Obesity Among US Immigrant Subgroups by Duration of Residence

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Context The prevalence of obesity has increased substantially since the 1980s. While immigrants are the fastest growing segment of the US population, little is known about obesity or clinician counseling about diet and exercise in this group.

Objectives To estimate the prevalence of obesity among immigrant subgroups and quantify the magnitude of the association with duration of US residence, and to describe reported diet and exercise counseling by birthplace, race, and ethnicity.

Design, Setting, and Participants Cross-sectional study using data from the 2000 National Health Interview Survey.

Main Outcome Measures Body mass index (BMI, measured as weight in kilograms divided by the square of height in meters) based on self-reported height and weight measurements, and self-reported rates of diet and exercise counseling.

Results Of 32374 respondents, 14% were immigrants. The prevalence of obesity was 16% among immigrants and 22% among US-born individuals. The age- and sex-adjusted prevalence of obesity was 8% among immigrants living in the United States for less than 1 year, but 19% among those living in the United States for at least 15 years. After adjusting for age, sociodemographic, and lifestyle factors, living in the United States for 10 to 15 and at least 15 years was associated with BMI increases of 0.88 and 1.39, respectively. The association for 15 years or more was significant for all immigrant subgroups except foreign-born blacks. Additionally, immigrants were less likely than US-born individuals to report discussing diet and exercise with clinicians (18% vs 24%, $P<.001$; 19% vs 23%, $P<.001$, respectively). These differences were not accounted for by sociodemographic characteristics, illness burden, BMI, or access to care among some subgroups of immigrants.

Conclusions Among different immigrant subgroups, number of years of residence in the United States is associated with higher BMI beginning after 10 years. The prevalence of obesity among immigrants living in the United States for at least 15 years approached that of US-born adults. Early intervention with diet and physical activity may represent an opportunity to prevent weight gain, obesity, and obesity-related chronic illnesses.

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Since the 1980s, the US population has become more obese, with similar trends documented worldwide.[1-3] The World Health Organization recently described "globesity" as a global epidemic of obesity affecting at least 300 million people, with a 3-fold or greater increase since 1980 in parts of Eastern Europe, the Middle East, the Pacific Islands, and China.[4] Nevertheless, the prevalence of obesity in most parts of the world is lower than in the United States.

The high prevalence of obesity has produced a major burden of obesity-related illnesses. In the year 2000, overweight and obesity accounted for nearly 17% of all deaths in the United States, a mortality rate surpassed only by that of tobacco use.[5]According to the Centers for Disease Control and Prevention, poor diet and physical inactivity, both modifiable behaviors, cause a large part of this mortality from overweight.[5] Thus, many guidelines recommend obesity prevention through the promotion of exercise and healthy diet.[6-8]

Evidence suggests significant racial and ethnic differences in the prevalence of obesity and the susceptibility to obesity-related illnesses, particularly among individuals who are black, Latino, and Asian, relative to whites.[9,10] However, few data are available about the epidemiology of obesity among immigrants, the fastest growing segment of the US population, currently comprising more than 11% of the total US population and an even larger proportion of many minority groups.[11] Immigrants generally originate from countries where the prevalence of obesity is lower than that of the United States, but acculturation to US norms over time may lead to an increasing prevalence of obesity among this population.[3,12] The magnitude of the change in body mass index (BMI) and the consistency of the effect of acculturation on BMI among various immigrant subgroups, however, remain unclear.

Additionally, immigrants face more barriers to quality health care[13] and are less likely to receive preventive health care than persons born in the United

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States.[14] Whether immigrants are less likely to discuss diet and exercise with clinicians is unknown.

We therefore examined the relationship between prevalence of obesity and years of US residence among immigrants nationally and explored whether counseling about diet and exercise may differ between immigrants and US-born adults.

METHODS

Data Source

We used data from the Sample Adult Module of the 2000 National Health Interview Survey (NHIS), an in-person health survey of the civilian, noninstitutionalized population, administered by the US Bureau of the Census for the National Center for Health Statistics.[15] Latino and black populations are oversampled to allow for more precise estimation of these minority groups. A total of 100 618 respondents from 38 633 households provided information about basic measures of health status, utilization of health services, and sociodemographics including country of birth. In addition, 1 randomly selected adult per household, aged 18 years or older, was asked to complete the Sample Adult Module (n=32 374), which elicited detailed information on health care services, behavior, and health status including height and weight. The combined response rate to both components of the survey, based on the American Association for Public Opinion Research standards for Response Rate 5,[16] was 72%. Sample weights provided by National Center for Health Statistics account for the complex sampling design of NHIS and also account for nonresponse. These weights are modified for poststratification adjustments for census sex, age, and race/ethnicity population controls. This weighting of data allows estimates that generalize to the civilian, noninstitutionalized population. The survey is administered in only Spanish or English languages and does not allow proxy respondents for Sample Adult questions. Family members may translate for a non–English- or non–Spanish-speaking respondent who is present in the home.

