



Short communication

Racial and ethnic disparities in obesity prevalence among children, adolescents, and young adults receiving inpatient care in Hawai'i, 2015–2016

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ABSTRACT

The number of hospitalizations with an obesity diagnosis have increased among youth in the past two decades, yet remain understudied, particularly among racial/ethnic minority groups. The purpose of this study was to characterize obesity prevalence among children, adolescents, and young adults receiving inpatient care in Hawai'i acute care hospitals during 2015–2016. This study analyzed statewide administrative data from a racially and ethnically diverse population. Participants (N = 7,751) included Hawai'i residents aged 5–29 years receiving inpatient care, excluding those hospitalized due to pregnancy. Recorded height and weight were used to calculate body mass index (BMI) and classify obesity. Primary or secondary diagnoses for obesity were assessed. A multivariable logistic regression model was used to determine characteristics associated with obesity, including race/ethnicity-sex interaction, age group, insurance payer, and county of residence. Based on BMI, 28.4% (2,202/7,751) of patients had obesity. However, an obesity diagnosis was present only in 40.4% (889/2,202) of patients with obesity based on BMI (11.9% of all patients). In the multivariable model, compared to whites, the odds of having obesity were highest among Pacific Islanders [adjusted odds ratio (aOR) = 4.07, 95% CI(3.16–5.23)] and Native Hawaiians [aOR = 2.16, 95% CI(1.75–2.67)] for females, and among Pacific Islanders [aOR = 5.39, 95% CI(4.27–6.81)], Native Hawaiians [aOR = 2.36, 95% CI(1.91–2.91)], and Filipinos [aOR = 2.08, 95% CI(1.64–2.64)] for males. Obesity was also associated with age group, but not insurance payer type or county of residence. These findings support the need for greater attention to obesity in the inpatient setting and equity-focused interventions to reduce obesity among younger hospitalized patients.

1. Introduction

Obesity in children, adolescents, and young adults increases the risk for early morbidity and mortality over the lifespan (Kelsey et al., 2014). As obesity rates in younger populations have risen, so has the hospitalization rate for younger patients with an obesity diagnosis (Kompaniyets et al., 2020; Trasande et al., 2009; Wier and Encinosa, 2012). Obesity in hospitalized children has been linked to an increased risk for mortality and a longer length of stay (Bechard et al., 2013) and may affect how providers deliver care (Halvorson et al., 2019). An obesity diagnosis also is associated with higher hospitalization charges and costs, which were estimated in the U.S. to total \$3.03 billion in charges

and \$868.4 million in costs in 2016 for children aged 2–19 years (Kompaniyets et al., 2020). However, relying on an obesity diagnosis to fully capture the economic burden or true prevalence of obesity among younger patients receiving inpatient care is problematic because of under-coding (Woo et al., 2009).

Although studies have documented an increase in inpatient utilization among children with an obesity diagnosis, few have described obesity based on BMI among children, adolescents, and younger adults in the inpatient setting (Woo et al., 2009). Further, while persistent racial and ethnic disparities in obesity are well-established (Rossen & Schoendorf, 2012), heterogeneous Asian and Pacific Islander ethnic groups are often aggregated into the same category, masking obesity

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disparities between groups (Subica et al., 2017). A study of children aged 5–8 years old from one health maintenance organization in Hawai'i found that Samoan, Native Hawaiian, Filipino, and multiethnic children were more likely to be overweight or obese than white and Asian children (Novotny et al., 2013). Another study examined obesity among hospitalized patients aged 2–18 years from one Hawai'i pediatric hospital and found that obesity prevalence was higher among Samoan (45%), Native Hawaiian (21%), and Filipino (14%) patients compared to Other Pacific Islander (11%), white (8%) and Asian (5%) patients (Wong Ramsey et al., 2020). These results highlight the need to disaggregate Asian and Pacific Islander groups.

