

Continued efforts by the public health community to work closely with primary care physicians on occupational health could eventually have a positive impact on the recognition of occupational disease and, therefore, its reduction. Our experience indicates that this process of changing practitioners' attitudes will be lengthy and require both the resources and commitment of the public health and medical care community. Despite these difficulties, the recognition of occupational disease by primary care physicians is crucial for motivating industry to provide healthful working conditions.

References.....

1. Nineteenth annual report of the State board of health of New Jersey. New Jersey State Board of Health, Trenton, 1895, p. 290.

2. Thirty-sixth report of the State board of health of New Jersey. New Jersey State Board of Health, Trenton, 1912, p. 39.

3. U.S. Bureau of the Census: General social and economic characteristics: New Jersey. U.S. Government Printing Office, Washington, DC, 1980, pp. 20-769.

4. Borow, M., Conston, A., Livornese, L., and Schalet, N.: Mesothelioma following exposure to asbestos: a review of 72 cases. *Chest* 64: 641-646 (1973).

5. Rutstein, D. D., et al.: Sentinel health events (occupational): a basis for physician recognition and public health surveillance. *Am J Public Health* 73: 1054-1062 (1983).

6. Rosenstock, L.: Occupational medicine: too long neglected. *Ann Intern Med* 95: 774-775 (1981).

7. Levy, B. S.: The teaching of occupational health in United States schools: five year follow-up of an initial survey. *Am J Public Health* 75: 79-80 (1984).

8. Marier, R.: The underreporting of communicable diseases. *Am J Epidemiol* 105: 587-590 (1970).

Zuni Diabetes Project

BRUCE LEONARD, MPH
 CAROL LEONARD
 ROBERT WILSON, MD

Mr. Leonard is a Health Educator on the staff of the Public Health Service Indian Hospital in Zuni, NM. Carol Leonard served as a volunteer Aerobics Coordinator for the project. Dr. Wilson is the Diabetes Control Officer on the staff of the Zuni hospital.

Tearsheet requests to Dr. Wilson, PHS Indian Hospital, Box 467, Zuni, NM 87327.

Synopsis.....

Widespread type II diabetes among North American Indians and certain other populations is a relatively recent medical phenomenon. Increased

prevalence of diabetes appears to be related to sudden cultural shifts toward sedentary lifestyle and increased caloric intake. These changes, superimposed on a genetic predisposition to diabetes, pose a community health threat to the Zuni and similar populations.

Regular aerobic exercise is clearly beneficial to most type II diabetics. The key public health issue is how to establish community participation in effective aerobic activity. The Zuni Diabetes Project, fully described here, serves as a model in this respect.

DIABETES MELLITUS WAS RARELY REPORTED IN Native American populations prior to 1940—not for lack of investigation but because it was, in fact, uncommon (1). Prevalence rates have increased so rapidly and dramatically during this half of the century that diabetes is considered epidemic among many tribes of North American

Indians (1,2). The Pima of Arizona demonstrate the highest prevalence rates in the world with 50 percent of the population over age 35 affected (3). The Zuni Indians of western New Mexico were estimated, by chart review in 1978, to have a diabetes prevalence of 25 percent in the over-45 age group (4). The prevalence figure for this same

group is now closer to 40 percent, a crude estimate based on the 1984 Zuni Public Health Service Hospital Diabetic Registry.

At least a partial explanation for the explosive increase in rates of diabetes among Native Americans is the sudden change in living conditions that occurred on reservations during the mid-century. Segments of populations in the Pacific Basin have undergone similar changes with urbanization and economic development. Their diabetes prevalence is now much higher than hereditarily identical segments of the population that are, as yet, undeveloped (5, 6).

Among the Zuni, lifestyle suddenly became more sedentary as agriculture, stock-raising, hunting, hand labor, foot transportation, and foot-racing gave way to jewelry-making and marketing, mechanization, motor vehicle transportation, and television. A high-fiber diet based on corn meal products, beans, and supplemental meat has been supplanted by a highly refined diet based on processed foods with large proportions of simple carbohydrates, animal fat, and protein. Equally important, with economic development and government aid, abundant food is constantly available. In a traditionally feast-or-fast culture, feast conditions, in effect, now exist year around. These lifestyle changes, occurring in populations which are perhaps "thrifty genotypes" whose calories are super-efficiently stored and insulin metabolism is altered, are likely primary factors in the rapid upsurge of obesity and diabetes in these populations (7-9).