We received institutional review board exemption from Beth Israel Deaconess Medical Center for this study.

Outcomes of Interest

We defined obesity as having a BMI of more than 30 (measured as weight in kilograms divided by the square of height in meters) among adults.[17] The National Health Interview Survey calculates BMI from self-reported information on height and weight, measures previously established as largely valid for BMI when used in combination with adjustments for age.[18] We used BMI as a continuous outcome for all linear regression analyses examining the relationship between years of residence in the United States and BMI. For all other analyses, we classified BMI as a categorical outcome based on the National Institutes of Health classification scheme[17]: underweight (BMI <18.5), normal weight (18.5-<25), overweight (25-<30), obese class I (30-<35), obese class II (35-<40), and obese class III (≥ 40).

We were also interested in exploring differences in receipt of dietary and exercise counseling, which were ascertained only in respondents who reported seeing or talking with a health care professional in the past year (n=26 402). We considered those responding to the following questions in the affirmative as having received that counseling. Dietary counseling was assessed with the question "During the past 12 months has a doctor or other health professional talked with you about your diet and eating habits?" Exercise counseling was assessed with the question "During the past 12 months did a doctor or other health professional recommend that you begin or continue to do any type of exercise or physical activity?"

Race/Ethnicity, Birthplace, and Years of US Residence

Race/ethnicity was ascertained with 2 questions. Respondents were asked, "Do you consider yourself to be Hispanic, or Latino?" and "What race do you consider yourself to be?" Respondents were asked to select 1 or more of 16 options for the latter question. We considered foreign birth as a proxy for immigrant status and defined foreign birth as birthplace either in a US territory or outside of the United States, based on responses to the question "Where were you born?" Choices for responses included specific states within the United States, the United States, other countries, or territories. The National Health Interview Survey categorized respondents born in US territories as foreign born; as these respondents were likely to be culturally more similar to other foreign-born respondents than to US-born respondents, we used this grouping also.

For our analyses, we considered race/ethnicity and birthplace together. We classified respondents into the following 8 nonoverlapping categories: US-born white, black, Latino, and Asian (including Asian American and Pacific Islander); and foreign-born white, black, Latino, and Asian (including Asian American and Pacific Islander).

Finally, we categorized respondents according to their years of residence in the United States (<1 year, 1-<5 years, 5-<10 years, 10-<15 years, or ≥ 15 years) based on their response to the question "About how long have you been in the United States?"

Additional Factors of Interest

We also considered other sociodemographic characteristics, illness burden, measures of access to health care, and health behaviors. Sociodemographic characteristics included age (in decades), sex, marital status (married, not married), region of residence (Northeast, Midwest, South, West), level of education ($<$high school graduate, high school graduate, some post–high school education, $\geq$college graduate), and annual household income ($<\$20\,000$, $\geq\$20\,000$). We defined illness burden using several variables: self-reported health status (excellent/very good, good, fair/poor), which has previously been shown to be associated with mortality in a multiethnic cohort[19]; smoking status (never, cur-

rent, past); alcohol use (rare [<1 drink/wk], moderate [between 1 drink/wk and no more than 2 drinks/d], heavy [>2 drinks/d]); presence of concurrent illnesses (diabetes, hypertension, coronary artery disease, stroke, ulcer, arthritis, cancer other than nonmelanoma skin cancer, or other); and hospitalizations in the past year (0, 1, ≥2). We measured access to care using the following proxies: type of health insurance (none, Medicare, Medicaid, private, other), and usual source of care (general practitioner, specialist including obstetrician/gynecologist, no usual clinician but usual source of care [such as a health center, physician's office, hospital clinic, or some other place not

