Cardiovascular Risk Factors and Provision of Lifestyle Counseling for Diabetes or Prediabetes With Comorbid Obesity: Analysis of Office-Based Physician Visits Made by Patients 20 Years of Age or Older

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Obesity, defined as a BMI ≥30 kg/m^2, is one of the most common and costly preventable causes of death in the United States (1–3). Increased prevalence of obesity, which affects an estimated 36.5% of U.S. adults (1), has been linked to a growing risk of morbidity from several medical conditions, including diabetes and heart disease (4). In parallel with increases in obesity rates (4), the age-adjusted percentage of adults with diagnosed diabetes increased from 3.6% in 1990 to 8.7% in 2010 (5), and an estimated 9.3% of U.S. adults had diagnosed diabetes in 2015 (6). Prediabetes, another consequence of obesity, affects ~34% of U.S. adults, placing them at increased risk of developing diabetes and cardiovascular complications (5,7). Of those with prediabetes, only about 12% report having been told by a health care professional that they had the condition (5).

A previous analysis of office-based physician visits made by U.S. patients with diabetes in 2005, conducted by Neumiller et al. with data reported in the National Ambulatory Medical Care Survey (NAMCS), found that comorbid obesity increased the likelihood of presenting with concomitant disease states such as heart failure (6.1% for obesity/diabetes visits vs. 4.0% for all diabetes visits), depression (21.2 vs. 10.8%), hyperlipidemia (62.2 vs. 46.3%), and hypertension (71.4 vs. 64.1%) (8). Obesity was also associated with increases in the ordering or provision of lifestyle counseling (e.g., diet/nutrition counseling in 58.8% of obesity/diabetes visits vs. 36.6% of all diabetes visits) (8).

Since the time of the study by Neumiller et al., attention to obesity-related health risks has increased, with a focus on the potential for early screening and intervention to prevent disease progression, such as from prediabetes to diabetes or from diabetes to cardiovascular disease (9,10). These trends make it important to provide updated information on comorbid obesity and related lifestyle counseling in office-based physician visits made by patients with prediabetes or diabetes.

Accordingly, the present study investigators used NAMCS data on office-based physician visits made by adult patients to report *1*) temporal trends in rates of obesity and comorbid obesity/diabetes from 2010 to 2014 and *2*) rates of comorbid cardiovascular risk factors and provision of lifestyle counseling in office visits made by patients with diabetes or prediabetes with or without comorbid obesity in 2014.

Methods

Data Source

Study data were drawn from the NAMCS, a cross-sectional survey of U.S. office-based physician visits conducted annually by the National Center for Health Statistics (NCHS) (11,12). The NAMCS employs a three-stage probability sampling procedure that has been described in detail elsewhere (11,12). Briefly, the

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NAMCS unit of analysis is an individual office-based physician visit. Sampling is conducted first by primary sampling units (PSUs), which are geographic areas (e.g., counties or county groups), and then within PSU by physician name, stratified by physician specialty. Each selected physician is randomly assigned to one of 52 weeks of data collection within the survey year. Finally, for each physician and week, a systematic random sample of office visits is made.

NAMCS data are collected by U.S. Census Bureau field representatives using standardized protocols automated in a laptop-based tool (12). Available data include patient demographics; biometric information, including BMI; laboratory tests, if performed, including A1C; diagnoses in *International Classification of Diseases*, 9th revision (ICD-9), format; common and/or clinically important conditions (e.g., depression, hypertension, and substance abuse) that may not have been reported as diagnosed reasons for the visit; and visit-related services (e.g., various types of examinations, screenings, and counseling). Conditions are recorded by the field representatives using a series of check-box items preceded by a prompt that asks: "Regardless of the diagnoses previously entered, does the patient now have . . . ?" (13). Services, including lifestyle counseling, are collected using another series of check-box items preceded by a prompt asking about services "ordered or provided at this visit" (13).

Each NAMCS record (individual sampled office visit) includes weights, calculated by the NCHS, that adjust for the multistage sampling design and for survey nonresponse. Application of the weights to the data yields nationally representative information for U.S. office-based physician visits and enables the calculation of SEs for statistical testing and confidence interval estimation (14). To create datasets for analysis, NAMCS data for the 5-year time period from 2010 through 2014 were downloaded from the NCHS website (15).

