

Effects of Health Education on Glycemic Control During Holiday Time in Patients With Type 2 Diabetes Mellitus

Harn-Shen Chen, MD, PhD; Tzu-En Wu, MD; Tjin-Shing Jap, MD; Ru-Lin Chen, BSc; and Hong-Da Lin, MD

Poor glycemic control in type 2 diabetes mellitus (DM) is a major risk factor for the development of diabetic complications, and good control of blood glucose levels leads to fewer complications.¹ Although many patients with type 2 DM lose their glycemic control gradually during several years, this may also be related to periods of increased energy intake, decreased energy expenditure, or both such as during holiday periods or particular seasons.^{2,3} Previous data demonstrated a winter holiday effect on the glycemic control of patients who had type 2 DM, and this poor glycemic control might not be reversed during the summer and autumn months.⁴ Therefore, exposure to higher blood glucose levels during winter holidays every year is likely to increase the risk of diabetic complications.

The balance between dietary intake and energy consumption through daily physical activities is the most important factor in the glycemic control of patients with type 2 DM.⁵ Diabetes education is recognized as an essential element of good diabetes care and is important in managing DM to prevent, or at least to slow, the development of diabetes complications.⁶ Several research studies⁷⁻⁹ documented the association of effective diabetes education with favorable outcomes in glycemic control. Diabetes care teams incorporating nurses, dietitians, health educators, and other nonphysician specialists have a key role in diabetes care and education.¹⁰ Patients who received periodic primary care sessions organized to meet the complex needs of patients with DM demonstrated improved diabetes care and had better outcomes. We hypothesized that patients who received holiday-specific diabetes education would have better glycemic control during the winter holidays. This study investigated the effects of diabetes health education before the Chinese New Year holiday period and subsequent decreased hyperglycemia during the winter holidays among patients with type 2 DM.

METHODS

Subjects

The study was conducted from October 2004 to December 2005 in Taipei Veterans General Hospital. One hundred two subjects with type 2 DM were recruited for the study after signing informed consent forms.

Eligible participants were aged 50 to 70 years, had type 2 DM, and were treated with oral antidiabetic drugs. Their progress was followed up in our hospital for at least 6 months and for as long

Objective: To investigate whether the effects of regular diabetes health education or a holiday-specific pamphlet before the Chinese New Year holiday period could improve glycemic control during the winter holidays among patients with type 2 diabetes mellitus.

Study Design: Randomized controlled trial.

Methods: The study was conducted from October 2004 to December 2005 in Taipei Veterans General Hospital. Subjects were randomized to program 1 (receipt of regular diabetes education between October 20 and November 25, 2004, and then every 3-4 months) or to program 2 (receipt of a special reminder pamphlet during the holidays). The patients were seen and blood samples obtained on 4 occasions during the holidays and then every 4 months through December 2005.

Results: Ninety-three subjects completed the first 4 visits during the Chinese New Year holidays, and 89 subjects completed 12 months of the study. Fructosamine levels in program 1 increased more during the preholiday period than those in program 2 (mean [standard deviation] 7.4 [5.2] vs -5.3 [8.3] $\mu\text{mol/L}$, $P = .03$) during the preholiday period. Changes in fructosamine levels during the holiday and postholiday periods were similar in the 2 groups. At the end of the holidays, changes in glycosylated hemoglobin (A1C) levels were 0.34% (95% confidence interval, 0.03%-0.85%) in program 1 and 0.09% (95% confidence interval, -0.23% to 0.42%) in program 2. After the Chinese New Year holidays, the groups had similar changes in A1C levels, with a slight downward decline thereafter.

Conclusion: A special educational reminder pamphlet for the holidays led to improvements in glycemic control during the Chinese New Year holidays.

(*Am J Manag Care.* 2008;14:45-51)

In this issue

Take-away Points / p49

www.ajmc.com

Full text and PDF

For author information and disclosures, see end of text.

as they were willing to attend all study visits. Subjects were excluded if they had proliferative retinopathy or diabetic nephropathy with chronic kidney disease above stage 4, were taking insulin for glycemic control, or were pregnant.

