Age Variations in the Distribution and Determinants of Systemic Inflammation among Older Adults

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Extended Abstract

INTRODUCTION

Cardiovascular diseases and associated risk factors are differentially distributed by race/ethnicity and gender in the United States. For example, using data from the Atherosclerosis Risk in Communities Surveillance: 2005-2010, Go et al. (2013) show that the incidence of heart attacks among adults age 55-64 is highest among black men followed by white men, black women and white women. Between the ages of 65-74, black men still have the highest heart attack incidence but the incidence among black women surpass that of white men and is more than double that of white women. Lastly, among persons age 75-85, the race and gender patterning of incident heart attack parallel that of the previous age group, but the difference between black women and white women is attenuated and the incidence among white women resemble that of white men. At this age, heart attack incidence among black men, however, is still the highest.

These data illustrate the heterogeneity in health by race/ethnicity, gender and age among older adults. They also motivate two important directions for aging research. First, using broad age categories to classify the elderly (e.g., <65 versus ≥65) potentially masks heterogeneity in the occurrence and magnitude of health differentials. Therefore, researchers should investigate the interactive effects of race/ethnicity and age of gender and age on the health of older adults. Second, to aid in disease prevention efforts, it is desirable to investigate differentials in biological endpoints (i.e., biomarkers) that precede clinical diagnoses or fatal disease events. Because systemic inflammation is predictive of incident heart attack, coronary heart disease and other cardiovascular diseases (Danesh et al., 2004; Ridker et al, 1997; Ridker et al., 2000; Steptoe & Kivimäki, 2012), the primary outcome assessed in the current study is C-reactive protein (CRP)—a biological marker of systemic inflammation.

Past research has shown that much like the distribution of other chronic health conditions, average CRP levels are unequally distributed across the population based on demographic and socioeconomic characteristics. For example, in a sample of adults age 57-85 years old, Herd et al. (2012) found that black men and women had higher CRP values than white men and women, respectively. The race difference between blacks and whites remained after accounting for socioeconomic and behavioral risk factors such as educational attainment, body mass index (BMI) and smoking. A study by Khera et al. (2005) found similar patterning of CRP by race/ethnicity and gender but among a younger population of adults: age 30-65 years old.

These studies demonstrated racial/ethnic and gender differences in CRP using samples spanning approximately three decades: 28 years in the study by Herd et al. and 35 years in the study by Khera et al. (2005). We argue that a better understanding of the nuances of racial/ethnic and gender differences in inflammation among older adults is achieved by assessing age variations in this distribution. Accordingly, we use nationally representative data from the Health and Retirement Study (HRS) to assess whether the

magnitude and/or direction of racial/ethnic and gender differences in CRP differ across age categories defined as: late midlife (52-65 years old), early old age (65-74 years old), and old age (75+ years old). We also assess age variation in demographic, socioeconomic, behavioral, and health-related determinants of inflammation.

Based on the research reviewed and on existing research of cardiovascular health disparities (Adler & Rehkopf, 2008), we hypothesized that racial/ethnic minorities—specifically, blacks and Hispanics—and women will have higher CRP levels than whites and men, respectively. We further hypothesize that the magnitude of these differences in CRP will be attenuated across successive age groups. This patterning of CRP by age, race/ethnicity and gender is anticipated to remain even after accounting for demographic and socioeconomic characteristics and behavioral factors.

METHODS

The HRS began in 1992 and it is an ongoing biennial survey of a nationally representative sample of adults over the age of 50. Beginning in 2006, a random half-sample of HRS respondents were asked to complete a biomarker and physical assessment; the second half-sample completed the same assessments in 2008. We used pooled data from the 2006 and 2008 half samples to increase the sample size and statistical power of our analysis relative to using one half sample. The physical and biomarker assessments were completed by 6,204 individuals in 2006 and 5,899 individuals in 2008. Of the 12,103 participants, 168 individuals were dropped from the study: four individuals did not have valid sampling weights for the biomarker assessment and 164 individuals did not identify as one of the racial/ethnic groups studied here: white, black or Hispanic. Small sample sizes precluded analysis of the other groups. As a result, the final analytic sample consists of 11,935 individuals.

