DIABETES

Obesity and Type 2 Diabetes as Documented In Private Claims Data

Spotlight on This Growing Issue among the Nation's Youth

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Summary

For more than two decades, an epidemic of obesity in the United States has been cited as contributing to rising rates of type 2 diabetes, and, alarmingly, both conditions have been increasing among the nation's youth. A study of five years of healthcare insurance claims records by FAIR Health, a national, independent, nonprofit organization dedicated to transparency in healthcare costs and health insurance information, confirms this concerning trend.

FAIR Health analyzed data from its database of billions of privately billed healthcare claims to identify trends and patterns from 2011 to 2015 in obesity, type 2 diabetes and other obesity-related conditions in the nation's privately insured youth. As obesity rates have increased in children, adolescents and young adults, FAIR Health data show that type 2 diabetes also has increased in that population. Among the findings:

- The percent of claim lines with an obesity diagnosis increased annually in all age groups, from infants and toddlers to adults;
- In the age group 19 to 22 years, the increase in obesity claim lines was 154 percent;
- The percent of claim lines with a type 2 diabetes diagnosis more than doubled in the pediatric population (ages 0-22), increasing 109 percent;
- In most pediatric age groups, females were diagnosed more frequently with obesity than males, but males were more frequently diagnosed with type 2 diabetes than females; and
- Two conditions that are obesity-related, obstructive sleep apnea and hypertension, rose in the pediatric population by 161 percent and 67 percent, respectively.

Background

In many nations, including the United States, an epidemic of obesity has contributed to rising rates of type 2 diabetes for more than 20 years.[1] Although the mechanisms linking the two conditions are not completely clear, most patients with type 2 diabetes are obese. In 1994, the prevalence of obesity among adults 18 years or older was less than 18 percent in all but two US states and exceeded 22 percent in no state.[2] In 2014, by contrast, no state had less than 18 percent prevalence and all but two states exceeded 22 percent. For diagnosed diabetes (whether type 1 or type 2), in 1994, the prevalence was less than 6 percent in all states. In 2014, all states exceeded 6 percent and 28 states exceeded 9 percent.

Type 2 diabetes was once thought to be almost exclusively a disease of adulthood,[3] and when diabetes did occur in children, it was typically in the distinct form of type 1 diabetes.[4] But as long ago as 2000, as

[1] Robert H. Eckel et al., "Obesity and Type 2 Diabetes: What Can Be Unified and What Needs to Be Individualized?," *J Clin Endocrinol Metab* 96, no. 6 (2011): 1654-63, doi:10.1210/jc.2011-0585.
[2] *Maps of Trends in Diagnosed Diabetes and Obesity*, CDC's Division of Diabetes Translation, United States Diabetes Surveillance System, April 2016, https://www.cdc.gov/diabetes/statistics/slides/maps_diabetesobesity_trends.pdf.
[3] Ebe D'Adamo and Sonia Caprio, "Type 2 Diabetes in Youth: Epidemiology and Pathophysiology," *Diabetes Care* 34, supplement 2 (2011): S161-65, doi:10.2337/dc11-s212.
[4] American Diabetes Association, "Type 2 Diabetes in Children and Adolescents," *Diabetes Care* 23, no. 3 (2000): 381-89, http://care.diabetesjournals.org/content/23/3/381.full-text.pdf.

the wave of obesity affected younger as well as older populations, type 2 diabetes became increasingly prevalent in the United States among children and adolescents. From 2001 to 2009, in a study by Dabelea and colleagues, the prevalence of type 2 diabetes among people aged 10 to 19 years rose 35 percent, from 0.34 per 1,000 in 2001 to 0.46 per 1,000 in 2009.[5]

The potential consequences of the increased prevalence of type 2 diabetes among children, adolescents and young adults are serious and costly.[6] The chronic complications of type 2 diabetes include increased cardiovascular disease, end-stage renal disease, eye damage and limb amputations. The increase in type 2 diabetes among young people portends many decades of treatment of the disease and its complications for a larger population than previously known, with all the attendant cost in healthcare resources.

The public health implications of obesity and type 2 diabetes in young people motivated FAIR Health to examine its nationwide database of more than 21 billion privately billed healthcare claims dating to 2002. FAIR Health consulted claims records from the recent time period 2011 through 2015 to investigate current trends in obesity, type 2 diabetes and other obesity-related conditions in the nation's pediatric population, which FAIR Health herein defines as including individuals ages 0 to 22, in order to encompass not only children and adolescents but young adults.

Methodology

Using the International Classification of Diseases (ICD-9-CM and ICD-10-CM) diagnostic codes reported on claims for the period 2011-2015 in the FAIR Health dataset, FAIR Health identified and examined claims of professional providers. Then FAIR Health segregated data that were indicative of obesity in individuals between the ages of 0 and 22 (e.g., ICD-10-CM E66), compared that data with data for adults over 22, and then identified comorbidities that occurred in both groups. Among those notably found in both groups were type 2 diabetes (e.g., ICD-10-CM E11), hypertension (e.g., ICD-9-CM 401.9), hyperlipidemia (e.g., ICD-9-CM 272.4) and obstructive sleep apnea (e.g., ICD-9-CM 327.23). Thirty percent of the population who had an obesity diagnosis had one or more of those comorbidities. Because claims may have more than one diagnosis, obesity may not have been the primary reason for an individual to seek care.

To validate a positive correlation between an increasing number of claim lines and an increasing number of patients, FAIR Health calculated how many services were provided per patient for those individuals who had one of the diagnoses under study. Because there was not an increase in the number of services per patient over the period 2011-2015, the increase in claim lines was positively correlated with an increase in patients.

The data were aggregated by a variety of key fields, including state, gender, age and year of service, to identify trends and patterns in utilization. The aggregated data were evaluated with single and multiple variables to look for distinct trends and associations, which were then used to create graphical representations of the information.

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[5] Dana Dabelea et al., "Prevalence of Type 1 and Type 2 Diabetes among Children and Adolescents from 2001 to 2009," *JAMA* 311, no. 17 (2014): 1778-86, doi:10.1001/jama.2014.3201.
[6] American Diabetes Association, "Type 2 Diabetes in Children and Adolescents."

In the graphical representations, below, the term “claim lines” refers to the individual procedures or services listed on an insurance claim. “Percent of claim lines” is the percent of all claim lines associated with a given grouping of diagnosis codes (e.g., codes associated with diabetes, obesity or prediabetes) in the specified time period. All information is based on data in the FAIR Health repository, which includes the claims experience for approximately 150 million covered lives.

