

# A Randomized Clinical Trial Comparing Behavior Modification and Individual Counseling in the Nutritional Therapy of Non-insulin-dependent Diabetes Mellitus: Comparison of the Effect on Blood Sugar, Body Weight, and Serum Lipids

SIMON W. RABKIN, EVELYN BOYKO, ALLAN WILSON, AND DAN A. STREJA

To determine whether a group behavior modification approach might be preferable to individual counseling in the nutritional therapy of non-insulin-dependent diabetes mellitus, 40 adults younger than 65 yr of age with diabetes mellitus who were not receiving insulin were randomized to either a program of individualized dietary review and recommendations or a program of group meetings aimed at controlling the signals leading to overeating and noncompliance with a diabetic dietary regimen. Statistically significant ( $P < 0.05$ ) decreases in body weight, sum skin-fold thickness, fasting serum glucose, and serum triglycerides but not LDL-C or HDL-C were observed. The individual counseling group had a greater amount of weight loss than the behavior modification group. There were no significant ( $P > 0.05$ ) differences between the two groups with respect to the biochemical outcome variables. Patient characteristics assessed at entry—namely anxiety, internal versus external locus of control and perceived disease severity, and compliance with advice—were significantly associated with weight loss in the behavior modification group while only the latter index was of value in the individual counseling group. Thus, our use of these programs does not identify a clear advantage of either approach in the nutritional therapy of non-insulin-dependent diabetic patients. *DIABETES CARE* 6: 50–56, JANUARY–FEBRUARY 1983.

**N**utritional counseling, a basic tenet in the treatment of maturity-onset diabetes mellitus,<sup>1–4</sup> has several objectives, which include reduction in total caloric intake to attain ideal body weight, control of the degree of glucose intolerance to lower the level of hyperglycemia, and reduction in the level of serum lipids. Because of the concern that poor compliance with dietary advice limits the ability to achieve optimal results,<sup>5–9</sup> alternative methods of nutritional counseling must be evaluated. Behavior modification directed at circumstances and behaviors related to eating<sup>10–14</sup> offers an alternative to the traditional regimen that requires rigid adherence to a prescribed diet. Thus, the purpose of this study was to compare a behavior modification approach with individual dietary counseling, in the nutritional therapy of non-insulin-dependent diabetes mellitus. In addition, patient characteristics at entry are examined to define subsets that benefit from these programs.

## METHODS

Adult patients with diabetes mellitus who had attended clinics at the hospital or offices of attending physicians were requested to participate voluntarily in the study. The entry criteria were: (1) adults with non-insulin-dependent diabetes; (2) younger than 65 yr of age; (3) not receiving insulin; (4) fasting serum glucose levels currently over 135 mg/dl; and (5) their physicians assessed that the diabetes was “stable” and no change in therapy was intended over the next 3-mo period. Informed consent was obtained from the patient and the physician’s cooperation secured prior to participation in the study.

## PROTOCOL

All subjects at enrollment had a physical examination and completed a questionnaire. In addition, the sum of four skin-fold thicknesses (biceps, triceps, infrascapular, suprailiac) was

determined with a Harpender skin-fold caliper (British Indicators Limited, St. Alans, England) by one observer.

Information was obtained by questionnaire concerning the following:

(1) personal data—age, sex, family, income, and education;

(2) concern about health and adherence to clinicians' advice<sup>15</sup> using the following questions: (a) in general, how much would you say that you worry about your health? (b) in general, how closely do you tend to follow your doctor's advice? (c) how much do you try to do exactly what your clinician tells you to do without question? (d) do you have to use your own judgment deciding how much of the doctor's advice to follow? These questions were scored on a 1-to-5 scale where 5 indicated the most concern about health or that the patient closely followed the clinician's advice. These responses were summed to give a composite index.

(3) the patient's locus of control was assessed using Rotter's I/E scale;<sup>16</sup>

(4) a measure of generalized level of anxiety was assessed using the Taylor Manifest Anxiety Scale;<sup>17</sup>

(5) a general personality profile was obtained by the Minnesota Multiphasic Personality Inventory.<sup>18</sup>

A sample of blood was obtained after a 14-h overnight fast and assayed as described below.

