Influence of Small-Group Education Sessions on Glucose Homeostasis in NIDDM

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In patients with non-insulin-dependent diabetes mellitus (NIDDM), the influence of knowledge about their disease on the treatment and control of the disease is not clear. We evaluated the efficacy of educational group meetings with NIDDM patients on improving their knowledge of the disease and on disease management. Fifty-one NIDDM patients were randomly assigned to either intervention or control groups. The intervention group participated in courses of three weekly lessons presented by a physician, nurse, and dietitian once every 4 mo. The intervention and control groups were also followed once every 2 mo in the clinic by the same staff. Medical treatment remained unchanged during the study. After a 12-mo follow-up of the intervention group, no significant improvement in their knowledge of diabetes could be demonstrated. However, mean fasting and postprandial blood glucose levels and HbA_{1c} improved significantly in comparison with the control goup. The same tendency was evident with the weight and lipoprotein profile. We conclude that educational group therapy can improve diabetes control in patients with NIDDM. *Diabetes Care* 11: 67–71, 1988

Despite obvious improvements in diabetes treatment during the last 20 yr, the quality of diabetes care has generally remained unsatisfactory. The widespread failure to acknowledge the importance of patient education seems to be a major reason for this situation. In 1960, Bowen et al. (1) tested a five-part lecture, demonstration, and discussion program. The program produced a modest reduction of body weight in obese patients but did not improve blood glucose control. In the late 1970s, work by Miller and Goldstein (2), Davidson et al. (3), and Moffitt et al. (4) demonstrated the efficacy of diabetes education in reducing the frequency of acute metabolic deterioration. More recently, Korhonen et al. (5) found no significant improvement in glycemic control despite intensive patient education. Mazzuca et al. (6) tested the efficacy of education in non-insulin-dependent diabetic (NIDDM) patients on the knowledge and control of their disease. Although they failed to improve knowledge, they were able to demonstrate improvement in diabetes control. Patient education programs based on group instruction and discussion are also widely accepted. They have the advantages of being timesaving and of creating an interactional process among the patients. Assal et al. (7) stress that to deliver effective group teaching, educators should have considerable medical knowledge and experience and be familiar with the patients and their medical and personal histories. The purpose of this study was to test the efficacy of small-group education in NIDDM patients to improve diabetes control.

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MATERIALS AND METHODS

Subjects. Patients with NIDDM were selected from the diabetic clinic of Hadassah Hospital in Jerusalem according to the following criteria: *1*) age 30–65 yr; *2*) 1 yr or more since diagnosis and clinic record demonstrating uncontrolled diabetes during the last 12 mo (fasting blood glucose >160 mg/dl, postprandial blood glucose

TABLE 1
Background variables of intervention and control groups

	Intervention group (n = 23)	Control group (n = 26)	P
Age (yr)	51.1 ± 8.1	53.7 ± 12.8	NS*
Education (yr)	10.4 ± 5.1	9.3 ± 3.7	NS*
Gender (M/F)	7 (30%)/16 (70%)	10 (38%)/16 (62%)	NS†
Work (no/yes)	7 (30%)/16 (70%)	11 (42%)/15 (58%)	NS†
Origin (Israel/Asia and Africa/Europe and America)	8 (35%)/7 (30%)/8 (35%)	3 (12%)/10 (38%)/13 (50%)	NS†

Values are means ± SD.
*Determined with t test.
†Determined with χ^2-test.

>200 mg/dl, and HbA_{1c} >9 in four or more consecutive blood checks; and 3) patient suffered no late diabetic complications or concurrent psychiatric or terminal illness. Informed consent was signed by each patient after the aims and the process of the study were explained by the physician.

Fifty-one patients participated in the study; 10 were treated with 5–10 mg glyburide/day, 6 were treated with 850–1700 mg metformin/day, and 4 were treated with both drugs together. Thirty-one were treated with diet alone.