The claims-level analysis is a strength of the study. Claims reflect healthcare usage and the information provided on claims reflects the assessments of providers, whose training and experience make them better judges of conditions and comorbidities than laypeople. A limitation of the study is that the population may have changed over time. It is likely, however, that the population of privately insured individuals in the study has not changed greatly, because the same geographic regions were analyzed and the data were contributed by the same insurers.

Obesity

From 2011 to 2015, the percent of claim lines in the FAIR Health data with an obesity diagnosis increased annually in all age groups (figure 1). Although the increase was most pronounced in the adult age group (over 22 years of age), in which obesity grew by 191 percent, it occurred in varying degrees in all younger age groups as well (table). The smallest increase among youth was in the age group 3 to 5 years (45 percent, from 2,839 to 4,109 claim lines); the greatest increase among youth was in the age group 19 to 22 years (154 percent, from 18,800 to 47,816 claim lines). Every age group above 5 years had a larger percent increase in obesity than had the group preceding it in age.

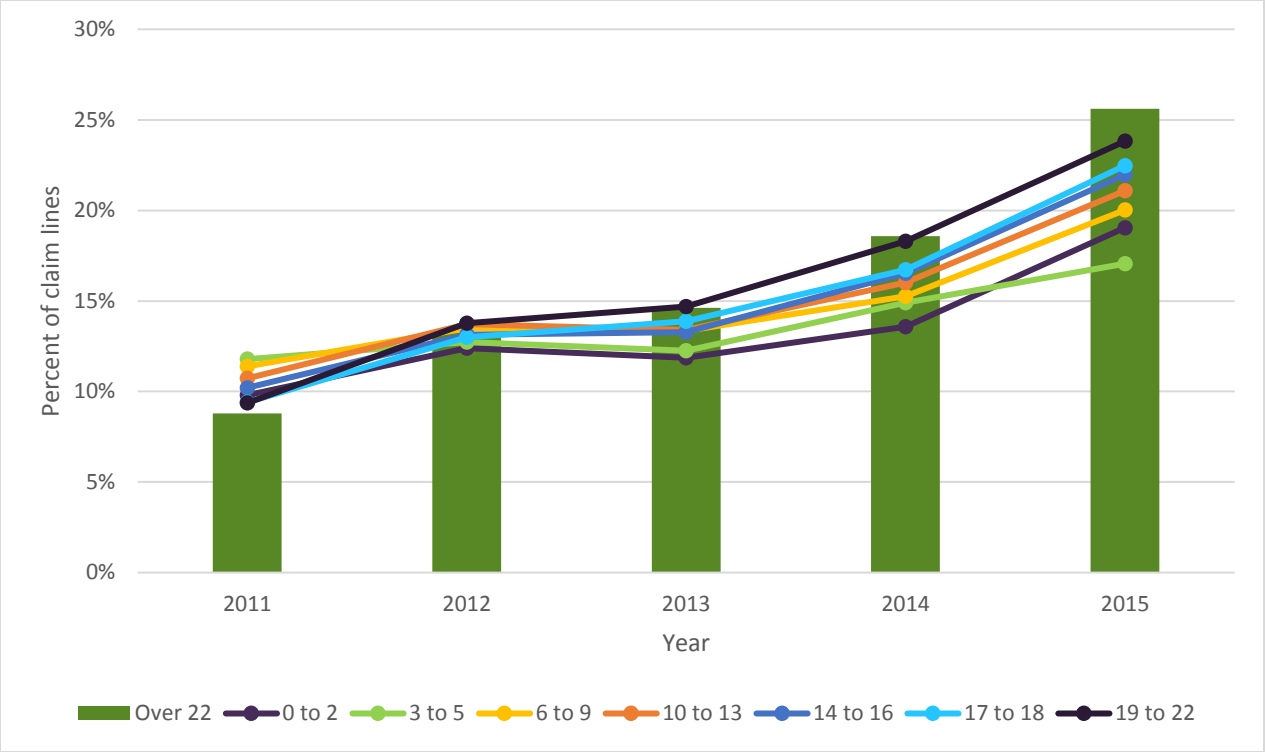

Figure 1. Annual percent of all claim lines with an obesity diagnosis by age group (in years), 2011-2015.

Table. Increase in obesity diagnoses by age group, 2011-2015.

Age Group (in Years)	Description	Percent Increase in Obesity Diagnoses
0-2	Infants and toddlers	94
3-5	Preschoolers	45
6-9	Elementary school students	76
10-13	Middle schoolers	97
14-16	Younger high school students	115
17-18	Older high school students	139
19-22	College age people	154
Over 22	Adults over 22	191

In contrast to the FAIR Health evidence of increasing youth obesity, the Centers for Disease Control and Prevention (CDC) found that the prevalence of obesity remained fairly stable (at about 17 percent) for children and adolescents aged 2-19 years from 2011 to 2014.[7] A possible reason for the apparent difference between the two studies is that FAIR Health's results are based on actual health insurance claims for the privately insured population, with Medicaid excluded, whereas the CDC results are based

[7] "Overweight & Obesity: Childhood Obesity Facts," Centers for Disease Control and Prevention, last updated November 17, 2016, https://www.cdc.gov/obesity/data/childhood.html.

on surveys based on interviews and physical examinations of a cross-section of the civilian, noninstitutionalized, US population.[8] One point of similarity in the FAIR Health and the CDC findings from 2011 to 2014 is that both found a correlation between the increasing prevalence of obesity and increase in age among youth. The CDC found that children ages 2 to 5 years had a prevalence of obesity of 8.9 percent, compared to 17.5 percent for 6- to 11-year-olds and 20.5 percent for 12- to 19-year-olds.[9]

In all but one age group, according to FAIR Health data, claim lines with an obesity diagnosis occurred more frequently in females during the period 2011-2015 than in males (figure 2). The only exception was the middle school age group (ages 10-13), in which the diagnosis appeared in claims for both males and females at approximately the same rate. Afterward, beginning in early high school (ages 14-16), the rate of female obesity compared to male obesity increased continuously until college age (ages 19-22). For college age youth, the gender distribution of obesity diagnoses was the same as that in adults over 22: 72 percent female to 28 percent male. It is not known how much of the difference between male and female diagnoses might be ascribed to more rampant obesity among females or how much might be due to females receiving more treatments for obesity. If the latter is true, it raises the question whether the greater cultural significance placed on female rather than male thinness might be a factor.