Study Design

The Chinese New Year holiday period in this study was from February 6 to February 12, 2005, a total of 7 days, during which time most people did not work. The subjects were randomized between October 20 and November 25, 2004, to program 1 or to program 2. Program 1 was a structured managed care system supported by our National Bureau of Health Promotion Department of Health. Regular diabetes health education comprised individual counseling, which was performed quarterly. Dietitians provided nutrition recommendations, and diabetes educators provided information about DM and screened for diabetes complications. The processes of care include regular assessment of glycosylated hemoglobin (A1C) levels, blood pressure and lipid tests, regular diabetes health education, and eye, renal, and foot screening. Subjects in program 2 were given an 8-page holiday reminder pamphlet about diet, exercise, and travel. They also received regular assessment of A1C levels, blood pressure and lipid tests, and eye, renal, and foot screening, but without the offer of regular diabetes health education. All participants were required to complete the recommended screening examinations before randomization. Subjects in both groups were seen and blood samples obtained on 4 occasions at intervals of 4 to 6 weeks. Visit 1 was between November 26 and December 31, 2004; visit 2 was between January 1 and February 5 before Chinese New Year's Day (February 9, 2005); visit 3 was between February 13 and March 20, 2005; and visit 4 was between March 21 and April 24, 2005. Visits 1 and 2 were before the holiday, and visits 3 and 4 were after the holiday. The preholiday period was from visit 1 to visit 2; the holiday period was from visit 2 to visit 3; and the postholiday period from visit 3 to visit 4. Glycemic change was determined for the following 3 periods: preholiday period (November 26 to December 31, 2004, until January 1 to February 5, 2005), holiday period (January 27 to February 5 until February 13 to March 20, 2005), and postholiday period (February 13 to March 20 until March 21 to April 24, 2005). At every clinic visit, fasting whole blood samples were obtained for plasma glucose and fructosamine assays. The A1C level was measured at visit 1, at visit 4, and then every 4 months through December 2005. At visits 1 and 4, the urine albumin-to-creatinine ratio and the serum lipid, creatinine, and alanine aminotransferase levels were checked. We measured the subjects' body weight, blood pressure, and pulse rate at every visit, as well as their body height at the first visit.

Biochemical Assessments

Plasma glucose levels were measured using the glucose oxidase method via a glucose analyzer (model 2300; Yellow Springs Instruments, Yellow Springs, Ohio). The A1C level was measured using high-performance liquid chromatography instruments (HLC-723 GHB III; Tosoh Corporation, Tokyo, Japan) with a reference range of 4.5% to 6.2%. The interassay coefficient of variance was less than 2.0% at mean A1C levels between 4.4% and 8.2%. The serum fructosamine level was measured using the colorimetric enzyme-based method (Hoffmann-La Roche, Basel, Switzerland) in an automated analyzer with a reference range of 205 to 285 $\mu\text{mol/L}$. The interassay coefficients of variance were 4.5% at 206 $\mu\text{mol/L}$, 5.7% at 483 $\mu\text{mol/L}$, and 2.9% at 578 $\mu\text{mol/L}$.

The subjects were weighed wearing clothes without shoes in the morning after breakfast to the nearest 0.1 kg using an electronic scale, and height was measured to the nearest 1 cm using a stadiometer. Blood pressure and pulse rate were obtained using an electronic sphygmomanometer in a sitting position after 10 minutes of rest.

Outcomes

The primary outcome was glycemic control during the winter holidays measured as fasting blood glucose, fructosamine, and A1C levels. The secondary analyses examined changes in blood pressure, body weight, and lipid profiles during the period.