The Zuni Diabetes Project, based on this theory of genetic predisposition, has focused its resources on promoting lifestyle changes in physical activity and diet. It is known that physical activity will improve glucose homeostasis in some noninsulin-dependent diabetics and could be very effective in preventing certain cardiovascular complications of diabetes (10-12). Within 2 weeks of cessation of exercise, however, improvements gained in insulin function and fasting glucose levels are significantly diminished (11). Medical research, then, demonstrates that in order for increased physical activity to be of significant value, lifestyle change must be permanent. To our knowledge, none of the controlled studies of exercise in diabetics has followed subjects for longer than 6 months.

Nearly all current treatment regimens for noninsulin-dependent (type II) diabetes recommend a physical conditioning program—with particular caution towards, or exclusion of, patients with poor diabetic control, pre-existing cardiovascular

disease, neuropathy, or proliferative retinopathy (10, 13-15). We are not aware, however, of any other public or community programs structured for the purpose of enlisting diabetics in regular physical activity, providing motivation, guidance, and education, and following their clinical response.

The Zuni Diabetes Project has been in operation, for these purposes, since July 1983. It is an exercise-education program designed to provide primary and secondary prevention of type II diabetes.

Zuni Community Profile

The Pueblo of Zuni, encompassing more than 400,000 acres in western New Mexico, has an Indian population of 7,754, of whom 33 percent are less than 16 years of age. The Zunis are a tribe whose lifestyle is shaped to a large extent by tradition and religious doctrine. They still speak the Zuni language.

The local economy is based on jewelry making, livestock raising, and employment with the Indian Health Service, the Bureau of Indian Affairs, tribal agencies, the school system, and a few local enterprises. Nonetheless, the estimated unemployment rate among Zunis is 77 percent.

Type II diabetes is the most prevalent disease among Zunis. In 1984, diabetes was the leading cause of outpatient visits to the Zuni Public Health Service Hospital. Of the many complications arising from diabetes, renal failure has shown an alarming increase among Zunis. Eleven of 23 patients with end-stage renal disease are diabetic. Serious complications of diabetes, including infections, neuropathy, amputations, retinopathy, and periodontal disease are seen frequently in Zunis. (Macrovascular complications are less common.) The burden of diabetes on the Zuni Reservation is growing rapidly, both for the Zuni People and the Indian health care system.

Description of the Project

Thirty diabetic patients were selected to participate in the exercise-education program on the basis of their projected compliance as predicted by the Zuni Public Health Service medical staff. The health educator sent each candidate a letter detailing the program and its merits, inviting them to participate. The letters were augmented by phone calls and home visits.

'Among the Zuni, lifestyle suddenly became more sedentary as agriculture, stock-raising, hunting, hand labor, foot transportation, and foot-racing gave way to jewelry-making and marketing, mechanization, motor vehicle transportation, and television.'

Exercise classes were to be held twice a week in a gymnasium centrally located within the pueblo, with the health educator personally choreographing and leading the exercises. The initial response was dismal; with the exception of the health educator, attendance was zero for the first six classes. This initial lack of response to the program could be attributed to participants' self-consciousness, skepticism about the efficacy of weight-loss as a means of controlling blood glucose levels, aversion to exercise, and lack of familiarity with the health educator who was new in the community.

Eventually, one diabetic woman attended the seventh class. She brought a friend the following week, and by the end of the second month, there were eight regular participants. Slowly, attendance grew to the point where there are now 50 men and women in the program.

Program attendance appears to have been increased by word-of-mouth referrals and the visible signs of weight-loss in class members. Friends and relatives were recruited as the program grew in credibility. The publicity that the program received through television news shows and local newspaper articles may have interested others. The majority of participants seem to have become involved through the influence and persuasion of other members. In addition, persons newly diagnosed as diabetic are now referred to the exercise-education program by the medical staff. Because of the risk involved, no patients with proliferative retinopathy or known cardiovascular disease were recruited.

Fitness Component

The format of the exercise program includes an hour-long routine performed to music, with 12 to 15 songs per routine. New exercise routines are introduced approximately every 2 months.

The hour is divided into five segments: warm-up, aerobics, heart-rate monitoring, strength, and cool down.

Warm-up. Class begins with a 5–10 minute warm-up. The purpose of this phase is to prevent injury by “warming up” major muscle groups and increasing flexibility and to elevate the heart rate gradually in preparation for the aerobic phase.

