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Examining the association between international migration and colorectal cancer among multiple ancestry groups in the United States

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ABSTRACT

Objectives: Prior research has not adequately examined the relationship between international migration and colorectal cancer (CRC) by cultural regions in the US. The purpose of this exploratory study was to determine how annual CRC incidence varied with US annual international migrant inflow in ten different regions, corresponding to dominant ancestry group.

Design: County-level international migrant inflow and dominant ancestry type were obtained from the American Community Survey, and age-adjusted CRC incidence was obtained from the National Cancer Institute. A linear regression model was tested for each ancestry region to assess the relationship between migrant inflow and CRC incidence.

Results: Higher international migrant inflow was associated with lower CRC incidence among counties where the dominant ancestry group was African American ($p = 0.0207$), British ($p = 0.0212$), Hispanic ($p = 0.0001$), and Native American ($p = 0.0056$).

Conclusions: These findings suggest that US residents in certain ancestry groups are at higher risk for CRC.

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Colorectal cancer; international migration; risk factors; ancestry

Introduction

Colorectal cancer (CRC) has the fourth highest incidence and second highest death rate in the United States (Siegel, Miller, and Jemal 2015). Cases of CRC have increased rapidly since 1975 (Boyle and Langman 2000) and CRC currently results in 132,700 new cases of cancer and 49,700 deaths each year (Siegel, Miller, and Jemal 2015). Although there is mixed evidence, the World Cancer Research Fund has identified several behaviors that appear to be predictors for risk of developing CRC. For example, decreases in risk may occur through physical activity and intake of dietary fiber and calcium; while increases in risk may come from alcohol use, red meat consumption, and obesity (Marmot et al. 2007). The social environment has a major influence on these health behaviors that in turn are associated with risk for CRC (Christakis and Fowler 2007). Therefore, this disease may be influenced by changes in lifestyle and acculturation resulting from migration.

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With some 41.3 million international migrants currently residing in the US and several million new migrants arriving annually, migration represents an uncontrolled experiment that could provide evidence regarding the impact of environmental and sociocultural factors for cancer risk and susceptibility (Zong and Batalova 2015; Parkin and Khlat 1996). For example, Ziegler and colleagues found that less recent Asian-American migrants had greater risk for breast cancer than more recent Asian-American migrants, thereby indicating a possible harmful role for cultural adaptation and acclimation to westernized lifestyles (Ziegler et al. 1993).

Additionally, within the US population, health behaviors that increase risk for CRC, such as poor diet and sedentary lifestyle, are more prevalent among members of certain ethnic groups, including those of the African American and Hispanic identity (Ward et al. 2004). Prior studies have shown that migrants to the US (and Western Europe) tend to be at lower risk for CRC, and the adoption of a westernized diet and lifestyle dramatically increases their risk (Arnold, Razum, and Coebergh 2010; Le Marchand et al. 1997). Other studies on Vietnamese migrants suggest that westernized diet and lifestyles can also contribute to risk of CRC (Le et al. 2002). Therefore, CRC incidence in counties with high proportions of residents that have existing CRC-related risk factors may be masked by the influx of migrants with fewer CRC-related risk factors.

To date, the relationship between CRC and international migration has generally only been examined at national or multinational levels. These studies tend to broadly show that the environment where migrants settle has the potential to affect disease risk. As an example, a study among non-Western migrants to Europe found increased risk for CRC when compared with both native populations and Western migrants to Europe (Arnold, Razum, and Coebergh 2010). Another study found that US-born Japanese had much higher rates of CRC than both US natives and foreign-born Japanese migrants (Flood et al. 2000). However, studies assessing the relationship between CRC and international migration have not examined variation by place of settlement, such as at the US county level, which could provide a more detailed explanation of potential factors that influence risk for CRC.