This study examined obesity prevalence among young patients aged 5–29 years who received inpatient care across all acute care hospitals in Hawai'i. We applied a broad definition of youth to characterize obesity across the early life-course, including the critical developmental periods of adolescence and young adulthood, which are understudied (Institute of Medicine and National Research Council, 2015). The transition from adolescence to young adulthood is of particular relevance from an intervention perspective because of the significant amount of weight gained during this period (Gordon-Larsen et al., 2010). The study objectives were to examine by disaggregated race/ethnicity: (1) the prevalence of obesity based on body mass index (BMI) and associated inpatient characteristics; and (2) the level of agreement between obesity based on BMI and the presence of obesity diagnostic codes.

2. Methods

The study period for this secondary data analysis was January 2015 through December 2016. Inpatient data were obtained from the Hawai'i Health Information Corporation (HHIC), the source for Hawai'i's Healthcare Cost and Utilization Project during the study period. HHIC generated unique patient identifiers for the dataset, enabling linkages across hospitals. Inpatient visits among those aged 5–29 in Hawai'i were available across all payers (N = 31,400). Visits were excluded if there was a pregnancy-related diagnostic code (N = 16,976), missing race/ethnicity information (N = 514), missing height and/or weight information (N = 7,681), and/or unknown/non-Hawai'i residence (N = 762). An additional 39 visits were excluded for implausible BMI values based on Centers for Disease Control and Prevention (CDC) criteria for ages 5–19 (CDC, 2019); if the patient height was reported as > 90 in. (N = 5) or height/weight was recorded as 0 (N = 10). Exclusion criteria were not mutually exclusive. The final sample consisted of 10,568 inpatient hospitalizations for 7,751 unique individuals.

2.1. Measures

Patient variables from the first visit were used for age group, sex, race/ethnicity, insurance payer, county of residence, and county of the hospital. Race/ethnicity was based on a patient's self-reported primary race/ethnicity at intake. If more than one race/ethnicity was provided, HHIC used a standardized protocol to determine the primary race/ethnicity. If Native Hawaiian was one of the provided races/ethnicities, then the patient was coded as Native Hawaiian. If a non-white race/ethnicity was in conjunction with a white category, then the non-white race/ethnicity code was used. If more than one non-white race/ethnicity was provided, then the first code listed was used. Given HHIC data use agreement rules that limit reporting when the number of observations in any given cell of tabulated data are ≤ 10 , only the largest racial/ethnic groups are reported in this analysis. The smaller groups for Hawai'i (e.g., Black, Hispanic/Latino, Alaska Native, American Indian) were combined into the "Other race/ethnicity" category. Insurance payer was categorized as Medicaid, private, or other (including Medicare and Tricare). County of residence and of hospital were recoded into two categories: O'ahu (the City & County of Honolulu where the majority of the state population resides) and Other (the more rural counties of Maui, Kaua'i, and Hawai'i Island).

Primary and secondary *International Classification of Diseases, Clinical Modification* (ICD-CM) diagnostic codes were also used in the analysis. During the study period, the diagnostic codes transitioned from ICD-9-CM (January–September 2015) to ICD-10-CM (October 2015–December 2016). Specific diagnostic codes for obesity, diabetes, and hypertension were examined (Supplemental File).

The primary outcome variable was obesity at any visit; patients with multiple inpatient visits were considered to have obesity if their BMI ever fell into an obese category. Obesity was assessed using height and weight data to calculate body mass index (BMI). For patients aged 5–19 years old, BMI was converted to z-scores and obesity was determined using the CDC age- and sex-specific growth chart references (obesity \geq 95th percentile) (CDC, 2014). For patients aged 20–29 years old, those with BMI values of 30.0 or higher were considered to have obesity.