Clinical Classification and Measures

Classification of visits into four groups (diabetes, obesity/diabetes, prediabetes, and obesity/prediabetes) was made using recorded diagnoses and biometric data. Diagnoses were measured using any of three diagnosis fields (i.e., primary, secondary, or tertiary) on the NAMCS record. Diabetes was defined as ICD-9 codes of 250.xx. This set of diagnoses, which includes both type 1 and type 2 diabetes, was used, as in the previous study by Neumiller et al. (8), because of evidence suggesting that coded diagnoses for diabetes may be ambiguous as to type (16).

Obesity was defined as ICD-9 codes of 278.00 (obesity, unspecified), 278.01 (morbid obesity), or 278.03 (obesity hypoventilation syndrome); or a recorded BMI of ≥30 kg/m^2. Prediabetes was measured as a recorded A1C of 5.5–6.4%, the criterion suggested by the American Association of Clinical Endocrinologists (AACE) (17). In a sensitivity analysis, prediabetes was defined as an A1C of 5.7–6.4%, the alternative criterion established by the American Diabetes Association (ADA) (18). Comorbidities (cerebrovascular disease; depression; heart disease, defined as either coronary artery disease, ischemic heart disease, or history of myocardial infarction; kidney disease, defined as either end-stage renal disease or chronic kidney disease; heart failure; hyperlipidemia; hypertension; and obstructive sleep apnea) were defined using the condition indicators in the NAMCS record.

In addition to the two lifestyle counseling measures assessed by Neumiller et al. (8) (diet/nutrition and exercise counseling), the present study assessed weight reduction counseling and diabetes education, a metric added to the NAMCS in 2014. A composite measure of lifestyle counseling/education assessed whether any of these four lifestyle counseling interventions were ordered or provided at the visit.

Statistical Analyses

To assess trends in obesity and obesity/diabetes, the following were measured: *1*) obesity as a percentage of all visits, *2*) obesity as a percentage of visits made for diagnosed diabetes, and *3*) diabetes diagnosis or condition code as a percentage of obesity visits. The third measure included all diabetes regardless of whether diabetes was a diagnosed reason for the visit, to reflect the full scope of obesity-related diabetes for the prevalence measures. Temporal trends in rates of prediabetes were not calculated because A1C testing was performed in only a small percentage of office visits (e.g., 9% in 2014). The Pearson χ^2 test was used to assess the statistical significance of between-year differences in these rates (12).

For the analyses of visits made by each clinical group (diabetes, obesity/diabetes, prediabetes, and obesity/prediabetes) in 2014, all patient characteristics and lifestyle counseling rates were calculated as percentages of visits. Pearson χ^2 tests were used to compare obese and nonobese patients.

All estimates were verified against the NCHS reliability standard of ≥30 unweighted cases and a relative SE of ≤30%. All statistical tests and SEs were adjusted for the complex sampling design. Study analyses were performed using SPSS version 24.0 software (IBM, Armonk, N.Y.).

Results

From 2010 through 2014, the rate of obesity among U.S. adults increased significantly (P <0.001), from 16.3% (95% CI 14.5–18.1%) to 25.4% (95% CI 24.0–26.8%) of all visits, and from 31.0% (95% CI 24.7–37.3%) to 43.8% (95% CI 39.9–47.7%) of visits made for diagnosed diabetes (Figure 1). Of the visits in which obesity was recorded, rates of diabetes did not significantly change over time, remaining relatively constant at 22–26%.

