Obesity and COVID-19 Hospitalizations Report

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Abstract

This report is to describe the relationship between obesity and COVID-19 inpatient hospitalizations in Connecticut and compare this relationship to that of non-obesity and COVID-19 inpatient hospitalizations.

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Introduction

Obesity is very common in the United States (US) and obesity prevalence for adults has increased over time. According to Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance System (BRFSS) data, from 1999-2000 through 2017-2018, US obesity prevalence increased from 30.5% to 42.4%. BRFSS data estimates that the Connecticut obesity prevalence among adults is 29.2% (2020 data). The prevalence of obesity in the US has continually increased and reached an epidemic level. Obesity is a fundamental disease and increases the risk of many noncommunicable diseases and metabolic diseases[1]. Coronavirus Disease 2019 (COVID-19) has exacerbated the obesity risk factors and may result in worsening obesity rates in the future[2].

Adults with obesity are at increased risk for a number of serious health conditions. One of these serious health conditions is COVID-19 infection. Studies suggest that obesity may reduce the immunological response to infections thus linking obesity to increased risk of infection with COVID-19. Furthermore, obesity increases the risk for severe COVID-19–associated illness and risk of death[3,4]. The literature suggests a cause of this risk is that obesity decreases lung capacity and makes ventilation difficult[4]. Therefore, evidence-based strategies that promote improvements in weight status may prevent severe complications of COVID-19.

The Obesity and COVID-19 Hospitalizations Report is a publication of the Connecticut Department of Public Health. The main objective of this report is to describe the relationship between obesity and COVID-19 inpatient hospitalizations in Connecticut and compare this relationship to that of non-obesity and COVID-19 inpatient hospitalizations. The secondary objective is to detail which population subgroups are disproportionately impacted by obesity and COVID-19. This information may be used by the Connecticut Department of Public Health (DPH) and its partners to support and target activities that reduce risk factors for severe complications of COVID-19.

Methods

The Connecticut Inpatient Hospitalization and Emergency Department dataset contains the number of inpatient discharges and emergency department visits in Connecticut. Each record in the dataset is a hospital discharge and not an unduplicated patient. In other words, one patient may be in the dataset multiple times if they were hospitalized multiple times. Therefore, throughout this report, numbers, percentages, and odds ratios are associated with inpatient discharges and not individual patients. Also, this analysis is limited to inpatient hospital discharges among Connecticut residents 20 years of age or older with admissions from April 1, 2020, to December 31, 2020.

Hospitalizations with obesity as any diagnosis are defined as inpatient discharges with International Classification of Diseases (ICD)-10 Clinical Modification (CM) code E66 in any of the 15 diagnosis fields. Throughout this document inpatient discharges with obesity as any diagnosis are referred to as obesity hospitalizations. Hospitalizations with COVID-19 as any diagnosis are defined as inpatient discharges with ICD-10 CM code U07.1 in any of the 15 diagnosis fields. Inpatient discharges with COVID-19 as any diagnosis are referred to as COVID-19 hospitalizations or diagnoses.

Throughout this report, all racial groupings (e.g., Black or African American, White, Asian) exclude persons of Hispanic ethnicity. A Hispanic or Latino/a ethnicity category is included in text and tables reflecting data separate from race categories. Therefore, the modifier “Non-Hispanic or Latino/a” is

assumed. Hospital discharges among adults who identify as Pacific Islander, American Indian or Alaskan Native, other race, or multiracial are grouped into a Non-Hispanic Other category due to small numbers of hospitalizations among these residents.

Also, throughout this document, only male and female gender categories are reported. Inpatient hospital discharge data only include the 2 gender categories. Gender is self-reported.

Additionally, data and statistics are presented by primary payer source. Primary payer source is the classification of the type of coverage expected for the patient visit. Data are categorized as public, private, self-pay or uninsured, and "other" payer. Public payers include Medicaid, Medicare, Medicare Advantage, Tricare, Title V, and other federal programs. Private payers include commercial health insurance, workers compensation, Blue Cross, health maintenance organization (HMO), and preferred provider organization (PPO). Self-pay or uninsured includes hospital discharges in which the patients are self-pay or have no medical insurance. "Other" payer includes payer sources categorized as other and discharges that are "no charge"

Unadjusted odds ratios are presented in this report. PROC Logistic (SAS Enterprise Guide version 7.15 HF8) produces odds ratios with Wald 95% Confidence intervals and p-values. The odds ratios represent the odds, or likelihood, that a hospitalization (obesity or non-obesity) will have a COVID-19 diagnosis. For each demographic category, the reference group is typically the group with the lowest percentage of COVID-19 hospitalizations. The confidence intervals and p-values are used to determine the statistical significance of the odds ratio. An odds ratio is considered statistically significant if the confidence interval does not contain one. Also, a p-value of less than 0.05 indicates statistical significance.

