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## Obesity among Nursing Home Residents: Association with Potentially Avoidable Hospitalizations

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### Abstract

**Background/Objectives**—Studies show that in nursing homes (NHs) the prevalence of moderate-to-severe obesity has doubled in the last decade, and continues to increase. Obese residents are often complex and costly, and this increase in prevalence has come at a time when NHs struggle to decrease hospitalizations, particularly those that are potentially avoidable. This study examined the association between obesity and hospitalizations.

**Design**—We linked 2011–2014 national data using Medicare NH assessments, hospital claims, and the NH Compare.

**Setting & Participants**—Individuals age 65+, newly admitted to NHs, who became long-term residents between July 1st, 2011 and March 26th, 2014. The analytical sample included 490,086 residents.

**Methods**—NH-originating hospitalization was the outcome; a categorical variable defined as no hospitalization, potentially avoidable hospitalization (PAH) and other hospitalization (non-PAH). The main independent variable was body mass index (BMI) defined as normal weight ( $30 > \text{BMI} \geq 18.5 \text{ kg/m}^2$ ), mildly obese ( $35 > \text{BMI} \geq 30 \text{ kg/m}^2$ ) or moderately-to-severely obese ( $\text{BMI} \geq 35 \text{ kg/m}^2$ ). Covariates included individual and NH characteristics. Multinomial models with NH random effects and state dummies were estimated.

**Results**—After adjusting for individual level covariates, the risk of non-PAH for the mildly and moderate/severely obese was not different from normal weight residents. But the risk of PAH remained significantly higher for the moderate/severely obese ( $\text{RRR} = 1.055; 95\% \text{ CI } 1.018, 1.094$ ). Several NH-level factors also influenced hospitalization risk.

**Conclusions and Implications**—Obese residents are more likely to experience PAH but not non-PAH. Efforts to improve care for these residents may need to broadly consider NHs' ability to commit additional resources to fully integrate care for this growing segment of the population.

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Conflicts of Interest

The authors have no conflicts of interest to disclose.

## Brief summary

Obese nursing home residents are more likely to experience potentially avoidable hospitalizations than their non-obese counterparts. Caring for obese residents may place higher resource demands on nursing home resources.

## Keywords

obesity; potentially avoidable hospitalizations; nursing home

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## Introduction

The prevalence of obesity among Americans age 65 and older exceeds 35% and is growing.<sup>1,2</sup> In this age group, obesity is associated with greater functional decline, increased morbidity, higher hospitalization rates, longer length of stay, and increased risk of nursing home (NH) admissions.<sup>3,4</sup> Recent studies have shown that in NHs the prevalence of moderate-to-severe obesity (Body Mass Index [BMI]  $\geq 35$ ) has increased from 14.7% to 23.9% between 2000 and 2010,<sup>5</sup> and to 28% in 2015.<sup>6</sup>

The increase in prevalence of obese residents whose care needs are often complex and costly<sup>7</sup> comes at a time when NHs are increasingly struggling to decrease hospital readmissions<sup>8,9</sup> and to reduce potentially avoidable hospitalizations.<sup>10</sup> To date only two studies have examined the relationship between obesity and hospitalizations of NH residents. A study of patients with hip fracture receiving post-acute care in a skilled nursing facility (SNF) found obesity to be associated with increased readmission risk.<sup>11</sup> Another recent study focusing on the general population of newly admitted SNF residents found the association between obesity and hospital readmissions to be complex and to vary by age and type of index hospitalization.<sup>12</sup>

These studies have suggested that care specifically targeted to obese residents may be needed to reduce readmissions in this vulnerable population. Others have pointed out that accommodating care needs of obese residents may require NHs to invest resources in special equipment, architectural modifications<sup>13,14</sup>, and staffing<sup>15,16</sup>, all of which are costly and difficult to achieve for most facilities. Without such accommodations, NHs may find it difficult not only to reduce hospital readmissions among obese residents, but they may also be less able to prevent or manage clinical conditions that result in otherwise potentially avoidable hospitalizations (PAH).

