
Obesity in a Commercially Insured Population: An Analysis of NHANES Data

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ANALYSIS OF NHANES DATA PROVIDES INSIGHTS REGARDING TRENDS AND PREVALENCE OF OBESITY AND ASSOCIATED COMORBIDITIES IN A COMMERCIALY INSURED POPULATION

OVERVIEW

Data Sources

The analysis is based on the National Health and Nutrition Examination Survey (NHANES), a database series designed to assess United States health and nutritional status.¹ The survey combines interviews and physical examinations. NHANES is a major program of the National Center for Health Statistics (NCHS).¹ NCHS is part of the Centers for Disease Control and Prevention and is responsible for producing vital and health statistics for the nation.¹

The NHANES data set is divided into 4 sections labeled by collection method: Demographics, Dietary, Examination, Laboratory, and Questionnaire.²

The results described herein are based on the NHANES database series NHANES III (1988-1994), 1999-2000, 2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010, and 2011-2012. These surveys include at least 9,000 noninstitutionalized, nationally representative US citizens (except for NHANES III, which surveyed approximately 30,000 individuals).³⁻⁵ Additional information regarding NHANES and the detailed criteria for population identification utilized in these analyses are described in Appendix A.

In addition, we used the Milliman 2013 *Health Cost Guidelines* to demographically adjust the NHANES population to that of a commercially insured 18- to 64-year-old population, not including pregnant women. See the methodology for a description of the Milliman *Health Cost Guidelines*.

As the NHANES data set consolidates quantitative and qualitative data, which were also demographically adjusted, the summary results presented herein are national estimates. Results will vary for specific commercially insured populations.

Study Design

We used the NHANES demographic, examination, questionnaire, and laboratory data files to identify all individuals aged 18-64 years and for each subject, their body mass index (BMI) and presence of the following comorbidities: type 2 diabetes (diagnosed and undiagnosed), prediabetes, hypertension, coronary heart disease (CHD), dyslipidemia, sleep disorder, osteoarthritis, asthma, and depression. We excluded pregnant women from the sample. See the methodology in Appendix A for a description of the NHANES fields used to identify BMI and comorbidities. We used NHANES series III (1988-1994) through NHANES series 2011-2012 to calculate trends in BMI levels across all of the NHANES series. The definitions of overweight and obesity appear in Table 1.

Table 1: Classification of Overweight and Obesity by BMI⁶

Weight Status	BMI, kg/m ²	Obesity Class
Underweight	<18.5	
Normal weight	18.5-24.9	
Overweight	25-29.9	
Obesity	30-34.9	I
	35-39.9	II
Extreme obesity	≥40	III

Statistical Analysis

NHANES 2011-2012 prevalence estimates were calculated using NCHS sampling weights (for each age/gender band) to extrapolate to the US population.

Table 2 provides:

- The raw count of subjects in NHANES by age/gender band (without requirement to have BMI populated and without exclusion of pregnant women).
- The NHANES reweighted US population; NHANES provides weighting to apply to each age/gender band to extrapolate the raw sample to the total US population.
- The *Milliman Health Cost Guidelines* reweighted population to reflect the demographics of 1 million 18- to 64-year-old commercially insured, working-age individuals.

Table 2: Starting Sample Size by Age/Gender from NHANES 2011-2012 and Reweighted Sample for a Commercially Insured Population

Gender	Age Group	NHANES Raw Count	NHANES Reweighted US Population	Milliman HCG Demographics Adjusted for 1 Million 18- to 64-Year-Old Commercial Members	% NHANES Raw Count	% NHANES Reweighted US Population	% Milliman HCG Demographics Adjusted for 1 Million 18- to 64-Year-Old Commercial Members
Male	18-19	157	4,707,587	18,840	3.4%	2.4%	1.9%
Male	20-24	288	11,070,736	58,882	6.2%	5.8%	5.9%
Male	25-29	222	9,746,454	49,362	4.8%	5.1%	4.9%
Male	30-34	249	9,728,299	51,064	5.4%	5.1%	5.1%
Male	35-39	232	9,525,140	54,514	5.0%	4.9%	5.5%
Male	40-44	220	10,620,099	55,274	4.8%	5.5%	5.5%
Male	45-49	208	9,877,581	58,729	4.5%	5.1%	5.9%
Male	50-54	233	10,295,083	57,267	5.0%	5.3%	5.7%
Male	55-59	202	10,558,215	49,693	4.4%	5.5%	5.0%
Male	60-64	268	8,540,545	38,267	5.8%	4.4%	3.8%
Female	18-19	147	3,328,062	18,002	3.2%	1.7%	1.8%
Female	20-24	255	11,327,701	55,605	5.5%	5.9%	5.6%
Female	25-29	229	9,782,576	50,992	5.0%	5.1%	5.1%
Female	30-34	247	10,155,381	52,289	5.4%	5.3%	5.2%
Female	35-39	235	9,869,445	54,135	5.1%	5.1%	5.4%
Female	40-44	242	10,316,244	57,857	5.2%	5.4%	5.8%
Female	45-49	229	11,280,858	62,522	5.0%	5.9%	6.3%
Female	50-54	270	11,556,429	62,256	5.9%	6.0%	6.2%
Female	55-59	208	10,413,974	53,991	4.5%	5.4%	5.4%
Female	60-64	273	9,760,575	40,460	5.9%	5.1%	4.0%
Total		4,614	192,460,983	1,000,000	100%	100%	100%

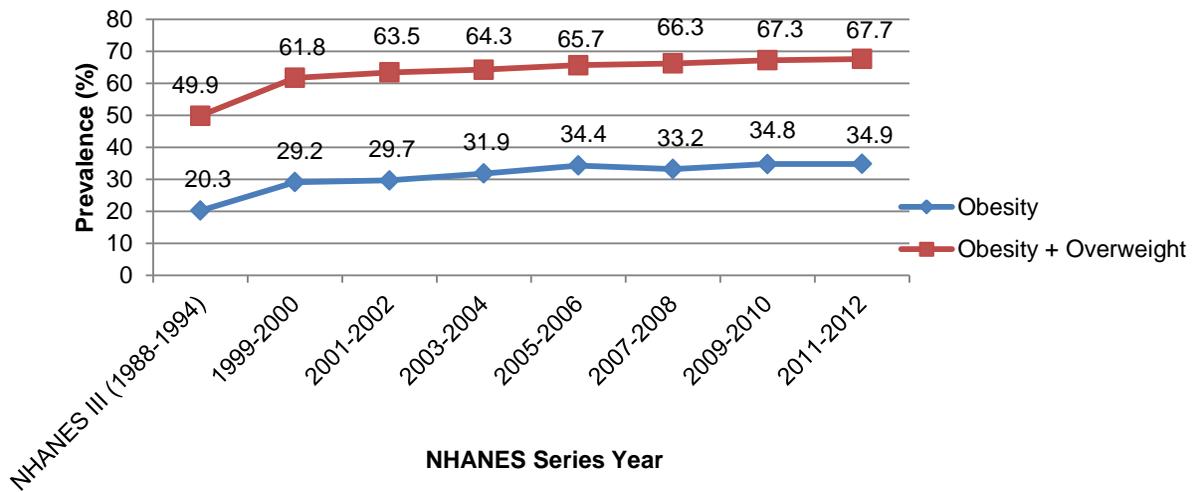
We limited our analysis to nonpregnant 18- to 64-year-olds and identified 4,336 participants who had BMI populated. The sample size reported in Table 2 represents the NHANES sample of 18- to 64-year-olds without requiring that they have BMI populated and without excluding pregnant individuals.

