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Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Short Communication

Gaps in provider lifestyle counseling and its adherence among obese adults with prediabetes and diabetes in the United States

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ARTICLE INFO

Keywords:

Diabetes

Lifestyle counseling

Obesity

Prediabetes

Prevention

ABSTRACT

Obesity is an epidemic affecting about 40% of the US adult population. Tracking with the obesity epidemic is an increase in the prevalence of diabetes and pre-diabetes. Both pre-diabetes and diabetes are often coexistent with obesity and contribute to an increased total and cardiovascular disease related morbidity and mortality. Lifestyle modification is usually the first step in management among individuals with obesity and/or pre-diabetes or diabetes, but remains an unfulfilled potential by healthcare providers to promote healthier lifestyles in obese patients. We aimed to describe the current patterns of lifestyle counseling (diet, physical activity, and weight loss) and their adherence by patients with obesity in the US using the National Health Interview Survey, 2016–2017. We analyzed these patterns among individuals with pre-diabetes and diabetes. We found that, regardless of pre-diabetes or diabetes status, almost 1 in 3 individuals with mild obesity (BMI ≥ 30 & < 35) and 1 in 4 with severe obesity (BMI ≥ 35) reported lack of lifestyle counseling from healthcare providers regarding diet or physical activity, and 2 in 3 individuals with any level of obesity reported lack of referral/counsel concerning weight loss programs. Lifestyle counseling and its compliance among obese adults from a contemporary dataset in the US is still suboptimal. This study highlights the gaps in the implementation of the AHA/ACC 2013 guidelines on management of obesity among adults particularly among those with metabolic disease, who would derive the greatest benefit.

1. Introduction

Obesity is a slow growing world-wide epidemic affecting about 40% of the US adult population. (Tsai et al., 2018; Cecchini, 2018) Tracking with the obesity epidemic is an increase in the prevalence of diabetes and pre-diabetes. (Nguyen et al., 2011; Albrecht et al., 2017) Pre-diabetes, an abnormal metabolic state defined as blood glucose or hemoglobin A1c levels above normal but not reaching the threshold for diabetes, is a major risk factor for the development of diabetes mellitus, (Warren et al., 2017) and increases cardiovascular disease (CVD) risk. Both pre-diabetes and diabetes are often coexistent with obesity and

contribute to an increased morbidity and mortality.

Encouraging a healthy lifestyle is important in the management of obesity and in the reduction of its related comorbidities such as hypertension, diabetes, (Powell-Wiley et al., 2012) and cancers. (Sung et al., 2019) Maintaining a healthy lifestyle can prevent the development of diabetes and can slow down the progression of pre-diabetes to diabetes. (Yang et al., 2011) In obese individuals, even modest weight reduction through modifying diet and increasing physical activity has been shown to prevent diabetes. (Hemmingsen et al., 2017) Unfortunately, there remains an unfulfilled potential for healthcare providers to encourage obese patients to pursue healthier lifestyles. (Tsai

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et al., 2018)

While older studies have examined lifestyle counseling and adherence among obese persons in general, there is no contemporary, national-level data on this topic among obese persons who are at high cardiometabolic risk such as those with pre-diabetes or diabetes.

Given this gap in knowledge, using nationally-representative data, we aimed to describe the current patterns of lifestyle counseling (diet, physical activity, and weight loss) and their adherence by patients with obesity in the US. We analyzed these patterns among individuals with pre-diabetes and diabetes.

2. Methods

2.1. Study design

We utilized the most recent 2 years of data (2016 to 2017) from the National Health Interview Survey (NHIS). The NHIS, a database compiled by the National Center for Health Statistics/Center for Disease Control and Prevention, comprises annual, cross-sectional national surveys which incorporate complex, multi-stage sampling to provide estimates representative of noninstitutionalized US population. (About NHIS, n.d.) The NHIS questionnaire is divided into four core components: Household Composition, Family Core, Sample Child Core and Sample Adult Core. This study was based on the Sample Adult Core files, supplemented with demographic and socioeconomic characteristics, health status, health care services, and health-related behaviors on the US adult population. (About NHIS, n.d.) Since NHIS data is publicly available as de-identified data, this study was exempt from the purview of the Yale University's Institutional Review Board Committee.

2.2. Study population

We used self-reported diagnoses to identify pre-diabetes and diabetes, in all non-institutionalized US adults older than 18 years of age who had a usual source of care. Specifically, individuals were included if they answered "Yes" to any of the following questions: "Have you ever been told by a doctor or other health professional that you had: "pre-diabetes?", "diabetes?" (Appendix Table 1).