CRP levels were assayed from blood samples collected during the biomarker assessment and are measured in micrograms/milliliter (ug/mL). The determinants assessed include: educational attainment, household income, employment, marital status, smoking status, alcohol consumption, moderate and vigorous physical activity, body mass index (BMI), waist circumference, and depressive symptoms. To account for the complex sampling design, all analyses were conducted using the SVY commands offered in Stata® version 13 and multivariate analyses were conducted with Stata's structural equation model (SEM) command, which permits uses of full information maximum likelihood (FIML) estimation for missing data.

PRELIMINARY RESULTS

Age-stratified characteristics of the sample are presented in Table 1 and age-adjusted mean CRP levels are depicted in Figure 1 by race/ethnicity and gender. Figure 1 suggests that systemic inflammation is patterned by race/ethnicity and gender. Regardless of gender, blacks have the highest CRP levels relative to Hispanics and whites, with black women standing out for having the highest levels among all race-gender groups. Fully adjusted regression models show that chronic inflammation is

significantly higher among blacks than Hispanics or whites, but the difference between Hispanics and whites is not significant. Gender differences in inflammation are significant in unadjusted and fully adjusted models and show that women have higher CRP levels than men. Preliminary stratified models suggest that this difference in inflammation is most pronounced in late midlife, decreases with increasing age and is no longer present in old age.

CONCLUSION

Initial findings from this study provide support for our hypotheses. On average, blacks had higher levels of systemic inflammation than other racial/ethnic groups, even after adjusting for determinants of inflammation that potentially differ by race/ethnicity; however, inflammation among Hispanics and whites did not differ, which is in contrast to our hypotheses. Systemic inflammation among women is greater than inflammation among men, but the gender difference decreased with increasing age. Future analyses will evaluate potential explanations for these age variations in the gender difference and will assess the extent to which the determinants of inflammation also vary by age. As it stands, however, these preliminary results offer and important contribution to aging research by highlight the importance of population-level studies that takes a more nuanced perspective on health differentials among older, namely, a perspective that recognizes the age-based heterogeneity in health and disease risk factors among this ever-growing population.

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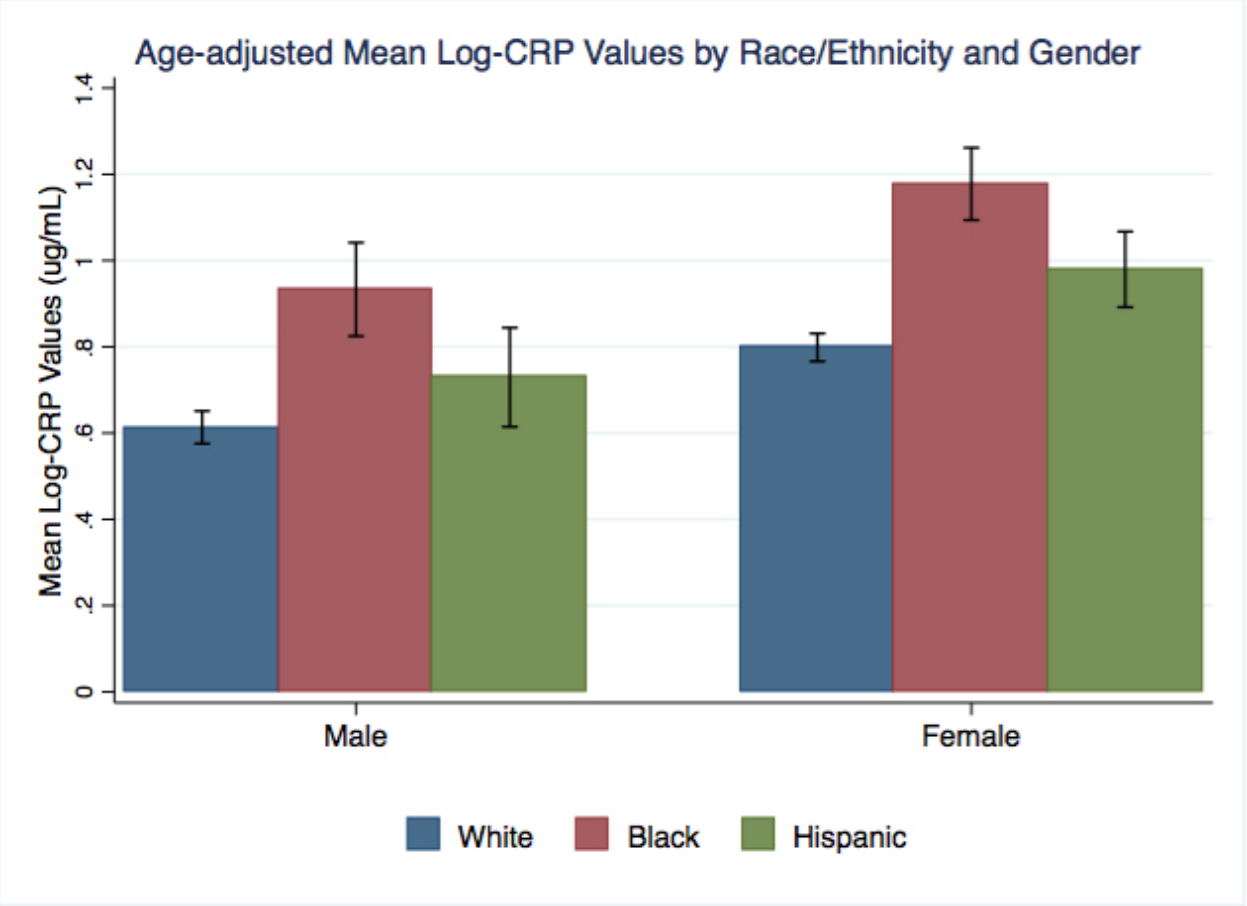
TABLES & FIGURES