Aerobic. This phase lasts 20–30 minutes, with the aim of elevating heart rates to 60–80 percent of maximum capacity for a sustained period (20 minutes minimum).

Heart-rate monitoring. Each class member receives an age-adjusted heart rate chart indicating his or her target heart rate for the aerobic phase. Beginners are advised to limit exertion to 60 percent of maximum heart-rate capacity; those in better condition are encouraged to work at 70–80 percent. Pulse checks are taken intermittently during the aerobic segment to insure that individuals are working within the appropriate intensity level.

Strength. Calisthenics for strength conditioning follow the gradual tapering of the aerobic component. These exercises concentrate on strengthening muscles of the arms, shoulders, abdominal wall, lumbar region, buttocks, and legs. In addition to enhancing muscle endurance, the regimen serves to prevent injuries by strengthening supportive tissue. This segment of the program lasts approximately 30 minutes.

Cool-down, stretching. This final phase of 5 to 10 minutes stretches muscles that have contracted during the aerobic and strength portions of the program, increases flexibility, and enables heart rates to return to pre-exercise levels slowly. The recovery pulse is measured to insure that class members do not leave with elevated heart rates. By tracking the decreasing number of beats per minutes in successive recovery periods, cardiovascular fitness can be gauged.

Adherence Factors

Convenience. Not to be overlooked as an adherence factor is the matter of convenience. Sedentary persons usually will not go out of their way to seek fitness events or exercise classes. For this reason, the Zuni Diabetes Project exercise class meets at a centrally located high school cafeteria

within walking or bicycling distance of most Zuni homes. Class hours are convenient for the majority of the participants.

Organized context. The ultimate success of a program depends on organization and competent leadership. Participants must be able to count on the punctuality and consistency of exercise leaders and organizers. The Zuni Diabetes Project exercise classes begin promptly at 9 a.m. Substitute instructors have been trained and are available when the regular instructors cannot be there. Cancelled classes are announced in advance. The regular exercise instructors are well trained, with certification from the Institute of Aerobic Research in Dallas, TX, and participants know they can count on safe, properly designed classes.

Education. Health and fitness information is consistently provided through printed materials and lectures that are scheduled every other week preceding the exercise class. Topics include exercise precautions, nutrition, weight control theory, lifestyle considerations, diabetes information, and other health topics.

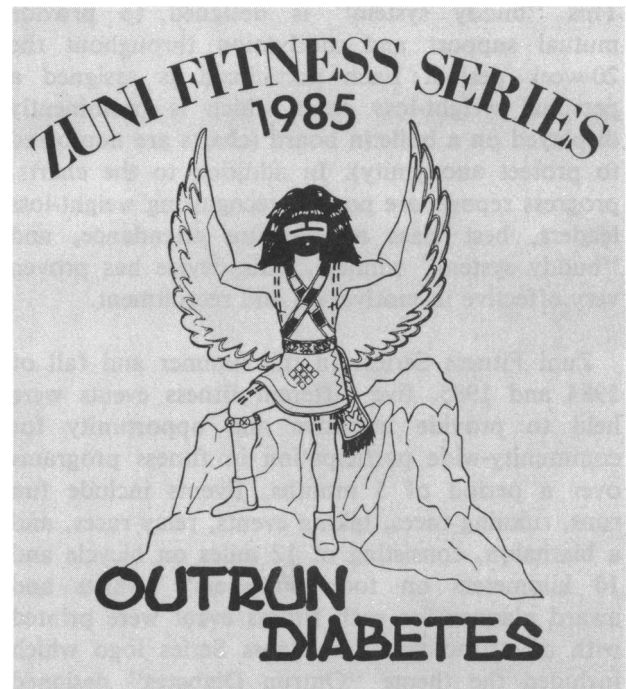
The Indian Health Service medical staff is closely involved with the program. Once a week, clinics are held in conjunction with the exercise classes. At the time, physicians monitor patient progress, check serum glucose and blood pressure, and dispense medicines from a small portable pharmacy. The opportunity for individuals to see their health provider at the class instead of the hospital is an attractive inducement for program participation. A provider's appearance at the class serves to demonstrate to patients that exercise is an appropriate treatment modality. Often the providers join in the exercises and enhance their own credibility as role models.

Assessment and feedback. Every participant undergoes an initial physical assessment, which is repeated periodically throughout the year. The assessment consists of determining weight, skin fold thickness, blood pressure, anthropomorphic measurements, resting pulse, and blood sugar. A person who may be frustrated because of slow weight loss can usually find encouragement through periodic assessments that reveal loss of inches, decreased body fat, or lower blood pressure. Periodic one-on-one counseling is another productive method of feedback. It allows the program director to provide encouragement, demonstrate concern, and address specific problems.

