	1.05	1.09*	1.03	1.15
	1 (Low)	1.10*	1.02	1.20	1.32*	1.24	1.41

* Denotes statistical significance

Table AE4. Relative Rate Ratios for Early and Late Stage Colorectal Cancer: Hispanics

	SES	Early Stage	95% CI Lower	95% CI Upper	Late Stage	95% CI Lower	95% CI Upper
Hispanics	4 (High)	1.00			1.00		
	3	0.72*	0.61	0.84	0.90	0.79	1.03
	2	0.78*	0.69	0.88	0.79*	0.70	0.90
	1 (Low)	0.84*	0.72	0.97	0.91	0.80	1.03
Hispanic Females	4 (High)	1.00			1.00		
	3	0.84	0.66	1.05	0.83*	0.69	0.99
	2	0.87	0.73	1.04	0.78*	0.66	0.93
	1 (Low)	0.93	0.75	1.16	0.85	0.72	1.02
Hispanic Males	4 (High)	1.00			1.00		
	3	0.61*	0.48	0.78	0.95	0.79	1.15
	2	0.69*	0.58	0.83	0.78*	0.65	0.94
	1 (Low)	0.75*	0.61	0.94	0.96	0.80	1.16
Urban Hispanics	4 (High)	1.00			1.00		
	3	0.72*	0.61	0.84	0.90	0.79	1.02
	2	0.77*	0.68	0.87	0.79*	0.69	0.89
	1 (Low)	0.83*	0.71	0.97	0.89*	0.79	1.02
Urban Hispanic Females	4 (High)	1.00			1.00		
	3	0.82	0.65	1.03	0.83	0.69	1.00
	2	0.86	0.72	1.03	0.78*	0.66	0.93
	1 (Low)	0.91	0.73	1.14	0.85	0.71	1.01
Urban Hispanic Males	4 (High)	1.00			1.00		
	3	0.63*	0.49	0.80	0.94	0.78	1.15
	2	0.68*	0.57	0.81	0.77*	0.64	0.93
	1 (Low)	0.76*	0.61	0.95	0.94	0.78	1.13

* Denotes statistical significance

Table AE5. Relative Rate Ratios for Early and Late Stage Colorectal Cancer: Non-Hispanic Whites

	SES	Early Stage	95% CI Lower	95% CI Upper	Late Stage	95% CI Lower	95% CI Upper
Non-Hispanic Whites	4 (High)	1.00			1.00		
	3	1.02	0.98	1.07	1.03	0.99	1.06
	2	0.99	0.96	1.02	1.06*	1.01	1.10
	1 (Low)	1.15*	1.08	1.22	1.24*	1.18	1.31
Non-Hispanic White Females	4 (High)	1.00			1.00		
	3	1.00	0.94	1.06	1.03	0.98	1.08
	2	0.99	0.95	1.04	1.05	0.99	1.11
	1 (Low)	1.22*	1.12	1.33	1.24*	1.15	1.33
Non-Hispanic White Males	4 (High)	1.00			1.00		
	3	1.06	1.00	1.12	1.03	0.98	1.09
	2	1.01	0.97	1.06	1.07*	1.01	1.13
	1 (Low)	1.12*	1.03	1.22	1.28*	1.19	1.38
Rural Non-Hispanic Whites	4 (High)	1.00			1.00		
	3	0.99	0.82	1.21	1.07	0.91	1.27
	2	0.83*	0.70	0.97	0.81*	0.69	0.96
	1 (Low)	0.88	0.71	1.10	0.81*	0.67	0.98
Rural Non-Hispanic White Females	4 (High)	1.00			1.00		
	3	1.08	0.81	1.45	1.05	0.82	1.34
	2	0.85	0.67	1.09	0.83	0.65	1.06
	1 (Low)	0.96	0.69	1.32	0.81	0.61	1.08
Rural Non-Hispanic White Males	4 (High)	1.00			1.00		
	3	0.91	0.69	1.20	1.07	0.85	1.35
	2	0.80	0.64	1.01	0.78*	0.62	0.98
	1 (Low)	0.78	0.57	1.06	0.82	0.62	1.08
Urban Non-Hispanic Whites	4 (High)	1.00			1.00		
	3	1.02	0.98	1.07	1.02	0.98	1.06
	2	1.02	0.98	1.05	1.09*	1.05	1.14
	1 (Low)	1.20*	1.13	1.28	1.33*	1.26	1.40
Urban Non-Hispanic White Females	4 (High)	1.00			1.00		
	3	0.99	0.93	1.06	1.03	0.98	1.09
	2	1.01	0.96	1.05	1.08*	1.02	1.15
	1 (Low)	1.28*	1.17	1.41	1.32*	1.22	1.42
Urban Non-Hispanic White Males	4 (High)	1.00			1.00		
	3	1.07*	1.01	1.13	1.03	0.97	1.08
	2	1.05*	1.00	1.10	1.12*	1.06	1.19
	1 (Low)	1.18*	1.07	1.29	1.38*	1.28	1.49

