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## Research Report

# Weight Loss in Newly Admitted Nursing Home Residents With Obesity

Ning Zhang, PhD,<sup>1,2,\*</sup> Terry Field, DSc,<sup>2</sup> Kathleen M. Mazor, EdD,<sup>2</sup> Yanhua Zhou, MS,<sup>2</sup> and Jerry H. Gurwitz, MD<sup>2</sup>

<sup>1</sup>Department of Pharmacy and Health Systems Sciences, School of Pharmacy, Bouve College of Health Sciences, Northeastern University, Boston, Massachusetts, USA. <sup>2</sup>Meyers Health Care Institute, a joint endeavor of the University of Massachusetts Chan Medical School, Reliant Medical Group, and Fallon Health, Worcester, Massachusetts, USA.

\*Address correspondence to: Ning Zhang, PhD. Department of Pharmacy and Health Systems Sciences, School of Pharmacy, Bouve College of Health Sciences, Northeastern University, 360 Huntington Street, Boston, MA 02115, USA. E-mail: [n.zhang@northeastern.edu](mailto:n.zhang@northeastern.edu)

Received: December 7, 2021; Editorial Decision Date: June 9, 2022

**Decision Editor:** Lewis A. Lipsitz, MD, FGSA

## Abstract

**Background:** The prevalence of obesity (body mass index  $\geq 30$ ) among nursing home residents has been increasing, but there has been little research on weight change in this population. We examined resident characteristics associated with substantial weight loss among nursing home residents with obesity.

**Methods:** Using data from the Minimum Data Set 3.0, this retrospective study included long-stay nursing home residents with obesity newly admitted to a facility in 2014 who had annual assessments in 2015. Substantial weight loss was defined as a loss of  $\geq 10\%$  body weight within a year. Multivariate regression analyses were conducted to identify factors associated with weight loss, including demographic characteristics, medical conditions, and functional limitations in activities of daily living (ADL).

**Results:** Among 59782 newly admitted nursing home residents with obesity, 23% experienced substantial weight loss during their first year in the nursing home. Moderate ADL dependency (odds ratio [OR] = 1.42, 95% confidence interval [CI]: 1.31–1.53), severe ADL dependency (OR = 1.83; 95% CI: 1.67–1.99), severe mobility impairment (OR = 1.15; 95% CI: 1.04–1.23), and severe cognitive impairment (OR = 1.13; 95% CI: 1.07–1.19), as well as cancer (OR = 1.10; 95% CI: 1.01–1.20), heart failure (OR = 1.06; 95% CI: 1.01–1.11), end-stage renal disease (OR = 1.17; 95% CI: 1.11–1.23), and bowel incontinence (OR = 1.19; 95% CI: 1.14–1.25) were associated with weight loss.

**Conclusion:** Substantial weight loss is common among nursing home residents with obesity over a 1-year period following admission, and these residents have a greater burden of functional and cognitive impairment and specific medical conditions. These findings suggest the need to further elucidate the clinical implications of weight loss among this population.

**Keywords:** Long-term care, Obesity, Weight loss

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Nursing home residents, like Americans of all ages, suffer increasingly from obesity, as defined by body mass index, BMI  $\geq 30$ . The prevalence of obesity among nursing home residents has almost doubled, increasing from 15% in 1992 to 29% in 2015 (1–3). During this period, the prevalence of class III obesity (BMI  $\geq 40$ ) increased from 3% to 6.2% (2). Our previous study showed that residents with obesity have high levels of mobility impairment and are more likely to have certain medical conditions, including chronic obstructive pulmonary disease, diabetes, heart failure, and hypertension (2). Because of the rising prevalence of obesity and the conditions associated with it, nursing home facilities face

special challenges in providing optimal care to nursing home residents with obesity.

Weight loss is a common problem among the nursing home population and is employed as a quality indicator, as there is a strong association between weight loss and mortality and morbidity (4,5). However, weight loss among obese residents of nursing homes has not been adequately investigated. In this study, we assessed the incidence of substantial weight loss, defined as a 10% or more reduction in body weight during a 1-year period, among newly admitted obese residents of nursing homes, and identified functional and clinical characteristics associated with substantial weight loss in this group.

