

# Effectiveness of a Structured Nutritional Intervention Program on Employee Health and Productivity in China

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## Abstract

A clinical pilot study was conducted to test the effectiveness of a structured intervention to improve control and management of type 2 diabetic individuals. Employees from Shanghai Turbine Company, Shanghai Electric Motor Company, and Huadong Hospital participated the study. Care was provided by Department of Clinical Nutrition, Huadong Hospital in Shanghai, China. Subjects were randomly assigned into the treatment (n=100) and control (n=50) groups. The treatment group received an Optium<sup>®</sup> blood glucose monitor to encourage increased testing, diabetes education, and a nutritional diabetic product (Glucerna<sup>®</sup>SR<sup>™</sup>) as meal replacement. The comparison group received with usual care and group diabetes education and dietary counseling. Biomedical parameters and survey of self-reports of health and productivity were obtained at baseline and six months (endpoint) of the study.

Individuals in treatment groups showed the significant improvement in glucose and blood pressure control, while those changes were not significant in control group. Treatment group also increased their dietary nutrient intakes significantly.

Both groups recorded improvements in diabetes symptom severity, but improvements were greater in the treatment group. The treatment group improved in overall physical health and capacity to meet output work demands, but overall there were no differences between groups at endpoint. Both groups demonstrated improved satisfaction with diabetes management and information, linked to dietary counseling and improved diabetes awareness. These results are indicative of the promise this type of intervention offers for assisting in the management of diabetes in employee populations.

## Introduction

- The prevalence of type 2 diabetes in China has increased from 4.6% in 1995 to 6.4% in 2002 among large urban cities, and from 3.4% to 3.9% in middle and small size cities, representing a 44% and 15% increase, respectively.
- WHO predicted that the number of diabetes patients in China will reach 37.6 million by 2025 (King et al., 1998), and it will be the second largest in the world. Diabetes has become a heavy burden to public health, and it impacts quality of life for individuals and productivity for employers.
- Undiagnosed diabetes accounted for 2/3 of total diabetes population, and 2/3 of those diagnosed patients could not reach the treatment goal.
- Evidence-based research has strongly suggested that medical nutritional management can help to achieve and maintain better metabolic control in individuals with diabetes.
- Present study was designed to apply a structured diabetes intervention to provide knowledge about better diabetes control and management for individuals with type 2 diabetes.

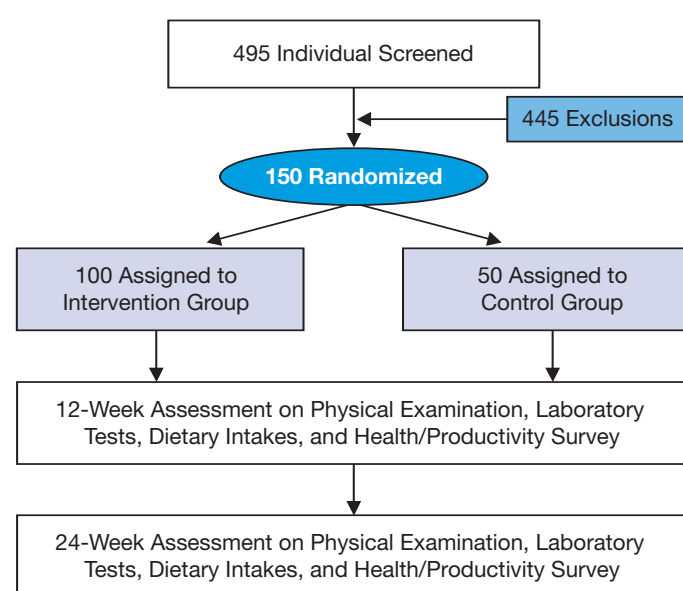
## Objective

Primary objective was to compare the effectiveness of this structured diabetes management program compared to usual care in people with diabetes who were also overweight. The secondary objective was to examine the burden of diabetes on health and productivity measurements obtained from self-reported information about health status, work productivity and work safety.