Multivariable logistic regression produces the odds of COVID-19 hospitalizations predicted by the presence of multiple demographic characteristics (PROC Logistic, SAS Enterprise Guide version 7.15 HF8). For this analysis, backward stepwise regression approach is used with age, gender, race and ethnicity, and payer included in the full logistic regression model. Age and race and ethnicity are included in the final logistic regression model as a way to control for the relationship that these factors have with hospitalizations in general and COVID-19 infection. For example, increasing age is a risk factor for being hospitalized. Also, the unadjusted COVID-19 odds ratios vary by race and ethnicity. Both race and ethnicity and age are included in the model because each racial and ethnic group has a different age distribution (e.g., the White populations group tends to be older than the other groups); therefore, it is important to control for age to decrease its effects on the odds ratios for the racial and ethnic groups.

Gender and payer are not in the final multivariable logistic regression model based on backward elimination findings. Backward elimination means that variables are removed from the model one-by-one to determine the statistical effect on the regression model. When the gender and payer variables are each removed from the full logistic regression model (i.e., the model with gender, race and ethnicity, age, and payer as predictors), the likelihood ratio changes by less than 10%. This means that removing the gender and payer variables does not have a statistically significant impact on the model.

Results

Description of the Dataset

(Refer to Table 1)

The dataset has 214,123 inpatient hospital discharges among Connecticut residents with admissions from April 1, 2020, to December 31, 2020, of which 34,227 are obesity hospitalizations (16.0%) and 179,896 are non-obesity hospitalizations (84.0%). The distribution of obesity and non-obesity hospitalizations is similar for each patient characteristic. Most hospitalizations are among women, residents who are White, and residents with public insurance as the primary payer.

Table 1. Description of the dataset, by Obesity Status, Connecticut[a]

	Obesity Status		
Characteristic	Yes (N = 34,227)[b]	No (N = 179,896)[b]	p[c]
Age (years)	56.5 ± 16.8	60.6 ± 20.7	<0.001
Sex			<0.001
Male	40.0%	45.7%	
Female	60.0%	54.3%	
Race and Ethnicity			<0.001
White	62.5%	68.5%	
Black	17.0%	12.45	
Hispanic	16.5%	13.4%	
Asian	0.5%	1.7%	
Other	1.9%	2.4%	
Missing	1.5%	1.7%	
Primary Payer			<0.001
Public	69.2%	73.1%	
Private	28.5%	24.5%	
Self-Pay/Uninsured	2.1%	2.1%	
Other	0.2%	0.3%	

[a] Table values are mean ± standard deviation for continuous variables and n (column %) for categorical variables.

[b] Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.

[c] P-value is for **T-test** (comparing means of continuous variables) or chi-squared (**χ2) test** (categorical variables).

Unadjusted Associations

(Refer to Table 2)

Almost 10% of obesity hospitalizations have a COVID-19 diagnosis. Among these hospitalizations, the likelihood of a COVID-19 hospitalization is higher among adults ages 50-64 years compared with adults ages 20-49. Obesity hospitalizations among adults ages 65-79 years and 80+ years have similar likelihoods of COVID-19 hospitalizations compared with adults 20-49 years. Also, among obesity hospitalizations, men are more likely than women to have COVID-19 hospitalizations. Additionally, obesity hospitalizations among White residents have the lowest odds of COVID-19 hospitalization compared with other racial and ethnic groups. Furthermore, obesity hospitalizations among those with self-pay or no insurance and other payer are more likely to have a COVID-19 hospitalization compared to those with private payers. In contrast, obesity hospitalizations among those with public insurance are less likely to have a COVID-19 hospitalization compared to those with private payers.

Almost 8% of non-obesity hospitalizations have a COVID-19 diagnosis. The likelihood of a COVID-19 hospitalization increases with age among non-obesity hospitalizations. Also, among non-obesity hospitalizations, men are more likely than women to have a COVID-19 diagnosis. Non-obesity hospitalizations among White residents have the lowest odds of COVID-19 hospitalization compared with other racial and ethnic groups. Moreover, non-obesity hospitalizations among those with private insurance are least likely to also have a COVID-19 diagnosis compared to hospitalizations with other types of primary payers.

