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Cohort-Based Income Gradients in Obesity among US Adults

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Abstract

This study examines the cohort-based income gradients in obesity among whites, blacks, and Mexican-American using the National Health and Nutrition Examination Survey between 1971 and 2010. Predicted probabilities of obesity by poverty income ratio were estimated. We also stratified this relationship by gender, race/ethnicity, and birthplace. Our analyses revealed that the income gradients of obesity across cohorts vary markedly by gender, race/ethnicity, and birthplace. Females who earned higher income have lower risks of obesity with the exception of Mexican-American females in the early cohorts. Compared to females, relatively weaker income gradients were observed for males across cohorts except for black males. Additionally, an increasingly larger gap was shown in the predicted probability of obesity between US-born and foreign-born respondents regardless of the race/ethnicity. Our findings imply that policies and interventions need to be tailored and taken into account of the cohort effects among targeted race/ethnicity and gender.

Introduction

Socioeconomic status (SES) has been identified as a fundamental cause of the social inequalities in health (House, Kessler and Herzog 1990; Williams 1990). Interestingly, epidemiological studies have shown that the relationship between SES and health is not simply a threshold effect, but a graded association (gradient) with health and all the levels of SES (Adler et al. 1994; Baltrus et al. 2005). This is also true to the relationship between obesity and income. Intuitively, it may seem to be natural that people of higher SES have less risk of obesity in US; however, past studies found various patterns and strengths in different population subgroups stratified by gender (Ball and Crawford 2005), race/ethnicity (Goldman et al. 2006; Wang and Beydoun 2007; Zhang and Wang 2004), and immigration status (Bates et al. 2008; Goel et al. 2004; Sanchez-Vaznaugh et al. 2008). They offered mainly three explanations to the different SES gradient across subgroups: psychosocial factors, behavioral factors, and social and physical features of residential environments (Sánchez-Vaznaugh et al. 2009).

However, this cross-sectional or short-term longitudinal evidence in epidemiologic studies examined SES gradients in obesity did not disentangle period and cohort effects. In fact, much of obesity research that reported consistent increase of the obesity prevalence during the last three decades (Flegal et al. 2012; Flegal et al. 2002; Ogden et al. 2006; Ogden et al. 2012) have explained such increase was contributed by technological innovations (Cutler, Glaeser and Shapiro 2003; Philipson and Posner 1999), the aggressive marketing of high calorie foods (Brownell and Fairburn 1995), and passive leisure activities (French, Harnack and Jeffery 2000) which greatly affects the secular changes (period effect) of obesity prevalence in the U.S. society.

In contrast to the literature, we examined income gradients in obesity by focusing on the birth cohort dimension. We considered birth-cohort effects in obesity because birth cohorts has similar risks of obesity based on the sharing experiences of social, economic, and technological changes at early life time. Moreover, analyzing birth cohorts in obesity is supported by past studies that showed that the influences of lifestyle habits and weight status at early in life time persist in adulthood (Freedman et al. 2005; Guo et al. 2000). More recently, fetal over-nutrition hypothesis called for studies to examine the SES gradient in obesity across birth-cohorts. The hypothesis posits that maternal obesity may lead to offspring obesity through in utero environments (Cole, Power and Moore 2008; Gillman 2004; Keith et al. 2006).

To better understand US socioeconomic inequalities in obesity, this study examine the income gradients in four 20-year birth cohort bands among non-Hispanic white (hereafter white), non-Hispanic black (hereafter black), and Mexican-American adults using the data from National Health Nutrition and Examination Survey (NHANES). In this study, we investigated: (a) whether the cohort-based income gradients in obesity vary across race/ethnicity, (b) whether cohort-based income gradients in obesity vary by race and gender, and (c) whether cohort-based income gradients in obesity vary by race and nativity.

Data and Methods

Study population

We used the pooled data from the National Health and Nutrition Examination Survey (NHANES) Wave 1-9 (1971-2010) with a total sample size of 143,457 respondents. This survey uses a complex, multistage, and clustered sampling design to provide cross-sectional and nationally representative data on the health and nutritional status of the civilian noninstitutionalized US population. We excluded children, adolescents, and pregnant women in this study. The final sample of our study consists of 65,207 adults aged 18-75. The racial distribution of our sample is as followed: 30.6% (n=17,330) white male; 31.6% (n=20,607) white female; 10.0% (n=6,534) black male; 11.1% (n=7,233) black female; 9.1% (n=5,964) Mexican-American male; and 8.7% (n=5,686) Mexican-American female.

