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Identifying sustainable lifestyle strategies for maintaining good glycemic control: a validation of qualitative findings

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ABSTRACT

Introduction Diabetes self-care practices are less effective outside of controlled research settings, and almost half of patients do not achieve good glycemic control. Qualitative studies suggest some lifestyle strategies may be linked to good control, but those strategies have not been validated. This study provides population-based evidence that dietary strategies identified in qualitative studies are associated with glycemic control in US patients with diabetes.

Research design and methods In a cross-sectional sample of the National Health and Nutrition Examination Survey (NHANES), qualitative self-management themes were matched to survey questions and used to predict good glycemic control (hemoglobin A1c <7.0% (53 mmol/mol)). Patients were limited to those 50 years of age and older with a diagnosis of diabetes for at least 1 year (N=465).

Results Patients averaged 65 years of age with a body mass index of 32.56 kg/m^2 and 42% reported no physical activity. In logistic regression models controlling for sociodemographic and medical history variables, self-monitoring of blood glucose, weight loss, and physical activity were not significantly associated with glycemic control. Instead, dietary practices such as consuming low-calorie foods (OR=4.05, 95% CI 1.64 to 10.01), eating less fat (OR=2.15, 95% CI 1.03 to 4.47), and reducing sodium (OR=1.94, 95% CI 1.18 to 3.17) were significantly associated with good glycemic control, as was diabetes education or consultation with a dietitian (OR=3.48, 95% CI 1.28 to 9.45). Non-adherence to medications (OR=0.27, 95% CI 0.11 to 0.68) and general dietary descriptions, such as following a 'diabetic diet' (OR=0.32, 95% CI 0.17 to 0.57) and 'changing eating habits for weight loss' (OR=0.34, 95% CI 0.15 to 0.77), were associated with poorer glycemic control.

Conclusions The NHANES validation of lifestyle management strategies suggests practices that may be sustainable. In a population that tends to be obese with low physical activity, successful self-care might emphasize specific dietary practices offering concrete touchpoints for patient communication and guidance. These strategies might help maintain glycemic control.

Significance of this study

What is already known about this subject?

- Fewer than half of patients with diabetes are in good glycemic control, and lifestyle recommendations for management of glycemia (self-monitoring of blood glucose, exercise, and weight loss) are not very effective in unsupervised settings.

What are the new findings?

- Dietary strategies suggested by qualitative studies are significantly associated with glycemic control in a US national sample of patients with diabetes.
- Patient-reported dietary practices are associated with glycemia.
- Simple practices such as monitoring/limiting sodium intake or following a low-calorie or low-fat diet may help with glycemic maintenance, even with low activity levels.
- Patients may misunderstand what a 'diabetic diet' is and those who reported following a diabetic diet were more likely to be in poorer control.

How might these results change the focus of research or clinical practice?

- National health surveys may offer a means to validate ideas generated in qualitative studies.
- Furthermore, naturally occurring dietary practices linked to better glycemic control may offer patients practical and sustainable options for improved self-care.

INTRODUCTION

Although there are diabetic lifestyle and self-management practices shown to be efficacious for improving glycemic control in clinical trials, these lifestyle changes may be difficult for patients to integrate and maintain in everyday life. Diabetes education can improve self-care, but beneficial effects may wane after a few months, and almost half of US patients with diabetes are not in good glycemic control.[1] Identification of successful practices from everyday life may suggest sustainable lifestyle changes. The problem is how to identify strategies and possible adaptations of standard recommendations that

are effective in achieving medical management targets for reducing risk of diabetes complications, but that are acceptable and will be used by patients. Qualitative studies have identified lifestyle behaviors and dietary patterns linked to better glycemic control—behaviors distinctive of those in better glycemic control that may be sustainable due to their occurrence in descriptions of everyday home management of diabetes.[2 3] This study validates those results by testing whether the practices are associated with glycemic control in a nationally representative sample of patients with diabetes. Practices identified in a national survey about lifestyle and dietary practices may help to identify sustainable practices.