The patients were independently assessed by a nurse, dietitian, and physician. A medical history, social and nutritional status, physical examination, and laboratory measurement (i.e., hemoglobin, white blood cell count, electrolyte, and liver and kidney function tests) were completed on each patient. The data used to characterize glucose homeostasis included mean pre- and postprandial blood glucose, HbA_{1c}, cholesterol, triglyceride, and high-density lipoprotein cholesterol (HDL-chol) levels and body weight. The patients were stratified according to their mean values of pre- and postprandial glucose and HbA_{1c} (each dichotomized at the median) and were randomly allocated from each of the resulting eight strata to an intervention group (25 patients) and control group (26 patients). Two of the patients from the intervention group did not participate in the education program, nor did they keep their clinic visits; thus, they were eliminated from the study. The patients had never participated in group education sessions and had only been individually instructed by a physician, nurse, and dietitian during their regular clinic visits over the years.

Methods. The 23 patients of the intervention group were divided into two groups for the education meetings. They underwent a course of three lessons within 3 wk. The lessons were given by a physician explaining the disease and the main mode of treatment, a nurse explaining and demonstrating self-care and treatment techniques, a dietitian explaining the logic and practice of diet, and a physical therapist teaching the patient home exercise. All of the educators belong to the permanent staff of the diabetic clinic and were well known to the patients. A similar meeting of three sessions was performed every 4 mo during the following year. The patients were encouraged to interact between the sessions and were also individually followed in the diabetic clinic every 2 mo by the same physician (I.R.). The biochemical analyses were carried out in the laboratory by a technician who was unfamiliar with the research design. The control group (26 patients) was only followed once every 2 mo by the same physician.

A measure of patient disease knowledge at baseline and at the end of the study was evaluated from a questionnaire containing 42 closed-ended questions prepared for this study. The questions were designed to assess the patient's knowledge of the disease, mainly the optimal way of living and medical treatment involved. They related to the important subjects of diabetes care as taught by the four professionals who took part in the education meetings. Thus, this questionnaire seems to have validity, but more elaborate methods are needed to examine its validity and reliability. Each question had three or four possible answers with only one correct answer (see APPENDIX for examples). For every question answered properly the patient scored 2 points, the maximal score being 84 points.

TABLE 2
Medical variables of intervention and control groups (before meetings)

	Intervention group (n = 23)	Control group (n = 26)
Time since diagnosis (yr)	9.0 ± 4.5	9.2 ± 5.3
Fasting glucose (mg/dl)	200.1 ± 55.1	200.8 ± 59.9
Postprandial glucose (mg/dl)	234.3 ± 68.6	238.5 ± 69.3
HbA_{1c} (%)	10.0 ± 2.7	9.6 ± 2.6
Cholesterol (mg/dl)	226.1 ± 42.6	220.3 ± 55.4
Triglyceride (mg/dl)	232.0 ± 32.0	211.0 ± 34.0
High-density lipoprotein cholesterol (mg/dl)	47.0 ± 4.2	45.8 ± 4.5
Weight (kg)	75.4 ± 11.7	73.4 ± 11.5
Knowledge*	51.4 ± 17.4	48.1 ± 15.6

Values are means ± SD. Differences were not significant according to t test for independent samples.
*See MATERIALS AND METHODS for method of measurement.