2.2. Data analysis

Statistical analysis was conducted using R, version 3.6.3 (R Core Team). First, descriptive statistics were calculated to compare patients with obesity based on BMI to patients without obesity. Chi-square tests of independence were used for the categorical variables and Kruskal-Wallis tests were used for the continuous variables. Second, logistic regression was used to determine characteristics of patients with obesity in a multivariable model. Based on previous research that found a sex difference among Asian youth, but not other races (Ogden et al., 2015), we included an interaction term between race/ethnicity and sex. To aid interpretation, we calculated the odds ratios (OR) and 95% confidence intervals (CI) for the effects of race/ethnicity by each sex and effects of sex by each racial/ethnic group. Lastly, agreement between obesity based on BMI and obesity based on the presence of a diagnostic code (primary or secondary) was assessed using the kappa statistic. This study was deemed not human subjects research by the University of Hawai'i Human Studies Program.

3. Results

3.1. Characteristics of patients with obesity based on BMI

Approximately three-fourths of the inpatient study sample was non-white, with Native Hawaiian patients comprising one-fourth of the sample (Table 1). The majority of individuals (82.4%) had a single visit. Overall, 28.4% (2,202/7,751) of unique patients aged 5–29 years had obesity based on BMI. The prevalence of obesity varied by race/ethnicity, age group, and insurance payer, but not sex, county of residence, or county of hospitalization. Higher proportions of patients with obesity were observed among Native Hawaiians, Pacific Islanders, ages 25–29 years, and those covered under Medicaid. Across all visits, diagnostic codes for obesity, diabetes, and hypertension were higher among patients with obesity.

Table 2 presents the results of the multivariable logistic regression model. While there was no statistically significant difference in obesity by sex at the bivariate level, there was a significant interaction between race/ethnicity and sex. Among females, the adjusted OR (aOR) and 95% CIs for having obesity were highest among Pacific Islanders [aOR = 4.07 (3.16–5.23)] and Native Hawaiians [aOR = 2.16 (1.75–2.67)], compared to whites. Similarly, among males, the odds of having obesity were higher among Pacific Islanders [aOR = 5.39 (4.27–6.81)] and Native Hawaiians [aOR = 2.36 (1.91–2.91)], plus Filipinos [aOR = 2.08 (1.64–2.64)], compared to whites. The only significant sex difference in the odds of having obesity by race/ethnicity was among whites: white males were 23% less likely to have obesity compared to their female counterparts [aOR = 0.77 (0.62–0.97)]. Additionally, obesity was also significantly associated with age group [compared to 5–9y, higher for 20–24y and 25–29y, but not 10–14y and 15–19y], but not insurance payer type or county of residence.

Table 1
Characteristics of hospitalized patients by obesity status based on body mass index (BMI).