Motivation. A variety of methods are employed to enhance motivation and stimulate enthusiasm for physical activities.

Special events. To encourage wider community involvement and provide a broader range of exercise opportunities, special events offering reward incentives have been conceived.

The "100 Mile Club" and the "250-Mile Club". Participants must run or walk a minimum of 2 miles 3 days a week, with progress recorded weekly. A bar graph illustrating each participant's progress is maintained on a large bulletin board. Once the goal of 100 miles has been achieved, the individual is awarded a silkscreened "Zuni 100 Mile Club" T-shirt. Those who attain 250 miles are awarded running shorts. There is a minimal enrollment fee which partially defrays the cost of the T-shirts and shorts. The balance is funded by the Hospital Employees' Club and the Zuni Diabetes Project.



Logo used for the fitness series on T-shirts and posters

Weight Control Program. This 20-week behavior modification program encourages a half-pound per week weight-loss goal. Participants pay a set fee in the beginning, which is eventually reimbursed in the form of financial rewards for attending exercise classes and health and fitness lectures, completing written and exercise homework, and for attaining their half-pound per week goals.

'The initial response was dismal; with the exception of the health educator, attendance was zero for the first six classes. This initial lack of response to the program could be attributed to participants' self-consciousness, skepticism about the efficacy of weight-loss as a means of controlling blood glucose levels, aversion to exercise, and lack of familiarity with the health educator, who was new in the community.'

Bonus rewards are paid every fifth week to the pair of participants who have lost the most weight. This "buddy system" is designed to provide mutual support and motivation throughout the 20-week period. Each participant is assigned a personal weight-loss chart which is prominently displayed on a bulletin board (charts are numbered to protect anonymity). In addition to the charts, progress reports are posted, recognizing weight-loss leaders, best class and lecture attendance, and "buddy system" winners. This device has proven very effective in motivation and recruitment.

Zuni Fitness Series. In the summer and fall of 1984 and 1985, five different fitness events were held to provide incentive and opportunity for community-wide participation in fitness programs over a period of 5 months. Events include fun runs, running races, biking events, relay races, and a biathlon, consisting of 12 miles on bicycle and 10 kilometers on foot. Finishers' T-shirts and award plaques for each fitness event were printed with an attractive Zuni fitness Series logo which included the theme "Outrun Diabetes" designed by a local Zuni artist. The T-shirts became coveted items, adding motivational impetus for the series.

Zuni Winter Aerobic Challenge. This structured incentive program was designed to motivate the community to remain physically active during the winter by encouraging participants to select from a number of aerobic activities, such as cross country skiing, swimming, stationary bicycling, aerobic exercise class, and many others. Aerobic points are

awarded depending on the activity, duration of activity, and intensity level. This aerobic point system was developed by Dr. Kenneth Cooper and is delineated in his book "The Aerobics Program for Total Well Being."

Participants maintain a log of weekly activities and point totals during the months of January and February, with certificates and T-shirts awarded to those who attained good, excellent, or superior fitness levels. Participants pay a nominal enrollment fee to help cover the cost of T-shirts and certificates (those who do not want a T-shirt or certificate are allowed to enroll free of charge).

Rewards. In addition to the incentives already mentioned, exercise mats have been awarded to those who lost 5 pounds and were able to maintain that weight loss for 2 weeks. Those who managed to lose 15 pounds and maintain the weight loss for 3 weeks were awarded running shoes. All persons who have successfully controlled their blood sugars and been taken off medication have received "I Outran Diabetes" T-shirts. Such rewards have proven to be very effective motivational tools. The incentive provided by the financial rewards was surprisingly high, relative to the very modest incremental expenses meted out. Special event T-shirts, singlets, and running shorts are visible signs of status and achievement, particularly in a small community where everyone is aware of the fitness events commemorated in the sports apparel.

Bulletin boards. As mentioned previously, a bulletin board located in a high-visibility area can be an effective means of disseminating information, posting achievements and progress, and providing participant feedback. Additionally, it is useful in promoting programs and attracting broader participation.

Recognition. Essential to the success of any behavior modification program is recognition of accomplishment provided by the program director, peers within the program, and the public at large. This can be achieved through variety of means, including awards, publicly displayed charts and graphs, and public acknowledgement offered by the program director at classes and lectures.