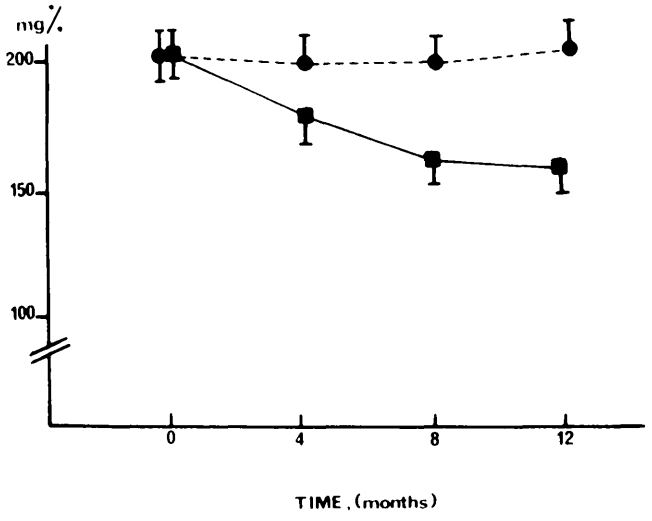

FIG. 1. Mean reduction of preprandial blood glucose level during 12-mo follow-up in intervention (■) and control (●) groups ($P < .05$). Blood samples were taken before breakfast (10-h fast) and before lunch (4-h fast). *Bars* indicate 1SE.

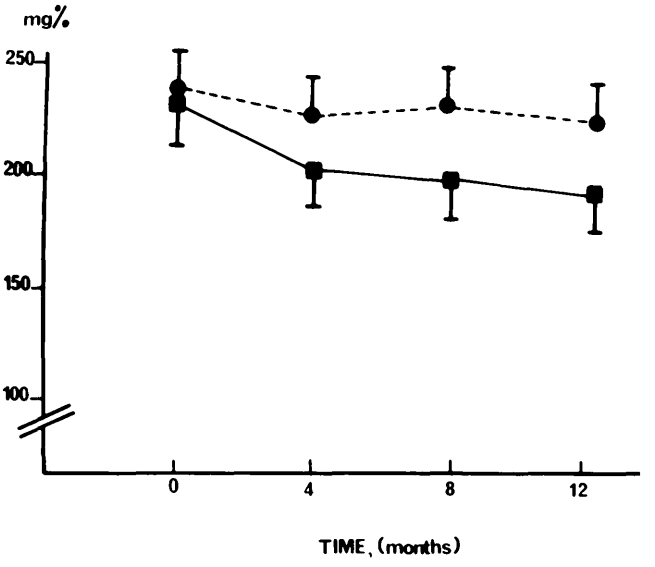

FIG. 2. Mean reduction of postprandial blood glucose level during 12-mo follow-up in intervention (■) and control (●) groups ($P < .05$). Blood samples were taken 2 h after breakfast and lunch. *Bars* indicate 1SE.

Weight, blood pressure, mean pre- and postprandial blood glucose, HbA_{1c}, and lipoprotein measurements were taken from both groups before the study and once every 4 mo. During the study, manipulation in diet and exercise was permitted, but drug therapy was kept unchanged.

Blood glucose was measured by a glucose oxidase method (8). HbA_{1c} was determined by the thiobarbituric acid colorimetric assay (9). Plasma cholesterol triglyceride and HDL-chol concentrations were determined by the methods of the Lipid Research Clinics (LRC; 10).

Statistical methods. Because the subjects were assessed repeatedly during 1 yr of follow-up, the differences between their four measurements were analyzed with analysis of variance for repeated measurements. The means of each group at each point of measurement are shown in the figures. One-tailed *t* test for independent samples and the χ^2-test were used to analyze the differences between the groups at the beginning of the study.

RESULTS

Randomization resulted in two similar groups with regard to their sociodemographic background, duration of diabetes, weight, and level of diabetes control and knowledge scores (Tables 1 and 2). Twenty-three patients participated in the first meetings, 21 in the second, and 18 in the third and fourth. However, even those patients who did not attend all meetings underwent a full regimen of blood tests.

Analysis of variance for repeated measurements revealed a significant interaction between the variables of glucose homeostasis and the intervention factor, e.g., intervention versus control (Figs. 1–3). Reduction in blood glucose levels of the intervention group compared with the control group was evident both in the mean preprandial ($F = 4.24$, df = 3–126, $P < .01$; Fig. 1) and mean postprandial ($F = 3.29$, df = 3–126, $P < .05$; Fig. 2) measurements. The HbA_{1c} level was similarly reduced ($F = 3.96$, df = 3–126, $P < .05$; Fig. 3). The improvement in glucose homeostasis was maximal