*** Denotes statistical significance**

Appendix F –Ratio of Late:Early Stage CRC Incidence

Table AF1. Ratio of Late:Early Stage Colorectal Cancer Incidence: All Floridians

		Ratio	Relative Rate Ratio		
		Late:		95% CI	
	SES	Early	RRR	Lower	Upper
All Floridians	4 (High)	1.33	1.00		
	3	1.34	1.01	0.96	1.06
	2	1.42	1.07*	1.01	1.13
	1 (Low)	1.47	1.11*	1.04	1.18
Females	4 (High)	1.39	1.00		
	3	1.39	1.00	0.93	1.08
	2	1.45	1.04	0.96	1.13
	1 (Low)	1.41	1.01	0.92	1.11
Males	4 (High)	1.28	1.00		
	3	1.29	1.01	0.94	1.08
	2	1.38	1.08*	1.00	1.16
	1 (Low)	1.54	1.20*	1.10	1.32
Rural	4 (High)	1.38	1.00		
	3	1.46	1.06	0.83	1.36
	2	1.34	0.97	0.76	1.23
	1 (Low)	1.32	0.96	0.73	1.26
Rural Females	4 (High)	1.47	1.00		
	3	1.31	0.89	0.62	1.28
	2	1.37	0.93	0.66	1.33
	1 (Low)	1.17	0.80	0.53	1.20
Rural Males	4 (High)	1.30	1.00		
	3	1.60	1.23	0.87	1.74
	2	1.28	0.98	0.70	1.37
	1 (Low)	1.52	1.17	0.79	1.72
Urban	4 (High)	1.33	1.00		
	3	1.34	1.00	0.95	1.06
	2	1.44	1.08*	1.02	1.15
	1 (Low)	1.49	1.12*	1.05	1.20
Urban Females	4 (High)	1.39	1.00		
	3	1.40	1.01	0.93	1.09
	2	1.47	1.06	0.98	1.15
	1 (Low)	1.43	1.03	0.94	1.13
Urban Males	4 (High)	1.28	1.00		
	3	1.27	0.99	0.92	1.07
	2	1.40	1.09*	1.01	1.18
	1 (Low)	1.55	1.21*	1.10	1.33

* Denotes statistical significance

Table AF2. Ratio of Late:Early Stage Colorectal Cancer Incidence: Blacks

		Ratio	Relative Rate Ratio		
		Late:		95% CI	
	Early	Early	RRR	Lower	Upper
Blacks	4 (High)	1.67	1.00		
	3	1.11	0.67*	0.50	0.89
	2	1.78	1.06	0.81	1.39
	1 (Low)	1.56	0.93	0.72	1.21
Black Females	4 (High)	1.91	1.00		
	3	1.00	0.52*	0.35	0.78
	2	1.76	0.92	0.63	1.34
	1 (Low)	1.49	0.78	0.55	1.12
Black Males	4 (High)	1.52	1.00		
	3	1.25	0.82	0.54	1.26
	2	1.70	1.12	0.75	1.68
	1 (Low)	1.65	1.09	0.74	1.59
Rural Blacks	4 (High)	1.77	1.00		
	3	0.83	0.47	0.15	1.49
	2	1.31	0.74	0.25	2.17
	1 (Low)	1.16	0.65	0.20	2.11
Rural Black Females	4 (High)	2.11	1.00		
	3	0.87	0.41	0.05	3.58
	2	0.99	0.47	0.06	3.71
	1 (Low)	1.00	0.47	0.06	3.59
Rural Black Males	4 (High)	1.12	1.00		
	3	1.25	1.12	0.22	5.74
	2	1.23	1.10	0.24	5.03
	1 (Low)	1.68	1.49	0.30	7.43
Urban Blacks	4 (High)	1.66	1.00		
	3	1.14	0.68*	0.51	0.92
	2	1.84	1.10	0.83	1.46
	1 (Low)	1.58	0.95	0.73	1.23
Urban Black Females	4 (High)	1.86	1.00		
	3	1.04	0.56*	0.37	0.85
	2	1.82	0.98	0.66	1.45
	1 (Low)	1.53	0.82	0.57	1.18
Urban Black Males	4 (High)	1.54	1.00		
	3	1.25	0.81	0.52	1.26
	2	1.77	1.15	0.76	1.75
	1 (Low)	1.65	1.07	0.73	1.59