Hence, it is worthwhile to further examine the relationship between CRC and international migration at the place of settlement and how it may vary across dominant ancestry groups in the US (Figure 1). To explore this potential association, annual county-level data on annual migrant inflows from the American Community Survey's five-year

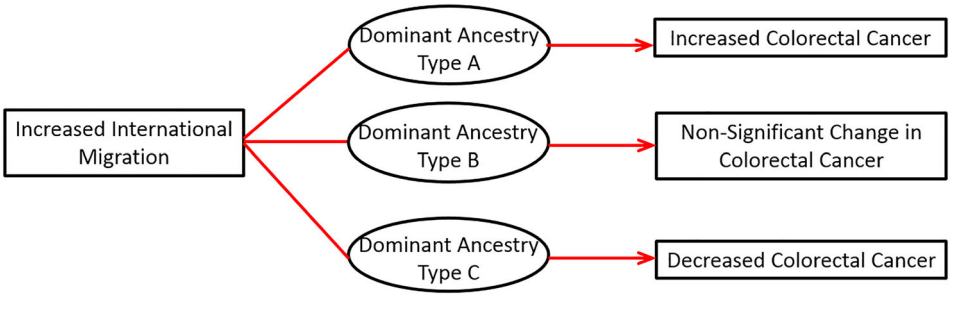

Figure 1. Conceptual model illustrating three possible ancestry categories, by their ability to moderate the relationship between international migration and CRC incidence.

estimates (2006–2010) (US Census Bureau 2006-2010) will be compared to annual county-level CRC incidence from the National Cancer Institute's (NCI) five-year estimates (2007–2011) (National Cancer Institute 2007). It should be noted that ethnic background is considered to delineate sociocultural identification, whereas ancestral background is considered to specifically refer to the geographic area of the migrant's lineage. In order to investigate the role of dominant ancestry group for counties where migrants settle (a.k.a. 'receiving' counties), annual migrant inflows will be regressed on CRC incidence for each of the ten largest (self-reported) ancestry groups in the US: African American, American (including those responding 'unknown'), British, French, German, Hispanic, Irish, Italian, Native American, and Scandinavian. Individuals who report being part of the American ancestry group may not know the specific nationality corresponding to their lineage; they may have had European ancestors who migrated to the United States many centuries ago.

Methods

Data

Annual county-level CRC incidence, for the most recent five-year estimate (2007–2011), was obtained from the NCI's online portal (National Cancer Institute 2015), which provided age-standardized incidence rates at the county level. These rates were computed from population-based registries coordinated by either the NCI's Surveillance, Epidemiology, and End Results (SEER) program or the Center for Disease Control and Prevention's National Program of Cancer Registries.

Annual county-level international migrant inflows, also for the most recent five-year estimate (2006–2010), were obtained from the US Census Bureau's American Community Survey. The American Community Survey is a questionnaire administered to randomly-selected households across the US. This survey includes the following question for each of the household's members: 'Did this person live in this house or apartment 1 year ago?' A possible response is 'No, outside the United States and Puerto Rico,' which designates the respondent as an international migrant. For this study, rates of annual county-level international migrant inflows were not partitioned by ancestry or ethnicity. Annual international migrant inflows were converted to percentages of total county populations to produce descriptive statistics. For regression analyses, annual international migrant inflows were log-adjusted to establish normality. County population data were also obtained from the American Community Survey.

County-level dominant ancestry group was obtained from the American Community Survey. The survey includes the open response question 'What is this person's ancestry or ethnic origin?' For this study, the greatest single entry for each county was selected as the dominant ancestry. Categories (and color scheme) were based on a previous methodology (Lombard 2014).

Analysis

Eleven separate linear regressions were conducted. One regression compared international migrant inflows with CRC incidence for all counties in the US with available data. The

other ten regressions were conducted for each of the ancestry groups. In each of these regressions, the only counties included were those where the ancestry group was dominant, which is defined as the ancestry group with the greatest number of inhabitants in a given county. All statistical analyses were conducted in SAS version 9.3 (SAS Institute: Armonk, NY). A cartographic display was produced to illustrate the county-level distribution of dominant ancestry groups in the US. All geospatial visualizations were made using ArcGIS (Esri: Redlands, CA). This study did not require approval from an Institutional Review Board.

