The Role of Immigration Status and Residency Duration in the Risk of Obesity: Insights from an Adjusted Logistic Regression Analysis

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Abstract

Introduction: Obesity impacts about 42% of adults in the United States, affecting both U.S.-born and non-U.S.-born individuals, who comprise 14% of the population. This study investigates how migration status and residency duration influence obesity risk, adjusting for clinical, socioeconomic, and behavioral factors.

Methods: Data from the 2017-2018 National Health and Nutrition Examination Survey (NHANES) were analyzed, including 5,591 adults aged 20 and older. Logistic regression assessed obesity, defined as a Body Mass Index (BMI) ≥ 30 kg/m², relative to migration status, with adjustments for age, gender, race, income, education, comorbidities, and behaviors.

Results: Among 2,540 participants, 45.4% were classified as obese. Of U.S.-born individuals, 77.1% had a BMI ≥ 30 kg/m², compared to 40.9% of non-U.S.-born individuals. Non-U.S.-born individuals showed 46.2% lower odds of obesity (OR 0.54; p < 0.0001). In the adjusted model, foreign-born status was associated with 40% lower obesity odds (adjusted OR 0.6; p < 0.0001), though longer residency increased risk. Risk factors included female gender, Hispanic or Black race, higher income, and depression. Specifically, those residing in the U.S. for 15-20 years had 60% greater obesity odds (OR 1.62; p = 0.04), while over 20 years of residence saw an 88% increase (OR 1.88; p = 0.002).

Conclusion: Migration status significantly influences obesity risk, with lower prevalence in non-U.S.-born individuals. However, longer U.S. residency heightens obesity risk, emphasizing the need for targeted public health strategies addressing cultural, socioeconomic, and dietary challenges faced by immigrants.

Introduction

The United States (U.S.) has one of the highest obesity rates in the world, with an estimated 42% of individuals affected by this condition (Cawley et al., 2021). Despite significant public policy and therapeutic efforts to reduce obesity in the U.S., obesity continues to rise, leading to substantial healthcare and economic burdens (Cawley et al., 2021; Commodore-Mensah et al., 2018). Additionally, obesity-related conditions are among the major causes of morbidity and mortality in the U.S. (Goel, 2004). Various genetic, sociocultural, and financial factors may influence its prevalence and associated health outcomes (Goel, 2004; Kaplan et al., 2024).

According to the 2024 World Migration Report, the U.S. hosts 47.8 million migrants, representing nearly 14% of the total population by 2023 (Moslimani & Pasel, 2024). Individuals born in other countries may have varying susceptibilities to obesity and face increased risks of adverse health outcomes, as immigration is increasingly recognized as an independent

determinant of health (Castañeda, 2015). However, despite its importance to both individual and public health, the issue of obesity among immigrants remains underexplored. The World Health Organization (WHO) encourages health researchers worldwide to prioritize research focused on this vulnerable population, as further studies are required to investigate immigration status as a risk factor for obesity (WHO Health and Migration Programme, 2023).

In a rapidly developing and globalized society, along with new obesity prevention and treatment approaches, it is crucial to assess the impact of immigration on obesity in diverse populations to better understand their needs and inform effective primary prevention strategies (Kaplan et al., 2024; Papamargaritis et al., 2024).

Therefore, in this study, we aimed to compare the risk of obesity among immigrants and U.S.-born individuals by analyzing factors such as country of origin, length of stay in the U.S., income, education, health conditions, and lifestyle. Given the multifactorial nature of obesity, understanding its association within the immigrant population is crucial, requiring a more holistic approach by identifying the key drivers of this condition. We hypothesized that longer residency and socioeconomic challenges would contribute to higher obesity rates.

Materials and Methods

Study Design, Data Source, and Participants

This cross-sectional study utilized data from the 2017-2018 to National Health and Nutrition Examination Survey (NHANES) dataset, a comprehensive survey assessing health and nutritional factors in the United States (U.S.) with a representative sample of the American population (Centers for Disease Control and Prevention [CDC], 2024).