#### PROGRAMS

The *individual counseling program* was a conventional approach to diet counseling for non-insulin-dependent diabetic patients. A brief lecture in lay terms of the pathophysiology of diabetes and its complications was given by the nutritionist. The counseling session focused on a review of the patient's eating habits. The individual received the St. Paul's diabetes guide to meal planning.<sup>19</sup> An individualized meal plan specifying the amount of recommended food for each meal and snack was established. Based on an estimate of the individual's usual daily food intake, the daily food allowance was designed to reduce intake by 500–1000 calories per day so that daily calorie consumption was 1200 for women and 1500 for men. This arbitrary level was selected because it is an often recommended goal that would be the same for both groups. The patients were counseled about the necessity of losing weight as part of a dietary treatment for diabetes. Patients returned 6 wk later for follow-up examination and blood tests. Then a dietary review and discussion of problems took place which was designed to be supportive and to reinforce the principles previously taught. The duration of the initial counseling session was 1 h and the final session 15 min.

*Behavior modification group.* The same nutritionist-interventionist directed both programs. She was trained in behavior modification techniques and had experience leading behavior modification groups designed to treat obesity as well as in nutritional counseling of diabetic patients. The behavior modification program was a group approach consisting of no

fewer than six and no more than nine patients meeting on 6 consecutive weeks for approximately 1½ h per session. The times were made equivalent so that the therapist's time per patient was the same in both programs. The program began with more intensive discussion and graphic presentation of the pathophysiology of diabetes from the lay perspective.<sup>20</sup> A detailed explanation of the St. Paul's diabetes guide<sup>19</sup> stressing calorie counting was given. The patient's eating habits were not assessed nor was an individualized meal plan established. Indeed, patients were taught to count calories using the St. Paul's system and advised to consume no more than 1200 calories for women or 1500 for men. The remainder, the majority, of the program focused on behavioral strategies to manage or alter eating habits.<sup>11</sup> The importance of altering eating habits was stressed from the perspective of improving diabetes control. The topics covered included signals—physical, emotional, and social—that lead to over-eating and noncompliance with dietary regimens; approaches to the management of one's thoughts and of influences from the environment and coping with emotions to limit consumption of foods (especially foods that were not recommended) were stressed. Self-observation was encouraged by having the patient maintain daily eating records that were reviewed weekly by the group leader to identify stimuli for eating and to suggest alternative responses. Overall attendance for this program was 86%.

#### FOLLOW-UP

There were two follow-up examinations. The first was at 6 wk and the second was at 12 wk after commencing the program. At follow-up, all patients were measured for body weight and skin-fold thickness and had blood samples collected after a 14-h overnight fast.

#### BIOCHEMICAL METHODS

The serum was separated and assayed for serum glucose<sup>21</sup> and triglycerides,<sup>22</sup> using enzymatic methods. LDL-cholesterol was analyzed using the Beckman lipoprotein profiling system (Beckman Company, Palo Alto, California) and for HDL-cholesterol using the cholesterol methodology<sup>23</sup> after precipitating with manganese heparin.<sup>24</sup>

#### DATA ANALYSIS

Paired *t* tests were used to examine hypotheses for within group comparison of paired data. Nonpaired *t* tests or chi square tests, whichever was appropriate, were used for between group (program) comparisons. When contingency data had empty cells due to the uncertain category, the data were reduced to the 2 × 2 format. Linear regression models, both simple and multivariate, were used to evaluate the relationship between the outcome predictors and the outcome variables.<sup>25</sup> The null hypothesis was rejected if the probability of a type I error was less than 5%.