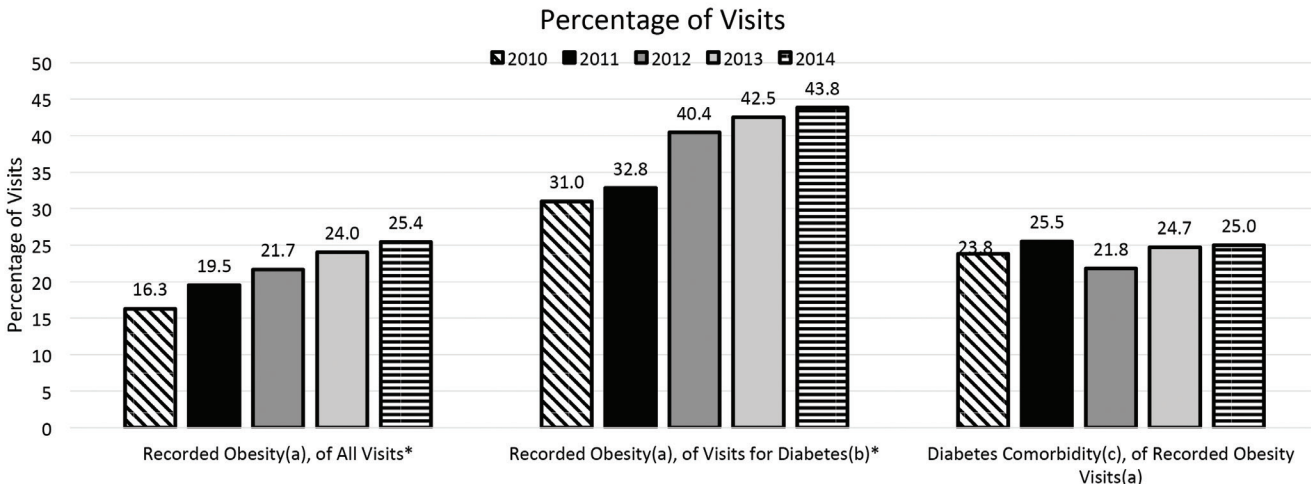

FIGURE 1. Trends in obesity and diabetes/obesity visits made by U.S. adults aged ≥20 years, 2010–2014. (a) Obesity diagnosis based on ICD-9 code of 278.00 (obesity unspecified), 278.01 (morbid obesity), or 278.03 (obesity hypoventilation syndrome) in any of the first three diagnosis fields, or BMI ≥30 kg/m^2). (b) ICD-9 code for diabetes (250.xx) in any of the first three diagnosis fields. (c) Condition code for diabetes, including all diagnoses meeting condition described in the previous footnote. *Pearson χ^2 <0.001.

Obesity was common in patients with A1C values indicating prediabetes (Table 1); 13.1 million of the 32.2 million prediabetes visits (40.6%, 95% CI 34.9–46.3%) were made by patients with evidence of obesity. Obesity was associated with younger age and non-Hispanic white race. Payer coverage for the visits was consistent with the observed age differences. For example, Medicare covered 51.7% of all diabetes visits and 46.9% of comorbid obesity/diabetes visits.

Several cardiovascular risk factors were associated with comorbid obesity, including hypertension, sleep apnea, and, for patients with diabetes, hyperlipidemia (Table 1). Of these, the most pronounced relative difference was for sleep apnea. Specifically, the obesity-associated increase in sleep apnea prevalence was 146% for patients with diabetes (8.6 vs. 3.5% for those with and without comorbid obesity, respectively; P <0.01) and 242% for those with prediabetes (10.6 vs. 3.1%, respectively; P <0.01; rates for nonobese patients are not shown in Table 1). Notably, more than three-fourths (76.9%) of patients with diabetes and comorbid obesity also had hypertension.

Rates of lifestyle counseling were generally consistent with the pattern of cardiovascular risk factors, with increased rates associated with comorbid obesity (Table 2). For example, diet/nutrition counseling was provided or ordered in 23.1% of all office-based visits for those with diabetes, 30.2% of obesity/diabetes visits, and 17.5% of visits made by nonobese patients with diabetes (rates for nonobese patients not shown in Table 2; P <0.01). Similarly, exercise counseling was provided or ordered in 15.2% of all diabetes visits, 21.7% of obesity/diabetes visits, and 10.1% of visits made by nonobese patients with diabetes (P <0.01). Similar patterns were observed for patients with prediabetes.

However, all lifestyle counseling rates were generally low at ≤30% for all individual lifestyle counseling metrics. Any lifestyle counseling—diet/nutrition, exercise, weight reduction, or diabetes education—occurred in 29.2% (95% CI 23.1–35.3%) of diabetes visits, 36.4% (95% CI 27.8–45.0%) of obesity/diabetes visits, 25.1% (95% CI 18.4–31.8%) of prediabetes visits, and 32.6% (95% CI 24.2–41.0%) of obesity/prediabetes visits.

Nearly all patients with prediabetes identified by the AACE standard (A1C 5.5–6.4%) also met the alternative ADA standard (A1C 5.7–6.4%). For this reason, patient characteristics for these sample subgroups were nearly identical in sensitivity analyses.

Discussion

This retrospective analysis of a nationally representative sample of office-based physician visits indicated that the rates of obesity, comorbid obesity/diabetes, and obesity/prediabetes have increased markedly over time among U.S. adults and that obesity comorbid with diabetes or prediabetes is associated with an increased prevalence of cardiovascular risk factors. Despite these trends, lifestyle counseling in U.S. physician office visits occurred in 2014 at suboptimal rates. These findings are concerning because evidence supports implementing lifestyle measures and related education to improve clinical outcomes and quality of life (19–21).