Source: NHANES 2011-2012. Milliman *Health Cost Guidelines* 2013.

RESULTS

Although Estimated Obesity Rates Among Commercially Insured Adults Aged 18-64 Years Appeared to Have Leveled Off, the Rate Remained at 35%

Figure 1: Year Over Year Estimated Prevalence in Obesity and Overweight Among Commercially Insured Adults Aged 18-64 Years

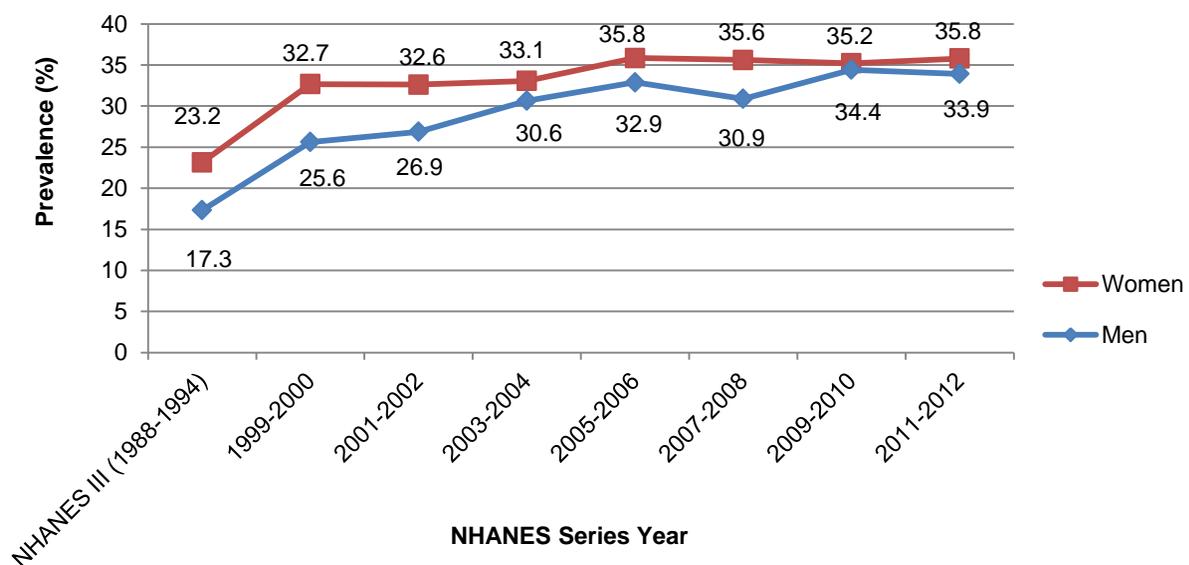


N=12,935 (NHANES III), 3,463 (1999-2000), 3,856 (2001-2002), 3,619 (2003-2004), 3,809 (2005-2006), 4,409 (2007-2008), 4,792 (2009-2010), 4,336 (2011-2012). (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women and individuals without BMI populated.)

Obesity = Classes I, II, and III (BMI ≥ 30 kg/m²); obesity + overweight = BMI ≥ 25 kg/m².

Source: Milliman analysis of NHANES III (1988-1994) through NHANES 2011-2012 data applied to a commercial standard demographic.

Figure 2: Year Over Year Estimated Obesity Prevalence by Gender Among Commercially Insured Adults Aged 18-64 Years



N=12,935 (NHANES III), 3,463 (1999-2000), 3,856 (2001-2002), 3,619 (2003-2004), 3,809 (2005-2006), 4,409 (2007-2008), 4,792 (2009-2010), 4,336 (2011-2012) (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women and individuals without BMI populated.)

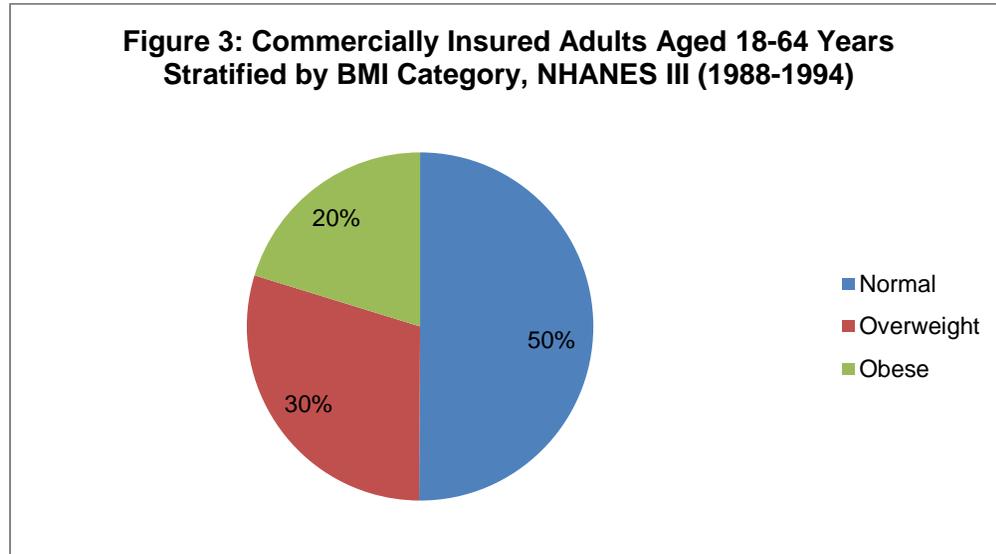
Obesity = Classes I, II, and III (BMI ≥ 30 kg/m²).

Source: Milliman analysis of NHANES III (1988-1994) through NHANES 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- Obesity rates appear to have leveled off to 34.9%.
- Overweight plus obesity rates seem to have leveled off to 67.7%.
- The 2011-2012 obesity rate in men appears to be similar to the obesity rate in women.

