Socioeconomic Stagnation, Metabolic Syndrome, and Cancer Risk in the NHANES

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Introduction

- Cancer risk and mortality for certain cancers has been shown to differ among racial and socioeconomic classes.
  - IARC reported significantly higher risks among socially disadvantaged people for cancers of the lung, stomach, upper aero-digestive tract, and cervical cancer; the relationship with social status appeared direct for colon cancer, bone neoplasm, melanoma, and malignant breast and ovarian cancer.
  - Data has shown poorer survival for more disadvantaged groups of patients with relative risks being largest for cancers with normally better prognosis, such as breast, body of uterus, bladder, and colon.
- Medical knowledge has proven causation of cancer by several oncogenic viral infections:
  - Hepatitis C Virus (HCV) has been linked to liver cancer
  - Human Papilloma Virus (HPV) 16/18 have been linked to cervical, vulvar, vaginal, penile, anal, and oropharyngeal cancer.
  - Human Immunodeficiency Virus (HIV) has been linked to Kaposi's sarcoma, non-Hodgkin lymphoma, and cervical cancer.
- In addition, a prior study found a 1.3-fold increased risk of cancer of any type and a 2-fold increased risk of lung cancer for individuals with C-reactive protein (CRP) levels in the highest versus the lowest quintile.
  - CRP is an acute-phase protein synthesized by the liver in response to inflammatory signals released by macrophages and adipocytes.
- Previous studies have linked metabolic syndrome criteria and metabolic syndrome disease state with elevated levels of serum CRP.
- Our study aims to investigate the possible link between the social and socioeconomic factors of race, poverty, education, and employment status and cancer risk via serum CRP levels and oncogenic viral infections.
- Furthermore, any association between the social and socioeconomic factors and CRP levels will be further investigated for association with metabolic syndrome criteria and diagnosis.
- We hypothesize that African American race, poverty, low education, and unemployment will increase one's probability of elevated CRP and oncogenic viral infections. Also, these social and socioeconomic factors will also increase one's probability of metabolic syndrome diagnosis. Finally, metabolic syndrome diagnosis will increase one's probability of elevated CRP and, thus, one's cancer risk.

Methods

- ***Continuous NHANES:*** Demographic, questionnaire, examination, and laboratory data were collected from 17,132 men and women aged ≥20 years from the National Health and Nutrition Examination Survey (NHANES) from 2005-2006, 2007-2008, and 2009-2010 cycles.
- ***Socioeconomic Stagnation:*** Socioeconomic stagnation was defined by the following criteria: African American race, a family income to poverty ratio <1, less than a high school degree, and unemployed.
- ***Metabolic Syndrome:*** Metabolic syndrome was defined using the ATP III guidelines as meeting three or more of the following criteria:
  - Waist circumference of ≥102 cm for males and ≥88 cm for females.
  - Serum triglyceride level of ≥150 mg/dL or dyslipidemia treatment.
  - High density lipoprotein (HDL) levels of <40 mg/dL for males and <50 mg/dL for females or hypoalphalipoproteinemia treatment.
  - Fasting plasma glucose level of ≥100 mg/dL or fasting hyperglycemia treatment.
  - Systolic blood pressure of ≥130 mmHg and/or diastolic blood pressure of ≥85 mmHg or hypertension treatment.
- ***Pathological C-Reactive Protein:*** Pathological C-reactive protein was defined as a serum CRP level >1 mg/dL, qualifying as intermediate risk level.
- ***Covariates:*** The NHANES data were used to construct control variables for tobacco history, alcohol history, gender, age, and marital status.
- ***SAS 9.3:*** Data were analyzed using SAS 9.3. Multivariable logistic regression was used to calculate odds ratios for investigated predictors versus outcomes.

Study Design

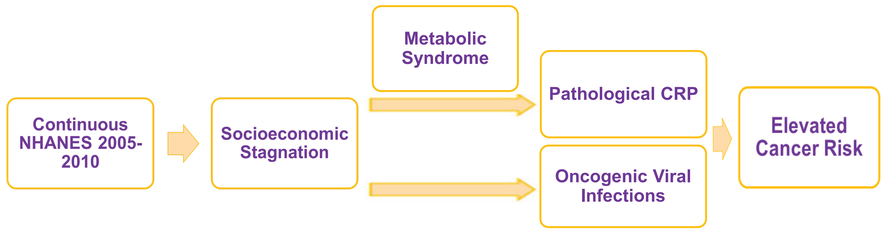

Figure 1. A flow chart of experimental design investigating the potential association between socioeconomic stagnation and cancer risk and metabolic syndrome.

Results

VARIABLE	ODDS RATIO			
	Pathological CRP	HCV+	HPV+	HIV+
African American	1.451**	2.340**	1.469**	26.230**
Poverty	1.442**	1.712*	1.000	1.391
< High School Degree	1.856**	3.220**	1.519*	1.098
Unemployed	1.835**	2.801**	1.155	1.651
Socioeconomic Stagnation 1	1.384*	2.063*	1.029	-
Socioeconomic Stagnation 2	1.618	3.194	1.260	-
Socioeconomic Stagnation 3	2.856**	4.133	2.295**	-
Socioeconomic Stagnation 4	2.502	16.352**	0.884	5.076

Table 1. The multivariate logistic regression odds ratios for socioeconomic stagnation versus cancer risk factors (* = P-value <0.05, ** = P-value <0.01). HCV: n= 4546, HPV: n=2777, HIV: n=2322, and Pathological CRP: n=4562.