## Method

### Data Sources and Study Sample

To identify weight changes among long-term nursing home residents, we used data from the national Minimum Data Set (MDS) 3.0 for 2014 and 2015. The MDS is an administrative data set that includes all residents of Medicare- or Medicaid-certified nursing homes, with data collected upon admission and in regular intervals thereafter until discharge. The assessment records include medical conditions, cognitive function, physical function, and demographic characteristics.

In the United States, long-term nursing home residents are defined as residents who reside in a facility for at least 100 days during a specified year (6). Older adults are eligible for nursing home care if they have debilitating health issues or serious conditions that require frequent medical supervision and round-the-clock care (6). There were 488 068 long-term nursing home residents who were newly admitted in 2014. Residents were excluded from the study if they were comatose or receiving hospice care at admission ( $n = 14\,743$ ), missing information on body weight or height on admission records ( $n = 10\,351$ ), or died or were discharged before annual assessment ( $n = 94\,948$ ). We also excluded residents if they had no information on body weight or height over the year following admission ( $n = 93\,617$ ), had extreme values of body weight and height defined as below the 1st or above the 99th percentile of body height or weight at admission or at the 1-year follow-up assessment ( $n = 14\,478$ ), or had extreme changes in body weight between admission and the 1-year follow-up assessment ( $n = 8\,330$ ), leaving 254 601 residents in the sample. After excluding those without obesity ( $n = 194\,819$ ), there were 59 782 residents with obesity (23%). These residents were further categorized into 3 classes of obesity: class I ( $30 \leq \text{BMI} < 35$ ), class II ( $35 \leq \text{BMI} < 40$ ), and class III ( $\text{BMI} \geq 40$ ). Complete details are provided in Figure 1.

### Measures

For each resident, we calculated the percentage change in body weight measured at admission in 2014 and 1 year later in 2015 when residents were reassessed. We defined substantial weight loss as a loss of 10% or more of body weight. Among residents with obesity,

we compared residents with substantial weight loss to those who lost less than 10% of body weight, gained weight, or had no weight change.

### Resident Characteristics

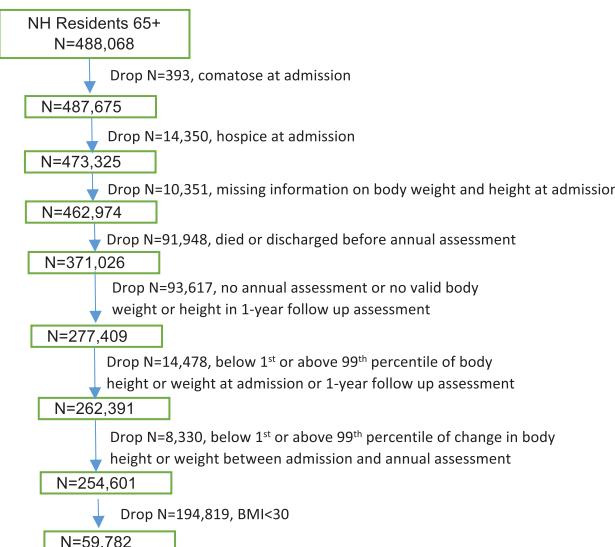
Resident characteristics were specified based on information available in the admission assessment. Demographic characteristics included age, gender, race, and ethnicity categorized as white non-Hispanic, Black non-Hispanic, Hispanic, Asian, American Indian/Alaskan Native, or Native Hawaiian/Pacific Islander. We also captured the MDS measures of activities of daily living (ADLs), mobility impairment, and cognitive impairment, and categorized residents' level of functioning (6). The ADL Long Form Scale characterizes physical dependency by summing the scores of the 7 individual ADLs (bed mobility, transfer, locomotion, eating, bathing, dressing, and toileting) (7). We categorized residents using the ADL scale as mild (0–12), moderate (13–20), and severe dependency (21–28) (8). For mobility impairment, we categorized residents as having no mobility impairment if residents could walk in a room or corridor independently, mild impairment if they could walk with minimal assistance, moderate impairment if they could walk with limited assistance, or severe impairment if they could only walk with extensive assistance or exhibited complete dependence on staff (2).