Successful management of hyperglycemia, hypertension, and dyslipidemia can prevent or delay microvascular and macrovascular complications.[4] Each percentage point reduction in hemoglobin A1c (HbA1c) (eg, from 9.0 to 8.0 (75–64 mmol/mol)) can result in 35% fewer microvascular complications and 25% fewer diabetes-related deaths.[5] Evidence indicates that weight loss, increased physical activity, and self-monitoring of blood glucose (SMBG) can reduce hyperglycemia.[6–10] However, a one-size-fits-all approach to lifestyle and management may not be necessary or beneficial to patients.[11] Newly diagnosed patients who achieve tighter glycemic control may reduce or delay cardiovascular, renal, visual, and neurological complications and even mortality,[12] while older patients with long-standing disease may not benefit from tight glycemic control.[13–16] Although SMBG, weight loss, and physical activity are efficacious in clinical trials in reducing hyperglycemia (HbA1c), their effectiveness diminishes over time and in less-controlled settings. Prevention or delay of diabetic complications requires patient and provider communication and cooperation, with patient adherence to lifestyle changes. Unfortunately, clinical support for these changes may be limited to encouragement. The result is that lifestyle changes may not be sustained in the daily lives of patients, resulting in poorer glycemic control.[1 17]

Two recent qualitative studies (one in the USA[2] and one in Mexico[3]) explored the lifestyle practices of patients with type 2 diabetes to identify successful strategies used by patients in good control. In contrast to most qualitative studies that have not systematically compared those in good control with those in poor control,[18–21] these two studies used a case–control design comparing patients with good and poor control matched across groups for duration of diabetes and treatment modality (oral or insulin treatment). This matched-pairs design controlled for factors not under patient control but that are associated with glycemia, in order to identify successful strategies and lifestyle practices. In both studies, clinic patients were interviewed and most had limited physical activity (many had physical disabilities) and instead used a variety of dietary strategies to manage their diabetes. For example, practices such as 'avoid eating sweets' were reported by both good and poor glycemic control patients, while 'drinking non-caloric beverages to avoid eating more food' was distinctive of patients in good control. In the US study, patients in good control tested their glucose more frequently, monitored dietary sodium, increased their intake of fruits and vegetables, limited portion sizes, and used memory aids to remember to take medications. Similar dietary strategies were identified in both the US and Mexico studies and suggest that these strategies may be useful more broadly in maintaining glycemic control.

The qualitative studies raised a very interesting issue: namely, how are patients in good control actually manage their diabetes and can these practices be validated and possibly disseminated to others? This study is the first step in that process, namely a validation of the strategies from the qualitative studies that were linked to better glycemic control. The qualitative results suggested lifestyle strategies that might be acceptable to patients and might be effective for maintaining good glycemic control. A strength of qualitative studies is their ability to generate and explore new ideas, but it is difficult to evaluate and generalize results from such studies due to the small, non-representative samples. In this study, themes and practices identified in the qualitative studies were matched to questions in the US National Health and Nutrition Examination Survey (NHANES) and responses were compared with glycemic control. The NHANES contains data on diabetes and dietary practices based on a nationally representative sample to monitor US health status and is also used to estimate the prevalence and general health of patients with diabetes.[1 17] Thus, this study validates the lifestyle practices identified in qualitative studies by testing whether those practices are associated with good control in a large, nationally representative sample. Future intervention studies might then test for the sustainability of those practices.

RESEARCH DESIGN AND METHODS

Data set

The NHANES is a nationally representative US sample with detailed health information (by self-report, physical examination, and laboratory measures). For this analysis, sample inclusion criteria matched the qualitative study: anyone with a prior diagnosis of diabetes mellitus for at least 1 year, 50 years of age and older, and with a valid HbA1c value. To restrict the sample to patients with type 2 diabetes, the sample was further restricted to those reporting an oral antidiabetic medication (with or without insulin) or no antidiabetic medications since their diagnosis. Anyone exclusively on insulin since their diagnosis was excluded. The 2011–2012 data set was selected to more closely match the date of the US qualitative study data collection.

