Growing Waistlines in the U.S.: Race/Ethnicity, Nativity, and Period Trends in Body Mass among U.S. Adults*

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ABSTRACT

The U.S. population is becoming increasingly diverse at the same time that the average body mass has increased. But prior research offers little insight into the influence age, calendar period, and birth cohort forces for driving increases in body mass in our racially and ethnically diverse population. We use data from the National Health Interview Survey to examine age, period, and cohort changes in body mass among six different race/ethnic groups in the U.S.: non-Hispanic whites, non-Hispanic blacks, Mexicans, Puerto Ricans, Cubans, and Asians. We find that calendar period forces are driving increasing body masses among nearly all race/ethnic groups except for Cubans. Further, calendar period increases in body mass are slower among foreign born adults than U.S. born adults for all race/ethnic groups except for Asians.

BACKGROUND

The prevalence of obesity among U.S. adults has almost tripled since 1960, increasing from 13.3% to 35.3% of the adult population (National Center for Health Statistics, 2012). Rising body masses will likely lead to increased rates of cardiovascular disease, diabetes, and cancers, as well as elevated rates of morbidity and mortality. In the year 2000 alone, 112,000 excess deaths resulted from obesity (Lloyd-Jones et al., 2010) and annual medical spending related to obesity is projected to reach 956.9 billion dollars by 2030 (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008).

Several studies have examined both period and cohort increases in body mass. Olsen, et al. (2006) used data from Denmark, Lee et al. (2010) used data from the United States, Diouf, et al. (2010) used data from France, Allman-Farinelli, et al. (2008) used data from the Australia, and Reither, et al. (2009) use data from the United States to document important calendar period and birth cohort effects on body mass or obesity. But few prior studies use current age-period-cohort (APC) methods to determine whether body mass is increasing due to birth cohort or calendar period forces, and as such, those studies risk biased and inefficient estimates (Yang, Fu, & Land, 2004). Both Lee et al. (2010) and Olsen, et al. (2006) emphasize the importance of birth cohorts, Allman-Farinelli et al. (2008) emphasize period effects, and Diouf et al. (2010) remain agnostic about whether birth cohort or period effects are more important for driving increases in body mass. To our knowledge, Reither, et al. (2009) is the only prior study to employ advanced APC methods that allow the simultaneous adjustment of age, period, and cohort effects, and their study finds modest variations in body mass across birth cohorts, but shows that calendar period trends have a far greater and more consistent effect on increasing body masses over time.

Prior research also offers limited insight into race/ethnic and nativity differences in increases in body mass across birth cohorts or calendar periods, even though the U.S. population is growing increasingly diverse. Between the mid 1970s and 2010, the share of the population that is black has increased by 10%, the share that is Hispanic has increased by over 300%, and the share that is Asian has increased by over 660% (Statistical Abstract of the United States, 2012; (Humes, Jones, & Ramirez, 2011). Further, the rise in obesity has not affected all racial and ethnic groups equally. Non-Hispanic blacks have the highest prevalence of obesity (Wang & Beydoun, 2007), Mexican-Americans are more likely to be obese than non-Hispanic whites (National Center for Health Statistics, 2012; Wang & Beydoun, 2007), and Asians are the ethnic group least likely to be overweight or obese (Denney, Krueger, Rogers, & Boardman, 2004; Lauderdale & Rathouz, 2000; Wang & Beydoun, 2007). Reither et al. (2009) compare whites and blacks in the U.S. and find that period increases in obesity are similar for blacks and non-blacks, although black females started off more obese in 1976, the beginning of their observation window. However, they were unable to examine Hispanics (or Hispanic subgroups) or Asians in their analyses.

The U.S. also has a substantial immigrant population, and immigrants tend weigh less than their U.S. counterparts, although their body mass increases with time lived in the U.S. (Goel, McCarthy, Phillips, & Wee, 2004; Lauderdale & Rathouz, 2000; Wang & Beydoun, 2007). Nativity has also been linked to broader indicators of health and wellbeing, with foreign born adults typically having better health and lower body masses than their U.S. born counterparts, an advantaged that actually increases when adjusting for socioeconomic status. The healthy immigrant effect may arise from the selection of healthy immigrants into the U.S., the non-random out-migration of the least healthy migrants, or from cultural practices that encourage less risk taking and healthier behaviors among immigrants than among their U.S. born counterparts.