TABLE 1  
Characteristics of subjects at entry into the trial

Feature	Behavior modification group	Individual counseling group
Age (yr)	52.7 ± 1.7	55.0 ± 2.2
Sex (male/female)	7/13	10/10
Height (cm)	166.3 ± 1.9	167.2 ± 1.8
Weight (kg)	87.3 ± 2.6	87.5 ± 3.4
Body mass index (kg/m <sup>2</sup> )	27.2 ± 0.8	26.2 ± 0.8
Sum skin-fold thickness (mm)	910.2 ± 67.1	878.5 ± 83.7
Fasting serum glucose (mg/dl)	221 ± 16	221 ± 12
Serum triglycerides (mg/dl)	214 ± 24	199 ± 19
Total cholesterol (mg/dl)	204 ± 10	208 ± 12
LDL-C (mg/dl)	131 ± 9	137 ± 9
HDL-C (mg/dl)	42 ± 3	42 ± 2
Retinopathy		
none	17	15
mild	2	5
uncertain	1	
Neuropathy		
none	9	10
mild	10	8
uncertain	1	2
Pedal pulses		
normal	16	17
diminished	4	3
absent	—	—
Duration diabetes		
<1 yr	10% (2)	15% (3)
1-4 yr	45% (9)	45% (9)
5-9 yr	20% (4)	20% (4)
>10 yr	25% (5)	20% (4)
Medications (oral hypoglycemics)	5	6
Education		
grade school	3	2
high school	14	11
college—university	3	7
Family income		
<10,000	2	1
10-15	5	2
15-20	6	6
20-30	4	7
>30	1	3
unknown	2	1
Follows advice	18.4 ± 0.5	18.3 ± 0.6
MAS score	678.7 ± 33.6	675.2 ± 32.7
Internal/external score	383.8 ± 44.5	304.1 ± 41.1
MMPI scores		
Hypochondria	55.7 ± 2.3	61.0 ± 3.4
Depression	62.3 ± 2.6	61.0 ± 3.0
Hysteria	56.1 ± 1.8	58.4 ± 2.5
Psychopathy	55.5 ± 1.6	53.7 ± 2.2
Masculinity/femininity	48.7 ± 2.2	55.9 ± 2.2
Paranoia	53.3 ± 1.9	55.3 ± 2.2
Psychothemia	53.0 ± 1.9	53.4 ± 2.3
Schizophrenia	52.3 ± 1.9	54.7 ± 2.3
Hypomania	55.1 ± 1.9	53.9 ± 1.8
Social introversion	57.0 ± 2.6	55.9 ± 2.9

## RESULTS

**Entry characteristics.** The entry characteristics of 40 subjects randomized to the behavior modification (N = 20) and individual counseling groups (N = 20) are shown in Table 1. Two subjects initially randomized to individual counseling are excluded because they did not return for following examinations because of illness (cancer), absence from the city, or disinterest. There were no significant differences between the two groups for any of the entry variables.

**Changes after intervention.** The individual counseling group showed significant ( $P < 0.05$ ) reductions in body weight, sum of skin-fold thickness, and serum triglycerides both at the 6- and 12-wk re-examination (Figure 1). Fasting serum glucose fell at short-term ( $0.10 > P > 0.05$ ) follow-up but was significant ( $P < 0.05$ ) at long-term re-examination. There were no significant changes in serum LDL-C or HDL-C concentration at either re-examination. The group that received behavior modification (Figure 2) showed at 6-wk re-examination significant ( $P < 0.05$ ) reductions in fasting serum glucose and triglycerides, and at 12-wk re-examination, significant reductions in body weight and sum of skin-fold thickness. There were no significant changes in LDL-C or HDL-C.