Variables

To validate qualitative findings, the same main outcome variable was used, namely good glycemic control considered as HbA1c <7.0% (53 mmol/mol). A dozen

Table 1 Qualitative themes and corresponding NHANES variables

Qualitative themes	NHANES questions/variables
Glucose monitoring	How often do you check your blood for glucose or sugar?
Salt reduction	To lower your risk for certain diseases, are you reducing the amount of sodium or salt in your diet? What kind of diet are you on? Is it a low-sodium diet?
Changed diet for diabetes	What kind of diet are you on? Is it a diabetic diet? Changed eating habits to lose weight/to not gain weight.
Reduced or skipped medication (and memory aids, pillbox)	Told to take medicine for high blood pressure, but not taking it. Told to take medicine to lower cholesterol, but not taking it.
Sugar reduction	What kind of diet are you on? Is it sugar-free or low-sugar diet? Ate less sugar, candy, sweets to lose weight/not gain weight.
Starch/carbohydrate reduction	What kind of diet are you on? (Is it a low-carbohydrate diet?) Reducing carbohydrates to lose weight/not gain weight.
Portion control/calorie count	What kind of diet are you on? Is it a weight loss or low-calorie diet? Switched to lower calorie foods to lose weight/not gain weight. Ate less food to lose weight/not gain weight.
Diabetes education, at diagnosis	When was the last time you saw a diabetes nurse educator or dietitian or nutritionist for your diabetes? In the past 12 months, did you seek help from a dietitian to lose weight/not gain weight? In the past 12 months, did you seek help from a nutritionist to lose weight/not gain weight?
Eating only two meals	Skipped meals to lose weight/to not gain weight.
Increased intake of fruits and vegetables	Eating more fruits and vegetables to lose weight/not gain weight.
Fat reduction	What kind of diet are you on? Is it a low-fat or low-cholesterol diet? Eating less fat to lose weight/not gain weight.

NHANES, National Health and Nutrition Examination Survey.

independent variables were selected by attempting to match themes in the US qualitative study[2] with NHANES variables (table 1). Some variables matched well (eg, frequency of glucose monitoring), some were close (eg, 'Are you reducing the amount of sodium or salt in your diet?'), and some variables could not be matched. The theme 'changed my diet for diabetes' was operationalized into two variables (reporting a 'diabetic diet' and changing eating habits to lose weight), as was 'portion/calorie control' (low-calorie diet and ate less food). The NHANES did not have any questions to approximate 'cheating behaviors', such as 'every now and then I eat (ice cream, a candy bar)', or whether diet drinks (including tea and coffee) were used to avoid eating more food. Information on adherence to antidiabetic medications was also not available, so a proxy variable was created from two variables that asked if they were told to take a medication (for blood pressure or cholesterol) and did not take it. There were also no questions on the use of memory aids, such as pillboxes, to improve medication adherence. Themes in the set of questions about trying to lose weight or trying not to gain weight were coded as positive if someone said yes to either question.

Because physical activity, weight loss, and SMBG were often recommended for patients with diabetes, these variables were included in the analysis. Physical activity was coded into categories reflecting levels of recommended activity,[22] intensity (metabolic equivalent of task), and duration (minutes) of weekly activity into three categories: no physical activity (no moderate or vigorous activity), some activity or active, and highly active (moderate or vigorous activity in the highly active, recommended range). Weight change in the past year was estimated from current weight minus self-reported weight from the previous year. SMBG was categorized as less than once per day and once or more per day. Covariates included age, gender, ethnicity, education, disability (need assistance when walking), duration of disease, diabetes medications (none, oral only, insulin with or without oral antidiabetic medications), and body mass index (BMI).

Analysis

Bivariate tests compared variables with glycemic status using χ^2 and t-tests. Then, a series of logistic regression models weighted to represent the US population evaluated the association between self-management and dietary practices with HbA1c.[23 24] Sampling weights (from the mobile examination center (MEC)) were adjusted for subsample selection and non-response.[25] Models controlled for sociodemographic factors, disease duration, and medication modality as these variables are