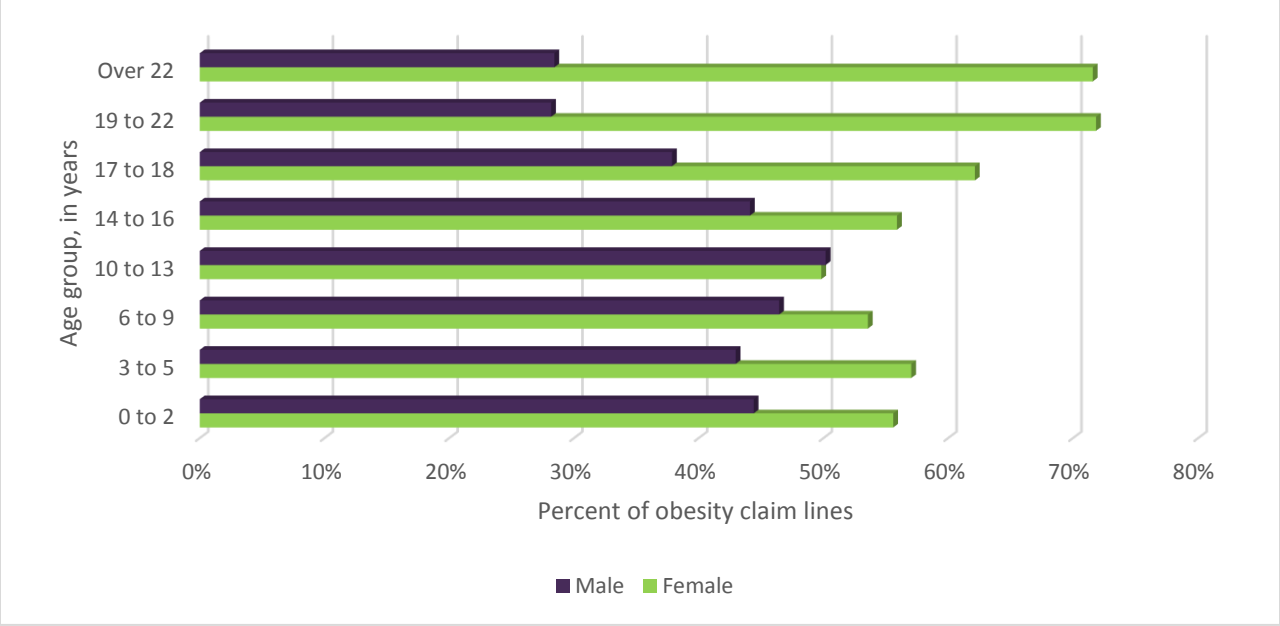

Figure 2. Distribution by gender of claim lines with an obesity diagnosis, by age group, 2011-2015.

The CDC and FAIR Health both found that obesity was more prevalent in women than in men in the period 2011-2014. The CDC found a 38.3 percent prevalence in women compared to 34.3 percent in

[8] Cynthia L. Ogden et al., *Prevalence of Obesity among Adults and Youth: United States, 2011-2014*, NCHS Data Brief no. 219, November 2015, https://www.cdc.gov/nchs/data/databriefs/db219.pdf.
[9] "Overweight & Obesity: Childhood Obesity Facts."

men.[10] The CDC found no gender-related difference among youth aged 2 to 19 years. However, a study by Staiano and colleagues found that girls had a 1.3 times higher chance of being obese than boys in the 10-19-year age range,[11] a result closer to that of the FAIR Health data.

Diabetes

According to FAIR Health data, the increase in claim lines with a diagnosis of obesity from 2011 to 2015 across all age groups was contemporaneous with an increase in claim lines with a diagnosis of type 2 diabetes in every age group in every year but one: there was a dip from 2014 to 2015 among 0- to 2-year-olds (figure 3). Among preschoolers (ages 3-5), the increase was 90 percent from 2011 to 2015. Elementary school students (ages 6-9) and middle school students (ages 10-13) had increases of 80 to 90 percent. In the age groups ranging from 14 to 22 years, type 2 diabetes diagnoses rose between 120 and 125 percent from 2011 to 2015.

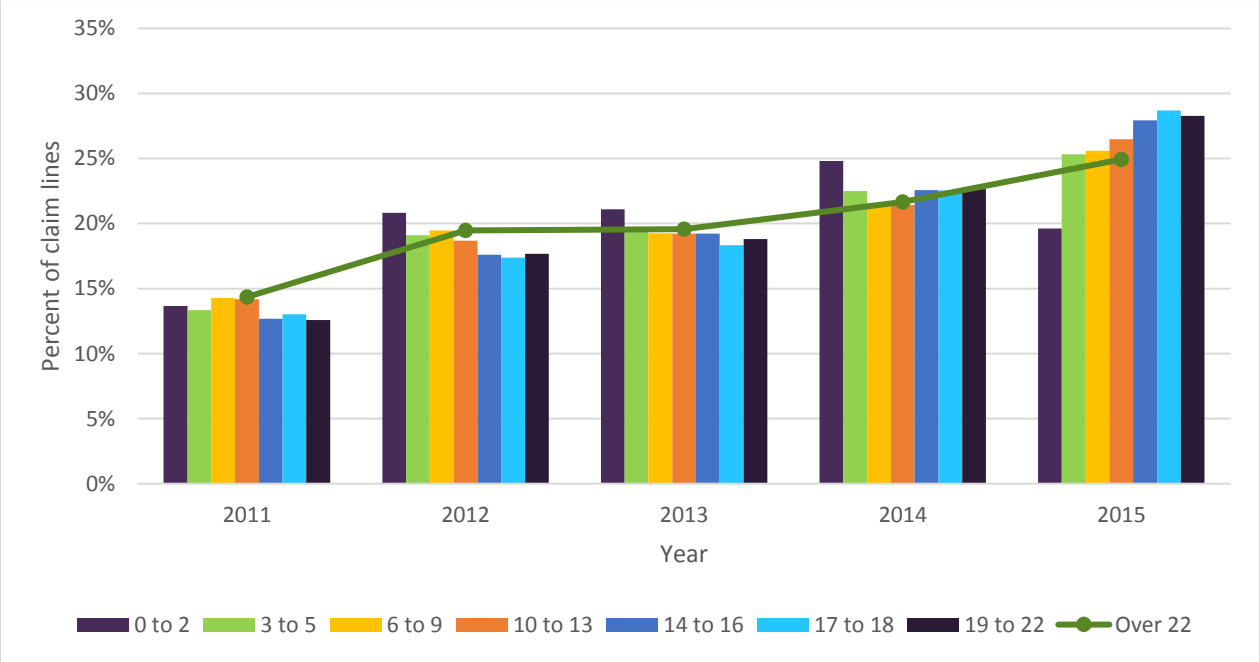

Figure 3. Annual percent of claim lines with a type 2 diabetes diagnosis by age group (in years), 2011-2015.