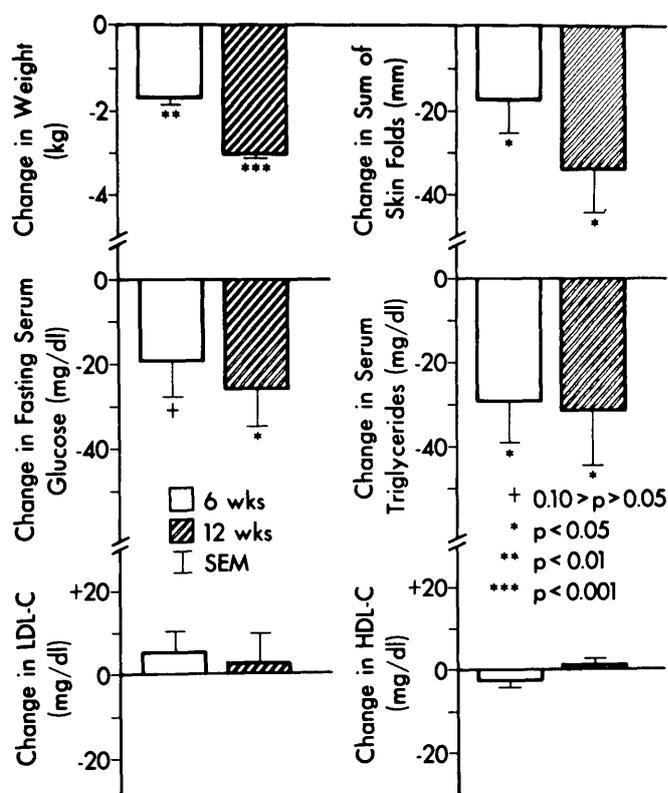


FIG. 1. For the individual counseling group, the changes in body weight (upper left), sum of skin-fold thickness (upper right), fasting serum glucose (middle left), serum triglycerides (middle right), LDL-C (lower left), and HDL-C (lower right).

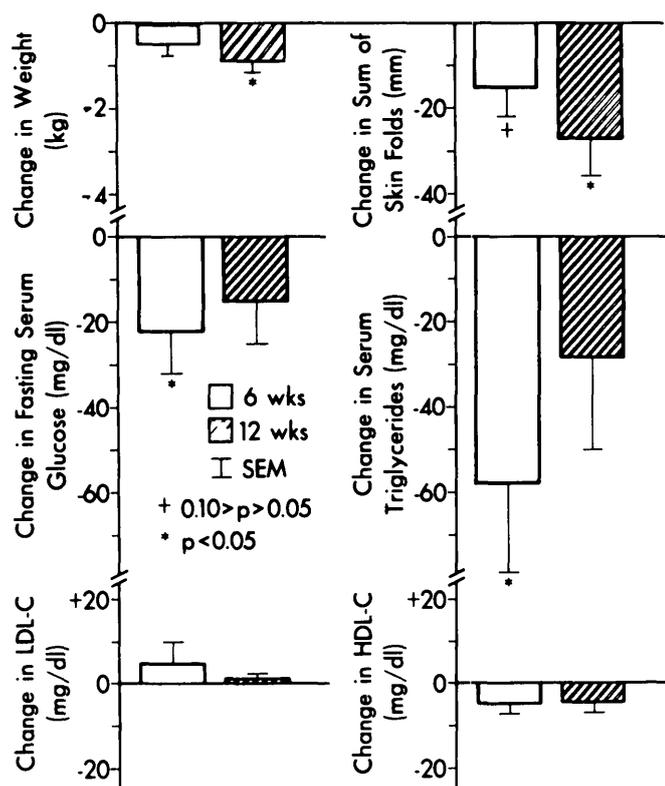


FIG. 2. For the behavior modification group, the changes in body weight (upper left), sum of skin-fold thickness (upper right), fasting serum glucose (middle left), serum triglycerides (middle right), LDL-C (lower left), and HDL-C (lower right).

Comparison of the change in each of these variables at 6- and 12-wk follow-up (Figures 1 and 2) showed no consistent statistically significant differences between the individual counseling and group behavior modification except for changes in body weight. Changes in body weight were greater for individual counseling compared with the behavior modification group at 12-wk ( $-3.0 \pm 0.5$  versus  $-0.9 \pm 0.4$  kg,  $P < 0.01$ ) and perhaps at 6-wk ( $-1.7 \pm 0.05$  versus  $-0.4 \pm 0.6$  kg,  $0.10 > P > 0.05$ ) follow-up. For these two groups, changes in fasting serum glucose at 6 and 12 wk were  $-18 \pm 9$  versus  $-22 \pm 10$  mg/dl and  $-26 \pm 10$  versus  $-15 \pm 10$  mg/dl, respectively, while for serum triglycerides they were  $-38 \pm 13$  versus  $-59 \pm 22$  and  $-13 \pm 14$  versus  $-28 \pm 22$  mg/dl.

**Predictors of outcome.** For the individual counseling groups, only the index of perceived disease severity and compliance with advice showed a significant correlation with outcome, but only for 6-wk changes in weight (Table 2). For a behavior modification group, the manifest anxiety scale was of value in prediction of weight loss at both follow-up periods and for fasting serum glucose and triglycerides at short-term follow-up only (Table 2). The internal/external locus of control was significantly associated with change in body weight, triglyc-

erides, and short-term change in HDL-C. The index of disease severity and compliance correlated only with weight loss. With regard to MMPI, there were no significant trends indicating a relationship between this scale and the outcome measurements for either of the two groups.