In addition, we used body mass index (BMI) scores (provided by NHIS from self-reported weight and height) to identify all individuals with obesity (BMI ≥ 30 kg/m²) and divided them into two mutually-exclusive categories: mild obesity (BMI ≥ 30 and < 35 kg/m²), and severe obesity (BMI ≥ 35 kg/m²).

Appendix Table 1

Itemized NHIS questions for diagnoses and study outcomes.

Diagnosis	Question	Answer
Diabetes	[if female, other than during pregnancy] have you EVER been told by a doctor or health professional that you have diabetes or sugar diabetes?	"Yes"
Prediabetes	[if female, other than during pregnancy] have you EVER been told by a doctor or health professional that you have diabetes or sugar diabetes?	"Borderline or pre-diabetes"
	Have you EVER been told by a doctor or other health professional that you have any of the following: pre-diabetes, impaired fasting glucose, impaired glucose tolerance, borderline diabetes, or high blood sugar?	"Yes"
Hypertension	Have you EVER been told by a doctor or other health professional that you had...	"Yes"
Dyslipidemia	... hypertension, also called high blood pressure? ... you had high cholesterol?	"Yes"

Lifestyle counseling and adherence	Question	Answer
Counsel:	<i>DURING THE PAST 12 MONTHS, have you been told by a doctor or health professional to do any of the following ...</i>	
Increase physical activity or exercise	...Increase your physical activity or exercise?	"Yes"
Reduce fat or calories in diet	...Reduce the amount of fat or calories in your diet?	
Weight loss program	...Participate in a weight loss program?	
Adherence:	Are you NOW doing any of the following..	
Increase physical activity or exercise	...Increasing your physical activity or exercise?	"Yes"
Reduce fat or calories in diet	...Reducing the amount of fat or calories in your diet?	
Weight loss program	...Participating in a weight loss program?	

2.3. Study outcomes

2.3.1. Lifestyle counseling

Individuals were asked if in the last 12 months, they had been told by their healthcare provider to reduce their caloric intake, increase physical activity or exercise, or if they had been referred to a weight-loss program. Additionally, surveyed individuals were asked if they, at the time of the survey, had followed each of the above advice(s) (Appendix Table 1). To further study lifestyle counseling in more detail, we created an aggregate sum of all three lifestyle counseling advices, with receiving ≥ 2 as our outcome, to capture most of the cases where lifestyle counseling had been provided.

2.3.2. Covariates

Other covariates included in this study included sex, race/ethnicity, family income, insurance status, smoking status, hypertension, dyslipidemia and cardiovascular disease. Family income was defined based on percent of family income to the federal poverty limit from the Census Bureau: Middle/High-income (≥ 200%) and Low-income (< 200%).

2.4. Statistical analysis

Proportions were used to study prevalence in our study population. Unadjusted and adjusted logistic regression models were utilized as measures of association between lifestyle counseling and explanatory variables, such as sex or family income. Variance estimation for the entire pooled cohort was obtained from the Integrated Public Use Microdata Series (<http://www.ipums.org>). (Blewett et al., 2016) For all statistical analyses, p < 0.05 was considered statistically significant. All analyses were carried out using Stata®, version 13.1 (StataCorp, LP, College Station, Texas, USA). All analyses were survey-specific, taking into consideration the complex survey design of the NHIS.

3. Results

Our study sample, restricted to only include individuals with a usual source of care, included 52,268 surveyed individuals between 2016 and 17, of which 4186 reported having pre-diabetes (weighted proportion: 9% [95% CI 8.4, 9.1], translating to ≈ 19.4 million US adults annually) and 6084 reported having diabetes (weighted proportion: 10.7% [95% CI 10.4, 11.1], translating to ≈ 25.5 million US adults annually). Among individuals with pre-diabetes, a total of 2034 individuals had a

Appendix Table 2
General characteristics among adults with obesity, from the National Health Interview Survey, 2016–17.