Measurement

The dependent variable for our analysis is obesity status which was dichotomized based on respondents' body mass index (BMI). Respondents' BMI that were equal or greater than 30 were considered obese (BMI>30) (WHO 1995, 2000). BMI was calculated as weight in kilograms divided by height in meters squared. Weight and height measurements were collected by interviewers through physical examination in a mobile examination center (CDC 2010). To measure economic status consistently, we chose poverty income ratio (PIR) rather than income variable which has different income range categories across the survey waves. The poverty income index was calculated based on the ratio of household income to the poverty threshold of each year after accounting for inflation and family size. The PIR was entered as a continuous variable in our model (range: 0-5). The race variable contains four groups (non-Hispanic white, non-Hispanic black, Mexican American, or other race); however we did not include other races in our analyses. Education level was measured with four categories: less than high school degree (reference), high school degree, college degree, and more than college degree. Marital status was measured with three categories: married (reference), never married, and other status (widowed, divorced, and separated). Employment status of respondents was categorized by employed (reference), unemployed, retired, and other. Nativity was measured by two categories: U.S. born and foreign born. We used smoking status as a control variable which has three categories: non-smoker, current user, and past user. To control for the period effects in obesity, period dummies (survey year from 1971 to 2010) were added to the model. Missing information on obesity (6.1%) and PIR (12.3%) was imputed by replacing the mean of the obesity and mean PIR of respondents' respective cohort. To examine the income gradients in obesity across cohorts, we collapsed respondents' birth years into four 20-year cohort bands (1895-1919, 1920-1939, 1940-1959, and 1960-1986).

Statistical analysis

We used a logistic multivariate model to predict the probabilities of obesity by PIR across cohorts. In our model, we controlled for gender, race/ethnicity, education, PIR, marital status, job status, nativity, smoking status, and period effects. First, to examine the differences of the racial specific income gradient across the cohorts, we estimated and graphed the predicted probabilities of obesity for each level of PIR among each racial group across 4 cohort bands. Subsequently, we stratified the above analysis by gender to assess the differences of the cohort-based income gradients between males and females. Lastly, to examine the differences by nativity, we stratified our analysis by nativity (U.S. born vs. foreign born). Data was analyzed using Stata software packages (version 11, Stata corp.).

Results

Figure 1 shows income gradients in predicted probabilities of obesity across race/ethnicity for each cohort after adjusting for other covariates. It revealed not only the income gradients but also differences in likelihoods of obesity in all the racial groups across cohortbands. Regardless of race/ethnicity, the birth cohort of 1920-1939 had highest probabilities of obesity than any other cohort. In terms of racial comparison, whites had the lowest probability of obesity and showed steepest income gradients across all the cohortbands. On the other hand, blacks showed highest probability of obesity in all cohorts except for the 1940-1959 cohort which overlapped with Mexican American. Blacks, however, had more gentle income gradients compared to whites. This is particularly true for the 1960-1986 cohort. The probabilities of obesity for Mexican-Americans seems to remain unchanged for 1895-1919 and 1940-1959 cohorts; however, a decreasing predicted probability of obesity with income poverty ratio was found for 1920-1939 and 1960-1986 cohorts.

Figure 2 displays income gradients in obesity for each of the six gender-racial subgroups across cohorts. Consistent with our findings in figure 1, all the subgroups showed a decreasing predicted probability of obesity in the 1920-1939 cohort comparing with the earlier cohort. Interestingly, the associations among black male and Mexican-American female were inversed in the 1920-1939 cohort. The income gradients tended to be less steep among males than females in all racial/ethnic groups. Women are more likely to be obese than men in all the race/ethnicity. For females, except the earliest cohort band in Mexican-American, all the female racial/ethnic groups showed decreasing income gradients in obesity across cohorts. For males, except for increasing income gradient among blacks in the later three cohorts (1920-1939; 1940-1959; and 1960-1986), the downward income gradients of white and Mexican-American males became less steep in the more recent cohorts.

White female showed a decreasing likelihood of obesity with income and this downward income gradient seems to be hastened in the more recent cohorts; whereas, the income gradients among white males seems to become weaker in the more recent cohorts. It should be noted that a weak inverse relationship between income and obesity among black male in the earliest cohort was observed; however, this relationship was reversed and became a positive relationship between income and obesity in the later cohorts. Although Mexican-Americans showed relatively flat trends across cohorts in Figure 1, stratification by gender showed greater variations in income gradients across cohorts—the downward income gradient among males became weaker and nearly flat in the most recent cohort; yet, the income gradients in obesity switched from a positive relationship in the earliest cohort to a negative relationship in the later three cohorts.