Although claim lines with obesity diagnoses were generally more frequent for females than males in the period 2011-2015 (figure 2), according to FAIR Health data, type 2 diabetes diagnoses showed a reverse pattern in the same period (figure 4). Claim lines with type 2 diabetes were more common for males,

[10] Ogden et al., *Prevalence of Obesity among Adults and Youth: United States, 2011-2014*.
[11] A.E. Staiano et al., "The Burden of Obesity, Elevated Blood Pressure, and Diabetes in Uninsured and Underinsured Adolescents," *Metab Syndr Relat Disord* 14, no. 9 (2016): 437-441; Epub July 11, 2016.

except for two age groups. In the age group 10 to 13 years, males and females were equal, and in the age group 19 to 22 years, claim lines for type 2 diabetes were somewhat more common for females (52 percent) than males (48 percent).

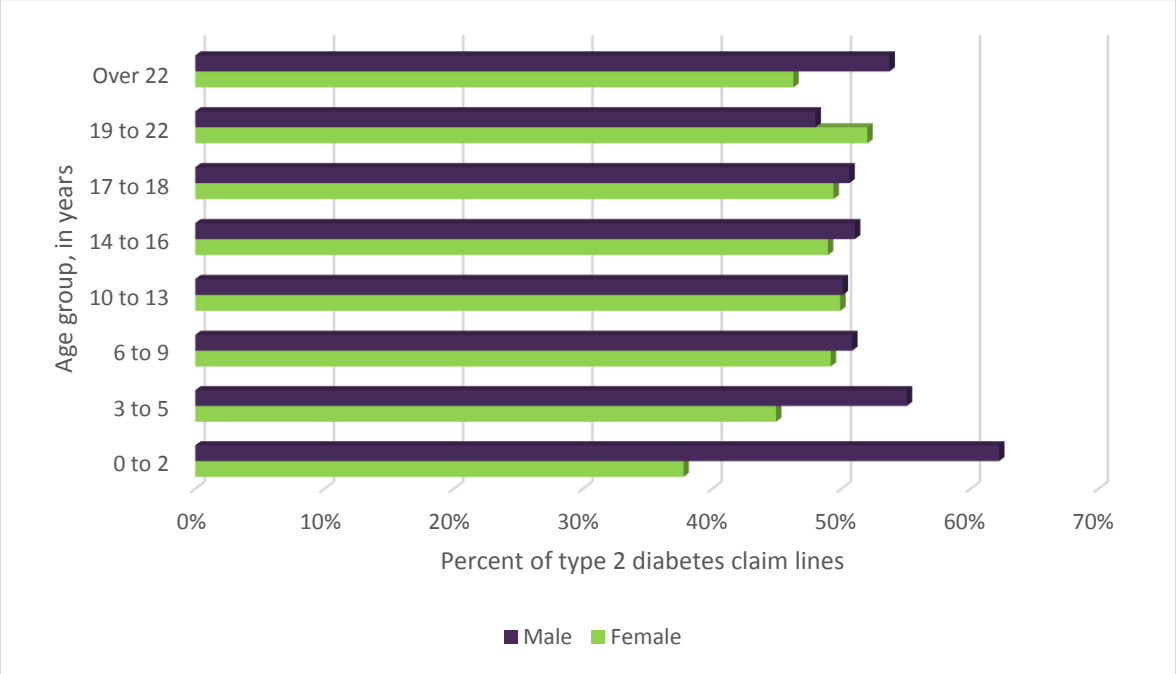

Figure 4. Distribution by gender of claim lines with a type 2 diabetes diagnosis, by age group, 2011-2015.

Two other studies, both based on surveys of patient records, reported that the prevalence of type 2 diabetes among youth aged 10 to 19 years was consistently greater in females than in males. Staiano et al., studying 10-19-year-olds in the period 1998-2012, found type 2 diabetes to be more prevalent in females than males.[12] Dabelea et al., also studying 10-19-year-olds in the period 2001-2009, similarly found type 2 diabetes to be more prevalent in females than males, and found a larger absolute increase among females than males.[13]

Other studies show, however, that middle-aged men are at higher risk of type 2 diabetes than women, at least in populations of European extraction, and men 30 and older develop the disease at a lower body mass index (BMI) than women.[14] Men have been found to have more baseline risk factors for type 2 diabetes than women,[15] and a Kuwaiti study of children aged 6-18 in 2000/2001 showed that type 2

[12] Staiano et al, "The Burden of Obesity, Elevated Blood Pressure, and Diabetes."
[13] Dabelea et al., "Prevalence of Type 1 and Type 2 Diabetes."
[14] J. Logue et al., "Do Men Develop Type 2 Diabetes at Lower Body Mass Indices Than Women?," *Diabetologia* 54 (2011): 3003-06, doi:10.1007/s00125-011-2313-3.
[15] Leigh Perreault et al., "Sex Differences in Diabetes Risk and the Effect of Intensive Lifestyle Modification in the Diabetes Prevention Program," *Diabetes Care* 31, no. 7 (2008): 1416-21, doi:10.2337/dc07-2390.

diabetes was more prevalent in boys than girls.[16] The relation of gender to type 2 diabetes prevalence in young people requires more study.

Other Obesity-Related Conditions

During the period 2011-2015, FAIR Health data show that other conditions associated with obesity also were reflected in an increase in claim lines for those conditions among young people (figure 5). The upward trend in claim lines displayed not only for type 2 diabetes but also for several other conditions is consistent with the upward trend in claim lines for obesity reported in pediatric patients (ages 0 to 22) during this period.