VARIABLE	ODDS RATIO					
	Hypertension	Triglycerides	Waist Size	HDL	Fasting Glucose	Metabolic Syndrome
African American	2.241**	0.727**	1.122*	0.848*	1.166*	1.126
Poverty	1.274*	1.035	1.174	1.392**	1.316**	1.393**
< High School Degree	2.237**	1.432*	1.694**	1.520**	1.549**	2.084**
Unemployed	2.118**	1.679**	1.606**	1.766**	1.446**	2.120**
Socioeconomic Stagnation 1	1.692**	0.914	1.246	1.104	1.197	1.297*
Socioeconomic Stagnation 2	2.439	1.060	1.474*	1.313	1.435	1.669
Socioeconomic Stagnation 3	3.381*	0.932	1.276	1.275	1.665	1.722
Socioeconomic Stagnation 4	5.322*	1.157	1.731	1.242	1.591	2.803*

Table 2. The multivariate logistic regression odds ratios for socioeconomic stagnation versus metabolic syndrome criteria and metabolic syndrome (* = P-value <0.05, ** = P-value <0.01). The same sample population was used for these variables as the Pathological CRP; n= 4562 for all variables.

VARIABLE	ODDS RATIO	95% CI		P-VALUE
	Pathological CRP			
Hypertension	1.701	1.591	2.195	<0.0001
Triglycerides	1.205	1.015	1.444	0.0595
Waist Size	3.118	2.641	3.722	<0.0001
HDL	1.606	1.315	1.719	<0.0001
Fasting Glucose	1.770	1.402	2.037	<0.0001
Metabolic Syndrome	2.045	1.668	2.238	<0.0001
Metabolic Syndrome 1	2.017	1.840	3.447	<0.0001
Metabolic Syndrome 2	4.288	3.353	6.149	0.0120
Metabolic Syndrome 3	4.834	3.984	7.493	0.0002
Metabolic Syndrome 4	5.592	4.216	8.195	<0.0001
Metabolic Syndrome 5	6.003	4.289	8.841	<0.0001

Table 3. The multivariate logistic regression odds ratios, 95% confidence intervals, and P-values for metabolic syndrome and for number of metabolic syndrome criteria met versus the cancer risk factor pathological CRP. The same sample population was used as before, n= 4562.

Results (Cont.)

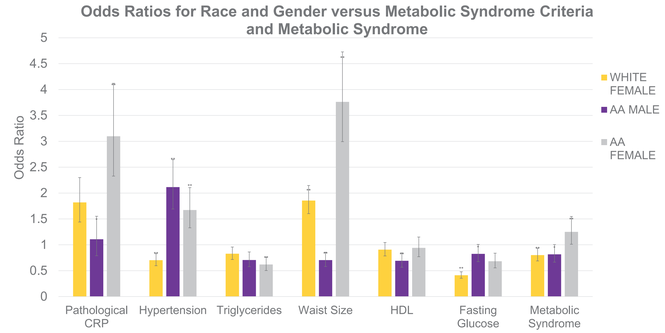

Figure 2. A graph showing the multivariate logistic regression odds ratios for gender and race versus metabolic syndrome criteria and metabolic syndrome (* = P-value <0.05, ** = P-value <0.01) compared to white males. Error bars represent the 95% confidence intervals. The same sample population was used as before, n= 4562.

Conclusions

- Socioeconomic stagnation showed a significant increase in cancer risk via increased risk of pathological CRP and oncogenic viral infections.
- In addition, socioeconomic stagnation showed increased probability of meeting metabolic syndrome criteria and metabolic syndrome diagnosis.
- Furthermore, metabolic syndrome criteria and metabolic syndrome diagnosis showed increased probability of pathological CRP and, thus, cancer risk.
- Specifically, African American females showed marked increase in probability of large waist size and pathological CRP.
  - Previous studies have linked elevated CRP and obesity to increased risk of malignant breast cancer and breast cancer mortality. Thus, this study exhibits a link between African American females and malignant breast cancer risk and mortality.
- These results identify populations that may particularly benefit from intervention with primary and secondary prevention measures and education efforts to lower incidence of metabolic syndrome and specific cancers in people of low socioeconomic status.

Strengths and Limitations

- The implications of our study are limited by causality and temporality issues inherent to cross-sectional data, the limited types of data collected by the NHANES, and limited subsample sizes in some parts of the multivariable regression analyses.
- However, the results of our study are strengthened by the use of data from a large, nationally representative population sample and the wide variety of relevant data collected at the time of the NHANES, including standardized laboratory measures.
- The results of this study warrant further research, including longitudinal studies directed at populations of interest to better address etiology.

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