Table 1 - Weighted Sample Characteristics of the Entire Sample and by Age: Health and Retirement Study, United States, 2006 and 2008 (n=11,935)

Study Variables	Entire Sample (n=11,935) Mean (SE) or %	Late Mid-life (Age 52-64, n=3,997) Mean (SE) or %	Early Old Age (Age 65-74, n=4,462) Mean (SE) or %	Old Age (Age 75+, n=3,476) Mean (SE) or %	p-value
Independent Variables					
Race/Ethnicity					
NH White	83.1	80.1	85.1	87.8	***
African American	9.3	10.6	8.3	7.3	
Hispanic	7.6	9.3	6.6	4.9	
Gender					
Female	54.2	51.9	53.5	60.4	***
Male	45.8	48.1	46.5	39.6	
Demographic & Socioeconomic Variables					
Education (years)	12.9 (0.07)	13.3 (0.10)	12.7 (0.09)	12.1 (0.09)	***
Household Income ($1,000)	73.9 (3.64)	93.3 (6.76)	65.2 (2.74)	38.1 (1.07)	***
Employment Status					
Full/Part Time	35.4	59.4	14.8	2.5	***
Retired	53.6	28.1	77.3	86.6	
Other	11.0	12.5	7.9	10.9	
Marital Status					
Married	66.4	73.6	68.1	47.6	***
Separated/Divorced	13.4	16.7	12.3	6.8	
Widowed	16.6	5.1	16.6	43.6	
Never Married	3.7	4.7	3.0	2.0	
Health Behaviors					
Smoking Status					
Never Smoked	42.8	43.2	38.8	46.4	***
Former Smoker	42.4	37.5	47.9	47.9	
Current Smoker	14.8	19.3	13.3	5.7	
Alcohol Consumption					
Non-Drinker	44.8	38.6	47.0	56.9	***
Moderate	47.6	51.9	45.6	39.7	
Heavy	7.6	9.5	7.4	3.4	
Vigorous Activity					
Never	59.0	52.1	58.9	75.4	***
≤ Once a Week	16.2	19.9	15.5	8.0	
> Once a Week	24.8	28.0	25.6	16.6	
Moderate Activity					
Never	19.1	14.0	18.2	31.8	***
≤ Once a Week	24.4	26.5	24.5	19.7	
> Once a Week	56.5	59.5	57.3	48.4	
Health Factors					
Waist Circumference (inches)	39.9 (0.09)	40.1 (0.13)	40.0 (0.13)	39.2 (0.13)	***
Body Mass index (kg/m^2)	28.4 (0.09)	29.2 (0.13)	28.2 (0.10)	26.5 (0.12)	***
Depressive Symptoms	1.4 (0.03)	1.5 (0.05)	1.3 (0.04)	1.5 (0.04)	***

NOTE: SE = standard error; p-value is for two-tailed test of significance
*p<0.05; **p<0.01; ***p<0.001


Age-adjusted Mean Log-CRP Values by Race/Ethnicity and Gender
Mean Log-CRP Values (ug/mL)
0
.2
.4
.6
.8
1
1.2
1.4
Male
Female
White
Black
Hispanic