Table 2 Participant characteristics by HbA1c status

Variables	HbA1c (unweighted n) <7.0% (n=264)	≥7.0% (n=201)	Overall (N=465)	P value
Age (years), mean	65.64	64.09	64.91	0.07
Female (%)	46.28	47.80	46.94	0.75
Race/ethnicity (%)				0.02
Non-Hispanic white	67.70	54.83	62.13	
Non-Hispanic black	14.52	16.80	15.51	
Hispanic	10.75	14.63	12.43	
Non-Hispanic Asian	3.98	4.89	4.37	
Other race/multiracial	3.05	8.85	5.56	
Education				
High school graduate/equivalent or higher (%)	68.19	76.20	71.65	0.06
Body mass index (kg/m^2), mean	31.34	34.16	32.56	<0.0001
Diabetes duration (%)				0.005
<10 years	52.68	40.01	47.20	
10–20 years	25.48	39.10	31.38	
≥20 years	21.84	20.89	21.43	
Diabetes medications (%)				<0.0001
None	20.83	5.76	14.31	
Oral medication only	64.46	52.12	59.11	
Insulin use (may also include oral)	14.71	42.12	26.58	
Need special equipment to walk (%)	19.90	26.85	22.90	0.08

HbA1c, hemoglobin A1c.

largely not under patient control, but can be associated with HbA1c. The first model tested the effect of physical activity, weight loss, and SMBG. The second model tested the additional effect of dietary and self-management qualitative themes. The third model used backwards elimination (p<0.10) to simplify the second model (ie, avoid overspecification), while forcing the inclusion of control variables.

RESULTS

Of the 9756 observations in 2011–2012, 493 had diabetes for at least 1 year, were 50 years and older, and had a valid HbA1c. To focus on type 2 diabetes, anyone on an oral diabetes medication or no medication was retained, and those who had been exclusively on insulin since their diagnosis were omitted (n=28). In the final sample (N=465), most tended to be overweight or obese (mean BMI 32.56 kg/m^2). Those in good control (HbA1c <7.0% (53 mmol/mol)) tended to be non-Hispanic whites (p<0.02), had a lower BMI (p<0.0001), had a shorter duration of disease (p<0.005), and were not taking antidiabetic medications (p<0.0001; table 2). There was no significant difference between genders, but whites were more likely to be in good control and blacks and Hispanics were less likely to be in good control.

Bivariate comparisons between glycemic control and lifestyle management strategies indicated that those in good control tended to be more physically active, lost weight in the past year, and tested their glucose less often than those in poor control, but the associations were not statistically significant (table 3). In fact, 42% of the sample reported no physical activity and 46% tested their glucose at least once a day. Comparisons between glycemic control and dietary themes suggested that patients with good control reported reducing their dietary sodium (p<0.02) or using weight management strategies such as consuming low-calorie foods (p<0.03), while those not in good glycemic control were more likely to report following a 'diabetic diet' (p<0.0003; table 3). Those in good control were not significantly different from those who were not in their unadjusted total daily intake of sodium (3340 mg vs 3525 mg, respectively; p=0.18), carbohydrates (227.6 g vs 219.6 g; p=0.35), or calories (1902 kcal vs 1917 kcal; p=0.83).

When adjusting for sociodemographic (age, sex, race/ethnicity, education) and medical history (duration of diabetes, medications, BMI) variables in logistic regression models, those in good glycemic control did not have significantly greater odds of testing their glucose daily, being more physically active, or having lost weight

Table 3 Management activities by HbA1c status

NHANES variables	<7.0 (n=264) (%)	≥7.0 (n=201) (%)	Total (N=465) (%)	P value
Physical activity				0.23
None	39.53	45.38	42.06	
Some or recommended level	27.23	28.56	27.81	
Exceeds recommended level	33.24	26.06	30.13	
Weight loss in the past year	45.32	41.85	43.82	0.46
Self-monitoring of blood glucose, >1 × a day	42.32	50.17	45.73	0.09
Low-salt/low-sodium diet *or* reducing salt/sodium	74.42	64.74	70.21	0.02
Diabetic diet	14.69	28.44	20.64	0.0003
Changed eating habits for weight	13.18	15.78	14.30	0.43
Non-adherent: told to take medicine and is not now taking	5.69	9.90	7.51	0.09
Diabetes education (<5 years) or dietitian/nutritionist	52.44	60.16	55.78	0.10
Low-sugar diet *or* ate less candy for weight	16.19	20.02	17.85	0.28
Low-carbohydrate diet *or* reducing carbohydrate for weight	17.32	15.47	16.52	0.59
Low-calorie diet *or* lower calorie for weight	21.59	13.93	18.28	0.03
Eating more fruits, vegetables, salads for weight	21.09	18.25	19.86	0.45
Low-fat diet *or* less fat for weight	20.18	14.76	17.83	0.13
Ate less food for weight	41.41	41.10	41.27	0.95
Skipped meals for weight	8.18	9.41	8.71	0.64