* Denotes statistical significance

Table AF3. Ratio of Late:Early Stage Colorectal Cancer Incidence: Whites

	SES	Ratio Late: Early	Relative Rate Ratio	95% CI	
			RRR	Lower	Upper
Whites	4 (High)	1.32	1.00		
	3	1.35	1.02	0.97	1.08
	2	1.40	1.06*	1.00	1.12
	1 (Low)	1.46	1.10*	1.03	1.18
White Females	4 (High)	1.38	1.00		
	3	1.41	1.02	0.95	1.11
	2	1.44	1.04	0.96	1.13
	1 (Low)	1.40	1.02	0.92	1.13
White Males	4 (High)	1.28	1.00		
	3	1.30	1.01	0.94	1.09
	2	1.36	1.06	0.98	1.15
	1 (Low)	1.52	1.18*	1.07	1.31
Rural Whites	4 (High)	1.39	1.00		
	3	1.51	1.08	0.84	1.40
	2	1.34	0.96	0.75	1.23
	1 (Low)	1.32	0.95	0.71	1.26
Rural White Females	4 (High)	1.44	1.00		
	3	1.37	0.95	0.65	1.38
	2	1.36	0.94	0.65	1.35
	1 (Low)	1.21	0.84	0.55	1.27
Rural White Males	4 (High)	1.35	1.00		
	3	1.63	1.21	0.84	1.73
	2	1.29	0.96	0.68	1.36
	1 (Low)	1.53	1.13	0.76	1.70
Urban Whites	4 (High)	1.32	1.00		
	3	1.34	1.02	0.96	1.07
	2	1.42	1.07*	1.01	1.14
	1 (Low)	1.48	1.12*	1.04	1.21
Urban White Females	4 (High)	1.37	1.00		
	3	1.42	1.03	0.95	1.12
	2	1.46	1.06	0.97	1.16
	1 (Low)	1.42	1.04	0.93	1.15
Urban White Males	4 (High)	1.28	1.00		
	3	1.27	1.00	0.92	1.07
	2	1.37	1.07	0.99	1.17
	1 (Low)	1.53	1.20*	1.08	1.33

* Denotes statistical significance

Table AF4. Ratio of Late:Early Stage Colorectal Cancer Incidence: Hispanics

		Ratio	Relative Rate Ratio		
		Late:		95% CI	
	SES	Early	RRR	Lower	Upper
Hispanics	4 (High)	1.39	1.00		
	3	1.75	1.26	0.97	1.64
	2	1.27	1.02	0.79	1.31
	1 (Low)	1.35	1.09	0.83	1.43
Hispanic Females	4 (High)	1.23	1.00		
	3	1.28	0.99	0.69	1.43
	2	1.19	0.90	0.64	1.26
	1 (Low)	1.21	0.92	0.63	1.33
Hispanic Males	4 (High)	1.00	1.00		
	3	1.60	1.55*	1.04	2.31
	2	1.21	1.13	0.77	1.65
	1 (Low)	1.37	1.27	0.85	1.92
Urban Hispanics	4 (High)	1.18	1.00		
	3	1.53	1.25	0.96	1.64
	2	1.28	1.02	0.79	1.32
	1 (Low)	1.34	1.08	0.81	1.42
Urban Hispanic Females	4 (High)	1.22	1.00		
	3	1.29	1.01	0.69	1.46
	2	1.20	0.91	0.64	1.29
	1 (Low)	1.22	0.93	0.63	1.36
Urban Hispanic Males	4 (High)	1.01	1.00		
	3	1.57	1.51*	1.01	2.26
	2	1.22	1.13	0.77	1.65
	1 (Low)	1.33	1.23	0.81	1.87

* Denotes statistical significance

Table AF5. Ratio of Early:Late Stage Colorectal Cancer Incidence: Non-Hispanic Whites