Table 1. Characteristics of the US-Born Population*

	White (n = 20 184)		Black (n = 4087)		Latino (n = 2179)		Asian (n = 150)	
	No.	% (SE)	No.	% (SE)	No.	% (SE)	No.	% (SE)
Demographics								
Age, mean (SE)		46 (0.17)		42 (0.34)		39 (0.46)		40 (2.20)
Female sex	11 266	52 (0.4)	2611	57 (1.0)	1267	54 (1.4)	74	45 (5.0)
Married	10 315	61 (0.5)	1116	36 (0.9)	953	52 (1.2)	55	40 (4.0)
Highest education level								
<High school graduate	2722	13 (0.3)	1063	25 (1.0)	681	28 (1.1)	8†	4 (2.0)
High school graduate	6350	32 (0.4)	1234	33 (0.9)	682	33 (1.3)	35	23 (4.5)
Some college	5834	29 (0.4)	1198	29 (0.9)	612	30 (1.4)	48	39 (4.8)
≥4 years of college	5111	25 (0.4)	550	13 (0.7)	190	9 (0.9)	59	33 (3.7)
Income <$20 000/y	4350	17 (0.3)	1620	34 (1.0)	746	26 (1.2)	35	17 (3.8)
Region of residence								
Northeast	3852	20 (0.4)	603	14 (0.7)	248	12 (1.2)	16†	13 (4.0)
Midwest	5896	30 (0.5)	849	21 (1.0)	146	8 (0.8)	5†	3 (1.5)
South	6790	35 (0.5)	2267	58 (1.3)	822	36 (2.0)	13†	9 (2.6)
West	3646	16 (0.5)	368	7 (0.5)	963	45 (2.1)	116	76 (5.4)
Self-reported illness burden								
Diabetes	1137	5 (0.2)	409	9 (0.5)	184	8 (0.6)	5†	4 (1.8)
Hypertension	5057	23 (0.3)	1408	30 (0.8)	393	16 (0.9)	33	23 (3.5)
Coronary artery disease	1391	6 (0.2)	217	5 (0.4)	95	4 (0.4)	8†	4 (1.2)
BMI‡								
18.5-<25	8259	43 (0.4)	1198	31 (0.8)	729	31 (1.2)	74	42 (2.9)
25-<30	6713	35 (0.4)	1400	37 (0.9)	746	37 (1.2)	44	35 (3.8)
30-<35	2616	14 (0.3)	749	19 (0.7)	395	20 (1.0)	7†	6 (2.4)
35-<40	874	5 (0.2)	283	7 (0.5)	141	8 (0.8)	2†	4 (0.6)
≥40	428	2 (0.1)	222	5 (0.4)	71	3 (0.4)	4†	7 (1.9)
Fair/poor health status	2343	11 (0.3)	809	18 (0.7)	335	14 (0.8)	12†	8 (2.9)
Not hospitalized in past year	18 045	90 (0.2)	3595	90 (0.5)	1956	91 (0.8)	137	94 (1.8)
Lifestyle behaviors								
Exercise								
Sedentary	7546	36 (0.5)	2206	53 (1.1)	1014	45 (1.3)	45	29 (4.2)
Moderate	4331	22 (0.4)	666	17 (0.8)	414	19 (1.0)	43	27 (3.6)
High	8051	40 (0.5)	1160	30 (1.0)	730	35 (1.5)	61	44 (4.8)
Current smoker	4864	24 (0.4)	1025	25 (0.7)	497	23 (1.2)	23†	17 (4.1)
Heavy alcohol use	3491	18 (0.4)	489	14 (0.7)	416	20 (1.2)	26†	18 (3.7)
Usual source of health care								
Generalist	13 999	69 (0.5)	2734	66 (1.0)	1274	59 (1.4)	110	73 (4.9)
Specialist, including obstetrician/gynecologist	1988	10 (0.3)	418	10 (0.6)	250	11 (0.9)	9†	5 (1.7)
Clinic only	2631	14 (0.3)	506	14 (0.8)	336	16 (0.9)	24†	18 (4.7)
No usual source of care	1388	7 (0.2)	370	10 (0.6)	292	14 (1.1)	7†	5 (1.9)
Insurance								
None	1983	10 (0.3)	732	19 (0.8)	509	23 (1.3)	9†	7 (3.3)
Medicare	4677	19 (0.4)	731	14 (0.6)	270	10 (0.9)	28†	14 (3.4)
Medicaid	519	2 (0.1)	442	10 (0.7)	232	9 (0.7)	6†	3 (1.5)
Private	12 373	67 (0.4)	1977	53 (1.0)	1103	57 (1.2)	100	73 (4.7)

*Sample sizes are based on unweighted and unadjusted data; however, all analyses and proportions are weighted to reflect national population estimates. χ^2 Statistics were used to compare respondent characteristics across the 8 subgroups defined by race/ethnicity and birthplace combined. All *P* values <.001. Column totals may not add to 100 due to rounding.
†Estimate based on a sample size of <30 respondents and should be interpreted with caution because they may not meet the standard of reliability or precision.
‡Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Proportion estimates (%) adjusted for age and sex.

including an emergency department], no usual source of care).