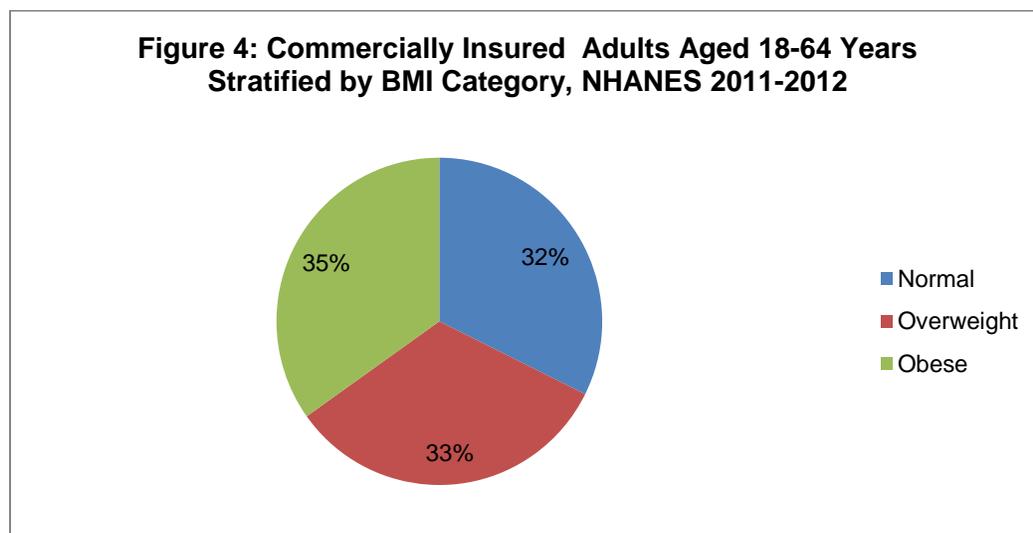
The NHANES III (1988-1994) Series Data Estimated 50% of the Commercially Insured Population as Normal Weight, Whereas the NHANES 2011-2012 Data Estimated 32%



N=12,935 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women and individuals without BMI populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obese = BMI ≥30 kg/m² (Classes I, II, and III).

Source: Milliman analysis of NHANES III (1988-1994) data applied to a commercial standard demographic.



N=4,336 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women and individuals without BMI populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obese = BMI ≥30 kg/m² (Classes I, II, and III).

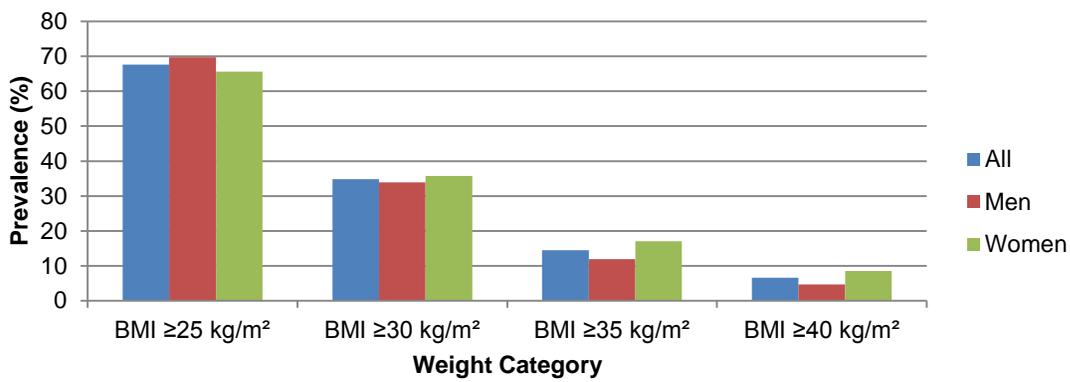
Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time periods analyzed, among commercially insured adults aged 18-64 years:

- The obesity rates were 20% and 35% between NHANES III (1988-1994) and 2011-2012, respectively.
- The overweight rates were 30% and 33% between NHANES III (1988-1994) and 2011-2012, respectively.
- The normal-weight rates were 50% and 32% between NHANES III (1988-1994) and 2011-2012, respectively.

For the Most Recent NHANES 2011-2012 Estimates, More Women Appeared to Be Obesity Class III Than Men, Whereas More Men Appeared to Be Overweight

Figure 5: Estimated Prevalence of Overweight and Obesity Among Commercially Insured Adults Aged 18-64 Years, by Gender, NHANES 2011-2012



N=4,336 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women and individuals without BMI populated.)

Overweight + obesity Classes I, II, and III = BMI ≥25 kg/m²; obesity Classes I, II, and III = BMI ≥30 kg/m²; obesity Classes II + III = BMI ≥35 kg/m²; obesity Class III = BMI ≥40 kg/m².

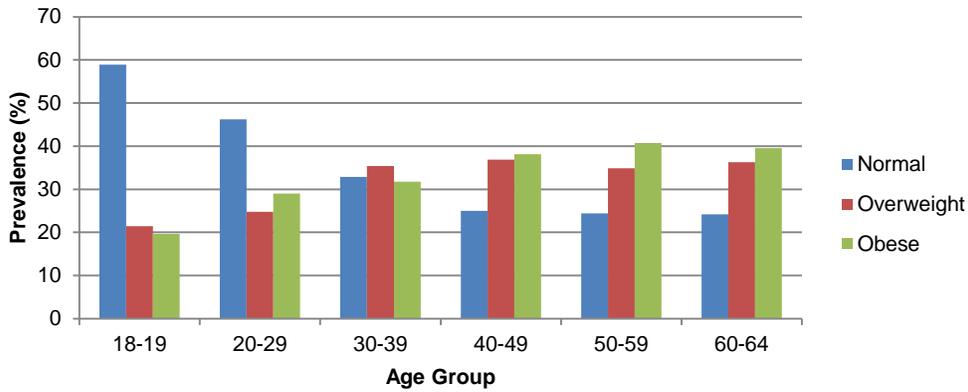
Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- For all men and women:
 - 67.7% seemed to be either overweight or obese (BMI ≥25 kg/m²).
 - 34.9% appeared to be Class I, II, or III obesity (BMI ≥30 kg/m²).
 - 14.5% appeared to be either Class II or Class III obesity (BMI ≥35 kg/m²).
 - 6.6% appeared to be Class III obesity (BMI ≥40 kg/m²).
- Women seemed to have a higher rate of Class II and III obesity (BMI ≥35 kg/m²) compared with men – 17.0% versus 11.9% for Class II or higher (BMI ≥35 kg/m²) and 8.5% versus 4.6% for Class III (BMI ≥40 kg/m²).

Proportion of Normal-Weight People Appeared to Decrease With Increase in Age

Figure 6: Estimated Prevalence of Overweight and Obesity Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012



N=4,336 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women and individuals without BMI populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obese = BMI ≥30 kg/m² (Classes I, II, and III).

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- The percentage of individuals who were overweight appeared to increase until the age group of 40-49 years.
- The percentage of individuals who were obese appeared to increase up to the age group of 50-59 years.