**Multivariate analysis of outcome predictors in behavior modification group.** To determine the independent contribution of the psychological factors when more than one was statistically significant, multivariate analysis was used. This was

TABLE 2

The relationship between manifest anxiety scale (MAS), internal vs. external locus of control (I/E), the index of perceived disease severity and compliance with advice (DS&C) and the outcome variables changes in body weight, fasting serum glucose, triglycerides, LDL-C, and HDL-C (Pearson Product Moment Correlation)

Change	Scale		
	MAS	I/E	DS&C
<b>Body weight</b>			
Individual counseling			
Short-term follow-up	0.249	-0.028	-0.534‡
Long-term	-0.003	0.101	-0.216
Behavior modification			
Short-term follow-up	-0.451*	-0.384*	-0.431*
Long-term follow-up	-0.412*	-0.319†	-0.583*
<b>Fasting serum glucose</b>			
Individual counseling			
Short-term	-0.113	-0.248	0.200
Long-term	-0.041	-0.088	-0.116
Behavior modification			
Short-term	-0.398*	0.1357	0.194
Long-term	-0.291	-0.270	0.018
<b>Triglycerides</b>			
Individual counseling			
Short-term	0.027	0.025	-0.318†
Long-term	0.076	0.061	-0.343†
Behavior modification			
Short-term	0.446*	0.427*	-0.242
Long-term	0.295	0.486*	-0.280
<b>LDL-C</b>			
Individual counseling			
Short-term	-0.262	0.221	-0.253
Long-term	-0.131	0.263	-0.134
Behavior modification			
Short-term	-0.308	0.093	-0.008
Long-term	-0.303	-0.119	0.229
<b>HDL-C</b>			
Individual counseling			
Short-term	-0.077	0.053	-0.262
Long-term	0.237	-0.106	-0.061
Behavior modification			
Short-term	-0.004	0.389*	0.143
Long-term	0.017	0.244	0.037

\*P < 0.05.

†0.05 < P < 0.10.

‡P < 0.01.

only relevant for body weight and triglyceride changes in the behavior modification group. The initial or entry value for each variable was included in multivariate analysis to adjust for regression to the mean.<sup>26</sup> For weight loss, where all the psychological predictors were significant in univariate analysis, only the MAS and I/E scores were significant predictors in multivariate analysis for short-term follow-up (Table 3). For long-term follow-up the index of perceived disease severity and I/E scale were significant independent predictors. For change in triglycerides, the I/E scale was the only significant independent factor both for short- and long-term follow-up.

## DISCUSSION

This study compared two approaches to the nutritional counseling of non-insulin-dependent diabetic patients. One approach, individual counseling, was a traditional method that involved a nutritionist evaluating the patients' food intake and giving dietary advice. The other approach, behavior modification, was a group approach that provided dietary information but focused primarily on managing the signals and responses to eating, especially eating foods that were not recommended. Each approach was equally time consuming for the interventionist. Both approaches were associated with significant reductions in body weight, skin-fold thickness, fasting blood glucose, and triglycerides. Although it is tempting to con-

clude that both methods are successful in accomplishing the objectives of dietary management of non-insulin-dependent diabetes, it must be stressed that the patients volunteered to participate in this study and because this was not the hypothesis examined, no control (no treatment) group was included. However, the results observed herein with respect to changes in body weight, fasting blood glucose, and serum triglycerides are similar to the reported changes in these variables after nutritional therapy of non-insulin-dependent diabetes in other studies.<sup>27-29</sup> The present study shows that to the extent that these outcome variables can be modified, there were no consistent statistically significant differences between the individual counseling and behavior modification groups with respect to changes in fasting serum glucose and lipoproteins. Weight loss was greater in the individual counseling group. Because serum glucose and lipoproteins are unquestionably more important than body weight changes in diabetic patients, we concluded that neither approach showed any clear advantage with regard to outcome.