Because the level of current physical activity might influence rates of obesity and receipt of dietary and exercise counseling, we included level of leisure physical activity as a potential confounder. We categorized physical activity level as high (vigorous activity ≥2 times/wk or moderate activity ≥4 times/wk), moderate (vigorous activity 1 time/wk or moderate activity 1-3 times/wk), or sedentary (no vigorous or moderate activity/week) based on validated methods described previously.[20]

Additionally, because respondent occupation may influence level of physical activity, in secondary subgroup analy-

Table 2. Characteristics of the Foreign-Born Population*

	White (n = 1019)		Black (n = 405)		Latino (n = 3198)		Asian (n = 696)	
	No.	% (SE)	No.	% (SE)	No.	% (SE)	No.	% (SE)
Demographics								
Age, mean (SE)		48 (0.69)		40 (0.76)		40 (0.47)		41 (0.72)
Female sex	558	51 (1.9)	216	45 (3.1)	1768	49 (1.1)	379	50 (2.4)
Married	537	64 (1.6)	140	41 (3.2)	1818	63 (1.1)	436	70 (2.1)
Highest education level								
<High school graduate	157	15 (1.4)	62	15 (2.3)	1839	57 (1.3)	84	12 (1.8)
High school graduate	244	27 (2.0)	109	28 (2.4)	560	19 (0.9)	114	18 (1.7)
Some college	257	25 (1.7)	131	33 (2.3)	489	16 (0.8)	153	23 (2.0)
≥4 years of college	327	33 (1.9)	96	24 (2.5)	257	8 (0.6)	332	47 (2.3)
Income <$20 000/y	279	25 (1.6)	129	25 (2.2)	1307	33 (1.4)	164	17 (1.3)
Region of residence								
Northeast	335	33 (1.8)	191	49 (3.3)	604	18 (1.1)	163	24 (1.9)
Midwest	172	18 (1.6)	38	9 (1.8)	192	8 (1.0)	96	14 (1.7)
South	232	22 (1.6)	143	36 (3.1)	1086	34 (1.6)	138	20 (1.9)
West	280	27 (2.1)	33	6 (1.5)	1316	39 (1.5)	299	41 (2.4)
Self-reported illness burden								
Diabetes	55	6 (0.9)	25†	5 (0.9)	195	6 (0.5)	22†	4 (1.0)
Hypertension	217	19 (1.4)	94	21 (2.2)	498	13 (0.7)	97	15 (1.7)
Coronary artery disease	55	5 (0.7)	10†	2 (0.6)	124	3 (0.3)	13†	2 (0.6)
BMI‡								
18.5-<25	462	48 (1.9)	153	40 (2.9)	1111	37 (1.2)	441	62 (2.1)
25-<30	315	33 (1.7)	153	36 (1.8)	1261	41 (1.1)	154	25 (1.8)
30-<35	111	11 (1.2)	61	15 (2.0)	434	14 (0.7)	28†	6 (1.1)
35-<40	25†	2 (0.5)	15†	6 (1.6)	119	4 (0.4)	2†	0 (0.3)
≥40	14†	2 (0.6)	6†	2 (0.7)	68	2 (0.3)	4†	1 (0.3)
Fair/poor health status	124	12 (1.2)	39	7 (1.3)	469	13 (0.9)	42	6 (0.9)
Not hospitalized in past year	921	92 (0.9)	369	94 (1.1)	2920	93 (0.4)	662	95 (0.9)
Lifestyle behaviors								
Exercise								
Sedentary	439	44 (1.7)	179	41 (3.3)	1915	59 (1.3)	276	39 (2.0)
Moderate	183	19 (1.6)	81	20 (2.2)	498	15 (0.8)	157	23 (2.2)
High	375	36 (1.8)	139	38 (2.7)	758	25 (1.1)	250	36 (2.1)
Current smoker	198	21 (1.9)	50	11 (1.5)	487	16 (0.8)	104	14 (1.5)
Heavy alcohol use	135	13 (1.2)	29†	7 (1.4)	432	14 (0.9)	51	6 (1.1)
Usual source of health care								
Generalist	637	63 (2.2)	259	62 (3.4)	1656	49 (1.3)	382	58 (2.1)
Specialist, including obstetrician/gynecologist	106	10 (1.0)	33	10 (1.8)	317	10 (0.6)	70	10 (1.1)
Clinic only	143	16 (1.5)	60	15 (3.3)	417	14 (0.8)	128	18 (1.6)
No usual source of care	108	11 (1.4)	49	13 (2.8)	754	27 (1.4)	99	15 (1.5)
Insurance								
None	131	13 (1.3)	99	26 (2.8)	1364	46 (1.4)	123	19 (1.5)
Medicare	254	21 (1.5)	27†	7 (1.2)	322	8 (0.8)	47	6 (1.1)
Medicaid	45	5 (0.7)	29†	6 (1.6)	268	6 (0.4)	31	3 (0.7)
Private	549	59 (1.8)	233	60 (2.9)	1138	38 (1.2)	452	69 (1.9)