HbA1c, hemoglobin A1c; NHANES, National Health and Nutrition Examination Survey.

in the past year (model 1, table 4). Instead, those in good glycemic control had significantly greater odds of reporting specific dietary strategies (model 2, table 4). The odds of being in good control were four times greater for those who reported consuming low-calorie foods for weight management than for those who did not

Table 4 Association between self-management activities and glycemic control

Variables	Model 1*	Model 2*	Model 3*
Recommended strategies			
Physical activity	1.160 (0.890–1.512)	1.184 (0.865–1.621)	
Self-monitoring of blood glucose (≥1 × day)	1.245 (0.777–1.994)	1.221 (0.705–2.113)	
Lost weight in the past year	1.099 (0.709–1.704)	0.954 (0.570–1.596)	
Dietary/weight loss strategies			
Non-adherent with medicines		0.280 (0.109–0.717)	0.272 (0.109–0.677)
Salt/sodium reduction		2.098 (1.192–3.695)	1.937 (1.183–3.172)
Diabetic diet		0.315 (0.169–0.589)	0.315 (0.174–0.569)
Diabetes education (<5 years) or dietitian		3.440 (1.164–10.161)	3.480 (1.281–9.453)
Ate less food		1.330 (0.735–2.409)	
Low-calorie diet		4.564 (1.658–12.562)	4.048 (1.637–10.009)
Low-fat diet		1.910 (0.875–4.169)	2.149 (1.032–4.474)
Skipped meals		1.138 (0.459–2.824)	
Low-carbohydrate diet		1.281 (0.603–2.722)	
More fruits/vegetables		1.828 (0.839–3.986)	2.001 (0.986–4.058)
Changed eating habits		0.377 (0.159–0.893)	0.340 (0.150–0.772)
Low-sugar diet		0.827 (0.380–1.797)	

*Controlling for age, sex, race/ethnicity, education (more than high school), duration of disease (<10, 10–20, >20 years), body mass index, antidiabetic medications (none, oral only, any insulin), and needs equipment to walk.

report low-calorie foods (OR=4.56, 95% CI 1.66 to 12.56) and were two times greater for those who were currently reducing sodium in their diet (OR=2.10, 95% CI 1.19 to 3.70). Those who ate more fruits and vegetables, fewer carbohydrate, or smaller portions (ate less) were more likely to be in good control, but the effects were not significant. Those who reported non-adherence to blood pressure and cholesterol medications were significantly less likely than those who were adherent to be in good control (OR=0.28, 95% CI 0.11 to 0.72). Those who reported general dietary strategies had significantly lower odds of being in good control: those who reported eating a diabetic diet were less likely to be in good control (OR=0.32, 95% CI 0.17 to 0.59), as were those who reported 'changing their eating habits' (OR=0.38, 95% CI 0.16 to 0.89). Strategies such as eating less candy/sweets and skipping meals were not significantly associated with glycemic control. Although few people sought advice from a dietitian/nutritionist, the odds of being in good control were three times greater for those who did or who had recently completed a diabetes education class (OR=3.44, 95% CI 1.16 to 10.16). Backwards elimination, retaining demographic and medical history variables, was used to simplify the second model and obtain a final model (model 3, table 4). The results were essentially unchanged except for the addition of one variable: those reporting a low-fat dietary weight maintenance strategy were more likely to be in good control than those not reporting a low-fat diet (OR=2.15, 95% CI 1.03 to 4.47).

DISCUSSION

The NHANES is a nationally representative sample that monitors US health status and is also used to estimate the US population prevalence of diabetes and the general health of patients with diabetes. Information in the NHANES indicates that almost half of patients with diabetes are in good glycemic control, half meet blood pressure targets, and half meet low-density lipoprotein cholesterol targets, but only one out of five (19%) meet all three targets.[1] The NHANES questions on physical activity, fruit/vegetable intake,[26] carbohydrate intake, and diet type[27] indicate that most patients with type 2 diabetes do not meet lifestyle recommendations, as about two-thirds report low activity levels, eat fewer than five servings of fruits/vegetables per day, and consume more than 30% of their calories from fat.[9 28–31]