To our knowledge, there has been no previous randomized clinical trial comparing these two approaches for nutritional therapy of non-insulin-dependent diabetes mellitus. There are, however, several major caveats with respect to extrapolation of the data from this study. First, a single nutritionist-interventionist was used, raising the question of whether these results merely reflect the interventionist's ability and interest. A single interventionist was selected to eliminate between-therapist effects that might have occurred if each

TABLE 3  
Multivariate analysis relating predictor of outcome to change in each outcome variable

	Multiple R	R squared	R squared change	Significance level P
Change in body weight				
Short-term				
MAS	0.451	0.204	0.204	P < 0.05
I/E	0.668	0.446	0.242	P < 0.05
Entry weight	0.757	0.573	0.127	P < 0.05
DS&C	0.771	0.594	0.021	NS
Long-term				
DS&C	0.583	0.340	0.340	P < 0.05
I/E	0.642	0.412	0.072	P < 0.05
MAS	0.675	0.455	0.044	NS
Entry weight	0.679	0.461	0.006	NS
Change in triglycerides				
Short-term				
Entry triglycerides	0.823	0.678	0.678	P < 0.01
Change in fasting serum glucose	0.892	0.797	0.119	P < 0.05
I/E	0.924	0.854	0.058	P < 0.05
MAS	0.927	0.860	0.005	NS
Change in body weight	0.928	0.860	0.001	NS
Long-term				
Entry triglycerides	0.667	0.445	0.485	P < 0.01
Change in fasting serum glucose	0.755	0.571	0.125	P < 0.05
I/E	0.770	0.593	0.022	NS
MAS	0.778	0.606	0.013	NS
Change in body weight	0.779	0.607	0.001	NS

group were led by a different therapist. The nutritionist-interventionist was trained and had extensive experience with both approaches and thus represented the ideal individual to conduct these trials. The failure of the trial to show a benefit of either procedure would suggest the absence of a bias of outcome to one approach by the nutritionist-interventionist. Second, one difference between the two groups was the number of times the patients met with the interventionist. We sought to standardize therapists' time to make the program equally cost-effective from the perspective. It is possible, however, that varying duration of patient-intervention contact may produce different results. Third, some of the patients undoubtedly had previous exposure to dietary instruction, which might have affected the results. Nevertheless, significant changes were observed, perhaps indicating that they were not rendered insensitive to further nutritional therapy. Fourth, no data were obtained on activity levels, whether they changed, and their relationship to caloric intake. However, no recommendations were made to alter physical activity and any changes may have occurred in both groups so that no between-group bias would be expected. Other issues include the sample size and duration of follow-up. It is possible that a much larger patient group,<sup>30</sup> a longer duration of therapy, or longer durations of follow-up<sup>31</sup> may show differences. The degree to which the individual modified his/her behavior program was not assessed because the reliability of self-recorded data in these subjects has been seriously questioned because the nature of the intervention strategy biases the participants' reporting accuracy.<sup>32,33</sup> Instead, objective endpoints such as body weight or blood glucose are recommended<sup>10,32</sup> and were used herein. Last, this study used one behavior modification method. It is possible that other behavior modification approaches may prove to be more or less beneficial.

The present study also found that individuals who report they follow a clinician's advice are more likely to lose body weight with either approach perhaps because it was the only variable that could be self-monitored. This is consistent with the observation that the health belief can influence adherence to diet alterations.<sup>15</sup> Psychological factors correlated with outcome only in the behavior modification programs, perhaps due to the reliance on psychological strategies in the behavior modification program. Although we must be cautious in evaluating the psychological predictors because of the large number of outcome variables used and the possibility of a positive result by chance, the correlation is strengthened by its consistent occurrence with weight change for all predictors. The level of anxiety was assessed by a scale with high test-retest reliability which is not modified by transient or temporary stress conditions.<sup>34</sup> The greater weight loss and reduction in fasting blood glucose levels in those with higher anxiety levels in the present study suggests that high overall anxiety level may predispose the individual to expend greater effort in controlling the source of his anxiety. Subjects had been rated by Rotter's I/E scale, for their perception of the likelihood that events depend on their own behavior ("internals") or are a result of luck, fate or powers beyond one's

personal control and understanding ("externals"). Those classified as "internal" have been shown to be more successful in weight reduction programs, particularly in group programs,<sup>35</sup> and also have a higher likelihood to quit smoking permanently.<sup>36</sup> Our findings of a statistically significant relationship between greater internal score and weight loss or reduction in serum triglycerides is consistent with the thesis that internally oriented individuals are better able to control important aspects in their life.