*Sample sizes are based on unweighted and unadjusted data; however, all analyses and proportions are weighted to reflect national population estimates. χ^2 Statistics were used to compare respondent characteristics across the 8 subgroups defined by race/ethnicity and birthplace combined. All *P* values <.001. Column totals may not add to 100 due to rounding.
†Estimate based on a sample size of <30 respondents and should be interpreted with caution because they may not meet the standard of reliability or precision.
‡Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Proportion estimates (%) adjusted for age and sex.

ses we also examined the association of occupation on change in BMI with duration of residence, and on reported receipt of dietary and exercise counseling in a subgroup of respondents with information on occupation. We qualitatively categorized NHIS-defined occupations into sedentary (eg, administrators, engineers, health care providers) or active (eg, police/firefighters, construction laborers, farm/agricultural workers) by adapting methods used by Wee et al.[21] We were able to classify occupational activity levels for 54% of those who reported having an occupation (n=19 707), and excluded those with occupations that were difficult to classify (eg, personal service, farm operators/managers).

Statistical Analysis

We conducted bivariable analyses comparing baseline characteristics across our 8 groups of interest defined according to race/ethnicity and birthplace. We used χ^2 statistics for all categorical variables.

To determine differences in BMI among foreign-born adults according to duration of residence in the United States, we first described the age- and sex-adjusted prevalence of obesity among the foreign-born by years of US residence, and used the χ^2 test for trend in this relationship. We then fit a linear regression model with BMI as the continuous outcome and the categorical variable of years in the United States as the primary association of interest, collapsing the lowest 2 categories after ensuring no significant differences (0-<5 years, 5-<10 years, 10-<15 years, ≥15 years), and adjusting for age, sex, race/ethnicity, education, and income. To examine whether differences in BMI could be attributable to differences in lifestyle, we additionally adjusted for health behaviors such as alcohol use, smoking, and leisure physical activity. We then further adjusted for occupation (sedentary, active) among a subgroup with information on level of occupational activity. To examine the association between duration of US residence and BMI among various subgroups, we stratified our primary analysis by sex, then by race/ethnicity.

To explore differences in reported dietary or exercise counseling by race/ethnicity and birthplace, we fit logistic regression models for each respective outcome, adjusting for potential confounders: sociodemographic characteristics, illness burden, and access to care, as previously defined. To examine the influence of physical activity, we further adjusted for level of leisure physical activity (high, moderate, sedentary) and performed subgroup analyses among those with classifiable occupational activity (active, sedentary).

For all multivariable analyses, we assessed confounding using a 10% change in the estimated β coefficients from the multivariable models as our criterion. For all analyses, data were weighted to reflect national population estimates and analyzed using SAS-callable SUDAAN software, version 7.5 (Research Triangle Institute, Research Triangle Park, NC) to adjust for the complex sampling design. We considered a 2-tailed P value of ≤.05 statistically significant for all analyses.

Because this is a secondary analysis of a survey database, we were limited to post hoc power analyses. Based on these, we estimated an 80% power to detect the following differences in BMI between immigrants living in the United States less than 5 years and those living in the United States for 10 to 15 years: 0.8 for all immigrants, 1.6 for whites, 2.7 for blacks, 1.0 for Latinos, and 1.6 for Asians. Comparing immigrants living in the United States less than 5 years and those living in the United States for 15 or more years, we could detect the following differences in BMI: 0.7 for all immigrants, 1.2 for whites, 2.5 for blacks, 1.0 for Latinos, and 1.3 for Asians.