The mixed methods approach used in this study—using a nationally representative sample to validate qualitative results—appears promising for identifying patient-centered management techniques and as a methodological approach. Here, most of the themes identified in the previous qualitative study[2] were validated in the NHANES sample. The qualitative study used an analytical technique (qualitative comparative analysis)[32 33] to compare the responses of patients with diabetes between glycemic control groups. A qualitative comparative analysis examines all possible combinations of themes to determine sets and subsets linked by their occurrence and non-occurrence with the outcome variable to create a causal pathway based on logic (and not probability and statistics). Their results indicated that sodium monitoring, SMBG, and no dietary cheating were distinctive of those in better glycemic control. Specifically, those in fair control (HbA1c between 7.0% and 8.0% (53–64 mmol/mol)) were distinguished from those in poor control (HbA1c >8.0% (64 mmol/mol)) by sodium monitoring and not skipping medications, and from fair (7.0%–8.0% (53–64 mmol/mol)) to good (<7.0% (53 mmol/mol)) control by SMBG, no cheating, and no dietary changes for diabetes. Although the present study operationalized glycemic control into two categories, monitoring sodium, not skipping medications, and not making dietary changes were also associated with good control in a nationally representative sample of patients with diabetes. 'Cheating' could not be assessed in the NHANES questions and SMBG was not associated with glycemia.

Monitoring sodium intake was an enigmatic result in the qualitative study, but the theme encompassed reading food labels for sodium content and thus may have been an indicator of trying to monitor nutritional intake. In the NHANES data, self-reported sodium reduction was also significantly associated with good glycemic control, although estimated sodium intake was not. Estimated sodium intake was high but consistent with other estimates,[34] without differences between glycemic groups.[35] Previous versions of the NHANES had several variables concerning dietary sodium, including whether respondents checked for sodium on food labels. People who reported reading food labels for nutritional content had slightly lower sodium, fat, and caloric intake[36] and the practice may help patients with diabetes.

Skipping medications was associated with poorer control, both in the qualitative study and in this study. The qualitative study suggested that non-adherence to diabetic medications was due to forgetting or misunderstanding how to take medications. Unfortunately, the NHANES had no direct questions about actually taking diabetes medications, so in this study we used a proxy variable created from questions about whether respondents were non-adherent to blood pressure and cholesterol medications. The assumption was that people who were non-adherent to blood pressure and cholesterol medications might also be non-adherent to diabetes medications. Those who were non-adherent to other medications were significantly more likely to be in poorer glycemic control. Results from the qualitative study suggested that memory devices (eg, pillboxes or turning bottles upside down after taking a medication) helped patients to remember to take medications, although trials providing inexpensive passive devices (pill strips, pillboxes and so on)[37] did not increase adherence and those with more expensive active reminders (phone calls, texts, electronic devices)[38] did.

SMBG was linked to better control in the qualitative study, but was not in the NHANES data. Randomized controlled trials suggest that SMBG is effective in reducing HbA1c for those on insulin and can be minimally effective for those on non-insulin therapies for up to 6 months post-training.[6] The cross-sectional design of the NHANES may fail to detect an association due to patients in poor control being encouraged to test or due to the association between modality of treatment and glycemic control; those on insulin tend to be in poorer control and are more likely to test.[39] Because SMBG may have limited value for those on non-insulin therapies (approximately 85% of patients with type 2 diabetes 50 years of age and older), the American Diabetes Association[40] currently recommends that SMBG be used in conjunction with diet, exercise, and/or medication modifications and that patients learn how to use SMBG results to adjust self-care activities.

Clinical trials have indicated that increased physical activity[7 8] and weight loss[9 10] are efficacious for lowering HbA1c and have been recommended for lifestyle management of diabetes. Physical activity and weight loss also offer cardiovascular benefits. However, physical activity and weight loss were not associated with glycemic control in this analysis. Although the lack of an association may be an artifact of the cross-sectional sampling design, more likely it is due to the limited amount of physical activity in the population of patients with type 2 diabetes: most were overweight or obese, many reported no physical activity, and some needed special equipment to walk. Groups also did not differ in terms of the per cent that reported losing weight in the past year.