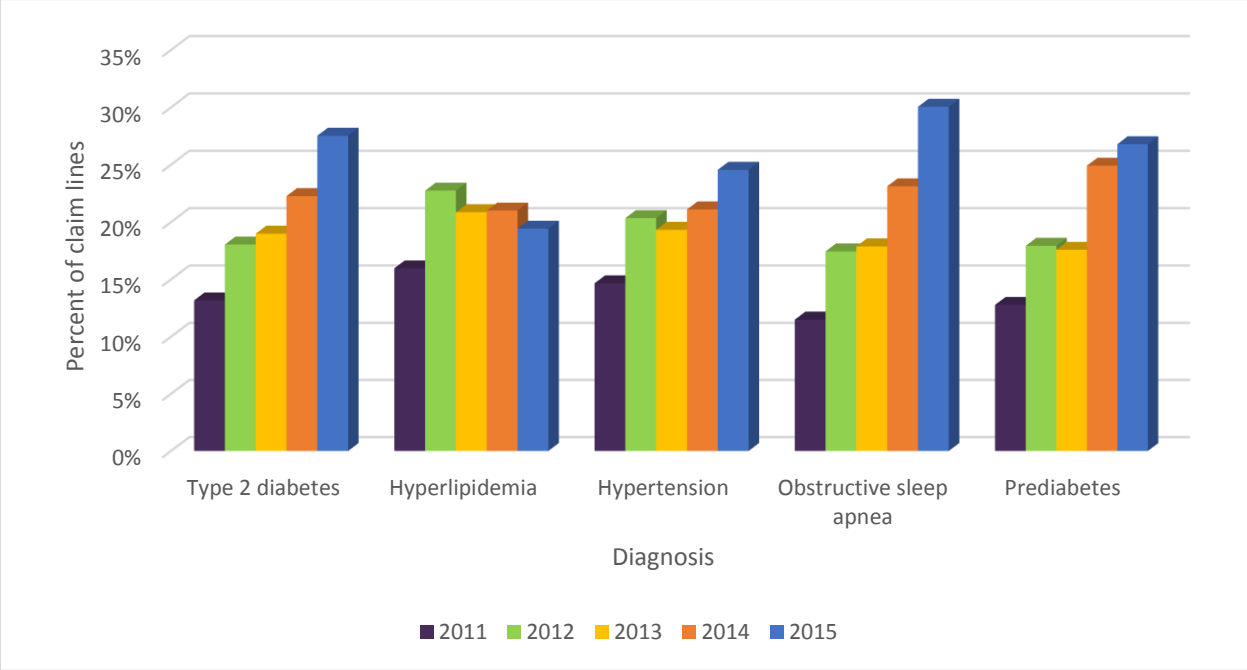

Figure 5. Annual percent of claim lines with various obesity-related diagnoses for pediatric patients, 2011-2015.

Claim lines with diagnoses for type 2 diabetes increased annually among pediatric patients, rising 109 percent across all age groups. There was a similar increase for claim lines with diagnoses of prediabetes (110 percent), a condition in which blood sugar is higher than normal, but not high enough to be considered diabetes. Claim lines for hyperlipidemia remained fairly constant, but those for hypertension increased 67 percent. Claim lines with diagnoses of obstructive sleep apnea had the greatest increase of this group of conditions, at 161 percent.

[16] Mohamed A.A. Moussa et al., "Prevalence of Type 2 Diabetes Mellitus among Kuwaiti Children and Adolescents," *Med Princ Pract* 17 (2008): 270-75, doi:10.1159/000129604.

Figures 6 through 9 below focus on claim lines for just two of these obesity-related conditions: obstructive sleep apnea and hypertension. Obstructive sleep apnea can have more than one cause, but at least one type of obstructive sleep apnea in children is associated with obesity.[17] As early as 2005, Nixon and Brouillette commented that "the increasing prevalence of obesity may be leading to the emergence of a new at-risk population [for obstructive sleep apnea] in middle childhood and adolescence."[18] Indeed, FAIR Health data show that claims associated with obstructive sleep apnea increased in both adults and children from 2011 to 2015 (figure 6). Middle schoolers (ages 10-13) had the highest increase (218 percent) among patients age 22 and younger. In younger high school students (ages 14-16), the increase was 199 percent. In preschoolers (ages 3-5) and elementary school students (ages 6-9), the increase was 127 and 190 percent, respectively. Among those age 17 and over, the increase was between 142 percent and 158 percent.

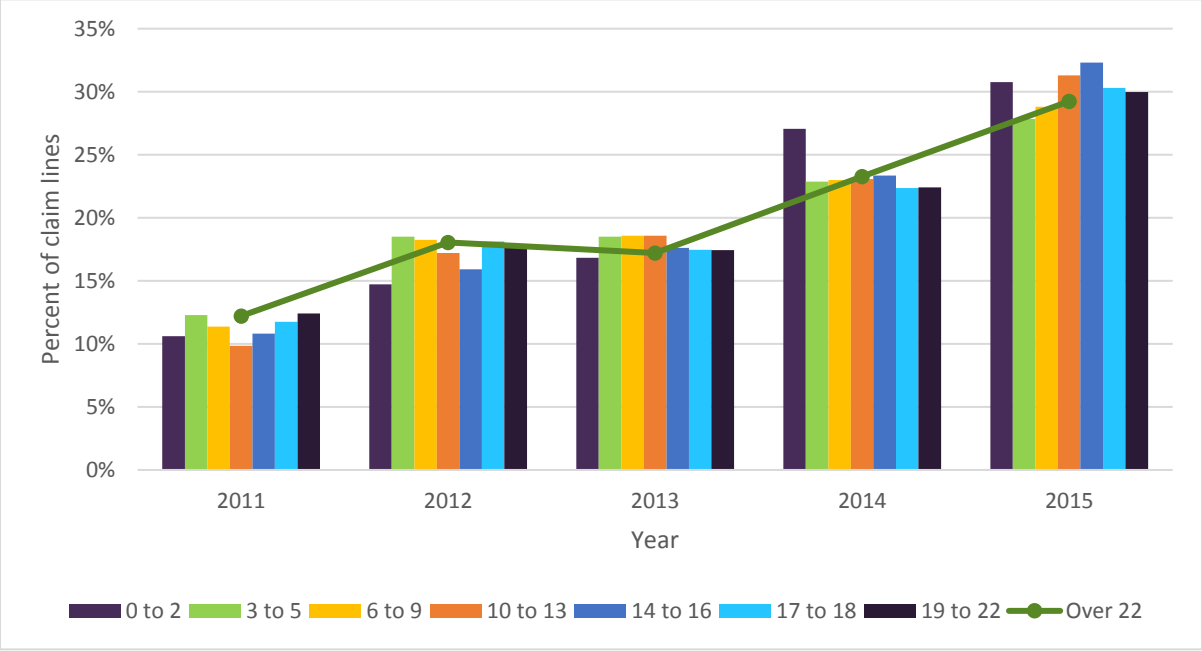

Figure 6. Annual percent of claim lines with an obstructive sleep apnea diagnosis by age group (in years), 2011-2015.

In the pediatric population, the review of claim lines suggests that obstructive sleep apnea was more likely to be diagnosed in males than in females at a generally increasing rate as children got older (figure 7). The increase reached 66 percent in males compared to 34 percent in females in the college age range (ages 19-22).

[17] Oscar Sans Capdevila et al., "Pediatric Obstructive Sleep Apnea: Complications, Management, and Long-Term Outcomes," *Proc Am Thorac Soc* 5, no. 2 (2008): 274-82, doi:10.1513/pats.200708-138MG.
[18] G.M. Nixon and R.T. Brouillette, "Sleep 8: Paediatric Obstructive Sleep Apnoea," *Thorax* 60 (2005): 511-16, doi: 10.1136/thx.2003.007203.