The MDS 3.0 includes the Brief Interview for Mental Status (BIMS). However, not all residents are able to complete the BIMS and are assessed by staff. For these residents, a Cognitive Performance Scale (CPS) is calculated using an algorithm assigning a score between 0 and 6 based on the staff assessment items (9). These 2 sources are combined to form the 4-level hierarchical Cognitive Function Scale developed and validated by previous researchers (10). Residents are categorized as severely impaired if they did not complete the BIMS and have a CPS score of 5 or 6. They are categorized as moderately impaired with a score of 0–7 on the BIMS or 3–4 on the CPS. With a BIMS score of 8–12 or a CPS score of 0–2 they are categorized as mildly impaired. The remaining residents are categorized as cognitively intact.

We also evaluated the association between substantial weight loss and the following medical conditions: arthritis, stroke, cancer, chronic obstructive pulmonary disease, diabetes, dementia, depression, heart failure, hypertension, end-stage renal failure, fall history, hearing impairment, bowel incontinence, urinary incontinence, and pressure ulcers.

### Statistical Analysis

Among residents with obesity, we compared the baseline characteristics of those with and without substantial weight loss. We then conducted bivariate analyses to identify relationships between weight loss and each of the individual characteristics. Similar analyses were conducted among residents with different classes of obesity. Finally, we used multivariate analysis to determine the independent association of weight loss with characteristics that were statistically significant in the bivariate analyses. The models included: age; gender; race and ethnicity; mild, moderate, or severe functional limitation; mobility; cognitive impairment; and selected medical conditions (arthritis, cancer, depression, heart failure, end-stage renal disease, fall history, bowel incontinence, urinary incontinence, and pressure ulcers). We repeated these analyses among residents within different weight classes. All analyses were performed using SAS 9.3 (SAS Institute, Cary, NC) and Stata 14 (StataCorp LLC, College Station, TX). The University of Massachusetts Institutional Review Board deemed this study exempt from review.