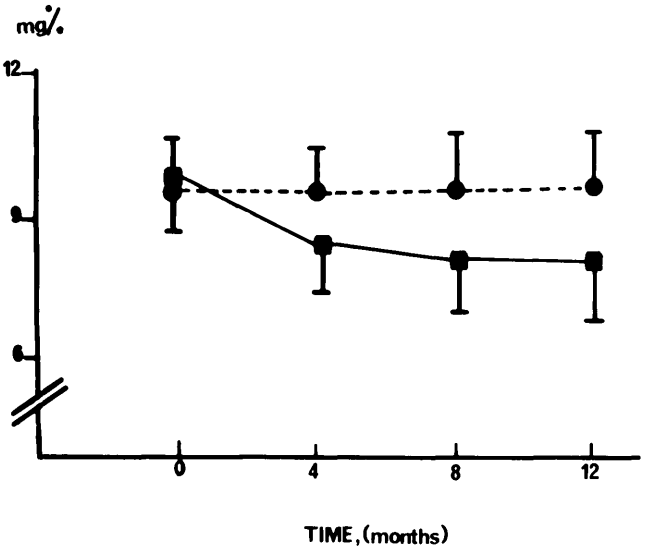

FIG. 3. Mean reduction in HbA_{1c} levels (mg/dl) during 12-mo follow-up in intervention (■) and control (●) groups ($P < .05$). *Bars* indicate 1SE.

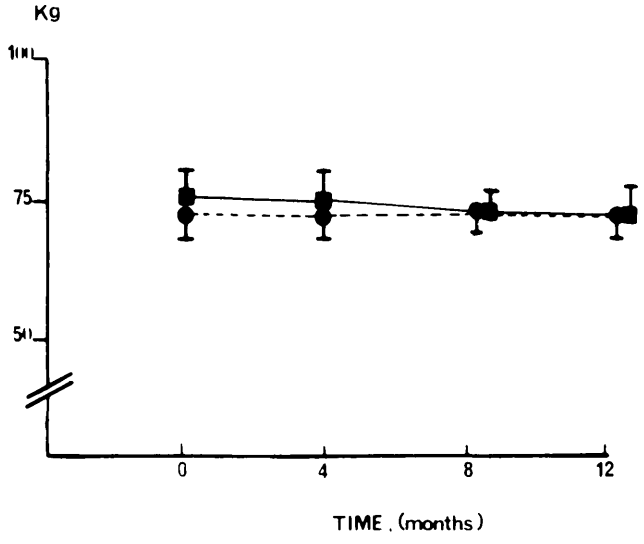

FIG. 4. Mean weight reduction during 12-mo follow-up in intervention (■) and control (●) groups (NS). *Bars* indicate 1SE.

after the first 4 mo and remained constant during the remainder of the study.

A slight (2 kg) but significant loss of weight was observed in the intervention group compared with the control group ($F = 3.15$, df = 3–126, $P < .05$; Fig. 4). The reduction in weight was mainly at the beginning of the study.

In the intervention group, mean blood cholesterol level was reduced from 226.1 ± 42.6 mg/dl at the beginning of the study to 213.8 ± 37.7 mg/dl at the end, whereas no reduction in blood cholesterol level was evident in the control group (from 220.3 ± 53.4 to 226.1 ± 60.8 mg/dl). However, the difference in mean cholesterol level between the intervention and control groups was not significant.

In the intervention group, the blood triglyceride levels decreased from 232 ± 32 mg/dl at the beginning of the study to 214 ± 24 mg/dl at the end. This compared to 211 ± 34 and 204 ± 31 mg/dl, respectively, in the control group at the beginning and end of the study. The difference between the final triglyceride values in the intervention and control groups was not significant. In the intervention group, HDL-chol was slightly elevated, from 47.0 ± 4.2 to 49.6 ± 4.3 mg/dl 1 yr later, whereas in the control group it remained constant (from 45.8 ± 4.5 to 45.2 ± 4.4 mg/dl). Here, too, the difference in the final HDL-chol values between the intervention and control groups was not significant.