Adults aged 20 years or older who participated in the NHANES survey were included using the age-appropriate WHO Body Mass Index (BMI) definitions for this population (World Health Organization [WHO], 2024). Exclusion criteria included missing information on BMI (or its components, height and weight, if BMI was not already calculated), lack of information about immigration status or U.S.-born status, and data that were unreliable, misclassified, or questionable.

Exposure and Outcomes

The primary exposure was immigration status, categorized as a binary variable (*U.S.-born* vs. *foreign-born*). The primary outcome was obesity, defined as body mass index (BMI) $\geq$ 30 kg/m^2.

Additionally, we examined the association between duration of U.S. residency and obesity among immigrants, stratified into the following groups: <5 years, 5–10 years, 10–15 years, and >20 years.

Covariates and Missing Data

Key covariates included age, sex, race/ethnicity (non-Hispanic White, non-Hispanic Black, Asian American, Latino, including Mexican Americans and other Latinos), education level, depression (PHQ9 score), family income, length of U.S. residency, smoking status, and moderate recreational physical activity. We chose to include these variables as covariates because they represent important social determinants of health that could confound or explain the observed relationships between other covariates and outcomes. We also included smoking status and physical activity as health and behavioral indicators, as they could potentially influence health outcomes and behaviors. Education was categorized as less than high school, some college, or above. Marital status was defined by the presence or absence of a partner. Family income was classified as less than $40,000 per year or above. Smoking status was classified based on several questions about cigarette smoking, into categories of current smoker, former smoker, and never smoked, based on the concepts defined in the National Health Interview Survey (NHIS - Adult Tobacco Use - Glossary, 2019). Moderate recreational physical activity was categorized into two groups: less than 33 minutes per week and 33 minutes or more per week. Additionally, physical activity was classified according to recommendations for adults by the U.S.. Department of Health and Human Services into three categories: I) Insufficient/Inactive (< Category II), II) Meets Criteria (150–300 minutes of moderate physical activity per week or 75–150 minutes of vigorous physical activity per week), and III) Highly Active (more than 300 minutes of moderate physical activity per week or more than 150 minutes of vigorous activity per week) (. Department of Health and Human Services, 2018).

The analysis utilized complete case data to handle missing values. For missing length-of-stay data among U.S-born people, we imputed 20 years—an optimistic assumption made to enhance the specificity of potential positive findings, since these categorized data were not available to indicate the actual age of Americans. In addition, since we only included adults aged 20 years or older, we assume that U.S-born people had spent at least 20 years living in the U.S. if their length of stay was missing from the dataset.

Statistical Analysis

Descriptive statistics were calculated, with categorical variables expressed as frequencies and percentages, and compared between groups using the chi-square or Fisher's exact tests. Continuous variables were presented as means and standard deviations or medians and interquartile ranges, based on their distribution, and compared using t-tests or Mann-Whitney U tests, as appropriate.

The primary analysis employed univariate and multivariate logistic regression to evaluate the odds of obesity based on immigration status. For the adjusted models, all clinically relevant covariates—identified a priori—including demographic, socioeconomic, behavioral, and psychological factors–were included. For the secondary analysis, we selected a subset of foreign-born individuals and applied univariable and multivariable regression models to assess obesity risk across length-of-stay categories, adjusting for the same covariates.

Sensitivity analysis was conducted using other strategies for categorizing smoking status and physical activity, treating Patient Health Questionnaire 9 (PHQ-9) scores as a continuous variable, and substituting income with a continuous variable representing the ratio to poverty to assess the robustness of our findings. By testing different definitions of smoking and activity, we tested arbitrary cut-offs to strengthen the reliability of our findings. The ratio to poverty captures relative socioeconomic status and may be more informative if income does not fully account for socioeconomic variability. Inclusion of PHQ-9 scores increased granularity, avoiding the potential loss of information by categorization.

Additionally, ANOVA and stratified chi-square tests were used to evaluate the BMI and obesity proportion rates across the length of stay strata.

Analyses were conducted using Stata v18.0 (StataCorp LLC, College Station, TX, U.S.) with a two-sided significance level of p<0.05.