Statistical Analysis

Commercially available statistical software (SPSS for Windows, version 14.0; SPSS Inc, Chicago, Ill) was used for data analysis. Glycemic control data from the first 4 measurements were used to compute changes in fructosamine levels for the preholiday, holiday, and postholiday periods. Two-tailed *t* tests and χ^2 tests were used to analyze differences between groups at baseline and during follow-up. Paired *t* tests were used to determine differences in glycemic control among the 3 periods, and differences in blood pressure, pulse rate, and body weight were assessed between the baseline and postholiday periods. All analyses were based on the intent-to-treat principle. Data are given as mean (standard deviation) unless otherwise stated, and *P* < .05 was considered statistically significant.

RESULTS

Between September 1 and December 6, 2004, we randomly assigned 102 patients having type 2 DM without insulin therapy to each intervention program. Fifty-two subjects were

Effects of Health Education on Glycemic Control During Holiday Time

randomly assigned to program 1 and 50 subjects to program 2. Subjects in the 2 groups were well matched with regard to baseline demographic characteristics (Table 1). Ninety-three subjects (48 in program 1 and 45 in program 2) completed the first 4 visits during the Chinese New Year holiday period, and 89 subjects (46 in program 1 and 43 in program 2) completed 12 months of the study. The mean age of participants who dropped out was 63.8 (7.7) years in program 1 ($P = .69$ compared with subjects who completed the study) and 65.1 (8.6) years in program 2 ($P = .49$). The mean A1C level of participants who dropped out was 7.78% (1.13%) in program 1 ($P = .77$) and 7.84% (0.63%) in program 2 ($P = .92$). Those who dropped out did not differ in age or glycemic control from those who completed the study.

The absolute values of diabetic control at each visit during the Chinese New Year holiday period are given in Table 2. Systolic blood pressure was statistically significantly lower in program 1 at visit 3. Fasting plasma glucose and fructosamine

levels were higher in program 1 at visits 2 and 3. There were no statistically significant differences in body weight or diastolic blood pressure between the 2 groups at the visits.

Figure 1 shows the fructosamine levels during the holiday period. During the preholiday period, the fructosamine level was increased in program 1 and was decreased in program 2. The mean fructosamine level in program 1 increased more during the preholiday period than that in program 2 (7.4 [5.2] vs -5.3 [8.3] $\mu\text{mol/L}$, $P = .03$). The changes in fructosamine levels during the holiday and postholiday periods were similar between the 2 groups. The mean change in A1C level during the holiday period was increased in both groups and was statistically significantly higher in program 1 (0.34% [0.21%] vs 0.09% [0.16%], $P = .03$).

Figure 2 shows the sequential changes in A1C levels for the 2 groups. At the end of the holiday period, the mean changes in A1C levels were 0.34% (95% confidence interval [CI], 0.03%-0.85%) in program 1 and 0.09%

■ **Table 1.** Baseline Characteristics of Patients With Type 2 Diabetes Mellitus (DM)*