## Study Design

Present study was designed as a randomized clinical trial with a total of 150 participants. Individuals who were assigned to the intervention group received a structured diabetes intervention program consisting of Glucerna<sup>®</sup>SR<sup>™</sup> (GSR) as a meal replacement as part of an individualized diet plan, scheduled glucose monitoring with instruction, and a diabetes education program that included instruction about diet and nutrition, exercise, and other diabetes management related information (Figure 1).

Figure 1. Study Design



For those in the control group, usual diabetes care was provided. However, all individuals in the control group received the same glucose monitor (Optium<sup>®</sup>) with test strips, and all education materials after the completion of the study to benefit the participants equally.

## Selection of Study Population

Study participants were selected from employees of Shanghai Tubing Company, Shanghai Electric Motor Company (each with more than 1000 employees), and outpatients of HuaDong Hospital. Sampling method is also shown in Figure 1. All participants signed Informed Consent Forms before being enrolled into the study, and the study protocol was approved by the Institutional Review Board of Huadong Hospital.

### Inclusion Criteria

- Age 18–70 years
- BMI  $\geq 24$  kg/m<sup>2</sup>
- Previous diagnosed with type 2 diabetes
- No current participation in any other disease management or intervention program

## Study Measurement

All questionnaires, interviews, physical examinations and laboratory tests were conducted at baseline and were repeated at the end of the study, except the KYN questionnaire, which used a shortened version at endpoint.

### Questionnaires

- A KYN questionnaire that collected information on demographic characteristics, health behavior, physical activity, and medical history.
- Dietary questionnaire that obtained information on 24 hr recall, food frequency, and change of dietary habits.
- Productivity questionnaire with questions on health status, work productivity, work safety and quality of life (QOL).

### Physical Examination

- Height
- Weight
- Waist and hip circumference
- Blood pressure

### Laboratory Tests

- Fasting glucose
- Fasting insulin
- HbA1c
- Total cholesterol, LDL and HDL cholesterol, triglycerides

## Results

- No statistical difference was seen between treatment and control group for all subject characteristics at baseline (Table 1).

Table 1. Sample Characteristics at Baseline: Treatment vs. Control Group

Characteristic	Treatment (n=100)	Control (n=50)
Age (yrs), mean (Std)	50.7 (6.1)	51.1(7.8)
Body weight (kg), mean (Std)	75.8 (7.4)	75.7 (10.8)
BMI (kg/m <sup>2</sup> ), mean (Std)	26.7 (2.8)	27.2 (2.3)
Male, # (%)	74 (74.0)	34 (68.0)
Education, # (%)		
Middle school	16 (32.7)	27 (27.6)
High school	16 (32.7)	35 (35.7)
College	+17 (34.6)	36 (36.7)
Smoking, # (%)	54 (54.0)	18 (36.0)
Hypertension, # (%)	27 (54.0)	49 (49.0)

No statistical significance between treatment and control group in all variables.

- There was an 18% and 8.1% reduction in glucose and HbA1c, respectively for the treatment group at endpoint. LDL-cholesterol, and blood pressure of the treatment group were also decreased significantly at endpoint (Table 2).

Table 2. Mean Values of Metabolic Variables

Outcome Variables	Treatment (n=100)		Control (n=50)	
	Baseline	6-month	Baseline	6-month
Blood Glucose (mmol/L)	8.3	6.8 <sup>1</sup>	8.7	7.7
HbA1c (%)	7.1	6.5 <sup>2</sup>	7.0	7.0
Insulin (pmol/L)	25.0	21.8	31.8	23.3
Total cholesterol (mmol/L)	4.8	4.7	5.2	4.9
HDL-cholesterol (mmol/L)	1.23	1.16 <sup>3</sup>	1.26	1.13 <sup>3</sup>
LDL-cholesterol (mmol/L)	2.88	2.56 <sup>3</sup>	2.93	2.63
Triglycerides (mmol/L)	1.23	1.16	1.26	1.10
SBP (mmHg)	131.1	124.5 <sup>4</sup>	135.1	130.1
DBP (mmHg)	86.8	83.5 <sup>5</sup>	88.9	87.3

<sup>1</sup> < 0.0001, <sup>2</sup> < 0.01, <sup>3</sup> < 0.05, <sup>4</sup> > 0.05.