Periodic physical assessment is a valuable means of providing feedback to individuals participating in a weight-control program. Periodic one-on-one counseling is another method of feedback. It allows the program director to provide encouragement, demonstrate concern, and address specific problems.

Progress chart of diabetic participants in Zuni Diabetes Project with regard to weight and average fasting serum glucose.

Individual	Weight (pounds)		Fasting serum glucose (mg/dl)		Time span	Diabetes medication
	1-year average before beginning	Most recent or when stopped	1-year average before beginning	Most recent or when stopped		
A.....	240	190	200	120	2 yrs, 2 mos	Never on
B.....	209	174	233	107	2 yrs., 1 mo.	Discontinued
C.....	181	170	300	120	11 mos.	Discontinued
D.....	143	163	155	123	2 yrs., 2 mos.	Discontinued
E.....	160	133	2 yrs.	Never on
F.....	174	146	168	126	1 yr., 11 mos.	Discontinued
G.....	174	156	130	133	1 yr., 6 mos.	Discontinued
H.....	184	172	198	147	1 yr., 4 mos.	Never on
I.....	180	185	415	234	10 mos.	Still on
J.....	177	157	233	130	1 yr.	Discontinued
K.....	180	168	253	155	6 mos.	Discontinued
L.....	199	181	152	137	4 mos.	Discontinued
M.....	211	201	208	136	5 mos.	Reduced
N.....	187	181	320	300	5 mos.	Still on
O.....	187	181	264	160	3 mos.	Never on
P.....	172	159	230	93	4 mos.	Never on
Q.....	156	154	270	228	4 mos.	Reduced
R.....	144	143	199	110	4 mos.	Reduced
S.....	141	138	117	114	4 mos.	Discontinued

Results

A total of 220 Zunis have been involved in the diabetes project, at one time or another, from July 1983 to September 1985. The age range of participants is 22 to 55 years. Exercise attendance currently averages from 30 to 50 persons per class.

An unexpected but gratifying observation has been the finding that most exercisers in the program are people who have been obese and sedentary their entire adult lives. Through a combination of peer role models, supportive family and friends, and motivational elements connected with the Diabetes Project, these formerly nonathletic adults are now embracing a fitness-oriented lifestyle.

The goal of persons with or without diabetes was to lose weight slowly through increased aerobic activity and minimal adjustments in eating habits. Sixty-one persons have lost an average of 21 pounds.

Approximately 35 persons with diabetes (and many more at risk of developing diabetes) have participated in the Zuni Diabetes Project. Changes in weight and average serum glucose are illustrated in the table for more than half of these persons. The remaining participants were either inconsistent in long-term attendance (less than 3 months) or were not weighed or had serum glucose measurements within the year prior to entry in the project.

Seventeen of 19 persons lost weight in amounts ranging from 1 to 50 pounds (see table). Seventeen of 18 persons achieved reduction in average fasting serum glucoses ranging from 3 milligrams per

deciliter (mg/dl) to 181 mg/dl (see table). Nine of these diabetic patients were taken off insulin or oral hypoglycemic therapy, and all but one had reduced glucose levels. Five were never started on medication, and five others were still taking some diabetes medication as of August 1985 (see table).

The ultimate goal of the Zuni Diabetes Project is to create within the Zuni community a culture that encourages healthy lifestyles and insures sustained behavior change. The project has served as a catalyst for the creation of 48 weekly community exercise classes. These classes are available at worksites, for special population groups, and for the general public. Twenty Zuni aerobic instructors have been trained and certified to lead these classes. Training and certification for these leaders has been conducted by the health educator's wife and the St. Joseph's Hospital Health and Fitness Center of Albuquerque, NM. Worksite classes include nine a week for hospital employees, daily classes for tribal employees, and classes available for the staff at three school sites. There are now five weekly aerobic fitness classes offered for persons with diabetes, three classes for the elderly, and three classes for pregnant women. Classes are available for the general public several times a day every day of the week.

The "Outrun Diabetes" Zuni Fitness Series has just completed its third summer. In the summer of 1983, there were two monthly events and a total of 223 participants. The series was expanded to five monthly events during the summer of 1984 and had 1,180 participants. During the 1985 five-event series, the participation grew to 1,570 runners.

'An unexpected but gratifying observation has been the finding that most exercisers in the program are people who have been obese and sedentary their entire adult lives. Through a combination of peer role models, supportive family and friends, and motivational elements connected with the Diabetes Project, these formerly nonathletic adults are now embracing a fitness-oriented lifestyle.'