The mean score of disease knowledge as assessed by the questionnaire at the beginning of the study was 51.4 ± 17.4 and 48.1 ± 15.6 points in the intervention and control groups, respectively. The mean score of disease knowledge at the end of the study was 54.2 ± 19.1 and 49.2 ± 16.7 in the intervention and control groups, respectively (NS).

DISCUSSION

This study was designed to determine whether a systematic patient education program in a relatively small group could affect patient knowledge and glucose homeostasis. The program was a combination of education about diabetes mellitus, i.e., lectures, discussions, and exercise demonstration and practice. The results of this study indicate that our NIDDM subjects participating in educational small-group meetings did not improve their knowledge significantly, as assessed by our questionnaire. Several methodologic problems may have hampered the efforts to assess the effects of the teaching program on patient knowledge. The individuals who elected to participate in the study may represent a more highly motivated sample of the population than those who chose not to participate. Because highly motivated subjects would probably have been better educated about their diabetes than a random sample of the diabetic population, this selection could have resulted in the recruitment of subjects for whom any form of patient teaching would have added little to their knowledge. However, the group-education setup may have been effective as a behavior-modification method.

A major methodologic problem concerns the lack of ascertainment of the reliability and validity of the questionnaire used to measure the patient's knowledge of the disease. An easier or more comprehensible questionnaire might demonstrate a better response of the intervention group to the teaching sessions. Due to the relatively few cases in the intervention group, no further analyses as to the impact of specific topic areas was appropriate.

The influence of the education program on diabetes control was impressive. Improved control was already achieved 4 mo after the first three meetings, as was evident by weight reduction and improvement in mean pre- and postprandial blood glucose levels together with a significant reduction in HbA_{1c}. This improvement in diabetes control remained constant during the study. The significant improvement of diabetes control in the intervention group despite a nonsignificant change in disease knowledge suggests that other factors had a major influence on diabetes control in these patients, e.g., elevated patient motivation and greater psychosocial support of the medical team and of other patients. Group dynamics developed, and some kind of a self-help group was formed. Future intervention should include better psychosocial and group evaluations to better assess their specific influences on the metabolic control.

The results of this study are not consistent with other diabetes education programs described elsewhere in the literature (5,11). Improved knowledge in a young population does not necessarily mean better diabetes control (2). This study suggests that in patients with NIDDM,

education may create support that helps modify behavior and improve diabetes care and control even if knowledge does not improve significantly.

Small-group educational meetings have rarely been used for NIDDM patients. Our study demonstrates the possible value of such an approach in the management of NIDDM patients and raises the need for further studies to support or refute these findings. We intend to follow the patients in both groups to assess whether the better diabetic control remained at that level over longer periods.

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APPENDIX

An excerpt of the American-style questionnaire.

1. Describe three symptoms of hypoglycemia.
2. Describe three symptoms of hyperglycemia.
3. Can adult diabetes be totally cured?
4. Is adult diabetes a hereditary disease?
5. Which organs are mainly affected by the disease?
6. What is the significance of weight loss in the treatment of adult diabetes?
7. How does glyburide (short-acting sulfonylurea) affect your blood glucose level?
8. How does metformin affect your blood glucose level?
9. What are the best means to improve your blood glucose level?
10. What are the main principal infectious diseases affecting diabetic patients?
11. Can a hidden infectious disease upset the control of your blood glucose level?
12. Under which of the following disorders will you seek immediate medical attention?
13. Is it important to keep strict meal times?
14. Is it important that each meal should contain carbohydrates?
15. When do you have to take the following medicine (glyburide, metformin) in relation to your meals?
16. Is it important to remove or exchange your shoes during the day?
17. What is the relation between uncontrolled diabetes and late complications?
18. Is it possible to stabilize your blood glucose level satisfactorily by monitoring your urine glucose levels?
19. What is the significance of HbA_{1c} level in assessing your diabetic control?
20. Can strict control of blood glucose levels relieve diabetic neuropathic pain?

The closed-ended answers in the original form are not presented.

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