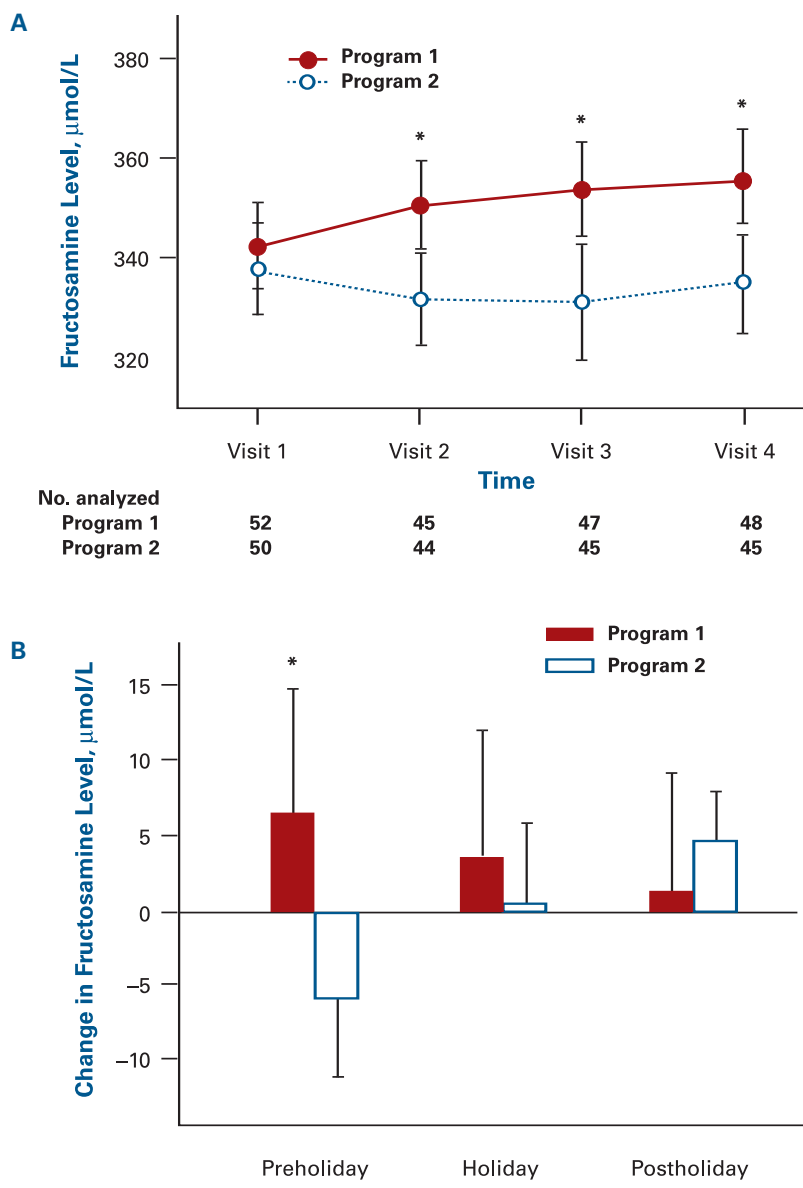
Characteristic	Program 1 (n = 52)	Program 2 (n = 50)	P
Age, y	62.0 (10.1)	63.6 (8.0)	.62
Male-female ratio	27:27	25:23	.84 [†]
DM duration, y	10.4 (6.7)	10.0 (8.9)	.83
Body height, cm	160.7 (9.5)	160.5 (8.1)	.90
Body weight, kg	64.7 (10.5)	67.5 (9.4)	.22
Blood pressure, mm Hg			
Systolic	140.5 (17.4)	140.1 (24.9)	.97
Diastolic	77.1 (13.9)	77.1 (12.4)	.99
Fasting plasma glucose level, mg/dL	177.1 (40.5)	168.6 (34.9)	.31
Glycosylated hemoglobin level, %	7.86 (1.08)	7.81 (0.83)	.83
Fructosamine level, $\mu\text{mol/L}$	344.2 (53.4)	337.7 (55.9)	.31
Cholesterol level, mg/dL			
Total	204.4 (29.5)	197.3 (37.1)	.40
High-density lipoprotein	46.0 (8.6)	48.85 (9.9)	.18
Triglyceride level, mean (range), mg/dL	155 (36-1105)	157 (46-365)	.52 [‡]
Creatinine level, mg/dL	0.91 (0.21)	0.96 (0.29)	.35
Alanine aminotransferase level, U/L	26.1 (14.1)	25.0 (12.6)	.69
Urine albumin-to-creatinine ratio, mean (range), mg/g	20.64 (1.88-1199.00)	18.25 (1.64-905.00)	.29 [‡]

*Data are given as mean (standard deviation) unless otherwise indicated. To convert glucose levels to millimoles per liter, multiply by 0.0555; to convert cholesterol levels to micromoles per liter, multiply by 0.0259; to convert triglyceride levels to millimoles per liter, multiply by 0.0113; to convert creatinine levels to micromoles per liter, multiply by 88.4.

[†]Fisher exact test.

[‡]Mann-Whitney test.