**Figure 1.** Cohort assembly. BMI = body mass index; NH = nursing home.

**Table 1.** Characteristics of Nursing Home Residents With Obesity Newly Admitted to Nursing Homes in 2014.

	All (N = 59 782)		Residents With Weight Loss* (N = 13 626, 22.8%)		Residents Without Weight Loss† (N = 46 156, 77.2%)	
	N	%	N	%	N	%
Class I obesity	35 752	59.8	7 832	57.5	27 920	60.5
Class II obesity	15 088	25.2	3 558	26.1	11 530	25
Class III obesity	8 842	15.0	2 236	16.4	6 706	14.5
Demographics						
Age groups						
65–74	19 013	31.8	4 209	30.9	14 804	32.1
75–84	24 390	40.1	5 696	41.8	18 694	40.5
85–94	15 350	25.7	3 470	25.5	11 880	25.7
≥95	1 029	1.7	251	1.8	779	1.7
Male	16 028	27.8	3 421	25.1	12 607	27.3
Female	43 754	73.2	10 205	74.9	33 549	72.7
Race						
White	47 770	80.0	10 826	79.5	36 944	80
Black	6 814	11.4	1 511	11.1	5 303	11.5
Hispanic	2 582	4.4	637	4.7	1 945	4.2
Asian	248	0.4	72	0.5	176	0.4
American Indian/Alaskan Natives	208	0.4	50	0.4	158	0.3
Native Hawaiian/Pacific Islander	78	0.1	20	0.2	58	0.1
Missing	2 082	3.5	510	3.6	1 572	3.4
Need for assistance in performing ADL (scores 0–28)‡						
Mild (0–12)	9 217	15.3	1 449	10.6	7 768	16.8
Moderate (13–20)	39 054	65.3	8 807	64.6	30 247	65.5
Severe (21–28)	11 511	19.3	3 370	24.7	8 141	17.6
Mobility impairment§						
No impairment	2 294	3.8	345	2.5	1 949	4.2
Mild impairment	13 063	21.9	2 490	18.3	10 573	22.9
Moderate impairment	9 606	16.1	2 131	15.6	7 475	16.2
Severe impairment	34 819	58.2	8 660	63.6	26 159	56.7
Cognitive Function Scale						
No or mild impairment	29 954	50.4	6 585	48.7	23 469	50.9
Moderate impairment	18 210	30.7	4 120	30.5	14 090	30.7
Severe impairment	11 221	18.9	2 806	20.7	8 415	18.3
Medical conditions						
Arthritis	19 358	32.4	4 152	30.5	15 206	32.9
Stroke	9 239	15.5	2 102	15.4	7 137	15.5
Cancer	2 994	5.0	727	5.3	2 267	4.9
COPD	15 082	25.2	3 512	25.8	11 570	25.1
Diabetes	30 352	50.8	6 951	51	23 401	50.7
Dementia	17 232	28.8	3 767	27.7	13 465	29.2
Depression	25 541	42.7	5 436	39.9	20 105	43.6
Heart failure	28 753	48.1	6 886	50.5	22 013	47.7
Hypertension	49 598	83.0	11 303	83	38 295	83
End-stage renal disease	9 943	16.6	2 540	18.6	7 403	16
Fall history	12 531	21.0	2 619	19.2	9 912	21.5
Hearing impairment	3 777	6.3	861	6.3	2 916	6.3
Bowel incontinence	29 794	49.9	7 569	55.6	22 225	48.2
Urinary incontinence	39 968	66.9	9 282	68.2	30 686	66.5
Pressure ulcers	5 959	10.0	1 575	11.6	4 384	9.5

Notes: ADL = activities of daily living; COPD = chronic obstructive pulmonary disease.

\*Defined as residents who lost 10% or more body weight between 2014 and 2015.

†Defined as residents' weight was unchanged, increased, or decreased, but by less than 10% between 2014 and 2015.

‡Defined as score (range = 0–28) from the ADL Long Form Scale using dependencies in self performance of 7 ADLs, including bed mobility, transfer, locomotion, dressing, eating, toilet use, and bathing.

§Defined as the assistance level a resident needs to walk in a room or a corridor in the 7 days before the index assessment date: no impairment (no assistance), mild impairment (supervise or limited assistance), moderate impairment (extensive assistance), and severe impairment (total dependence or the resident did not walk or walked only 1 or 2 times).

**Table 2.** Bivariate Analysis: Odds Ratios (ORs) for Nursing Home Residents With Obesity Who Had Weight Loss Between 2014 and 2015