For rates of reported dietary counseling, we had 80% power to detect the following absolute differences relative to our reference group of US-born whites: 2.3% for US-born blacks, 3.1% for US-born Latinos, 10.1% for US-born Asians, 4.3% for foreign-born whites, 6.5% for foreign-born blacks, 2.8% for foreign-born Latinos, and 5.3% for foreign-born Asians. This was similar for reported exercise counseling.

RESULTS

Study Population Characteristics

The 32 374 eligible respondents represent an estimated 201 million adults in the United States. Of these respondents, 14% were foreign born. Compared with US-born respondents, foreign-born respondents were generally older, had lower annual household incomes and education, had lower illness burden, and had poorer access to care (TABLE 1 and TABLE 2). The foreign-born respondents were less often obese than those born in the United States (16% vs 22%, $P<.001$), but they were also more often sedentary than US-born respondents.

Changes in BMI With Duration of Residence in the United States

In this cross-sectional analysis, adjusted for age and sex, the foreign-born were generally less likely than the US-born to be overweight and obese (FIGURE). However, the proportion of overweight and obese foreign-born individuals increased with longer duration of residence in the United States. The prevalence of obesity among foreign-born respondents living in the United States for less than 1 year was 8%. In contrast, the BMI distribution of foreign-born respondents living in the United States for at least 15 years approached that of US-born respondents, with 41% at normal weight, 38% overweight, and 19% obese, compared with 41%, 35%, and 22% of the US-born, respectively.

Examining the relationship between the magnitude of change in BMI and duration of US residence showed that living in the United States for 10 years or more was associated with a significantly higher BMI (TABLE 3). Results were similar after additional adjustment for health behaviors and in a subgroup with classifiable occupational activity. Years of US residence was associated with a significant increase in BMI for men, women, and all racial/ethnic groups, except for foreign-

born blacks. We found no significant interaction between race/ethnicity and number of years in the United States.

Differences in Reported Dietary and Exercise Counseling by Race/Ethnicity and Birthplace

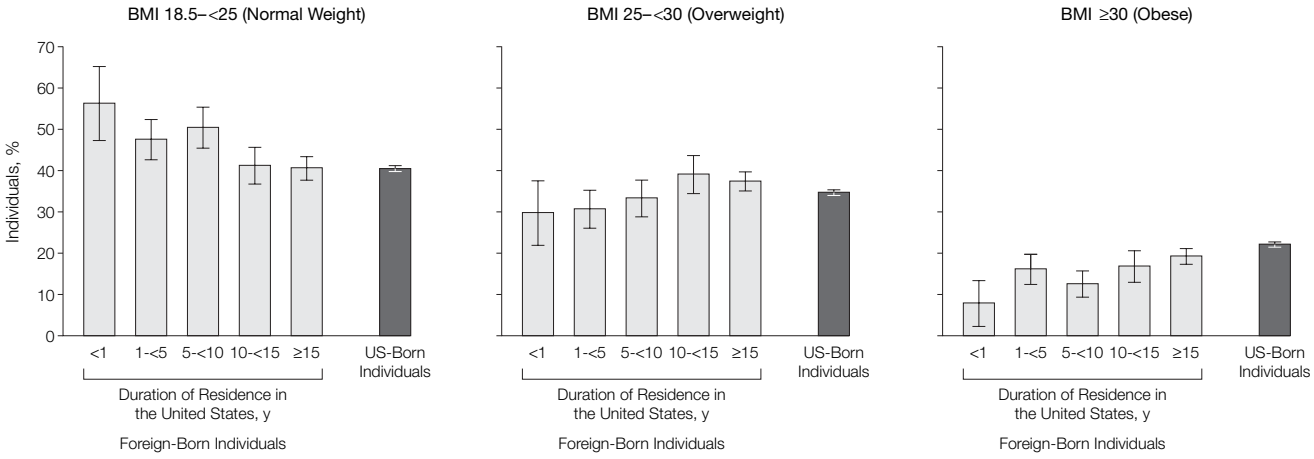
Overall, 24% of respondents reported discussing their diet and eating habits with a clinician in the past year; foreign-born respondents were less likely to report counseling than were US-born respondents (18% vs 24%, $P<.001$). After adjustment, foreign-born blacks and Latinos were less likely to report dietary counseling than US-born whites (TABLE 4). Results were similar after additional adjustment for level of leisure physical activity and in a subgroup analysis incorporating occupational activity.