■ **Figure 1. Fructosamine Levels**



A The fructosamine values (mean ±SE) for program 1 and 2 at each time of measurement.
B Mean (±SE) fructosamine change for program 1 and 2 at three periods: preholiday, holiday, and postholiday.
 **P* < .05 vs the subjects in Program 2.

(95% CI, -0.23% to 0.42%) in program 2. The change in A1C level for program 1 was statistically significantly greater than that for program 2. After the Chinese New Year holiday period, the groups showed similar changes in A1C levels, with a slight downward decline thereafter. The mean 12-month changes in A1C levels were 0.18% (95% CI, -0.09% to 0.74%) for program 1 and -0.06% (95% CI, -0.34% to 0.22%) for program 2, a statistically nonsignificant difference.

our holiday reminder pamphlets provided specific information to deal with problems arising during the Chinese New Year holidays. For patients with DM, a serum fructosamine assay can better reflect the mean blood glucose level during the previous 3 to 6 weeks.¹⁴ In the present study, we used changes in fructosamine levels to assess glycemic control between visits. These results revealed better glycemic control in program 2 during the preholiday period, which was when subjects had just received their holiday

DISCUSSION

The main finding of our study is that patients with type 2 DM who received holiday-specific educational pamphlets had better glycemic control during the Chinese New Year holidays than those who received diabetic managed care. Our data revealed that patients with type 2 DM assigned to receive educational pamphlets for the holidays (program 2) had favorable fasting blood glucose and fructosamine levels at visit 2 (preholiday visit) and at visit 3 (postholiday visit). The change in A1C level during the holiday period was less increased in program 2, reflecting good glycemic control during the Chinese New Year holidays.

Diabetes health education is the cornerstone of care for all individuals with DM who want to achieve successful health-related outcomes. Some diabetes management programs are associated with better processes of care but not with improvement of glycemic control.¹² Shojania et al¹³ evaluated the effectiveness of 11 categories of interventions designed to improve the outpatient care of patients with type 2 DM. They found that most strategies produced small-to-modest improvements in glycemic control. They also found that team changes and case management demonstrated more robust improvements, especially for interventions in which case managers could adjust medications without awaiting physician approval. Our regular diabetes education (program 1) provided general diabetes information and nutrition recommendations. However,

Effects of Health Education on Glycemic Control During Holiday Time

reminder pamphlets. Therefore, this finding suggests that simple and easy-to-follow reminder pamphlets may facilitate effective glycemic control in patients with DM during the winter holidays.

Although health education can substantially improve glycemic control, the extent of treatment benefits may be limited by lack of treatment adherence. Some believe that good health education is essential but is not necessarily related to the final outcome in patients with DM.^{13,15,16}

Documentation of clinical nutrition education is associated with favorable trends in glycemic control.^{9,17} However, a problem in diabetes care is poor translation of knowledge to lifestyle modification. Previous studies^{9,17} provide evidence that changes in lifestyle using nonpharmacologic intervention are effective in glycemic control in patients with type 2 DM. These studies attempted to determine whether an intervention could achieve better lifestyle changes and obtain improved outcomes. In our study, we did not address lifestyle changes but, rather, compared the outcomes between the 2 interventions. We hypothesized that patients who received regular diabetes health education would have better glycemic control during the winter holidays, but they did not. Our results seem compatible with daily clinical practice, as some subjects cannot follow recommendations about diet and exercise from health-care providers.

Take-away Points

Loss of glycemic control may be related to periods of increased energy intake, decreased energy expenditure, or both such as during holidays or particular seasons. For example, exposure to higher blood glucose levels during winter holidays every year is likely to increase the risk of diabetic complications.

- Our main finding is that patients with type 2 diabetes mellitus who received holiday-specific educational pamphlets had better glycemic control during the Chinese New Year holidays than those who received diabetic managed care.
- Distribution of a holiday-specific diabetes counseling pamphlet might be applied to settings such as Thanksgiving, Christmas Day, and other special holidays.