Despite the diversity of the U.S. population, prior research offers limited insight into age, period, and cohort patterns of body mass by nativity, especially across a diverse array of race/ethnic groups. Thus, two aims guide our analyses. First, we will estimate age, period, and cohort trends in body mass among six different race/ethnic groups in the U.S. Our analyses will focus on non-Hispanic whites, non-Hispanic blacks, Mexicans, Puerto Ricans, Cubans, and Asians aged 18 to 84, and who were in the U.S. between 1989 and 2011. Following Reither et al. (2009), we expect that calendar periods will have a more substantial impact on body mass than birth cohort variation. Second, we will examine whether calendar period trends in body mass differ for U.S. born and foreign born adults across the six race/ethnic groups in our study. If prior research on the healthy immigrant hypothesis holds, foreign born adults will weigh less and perhaps increase their body mass across calendar years more slowly than their U.S. born counterparts.

DATA AND METHODS

Data

We use data from the National Health Interview Survey (NHIS). The NHIS is nationally representative of the non-institutionalized civilian U.S. population, and conducts face-to-face interviews with all members of sampled families (or their proxy respondents). The data is considered very high quality and has a response rate of 90% for eligible households. The Integrated Health Interview Series (IHIS) harmonizes the original NHIS data, facilitating their usage for the examination of trends over time (Minnesota Population Center and State Health Access Data Assistance Center, 2012). We use data from 1989 to 2011; 1989 is the first year that the NHIS collects information about nativity and 2011 is the most recent year of data available. The large annual sample size ensures adequate numbers of respondents for our analyses. We have 1,024,668 respondents across our 23 years of data, of whom 704,357 are non-Hispanic whites, 137,717 are non-Hispanic blacks, 78,940 are Mexican, 14,425 are Puerto Rican, 7,792 are Cuban, and 32,179 are Asian. The total for the race/ethnic groups are less than the full sample size in the data because some individuals did not report a race or reported multiple races without designating one as their primary race.

Variables

Our outcome variable, body mass index (BMI) is calculated from respondent reported height and weight which we convert to BMI by multiplying weight in pounds by 703, and dividing the resulting value by height in inches squared. From 1989 to 1996 about 38% of respondents' body mass values come from proxy reports of height and weight. Between 1997 and 2000 the NHIS does not allow any proxy reports, and between 2001 and 2011 just 0.8% the BMI scores come from proxy reports. Because proxy reports typically understate weights, the greater reliance on proxy report data in earlier waves would lead to biased calendar trends in body mass. Therefore, we follow the method outlined by Reither and Utz (2009) to correct for the known biases in proxy reported heights and weights. We estimate our correction models separately for each race/ethnic, nativity, and gender group and use variables including survey year, age, age squared, self-reported health, activity limitations, union status, Census region, presence of children of specific ages in the home, education, employment status, proxy data, and interactions between proxy reporting and all other covariates to estimate the degree to which body mass scores are too low due to proxy reports.

Age in single years ranges from 18 to 84 in our analyses. Because age is top-coded to ages 85+, we drop the very oldest adults for whom we do not have precise ages. Survey year ranges from 1989 to 2011 in single year increments. Birth cohort is calculated as survey year minus age. We group birth cohort into 5 year categories ranging from 1909 and earlier to 1990 to 1994. Nativity is coded as 1 for those who are U.S. born and 0 for those who were born elsewhere. Gender is coded as 1 for females and 0 for males.

Analysis

Given our interest in identifying the role of nativity in period trends in body mass we started our analyses by applying Age-Period-Cohort (APC) models via the Intrinsic Estimator (IE) (Yang, Fu, & Land, 2004) to our data separately by race/ethnicity and nativity. However, the models for several race/ethnic groups did not converge. Further, the APC-IE models do not allow us to formally test for interactions between calendar year and nativity.

In order to identify APC patterns for all race/ethnic groups, we use ordinary least squares linear regression models to predict body mass, while drawing on our knowledge about the functional form of age, period, and cohort from the APC-IE models to identify our models. Our APC-IE models consistently found a concave parabolic relationship between age and body mass and a linear relationship between calendar period and body mass (see also Reither et al. (2009)). In turn, we include age, age-squared, and a continuous term for survey year in our linear regression models to recover the trends identified in our APC-IE models. At least for those groups for whom our APC-IE models converged, comparisons demonstrate that we recovered the underlying age, period, and cohort patterns in our linear regression models. Finally, we adjust for gender and test for interactions between nativity and survey year.

Comparisons of models that include and then exclude sample weights yield virtually identical coefficients, but larger standard errors in the weighted models due to changes in the construction of the sample weights over time. As a result, our final models exclude sample weights.