Overall, 23% of respondents reported that a clinician recommended beginning or continuing exercise within the last 12 months: 19% of foreign-born compared with 23% of US-born respondents ($P<.001$). After adjustment, foreign-born black, but not foreign-born Latino or Asian, respondents were less likely to report exercise counseling than were US-born whites; US-born black respondents were also significantly less likely to report exercise counseling (Table 4). Relationships were similar after adjustment for level of leisure physical activity and in a subgroup analysis adjusting for occupational activity.

COMMENT

Our study shows that among a number of immigrant subgroups, longer duration of residence in the United States is associated with higher BMI, such that the distribution of obesity among immigrants residing in the United States for 15 or more years approaches that of the US born. To illustrate the impact, for a typical 5′4″ (1.63-m) immigrant woman and a typical 5′9″ (1.75-m) immigrant man this amounts to an excess 9 lb (4.05 kg) and 11 lb (4.95 kg), respectively, in addition to any weight gained due to aging or other factors. Using a nationally representative sample of foreign-born individuals, we found that this trend is present among immigrant whites, Lati-

Figure. Adjusted Body Mass Index of Foreign-Born Individuals (n = 4631) by Years of US Residence



Body mass index was calculated as weight in kilograms divided by height in meters squared. Estimates were adjusted for age and sex and weighted to reflect national population estimates. Data for underweight respondents are not reported. $P<.001$ for trend in the age- and sex-adjusted prevalence of obesity with longer duration of US residence among foreign-born individuals. Error bars represent 95% confidence intervals.

Table 3. Adjusted Change in BMI With Duration of US Residency Among Foreign-Born Individuals (n = 4413)*

	0-<5 y		5-<10 y		10-<15 y		≥15 y	
	No. of Individuals	Adjusted β Coefficient (95% CI)†	No. of Individuals	Adjusted β Coefficient (95% CI)†	No. of Individuals	Adjusted β Coefficient (95% CI)†	No. of Individuals	Adjusted β Coefficient (95% CI)†
Overall foreign-born‡ (n = 4413)	745	Reference	681	0.15 (–0.40 to 0.70)	692	0.88 (0.35 to 1.41)	2295	1.39 (0.84 to 1.94)
Stratified by race/ethnicity§								
White (n = 820)	130	Reference	72	0 (–1.22 to 1.22)	82	0.82 (–0.40 to 2.03)	536	2.15 (1.05 to 3.25)
Black (n = 343)	51	Reference	53	–0.05 (–2.28 to 2.18)	59	–0.06 (–2.67 to 2.55)	180	0.33 (–2.04 to 2.70)
Latino (n = 2626)	420	Reference	447	0.28 (–0.46 to 1.02)	450	1.13 (0.54 to 1.72)	1309	1.35 (0.70 to 2.00)
Asian (n = 585)	138	Reference	106	–0.28 (–1.20 to 0.64)	95	0.08 (–1.03 to 1.97)	246	1.00 (0 to 1.99)

Abbreviation: CI, confidence interval.
*Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters.
†The β coefficient represents the change in BMI for a given duration of residence in the US from a linear regression model. Model sample sizes may vary due to missing data.
‡Adjusted for age, race/ethnicity, sex, education, and income. Analyses were weighted to reflect national population estimates.
§Adjusted for age, sex, education, and income. Analyses were weighted to reflect national population estimates.

Table 4. Reported Receipt of Dietary and Exercise Counseling

	US-Born				Foreign-Born			
	White	Black	Latino	Asian	White	Black	Latino	Asian
Dietary Counseling (n = 25 446)								
Weighted % (SE)*	24 (0.4)	26 (1.1)	22 (1.3)	25 (4.8)	22 (1.6)	18 (2.2)	17 (0.9)	16 (1.9)
Adjusted odds ratio (95% CI)†	Reference	1.02 (0.89-1.17)	0.87 (0.72-1.05)	1.01 (0.57-1.79)	0.97 (0.78-1.21)	0.70 (0.53-0.92)	0.80 (0.67-0.96)	0.76 (0.54-1.06)
Exercise Counseling (n = 25 365)								
Weighted % (SE)*	23 (0.4)	22 (0.9)	24 (1.2)	25 (5.3)	22 (1.6)	16 (2.2)	17 (1.0)	20 (1.9)
Adjusted odds ratio (95% CI)†	Reference	0.88 (0.77-1.00)	0.94 (0.79-1.12)	0.87 (0.43-1.74)	0.97 (0.79-1.19)	0.64 (0.47-0.88)	0.89 (0.74-1.07)	0.99 (0.74-1.33)

Abbreviation: CI, confidence interval.
*All analyses are weighted to reflect national estimates. $P<.001$ for comparison of receipt of counseling across 8 groups defined by race/ethnicity and birthplace.
†n=21 510 for dietary and n=21 432 for exercise counseling due to missing covariate data. Adjusted for age in decades, sex, marital status, education, income, region of residence, smoking status, alcohol intake, body mass index, reported health status, hypertension, coronary artery disease, stroke, diabetes, ulcer, cancer, arthritis, other concurrent illnesses, hospitalizations, usual source of health care, and type of insurance.

nos, and Asians. Our study also suggests that some immigrant minority groups may be less likely to discuss diet or exercise with their clinicians.