Ethics Statement

The study was not determined to be a human subject research because it used a de-identified dataset. Therefore, institutional review board approval and informed consent were not required for this study.

Results

Our study included 5,566 adult participants with the NHANES. A total of 3,829 (68.79%) individuals were included in the U.S-born group and 1,737 (31,21%) were immigrants. The baseline characteristics of the study population, categorized by immigration status, are presented in Table 1.

A total of 2,565 (46%) participants were classified as obese. According to immigration status, the proportion of obese individuals living with obesity differed between the groups. In the U.S.-born group, 50.8% (n=1,946/3,829) of individuals had a BMI greater than or equal to 30 kg/m2, whereas this number was 35.5% for non-U.S.-born individuals (n=617/1737). In the unadjusted logistic regression analysis, non-U.S.-born individuals had 46.2% lower odds of obesity than U.S.-born individuals (odds ratio [OR] 0.538, 95% confidence interval [CI] 0.477–0.605, p <0.0001).

Using logistic regression, the adjusted model included 4,997 participants, with 10.2% missing covariate data. Being born outside the U.S. was associated with 40% lower odds of obesity than being born in the U.S. (adjusted OR 0.6, 95% CI 0.49–0.73; p < 0.0001), although a longer duration of residence among immigrants was associated with a significant increase in obesity rates. Additionally, the analysis showed that Hispanic and Black immigrants, and individuals with higher incomes, had higher odds of obesity. A relationship was also found between depression and increased risk of obesity (Table 2).

When considering only the model in immigrants, we observed similar results, except for age (OR: 0.98, 95% CI: 0.97–0.99, p = 0.001) and female gender (OR: 1.33; 95% CI, 1.03–1.72, p = 0.03), which gained significance, although with limited relevance. Income, as well as Hispanic and Black race, lost significance. The results for depression remained unchanged (see Table 3).

In terms of length of residence in the U.S., our findings revealed a strong association between extended time in the country and higher obesity rates among immigrants. Specifically, those who had lived in the U.S. for 15 to 20 years had 61% greater odds of obesity (OR = 1.61; 95% CI, 1.00–2.61; p = 0.05), while the odds increased to 88% for individuals residing for over 20 years (OR = 1.86; 95% CI, 1.25 - 2.77; p = 0.002), compared to immigrants who had been in the U.S. for less than 5 years.

Additionally, our sensitivity analysis, which focused exclusively on immigrants, confirmed a positive correlation between increased obesity rates and length of stay in the United States. This was found in both the BMI analysis using ANOVA (p < 0.001) and the qualitative assessment conducted using a stratified chi-square test (p = 0.002). Notably, residents with less than 5 years in the U.S. had a mean BMI of 26.93 ± 4.83 kg/m², while those residing for over 20 years had a higher mean BMI of 28.78 ± 5.97 kg/m². Furthermore, the analysis indicated that 58.8% of individuals living in the U.S. for more than 20 years