	Overall	Obese (BMI) ^a	Not Obese
	n(%)	n(%)	n(%)
Total N	10,568	3,193 (30.2%)	7,375 (69.8%)
Total Unique Individuals	7,751	2,202 (28.4%)	5,549 (71.6%)
# of visit/person (Mean ± SD)	1.36 ± 1.29	1.45 ± 1.51	1.33 ± 1.19
Characteristics (at first visit)			
Race/Ethnicity			
Chinese	202 (2.6%)	36 (1.6%)	166 (3.0%)
Filipino	1177 (15.2%)	316 (14.4%)	861 (15.5%)
Native Hawaiian	1942 (25.1%)	652 (29.6%)	1290 (23.3%)
Japanese	587 (7.6%)	105 (4.8%)	482 (8.7%)
Pacific Islander	1010 (13.0%)	519 (23.6%)	491 (8.9%)
Other Race/Ethnicity	845 (10.9%)	189 (8.6%)	656 (11.8%)
White	1988 (25.7%)	385 (17.5%)	1603 (28.9%)
Age Group			
5–9	864 (11.2%)	205 (9.3%)	659 (11.9%)
10–14	934 (12.1%)	239 (10.9%)	695 (12.5%)
15–19	1618 (20.9%)	365 (16.6%)	1253 (22.6%)
20–24	1997 (25.7%)	522 (23.7%)	1475 (26.6%)
25–29	2338 (30.2%)	871 (39.6%)	1467 (26.4%)
Sex			
Female	3588 (46.3%)	1044 (47.4%)	2544 (45.9%)
Male	4163 (53.7%)	1158 (52.6%)	3005 (54.2%)
Payer			
Medicaid	3752 (48.4%)	1165 (52.9%)	2587 (46.6%)
Private Insurance	3050 (39.4%)	785 (35.7%)	2265 (40.8%)
Other Payer	949 (12.2%)	252 (11.4%)	697 (12.6%)
County (residence)			
O’ahu	5264 (67.9%)	1530 (69.5%)	3734 (67.3%)
Other (Maui, Kauai, Hawaii Counties)	2487 (32.1%)	672 (30.5%)	1815 (32.7%)
County (hospital)			
O’ahu	5884 (75.9%)	1703 (77.3%)	4181 (75.4%)
Other (Maui, Kaua’i, Hawai’i Counties)	1867 (24.1%)	499 (22.7%)	1368 (24.6%)
Presence of diagnostic codes (at any visit)			
Obesity diagnostic code	926 (11.9%)	889 (40.4%)	37 (0.7%)
Diabetes diagnostic code	657 (8.5%)	317 (14.4%)	340 (6.1%)
Hypertension diagnostic code	641 (8.3%)	346 (15.7%)	295 (5.3%)
Continuous Characteristics (at first visit)			
Age, Mean ± SD	19.64 ± 6.83	20.78 ± 6.84	19.18 ± 6.78
Age, Median (Q1, Q3)	21 (15, 25)	22 (16, 27)	20 (15, 25)

^a Obesity based on BMI at any visit.

Table 2
Logistic regression model for obesity based on body mass index by patient characteristics, with race/ethnicity by sex interaction.

Predictor	Obesity (based on Body mass Index)		
	Odds Ratio	95% CI	P-value
Race/Ethnicity (ref: White) among Females			
Chinese	0.61	0.32–1.15	0.1245
Filipino	1.25	0.97–1.61	0.0854
Native Hawaiian	2.16	1.75–2.67	<0.001
Japanese	1.03	0.74–1.44	0.8647
Pacific Islander	4.07	3.16–5.23	<0.001
Other Race/Ethnicity	1.22	0.92–1.61	0.1699
Race/Ethnicity (ref: White) among Males			
Chinese	1.28	0.79–2.08	0.3184
Filipino	2.08	1.64–2.64	<0.001
Native Hawaiian	2.36	1.91–2.91	<0.001
Japanese	0.90	0.63–1.28	0.5446
Pacific Islander	5.39	4.27–6.81	<0.001
Other Race/Ethnicity	1.16	0.87–1.54	0.3144
Male (ref: Female) among Whites			
Male (ref: Female) among Chinese	1.63	0.76–3.50	0.2108
Male (ref: Female) among Filipinos	1.29	0.99–1.68	0.0584
Male (ref: Female) among Native Hawaiians	0.85	0.70–1.02	0.0868
Male (ref: Female) among Japanese	0.67	0.44–1.03	0.0708
Male (ref: Female) among Pacific Islanders	1.03	0.80–1.32	0.8405
Male (ref: Female) among Other Racial/	0.74	0.53–1.02	0.0683
Ethnic groups			
Age (ref: 5–9 y/d)			
10 to 14	1.21	0.97–1.52	0.0871
15 to 19	1.10	0.90–1.35	0.3606
20 to 24	1.38	1.13–1.67	0.0013
25 to 29	2.40	2.00–2.90	<0.001
Payer (ref: Medicaid/Quest)			
Private Insurance	0.91	0.81–1.02	0.1187
Other Payer	0.88	0.74–1.04	0.1441
O’ahu Residency (ref: non-O’ahu)	1.04	0.93–1.17	0.4622