	All	Class I Obesity	Class II Obesity	Class III Obesity
	ORs (95% CI)	ORs (95% CI)	ORs (95% CI)	ORs (95% CI)
<b>Demographics</b>				
Age groups				
65–74	Reference	Reference	Reference	Reference
75–84	1.05 (1.02–1.10)	1.03 (0.98–1.07)	1.04 (0.98–1.11)	1.02 (0.95–1.10)
85–94	0.98 (0.96–1.02)	0.99 (0.93–1.07)	0.99 (0.93–1.07)	0.99 (0.89–1.10)
≥95	1.09 (0.96–1.19)	1.03 (0.91–1.16)	1.03 (0.98–1.07)	1.06 (0.61–1.86)
Male	Reference	Reference	Reference	Reference
Female	1.12 (1.07–1.17)	1.13 (1.09–1.18)	1.07 (0.99–1.13)	1.06 (0.95–1.18)
Race				
White	Reference	Reference	Reference	Reference
Black	0.97 (0.90–1.02)	1.10 (1.1–1.29)	1.10 (1.1–1.29)	1.12 (0.92–1.02)
Hispanic	1.09 (1.01–1.16)	1.15 (1.06–1.22)	1.17 (1.03–1.33)	1.01 (0.82–1.24)
Asian	0.92 (0.86–0.96)	1.09 (0.91–1.22)	0.94 (0.82–1.06)	0.91 (0.79–1.00)
American Indian/Alaskan Natives	0.92 (0.85–1.00)	0.96 (0.78–1.12)	0.90 (0.78–1.00)	0.95 (0.77–1.13)
Native Hawaiian/Pacific Islander	0.90 (0.73–1.11)	0.88 (0.73–1.09)	0.92 (0.74–1.17)	0.96 (0.74–1.19)
Missing	0.94 (0.81–0.99)	1.11 (1.07–1.29)	1.04 (1.00–1.19)	0.99 (0.89–1.08)
Need for assistance in performing ADL				
Mild (0–12)	Reference	Reference	Reference	Reference
Moderate (13–20)	1.37 (1.33–1.42)	1.45 (1.31–1.60)	1.45 (1.31–1.60)	0.96 (0.89–1.04)
Severe (21–28)	1.53 (1.47–1.60)	1.89 (1.69–2.11)	1.89 (1.69–2.11)	1.27 (1.17–1.38)
Mobility impairment				
No impairment	Reference	Reference	Reference	Reference
Mild	1.04 (0.96–1.11)	0.75 (0.71–0.80)	1.01 (0.87–1.08)	0.78 (0.68–0.89)
Moderate	1.12 (1.04–1.19)	0.97 (0.91–1.03)	1.13 (1.09–1.19)	0.96 (0.84–1.16)
Severe	125 (1.21–1.29)	1.34 (1.27–1.41)	1.23 (1.16–1.30)	1.22 (1.11–1.36)
Cognitive Function Scale				
No or mild impairment	Reference	Reference	Reference	Reference
Moderate	1.00 (0.96–1.02)	1.02 (0.99–1.09)	1.02 (1.01–1.11)	1.13 (1.04–1.22)
Severe	1.12 (1.08–1.16)	1.16 (1.10–1.23)	1.06 (1.01–1.13)	1.26 (1.08–1.47)
Medical conditions				
Arthritis	0.92 (0.89–0.95)	0.89 (0.84–0.94)	0.92 (0.85–1.00)	0.83 (0.75–0.91)
Stroke	1.00 (0.95–1.05)	0.95 (0.89–1.02)	1.13 (1.02–1.26)	1.01 (0.87–1.10)
Cancer	1.07 (1.00–1.14)	1.05 (0.95–1.18)	1.23 (1.04–1.45)	1.02 (0.82–1.27)
COPD	1.04 (0.99–1.06)	1.02 (0.96–1.08)	1.07 (0.98–1.16)	0.97 (0.88–1.07)
Diabetes	1.01 (0.97–1.03)	1.00 (0.94–1.04)	1.02 (0.94–1.10)	0.98 (0.89–1.09)
Depression	0.86 (0.93–0.89)	0.89 (0.85–0.94)	0.82 (0.76–0.89)	0.79 (0.71–0.87)
Heart failure	1.07 (1.03–1.09)	1.05 (1.00–1.11)	1.09 (1.01–1.18)	1.08 (0.97–1.18)
Hypertension	1.00 (0.95–1.05)	0.98 (0.92–1.04)	1.00 (0.90–1.10)	1.06 (0.92–1.21)
End-stage renal disease	1.14 (1.10–1.19)	1.17 (1.09–1.25)	1.24 (1.13–1.36)	1.18 (1.04–1.32)
Fall history	0.87 (0.83–0.93)	0.85 (0.80–0.91)	0.88 (0.80–0.96)	0.94 (0.83–1.06)
Hearing impairment	1.00 (0.92–1.06)	1.00 (0.91–1.10)	1.10 (0.94–1.29)	0.92 (0.71–1.18)
Bowel incontinence	1.25 (1.22–1.30)	1.36 (1.30–1.43)	1.33 (1.24–1.44)	1.32 (1.20–1.40)
Urinary incontinence	1.06 (1.03–1.09)	1.11 (1.05–1.17)	1.05 (0.97–1.14)	1.01 (0.91–1.12)
Pressure ulcers	1.18 (1.13–1.23)	1.24 (1.15–1.35)	1.22 (1.09–1.38)	1.24 (1.07–1.44)

Notes: ADL = activities of daily living; CI = confidence interval; COPD = chronic obstructive pulmonary disease.