■ **Table 2.** Selected Variables at Visits During the Chinese New Year Holiday Period*

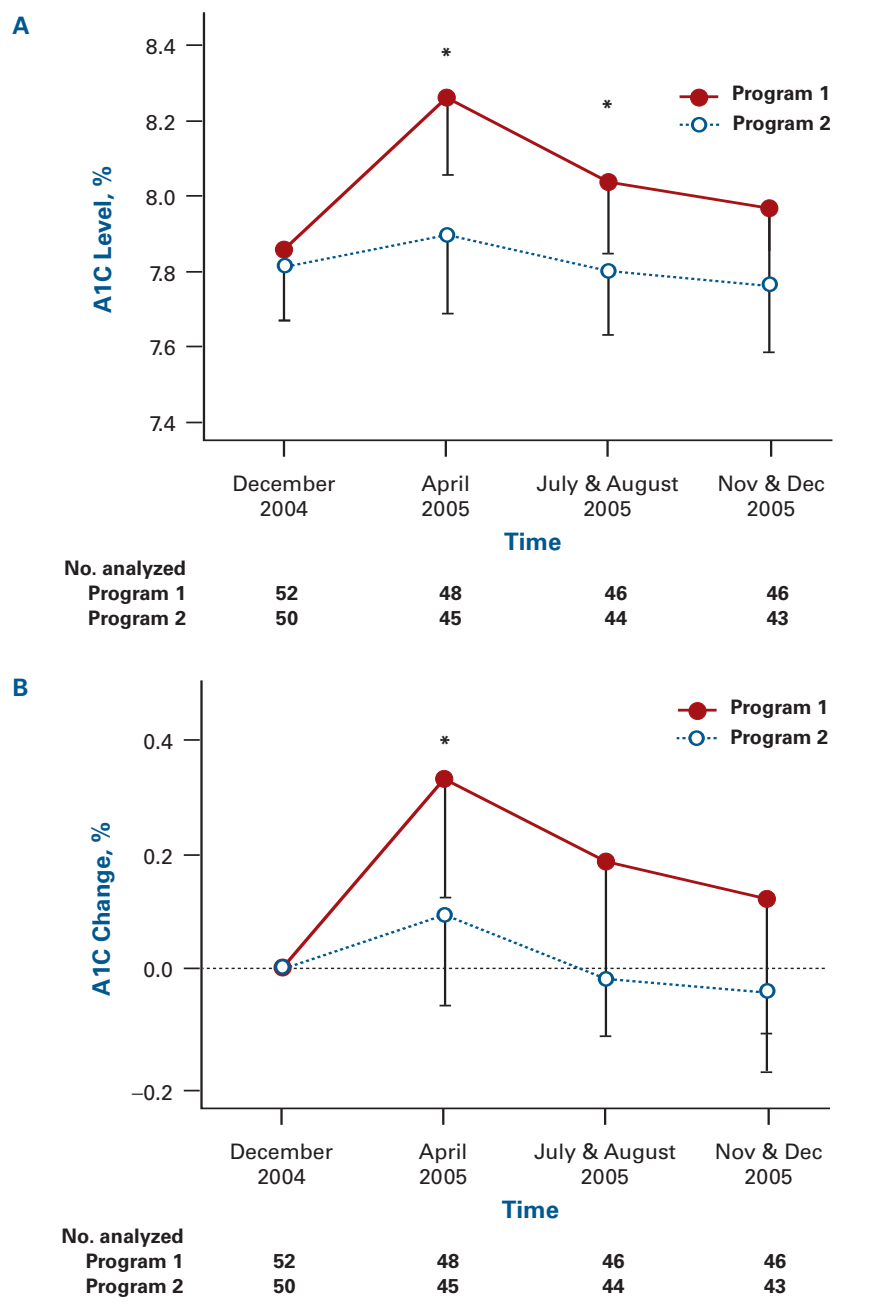
Variable	Program 1	Program 2	P
Body weight, kg			
Visit 1	64.7 (10.5)	67.5 (9.4)	.97
Visit 2	64.8 (10.4)	67.7 (9.7)	.20
Visit 3	64.8 (10.5)	67.8 (9.7)	.20
Visit 4	64.8 (10.5)	67.7 (9.6)	.21
Blood pressure, mm Hg			
Systolic			
Visit 1	140.5 (17.4)	140.1 (24.9)	.97
Visit 2	141.9 (11.0)	142.6 (16.9)	.87
Visit 3	136.8 (12.0)	149.4 (16.6)	.009
Visit 4	140.4 (14.7)	139.6 (13.0)	.86
Diastolic			
Visit 1	77.1 (13.9)	77.1 (12.4)	.99
Visit 2	82.1 (11.8)	80.0 (7.7)	.51
Visit 3	76.2 (11.5)	80.4 (9.0)	.21
Visit 4	84.1 (11.7)	80.0 (8.8)	.20
Fasting plasma glucose level, mg/dL			
Visit 1	177.1 (40.5)	168.6 (34.9)	.31
Visit 2	187.1 (46.4)	163.1 (42.6)	.02
Visit 3	199.9 (52.1)	171.2 (43.5)	.01
Visit 4	140.4 (14.7)	140.0 (14.7)	.86
Fructosamine level, μmol/L			
Visit 1	344.2 (53.4)	337.7 (55.9)	.31
Visit 2	350.6 (52.7)	331.7 (55.0)	.03
Visit 3	354.0 (66.3)	331.2 (59.1)	.01
Visit 4	355.2 (66.1)	335.8 (64.6)	.21