Characteristics	Immigrants (N = 1,737)	US-Born (N = 3829)	p-value
Age (years)	50.7 ± 15.60	51.9 ± 18.70	0.83
Gender			
Male, n (%)	809 (46.6)	1,892 (49.4)	0.09
Female, n (%)	928 (53.4)	1,937 (50.6)	
Marital Status,			
Present partner, n (%)	1,809 (71.1)	2,017 (52.7)	< 0.001
No partner, n (%)	501 (28.9)	1,809 (47.3)	
Ethnicity			
Hispanic, n (%)	834 (46.70)	500 (12.29)	
White, n (%)	80 (4.60)	1,853 (48.4)	< 0.001
Black, n (%)	117 (6.50)	1,225 (30.12)	
Others, n (%)	753 (42.160)	392 (9.6)	
Educational Level			
< High school, n (%)	377 (22.8)	102 (2.7)	< 0.001
College, n (%)	492 (28.4)	1,470 (38.4)	
College graduate or above, n (%)	861 (49.8)	2,253 (58.9)	
Family income			
< US$ 40,000/year, n (%)	1,427 (93.1)	3,516 (94.4)	0.07
≥ US$ 40,000/year, n (%)	106 (6.9)	209 (5.6)	
Family Income to Poverty Ratio			
< 1.3, n (%)	440 (24.6)	1,024 (25.2)	< 0.001
1.3 - 3.5, n (%)	559 (31.3)	1,511 (37.15)	
≥ 3.5, n (%)	787 (44)	1,532 (37.67)	
Length of time in USA			
Less than 5 years	214 (12.6)		
Between 5 and 10 years	158 (9.3)	NA	
Between 10 and 15 years	185 (10.9)		
Between 15 and 20 years	240 (14.1)		
More than 20 years	902 (53)		
BMI	28.28 ± 5.67	30.32 ± 8.02	< 0.001
Total Sugars (grams/day)	5.26 ± 0.37	8.29 ± 0.44	< 0.001
Dietary Fiber (grams/day)	1.1 ± 0.07	1.14 ± 0.04	< 0.59
Total Protein (grams/day)	4.32 ± 0.25	5.62 ± 0.17	< 0.001
At least one comorbidity, n (%)	845 (47.3)	2,572 (63.2)	< 0.001
PHQ-9 Score	2.71 ± 4.23	3.59 ± 4.81	< 0.001
Depression categorization			
Minimal or no depression, n (%)	1,179 (66)	2,592 (63.7)	
Mild, n (%)	213 (11.9)	629 (15.47)	
Moderate, n (%)	62 (3.5)	237 (5.8)	< 0.001
Moderately Severe, n (%)	29 (1.6)	100 (2.4)	
Severe, n (%)	303 (16.9)	509 (12.5)	
Weekly minutes of moderate physical activity	56.59 ± 48.8	67.29 ± 61.9	< 0.001
Smoked at least 100 cigarettes in life, N (%)	457 (25.6)	1,902 (46.8)	< 0.001

N: sample size; n: number of observations; %: percentage; US$ dollar; BMI: body mass index; PHQ-9: Patient Health Questionnaire-9.

Table 1: *Baseline characteristics of the participants.*

Variable	OR	95% CI	p-value
Immigrant	0.61	0.50 - 0.74	< 0.001
Length of time in USA			
between 5 and 10 years	1.26	0.73 - 2.2	0.38
between 10 and 15 years	1.1	0.64 - 1.88	0.67
between 15 and 20 years	1.61	1.00 - 2.61	0.05
more than 20 years	1.86	1.25 - 2.77	0.002
Gender			
Female	1.11	0.99 - 1.26	0.07
Age (years)	0.99	0.99 - 1.00	0.59
Ethnicity			
Hispanic	1.57	1.30 - 1.89	< 0.001
Black	1.33	1.14 - 1.54	< 0.001
Other	0.59	0.49 - 0.73	< 0.001
Family income			
≥ US$ 40,000/year	1.38	1.08 - 1.76	0.01
Educational Level			
College	1.1	0.86 - 1.41	0.59
College graduate or above	1.06	0.83 - 1.36	0.72
Smoked at least 100 cigarettes	1.06	0.93 - 1.20	0.74
PHQ-9 Categorization			
Mild depression	1.47	1.24 - 1.73	< 0.001
Moderate depression	1.51	1.16 - 1.96	0.002
Moderately severe depression	1.82	1.22 - 2.73	0.003
Severe depression	3.03	2.50 - 3.66	< 0.001
≥ 33 minutes of moderate recreational activity/week	1.05	0.89 - 1.23	0.55

US$: United States Dollar; PHQ-9: Patient Health Questionnaire-9; OR = Odds Ratio; 95% CI: 95% confidence interval.

Table 2: *Results of the multivariable logistic regression comparing natives and immigrants.*

were classified as obese compared to 41% of those who had lived in the country for up to 20 years.