These findings should be interpreted in light of ADA's universal standards for accredited diabetes

TABLE 1. Patient Characteristics, U.S. Office-Based Physician Visits for Patients Aged ≥20 Years With Diabetes or Prediabetes, With or Without Comorbid Obesity, 2014

	All Diabetes[a]	Comorbid Obesity and Diabetes[a,b]	All Prediabetes[a]	Comorbid Obesity and Prediabetes[a,b]
Unweighted *n* of visits	2,419	1,104	1,373	577
Weighted *n* of visits	54,536,297	23,893,963	32,205,432	13,086,999
Patient characteristics				
Age, years				
20–64	46.9 (1.8)	53.4 (2.2)**	52.5 (3.1)	57.3 (3.0)
≥65	53.1 (1.8)	46.6 (2.2)**	47.5 (3.1)	42.7 (3.0)
Female	49.1 (1.6)	50.5 (2.3)	57.2 (2.8)	59.3 (2.7)
Race				
Non-Hispanic white	64.5 (2.4)	70.3 (3.1)**	64.5 (4.4)	73.9 (3.7)**
Black	11.9 (1.4)	13.1 (2.1)**	7.6 (1.2)	9.1 (1.9)**
Hispanic	16.5 (2.1)	13.7 (2.3)**	16.4 (3.7)	13.6 (3.3)**
Other	7.2 (1.2)	[c]	[c]	[c]
Primary payer				
Private	38.1 (1.9)	44.0 (2.4)*	47.7 (3.4)	50.5 (3.4)
Medicare	51.7 (1.8)	46.9 (2.3)*	43.9 (3.3)	40.4 (3.1)
Medicaid	6.0 (0.8)	5.5 (1.2)*	6.2 (1.2)	7.3 (1.9)
Other	4.3 (0.9)	[c]	[c]	[c]
Comorbidities[d]				
CAD	13.1 (1.1)	14.0 (1.5)	13.2 (1.3)	12.8 (2.0)
CEBVD	2.9 (0.4)	[c]	4.1 (0.6)	[c]
CHF	2.9 (0.5)	3.2 (0.6)	3.6 (0.9)	[c]
CKD	8.3 (1.1)	8.5 (1.5)	7.5 (1.1)	7.6 (1.7)
Depression	9.4 (0.9)	11.2 (1.4)	12.2 (1.3)	13.3 (1.7)
Hyperlipidemia	55.4 (2.2)	62.3 (2.8)**	54.9 (2.6)	59.0 (3.3)
Hypertension	69.8 (1.9)	76.9 (2.1)**	66.1 (2.5)	71.1 (2.8)*
Sleep apnea	5.7 (0.7)	8.6 (1.2)**	6.2 (1.0)	10.6 (1.9)**

*Patient characteristics are reported as percentage (SE). [a]Diabetes = ICD-9 codes of 250.00–250.99; prediabetes = A1C 5.5–6.4%. [b]Obesity = BMI ≥30 kg/m^2 or ICD-9 codes for unspecified obesity, morbid obesity, or obesity hypoventilation syndrome. [c]Sample size too small for reliable estimate. [d]Based on condition indicator codes. *P <0.05, Pearson χ^2 comparing obese with nonobese patients. **P <0.01, Pearson χ^2 comparing obese with nonobese patients. CAD, coronary artery disease, including ischemic heart disease and history of myocardial infarction; CEBVD, cerebrovascular disease; CHF, congestive heart failure; CKD, chronic kidney disease, including end-stage renal disease.*

self-management training program curriculums, which include education regarding nutrition and exercise recommendations and, often, assistance in implementing individualized plans that address these components of care (22). ADA standards indicate that accredited education programs facilitate the knowledge, skills, and abilities necessary for optimal diabetes self-care and incorporate the needs, goals, and life experiences of people with diabetes. Specifically, the ADA states that nutrition therapy plays an integral role in overall diabetes management and that all individuals with diabetes should receive individualized medical nutrition therapy (MNT), preferably provided by a registered dietitian who is knowledgeable and skilled in providing diabetes-specific MNT (18,23).

Similarly, exercise has been shown to lead to a number of benefits in patients with diabetes, including improved blood glucose control, reduction of cardiovascular risk factors, weight loss, improved mobility, and overall improvement in well-being (24–26). Even without a significant

TABLE 2. Services Provided in U.S. Office-Based Physician Visits Made by Patients Aged ≥20 Years With Diabetes or Prediabetes, With or Without Comorbid Obesity, 2014