- Treatment group had a 2.6% reduction in waist circumference compared to a 1.6% increase in control group (Figure 2a). Prevalence of metabolic syndrome decreased 18% in treatment group (p<0.05), and it slightly increased in control group without statistical significance (Figure 2b).

Figure 2a. Change of Waist Circumference at Endpoint

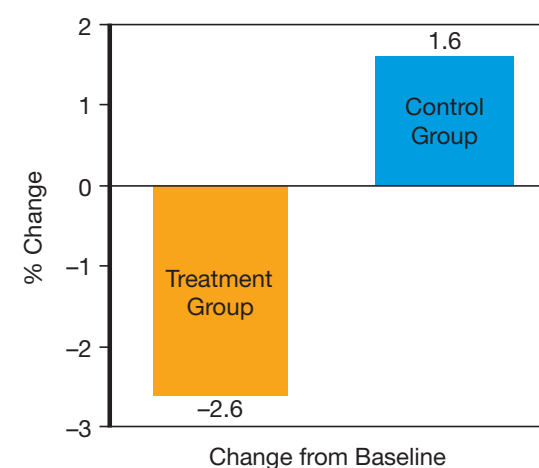
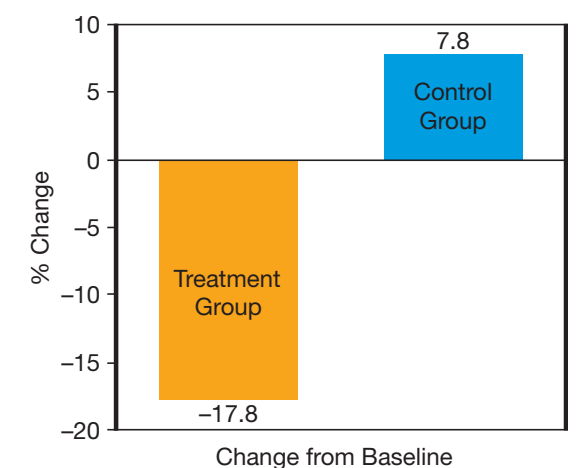


Figure 2b. Change of Metabolic Syndrome Prevalence at End of the Study



- Most of the nutrient intakes of the treatment group were significantly increased at endpoint compared with baseline except total energy and carbohydrate intake. The intake of thiamin and vitamin E were also significantly increased in the control group (p<0.05) but by a smaller proportion than that of the treatment group (Table 3).

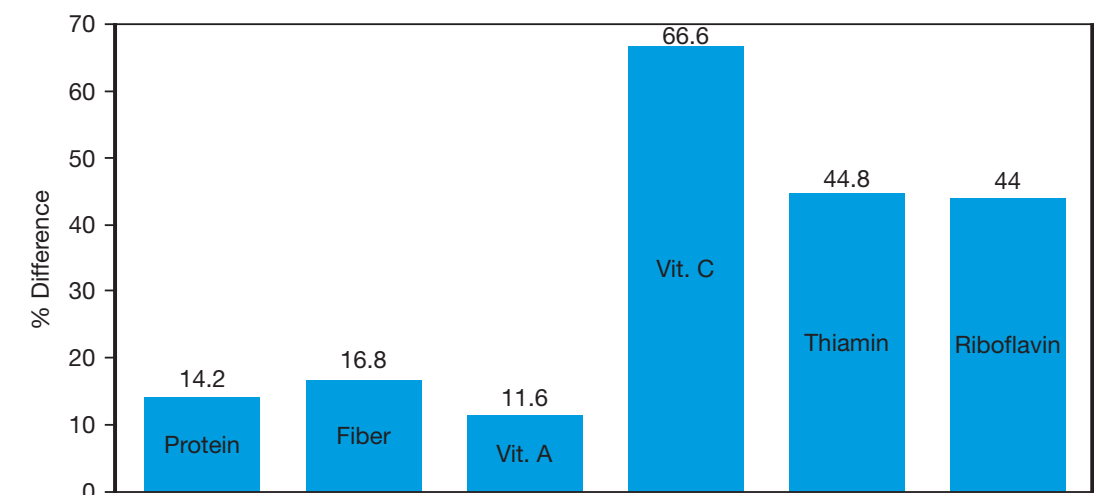
Table 3. Mean Dietary Intake of Nutrient