Our Sensitivity analysis with different approaches to handle data yielded similar results - Table 4

Discussion

This study examined the complex relationships among immigration status, socioeconomic determinants, mental health status, and physical activity patterns in relation to adult obesity prevalence. Among the 5,566 participants, immigrants accounted for 31.21% of the sample and had a significantly lower obesity prevalence (35.52%) than U.S.-born individuals (50.82%). Our findings revealed significant gender and income-based disparities, with females and higher-income individuals demonstrating elevated odds of obesity. Notably, foreign-born status emerged as a protective factor against obesity, although this effect was partially attenuated after adjusting for the demographic and lifestyle covariates. The observed positive association between duration of U.S. residency and obesity risk aligns with the 'healthy immigrant effect' documented in previous literature, suggesting potential acculturation influences on weight status (Alidu & Grunfeld, 2018)

These findings are consistent with global obesity trends that exhibit significant regional variations influenced by lifestyle, diet, and socioeconomic factors. According to the WHO, approximately 60% of the population in Europe is either overweight or obese, with a higher prevalence among women than among men (Jaacks et al., 2019). In contrast, the prevalence of obesity in Asia is generally lower. For instance, overweight and obesity rates are reported to be approximately 13.7% in Southeast Asia and 25.4% in the Western Pacific region (NCD Risk Factor Collaboration [NCD-RisC], 2017). Even in Asia, urbanization and dietary changes contribute to rising obesity rates, similar to the challenges faced by long-term immigrants in the United States (Jaacks et al., 2019). These results underscore the importance of developing culturally tailored public health strategies to address the unique challenges faced by immigrant populations. Preventive measures that focus on promoting healthy lifestyles during the acculturation process could play a crucial role in mitigating the risk of obesity in this growing population.

Our findings on immigrant obesity patterns align with and extend the complex multifactorial framework of obesity development identified by Narciso et al. (2019) in their systematic review. While their review highlighted the consistent association between

Variable	OR	95% CI	p-value
Length of time in USA			
Between 5 and 10 years	1.41	0.8 - 2.46	0.23
Between 10 and 15 years	1.12	0.68 - 2.09	0.53
Between 15 and 20 years	1.69	1.03 - 2.79	0.037
More than 20 years	2.36	1.52 - 3.66	< 0.001
Gender			
Female	1.33	1.03 - 1.72	0.03
Age (years)	0.98	0.98 - 0.99	0.001
Ethnicity			
Hispanic	1.48	0.87 - 2.53	< 0.15
Black	1.23	0.64 - 2.37	< 0.53
Other	0.37	0.21 - 0.63	< 0.001
Family income			
≥ US$ 40,000/year	1.02	0.63 - 1.65	0.93
Educational Level			
College	1.14	0.81 - 1.61	0.46
College graduate or above	1.12	0.79 - 1.59	0.53
Smoked at least 100 cigarettes	0.97	0.73 - 1.29	0.83
PHQ-9 Categorization			
Mild depression	1.11	0.77 - 1.6	0.59
Moderate depression	1.92	1.02 - 3.58	0.04
Moderately severe depression	3.35	1.2 - 9.32	0.02
Severe depression	3.6	2.57 - 5.04	< 0.001
≥ 33 minutes of moderate recreational activity/week	1.1	0.81 - 1.51	0.54

US$: United States Dollar; PHQ-9: Patient Health Questionnaire-9; OR: Odds Ratio; 95% CI: 95% confidence interval.

Table 3: *Results of the multivariable logistic regression for immigrants only.*

Model	OR	95% CI	P value
1 §	0.59	0.49 - 0.73	0.0001
2 ¶	0.6	0.49 - 0.74	0.0001
3 ε	0.6	0.49 - 0.73	0.0001
4 ø	0.6	0.49 - 0.74	0.0001

§ Smoking status recategorized into "never", "former smoker" and "current smoker".

¶ PHQ scores are included as a continuous variable.

ε Ratio to poverty is included as a continuous variable instead of the binary income variable.