Interventional trials indicate that weight management strategies (especially restricted energy intake) can affect glycemic control[9] and significant weight loss can cause remission of diabetes.[29] Clinical trials comparing dietary macronutrient content, whether low fat or low carbohydrate, often have shown similar results for weight loss and metabolic control.[30 31] In this NHANES sample, glycemic control groups did not differ in the per cent limiting their carbohydrate intake, although it is possible that a more recent survey might obtain a different result.

Instead, people reporting specific dietary and weight management strategies such as choosing low-calorie or low-fat foods were more likely to be in good control. These practices may slow weight gain and slow the worsening of HbA1c over time. In contrast, those who indicated non-specific strategies, specifically those who reported that they changed their diet for weight management or followed a 'diabetic diet', were more likely to be in poor control. A limitation of using secondary data sources is that some questions may be relevant but vague. The meaning of a 'diabetic diet' is unclear, but those who reported this tended to be in poorer control. It is possible that they did not understand what such a diet was or that those who reported following such a diet were trying to improve control. While the latter is a possibility, the former seems more likely as those reporting simply that they followed a low-calorie or a low-fat diet were in better control. Unfortunately, there was no way to test some of the qualitative themes because the NHANES had no direct equivalence for 'cheating behaviors', with the exception of skipping meals, nor was there a way to test for the effectiveness of drinking low-calorie beverages (especially tea or coffee) to reduce food intake.

The study was limited by the cross-sectional design in both the qualitative and NHANES studies. Also, good glycemic control was operationally defined as HbA1c <7.0% (53 mmol/mol) in order to more closely follow the qualitative study protocol. Considering HbA1c as a continuous measure might have offered more power to detect statistical significance in some factors with borderline effects, such as eating more fruits and vegetables. However, the dichotomization offered a reasonable replication and test for similar factors associated with glycemic control. A further issue was that survey questions themselves sometimes contained ambiguities.

A strength of the present study was the integration of qualitative results with survey methods. The mixed methods approach allowed for the identification of patient-relevant lifestyle practices associated with better glycemic control and their validation in a population-based sample. Furthermore, the representative sample of the US population in the NHANES allows for the estimation of naturally occurring dietary and lifestyle practices and thus may help to identify practices that may be sustainable.

CONCLUSIONS

Evidence-based management of diabetes now departs from 'one-size fits all' guidelines, especially for glycemic targets. Guidelines, however, are still based on patient characteristics (age, duration of disease, and the presence of comorbidities)[41] without clear guidance on how to incorporate or accommodate patient preferences.[11 42] Patient-centered discussions typically depend on good communication between the patient and the doctor, with patient involvement in discussions concerning shared decision-making about management and outcomes. Unfortunately, the clinical reality is that little time is available for these discussions. Even in the transition to patient-centered medical homes, where clinic reorganization focuses on better access to care and a team of healthcare providers familiar with a patient's medical history, time with the doctor and healthcare educators remains limited. This study identified some successful lifestyle practices that might be useful and sustainable in everyday life. Some of these factors already have been shown to be efficacious in clinical trials (diabetes education, adhering to medications, low-fat or low-calorie diet), while others (monitoring sodium) are less clear. These practices may help to maintain good glycemic control and could be emphasized in diabetes education and clinical support discussions. Themes validated in this study may offer concrete discussion points about self-care. Future studies

might also explore the sustainability of these practices as well as other strategies, such as drinking low-calorie beverages to reduce food intake.

Diabetes education remains a cornerstone for improved self-care for diabetes. Maintenance of good glycemic control, especially early in the disease progression, is important to diabetes management as it can delay or prevent diabetes complications. Lifestyle and self-care practices focused on physical activity, weight loss, and SMBG may not be sufficient to help patients achieve good control. Often patients with diabetes have limited mobility due to injuries or conditions secondary to obesity, and large, unsupervised weight loss appears unattainable for most patients. This study identified some dietary practices that may be effective in achieving good control even in the absence of exercise. Overall, the results suggest that healthy eating patterns for weight management (low-fat or low-calorie diet, monitoring sodium) should be encouraged and appear to be sustainable. Clinical trial evidence supports the use of most of these strategies for diabetes self-care, but the simple combination of a few key strategies may translate directly to better maintenance of glycemic control over time.

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