In summary, individual counseling and group behavior modification are equally effective approaches for non-insulin-dependent diabetic patients as assessed by changes in fasting serum glucose and lipoproteins, but individual counseling was associated with a greater weight loss. Patient characteristics can identify individuals with different responses to these nutritional approaches to non-insulin-dependent diabetes.

**ACKNOWLEDGMENTS:** This study was supported by grants from the Manitoba Medical Services Foundation and from N.H.R.D.P. to Dr. S. W. Rabkin.

**From the Department of Medicine, University of British Columbia, and Departments of Medicine and Psychiatry, University of Manitoba, Canada.**

**Address reprint requests to S. W. Rabkin, M.D., Department of Medicine, University of British Columbia, 4500 Oak Street, Vancouver, B. C., Canada V6H 3N1.**

#### REFERENCES

- 1 Krall, L. P., and Joslin, A. P.: *Joslin's Diabetes Mellitus*. Marble, A., White, P., Bradley, R. F., and Krall, L. P., Eds. Philadelphia, Lea and Febiger, 1971.
- 2 Ricketts, H. T.: Editorial statement on University Group Diabetes Program Results. *Diabetes* 1970; 19 (Suppl. 2):iii-v.
- 3 Bierman, E. L., Albrink, M. J., Arky, R. A., Connor, W. E., Dayton, S., Spitz, N., and Steinberg, D.: Principles of nutrition and dietary recommendations for patients with diabetes mellitus. *Diabetes* 1971; 20:633-34.
- 4 Ensinck, J. W., and Bierman, E. L.: Dietary management of diabetes mellitus. *Ann. Rev. Med.* 1979; 30:155-70.
- 5 Wysocki, M., Czyzerk, A., Slonska, Z., Krolewski, A., and Saneczka, D.: Health behavior and its determinants among insulin-dependent diabetics. Results of the Diabetes Warsaw Study. *Diabetes Metab.* 1978; 4:117-22.
- 6 Holland, W. M.: The diabetes supplement of the National Health Survey. *J. Am. Diet. Assoc.* 1968; 52:389-90.
- 7 Williams, F., Martin, D. A., Hogan, M. D., Watkins, J. D., and Ellis, E. V.: The clinical picture of diabetic control studied in four settings. *Am. J. Public Health* 1967; 57:441-58.
- 8 Hulka, B. S., Cassel, J. C., Kupper, L. L., and Burdette, J. A.: Communication, compliance and concordance between physicians and patients with presented medication. *Am. J. Public Health* 1976; 66:847-53.
- 9 West, K. M.: Diet therapy of diabetes: an analysis of failure. *Ann. Intern. Med.* 1973; 79:425-34.
- 10 Pomerleau, O., Bass, F., and Crown, U.: Role of behavior modification in preventive medicine. *N. Engl. J. Med.* 1975; 292:1277-82.
- 11 Nash, J. D., and Long, L. O.: Taking charge of your weight and well being. Bull. Publ. Company, Alto C, 1978.