ø Physical activity was defined as "Insufficient", "Meets Criteria" and "Highly active"

Table 4: *Sensitivity analysis considering additional variables to assess the obesity risk of immigrants compared to U.S.-born individuals.*

socioeconomic status and obesity in adolescents, our NHANES analysis demonstrated similar socioeconomic influences in adults, with individuals earning ≥$40,000/year showing 38% higher odds of obesity (OR 1.38, 95% CI 1.08-1.76, p=0.01). However, our study reveals additional nuances in the relationship between sociocultural factors and obesity, particularly through the immigrant health paradox: foreign-born individuals demonstrated 40% lower odds of obesity compared to U.S.-born individuals (adjusted OR 0.6, 95% CI 0.49-0.73, p<0.0001), with this protective effect reducing with increased duration of U.S. residence (OR 1.88, 95% CI 1.26-2.82, p=0.002 for >20 years residency). While Narciso et al. found conflicting evidence for behavioral factors, such as physical activity and dietary intake in adolescents, our adult population showed significant associations between depression severity and obesity risk (OR 3.03, 95% CI 2.50-3.66, p<0.001 for severe depression), suggesting that psychological factors may play a more definitive role in adult obesity patterns than previously recognized in adolescent populations (Narciso et al., 2019).

Among immigrants, longer residence in the United States was associated with increased odds of obesity, displaying a linear trend where extended time in the country was correlated with progressively higher odds of obesity. This pattern supports established concepts such as the "healthy immigrant effect,salmon bias," and "immigrant paradox," where recent immigrants tend to have better health outcomes than the U.S.-born population, but these advantages often decline over time (Alidu & Grunfeld, 2018). Studies have found that second-generation immigrants face a higher risk of obesity than their first-generation counterparts, underscoring the generational shift in obesity prevalence among immigrant populations (Jäger et al., 2022). Acculturation is generally associated with an increase in body mass index, particularly among men, possibly due to the adoption of unhealthy behaviors prevalent in the host culture; however, results for women have been mixed, potentially due to cultural influences on body image and physical activity (Alidu & Grunfeld, 2018).

Limitations

This study has several limitations. Although the NHANES database utilizes complex sampling methods to represent the U.S. population, it may not fully capture all subpopulations, such as smaller ethnic groups and recent immigrants, potentially affecting the generalizability of our findings to these demographics. The absence of detailed information on participants' countries of origin limits our ability to consider cultural differences that may influence diet and lifestyle, which are important factors affecting obesity rates. Additionally, reliance on self-reported data for certain variables introduces potential recall and social desirability biases, as participants may underreport behaviors, such as poor dietary habits or low physical activity. The cross-sectional design of the study restricts our ability to establish causation or determine temporal relationships between variables, as the data were collected at a single point in time. To mitigate these limitations, we employed statistical adjustments for known confounders and conducted sensitivity analyses to assess the robustness of the findings. Future prospective longitudinal studies are warranted to gain a deeper understanding of how immigration and related factors affect obesity over time. Including additional variables and diverse populations in future research could enhance the comprehensiveness and applicability of these findings.

Public Health Implications

These findings underscore the importance of developing targeted public health initiatives for immigrants. Acculturation may lead to the adoption of unhealthy dietary practices and reduced physical activity levels common in U.S. lifestyles, contributing to the higher obesity rates among immigrants. Enhancing access to nutritious foods, healthcare services, and culturally tailored mental health resources is crucial for reducing the risk of obesity. Encouraging physical activity can support both mental and physical health, which is consistent with the findings of prior research. Public health policies should focus on promoting healthy lifestyle choices during the acculturation process, potentially through community-based programs and educational campaigns. Concrete steps such as creating supportive environments for healthy eating and active living and addressing socioeconomic barriers could play a significant role in mitigating the rising rates of obesity in this growing demographic.

Conclusion

Immigration status significantly impacts obesity risk, with non-U.S.-born individuals showing lower obesity prevalence. Our findings suggest a complex relationship between socioeconomic factors and obesity risk in this population with varying associations that merit careful interpretation. Depression was associated with a higher risk of obesity, whereas physical activity was associated with a lower risk of obesity in this population. However, obesity incidence increases with longer U.S. residency, underscoring the need for

public health strategies addressing cultural, socioeconomic, and dietary factors in immigrant populations. A comprehensive, culturally sensitive approach that addresses socioeconomic factors, mental health, and physical inactivity is essential to reduce obesity disparities between immigrants and U.S.-born individuals. Further research is necessary to understand how protective factors are eroded through acculturation and to better elucidate the complex relationship between socioeconomic status and obesity risk in immigrant populations.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

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