Estimated Prevalence of Comorbidities* Appeared to Increase as BMI Increased

Table 3: Estimated Prevalence of Comorbidities Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012, by BMI Range

Comorbidity	Prevalence				
	Normal Weight	Overweight	Obesity Class I	Obesity Class II	Obesity Class III
	BMI 18.5-24.9 kg/m ²	BMI 25-29.9 kg/m ²	BMI 30-34.9 kg/m ²	BMI 35-39.9 kg/m ²	BMI ≥40 kg/m ²
Diagnosed type 2 diabetes	1.8%	2.8%	7.0%	12.0%	22.1%
Hypertension	10.9%	22.4%	29.9%	39.8%	49.5%
CHD	1.2%	2.4%	3.2%	5.0%	3.7%
Dyslipidemia	6.6%	11.6%	13.8%	17.1%	19.1%
Sleep disorder	4.3%	6.6%	8.6%	21.0%	21.6%
Osteoarthritis	4.6%	6.0%	7.7%	10.0%	17.0%
Asthma	8.2%	6.4%	9.0%	11.9%	16.3%
Depression	6.2%	6.5%	9.0%	11.7%	12.4%

Comorbidities: N=4,336 (diagnosed type 2 diabetes), 4,336 (hypertension), 4,327 (CHD), 4,335 (dyslipidemia), 4,332 (sleep disorder), 4,333 (osteoarthritis), 4,326 (asthma), and 4,329 (depression) (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

See methodology in Appendix A for NHANES fields used to identify comorbidities.

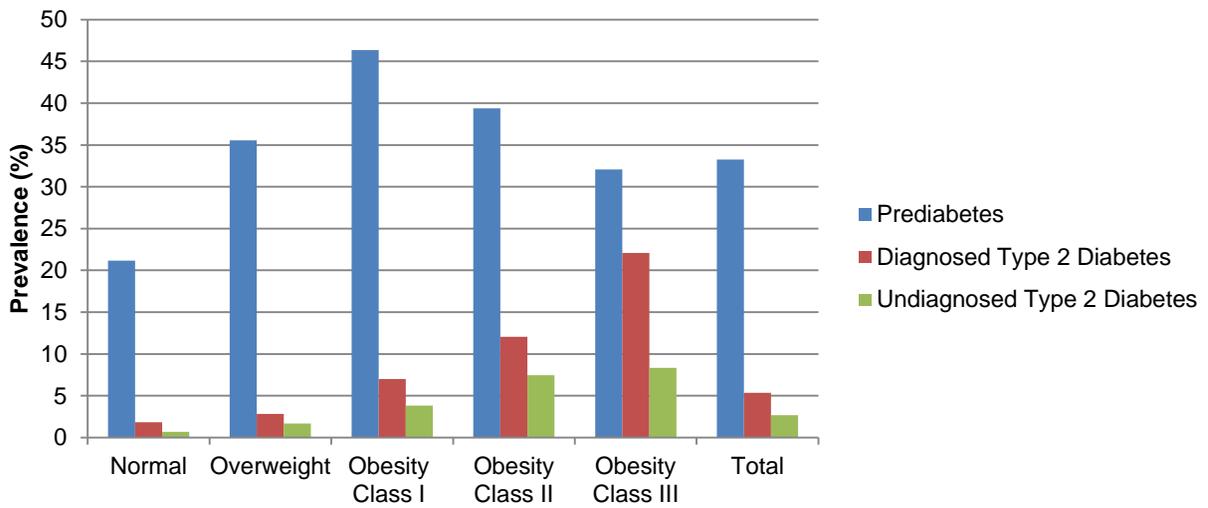
* Except for CHD; prevalence of CHD appeared lower in obesity class III than in obesity class II.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- The estimated prevalence of comorbidities appeared to increase as BMI increased in the obesity categories. In comparison with normal weight:
 - Diagnosed type 2 diabetes appeared to be 3.9x, 6.7x, and 12.3x greater for obesity Classes I, II, and III, respectively.
 - Hypertension appeared to be 2.7x, 3.7x, and 4.5x greater for obesity Classes I, II, and III, respectively.
 - CHD appeared to be 2.7x, 4.2x, and 3.1x greater for obesity Classes I, II, and III, respectively.
 - Dyslipidemia appeared to be 2.1x, 2.6x, and 2.9x greater for obesity Classes I, II, and III, respectively.
 - Sleep disorder appeared to be 2.0x, 4.9x, and 5.0x greater for obesity Classes I, II, and III, respectively.
 - Osteoarthritis appeared to be 1.7x, 2.2x, and 3.7x greater for obesity Classes I, II, and III, respectively.
 - Asthma appeared to be 1.1x, 1.5x, and 2.0x greater for obesity Classes I, II, and III, respectively.
 - Depression appeared to be 1.5x, 1.9x, and 2.0x greater for obesity Classes I, II, and III, respectively.

Estimated Prevalence of Type 2 Diabetes, Diagnosed and Undiagnosed, Appeared to Increase as BMI Increased

Figure 7: Estimated Prevalence of Diagnosed Type 2 Diabetes, Undiagnosed Type 2 Diabetes, and Prediabetes by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012



N=4,336 for diagnosed type 2 diabetes and 1,985 for prediabetes and undiagnosed type 2 diabetes (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated or the indicated lab values populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

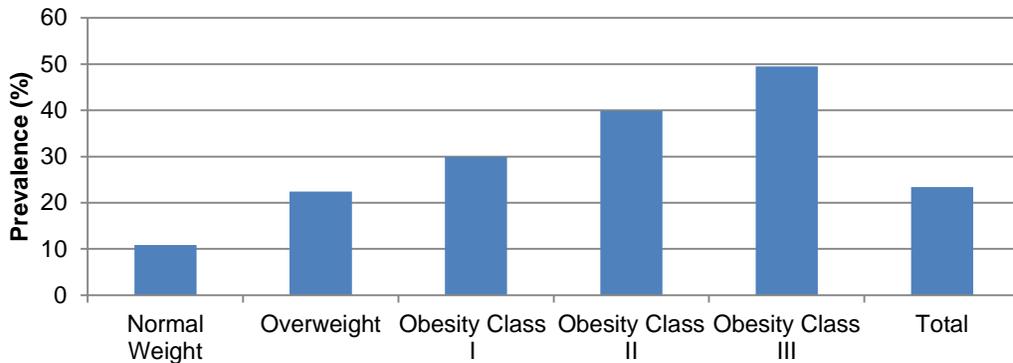
For the time period analyzed, among commercially insured adults aged 18-64 years:

- In comparison with normal weight, the estimated prevalence of type 2 diabetes (diagnosed and undiagnosed) appeared to increase as BMI increased.
- Prediabetes appeared to be highest in obesity Class I compared with other BMI strata estimates.