Our objective was to examine the association between obesity and PAH among long-stay NH residents. Because obesity-related accommodations are likely to be very infrequent in NHs, we hypothesized that obese long-stay residents experience significantly higher risk of PAH compared to residents of normal weight.

## Methods

### Data Sources

We used the following national data sets for CY2010–2014: Medicare Master Beneficiary Summary File (MBSF); Minimum Data Set (MDS) 3.0; Medicare Provider and Analysis Review (MedPAR) file; and Nursing Home Compare (NHC). The MDS is a federally mandated, comprehensive, clinical assessment database of all nursing home residents in Medicare or Medicaid certified NHs. The assessments are conducted at admission, quarterly, annually, when there is a significant change in health status, and at discharge. These assessments capture detailed information about residents' socio-demographics, weight and height, comorbidities, health status, and other factors. We used the MBSF to identify individuals who were dually entitled for Medicare and Medicaid, excluding enrollees of Medicare Advantage plans for whom hospitalization data may not be complete.<sup>17</sup> MedPAR was used to track inpatient admissions, and information on facility-level characteristics was obtained from the NHC. The Medicare beneficiary and provider identifiers were used to merge these databases.

The study protocol was reviewed and approved by the Institutional Research and Subjects Review Board.

### Study Population

We first identified a cohort of Medicare fee-for-service (FFS) enrollees, age 65 or older who were newly admitted to **free-standing NHs** between January 1, 2011 and March 26, 2014, and became long-term residents (**N=565,592**). New admissions were defined for individuals who did not have any NH stays during the 180 days preceding their index admission (2010 data were used to track prior NH use and to identify new 2011 admissions). Admissions occurring after March 26, 2014 were truncated to allow for the follow-up period (180 days after starting long-stay status). Among the newly admitted only those who became long-stayers were included in the study population. Long-stay NH residents were defined as those whose care episode was at least 100 days, with the long-stay status beginning at 101<sup>st</sup> day of the episode.

We excluded underweight residents, body mass index (BMI) lower than 18.5 (**N=47,219 or 8.3%**), as they may have substantially different risks for being hospitalized. Also excluded were residents with missing BMIs (**N=4,189 or 0.7%**). After excluding observations with missing covariate values (**N=24,098 or 4.3%**) the final analytical sample included 490,086 (**87%**) of the long-stay residents admitted to 14,469 NHs.

### Outcome Variables

We focused on two categorical outcomes, risk of hospitalizations deemed to be potentially avoidable (PAH) and risk of all other hospitalizations (non-PAH). Following the definition of PAH developed by RTI international,<sup>18</sup> and recently used by CMS in their evaluation of the Initiative to Reduce Potentially Avoidable Hospitalizations,<sup>10</sup> we focused on 17 conditions (Appendix) deemed as potentially manageable/preventable.<sup>19</sup>

## Independent Variables

We used the MDS assessment closest to the date of becoming a long-stay resident as the index assessment for defining the obesity category and for all other individual covariates. Following the definition of the WHO, residents were categorized as non-obese ( $30 < \text{BMI} \leq 18.5 \text{ kg/m}^2$ ), mildly obese ( $35 < \text{BMI} \leq 30 \text{ kg/m}^2$ ), or moderate-to-severely obese ( $\text{BMI} \geq 35 \text{ kg/m}^2$ ).

Because conditions defined as PAH are based on diagnoses alone, and do not reflect the severity of illness, we also controlled for individual factors that manifest residents' health condition and comorbidities. For example, we identified whether NH admission was post-acute or directly from the community. Functional status was measured by the level of Activities of Daily Living (ADL) impairments (score from 0-to-28).<sup>20</sup> Cognitive Function Scale (CFS) measured cognitive impairment on a scale from intact to severely impaired.<sup>21</sup> We controlled for co-morbid conditions and socio-demographic characteristics.<sup>12</sup>

We controlled for NH-level factors such as bed-size, percent of residents covered by Medicare and Medicaid, profit status, chain affiliation, nursing staffing levels (hours/resident/day), facility prevalence of obesity, and overall CMS star-rating. We also controlled for the year in which a resident became a long-stayer in order to account for any unobserved secular trends.