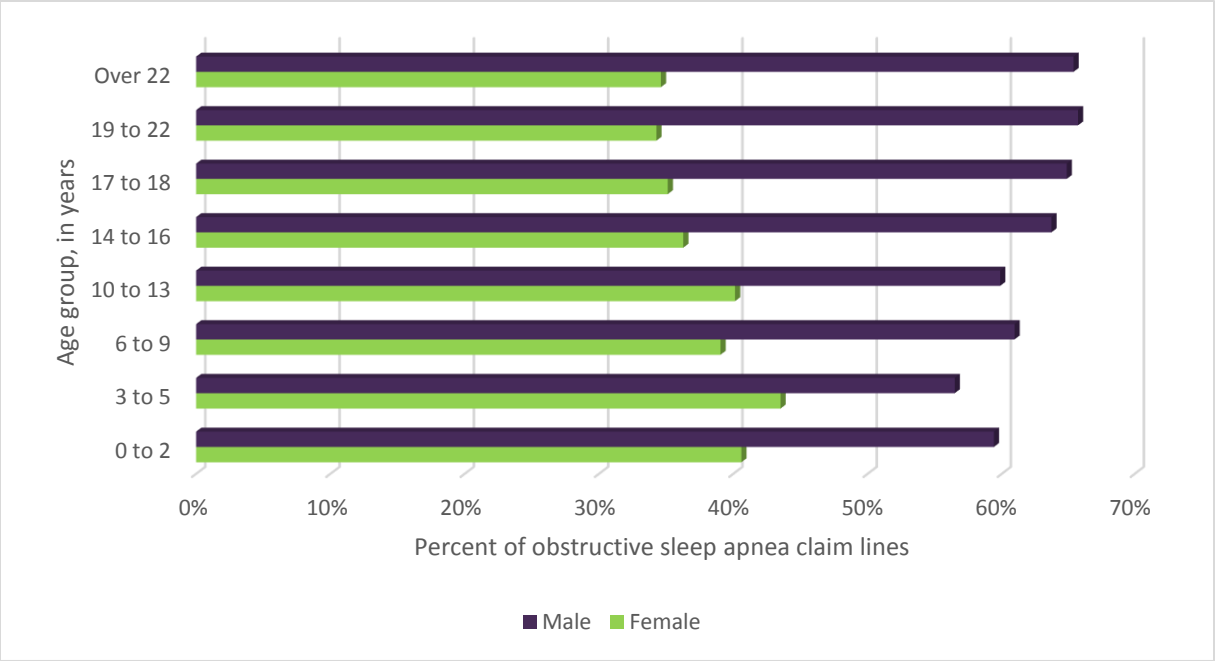

Figure 7. Distribution by gender of claim lines with an obstructive sleep apnea diagnosis, by age group, 2011-2015.

These findings are in keeping with the greater prevalence of obstructive sleep apnea in men than women.[19] In prepubertal children, no difference between boys and girls in obstructive sleep apnea prevalence has been noted previously, but there are reports that adolescent boys have been more affected by obstructive sleep apnea than adolescent girls.[20]

Hypertension is another condition associated with obesity[21] that, according to FAIR Health claims data, has been increasing in young people. Indeed, excess weight may be a stronger risk factor for hypertension in youths than in adults.[22] A 2004 study of trends in blood pressure among children and adolescents (ages 8-17) found that systolic blood pressure was 1.4 mm Hg higher and diastolic blood pressure 3.3 mm Hg higher in 1999-2000 compared with 1988-1994.[23]

[19] Sun Jung Chang and Kyu Young Chae, "Obstructive Sleep Apnea Syndrome in Children: Epidemiology, Pathophysiology, Diagnosis and Sequelae," *Korean J Pediatr* 53, no. 10 (2010): 863-71, doi:10.3345/kjp.2010.53.10.863.
[20] Chang and Chae, "Obstructive Sleep Apnea Syndrome in Children."
[21] Bonita Falkner, "Hypertension in Children and Adolescents: Epidemiology and Natural History," *Pediatr Nephrol* 25, no. 7 (2010): 1219-24, doi:10.1007/s00467-009-1200-3.
[22] Joshua Samuels, "The Increasing Burden of Pediatric Hypertension," *Hypertension* 60 (2012): 276-77, doi: 10.1161/HYPERTENSIONAHA.112.197624.
[23] Paul Muntner et al., "Trends in Blood Pressure among Children and Adolescents," *JAMA*, 291, no. 17 (2004): 2107-13, doi:10.1001/jama.291.17.2107.

FAIR Health data indicate this trend continued in the period 2011-2015, during which claim lines with diagnoses of hypertension increased for all age groups (figure 8). The greatest increase was 103 percent for elementary school students (ages 6-9). Claim lines for older high school students (ages 17-18) and college age individuals (ages 19-22) had an increase of roughly 75 percent. Claim lines for middle schoolers (ages 10-13) had a 63 percent increase and those for younger high school students (ages 14-16) had an increase of 51 percent.

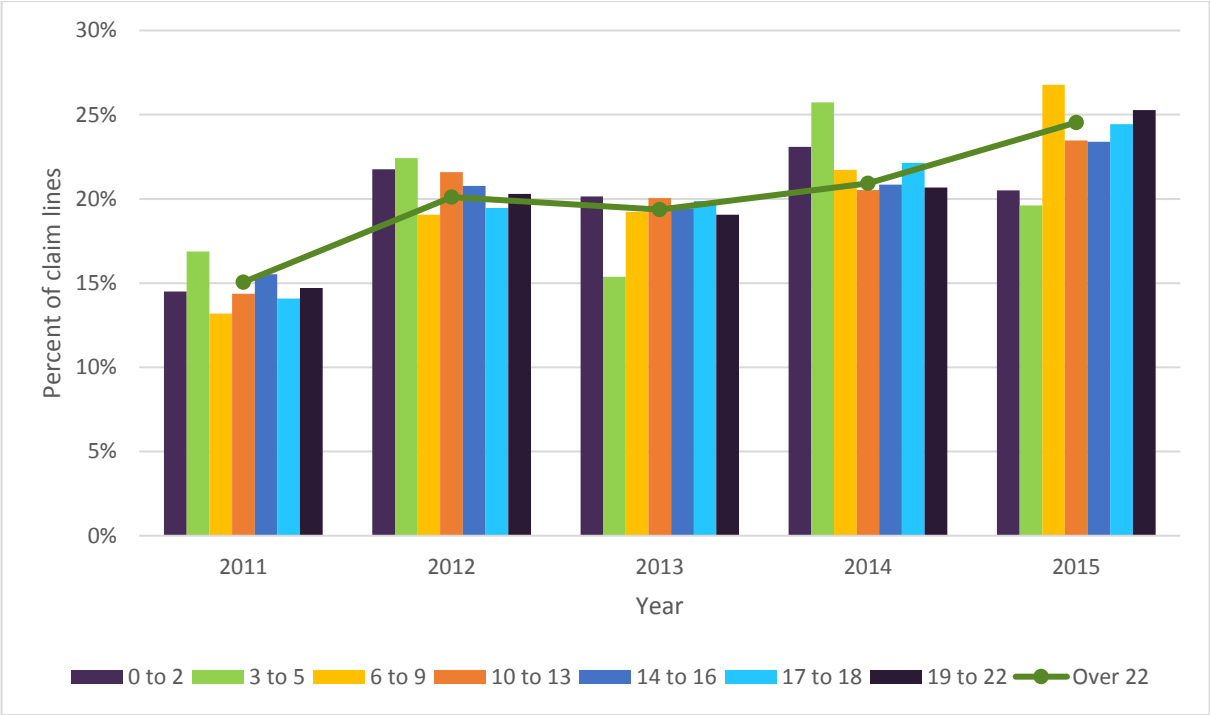

Figure 8. Annual percent of claim lines with a hypertension diagnosis by age group (in years), 2011-2015.