Please see Appendix A for additional details regarding criteria utilized to identify prediabetes and type 2 diabetes mellitus, including diagnosed and undiagnosed.

Estimated Prevalence of Comorbidities* Appeared to Increase as BMI Increased

Figure 8: Estimated Prevalence of Hypertension by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012

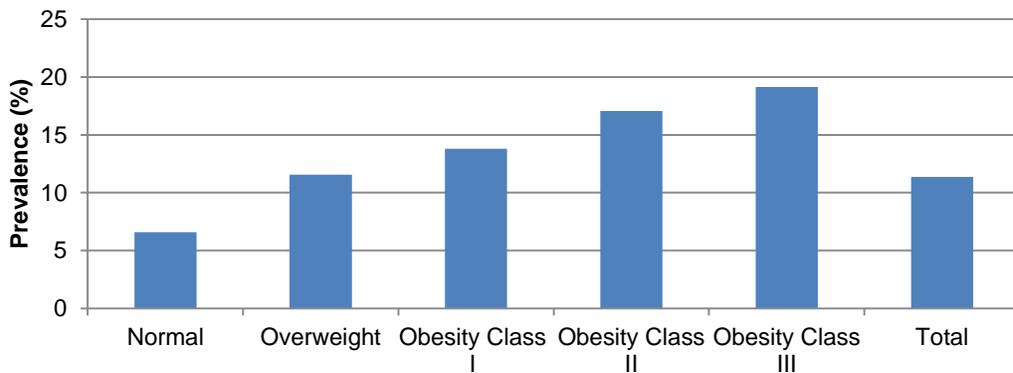


N=4,336 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

Figure 9: Estimated Prevalence of Dyslipidemia by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012



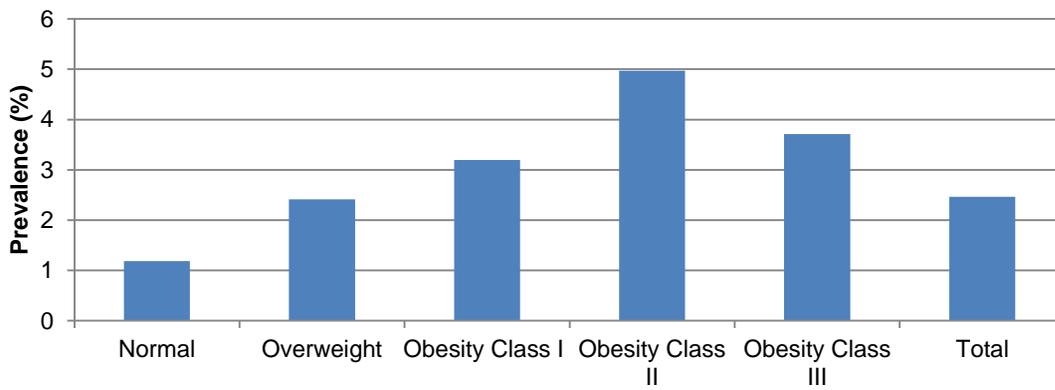
N=4,335 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

*Except for CHD and sleep disorder; prevalence of CHD was lower in obesity class III compared to obesity class II and appeared to level off between Class II and III for sleep disorder.

Figure 10: Estimated Prevalence of CHD by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012

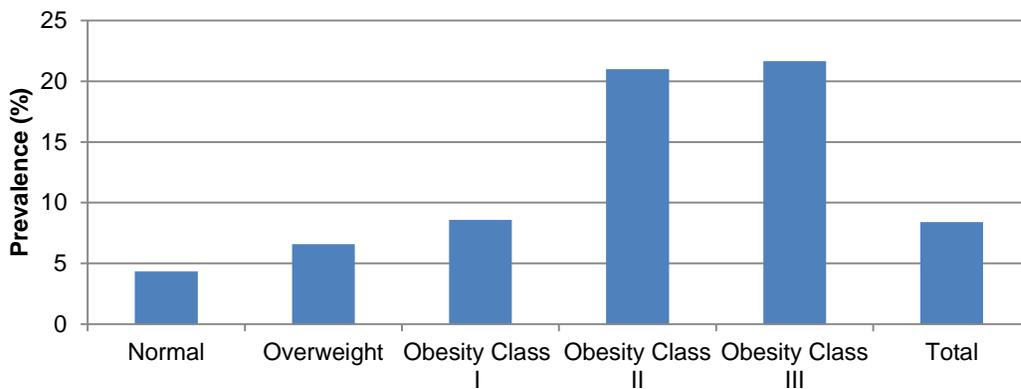


N=4,327 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

Figure 11: Estimated Prevalence of Sleep Disorder by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012



N=4,332 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

Table 4: Estimated Prevalence of Sleep Disorder by Obesity Class, Age, and Gender Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012

Weight	Men		Women	
	18-39 Years	40-64 Years	18-39 Years	40-64 Years
Normal	4.2%	5.7%	2.4%	6.0%
Overweight	2.1%	8.2%	9.7%	6.3%
Obesity Class I	4.4%	10.4%	5.2%	11.1%
Obesity Class II	15.4%	38.0%	7.1%	21.9%
Obesity Class III	15.2%	37.9%	8.8%	22.9%

N=4,332 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

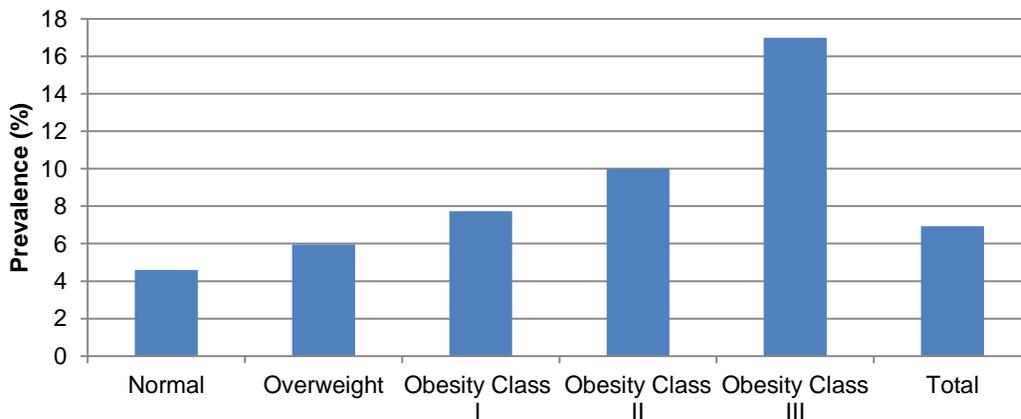
Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- Sleep disorder prevalence appeared to be 37.9% in men with Class III obesity aged 40-64 years, compared with 15.2% in men with Class III obesity aged 18-39 years.
- 22.9% of women aged 40-64 years and 8.8% of women aged 18-39 years with Class III obesity appeared to have sleep disorder.