## Results

Among residents with obesity, about 23% ( $N = 13\,626$ ) lost at least 10% of their body weight during the 1-year period following admission to a nursing home. A higher percentage of residents with class III obesity (25.3%) experienced substantial weight loss, as compared with residents with class I obesity (21.9%) or class II obesity (23.6%).

Table 1 describes the study population of 59 782 nursing home residents newly admitted in 2014 with obesity (Supplementary Appendix Table 1). In the study population, 17% had severe ADL dependency and 58% had severe mobility impairment. Compared to residents with obesity and without weight loss, in residents with obesity there was a higher prevalence of severe ADL dependency

(24.7% vs 17.6%), severe mobility impairment (63.6% vs 56.7%), and severe cognitive impairment (20.7% vs 18.3%).

Table 2 presents the bivariate associations of the analyzed characteristics and weight loss. Dependency in ADLs, mobility impairment and cognitive impairment, cancer, heart failure, end-stage renal disease, bowel incontinence, urinary incontinence, and pressure ulcers were significantly associated with weight loss. Patterns were similar among residents across the different classes of obesity.

Table 3 presents factors independently associated with weight loss. Female residents were more likely to have substantial weight loss. In addition, several variables were associated with weight loss including moderate ADL dependency (odds ratio [OR] = 1.42, 95% confidence interval [CI]: 1.31–1.53), severe ADL dependency (OR = 1.83; 95% CI: 1.67–1.99), severe mobility impairment