*Data are given as mean (standard deviation). To convert glucose levels to millimoles per liter, multiply by 0.0555.

A previous study indicated a negative influence of winter holidays on glycemic control in patients with type 2 DM.⁴ The present study was designed to test whether routine diabetic

■ TRENDS FROM THE FIELD ■

■ **Figure 2.** Glycosylated Hemoglobin (A1C) Levels



A Mean (\pm SE) A1C level.

B Mean A1C change relative to baseline between subjects with type 2 diabetes on Program 1 and those on Program 2 in the year of study.

* $P < .05$ vs the subjects in Program 2.

managed care could decrease elevated blood glucose levels during the Chinese New Year holidays. Our primary hypothesis was that patients who received diabetic management would have better glycemic control during the winter holidays. For ethical reasons, we gave the control group (program 2) a holiday-specific pamphlet. We believed that diabetic management

could maintain glycemic control during the holidays among patients with type 2 DM. However, our data revealed that subjects with type 2 DM assigned to receive educational pamphlets for the holidays had favorable glycemic control during the Chinese New Year holidays. Therefore, it seems that distribution of a holiday-specific diabetes counseling pamphlet is a feasible patient-centered intervention that improves intermediate outcomes. This might be applied to settings such as Thanksgiving, Christmas Day, and other special holidays. Further study should comprise a larger trial of longer duration across some major holidays to measure self-efficacy and health outcomes.

CONCLUSIONS

Taken together, our findings demonstrate that patients receiving a special reminder pamphlet for the holidays maintained better glycemic control during the Chinese New Year holidays than patients receiving regular diabetes health education. Holiday-specific health education should have favorable effects on glycemic control. Therefore, we suggest that holiday reminder pamphlets be included in general diabetes education before some special events.

Author Affiliations: From the Division of Endocrinology and Metabolism, Department of Medicine (H-SC, R-LC, H-DL), and Section of Biochemistry, Department of Pathology and Laboratory Medicine (T-SJ), Taipei Veterans General Hospital, and the National Yang-Ming University School of Medicine (H-SC, T-EW, T-SJ, H-DL), Taipei, Taiwan.

Funding Source: This study was supported by grant VGH94-169 for medical research from Taipei Veterans General Hospital.