Figure 12: Estimated Prevalence of Osteoarthritis by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012



N=4,333 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

Table 5: Estimated Prevalence of Osteoarthritis by Obesity Class, Age, and Gender Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012

Weight	Men		Women	
	18-39 Years	40-64 Years	18-39 Years	40-64 Years
Normal	1.9%	9.8%	1.6%	7.5%
Overweight	1.2%	6.4%	3.9%	10.6%
Obesity Class I	3.1%	8.4%	1.6%	13.4%
Obesity Class II	0.7%	8.0%	1.3%	23.4%
Obesity Class III	1.2%	17.0%	6.7%	28.6%

N=4,333 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

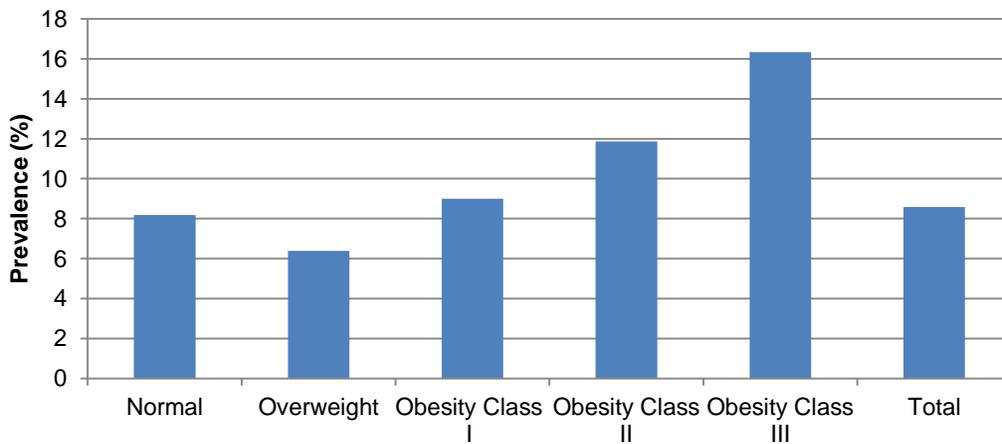
Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- Osteoarthritis prevalence appeared to be 17.0% in men with Class III obesity aged 40-64 years; among men aged 18-39 years, osteoarthritis prevalence seemed to be greater in those with Class I obesity compared with normal-weight individuals (3.1% vs 1.9%, respectively).
- The prevalence of osteoarthritis appeared to be 1.8x, 3.1x, and 3.8x greater for obesity classes I, II, and III, respectively, compared with normal weight among women aged 40-64 years. The prevalence of osteoarthritis among women aged 18-39 years appeared to be greater in those with Class III obesity compared with normal-weight women (6.7% vs 1.6%, respectively).

Figure 13: Estimated Prevalence of Asthma by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012

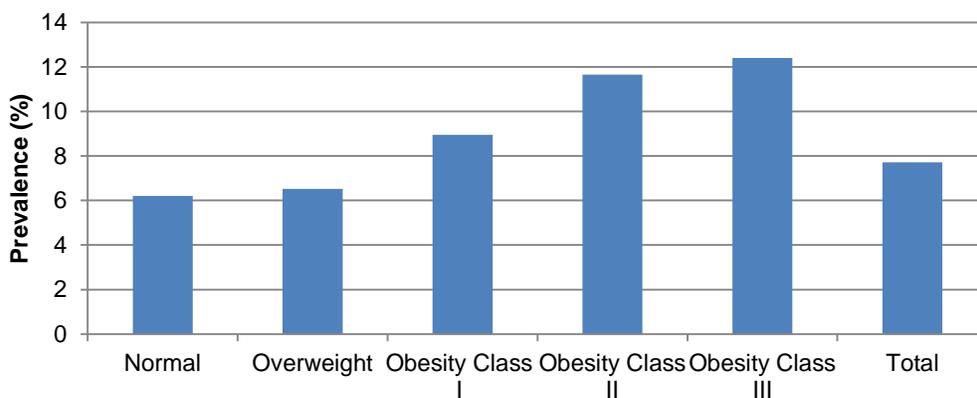


N=4,326 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

Figure 14: Estimated Prevalence of Depression by Obesity Class Among Commercially Insured Adults Aged 18-64 Years, NHANES 2011-2012

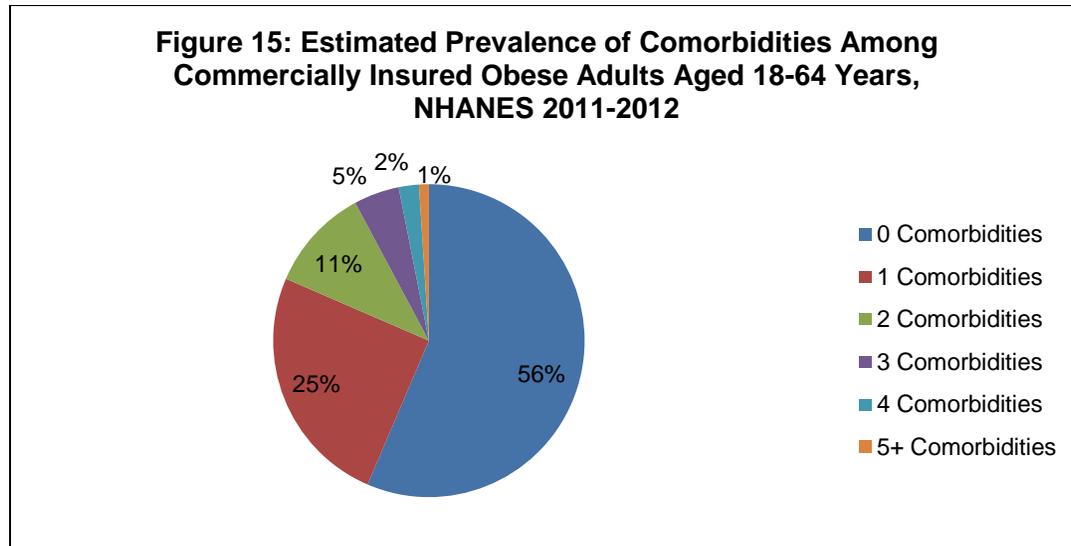


N=4,329 (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

An Estimated 44% of Obese Individuals Had 1 or More of 8 Comorbidities: Type 2 Diabetes, Hypertension, CHD, Dyslipidemia, Sleep Disorder, Osteoarthritis, Asthma, or Depression



Comorbidities: N=4,336 (diagnosed type 2 diabetes), 4,336 (hypertension), 4,327 (CHD), 4,335 (dyslipidemia), 4,332 (sleep disorder), 4,333 (osteoarthritis), 4,326 (asthma), and 4,329 (depression) (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Obese = BMI ≥ 30 kg/m² (Classes I, II, and III).