Using data from the 1993-1994 NHIS, Singh and Siahpush[22] reported that immigrants with longer duration of residence in the United States appear to be at higher risk of obesity than recent US immigrants. As part of a larger study examining causes of morbidity and mortality among immigrants, they described a cross-sectional relationship of increasing prevalence of obesity among immigrants and longer duration of residence in the United States, after adjusting for sociodemographic factors. Kaplan et al[23] confirmed this among Hispanics using 1998 NHIS data. Our study, using more recent data from 2000, in addition to being consistent with these previous results, estimated the magnitude of the increase in BMI associated with longer duration of residence in the United States and described these relationships across racial/ethnic subgroups. We found that BMI did not increase substantially until after living in the United States for at least 10 years, suggesting a threshold effect.

Trends in obesity among immigrants may reflect acculturation and adoption of the US lifestyle, such as increased sedentary behavior and poor dietary patterns. They may also be a response to the physical environment of the United States, with increased availability of calorically dense foods and higher reliance on labor-saving technologies. After 10 years, BMI appears to increase more substantially, a pattern that was consistent across sex and race/ethnicity, except among immigrant blacks for whom there was no change in BMI associated with years of US residence. Because of the cross-sectional nature of our data, we cannot establish a causal relationship between duration of residence and BMI. Our findings could reflect a cohort effect in which immigrants residing in the United States for a longer duration were more obese at the time of immigration than more recent immigrants; however, this is unlikely given the global trend toward obesity and the consistency between our findings and earlier studies.

Increasing obesity with longer duration of US residence is concerning given the rapid growth of the immigrant population[11] and the adverse health care consequences associated with obesity.[5] Unfortunately, our findings also suggest that clinicians may be paying less attention to diet and exercise among some immigrant groups. We found that foreign-born minorities were generally less likely to report discussing diet and exercise with their clinicians, and US-born blacks were also less likely to report discussing exercise.

Reasons for these differences are unclear. Variation in sociodemographics, illness burden, and access to care may have contributed. However, the measured differences may be an artifact of how questions about counseling in the NHIS were interpreted by different cultural groups.[24] Research is needed to replicate our findings using more culturally sensitive methods and should also explore potential mechanisms for any observed differences such as language barriers, cultural discordance between patient and clinician, and clinician perceptions about lifestyle behaviors and obesity risk among foreign-born individuals.

Our study has some important limitations. Our results were based on self-reported information, which may lead to recall bias. Whether foreign-born and US-born adults have different biases in reporting weight, height, receipt of counseling, illness burden, or health behaviors is unclear, given that these concepts may be understood differently in different cultural groups.[24] The NHIS attempts to account for the nonresponse rate of 28% in the weighting procedure; however, the possibility of residual bias remains, which could limit the generalizability of our findings. It is unclear what proportion of non–English- and non–Spanish-speaking adults were excluded and what proportion used translators. In addition, we had no direct measures of acculturation, except for years of US residence, thereby limiting our ability to examine mechanisms of weight gain among immigrants. Finally, our study may have missed some important associations due to inadequate power to detect potentially clinically important differences in reported counseling rates, up to 5.3% for foreign-born Asians.

In summary, immigrants appear to assume a similarly high prevalence of

obesity as US-born adults with longer duration of residence. With the growing immigrant population in the United States, early clinician intervention on diet and physical activity may represent an important opportunity to prevent weight gain, obesity, and obesity-related chronic illnesses.

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Study concept and design: Goel, McCarthy, Phillips, Wee.
Analysis and interpretation of data: Goel, McCarthy, Phillips, Wee.
Drafting of the manuscript: Goel, McCarthy, Phillips, Wee.
Critical revision of the manuscript for important intellectual content: Goel, McCarthy, Phillips, Wee.
Statistical analysis: Goel, McCarthy, Phillips, Wee.
Administrative, technical, or material support: Goel.
Study supervision: Goel, McCarthy, Phillips, Wee.
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