		Ratio	Relative Rate Ratio		
		Early:		95% CI	
	SES	Late	RRR	Lower	Upper
Non-Hispanics	4 (High)	1.31	1.00		
	3	1.32	1.00	0.95	1.06
	2	1.40	1.06*	1.00	1.13
	1 (Low)	1.42	1.08*	1.00	1.17
Non-Hispanic Females	4 (High)	1.36	1.00		
	3	1.40	1.03	0.95	1.11
	2	1.44	1.06	0.97	1.16
	1 (Low)	1.37	1.01	0.90	1.13
Non-Hispanic Males	4 (High)	1.28	1.00		
	3	1.25	0.98	0.91	1.05
	2	1.35	1.06	0.97	1.15
	1 (Low)	1.47	1.15*	1.03	1.28
Rural Non-Hispanics	4 (High)	1.39	1.00		
	3	1.50	1.08	0.83	1.40
	2	1.36	0.98	0.76	1.26
	1 (Low)	1.27	0.91	0.68	1.23
Rural Non-Hispanic Females	4 (High)	1.42	1.00		
	3	1.38	0.97	0.66	1.42
	2	1.39	0.97	0.67	1.41
	1 (Low)	1.21	0.85	0.56	1.31
Rural Non-Hispanic Males	4 (High)	1.35	1.00		
	3	1.59	1.18	0.82	1.69
	2	1.31	0.97	0.68	1.38
	1 (Low)	1.42	1.05	0.70	1.60
Urban Non-Hispanics	4 (High)	1.31	1.00		
	3	1.31	1.00	0.94	1.05
	2	1.41	1.08*	1.01	1.15
	1 (Low)	1.45	1.11*	1.02	1.20
Urban Non-Hispanic Females	4 (High)	1.36	1.00		
	3	1.40	1.04	0.95	1.13
	2	1.46	1.08	0.98	1.18
	1 (Low)	1.39	1.03	0.91	1.16
Urban Non-Hispanic Males	4 (High)	1.28	1.00		
	3	1.23	0.96	0.89	1.04
	2	1.37	1.07	0.98	1.17
	1 (Low)	1.50	1.17*	1.04	1.32

Appendix G –Ratio of Late:Early Stage CRC Incidence Using Quartiles for SES Levels

Table AG1. Ratio of Late:Early Stage Colorectal Cancer Incidence with Quartile SES for Blacks

		Ratio	Relative Rate Ratio		
		Late:		95% CI	
	SES	Early	RR	Lower	Upper
Blacks	4 (High)	1.37	1.00		
	3	1.42	1.04	0.79	1.35
	2	1.60	1.17	0.93	1.47
	1 (Low)	1.61	1.18	0.92	1.51
Black Females	4 (High)	1.43	1.00		
	3	1.44	1.00	0.70	1.44
	2	1.52	1.06	0.77	1.45
	1 (Low)	1.50	1.05	0.75	1.47
Black Males	4 (High)	1.31	1.00		
	3	1.37	1.05	0.71	1.56
	2	1.70	1.30	0.92	1.83
	1 (Low)	1.68	1.29	0.90	1.85
Rural Blacks	4 (High)	1.43	1.00		
	3	0.67	0.47	0.15	1.52
	2	1.24	0.87	0.32	2.33
	1 (Low)	1.66	1.16	0.40	3.37
Rural Black Females	4 (High)	1.74	1.00		
	3	0.45	0.26	0.05	1.40
	2	0.96	0.55	0.13	2.38
	1 (Low)	1.15	0.66	0.14	3.15
Rural Black Males	4 (High)	1.40	1.00		
	3	0.68	0.49	0.09	2.63
	2	1.68	1.20	0.34	4.29
	1 (Low)	1.69	1.21	0.29	5.00
Urban Blacks	4 (High)	1.37	1.00		
	3	1.48	1.08	0.82	1.42
	2	1.63	1.19	0.94	1.51
	1 (Low)	1.62	1.18	0.91	1.52
Urban Black Females	4 (High)	1.43	1.00		
	3	1.53	1.07	0.73	1.55
	2	1.56	1.09	0.79	1.51
	1 (Low)	1.52	1.06	0.75	1.50
Urban Black Males	4 (High)	1.30	1.00		
	3	1.41	1.09	0.73	1.63
	2	1.71	1.32	0.92	1.88
	1 (Low)	1.70	1.30	0.90	1.90

Table AG2. Ratio of Late:Early Stage Colorectal Cancer Incidence with Quartile SES for Hispanics