3.2. Obesity based on BMI and presence of diagnostic codes

Primary or secondary diagnostic codes for obesity were noted in 11.9% (926/7,751) of unique patients and 40.4% (889/2,202) of unique patients with obesity based on BMI. Across all inpatient visits, 73 inpatient visits (0.69%) had a primary diagnosis for obesity. The presence of primary or secondary diagnostic codes for obesity by race/ethnicity ranged from 4.0% for Japanese patients to 23.2% for Pacific Islander patients. The prevalence of primary or secondary diagnostic codes for obesity was lower relative to obesity based on BMI for all racial/ethnic groups. The level of agreement between obesity based on the presence of diagnostic code and BMI was moderate: the kappa statistic was 0.48. The kappa statistics by race/ethnicity ranged from 0.38 through 0.50; overlapping 95% CIs indicated no differences.

4. Discussion

In a statewide sample of younger people receiving inpatient care, this study found significant disparities in obesity among disaggregated Asian and Pacific Islander groups. In the multivariable model, Pacific Islanders had the highest odds of having obesity among both males and females, compared to whites. Pacific Islanders are a heterogeneous group that this study did not further disaggregate (e.g., Samoan, Guamanian/Chamorro, Marshallese). However, Pacific Islanders collectively experience inequities in social determinants of health that result in high rates of chronic diseases (Kaholokula et al., 2020) and hospitalization at younger ages (Hagiwara et al., 2016). Obesity prevalence also increased with age, highlighting the need for interventions that focus on hospitalized young adults aged 20–29 years with obesity. Health system interventions, such as screening and counseling, as well as early intervention to prevent the development of obesity, may reduce obesity-related health consequences in later adulthood (Institute of Medicine

and National Research Council, 2015; Kelsey et al., 2014). Our findings may be particularly relevant to Medicaid, which was the primary payer for half of the patients with obesity.

This study also examined the specific patterns of obesity by sex and race/ethnicity and found an interaction. White males were less likely to have obesity than white females. Although not statistically significant, that relationship was reversed in Chinese and Filipino groups, with males tending to have higher odds of obesity than females. This finding aligns with studies in Asian countries that report higher childhood obesity among males than females (Song et al., 2013). The dynamic relationships between obesity, race/ethnicity, gender, and sociocultural factors such as generational status (Bates et al., 2008) should be further investigated in disaggregated Asian American populations to inform culturally-relevant interventions.

The finding that the majority of patients with obesity based on BMI did not have ICD-CM codes for this risk factor aligns with previous research (Woo et al., 2009; Wong Ramsey et al., 2020). We expand on this work by finding no evidence of differential rates of obesity diagnoses based on race/ethnicity. More research is needed to understand the conditions and circumstances in which it is important for clinical providers to include an obesity diagnosis in the inpatient setting. Increased attention to diagnosing obesity in the inpatient setting could better support community-clinical linkages to obesity interventions, such as referrals to culturally-relevant and age-appropriate weight management programs or ensuring appropriate follow-up with primary care providers.

While a major strength of this study was the statewide scale of inpatient hospitalizations, several limitations should be noted. First, height and weight data were drawn from inpatient records, and we did not have the ability to validate these. Race/ethnicity was self-reported and may have been misclassified. We did not use modified BMI cutoffs for obesity specific to Asians or Pacific Islanders. The presence of an obesity diagnosis may have been impacted by the ICD coding transition. Our data analysis was cross-sectional, and we did not account for BMI changes in patients with multiple visits. To better inform clinical practice, future studies should also examine the severity of obesity among younger patients receiving inpatient care, as our analysis did not consider subclassifications of obesity.

In conclusion, among younger people receiving inpatient care in Hawai'i, disparities in obesity prevalence were found among Pacific Islanders, Native Hawaiians, and Filipinos. These findings support the need for greater attention to obesity in the inpatient setting and equity-focused interventions to reduce obesity among younger inpatient populations.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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human subjects research by the University of Hawai'i Human Studies Program.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2021.101542>.

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