Outcome Variables	Treatment (n=100)		Control (n=50)	
	Baseline	6-month	Baseline	6-month
Energy (kcal/day)	1478.9	1389.5 <sup>4</sup>	1459.4	1270.6 <sup>5</sup>
Protein (g/day)	78.0	82.0 <sup>4</sup>	78.6	71.7 <sup>4</sup>
Carbohydrate (g/day)	230.3	185.3 <sup>3</sup>	225.8	180.7 <sup>7</sup>
Fat (g/day)	28.3	35.6 <sup>1</sup>	26.9	29.0 <sup>4</sup>
Fiber (g/day)	6.7	7.4 <sup>4</sup>	6.9	6.3 <sup>4</sup>
Thiamin (mg/day)	0.97	1.26 <sup>1</sup>	1.06	0.87 <sup>3</sup>
Riboflavin (mg/day)	0.81	1.20 <sup>1</sup>	0.84	0.84 <sup>4</sup>
Vitamin C (mg/day)	70.9	129.5 <sup>1</sup>	73.9	77.8 <sup>4</sup>
Vitamin E (mg/day)	11.4	38.6 <sup>1</sup>	10.4	11.5 <sup>2</sup>
Niacin (mg/day)	13.4	17.6 <sup>1</sup>	152.4	13.6 <sup>4</sup>

<sup>1</sup> < 0.0001, <sup>2</sup> < 0.01, <sup>3</sup> < 0.05, <sup>4</sup> > 0.05.

- Figure 3 demonstrates the difference (%) of nutrient intake between treatment and control groups at endpoint (all p < 0.05).

Figure 3. Differences of Nutrient Intake Between Treatment and Control Group at Endpoint



- Treatment group significantly improved in overall physical health and diabetes symptom severity. It also reported significant or near significant improvements in output work demands and the Work Limitation Questionnaire (WLQ) Index (Table 4). Treatment group recorded significant within-group reductions on the "need more information" measure. It also posted significant within-group gains in the frequency of blood glucose testing and in satisfaction with the outcomes and overall approach to management of the condition.

Table 4. Managing the Burden of Diabetes

Outcome	Treatment Group		Control Group	
	Baseline	6-month	Baseline	6-month
Testing				
Blood Glucose: How Often Checked	1.38	3.66 <sup>1</sup>	1.51	1.78 <sup>2</sup>
Feet: How Often Checked	0.20	0.15	0.2	0.06
Evaluation				
Needs More Info re: Management	65.9	47.7 <sup>1</sup>	75.5	58.4 <sup>1</sup>
Overall Management of Diabetes	69.6	70.2 <sup>1</sup>	58.9	67.6 <sup>1</sup>
Health: Last 4 wks				
Overall Physical Health	50.2	51.4 <sup>2</sup>	49.1	48.9
Diabetes Symptom Severity	17.4	13.7 <sup>2</sup>	16.1	17.1
Productivity: Last 4 wks				
Output Work Demands	11.4	5.5 <sup>2</sup>	9.6	7.3
WLQ Index	6.7	5.9	6.6	6.0
Absentee Days	0.18	0.07	0.82	0.09
Total Lost Days	1.04	.68	1.99	0.78
Safety: Last 12 months				
Accidents/Injuries	0.07	0.06	0.12	0.08

<sup>1</sup> p < 0.01, <sup>2</sup> p < 0.05

## Summary

- This structured intervention program demonstrated significantly reduced blood glucose, insulin, HbA1c levels and blood pressure, improvement in diabetes and hypertension control in the treatment group compared to control group.
- Using GSR as a meal replacement provided sufficient nutrient intake such as protein, fiber, vitamin A, C, E, thiamin and riboflavin, after 6-month intervention.
- The intervention also showed that participants largely increased the frequency of glucose testing, gained more knowledge of diabetes management and control, improved individual's overall physical health, productivity level, and work safety score.
- Regarding the improvement in productivity and safety, more study is needed to investigate this issue further. It seems that the intervention needed to be more potent, such as longer intervention time, increase of study sample size, and better study control.