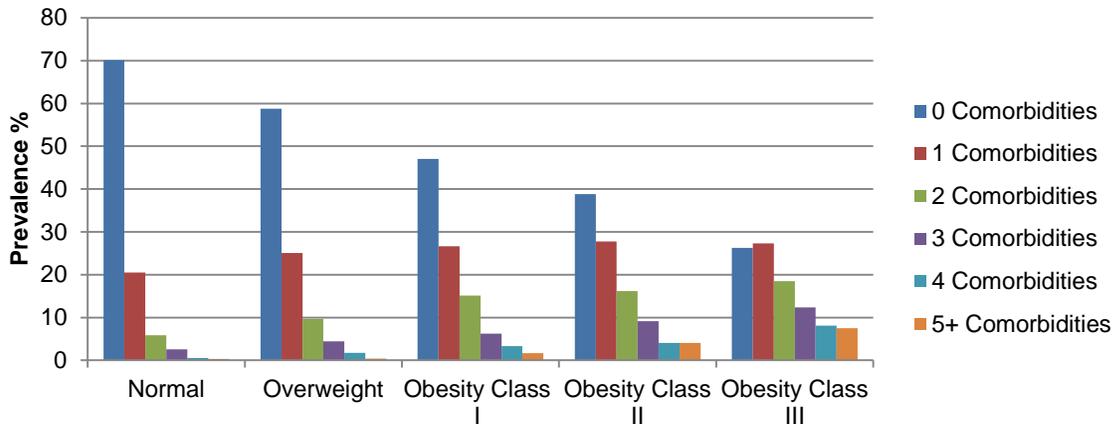
Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- 19% of the obese cohort had 2 or more comorbidities.
- 8% of the obese cohort had 3 or more comorbidities.
- 3% of the obese cohort had 4 or more comorbidities.

The Estimated Number of Comorbidities Appeared to Increase as BMI Increased

Figure 16: Estimated Prevalence of Comorbidities Among Commercially Insured Adults Aged 18-64 Years by Obesity Level, NHANES 2011-2012



Comorbidities: N=4,336 (diagnosed type 2 diabetes), 4,336 (hypertension), 4,327 (CHD), 4,335 (dyslipidemia), 4,332 (sleep disorder), 4,333 (osteoarthritis), 4,326 (asthma), and 4,329 (depression) (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity Class I = BMI 30-34.9 kg/m²; obesity Class II = BMI 35-39.9 kg/m²; obesity Class III = BMI ≥40 kg/m².

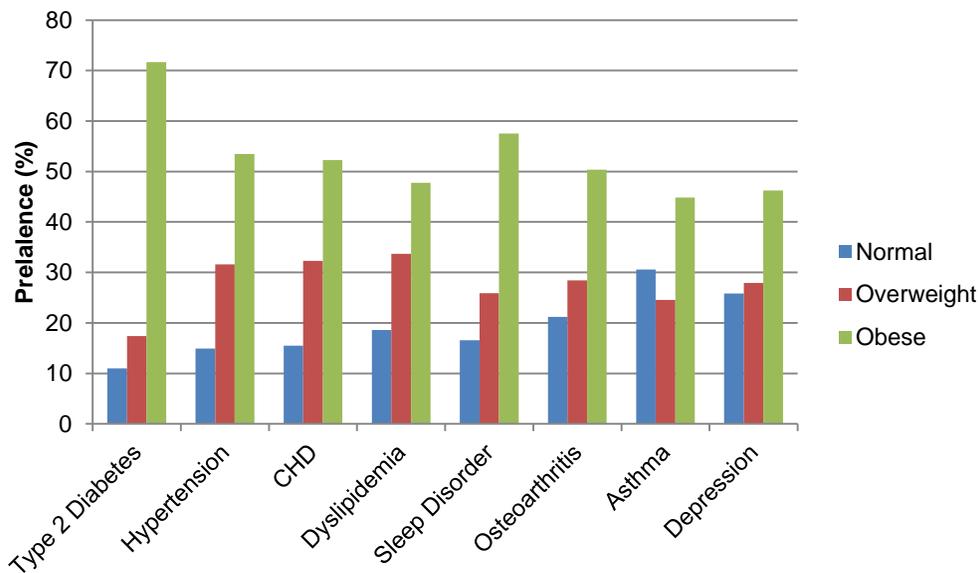
Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- 70% of normal-weight individuals had none of the 8 comorbidities, compared with 59% of overweight, 47% of obesity Class I, 39% of obesity Class II, and 26% of obesity Class III individuals.
- 7% of obesity Class III individuals had 5+ comorbidities, compared with 4% of obesity Class II, 2% of obesity Class I, and 0% of overweight and normal-weight individuals.

An Estimated 50% or More of 18- to 64-year-old Commercially Insured Individuals With Type 2 Diabetes, Hypertension, CHD, Sleep Disorder, and Osteoarthritis Were Obese

Figure 17: Portion of Commercially Insured Individuals Aged 18-64 Years With Disease, NHANES 2011-2012



Comorbidities: N=4,336 (diagnosed type 2 diabetes), 4,336 (hypertension), 4,327 (CHD), 4,335 (dyslipidemia), 4,332 (sleep disorder), 4,333 (osteoarthritis), 4,326 (asthma), and 4,329 (depression) (N reflects denominator population of 18- to 64-year-olds with exclusion of pregnant women, individuals without BMI populated, and individuals not having the condition questionnaire populated.)

Normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25-29.9 kg/m²; obesity = BMI ≥30 kg/m².

Source: Milliman analysis of NHANES series 2011-2012 data applied to a commercial standard demographic. Individuals may fall into more than 1 disease state.

For the time period analyzed, among commercially insured adults aged 18-64 years:

- 11% to 31% of individuals with each comorbidity were estimated as normal weight.
- 72% of individuals with type 2 diabetes were estimated to be obese, whereas 11% were normal weight.
- 48% of individuals with dyslipidemia were estimated as obese, whereas 19% were normal weight.

SUMMARY

- The estimated obesity rates (BMI ≥ 30 kg/m²) in commercially insured adults aged 18-64 years were 20% and 35% for NHANES III (1988-1994) and NHANES 2011-2012, respectively.
- In NHANES 2011-2012, estimated obesity rates appeared to be similar for men and women. However, women seemed to have a higher rate of Class III obesity (BMI ≥ 40 kg/m²) compared with men (8.5% vs 4.6%).
- The proportion of normal-weight (BMI 18.5-24.9 kg/m²) individuals in NHANES 2011-2012 appeared to decrease with an increase in age.
- Among commercially insured adults aged 18-64 years in NHANES 2011-2012, the estimated prevalence of comorbidities (including diagnosed type 2 diabetes, hypertension, dyslipidemia, sleep disorder, osteoarthritis, asthma, and depression) appeared to increase as BMI increased in comparison with normal weight. The prevalence of CHD was lower for obesity Class III than for obesity Class II.
- An estimated 44% of obese individuals had 1 or more of the 8 comorbidities noted above.
- An estimated 50% or more of individuals with diagnosed type 2 diabetes, hypertension, CHD, sleep disorder, and osteoarthritis were obese.