**Table 3.** Regression Analysis of Association Between Weight Loss and Key Factors (OR and 95% CI)

	All	Class I Obesity	Class II Obesity	Class III Obesity
	ORs (95% CI)	ORs (95% CI)	ORs (95% CI)	OR (95% CI)
<b>Age groups</b>				
65–74	Reference	Reference	Reference	Reference
75–84	1.05 (0.99–1.10)	0.99 (0.92–1.05)	1.05 (0.96–1.15)	0.99 (0.89–1.10)
85–94	0.99 (0.04–1.06)	0.92 (0.86–0.98)	0.98 (0.88–1.09)	0.94 (0.80–1.10)
≥95	1.06 (0.91–1.23)	0.95 (0.80–1.13)	1.23 (0.86–1.78)	1.02 (0.47–2.23)
Male	Reference	Reference	Reference	Reference
Female	1.10 (1.05–1.15)	1.17 (1.10–1.23)	1.05 (0.96–1.14)	1.07 (0.92–1.24)
<b>Race</b>				
White	Reference	Reference	Reference	Reference
Black	0.91 (0.85–0.97)	0.94 (0.80–1.13)	0.85 (0.75–0.96)	0.94 (0.81–1.09)
Hispanic	1.05 (0.96–1.15)	1.03 (0.91–1.16)	1.14 (0.95–1.37)	0.94 (0.70–1.25)
Asian	0.82 (0.75–0.91)	0.81 (0.72–1.09)	0.80 (0.73–0.99)	0.83 (0.70–1.19)
American Indian/Alaskan Natives	1.12 (0.92–1.37)	1.05 (0.87–1.40)	1.01 (0.87–1.21)	1.00 (0.65–1.27)
Native Hawaiian/Pacific Islander	0.81 (0.96–1.03)	0.78 (0.81–1.07)	0.89 (0.71–1.13)	0.79 (0.60–0.99)
Missing	0.98 (0.78–1.12)	0.92 (0.81–1.19)	0.97 (0.81–1.09)	0.91 (0.80–1.21)
<b>Need for assistance in performing ADL</b>				
Mild (0–12)	Reference	Reference	Reference	Reference
Moderate (13–20)	1.42 (1.31–1.53)	1.37 (1.24–1.51)	1.49 (1.28–1.74)	1.45 (1.21–1.73)
Severe (21–28)	1.83 (1.67–1.99)	1.77 (1.57–1.99)	2.02 (1.68–2.41)	1.75 (1.37–2.22)
<b>Mobility impairment</b>				
No impairment	Reference	Reference	Reference	Reference
Mild	1.06 (0.96–1.21)	1.07 (0.93–1.23)	1.08 (1.04–1.15)	1.07 (1.05–1.11)
Moderate	1.08 (0.93–1.24)	1.12 (0.94–1.35)	1.08 (1.04–1.19)	1.11 (1.07–1.20)
Severe	1.15 (1.04–1.23)	1.21 (1.02–1.40)	1.18 (1.01–1.56)	1.14 (1.10–1.23)
<b>Cognitive Function Scale</b>				
No or mild impairment	Reference	Reference	Reference	Reference
Moderate	1.03 (0.98–1.08)	1.01 (0.95–1.07)	1.03 (0.94–1.12)	1.19 (1.06–1.34)
Severe	1.13 (1.07–1.19)	1.10 (1.03–1.18)	1.20 (1.13–1.34)	1.34 (1.12–1.60)
<b>Medical conditions</b>				
Arthritis	0.91 (0.87–0.93)	0.91 (0.84–0.94)	0.94 (0.86–1.01)	0.85 (0.78–0.93)
Cancer	1.10 (1.01–1.20)	1.08 (0.96–1.21)	1.23 (1.04–1.45)	1.02 (0.81–1.26)
Depression	0.87 (0.83–0.90)	0.90 (0.86–0.95)	0.83 (0.77–0.90)	0.80 (0.72–0.89)
Heart failure	1.06 (1.01–1.11)	1.04 (0.99–1.10)	1.08 (1.00–1.16)	1.08 (0.97–1.19)
End-stage renal disease	1.17 (1.11–1.23)	1.15 (1.07–1.24)	1.21 (1.10–1.32)	1.17 (1.04–1.33)
Fall history	0.89 (0.85–0.94)	0.87 (0.81–0.92)	0.90 (0.82–0.99)	0.93 (0.82–1.06)
Bowel incontinence	1.19 (1.14–1.25)	1.18 (1.11–1.26)	1.18 (1.07–1.28)	1.22 (1.09–1.37)
Urinary incontinence	0.91 (0.87–0.95)	0.93 (0.87–0.98)	0.88 (0.80–0.96)	0.87 (0.77–0.97)
Pressure ulcers	1.06 (0.99–1.13)	1.04 (0.96–1.14)	1.03 (1.10–1.32)	1.10 (0.94–1.28)

**Notes:** All models include age, gender, race/ethnicity, functionality (mild, moderate, or severe functional limitation), mobility, cognitive impairment, and the listed medical conditions. ADL = activities of daily living; CI = confidence interval; COPD = chronic obstructive pulmonary disease; OR = odds ratio.

(OR = 1.15; 95% CI: 1.04–1.23), and severe cognitive impairment (OR = 1.13; 95% CI: 1.07–1.19). These associations were stronger among residents with class III obesity. Cancer (OR = 1.10; 95% CI: 1.01–1.20), heart failure (OR = 1.06; 95% CI: 1.01–1.11), end-stage renal disease (OR = 1.17; 95% CI: 1.11–1.23), and bowel incontinence (OR = 1.19; 95% CI: 1.14–1.25) were also associated with substantial weight loss. Several medical conditions were negatively associated with weight loss including arthritis (OR = 0.91; 95% CI: 0.87–0.93), depression (OR = 0.87; 95% CI: 0.83–0.90), fall history (OR = 0.89; 95% CI: 0.85–0.94), and urinary incontinence (OR = 0.91; 95% CI: 0.87–0.93). These patterns were similar in residents across the different classes of obesity.