## Statistical analyses

We first compared resident characteristics by obesity status. Chi-square and t-tests were employed for statistical inference. We then fit multinomial logistic regression models with NH random-effects and state dummies to explore the relationship between obesity and the risk of PAH and non-PAH. For each outcome three models were estimated. First, we estimated simple multinomial logit models with NH random-effect and state dummies (**to control for state policies influencing hospitalizations**) without adjusting for other covariates, in order to capture the overall relationship between obesity and NH-originating hospitalizations. We then estimated the second model to account for individual level covariates that may help to differentiate the effect of illness severity and comorbidities. In the third model we included both individual and NH-level characteristics as risk-adjustors. Normal weight residents were included as the reference group in all analyses. Analyses were performed using SAS, version 9.4<sup>@</sup> (SAS Institute, Inc. Cary, NC), and STATA (StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP.).

## Results

Our study cohort included 490,086 newly admitted, long-stay residents who experienced a total of 101,187 hospitalizations. Almost half (45%) of all hospitalizations were identified as potentially avoidable (Appendix). Regardless of the obesity status, the five most common conditions for PAH were pneumonia, falls and/or trauma, urinary tract infection, congestive heart failure (CHF), and dehydration; but the distribution of these conditions varied substantially with obesity. For example, while falls/trauma were common among the normal weight residents (20.2%), they were experienced at much lower rates among the mildly and

moderate/severely obese (11.0% & 6.9%, respectively). On the other hand, CHF was most common among the moderate/severely obese (22.2%) but less so among the normal weight (14.8%).

Residents with moderate/severe obesity were more likely than those of normal weight to have any hospitalizations (23.5% vs. 20.2%), and had higher unadjusted rates of PAH (46.9% vs. 44.8%) (Table 1). Compared to normal weight, obese residents were younger, female, and with a higher proportion of blacks. They were much more likely to be Medicaid eligible (54.5% of moderate/severely obese, compared to 47.8% of mildly obese, and 41.8% among normal weight). Obese residents were more likely than those of normal weight to be cognitively intact (35.2% for the mildly and 49.9% for the moderate/severely obese vs. 25.2% for normal weight), but had substantially higher rates of co-morbidities such as hypertension, diabetes, **and heart failure (for moderate/severely obese).**

When unadjusted for other covariates (model 1, Figure 1), residents with mild and with moderate/severe obesity were statistically significantly more likely to be hospitalized for non-PAH (RRR=1.083 and RRR=1.208, respectively) and PAH (RRR=1.075 and RRR=1.234, respectively) than normal weight residents. After adjusting for individual level covariates, the risk of non-PAH, for the mildly obese and moderate/severely obese, became statistically not different from the risk for normal weight individuals, but the risk of PAH for the latter group remained higher (RRR=1.054) (model 2). After adjusting for individual and facility-level covariates (model 3), only the risk of PAH for the moderate/severely obese remained significantly higher (RRR=1.055; 95%CI=1.018,1.094) than for normal weight residents (Figure 1).

In Table 2 **we show a fully adjusted model (3) with** individual and facility-level covariates, and year dummies, for the risk of PAH and non-PAH, independent of obesity. Most individual level factors, although statistically significantly associated with the risk of PAH (and non-PAH) were clinically quite insignificant, with a few notable exceptions. For example, dual eligibility for Medicare and Medicaid conferred a 17% higher risk (RRR=1.170) of PAH and 13% higher risk of non-PAH (RRR=1.133). **Post-acute NH admissions** increased the risk of PAH and non-PAH **24% and 28%**, respectively. Among co-morbid conditions, heart failure and asthma/COPD had particularly strong incremental effects on PAH (RRR=1.530 and RRR=1.465, respectively) and a lower effect on non-PAH (RRR=1.210 and RRR=1.193, respectively).