	Pre-diabetes		p Value	Diabetes		p Value
	Mild obesity	Severe obesity		Mild obesity	Severe obesity	
Sample (N)	1032	1002		1638	1761	
Weighted sample, (weighted %)	3,896,248 (48.4)	4,148,493 (51.6)		5,952,626 (48.3)	6,379,770 (51.7)	
	<i>Weighted % (95% CI)</i>	<i>Weighted % (95% CI)</i>		<i>Weighted % (95% CI)</i>	<i>Weighted % (95% CI)</i>	
Age category			< 0.001			< 0.001
18–39	15.7 (12.7, 18.7)	27.7 (23.9, 31.5)		5.2 (3.7, 6.8)	10.8 (8.7, 12.9)	
40–64	55.6 (51.6, 59.6)	54.3 (50.4, 58.1)		52.2 (49.3, 55.1)	57.6 (54.7, 60.5)	
≥ 65	28.7 (25.2, 32.2)	18.0 (15.5, 20.6)		42.6 (39.8, 45.4)	31.6 (28.9, 34.2)	
Sex			< 0.001			< 0.001
Male	48.6 (44.6, 52.6)	35.6 (31.6, 39.5)		57.0 (54.1, 60.0)	40.3 (37.5, 43.2)	
Female	51.4 (47.4, 55.4)	64.4 (60.5, 68.4)		43.0 (40.0, 45.9)	59.7 (56.8, 62.5)	
Race/Ethnicity			0.08			0.25
Non-Hispanic White	66.3 (62.0, 70.6)	63.5 (59.2, 67.7)		66.9 (63.4, 70.4)	67.8 (64.4, 71.2)	
Non-Hispanic black	14.6 (11.6, 17.7)	19.5 (16.1, 22.8)		16.3 (13.9, 18.7)	18.1 (15.3, 20.8)	
Hispanic	19.1 (15.1, 23.1)	17.1 (13.5, 20.7)		16.8 (13.6, 20.0)	14.1 (11.4, 16.9)	
Family income			0.11			0.02
Middle/High income	72.5 (69.1, 76.0)	68.1 (64.1, 72.0)		64.7 (61.7, 67.6)	59.4 (56.2, 62.7)	
Low income	27.5 (24.0, 30.9)	31.9 (28.0, 35.9)		35.3 (32.4, 38.3)	40.6 (37.3, 43.8)	
Insurance status			0.54			0.55
Public	46.2 (42.4, 50.0)	43.0 (39.0, 47.0)		62.3 (59.4, 65.3)	59.9 (56.6, 63.1)	
Private	48.8 (44.9, 52.7)	51.3 (47.3, 55.4)		32.3 (29.3, 35.3)	34.9 (31.6, 38.1)	
Uninsured	5.0 (3.2, 6.9)	5.6 (3.7, 7.6)		5.3 (3.6, 7.0)	5.3 (3.6, 6.9)	
CVD status			0.83			0.24
No CVD	78.9 (75.8, 82.1)	79.5 (76.0, 82.9)		64.6 (61.6, 67.7)	67.1 (64.2, 70.1)	
CVD	21.1 (17.9, 24.2)	20.5 (17.1, 24.0)		35.4 (32.3, 38.4)	32.9 (29.9, 35.8)	
Smoke			0.35			0.72
Non-smoker	86.3 (83.6, 89.1)	88.1 (85.4, 90.8)		86.3 (84.3, 88.4)	85.8 (83.4, 88.1)	
Smoker	13.7 (10.9, 16.4)	11.9 (9.2, 14.6)		13.7 (11.6, 15.7)	14.2 (11.9, 16.6)	
Hypertension			0.08			0.77
No hypertension	41.8 (37.7, 45.9)	37.1 (33.2, 41.0)		23.4 (20.8, 26.0)	22.8 (20.1, 25.4)	
Hypertension	58.2 (54.1, 62.3)	62.9 (59.0, 66.8)		76.6 (74.0, 79.2)	77.2 (74.6, 79.9)	
Dyslipidemia			0.005			0.44
No dyslipidemia	43.9 (39.8, 48.1)	52.6 (48.4, 56.7)		31.5 (28.6, 34.4)	33.0 (30.2, 35.9)	
Dyslipidemia	56.1 (51.9, 60.2)	47.4 (43.3, 51.6)		68.5 (65.6, 71.4)	67.0 (64.1, 69.8)	
Years since DM diagnosis			–			0.07
≤ 10 years	–	–		53.1 (50.0, 56.3)	57.1 (54.1, 60.2)	
> 10 years	–	–		46.9 (43.7, 50.0)	42.9 (39.8, 45.9)	

Abbreviations: CVD, cardiovascular disease; DM, diabetes mellitus.