In the pediatric population, claim lines for males more commonly included a diagnosis for hypertension than those for females (figure 9). The disparity was particularly marked in the high school age range (ages 14-18), in which males' claims had 68 percent of the hypertension diagnoses compared to the 32 percent that were on females' claims. These findings are consistent with observations that males in general are more likely to develop hypertension than females prior to the age of 55.[24] It is possible that androgens, hormones such as testosterone that are present in higher levels in men than women, may contribute to increasing blood pressure.[25]

[24] "Risk Factors for High Blood Pressure," "NIH: National Heart, Lung and Blood Institute, last updated September 10, 2015, https://www.nhlbi.nih.gov/health/health-topics/topics/hbp/atrisk.
[25] Jane F. Reckelhoff, "Gender Differences in the Regulation of Blood Pressure," *Hypertension* 37 (2001): 1199-1208, doi:10.1161/01.HYP.37.5.1199.

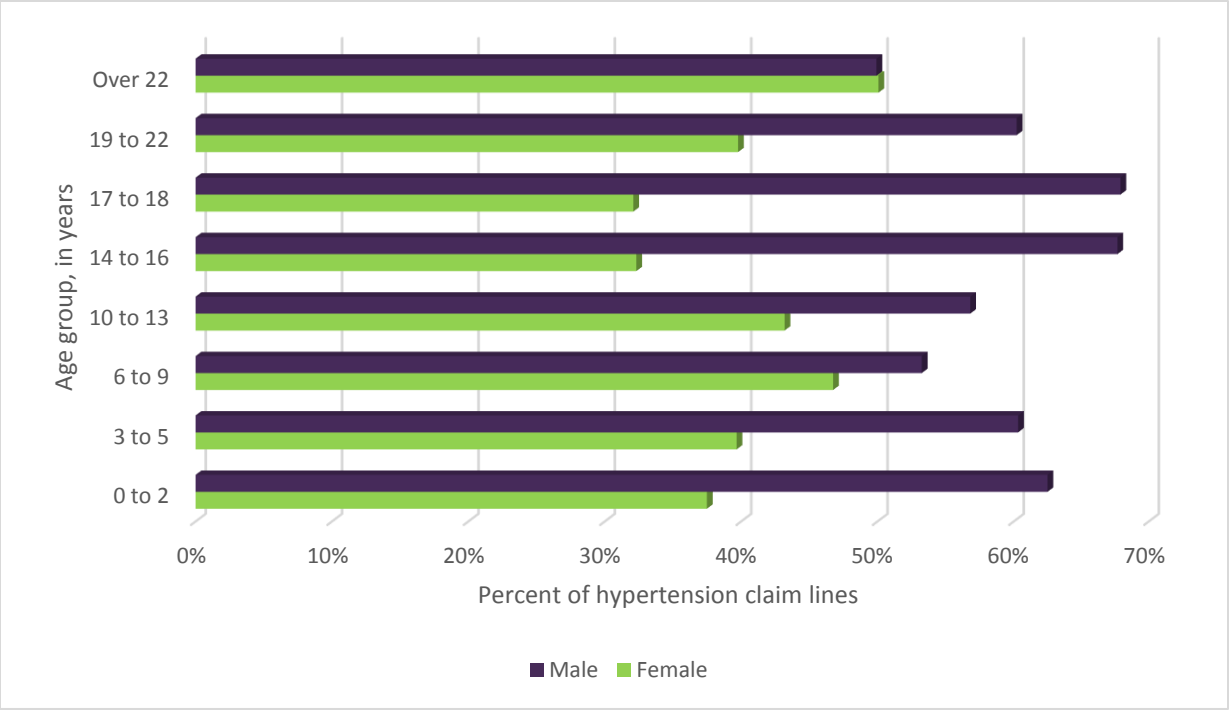

Figure 9. Distribution by gender of claim lines with a hypertension diagnosis, by age group, 2011-2015.

State-by-State Pattern

Comparing the percent of claim lines for pediatric type 2 diabetes diagnoses to the percent of claim lines for all pediatric medical claims by state is a way of determining prevalence by state. Using that standard, pediatric type 2 diabetes was most prevalent in the period 2011-2015 in Ohio, Pennsylvania, North Dakota, Utah and South Dakota (figure 10). It was least prevalent in New Hampshire, Vermont, Delaware, Hawaii and Rhode Island.