Table 2. Unadjusted Associations between Patient Demographics and COVID-19 Hospitalizations, by Obesity Status, Connecticut

	Obesity (n = 34,227)			Non-Obesity (n = 179,896)		
	N[a]	% COVID-19 Hospitalization	OR (95% CI)	N[a]	% COVID-19 Hospitalization	OR (95% CI)
Demographic Factors						
Age (years)						
20-49	11,066	9.0%	Reference	54,466	3.8%	Reference
50-64	11,072	10.9%	1.24 (1.14, 1.35)	39,758	8.2%	2.29 (2.16, 2.42)
65-79	9,521	8.9%	0.98 (0.89, 1.08)	47,526	9.6%	2.70 (2.56, 2.85)
80+	2,568	9.5%d	1.07 (0.92, 1.24)	38,146	11.3%	3.26 (3.08, 3.44)
Sex						
Female	20,547	8.9%	Reference	97,630	6.9%	Reference
Male	13,680	10.8%	1.24 (1.16, 1.34)	82,261	9.1%	1.36 (1.31, 1.40)
Race and Ethnicity						
White	21,406	7.1%%	Reference	123,182	6.5%	Reference
Black	5,826	12.9%	1.94 (1.77, 2.12)	22,334	10.6%	1.69 (1.61, 1.78)
Hispanic	5,662	15.2%	2.33 (2.13, 2.54)	24,060	12.3%	2.02 (1.93, 2.11)
Asian	175	17.7%	2.81 (1.90, 4.15)	3,019	8.2%	1.28 (1.12, 1.46)
Other	658	10.5%	1.53 (1.18, 1.97)	4,303	8.6%	1.35 (1.21, 1.50)
Missing	500	11.0%	1.61 (1.21, 2.14)	2,998	7.7%	1.20 (1.04, 1.37)
Primary Payer						
Private	9,762	10.2%	Reference	44,092	5.9%	Reference
Public	23,667	9.1%	0.88 (0.81, 0.95)	131,420	8.5%	1.48 (1.42, 1.55)
Self-Pay/Uninsured	719	16.7%	1.76 (1.43, 2.16)	3,771	10.1%	1.78 (1.60, 2.00)
Other	73	34.3%	4.57 (2.81, 7.44)	596	18.6%	3.67 (2.97, 4.52)

[a] Numbers may not sum to total due to missing data.

OR = Odds Ratio; CI = Confidence Interval

Multivariable Logistic Regression Results

(Refer to Table 3)

Table 3 summarizes the results of the multivariable logistic regression for obesity and non-obesity hospitalizations. Among obesity hospitalizations, the odds of a COVID-19 diagnosis increase for all older age groups when adjusted for race and ethnicity. In fact, the odds ratios among residents 65-79 years and 80+ years become statistically significant. In contrast, among obesity hospitalizations, the odds of a COVID-19 diagnosis are still higher among residents who are Black, Hispanic, Asian, and other race compared with residents who are White, but the magnitudes of those odds do not change significantly when age is included in the model. One reason may be that obesity hospitalizations do not vary much by age and, therefore, age does not have a great impact on the model.

The odds of COVID-19 diagnosis among non-obesity hospitalizations increases for all racial and ethnic groups and most age groups when both age and race and ethnicity are included in the model. The one exception is that the odds of a COVID-19 diagnosis among residents of other race does not change when age is added into the model. These increases may be due to the more varied age distribution of non-obesity hospitalizations in general and among the racial and ethnic subgroups.

Table 3. Multivariable logistic regression model of factors associated with COVID-19 hospitalizations, by obesity status

	Obesity (n = 34,221)	Non-Obesity (n = 179,874)
	OR (95% CI)	OR (95% CI)
Demographic Factors		
Age (years)		
20-49	Reference	Reference
50-64	1.50 (1.37, 1.65)	2.67 (2.52, 2.82)
65-79	1.36 (1.23, 1.50)	3.60 (3.41, 3.81)
80+	1.54 (1.32, 1.79)	4.77 (4.50, 5.05)
Race and Ethnicity		
White	Reference	Reference
Black	2.07 (1.88, 2.28)	2.22 (2.11, 2.33)
Hispanic	2.61 (2.37, 2.87)	3.07 (2.92, 3.21)
Asian	3.17 (2.14, 4.69)	1.92 (1.68, 2.20)
Other	1.65 (1.28, 2.14)	1.84 (1.65, 2.06)
Missing	1.68 (1.26, 2.23)	1.50 (1.31, 1.72)

Limitations

This analysis has some limitations. First, the results of this analysis cannot be used to establish a causal relationship between obesity and COVID-19. These results describe the distribution of and relationship between obesity and non-obesity hospitalizations and COVID-19 hospitalizations among Connecticut residents. The causes of the relationships between obesity and COVID-19 hospitalizations could not be determined using this data source and methodology. Second, inpatient hospital data from 2020 may only provide information on patients who were very ill because elective surgeries were canceled and people were practicing social distancing including not seeking medical care, unless necessary. Third, the analysis uses ICD-10-CM codes instead of biometric data or laboratory testing results. Lastly, some population groups only have small numbers of patients, thereby increasing the possibility of information bias.