Author Disclosures: The authors (H-SC, T-EW, T-SJ, R-LC, H-DL) report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (H-SC, T-SJ, H-DL); acquisition of data (H-SC, T-EW, R-LC, H-DL); analysis and interpretation of data (H-SC, T-EW, T-SJ, H-DL); drafting of the manuscript (H-SC); statisti-

Effects of Health Education on Glycemic Control During Holiday Time

cal analysis (T-EW); provision of study materials or patients (H-SC, R-LC); obtaining funding (H-DL); administrative, technical, or logistic support (R-LC); and supervision (T-SJ, H-DL).

Address correspondence to: Hong-Da Lin, MD, Division of Endocrinology and Metabolism, Department of Medicine, Taipei Veterans General Hospital, 201, Sec 2, Shih-Pai Rd, Taipei 112, Taiwan. E-mail: hmlin@vghtpe.gov.tw.

REFERENCES

- 1. UK Prospective Diabetes Study Group.** Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet*. 1998;352:837-853.
- 2. Asplund J.** Seasonal variation of HbA1c in adult diabetic patients. *Diabetes Care*. 1997;20:234.
- 3. Carney TA, Guy SP, Helliwell CD.** Seasonal variation in HbA1c in patients with type 2 diabetes. *Diabetic Med*. 2000;17:554-555.
- 4. Chen HS, Jap TS, Chen RL, Lin HD.** A prospective study of glycemic control during holiday time in type 2 diabetic patients. *Diabetes Care*. 2004;27:326-330.
- 5. American Diabetes Association.** Nutrition recommendations and interventions for diabetes (position statement). *Diabetes Care*. 2007;30(suppl 1):S48-S65.
- 6. American Diabetes Association.** Standards of medical care in diabetes: 2007. *Diabetes Care*. 2007;30(suppl 1): S4-S41.
- 7. Tuomilehto J, Lindström J, Eriksson JG, et al.** Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med*. 2001;344:1343-1350.
- 8. Hu FB, Manson JE, Stampfer MJ, et al.** Diet, lifestyle and the risk of type 2 diabetes mellitus in women. *N Engl J Med*. 2001;345:790-797.
- 9. Wilson C, Acton K, Brown T, Gilliland S.** Effect of clinical nutrition education and educator discipline on glycemic control outcomes in the Indian Health Service. *Diabetes Care*. 2003;26:2500-2504.
- 10. Rubin RR, Peyrot M, Siminerio LM.** Health care and patient-reported outcomes: results of the cross-national Diabetes Attitudes, Wishes and Needs (DAWN) study. *Diabetes Care*. 2006;29:1249-1255.
- 11. Wagner EH, Grothaus LC, Sandhu N, et al.** Chronic care clinics for diabetes in primary care: a system-wide randomized trial. *Diabetes Care*. 2001;24:695-700.
- 12. Mangione CM, Gerzoff RB, Williamson DF, et al; TRIAD Study Group.** The association between quality of care and the intensity of diabetes disease management programs. *Ann Intern Med*. 2006;145:107-116.
- 13. Shojania KG, Ranji SR, McDonald KM, et al.** Effects of quality improvement strategies for type 2 diabetes on glycemic control: a meta-regression analysis. *JAMA*. 2006;296:427-440.
- 14. Chen HS, Chen RL, Chang ZY, Lin HD.** A comparison of fructosamine and HbA1c for home self-monitoring blood glucose levels in type 2 diabetes. *Chin Med J (Taipei)*. 2002;65:151-155.
- 15. Ilag LL, Martin CL, Tabaei BP, et al.** Improving diabetes processes of care in managed care. *Diabetes Care*. 2003;26:2722-2727.
- 16. Hipsley-Cox J, Pringle M.** Prevalence, care, and outcomes for patients with diet-controlled diabetes in general practice: cross sectional survey. *Lancet*. 2004;364:423-428.
- 17. Young RJ, Taylor J, Friede T, et al.** Pro-Active Call Center Treatment Support (PACCTS) to improve glucose control in type 2 diabetes: a randomized controlled trial. *Diabetes Care*. 2005;28:278-282. ■