Figure 3 shows income gradients in obesity across race/ethnicity and birthplace across cohortbands. People who were born in US showed higher risk of obesity than those were born in foreign countries. The gap between the two groups became wider in later cohortbands in all the race/ethnicity. Especially in black, while the foreign-born group was in the continuous trends of decreasing risk of obesity, the US-born group has ranked highest across cohortbands. Regardless of birthplace, all the race/ethnicity groups showed negative or flat associations between income and risk of obesity except foreign-born black who showed positive associations between income and risk of obesity after the birth cohorts of 1920s. In terms of the strength of income gradients, whites and Mexican-American both showed similar forms for each cohort though the gap between foreign born and U.S. born were

increasing.

Discussion

Our analyses of the income gradient in obesity revealed the patterns and strength of the relationship between income and obesity. The likelihood of obesity differed markedly by gender, race/ethnicity, and nativity for each of the four cohort bands that we considered.

Our study showed that the birth cohorts of the 1920-1939, the post-First World War generation showed the highest obesity prevalence possibly due to the transition to a postindustrial lifestyle despite of Depression. After two decades, another peak in obesity was shown in the latest birth cohort (1960-1986). Birth cohorts of the 1920-1930s were the first generation whom was introduced to radio broadcasting and the rapid spread of automobiles. After a period of decline in the rate of obesity due to the second World War, cohorts of the 1960s and later had more risk of obesity due to rapid spread of television and fast food culture (Chou, Grossman and Saffer 2004; Komlos, Breitfelder and Sunder 2009; Powell et al. 2007). Most of the fast food chains were established during those periods. Television commercials is found to be highly correlated with fast food and sugar-sweetened beverage consumption (Chou, Rashad and Grossman 2008; Powell et al. 2007). Additionally, the increasing participation of women in the work force and the information technology revolution, an increase in income inequality, and a decrease in economic safety nets may contribute to the risk of obesity in the latest birth cohorts (Offer, Pechey and Ulijaszek 2009).

Within these mainstreams of obesity epidemic, income may become an essential driving force of differential behavioral adaptation. For example, income can moderate the use of technology or consumption of fast food differently across gender and race/ethnicity. That is, a certain subgroup of a specific birth cohort may tend to adopt an obesity promoting lifestyle based on their income (e.g. higher income earner may have higher discretionary income to eat at a high-end steak restaurant); whereas, another subgroup from a different birth cohorts may tend to use income to minimize the risk of obesity (e.g. some high-income earners may choose to purchase healthy and organic food that are generally more expensive than fast foods).

Regardless of race/ethnicity and cohorts, female in higher income groups tended to have lower risk of obesity with the exception of Mexican-American female in the earliest cohorts. It is possible that females in the more recent cohorts are more likely than males to utilize the modern technologies and adapt healthy lifestyle to reduce the risk of obesity. They also may be more sensitive to the social norms such as desirable thin body image in the society (Story et al. 1995). Interestingly, white female showed a downward income gradient in obesity and the gradient became steeper in the more recent cohorts. Compared to other racial groups, it is possible that white females are more likely to stay thin partly due to their sensitivity to the trend of accepting thinner and attractive body image among women in the 20th century (Paeratakul et al. 2002).

Compared to females, males showed less variation in income gradients across cohorts and generally showed weaker income gradients in obesity except for black males. Males among all racial groups showed similar patterns and strength of income gradients in the earliest cohort; however, social changes from 1920s may contribute to obesity differently across

race/ethnicity showing different trends and patterns of their income gradients. In the cohorts of 1960s and later, only black males showed an increasing income gradient in obesity suggesting higher risk of obesity was attributed by their higher income through, for instance, enjoying restaurant foods more frequently.

Our analysis stratified by nativity showed the gap between the US-born group and foreign-born group became wider in later cohorts among all the race/ethnicity. The increasing gap may attribute to the differences of social environments or norms related on weights between US other countries. Higher macro-economic status and relatively generous social norms on weights in US context may increase offspring's obesity risk through parents' nurturing and feeding behaviors regardless race/ethnicity. Residential segregation at early in life also may contribute to the higher risks of obesity among US-born black and Mexican-American. The residential segregation was imposed by legislation to limit the housing options of black Americans to the least desirable residential areas. The levels of black-white segregation increased dramatically until 1940s and have remained strikingly resisting to turn down mainly in urban areas since then (Massey 1993). Although the Civil Rights Act of 1968 made discrimination in the sale or rental of housing units illegal, but studies reveal that discrimination in housing persists (Fix and Struyk 1993; Glaeser and Vigdor 2001).