RESULTS

Table 1 presents unstandardized linear regression coefficients for the relationship between age, calendar year, cohort, nativity, and nativity interacted with survey year, while adjusting for gender. Each model focuses on a different race/ethnic group. Model 1 pools all groups, Model 2 includes non-Hispanic whites, Model 3 includes non-Hispanic blacks, Model 4 includes Mexicans, Model 5 includes Puerto Ricans, Model 6 includes Cubans, and Model 7 includes Asians.

The relationship between age and body mass is concave in all of the models. Model 1 shows that body mass increasing until about 53 (=-0.318/2*-.003) years of age, and then falling with each additional year of age. Body mass peaks at age 49.7 among whites, at age 48.1 among blacks, at age 44.8 among Mexicans, at age 58.5 among Puerto Ricans, at age 76.0 among Cubans, and at age 58.8 among Asians. These age effects are substantial. The model for all race/ethnic groups combined predicts that adults will gain 3.7 (=[0.318*53+0.003*53^2]-[0.318*18+-.003*18^2]) BMI points between ages 18 and the inflection point at age 53.0, and can expect to lose 2.9 (=[0.318*53+0.003*53^2]-[0.318*84+-.003*84^2]) BMI points between ages 53.0 and age 84.

The birth cohort variables are persistently significant for all race/ethnic groups combined in Model 1, but are only intermittently significant for distinct race/ethnic groups. Further, the magnitude of variation in BMI that can be attributed to variation across birth cohorts is relatively modest. Model 1 shows that compared to those adults who were born in 1909 or earlier, cohorts born between 1915 and 1964, or between 1985 and 1994 can expect to have BMIs that are 0.15 to 1.06 points lower. We interpret the earliest and latest birth cohorts with caution because only the oldest adults in the earliest survey years were born prior to 1910, and only the very youngest respondents in the most recent waves were born after 1990.

Because of our statistical interaction between calendar year and nativity, the main effect for calendar year shows the effect of a one year increase in the calendar year for foreign born adults. Model 1 shows that each calendar year is associated with a 0.091 unit increase in BMI for foreign born adults, when adjusting for age, age squared, birth cohort, and gender. The annual increase in BMI is largest for Mexicans (b=0.094) and Puerto Ricans (b=0.109), smallest for Asians (b=0.058), and not statistically significant among Cubans. The dummy variable for U.S. born indicates the difference in BMI between U.S born and foreign born adults when calendar period is equal to zero; because our earliest calendar period is 1989, that coefficient is difficult to interpret directly but becomes more useful when graphing our results. The interaction term between U.S. born and calendar year are generally positive and significant except for Asians, indicating that body mass increases more quickly among the U.S. born than among the foreign born. The dummy variable for gender shows that women have lower BMIs than men among whites, Mexicans, Cubans, and Asians; are not significantly different from males among Puerto Ricans; and have significantly higher BMIs than males among blacks.

Figure 1 graphs the relationship between calendar year, nativity, and BMI for all race/ethnic groups combined, and then for each race/ethnic group separately. The prediction lines are derived from the multivariate results on Table 1, while holding age, age squared, birth cohort, and gender at their mean values. Four important findings emerge. First, there are substantial differences in body mass across race/ethnic groups. Foreign born Asians typically have the lowest BMIs, and U.S. born Mexicans have the highest BMIs. Second, body mass is increases significantly across calendar periods for all race/ethnic groups and all nativity groups, with the exception of foreign born Cubans. These changes are substantial. For example, BMI increases from an average of 26.2 to 29.1 among the U.S. born when combining all race/ethnic groups, and from 25.8 to 27.8 for all foreign born adults from all race/ethnic groups. Third, for all groups except for Asians, U.S. born adults gain body mass more quickly than their foreign born counterparts. Finally, Puerto Ricans and Cubans experience a crossover in the mid-1990s, suggesting that the immigrant advantage has only recently emerged.

DISCUSSION

The obesity epidemic has been targeted as a current and pressing public health concern and Healthy People 2020 has multiple goals related to healthy weight, including a reduction in obesity across the lifespan and elimination of health disparities (U.S. Department of Health and Human Services, 2012). Our results confirm that body mass is increasing persistently across calendar periods for all race/ethnic groups in our data. Calendar period effects are more consistently important than birth cohort effects for driving increasing body mass in the U.S. population. Indeed, birth cohort effects are modest in magnitude and are seldom statistically significant for individual race/ethnic groups. In contrast, calendar period emerges as a significant and substantial factor in driving body mass among nearly all race/ethnic and nativity groups (with the exception of U.S. born Cubans).