Results

Among the ten dominant ancestry regions, the proportion of international migrants that arrived within the prior year ranged from 0.17% to 0.63%, and the age-standardized CRC incidence ranged from 41 per 100,000 to 46 per 100,000 (Table 1). Members of German ancestry were the dominant ancestry group in the largest number of counties: 943 counties out of 3109 total counties with available data (Figure 2).

Among all counties, higher annual international migrant inflow was significantly associated with lower CRC incidence ($p < 0.0001$). For county groups, categorized by dominant ancestry, higher annual international migrant inflow was significantly associated with lower CRC incidence among counties dominated by the African American ancestry ($p = 0.0207$), British ancestry ($p = 0.0212$), Hispanic ancestry ($p = 0.0001$), and Native American ancestry ($p = 0.0056$). Only in counties dominated by the American ancestry was higher migrant inflow associated with higher CRC incidence ($p = 0.0466$). There was no significant relationship between annual international migrant inflow and CRC incidence for counties dominated by the French ancestry, German ancestry, Irish ancestry, Italian ancestry, and Scandinavian ancestry.

Discussion

Residents of the US often claim a foreign country as the place where their ancestry or lineage originated. An ancestry group could be said to dominate an area if its descendants

Table 1. Results from simple linear regressions. Counties are the unit of analysis, annual age-adjusted colorectal cancer incidence is the dependent variable, and log-adjusted international migrant inflow is the independent variable.

Majority Ancestry	Number of Counties	Mean CRC Incidence	Mean Percent Migrants	β Coefficient	R-Squared	*p* Value
African American	392	45 per 100,000	0.32%	−2.150	0.014	**0.0207**
American	390	45 per 100,000	0.17%	+2.196	0.010	**0.0466**
British	441	41 per 100,000	0.40%	−2.245	0.012	**0.0212**
French	27	44 per 100,000	0.28%	−4.942	0.043	0.2988
German	943	46 per 100,000	0.27%	−1.581	0.003	0.0574
Hispanic	206	41 per 100,000	0.56%	−6.017	0.072	**0.0001**
Irish	35	43 per 100,000	0.55%	−3.586	0.036	0.2756
Italian	24	42 per 100,000	0.63%	−1.769	0.016	0.5604
Native American	37	42 per 100,000	0.13%	−14.904	0.199	**0.0056**
Scandinavian	35	46 per 100,000	0.25%	+7.444	0.057	0.1673
Total	2534	44 per 100,000	0.31%	−2.323	0.011	**<0.0001**

Note: Significant associations are denoted in bold.

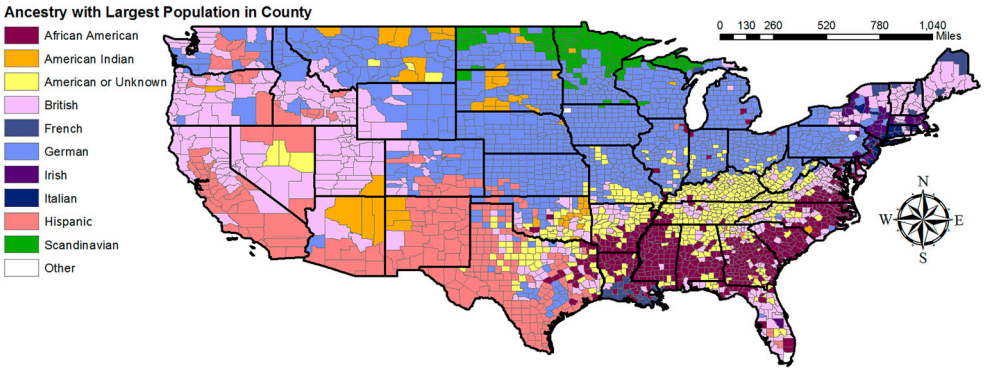

Figure 2. Choropleth map of counties, shaded according to dominant ancestry.