Our study has some limitations. We used PIR rather than exact measure of actual income. The PIR does not control for regional variation in housing, even though it does control for household size and for inflation. Although actual income was available in NHANES; the income variable had been recoded into income categories which are inconsistent and difficult to normalize across the survey waves. Thus, this limits our ability to use actual income reported by respondents. We also were not able to show income gradients stratified by racial-gender group for annual birth cohort because were no consistent patterns.

Our study showed that income gradient in obesity differed by gender, race/ethnicity, and nativity across cohorts. These findings imply that policies and interventions needs to be tailored taking into account cohort effects among targeted race/ethnicity and gender.

Figure 1. Income gradients in predicted probabilities of obesity (BMI>30) across race/ethnicity across cohortbands

1895-1919 cohort

1920-1939 cohort

1940-1959 cohort
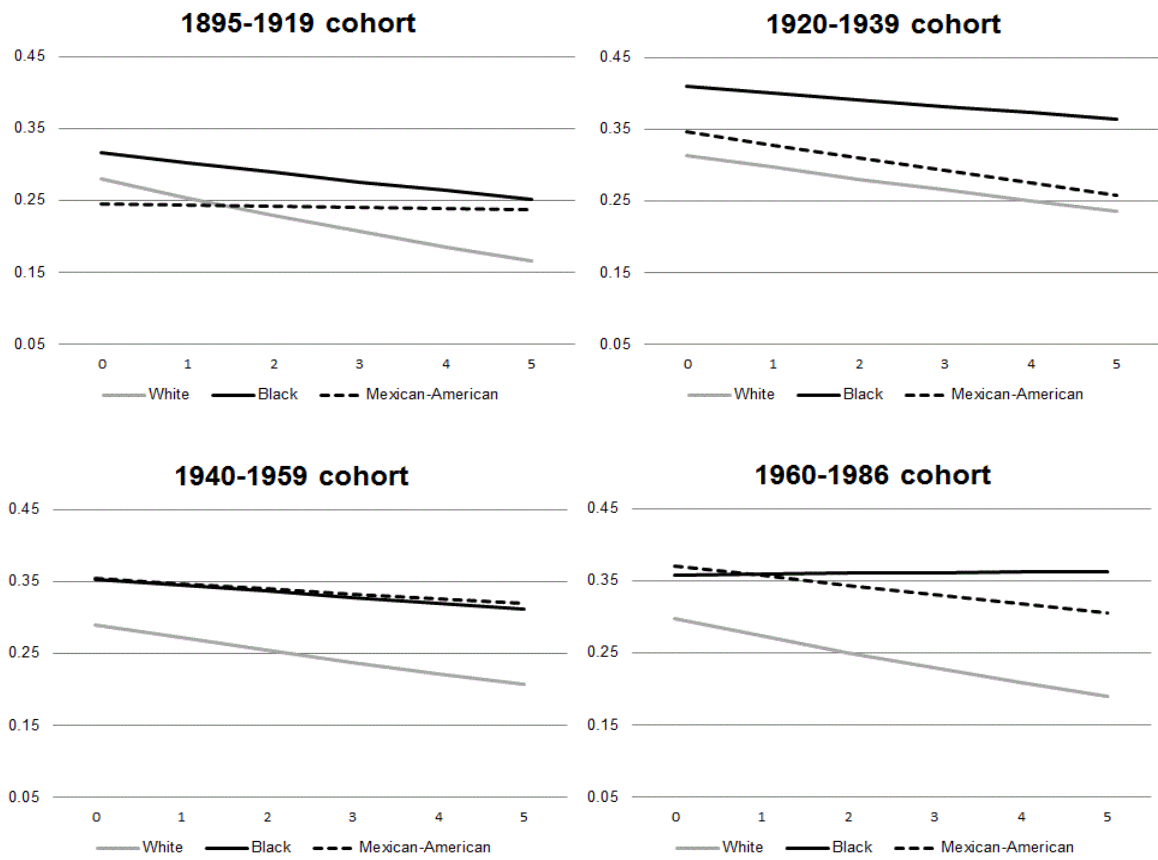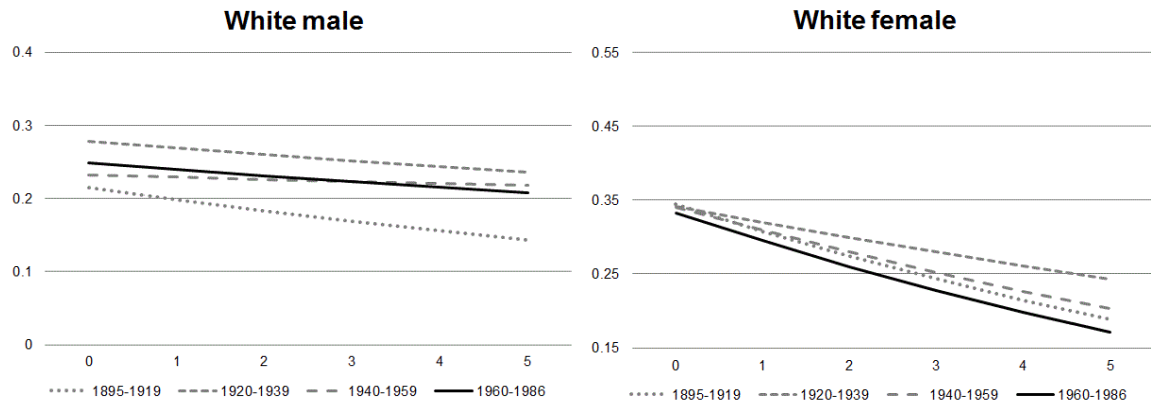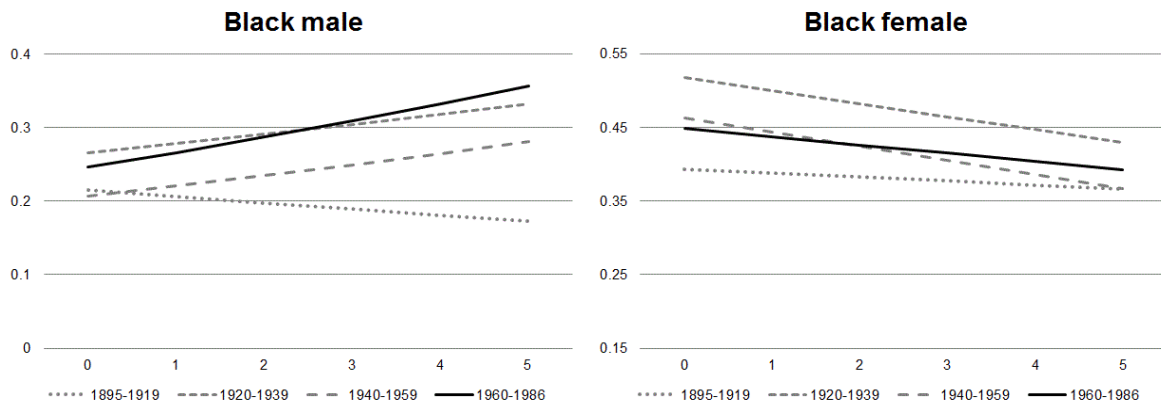
1960-1986 cohort