	All Diabetes[a]	Comorbid Obesity and Diabetes[a,b]	All Prediabetes[a]	Comorbid Obesity and Prediabetes[a,b]
Unweighted *n* of visits	2,419	1,104	1,373	577
Weighted *n* of visits	54,536,297	23,893,963	32,205,432	13,086,999
Physician specialty				
General/family practice	31.5 (2.7)	36.2 (3.5)	39.9 (4.4)	40.8 (4.2)
Internal medicine	29.4 (2.8)	30.2 (3.3)	33.5 (4.2)	33.6 (4.1)
Cardiology	[c]	4.7 (1.3)	5.4 (1.3)	8.2 (2.5)
All others	34.6 (3.1)	29.0 (4.3)	21.1 (4.2)	17.4 (4.0)
Treated by primary care physician	63.9 (3.2)	69.6 (4.6)*	79.4 (3.1)	74.1 (4.2)*
Diet/nutrition counseling	23.1 (3.1)	30.2 (4.4)**	21.2 (3.2)	28.4 (4.3)**
Exercise counseling	15.2 (3.1)	21.7 (4.5)**	16.8 (2.9)	22.7 (3.9)**
Diabetes education	13.5 (1.9)	15.3 (2.8)	[c]	[c]
Weight reduction	5.6 (0.7)	10.0 (1.5)**	6.9 (1.1)	13.3 (2.1)**
Any lifestyle counseling[d]	29.2 (3.1)	36.4 (4.4)**	25.1 (3.4)	32.6 (4.3)**

[a]Diabetes = ICD-9 codes of 250.00–250.99; prediabetes = A1C 5.5–6.4%. [b]Obesity = BMI ≥30 kg/m^2 or ICD-9 codes for unspecified obesity, morbid obesity, or obesity hypoventilation syndrome. [c]Cell sample size too small for reliable estimate. [d]Diet/nutrition counseling, exercise counseling, diabetes education, or weight reduction counseling. *P <0.05, *Pearson χ^2 comparing obese with nonobese patients.* **P <0.01, *Pearson χ^2 comparing obese with nonobese patients.*

change in BMI, structured exercise can have a significant positive impact on A1C in those with type 2 diabetes (27).

These recommendations could be carried out in a streamlined manner by providing general nutrition information and exercise recommendations, even to patients who will be referred to a dietitian for follow-up care. General education handouts covering a variety of topics are readily available from the ADA and could be distributed to patients at the end of each office visit (28).

It is difficult to compare the results of the present study to those of Neumiller et al. for patients seen in 2005 (8), because the NAMCS metric for diabetes education was new in 2014. Still, it does appear that rates of lifestyle counseling in U.S. physician office visits have declined over time. Reasons for this may include increasingly greater demands placed on providers' time by electronic health records and administrative activities, which have reduced direct clinical "face time" with patients (29–31).

In this regard, it should be noted that less than half of obesity/diabetes and obesity/prediabetes visits were paid by Medicare. Medicare Part B offers benefits for formal diabetes education, termed "diabetes self-management training," and accredited education providers are tasked with ensuring the delivery of formal program components such as discussion of lifestyle measures, including nutrition and exercise counseling (32,33). Specifically, MNT from a registered dietitian via an approved education program is a Medicare reimbursable benefit (34). Important topics for future research include the degree to which reimbursement policies, administrative requirements, and other visit- and patient-related factors affect the provision of lifestyle education to patients with diabetes or prediabetes with comorbid obesity.

Limitations

Several limitations of the present study should be noted. First, the identification of prediabetes was based on only patients in whom A1C was measured. For this reason, the prediabetes subgroups in this study may not be representative of all patients with these conditions. Second, it is possible that lifestyle education took place in some office visits but was not recorded. However, NAMCS information is collected using trained staff, and NAMCS data are commonly used to measure patient education and other quality-of-care metrics in patients with chronic disease (35–37). Third, although NAMCS data are commonly used to assess longitudinal trends (38), they are repeated cross-sectional measures rather than a patient panel.

Conclusion

Although lifestyle management, including counseling on diet/nutrition therapy and physical activity, is a cornerstone of care for prediabetes and diabetes, only a minority of U.S. patients with these conditions received lifestyle counseling in office-based ambulatory visits in 2014. Coupled with evidence of increasing prevalence

of obesity-related conditions and resulting cardiovascular diseases in the United States, these findings suggest a need for additional research on approaches to increase the provision of lifestyle counseling to patients with diabetes, prediabetes, and/or obesity.

Duality of Interest

No potential conflicts of interest relevant to this article were reported.

Author Contributions

S.K., R.M.J., K.D.B., and K.A.F. researched data, wrote the manuscript, contributed to discussion, and reviewed/edited the manuscript. D.A.S. contributed to discussion and reviewed/edited the manuscript. S.K. the guarantor of this work and, as such, has full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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