constitute a plurality of that area's inhabitants, even if members of the ancestry group do not constitute the majority of that area's population. A dominant ancestry group then has the potential to affect an area's prevailing customs, beliefs, and health behaviors. Well-documented racial and ethnic disparities for CRC may partly result from ways that the dominant ancestry group may influence the health behaviors of residents (Ward et al. 2004). Even though no study has illustrated the effect of dominant ancestry group on CRC within the US, the effect of dominant ancestry group has been documented elsewhere. In Brazil, a study found that areas dominated by members of European ancestry had higher incidence of celiac disease than other areas of Brazil, which was thought to result from higher levels of wheat consumption in these European-dominated areas of Brazil (Pereira et al. 2006). Though more evidence is needed, this indicates that an area's dominant ancestry group could also affect its inhabitants' behaviors, thereby influencing risk for CRC.

In examining this potential association between dominant ancestry group and CRC incidence, we found that, among the six groups of counties where European ancestry was dominant, five exhibited non-significant associations between CRC incidence and international migration. This could be explained by similarly low risk for CRC among both US residents of these ancestries and the individuals that migrate to regions dominated by these ancestries. If both residents and migrant populations exhibit similarly low risk for CRC (compared to other ethnic groups in the US), then there may be too little variance to detect a significant relationship between CRC incidence and international migration. For counties dominated by non-marginalized ancestry groups, the possible county-level variation in CRC risk is illustrated by the green area in Figure 3(A).

There are several potential explanations for the significantly lower rates of CRC in counties dominated by Hispanic, African American, and Native American populations with higher levels of international migration. Specifically, US residents of these racial/ethnic groups may encounter a relatively high level of socioeconomic marginalization (Flores et al. 1999), and they generally have a higher prevalence of behaviors and conditions that increase risk for CRC, including obesity (Wang and Beydoun 2007) and physical inactivity (Crespo et al. 2000). A potential mechanism for the deleterious health effects from socioeconomic marginalization among US residents (at a level distinct from that of international migrants) may be the weathering hypothesis, which posits that stressors

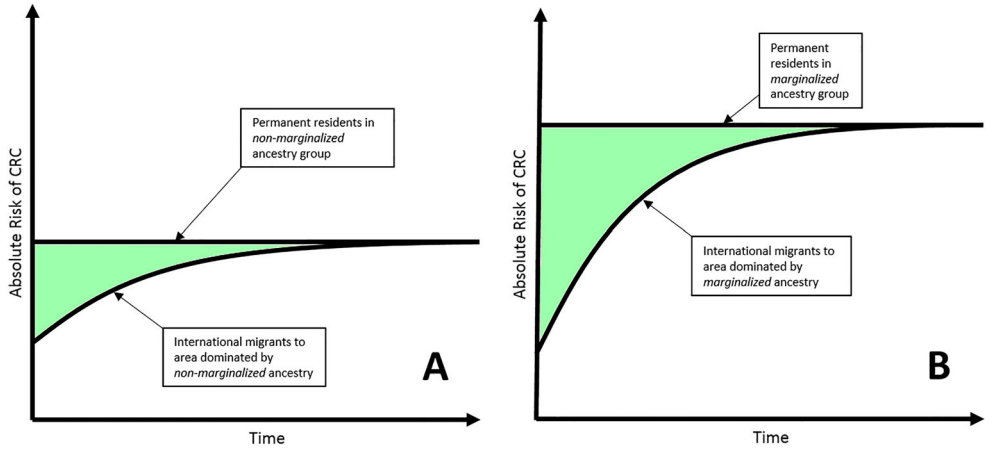

Figure 3. The relationship between absolute risk of CRC and time, for residents/migrants of counties dominated by a marginalized ancestry group (A) and for residents/migrants dominated by a non-marginalized ancestry group (B). The green area represents the possible variance in incidence rates for each type of county group.