BMI ≥ 30 mg/kg² (weighted proportion: 48.2%), of which 1032 (weighted proportion: 42.6%) and 1002 (weighted proportion: 51.2%) had mild and severe obesity, respectively. Similarly, among those with diabetes, 3413 individuals had a BMI ≥ 30 mg/kg² (weighted proportion: 56.1%), of which 1644 (weighted proportion: 43.4%) and 1769 (weighted proportion: 51.8%) had mild and severe obesity, respectively. General characteristics of this population are given in Appendix Table 2.

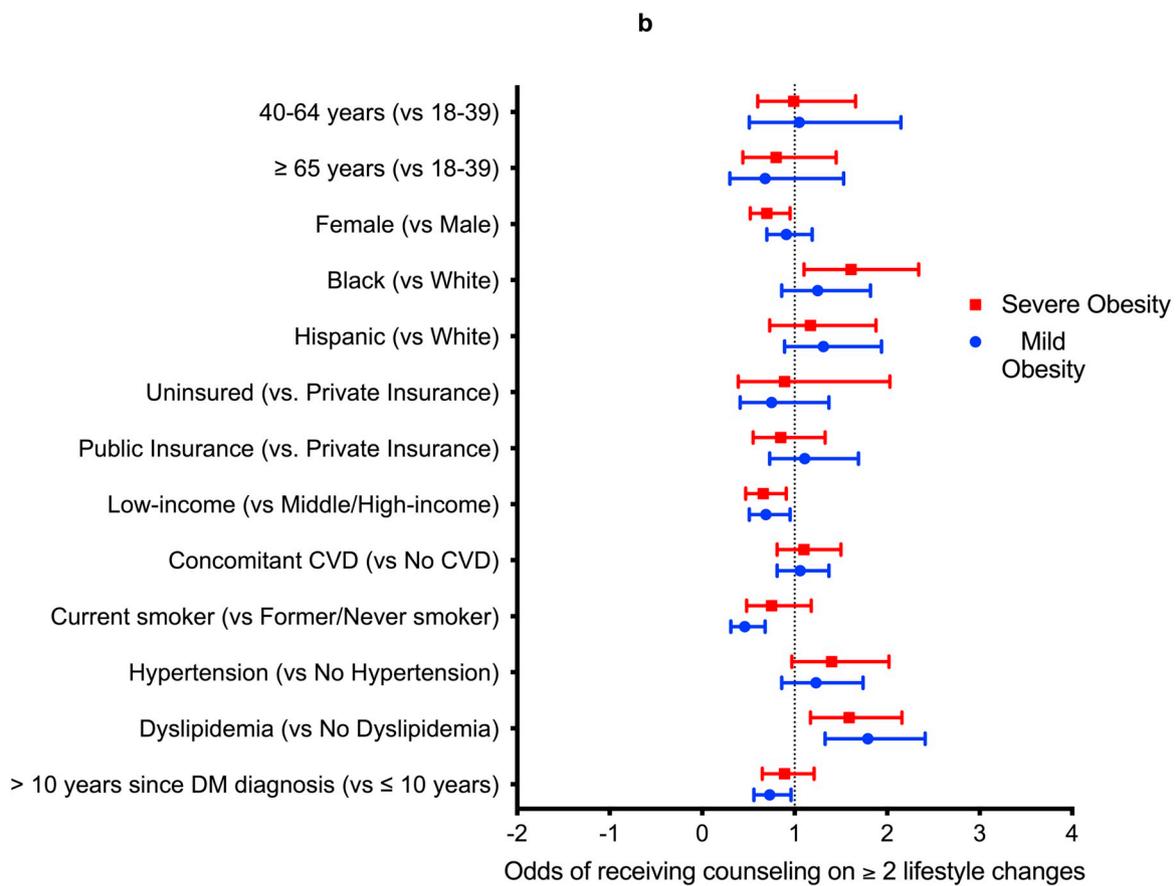
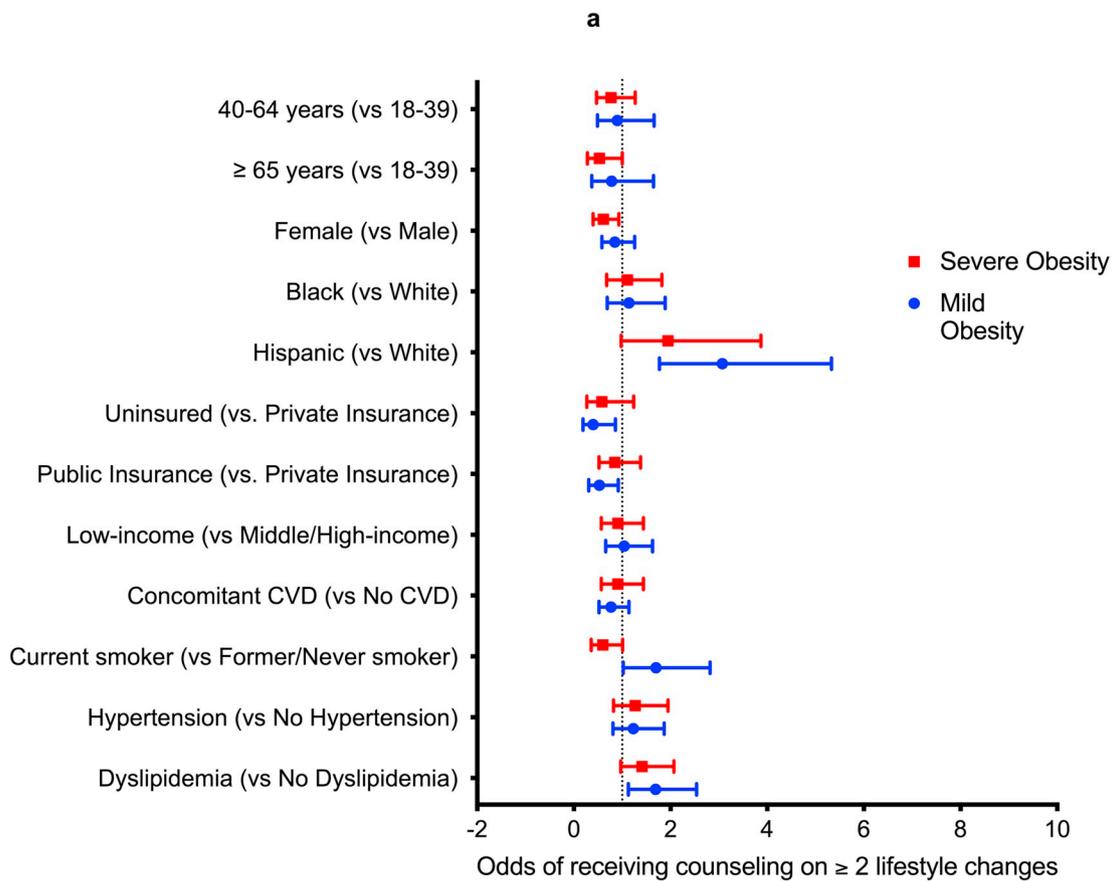
In general, the proportion of those with mild obesity with a lack of