Residents in highest quality NHs (CMS 5-star rating) had 7.4% and 6.5% lower risk of PAH and non-PAH, respectively than residents in lower (3-star) quality NHs. The risk of both PAH and non-PAH was lower in NHs with higher RN staffing (RRR=0.801 and RRR=0.913, respectively). The risk of hospitalizations, both PAH and non-PAH, was statistically significantly lower in chain facilities and higher in the for-profit NHs, but only for non-PAH. Compared to CY2011, there has been a significant decline in PAH and non-PAH alike in the subsequent CY2012–2014 time period.

## DISCUSSION

To the best of our knowledge this is the first study of the association between obesity and PAH among long-stay NH residents. In support of our hypothesis, we found that after controlling for individual covariates higher risk of PAH persisted for the moderate/severely obese but not for the mildly obese. Adjusting for facility factors did not change this pattern. However, we found no statistically significant differences in the risk of non-PAH among mildly or moderate/severely obese residents, compared to those of normal weight. Because caring for residents who are obese places higher demands on NH resources, such as higher staffing, weight-appropriate equipment and supplies, facilities may have less capacity in preventing or managing conditions that may result in PAH. Furthermore, the definition of what is preventable/manageable may be quite different when applied to obese residents. For example, residents who are obese have substantially higher rates of both CHF and COPD and experience much greater rates of hospitalizations for these conditions. The ability of NH staff to effectively recognize, prevent or manage exacerbations of these conditions in this population may be compromised by the complexity of their comorbid conditions. With increasing weight, edema or shortness of breath, all related to heart failure, may be more difficult to recognize in obese residents, and consequently harder to prevent or manage on site.

Consistent with the recent CMS reports of declines in PAH among NH residents,<sup>22</sup> our study found similar declines in PAHs and non-PAHs alike. However, the disparities in PAH between obese and normal weight residents have persisted.

We acknowledge several limitations. While we have accounted for many individual covariates, as is true in other cohort studies, uncaptured health conditions may confound the relationship between obesity and PAH. Our study cohort did not include individuals who repeatedly used SNF services or those enrolled in Medicare Advantage, thus making our results not fully generalizable.

## Conclusions and Implications

In conclusion, obese residents are more likely to experience PAH. Efforts to improve care for these residents may need to broadly consider NHs' capacity to commit additional resources to fully integrate care for this growing segment of the population.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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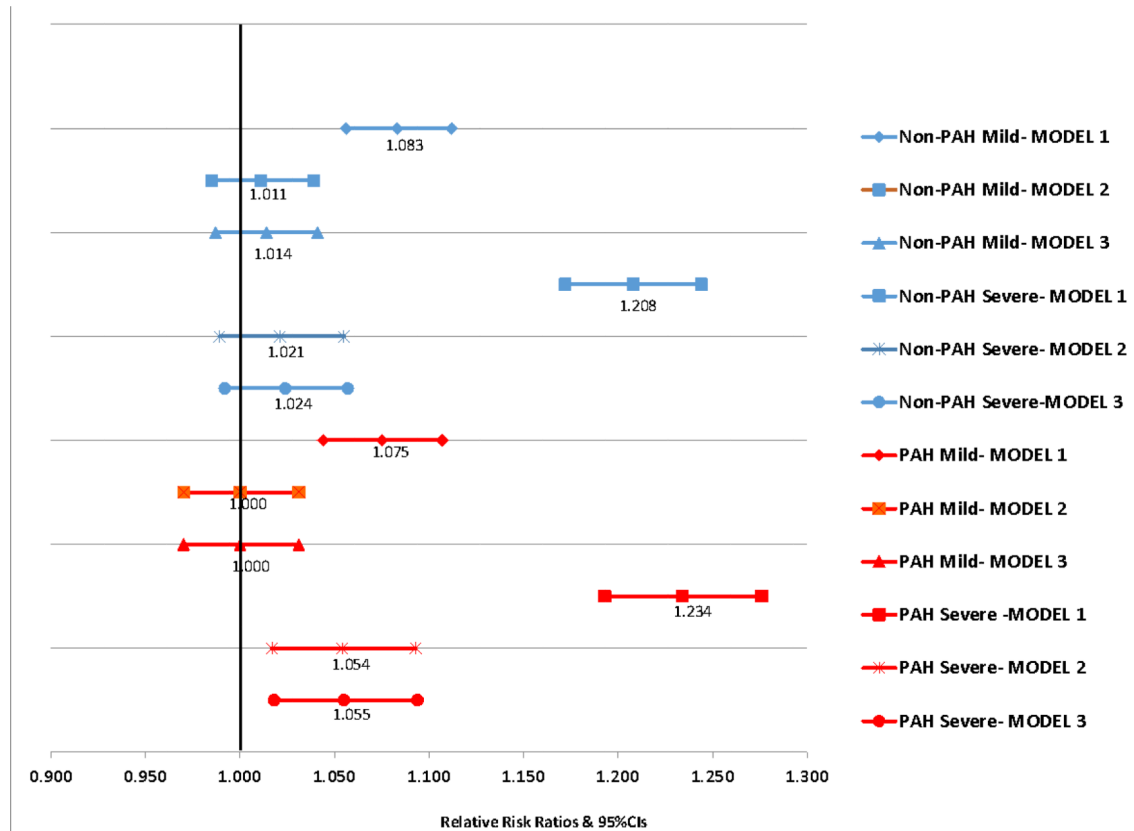
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**Figure 1:**  
Relative Risk and 95% CIs for Non-Avoidable (non-PAH) and Potentially Avoidable (PAH) Hospitalizations by Obesity Category: Simple and Risk-Adjusted Models\*