Figure 2. Income gradients in predicted probabilities of obesity (BMI>30) across cohortbands within six race/ethnicity-gender subgroups

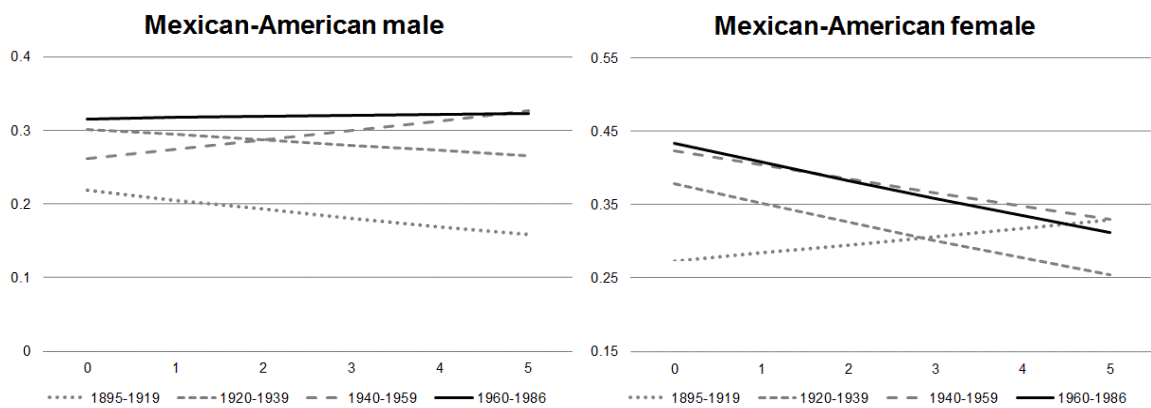(a) Whites

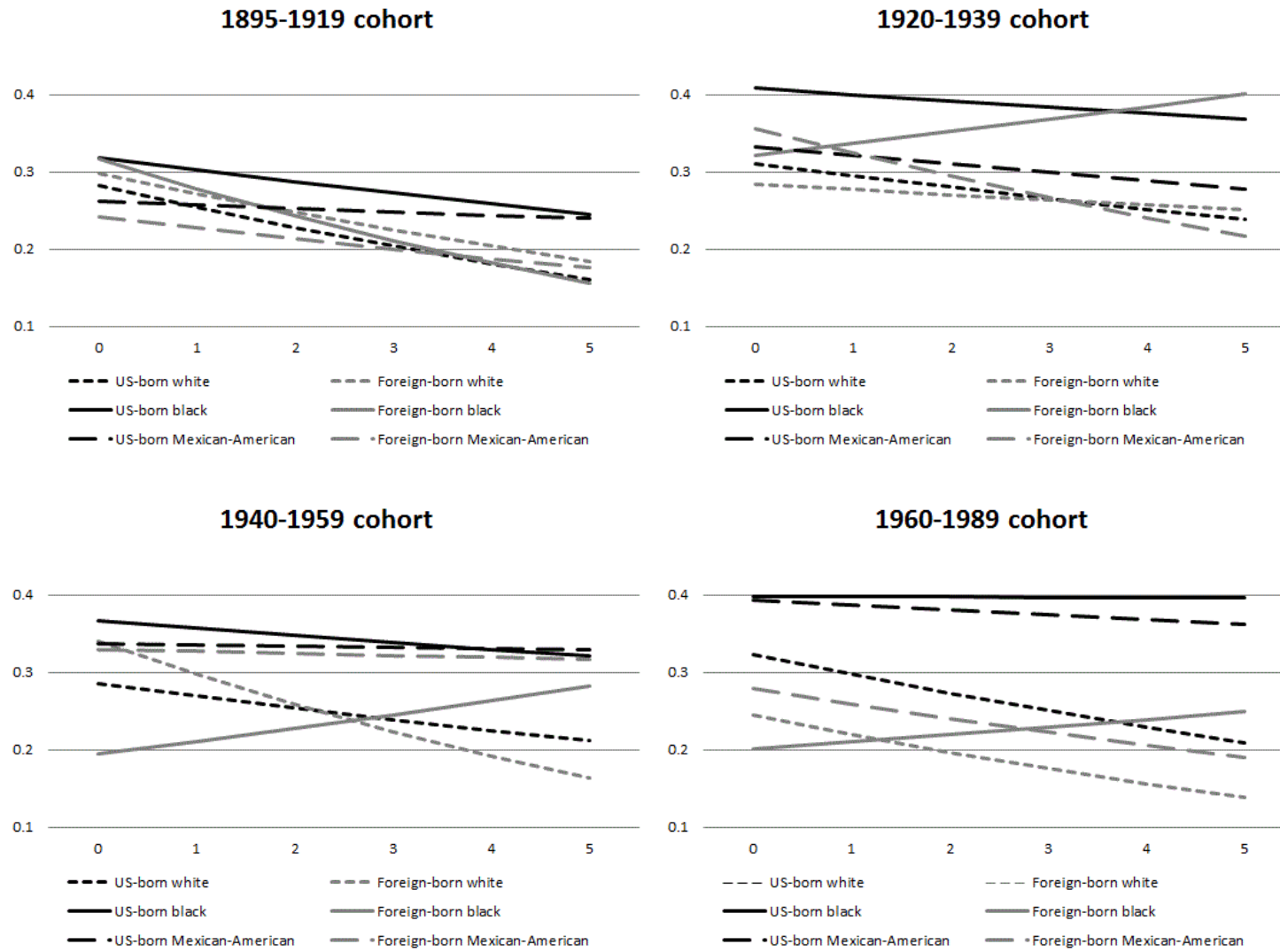

(b) Blacks

(c) Mexican-Americans

Figure 3. Income gradients in predicted probabilities of obesity (BMI>30) across race/ethnicity and birthplace across cohortbands

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