counseling on caloric restriction or increasing physical activity or exercise ranged between 33% and 39%, irrespective of diabetes status (Table 1). Similarly, this proportion ranged between 23% and 27% among those with severe obesity. Of those who were counseled, the highest prevalence of following said advice was found to be in relation to caloric restriction (ranging from 75% to 78%), followed by increasing physical activity or exercise (ranging from 64% to 70%). Absence of advice relating to a referral to a weight-loss program was high (nearly two-thirds) across the board, irrespective of obesity and

Table 1
Proportion of obese individuals with pre-diabetes, and metabolic disease counseled on lifestyle changes and adherence to the advice.

	Reduce fat or calories in diet		Increase physical activity or exercise		Weight loss program	
	Told to ... in last 12 months?	If 'Yes': are you now...?	Told to ... in last 12 months?	If 'Yes': are you now...?	Told to ... in last 12 months?	If 'Yes': are you now...?
Pre-diabetes						
Mild obesity (weighted % [95% CI])	64.2 (60.2, 68.2)	75.3 (71.0, 79.5)	67.3 (63.4, 71.1)	66.6 (62.0, 71.2)	24.5 (21.1, 28.0)	31.4 (24.0, 38.7)
Severe obesity (weighted % [95% CI])	74.6 (71.4, 77.7)	76.7 (72.3, 81.1)	76.6 (73.2, 80.0)	69.9 (65.7, 74.1)	34.8 (30.8, 38.8)	36.8 (29.5, 44.1)
Diabetes						
Mild obesity (weighted % [95% CI])	60.8 (58.0, 63.6)	77.6 (74.2, 81.1)	64.6 (61.7, 67.4)	65.3 (62.0, 68.6)	21.9 (19.4, 24.4)	30.7 (24.2, 37.2)
Severe obesity (weighted % [95% CI])	72.8 (70.0, 75.5)	78.4 (75.7, 81.1)	73.0 (70.3, 75.8)	63.9 (60.5, 67.4)	31.7 (28.9, 34.5)	29.4 (24.6, 34.3)

Note: Mild obesity = 30–34.9 kg/m²; Severe obesity ≥ 35 kg/m².



