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Impact of diabetes education and self-management support on the 4D series of diabetes patients.

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Abstract

The aim of this study was to assess the impacts of diabetes education and self-management support towards the 4D series of diabetes patients. A total of 1243 cases were selected through the single-blinded method, using a random number table, with 622 and 621 cases included in the experimental and control groups, respectively. The experimental group received health education, which extended towards diabetes self-management support, while the control group received traditional health education. Through questionnaires, observations, and other methods, the self-management skills, blood glucose and lipid levels, incidences of complications, cost issues, and other aspects of the two groups were compared. The 5- and 10-year self-management skills, glucose and lipid metabolism changes, incidences of acute and chronic complications, medical costs (i.e., 4D series observations) in the experimental group were significantly better than those in the control group (P<0.01 for all). These results indicate that extension of diabetes health education towards self-management support could effectively improve the self-management skills of diabetes patients, reduce the medical costs, and improve the patients' quality of life.

Keywords: Diabetes, Diabetes education, Self-management support, 4D series impacts.

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Introduction

Diabetes-related health improvements achieved from self-management education interventions, such as patient empowerment, have become widely recognized as a compelling paradigm in diabetes care. Diabetes is a long-term comprehensive metabolic disease, and is a major public health issue worldwide. It is estimated that 23.6 million people in the United States, 7.8% of the population, are suffering from diabetes, a serious and lifelong disease. Among these, 17.9 million people have reportedly been diagnosed, while 5.7 million remain undiagnosed. In 2007, approximately 1.6 million people aged 20 years or older were diagnosed with diabetes [1]. In 1995, India, China, and U.S. were estimated to have the highest numbers of people with diabetes in 2000 and 2030. In accordance with this estimation, China currently has the highest number of diabetics in the world, and the disease has reached epidemic proportions in the adult population. Particularly, type 2 diabetes, accounting for a large proportion of diabetes cases in adults, has reached an epidemic level worldwide, especially in the past 2 decades. In Asia [2], diabetes is life-threatening, and the prevalence continues to rise, with an increasing numbers of younger individuals now suffering from the disorder [3].

Diabetic acute and chronic complications are closely related to poor glycaemic control. Too high levels of blood glucose can cause serious problems, including damage to the eyes, kidneys, and nerves. Diabetes can also cause heart disease and stroke, and limb amputations may be necessary in serious cases [4], indicating the great physical and psychological suffering of the patients. The global pattern of this disorder has shown rapid and dramatic growth, with the subsequent burden falling increasingly onto countries with limited resources for the treatment [5,6]. Active diabetes health education should be carried out to provide a theoretical basis for achieving effective and long-term adherence to self-management; this could aid in the establishment of effective prevention and treatment of diabetes, and in a reduction of the incidence of diabetic complications [7-11]. Accordingly, diabetes education has become an important and indispensable therapeutic measure, and is now included in the comprehensive treatments of the patients, thereby affecting the development and prognosis of the disease [12].

The American Diabetes Control and Complications Trial showed that conducting diabetes education and obtaining the patients' active cooperation are prerequisites of achieving good glycaemic control [13], while another study found that the key to reducing the incidence of diabetes is to maintain a healthy lifestyle, while the key to reducing the complications of diabetes is to strictly control the blood glucose level [14]. Hence, carrying out health education in diabetic patients, establishing proper health behaviours, and mastering the

relevant preventive measures are keys to preventing and treating diabetic complications [15]. Especially, possession of self-management behaviours is the cornerstone of diabetes care. Patient empowerment positively influences the self-management behaviours of patients with diabetes. The availability of mindful eating and diabetes self-management education-based approaches offer the patients greater choices and opportunities in meeting their self-care needs [16]. Presently, the forms, contents, and education management models of the Chinese Diabetes Education are relatively poor and limited, and a self-management education model and long-term evaluation and analysis of the educational effects are still lacking.

With this in mind, in this research, a long-term, systematic, individualized, and comprehensive health education model was extended towards diabetes self-management support, and was compared with traditional diabetes education to observe the impacts from the 4D (4-dimensional variational) series; that is, to evaluate the effectiveness of the two health education models in terms of improving the self-management skills, controlling the glucose and lipid metabolism, and reducing the incidence of acute and chronic complications and the medical expenses, with the aim to verify the inevitability and scientific validity of implementing an extension of the health education towards diabetes self-management support.

Subjects and Methods

General information

Diabetic patients (n=1,243), treated at the Affiliated Chenggong Hospital of Xiamen University from March 2000 to November 2002, were selected using a single-blinded method, and the patients were divided into experimental and control groups according to a random number table. The enrolled number of cases in the experimental group was 732; of these, 124 cases were lost to follow-up (69 cases dropped out, 40 cases lost contact, and 15 cases died; dropout rate, 16.9%), resulting in 622 patients finally being included in the study. The enrolled number of cases I the control group was 728; of these, 132 cases were lost to follow-up (69 cases dropped out, 42 cases lost contact, and 21 cases died; dropout rate, 18.1%), resulting in 621 patients being included in the final analysis. The experimental group included 312 males and 310 females, aged 19 to 65 years, with disease duration of 1 to 15 years. The control group included 312 males and 309 females, aged 20 to 65 years old, with disease duration 1 to 15 years.