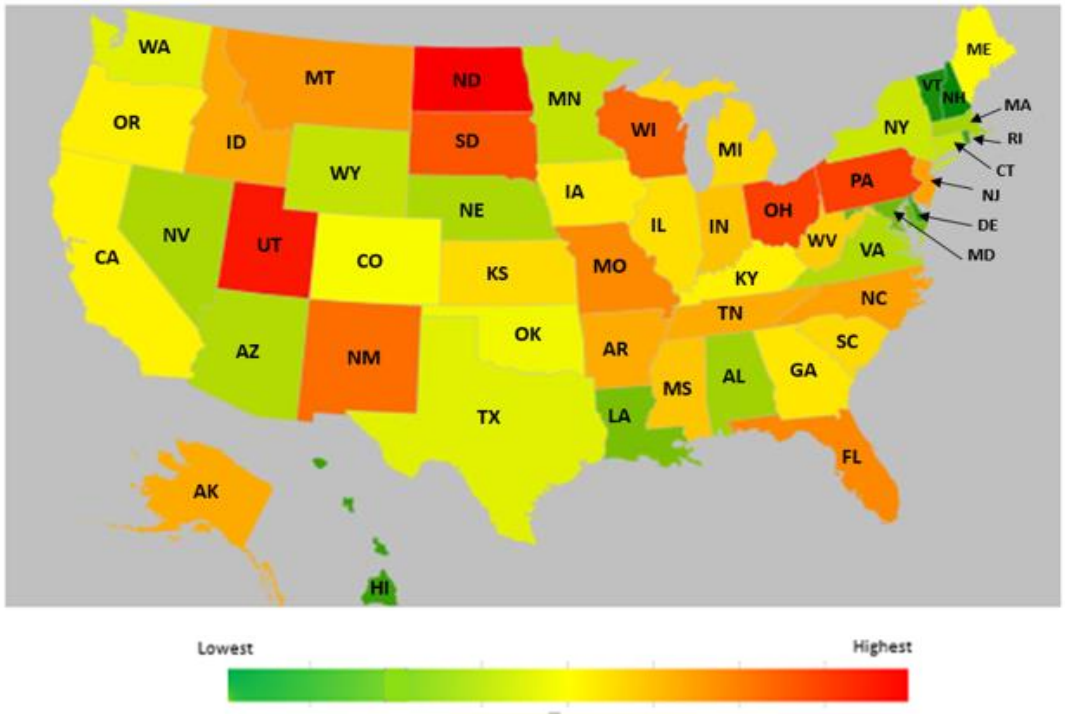

Figure 10. Percent of claim lines for pediatric type 2 diabetes diagnoses compared to percent of claim lines for all pediatric medical claims by state, 2011-2015.

Claim lines with diagnoses for obesity-related conditions besides diabetes, such as hypertension, hyperlipidemia, and obstructive sleep apnea, followed a similar pattern to those for type 2 diabetes for the top five and the bottom five states (figure 11). The five states with the highest prevalence of claim lines with nondiabetic, obesity-related, pediatric diagnoses in 2011-2015 were Ohio, New Jersey, North Dakota, Pennsylvania and West Virginia—including three of the states with the highest prevalence of claim lines with diagnoses for pediatric type 2 diabetes. The five states with the lowest prevalence of claim lines for nondiabetic, obesity-related, pediatric diagnoses were Vermont, New Hampshire, Rhode Island, Delaware and California—including four of the states with the lowest prevalence of claim lines with diagnoses for pediatric type 2 diabetes.

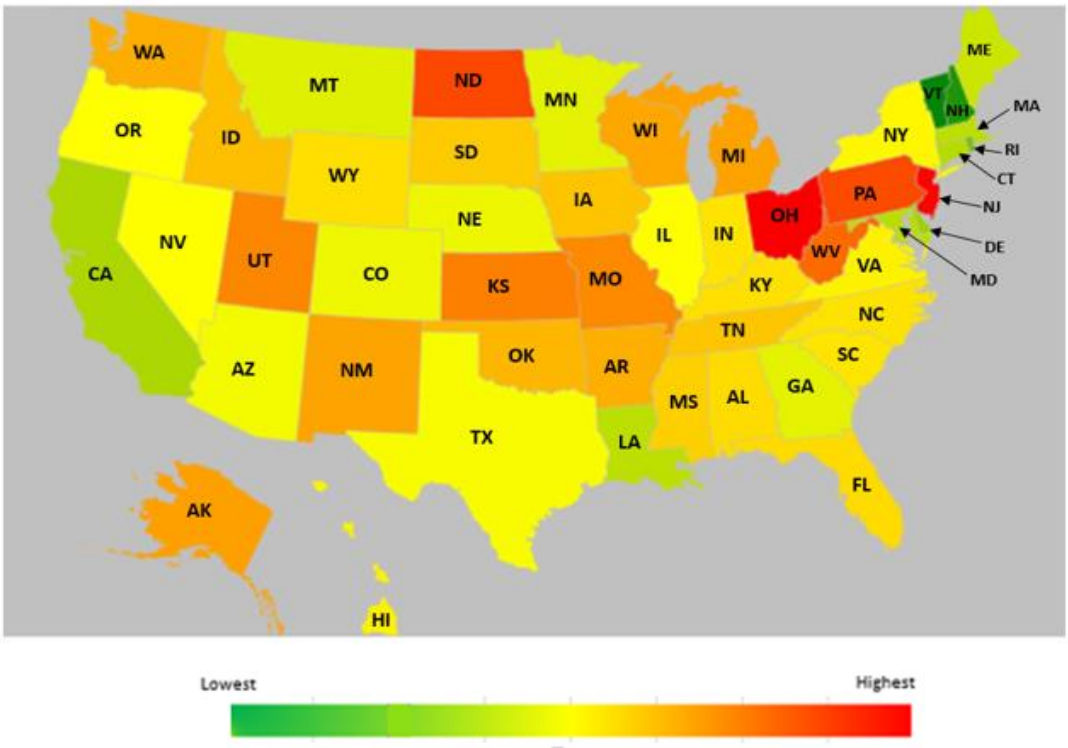

Figure 11. Percent of claim lines for nondiabetic, obesity-related, pediatric diagnoses compared to percent of claim lines for all pediatric medical claims by state, 2011-2015.

Conclusion

The epidemic of obesity is affecting society's youngest members, driving up rates of type 2 diabetes from infancy to the college years. FAIR Health data indicate that both obesity and type 2 diabetes increased in prevalence in the pediatric, privately insured population from 2011 to 2015. Other obesity-related conditions, such as obstructive sleep apnea and hypertension, also appeared to rise in the same population. The data suggest that females were diagnosed with obesity more frequently than males in most pediatric age groups. Type 2 diabetes, obstructive sleep apnea and hypertension all were diagnosed more frequently on claims for males in most such age groups. States varied in the prevalence of claims associated with pediatric type 2 diabetes and in the prevalence of nondiabetic, obesity-related, pediatric diagnoses—but there appeared to be a relationship between the two. Further research into the epidemiology, prevention and treatment of pediatric obesity and its sequelae, particularly type 2 diabetes, is merited, along with coordinated efforts by payors, providers, government officials and policy makers to improve the public health situation. As a source of robust, independent data, FAIR Health stands ready to assist as appropriate.

About FAIR Health

FAIR Health is a national, independent, nonprofit organization dedicated to bringing transparency to healthcare costs and health insurance information through data products, consumer resources and health systems research support. FAIR Health uses its database of over 21 billion privately billed medical and dental claims to power an award-winning free consumer website and to create data products serving all healthcare stakeholders, including government officials, researchers, consumers, providers, insurers and other businesses. FAIR Health has been certified by the Centers for Medicare & Medicaid Services (CMS) as a Qualified Entity, eligible to receive all Medicare claims data for use in its nationwide transparency efforts. In addition, FAIR Health's data have been authorized as the official data source for a variety of state health programs, including workers' compensation and personal injury protection (PIP) programs, and have been officially designated as standards for state consumer protection laws governing surprise out-of-network bills and emergency services. For more information, visit www.fairhealth.org.

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