NOTE: Lines that cross 1.0 depict parameters that are not statistically significant.

\* Reference variable = normal weight

Model 1 = NH random effects and state dummies only

Model 2 = Model 1+ resident level characteristics

Model 3 = Model 2 + facility-level factors

**Table 1:**

Descriptive Characteristics of the Study Population: By Obesity Status

Characteristics	Normal weight N=380,650 (77.7%)	Mild obesity N=65,250 (13.3%)	Moderate/severe obesity N=44,186 (9.0%)
<b>Hospitalizations</b>			
Pct. of residents with any hospitalization	20.2%	21.3% ***	23.5% ***
Pct. of potentially avoidable hospitalizations	44.8%	45.7% ***	46.9% ***
<b>Socio-demographic factors</b>			
Age	84.1	81.6 ***	78.2 ***
Male	34.8%	32.1% ***	23.8% ***
Race		***	***
white	83.3%	83.9%	83.3%
black	8.5%	9.1%	10.6%
other	8.3%	7.0%	6.1%
Medicare-Medicaid dual	41.8%	47.8% ***	54.5% ***
Post-acute admission	62.6%	60.0% ***	63.1% ***
<b>Functional Status</b>			
ADL (score 0–28)	15.8	15.0 ***	15.3 ***
Cognitive Function Score		***	***
Intact	25.2%	35.2%	49.9%
Mildly impaired	24.6%	26.0%	23.7%
Moderately impaired	38.4%	30.5%	19.7%
Severely impaired	8.6%	5.0%	2.9%
Missing	3.2%	3.3%	3.8%
<b>Major Diagnoses</b>			
Hypertension	79.8%	85.3% ***	87.8% ***
Diabetes	27.1%	43.7% ***	56.6% ***
Heart failure	20.9%	27.3% ***	35.3% ***
Coronary artery disease (CAD)	24.6%	26.9%	26.3% **
Peripheral vascular disease (PVD)	8.0%	8.9%	10.5% ***
Alzheimer's disease or related dementia (ADRD)	59.2%	51.2%	36.0% ***
Asthma/COPD	19.6%	23.3%	31.6% ***
Stroke	18.6%	19.5%	16.9% ***
Anxiety	27.6%	27.6%	28.6% ***
Depression	44.8%	49.6%	52.6% ***

\*\*\*  
P<0.001\*\*  
P<0.05 – comparison of mild and moderate/severely obese to normal weight residents

**Table 2:**

Potentially Avoidable and All Other Hospitalizations by Obesity Status: Adjusted Relative Risk Ratios (RRR) and 95% Confidence Intervals (Note: Coefficients for state dummies are not shown)