Appendix A: Methodology for NHANES Analysis

Milliman 2013 Health Cost Guidelines:

The Guidelines provide a basis for the determination of health claim costs and premium rates for a variety of health plans. The Guidelines are developed as a result of Milliman's continuing research on healthcare costs. First developed in 1954, the Guidelines have been updated and expanded annually since that time. The Guidelines are continually monitored as they are used in measuring the experience of, or evaluating the rates of, health plans and as they are compared with other data sources. The Guidelines are a proprietary and cooperative effort of Milliman health actuaries and represent a combination of their experience, research, and judgment. Data are used in developing these guidelines, including published and unpublished data. The standard demographics in the Guidelines were developed to represent the age and gender distribution for a typical large insured group. The standard demographics were developed using data from insurers combined with Department of Labor statistics. We used the standard demographics to represent the age and gender distribution for a typical insured group and applied incidence and prevalence rates to this group.

NHANES Obese Population Identification Criteria (NHANES III [1988-1994], 1999-2000, 2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010, 2011-2012):

A description of the NHANES data was provided earlier. To identify obese individuals in NHANES 2011-2012, we used the BMI data field BMXBMI. We limited our analysis to nonpregnant 18- to 64-year-olds and identified 4,336 participants who had BMI populated. The sample size reported in Table 2 represents the NHANES sample of 18- to 64-year-olds without requiring that they have BMI populated and without excluding pregnant individuals. NHANES 2011-2012 prevalence estimates were calculated using NCHS sampling weights (for each age/gender band) to extrapolate to the US population. We demographically adjusted the 18- to 64-year-old NHANES participants to a typical commercially insured, working-age population using the Milliman *Health Cost Guidelines*.

NHANES Identification Criteria for Comorbidities

Definitions are consistent with previously published studies/analyses for these therapeutic conditions.

Type 2 diabetes⁷:

Answering yes to any 1 of the following 3 questions:

- DIQ010 Other than during pregnancy, has a doctor ever told you that you had diabetes?
- DIQ050 Are you now taking insulin?
- DIQ070 Do you take diabetes pills to lower your blood sugar?

And excluding those with type 1 diabetes; either diagnosed before age 30 years or began taking insulin within 1 year of diagnosis⁷:

- DIQ040 Were you younger than the age of 31 years at the time of diabetes diagnosis?
- DIQ050 Are you now taking insulin?
- DIQ070 Do you take diabetes pills to lower your blood sugar?

Undiagnosed diabetes⁸:

Based on the American Diabetes Association diagnostic criteria for undiagnosed diabetes, those not meeting the above definitions of type 1 or 2 diabetes but having a fasting blood glucose level >125 mg/dL

LBXGLU field

Prediabetes^{8,9}:

Those not meeting the above definitions of type 1 or 2 diabetes but having a fasting blood glucose level of 100-125 mg/dL

LBXGLU field

Hypertension^{10,11}:

Answering yes to the following question:

BPQ050A Are you currently taking prescribed medicine for hypertension?

OR having systolic blood pressure (SBP) ≥ 140 mm Hg OR diastolic blood pressure (DBP) ≥ 90 mm Hg
For those with type 2 diabetes, the SBP threshold is ≥ 140 mm Hg and DBP ≥ 80 mm Hg

PBXSAR SBP
BPXDAR DBP

Coronary heart disease (CHD)¹²:

Answering yes to any **1** of the following questions:

MCQ160C Have you ever been told you have CHD?
MCQ160D Has a doctor told you that you had angina?
MCQ160E Has a doctor told you that you had a heart attack?

Dyslipidemia¹⁰:

Answering yes to the following question:

BPQ100D Are you currently taking prescribed medication for cholesterol?

Sleep disorder¹³:

Answering yes to both of the following questions:

SLQ050 Have you ever told a doctor you have trouble sleeping?
SLQ060 Have you ever been told by a doctor you have a sleep disorder?

Osteoarthritis¹⁴:

Answering yes to both of the following questions:

MCQ160A Have you ever been told you have arthritis?
MCQ195 Which type of arthritis? – with answer osteoarthritis (1)

Asthma¹⁵:

Answering yes to both of the following questions:

MCQ010: Have you ever been told you have asthma?
MCQ035: Do you still have asthma?

Depression^{16,17}:

Depression screener score is calculated for each person.

The score is compared to the PHQ-9 screening instrument, which provides level of depression as follows: none or minimal 0-4, mild 5-9, moderate 10-14, severely moderate 15-19, severe 20 or more. Patients with moderate or severe scores were designated as having depression.

APPENDIX B: BODY MASS INDEX TABLE ¹⁸																								
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Height (Inches)	Body Weight (pounds)																							
58	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167	172	177	181	186	191	196	201
59	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173	178	183	188	193	198	203	208
60	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179	184	189	194	199	204	209	215
61	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185	190	195	201	206	211	217	222
62	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191	196	202	207	213	218	224	229
63	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197	203	208	214	220	225	231	237
64	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204	209	215	221	227	232	238	244
65	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	216	222	228	234	240	246	252
66	118	124	130	136	142	148	155	161	167	173	179	186	192	198	204	210	216	223	229	235	241	247	253	260
67	121	127	134	140	146	153	159	166	172	178	185	191	198	204	211	217	223	230	236	242	249	255	261	268
68	125	131	138	144	151	158	164	171	177	184	190	197	203	210	216	223	230	236	243	249	256	262	269	276
69	128	135	142	149	155	162	169	176	182	189	196	203	209	216	223	230	236	243	250	257	263	270	277	284
70	132	139	146	153	160	167	174	181	188	195	202	209	216	222	229	236	243	250	257	264	271	278	285	292
71	136	143	150	157	165	172	179	186	193	200	208	215	222	229	236	243	250	257	265	272	279	286	293	301
72	140	147	154	162	169	177	184	191	199	206	213	221	228	235	242	250	258	265	272	279	287	294	302	309
73	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265	272	280	288	295	302	310	318
74	148	155	163	171	179	186	194	202	210	218	225	233	241	249	256	264	272	280	287	295	303	311	319	326
75	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279	287	295	303	311	319	327	335
76	156	164	172	180	189	197	205	213	221	230	238	246	254	263	271	279	287	295	304	312	320	328	336	344

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