- <sup>12</sup> Goldfried, M. R., and Merbaum, M.: Behavior Change Through Self Control. New York, Holt, Rinehart, and Winston, 1973.
- <sup>13</sup> Stokols, D.: The reduction of cardiovascular risk: an application of social learning perspectives. In *Applying Behavioral Science to Cardiovascular Risk*. Enelow, A. J., and Henderson, J. B., Eds. Am. Heart Assoc. Inc., 1975:133-46.
- <sup>14</sup> Jeffery, R. W., Wing, R. R., and Stunkard, A. J.: Behavioral treatment of obesity: the state of art in 1967. *Behav. Ther.* 1978; 9:189-99.
- <sup>15</sup> Becker, M. H., Marman, L. A., Kirseht, J. P., Haefner, D. P., and Drachman, R. H.: The health belief model and prediction of dietary compliance: a field experiment. *J. Health Soc. Behav.* 1977; 18:348-66.
- <sup>16</sup> Rotter, J. B.: Generalized expectancies for internal vs. external control of reinforcement. *Psychol. Monogr.* 1966; 80:1-28.
- <sup>17</sup> Taylor, J. A.: A personality scale of manifest anxiety. *J. Abnorm. Soc. Psychol.* 1953; 48:285-90.
- <sup>18</sup> Hathaway, S. R., and McKinley, J. C.: *The Minnesota Multiphasic Personality Inventory Manual*. New York, Psychological Corp., 1967.
- <sup>19</sup> St. Paul's Children Hospital: *Guide to Meal Planning*. St. Paul, Minnesota, Children's Hospital, 1975.
- <sup>20</sup> Hunt, J.: *Happy Living*. A slide/tape series. Continuing education in the health series. P.A. Vancouver, B.C., Woodward Instructional Resources Center, U.B.C., 1976.
- <sup>21</sup> Stein, M. W., and Bergumeyer, H. P.: *Methods of Enzymatic Analysis*. New York, Academic Press, 1963:117.
- <sup>22</sup> Kessler, G.: *Technicon Symposia. Automation in Analytical Chemistry*, New York, 1965:341.
- <sup>23</sup> Bronzert, T. J., and Brewer, H. B.: New micromethod for measuring cholesterol in plasma lipoprotein fractions. *Clin. Chem.* 1977; 23:2089-98.
- <sup>24</sup> Russel, G., and Warnick, J. J.: A comprehensive evaluation of heparin manganese precipitation procedure for estimating high density lipoprotein cholesterol. *J. Lipid Res.* 1978; 19:65-76.
- <sup>25</sup> Steel, R. G. H., and Torrie, J. H.: *Principles of Statistics*, Chapter 14. New York, McGraw Hill, 1960:277-301.
- <sup>26</sup> Rabkin, S. W., Mathewson, F. A. L., and Tate, R. B.: Long-term changes in systolic blood pressure and the risk of ischemic heart disease. *Am. J. Epidemiol.* 1979; 109:650-61.
- <sup>27</sup> Goldner, M. G., Knatterud, G. L., and Prout, T. E.: Effect of hypoglycemic agents on vascular complications in patients with adult-onset diabetes. III. Clinical implications of UDPG results. *JAMA* 1972; 218:1400-10.
- <sup>28</sup> Hadden, D. R., Montgomery, D. A. D., Skelly, R. J., Tremble, E. R., Weaver, J. A., Wilson, E. A., and Buchanan, K. D.: Maturity onset diabetes mellitus: response to intensive dietary management. *Br. Med. J.* 1975; 3:276-78.
- <sup>29</sup> Streja, D. A., Boyko, E., and Rabkin, S. W.: Nutritional therapy in non-insulin-dependent diabetes mellitus. *Diabetes Care* 1981; 4:81-84.
- <sup>30</sup> Freiman, J. A., Chalmers, T. C., Smith, H., and Kuebler, R. R.: Importance of beta, type II error and sample size in randomized control trial. *N. Engl. J. Med.* 1978; 299:690-94.
- <sup>31</sup> Stunkard, A. J., Craighead, L. W., and O'Brien, R. O.: Controlled trial of behaviour therapy and their combination in the treatment of obesity. *Lancet* 1980; 2:1045-47.
- <sup>32</sup> Mahoney, M. J.: Research issues in self-management. *Behav. Ther.* 1972; 3:45-63.
- <sup>33</sup> Brownell, K. D., and Stunkard, A. J.: Behaviour therapy and behaviour change: uncertainties in programs for weight control. *Behav. Res. Ther.* 1978; 16:301-302.
- <sup>34</sup> Hodges, W. F., and Durham, R. L.: Anxiety, ability and digit span performance. *J. Pers. Soc. Psychol.* 1972; 24:401-406.
- <sup>35</sup> Balch, P., and Ross, A. W.: Predicting success in weight reduction as a function of locus of control: a unidimensional and multidimensional approach. *J. Consult Clin. Psychol.* 1975; 43:119-30.
- <sup>36</sup> Foss, R.: Personality, social influence and cigarette smoking. *J. Health Soc. Behav.* 1973; 14:279-86.