(caption on next page)

Fig. 1. Predictors of Lifestyle Counseling among Adults with Obesity and Pre-Diabetes (a), or Diabetes (b), from the National Health Interview Survey, 2016–17. Abbreviations: CVD, cardiovascular disease; DM, diabetes mellitus.

diabetes strata, and follow-up for this advice ranged between 29% and 37%.

In univariate logistic regression models, the predictors against receiving counseling for ≥ 2 lifestyle changes among those with pre-diabetes and mild obesity were older patients (≥ 65 years), and those with public health insurance. In this group, Hispanics had higher odds of lifestyle counseling when compared to non-Hispanic whites. In adjusted analyses, these associations remained, except for older patients (where the association became non-significant). Among those with pre-diabetes and severe obesity, odds for lifestyle counseling were lowest for females, those with public insurance, low family income, and smokers. Hispanics and those with dyslipidemia had greater odds of lifestyle counseling. On adjusted analyses, only females remained significantly associated with lower odds of receiving lifestyle counseling (Fig. 1a).

Similarly, predictors against receiving counseling on ≥ 2 lifestyle changes among those with diabetes and mild obesity were being uninsured or having public insurance, having low family income, being a smoker, and having a longer time since diabetes diagnosis. On adjusted analyses, only low family income, smoking and time since diabetes diagnosis remained significant. Presence of dyslipidemia was associated with higher odds of lifestyle counseling for those with diabetes and mild obesity. Among those with diabetes and severe obesity, odds for lifestyle counseling were lowest for females, having public insurance, and low family income. Blacks, those with hypertension, and dyslipidemia had higher odds of reporting being counseled for lifestyle changes. On adjusted analyses, these predictors remained significant, with the exception of public insurance and hypertension (Fig. 1b).

4. Discussion

We found that, regardless of pre-diabetes or diabetes status, almost 1 in 3 individuals with mild obesity and 1 in 4 with severe obesity reported lack of lifestyle counseling from healthcare providers regarding diet or physical activity, and 2 in 3 individuals with any level of obesity reported lack of referral/counsel concerning weight loss programs. Our findings further show that females and people from lower family income levels were less likely to receive counseling or referral to a weight loss program even when they were morbidly obese and had metabolic diseases such as pre-diabetes or diabetes.

Our results are similar to those observed in previous studies. Kraschnewski et al. reported that less than a third of patients with obesity received weight counseling (Kraschnewski et al., 2013) and Yang et al. reported that $< 40\%$ of those with pre-diabetes received lifestyle counseling from their healthcare providers (Yang et al., 2011). We found that even though this prevalence seemed higher in our results, there is still work to be done. After adjusting for key covariates, we found that among those with pre-diabetes and mild obesity, those with public insurance and uninsured were less likely to receive lifestyle counseling; and in addition, among those with severe obesity, female sex, and a low family income were also less likely to receive lifestyle counseling, similar to previous studies (Kraschnewski et al., 2013; Galuska et al., 1999). Interestingly, Hispanics with pre-diabetes and mild obesity, and Blacks with diabetes and severe obesity were more likely to receive lifestyle counseling. These minority groups often present higher levels of obesity, and thus might receive more attention from healthcare providers (Powell-Wiley et al., 2012). Similarly, those with pre-diabetes, smoking, and dyslipidemia also demonstrated higher odds of lifestyle counseling, fitting the hypothesis from Powell-Wiley et al. that lifestyle counseling might be more heavily guided by cardiovascular risk factors than actual BMI (Powell-Wiley et al., 2012). It remains unclear why females and persons of lower socioeconomic levels

(regardless of insurance) were less likely to report receiving such counseling. Moreover, individuals with diabetes seemed to have lower prevalence of lifestyle counseling in general when compared to those with pre-diabetes. This could be a reflection of providers spending more time on other aspects of diabetes care and not talking about it as often as they would in patients with pre-diabetes, although we are limited into making this assumption based on the data from the current study.