Discussion

The COVID-19 pandemic is a major health threat internationally and has caused unprecedented challenges globally[5]. Risk assessment is an important step in identifying factors that contribute to the severity of COVID-19 and potentially reducing COVID-19 mortality. This project included a total of 214,123 inpatient hospitalizations of which 3,293 are for obesity and COVID-19. Our results showed that obesity hospitalizations have a higher percentage of COVID-19 hospitalizations compared with non-obesity hospitalizations (9.6% vs. 7.9%, $p<0.001$, data not shown). These results have implications for enhancing public awareness of the effects of obesity on COVID-19. These findings can also support the need for developing interventions that focus on obesity prevention strategies as a means of preventing severe illness from COVID-19 and other infectious diseases.

Our results also indicate that obesity hospitalizations among Black, Hispanic, and Asian residents and residents of other races are more likely to have a COVID-19 diagnosis compared with White residents. Cultural differences in food preparation and consumption or healthcare seeking may play a role. For example, African American and Hispanic adults have higher obesity rates compared to White adults, which is thought to be associated with higher fat diets in response to acute stress[6].

Furthermore, the results indicate that obesity hospitalizations among residents with “other” payers have a higher percentage of COVID-19 diagnoses compared with non-obesity hospitalizations). One reason for this association may be the small numbers in this subgroup. Another reason may be limited access to routine and preventive healthcare due to high copays and cost. Accessible, appropriate, and timely primary care services are important in promoting wellness and managing chronic conditions, such as obesity and its complications. Healthcare coverage, or health insurance, is needed to access most of these services.

Evidence-based strategies that promote healthy eating, being active, and maintaining a healthy body weight throughout the lifespan may decrease the risk of severe complications of COVID-19. DPH implements evidence-based strategies at state and local levels to promote breastfeeding, nutrition, and physical activity including the provision of quality education and implementation of policy, systems, and environmental change (PSE) initiatives. Specific initiatives include implementing food service guidelines that make healthier foods and beverages available in worksites and community sites; working with early care and education programs to implement policies and practices that support breastfeeding, improve nutrition, and increase physical activity; collaborating with partners to make walking and biking easier

for residents; and ensuring adequate support for breastfeeding families in birthing centers, community settings, and worksites. DPH receives federal funding to support these efforts including the CDC-funded State Physical Activity and Nutrition Program, or SPAN and the USDA-funded Supplemental Nutrition Assistance Program-Education, or SNAP-Ed.

Making low- or no-cost chronic disease prevention and control services available in the community may reduce the risk of chronic diseases and conditions, like obesity, and, therefore, reduce the risk of COVID-19 complication. Referrals from healthcare providers may also help increase utilization of these services. The Connecticut Well-Integrated Screening and Evaluation for Women Across the Nation (WISEWOMAN) Program serves as an example. The WISEWOMAN Program is a Centers for Disease Control and Prevention (CDC)-sponsored program designed to help 40–64-year-old women reduce their risk for heart disease and promote a heart-healthy lifestyle. The Connecticut WISEWOMAN Program offers free healthy and supportive Lifestyle Programs for Connecticut Early Detection and Prevention Program (CEDPP) participants, such as Health Coaching, Wellness Wins, Self-Monitored Blood Pressure, and the Diabetes Prevention Program. The WISEWOMAN program incorporates cardiovascular diseases screening and intervention services into the healthcare delivery system of the current DPH Breast and Cervical Cancer Early Detection Program contracted health care provider sites.

Conclusion

The current analysis reports an association between obesity and COVID-19 hospitalizations. It also reveals that the race and ethnicity play an important role in the relationship between obesity and COVID-19 hospitalization.

As the response to COVID-19 transitions from outbreak control to endemic management, culturally tailored, evidence-based public health programs aimed at preventing and controlling chronic diseases and promoting healthy lifestyles will be important in preventing COVID-19 complications. Effort should be focused on offering these programs at low or no cost in the community to all ages.

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