## Discussion

In our study, we found that nearly 1 in 4 nursing home residents with obesity experienced substantial weight loss during the 1-year period following admission. This prevalence is substantially higher than

reported in previous studies of nursing home residents not focused specifically on obese residents, with percentages ranging from 6% to 15% (11–13). Several factors may explain the differences from our findings, including differences in definitions of weight loss (we focused on substantial weight loss, defined as a loss of at least 10% of body weight), population (we focused on newly admitted residents), how weight change was determined (we relied on MDS assessments), the follow-up time period (available data in the MDS required use of a full year, allowing more time for weight loss than was used in some studies), and the fact that we limited our study to those residents who were obese at the time of admission to the facility.

Our analysis of the association between weight loss and baseline functional limitations, cognitive status and medical conditions indicates that moderate to severe ADL dependency, mobility impairment, severe cognitive impairment, and specific medical conditions predict weight loss among residents with obesity over the first year of residence in the nursing home. Some of the factors that we found to be associated with weight loss, including renal failure, have also

been found to be associated with weight loss in general nursing home populations (14). Our study, however, differs from several studies that found depression and arthritis to be associated with weight loss in the general nursing home population; we found that residents with obesity who had these diagnoses at admission were less likely to lose substantial amounts of weight during the year (15,16).

The characteristics with the strongest associations with weight loss in our study related to physical and cognitive function. We were able to identify only 1 previously published study that assessed the association of physical and cognitive function with weight loss in a general nursing home population, and that study found no association (17). However, that study was conducted in a single Italian nursing home with 161 residents, which limits its power and generalizability. In contrast, our study included nearly 60 000 nursing home residents.

The results from our study serve to stimulate a number of important research questions about short-term and long-term consequences of substantial weight loss among older nursing home residents with obesity, and the need to differentiate intentional from unintentional weight loss. The most important unanswered questions relate to the impact of weight loss in obese nursing home residents on a range of health outcomes including symptom burden, functional status, health-related quality of life, morbidity, and mortality. Only with this information will it be possible to consider whether interventions are appropriate, and how they should be designed and tested.

Our study sample was limited to residents who survived the first year following their initial nursing home admission. Therefore, the prevalence of obesity in nursing home residents found in the current study (23%) is slightly lower than reported in our previous study (28% in 2014) (2). The findings of our study may have been affected by issues in the measurement of residents' height and weight. While the MDS protocol provides explicit direction on the timing of height and weight measurement, strict adherence to this protocol is uncertain. Facility access to equipment capable of accurately measuring weight may vary. To limit the impact of these measurement issues on our results, we excluded extreme values of body weight and height, as well as extreme changes in body weight and height between admission records and 1-year follow-up records.

In addition, our study excluded nursing home residents who died or were discharged before their first annual assessment. Hence, our study may underestimate the incidence of substantial weight loss among nursing home residents with obesity. Furthermore, MDS data do not include reliable information to differentiate intentional and unintentional weight loss. Last, our results may be affected by our lack of ability to consider sarcopenia, an age-related loss of skeletal muscle mass. Multiple studies have documented a positive relationship between obesity and sarcopenia, placing nursing home residents with obesity at an increased risk for weight loss due to loss of lean body mass (18–20).

In summary, the high percentage with weight loss we found among nursing home residents with obesity coupled with associations with impaired function highlight the need for further investigation to determine the clinical implications of weight loss, both positive and negative, in this large and growing segment of the U.S. nursing home population.

## Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

## Funding

None declared.

## Conflict of Interest

None declared.

## Author Contributions

N.Z.: study design, data access, data analysis, results interpretation, and manuscript writing. T.F.: study design, results interpretation, and manuscript reading and editing. K.M.M.: results interpretation and manuscript reading and editing. Y.Z.: data access and data analysis. J.H.G.: study design, results interpretation, and manuscript reading and editing.

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