Previous research has shown that adequate patient-provider communication is critical for successful lifestyle counseling and adherence (Peimani et al., 2018; Nemeth et al., 2017). In difficult-to-manage patients, providers may not feel prepared to advise patients on weight loss targets (Halbert et al., 2017) while a good quality of communication between healthcare providers and patients has been tied to lower medication non-adherence, higher treatment satisfaction (White et al., 2015) better quality of life and lower healthcare resource utilization (Okunrintemi et al., 2017). Healthcare provider counseling, or lack thereof, is a complex issue that is determined by the interplay of many factors. These include patient- (e.g. self-motivation, perceived benefits), (Bardach and Schoenberg, 2012) and healthcare provider characteristics (e.g. heavy workload of primary care providers), healthcare provider type (e.g. physician [primary care provider/specialist], nurse practitioner, physician assistant) (Tsai et al., 2018) or even healthcare provider gender (Dutton et al., 2014). Better understanding of these determinants, including adequate patient-provider communication, is important to address this intricate public health issue. Improving lifestyle counseling by providers is fundamental to shifting current projections for obesity, its related mortality (D'Souza et al., 2018) costs, and resource utilization in the next decade (Cecchini, 2018).

The results from the current study are distressing, given that the USPSTF (U.S. Preventive Services Task Force) has recommended that all adults with BMI ≥ 30 kg/m² should be screened and counseled for multicomponent behavioral interventions (recommendation "B"), (Moyer, 2012) ideally including behavioral treatment and multi-specialty tailored strategies (Burgess et al., 2017). Moreover, the Patient Protection and Affordable Care Act mandates any USPSTF recommendations level "A" or "B" be covered without copays (Tsai et al., 2018). The findings of the present study should further: 1) motivate healthcare providers to provide lifestyle counseling to individuals with obesity, especially those with pre-diabetes and 2) could also, in turn, help patients increase adherence rates to lifestyle counseling, as attrition to lifestyle modification advice has been associated with poorer outcomes and diminished treatment effectiveness (Miller and Brennan, 2015).

This study is not without limitations. First, given how weight was self-reported, it is possible that some individuals might have under-reported their weight. However, this would likely mean that our estimates are actually an underestimation of the actual population results (Kraschnewski et al., 2013). Second, while our estimated prevalence of diabetes is very similar to that reported by the CDC (National Diabetes Statistics Report, 2017, 2017) the prevalence of pre-diabetes is significantly lower than that from the same report (34% vs 9%). This is due to the fact that the CDC, using NHANES, calculated this prevalence using fasting glucose or A1C levels, whereas we utilized self-reported data. Nevertheless, of all individuals with pre-diabetes in the CDC report, 11.6% reported being told by a healthcare professional that they had pre-diabetes, which more closely resemble our estimates. Hence, our results would actually represent more conservative estimates of the real problem. Third, due to the nature of the NHIS data, we lack the perspective from healthcare providers on provision of counseling. Fourth, since individuals were asked about lifestyle counseling in the past 12 months, recall bias could be present.

In summary, lifestyle counseling and its compliance among obese

adults from a contemporary dataset in the US is still suboptimal. This study highlights the gaps in the implementation of the AHA/ACC 2013 guidelines on management of obesity among adults particularly among those with metabolic disease who will derive the greatest benefit. Future studies should focus on the barriers to lifestyle counseling faced by health care providers who care for obese persons with or at high risk of diabetes and how to improve levels of compliance among these high-risk individuals.

Disclosures

The authors reported no disclosures or conflicts of interest.