Especially gratifying was the remarkable number of older, nonathletic Zuni participants.

Forty seven runners and walkers accomplished the task of covering 100 miles and were awarded Zuni 100 Mile Club T-shirts. Fifteen went on to receive "Zuni 250 Mile Club" running shoes. More than 150 members of the community earned Zuni Winter Aerobic Challenge T-shirts, and 200 have signed up for the Zuni Fall Aerobic Challenge.

Four 20-week weight control programs have been conducted with a total of 99 participants, with a 9.7-pound weight loss average.

Conclusion

Type II diabetes often can be controlled or prevented by losing weight through regular aerobic exercise and decreased caloric intake. It is difficult to motivate people to modify their activity levels and eating habits.

The Zuni Diabetes Project initiated a variety of strategies to encourage these behavior changes. Short-term goal setting and incentives were used to encourage participation. Developing role models was a very important aspect of the program. Many individuals who lost weight and controlled their blood sugars were trained as leaders and became powerful community advocates and inspirations. The social environment of the entire community was altered to accommodate and reinforce the new cultural fitness norms that are emerging. This was accomplished by providing a variety of exercise options such as runs, aerobic classes, weight control programs, and aerobic challenges; encouraging family and group opportunities and estab-

lishing administrative leave policies that support worksite exercise programs.

From July 1983 to September 1985, 220 Zunis participated in diabetes project exercise classes, and 61 individuals have lost an average of 21 pounds. Most of the 35 diabetic participants have improved fasting serum glucoses, despite reduction of dosage or discontinuance of diabetes medications.

References

1. West, K. M.: Diabetes in American Indians and other native populations of the new world. *Diabetes* 23: 841-855, October 1974.
2. Hill, C. A., Jr., and Spector, M. I.: Natality and mortality of American Indians compared with U.S. whites and non-whites. *HSMHA Health Rep* 86: 229-246 March 1971.
3. Knowler, W. C., Pettitt, D. J., Savage, P. J., and Bennett, P. H.: Diabetes incidence in Pima Indians: contributions of obesity and parental diabetes. *Am J Epidemiol* 113: 144-156 (1981).
4. Long, T. P.: The prevalence of clinically treated diabetes among Zuni reservation residents. *Am J Public Health* 68: 901-903, September 1978.
5. Zimmet, P., et al: The prevalence of diabetes in the rural and urban Polynesian population of Western Samoa. *Diabetes* 30: 45-51, January 1981.
6. King, H., et al: Non-insulin-dependent diabetes (NIDDM) in a newly independent Pacific nation: the republic of Kiribati. *Diabetes Care* 7: 409-415, September-October 1984.
7. Raffel, L. J., and Rotter J. I.: The genetics of diabetes. *Clinical Diabetes* 3: 49-54, May-June 1985.
8. Knowler, W. C., Pettitt, D. J., Bennett, P. H., and William, R. C.: Diabetes mellitus in the Pima Indians: genetic and evolution considerations. *Am J Phys Anthropol* 62: 107-114 (1983).
9. Neel, J. V.: Diabetes mellitus: A "thrifty genotype" rendered detrimental by "progress"? *Am J Hum Genet* 14: 353-362 (1962).
10. Richter, E. A., Ruberman, N. E., and Schneider, S. H., Diabetes and exercise. *Am J Med* 70: 201-209, January 1981.
11. Ruderman, N. B., Ganda, O. P., and Johansen, K.: The effect of physical training on glucose tolerance and plasma lipids in maturity-onset diabetes. *Diabetes* 28 (supp. 1): 89-92, January 1979.
12. Saltin, B., et al: Physical training and glucose tolerance in middle-aged men with chemical diabetes. *Diabetes* 28 (supp. 1): 30-32, January 1979.
13. DeFronzo, R. A., Ferrannini, E., and Koivisto, V.: New concepts in the pathogenesis and treatment of noninsulin-dependent diabetes mellitus. *Am J Med* 52-81, January 1983.
14. Cataland, S.: New concepts in the treatment of non-insulin-dependent (type II) diabetes mellitus. The Upjohn Co., Kalamazoo, MI, 1981, pp. 1-3.
15. Siscovick, D. S., LaPorte, R. E., and Newman, J. M.: The disease specific benefits and risks of physical activity and exercise. *Public Health Rep* 100: 180-188, March-April 1985.