		Ratio	Relative Rate Ratio		
		Late:		95% CI	
	SES	Early	RR	Lower	Upper
Hispanics	4 (High)	1.64	1.00		
	3	1.47	0.90	0.69	1.17
	2	1.48	0.90	0.70	1.16
	1 (Low)	1.60	0.97	0.74	1.28
Hispanic Females	4 (High)	1.47	1.00		
	3	1.46	1.00	0.69	1.44
	2	1.46	0.99	0.71	1.39
	1 (Low)	1.42	0.97	0.67	1.40
Hispanic Males	4 (High)	2.00	1.00		
	3	1.46	0.73	0.49	1.09
	2	1.48	0.74	0.51	1.08
	1 (Low)	1.81	0.91	0.60	1.36
Rural Hispanics	4 (High)	1.71	1.00		
	3	0.85	0.49	0.10	2.44
	2	0.99	0.58	0.13	2.49
	1 (Low)	2.00	1.16	0.29	4.73
Rural Hispanic Females	4 (High)	2.33	1.00		
	3	0.63	0.27	0.03	2.22
	2	0.64	0.28	0.04	1.83
	1 (Low)	1.16	0.50	0.09	2.81
Rural Hispanic Males	4 (High)	0.45	1.00		
	3	1.13	2.54	0.21	30.81
	2	1.70	3.82	0.36	39.98
	1 (Low)	3.72	8.35	0.83	83.98
Urban Hispanics	4 (High)	1.63	1.00		
	3	1.49	0.91	0.70	1.19
	2	1.49	0.91	0.71	1.17
	1 (Low)	1.57	0.96	0.73	1.27
Urban Hispanic Females	4 (High)	1.43	1.00		
	3	1.49	1.04	0.72	1.51
	2	1.47	1.03	0.72	1.46
	1 (Low)	1.43	1.00	0.68	1.47
Urban Hispanic Males	4 (High)	2.02	1.00		
	3	1.46	0.72	0.48	1.08
	2	1.48	0.73	0.50	1.08
	1 (Low)	1.74	0.86	0.57	1.30

Appendix H – Unstaged/"Death Clearance Only" Cases by Sex, Race, and Ethnicity

Table AH1. Unstaged Colorectal Cancer Cases by Sex, Urban/Rural Status Race, and Ethnicity

	Count	% of Invasive Cases	Age-Adjusted Rate	95% Rate C.I. Lower	Upper
Total Unstaged Cases	5516	12%	19.0	18.5	19.6
Females	2692	12%	16.1	15.4	16.8
Males	2824	13%	22.8	21.9	23.7
Rural	360	12%	18.0	16.3	19.8
Urban	5156	13%	19.2	18.6	19.8
Black	353	11%	18.4	16.7	20.2
White	5091	13%	19.3	18.7	19.9
Hispanic	630	14%	21.4	19.8	23.1
Non-Hispanic White	4473	12%	18.9	18.3	19.5

Table AH2. "Death Clearance Only" Colorectal Cancer Cases by Sex, Urban/Rural Status, Race and Ethnicity

	Count	% of Cases	Age-Adjusted Rate	95% Rate C.I. Lower	Upper
Total DCOs	1217	3%	4.1	3.8	4.4
Females	581	3%	3.2	2.9	3.5
Males	636	3%	5.3	4.9	5.7
Rural	101	3%	5.5	4.6	6.5
Urban	1116	3%	4.1	3.8	4.4
Black	109	3%	6.1	5.2	7.1
White	1098	3%	4.1	3.8	4.4
Hispanic	71	2%	2.5	2.0	3.1
Non-Hispanic White	1030	3%	4.2	3.9	4.5

Appendix I –Unstaged/"Death Clearance Only" Cases by SES

Table AI1. Unstaged Colorectal Cases by SES

	Count	% of Cases	Age-Adjusted Rate	Rate Ratio	95% Rate Ratio CI Lower	Upper
SES 4 (Highest)	1287	12%	18.0	1.00		
SES 3	1891	13%	19.4	1.08	1.0	1.2
SES 2	1489	13%	19.2	1.07	1.0	1.1
SES 1 (Lowest)	849	13%	20.3	1.13	1.0	1.2

Table AI2. "Death Clearance Only" Colorectal Cases by SES

	Count	% of Cases	Age-Adjusted Rate	Rate Ratio	95% % Rate Ratio C.I. Lower	Upper
SES 4 (Highest)	286	3%	4.2	1.00		
SES 3	391	3%	3.9	0.94	0.8	1.1
SES 2	330	3%	4.1	0.99	0.9	1.1
SES 1 (Lowest)	209	3%	4.9	1.18	1.0	1.4