References

- About NHIS. (Accessed July 13th, 2018, at https://www.cdc.gov/nchs/nhis/about_nhis.htm.)
- Albrecht, S.S., Mayer-Davis, E., Popkin, B.M., 2017. Secular and race/ethnic trends in glycemic outcomes by BMI in US adults: the role of waist circumference. *Diabetes Metab. Res. Rev.* 33.
- Bardach, S.H., Schoenberg, N.E., 2012. Primary care physicians' prevention counseling with patients with multiple morbidity. *Qual. Health Res.* 22, 1599–1611.
- Blewett L, Rivera Drew J, Griffin R, King M, Williams K. IPUMS Health Surveys: National Health Interview Survey, Version 6.2. Minneapolis: University of Minnesota 2016. (Accessed July 13th, 2018, at <https://www.ipums.org/>).
- Burgess, E., Hassmen, P., Welvaert, M., Pumpa, K.L., 2017. Behavioural treatment strategies improve adherence to lifestyle intervention programmes in adults with obesity: a systematic review and meta-analysis. *Clinical obesity* 7, 105–114.
- Cecchini, M., 2018. Use of healthcare services and expenditure in the US in 2025: the effect of obesity and morbid obesity. *PLoS One* 13, e0206703.
- D'Souza, M.J., Bautista, R.C., Wentzien, D.E., 2018. Data talks: obesity-related influences on US mortality rates. *Research in health science* 3, 65–78.
- Dutton, G.R., Herman, K.G., Tan, F., et al., 2014. Patient and physician characteristics associated with the provision of weight loss counseling in primary care. *Obes. Res. Clin. Pract.* 8, e123–e130.
- Galuska, D.A., Will, J.C., Serdula, M.K., Ford, E.S., 1999. Are health care professionals advising obese patients to lose weight? *Jama* 282, 1576–1578.
- Halbert, C.H., Jefferson, M., Melvin, C.L., Rice, L., Chukwuka, K.M., 2017. Provider advice about weight loss in a primary care sample of obese and overweight patients. *J. Prim. Care Community Health* 8, 239–246.
- Hemmingsen, B., Gimenez-Perez, G., Mauricio, D., Roque, I.F.M., Metzendorf, M.I., Richter, B., 2017. Diet, physical activity or both for prevention or delay of type 2 diabetes mellitus and its associated complications in people at increased risk of developing type 2 diabetes mellitus. *The Cochrane database of systematic reviews* 12, Cd003054.
- Kraschnewski, J.L., Sciamanna, C.N., Stuckey, H.L., et al., 2013. A silent response to the obesity epidemic: decline in US physician weight counseling. *Med. Care* 51, 186–192.
- Miller, B.M., Brennan, L., 2015. Measuring and reporting attrition from obesity treatment programs: a call to action!. *Obes. Res. Clin. Pract.* 9, 187–202.
- Moyer, V.A., 2012. Screening for and management of obesity in adults: U.S. preventive services task force recommendation statement. *Ann. Intern. Med.* 157, 373–378.
- National Diabetes Statistics Report, 2017. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2017. (Accessed Feb 16, 2019, at <https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf>).
- Nemeth, L.S., Rice, L.J., Potts, M., Melvin, C., Jefferson, M., Hughes-Halbert, C., 2017. Priorities and preferences for weight management and cardiovascular risk reduction in primary care. *Fam Community Health* 40, 245–252.
- Nguyen, N.T., Nguyen, X.M., Lane, J., Wang, P., 2011. Relationship between obesity and diabetes in a US adult population: findings from the National Health and Nutrition Examination Survey, 1999–2006. *Obes. Surg.* 21, 351–355.
- Okunrintemi, V., Spatz, E.S., Di Capua, P., et al., 2017. Patient-provider communication and health outcomes among individuals with atherosclerotic cardiovascular disease in the United States: Medical Expenditure Panel Survey 2010 to 2013. *Circulation Cardiovascular quality and outcomes* 10.
- Peimani, M., Nasli-Esfahani, E., Sadeghi, R., 2018. Patients' perceptions of patient-provider communication and diabetes care: A systematic review of quantitative and qualitative studies. 1742395318782378. *Chronic Illn.* https://journals.sagepub.com/doi/full/10.1177/1742395318782378?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed.
- Powell-Wiley, T.M., Ayers, C.R., Banks-Richard, K., et al., 2012. Disparities in counseling for lifestyle modification among obese adults: insights from the Dallas Heart Study. *Obesity (Silver Spring, Md)* 20, 849–855.
- Sung, H., Siegel, R.L., Rosenberg, P.S., Jemal, A., 2019. Emerging cancer trends among young adults in the USA: analysis of a population-based cancer registry. *Lancet Public Health* 4 (3), e137–e147.
- Tsai, A.G., Remmert, J.E., Butryn, M.L., Wadden, T.A., 2018. Treatment of obesity in primary care. *The Medical clinics of North America* 102, 35–47.
- Warren, B., Pankow, J.S., Matsushita, K., et al., 2017. Comparative prognostic performance of definitions of prediabetes: a prospective cohort analysis of the Atherosclerosis Risk in Communities (ARIC) study. *The lancet Diabetes & endocrinology* 5, 34–42.
- White, R.O., Eden, S., Wallston, K.A., et al., 2015. Health communication, self-care, and treatment satisfaction among low-income diabetes patients in a public health setting. *Patient Educ. Couns.* 98, 144–149.
- Yang, K., Lee, Y.S., Chasens, E.R., 2011. Outcomes of health care providers' recommendations for healthy lifestyle among U.S. adults with prediabetes. *Metab. Syndr. Relat. Disord.* 9, 231–237.