Characteristics	Non-Avoidable Hospitalizations			Potentially Avoidable Hospitalizations		
	RRR	95%CI		RRR	95%CI	
Individual Factors						
Mild obesity (ref=normal)	1.014	0.987	1.041	1.000	0.970	1.031
Moderate/severe obesity	1.024	0.992	1.057	1.055 *	1.018	1.094
Age	0.993 *	0.992	0.995	1.012 *	1.011	1.014
Male (ref=female)	1.301 *	1.277	1.327	1.063 *	1.040	1.088
Race: black (ref=white)	1.199 *	1.162	1.237	0.994	0.956	1.033
Race: other	1.082 *	1.045	1.121	0.950	0.911	0.992
Dual status	1.133 *	1.110	1.155	1.170 *	1.144	1.197
Post-acute admission	1.284 *	1.258	1.311	1.237 *	1.209	1.266
ADL (score 0–28)	1.026 *	1.025	1.028	1.008 *	1.007	1.010
CFS:(ref=intact) Mildly impaired	1.007	0.981	1.033	1.025	0.996	1.055
Moderately impaired	0.962 *	0.937	0.988	1.010	0.980	1.041
Severely impaired	1.005	0.965	1.046	0.958	0.911	1.006
Missing	3.451 *	3.310	3.600	3.773 *	3.602	3.953
Hypertension	1.098 *	1.072	1.126	1.125 *	1.093	1.157
Diabetes	1.209 *	1.186	1.233	1.223 *	1.196	1.251
Heart failure	1.210 *	1.184	1.236	1.530 *	1.495	1.566
CAD	1.085 *	1.063	1.108	1.130 *	1.104	1.157
PVD	1.184 *	1.149	1.221	1.092 *	1.054	1.132
ADRD	0.925 *	0.907	0.945	0.934 *	0.912	0.956
Asthma/COPD	1.193 *	1.168	1.219	1.465 *	1.431	1.500
Stroke	1.036 *	1.013	1.060	0.961 *	0.935	0.987
Anxiety	1.024	1.002	1.045	1.068 *	1.044	1.094
Depression	1.022	1.002	1.041	1.060 *	1.037	1.083
Nursing Home Factors						
NH rate: mild obesity	0.997	0.994	1.000	1.000	0.996	1.003
NH rate: mod/severe Obesity	0.998	0.995	1.000	0.996 *	0.993	0.998
Star rating: 1 star (ref=3 star)	1.053 *	1.019	1.089	1.045	1.007	1.085
Star rating: 2 star (ref=3 star)	1.010	0.982	1.040	0.988	0.956	1.021
Star rating: 4 star (ref=3 star)	0.968	0.942	0.995	0.973	0.944	1.004

Characteristics	Non-Avoidable Hospitalizations			Potentially Avoidable Hospitalizations		
	RRR	95%CI		RRR	95%CI	
Star rating: 5 star (ref=3 star)	0.935 *	0.906	0.965	0.926 *	0.894	0.960
CNA hours/resident/day	1.021	1.000	1.042	1.047 *	1.023	1.072
LPN hours/resident/day	1.000	0.973	1.029	1.007	0.975	1.039
RN hours/resident/day	0.913 *	0.858	0.970	0.801 *	0.746	0.859
Number of beds	1.000	1.000	1.000	0.999 *	0.999	0.999
Medicare%	1.002 *	1.001	1.003	1.001 *	1.000	1.003
Medicaid%	1.004 *	1.003	1.004	1.005 *	1.004	1.006
Chain	0.969 *	0.947	0.991	0.950 *	0.926	0.974
Profit	1.039 *	1.011	1.068	1.018	0.988	1.049
Year: 2012 (ref=2011)	0.948 *	0.925	0.971	0.921 *	0.896	0.948
Year: 2013 (ref=2011)	0.883 *	0.860	0.906	0.833 *	0.809	0.858
Year: 2014 (ref=2011)	0.877 *	0.850	0.905	0.794 *	0.766	0.824

\*  
p-value <0.01