early in life result in accumulation of biochemical damage which predisposes marginalized populations to morbidity (Geronimus 1992). Migrants to the US, on the other hand, have lower overall mortality rates than residents with similar demographic characteristics (age, sex, education, etc.) (Singh and Siahpush 2001), which may be the result of better health behaviors or different lifestyles and their associated protective factors (Fennelly 2005). Hence, the difference in CRC risk between US residents of marginalized populations and healthier migrants is a possible explanation for why counties attracting more international migrants have a significantly lower CRC incidence. For counties dominated by marginalized ancestry groups, the possible county-level variation in CRC risk is illustrated by the green area in Figure 3(B).

American-dominated counties exhibited higher CRC incidence rates among counties with higher international migration. The American ancestry group dominates most of the counties in West Virginia, Tennessee, and other parts of southern Appalachia. This set of counties is within the boundaries of the former Confederate States of America during its existence in the 1860s, and it was the last region to uphold educational segregation before the landmark *Brown v Board of Education* court case in 1954. These events illustrate a history of racial tension that may manifest today in poor conditions for recent migrants. Recently, there have surfaced media reports of hostility towards recent migrants in this region (Falconer 2007). Racial/ethnic hostility might partly result in poor conditions for migrants, thereby manifesting in the high levels of stress and lack of food choice which can result in higher CRC risk for recent migrants to counties dominated by the American ancestry group.

Studies have shown that recent migrants generally have relatively low income and educational attainment (Capps 2007). This is also true for marginalized groups in the US, including African American and Native American ancestries (Flores et al. 1999). Areas dominated by marginalized ancestries might facilitate better conditions for recent migrants, due to local policies and social support that may already exist to help marginalized residents. Furthermore, recent assessments have estimated that most people

migrating to US, for several large regions, are Hispanic (Monger and Yankay 2014; Hoefer, Rytina, and Baker 2010). It is plausible that counties dominated by the Hispanic ancestry would be especially willing to provide social support for recent Hispanic migrants. This possible phenomenon may partly help to explain the larger effect size observed in this study for the significant relationship between CRC incidence and international migration among counties where permanent residents were dominated by the Hispanic ancestry.

Limitations

As an ecological study, conclusions drawn from these statistical and geospatial analyses portray broad relationships, and they may not accurately represent CRC risks for every person or every county. Also, this study did not take into account the mitigation of behavior-modifying effects from the prevailing local ancestry group that corresponds to counties with several populous ancestry groups. As this study was exploratory, its objectives were to generate hypotheses for further study, rather than test a specific hypothesis. Furthermore, this study was not able to account for several factors that likely influence the relationship between CRC incidence and international migration at the county level. For example, we were not able to account for specific influential characteristics in the migrants or the counties, such as measures of economic wealth, and cultural diets/practices.

Conclusions

Among regions dominated by the African American, Hispanic, and Native American ancestries, counties with higher rates of migration had significantly lower rates of CRC. Compared with permanent residents of these ancestries, recent migrants have lower observed rates of obesity (Wang and Beydoun 2007), lower observed rates of physical inactivity (Crespo et al. 2000), and possibly other unobserved differences that may affect CRC risk. Findings from this study support these observations and provide added evidence of an ongoing health disparity for CRC among ancestry groups in the US. Further studies should be conducted that compare CRC risk in greater detail between individuals of different ancestries, including variations in cultural practices and health behaviors that may increase CRC risk. Further, the decreased CRC incidence among Hispanic-dominated counties with higher migration suggests the possible presence of protective community-based phenomena, whereas the increased CRC incidence among American-dominated counties with higher migration suggests the presence of a harmful phenomena. Therefore, this analysis suggests that further research is necessary to assess whether regionally-dominant cultural factors influence CRC risk among recent migrants, in order to better inform cancer control and prevention efforts for the benefit of both current and future residents.

Disclosure statement

No potential conflict of interest was reported by the authors.

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