Our results also demonstrate, however, that the growth in body mass varies across race/ethnic and nativity groups. Puerto Ricans and Mexicans gained more weight in each calendar period than Cubans or Asians. And U.S. born adults gained body mass points more quickly than their foreign born counterparts for all race/ethnic groups except Asians. Indeed, the immigrant advantage in body mass is growing over time. The differential growth in body mass among U.S. born and foreign born adults may result from the changing composition of migrants over time or persistent advantages among immigrants that remain strong even years after entering the U.S.

Our future work will examine the role of socioeconomic status (employment status, education, and family income) in explaining or even widening race/ethnic and nativity differences in body mass over time. Further, we will also test for interactions between nativity and age, and nativity and birth cohort, when predicting body mass.

Our research provides an important step in identifying how age, period, and cohort trends in body mass differ by race/ethnicity and nativity and at what points in the life course require intervention. The significant calendar effects suggest that interventions that slow the growing prevalence of obesity might be successful at any age and for all birth cohorts. Our results also provide direction to researchers who are seeking to identify the sources of our growing epidemic of obesity. Consistent with Reither et al. (2009), our results suggest that body mass has been increasing steadily each year. More research is needed to understand why these patterns are occurring and what factors offer protection to immigrants.

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Table 1: Ordinary least squares coefficients predicting body mass index (BMI) by race/ethnic groups, 1989-2011

	Model 1 All groups	Model 2 NH Whites	Model 3 NH Blacks	Model 4 Mexican	Model 5 Puerto Rican	Model 6 Cuban	Model 7 Asian
Age	0.318***	0.298***	0.385***	0.358***	0.351***	0.304***	0.235***
Age^2	-0.003***	-0.003***	-0.004***	-0.004***	-0.003***	-0.002***	-0.002***
Birth Cohort							
≤1909							
1910-1914	-0.039	0.007	0.167	0.608	-0.571	-0.638	0.814
1915-1919	-0.155*	-0.023	-0.081	0.247	-0.25	-0.283	0.396
1920-1924	-0.164*	0.048	-0.217	-0.009	-0.879	-0.362	0.453
1925-1929	-0.219**	0.012	-0.253	0.218	-1.016	0.191	0.626
1930-1934	-0.239*	0.065	-0.38	-0.231	-1.064	0.354	0.673
1935-1939	-0.283**	0.056	-0.454	-0.317	-1.148	0.605	0.757
1940-1944	-0.335**	0.04	-0.575	-0.365	-1.142	1.084	0.807
1945-1949	-0.451***	-0.022	-0.826	-0.482	-1.276	1.595	0.819
1950-1954	-0.542***	-0.136	-0.958	-0.589	-1.229	1.607	0.882
1955-1959	-0.613***	-0.224	-1.061*	-0.71	-1.116	1.843	0.887
1960-1964	-0.519**	-0.177	-0.854	-0.762	-0.797	2.063	0.993
1965-1969	-0.258	0.025	-0.394	-0.818	-0.67	2.25	1.193
1970-1974	-0.141	0.082	-0.202	-0.757	-0.664	2.062	1.206
1975-1979	-0.144	0.056	-0.254	-0.856	-0.686	2.456	1.204
1980-1984	-0.321	-0.097	-0.453	-1.039	-0.241	2.76	1.279
1985-1989	-0.610**	-0.298	-0.897	-1.524	-0.679	2.353	0.964
1990-1994	-1.063***	-0.890**	-1.740*	-1.797	-1.965	1.973	0.797
Calendar year	0.091***	0.071***	0.069***	0.094***	0.109***	0.053	0.058***
U.S. Born (=1)	-80.259***	-91.554***	-129.856***	-135.417***	-96.851***	-113.674**	-19.349
U.S. Born *							
Calendar year	0.041***	0.046***	0.066***	0.068***	0.049***	0.057**	0.01
Female (=1)	-0.748***	-1.252***	1.247***	-0.193***	-0.152	-0.452***	-1.544***
Intercept	-162.379***	-122.661***	-120.544***	-167.012***	-197.878	*** -88.515	-98.443***
R^2	0.063	0.074	0.069	0.075	0.065	0.061	0.108
N (unweighted)	1,024,668	704,357	137,717	78,940	14,425	7,792	32,179

Note: * p<.1; ** p<.05; *** p<.01

Figure 1: Predicted relationship between calendar year, nativity, and body mass index, calcuated from the corresponding models on Table 1.