The inclusion criteria were the following: patients who met the World Health Organization diagnostic criteria of diabetes, with consciousness and normal thinking, and who were capable of linguistic communication, possessed a certain ability of learning, capable of independently performing activities of daily living, and who permanently resided in Xiamen. Moreover, the patients had to be willing to participate in more than 70% of the health education classes, be willing to cooperate, and be able to be followed-up regularly for 5 to 10 years. Finally, all participants had to voluntarily provide written informed consent. The exclusion criteria were as follows: patients suffering from acute or chronic complications at the time of diagnosis of diabetes, patients suffering from severe liver or kidney dysfunction, pregnant or breast-feeding mothers, patients with other serious systemic illnesses, and patients who left the study before its completion or were lost to follow-up.

The current study was reviewed and approved by the Affiliated Chenggong Hospital of Xiamen University review board and is in accordance with the ethical standards of the Helsinki Declaration. Informed consent was obtained from all subjects.

Treatment methods

The control group received conventional health education, including regular delivery of health education materials, broadcasting of short films and videos, and a monthly lecture. The experimental group received extended health education towards diabetes self-management support; the main implementers were professional staff members, including endocrinologists, diabetes-educating nurses, dieticians, psychological counsellors, etc. In this group, the patients' demands of health education on diabetes were continuously met by clearing all existing issues, expressing their feelings, and setting goals to help the patients identify constructive solutions, and by developing an individualized mentoring program [17]. The Fasting Blood Glucose (FBG) and 2-Hour Postprandial Glucose (2h-PBG) were monitored once a week at no charge, and the Glycosylated Haemoglobin (HbA1c) and Total Cholesterol (TC) levels were tested once every three months. The FBG, 2h-PBG, HbA1c, and TC data were recorded for analysis and countermeasure investigations, carried out by diabetes-educating nurses, endocrinologists, and nutritionists, for patients whose blood glucose, blood lipids, and blood pressure did not reach the standards. Subsequently, behavioural observations and nursing measures were implemented based on the theoretical frameworks of self-determination and self-support. The patients took full responsibility for the self-management. Follow-up was performed one month later.

In the experimental group, the knowledge defects of the patients were individually targeted, and the educational tools were used to enhance the teaching information and mobilize the participants' interest and motivation. The health education team also opened a telephone-counselling service, timely answering the patients' questions, performing monthly in-home follow-ups, promptly addressed the disease management of the patients, and helped the patients to overcome any restrictions due to the disease as a means to improve the patients' follow-up compliance. At the same time, the importance of the patients' family members in promoting the self-management should also be considered [18], and psychological counselling was made available for the psychological care of the patients [19].

Self-management refers to each individual patient having the ability to manage the disease, including any changes in

symptoms, the treatment, physical and social relationships, and lifestyle. During the implementation process, traditional health education imparts knowledge to the patient, while it lacks individualized behavioural interventions, thus not allowing the knowledge of diabetes to be implemented into the activities of daily living, or for complex treatment issues to be simplified. With the self-management method, the patients receive lectures from the medical staff but subsequently draw their own conclusions. On the other hand, traditional health education uses "spoon-feeding" education, without considering the individual patients' needs. The extension of the education towards self-management support adapts a suitable, reasonable, and individualized self-management approach, which has been discussed with the patient, fully respecting the patient's autonomy, and is settled through communication with the patient; this should be adapted happily by the patients. According to the specific conditions of the educators and patients, a single or combined educational mode can be selected, as appropriate, to develop the individualized behavioural intervention, and the follow-up adherence can be improved through a variety of means.

After the application of extended management of the self-management support, the treatment programs can be continuously modified by the patient; accordingly, the programs to which the patient could adhere to are selected. The patients' subjective sense, self-management skills, and concept of responsibility for their own health are the major factors considered to affect the overall treatment effects; therefore, the patient compliance can be continuously improved.

The management mode of traditional diabetes education still lacks systematic and comprehensively estimated analytical methods towards the effectiveness of the education, as well as additional information and supporting evidence; in other words, the educational contents of diabetes lack systematics, consistency, and repeatability, and can therefore not meet the patients' demands of diabetic education.

In our hospital, health education has been carried out in the Diabetes Health Education Center for 12 years, continuously incorporating the latest domestic and foreign theories, while, at the same time, experiences have been summarized, ideas have been developed, and active methods have been explored. The main models of health education in our hospital are as follows: the same five steps of the nursing-procedural health education model (assessment, diagnosis, planning, implementation and evaluation), with a different focus. Using problem-based learning pedagogy; that is, questions are used as guidance, and the patient's self-help discussion is set as the theme, helping the patient to identify constructive solutions, i.e., the problem-based learning teaching mode. Based on the psychology, combined with the stimulating theory and cognitive theory, namely the health belief model; With self-determination and self-support set as the theoretical framework, the diabetes patients assume the full responsibility of self-management, and the responsibility of the health education commissioner is to provide the patients with information, technology, and support, rather than choosing the management approach for the patient. Hence, the educators need to give up the idea of authority, letting the patients make their own choices and determine their own behaviours, namely the authorized health model.

Measurements of observation indicators

The pre- and post-health-educational 5- and 10-year metabolic control levels, self-management skills, incidence of acute and chronic complications, and medical costs of the two groups were evaluated, as detailed below.

Self-management skills: The patients' diet and exercise habits, the times of initiative blood-glucose-monitoring per week, and self-foot-care were recorded and assessed. Self-management was measured by the Diabetes Empowerment Scale-Short Form, an 8-item scale assessing the perceived ability to manage the psychosocial demands and challenges associated with diabetes.

Metabolic parameters: The FBG and 2h-PBG were measured with the Johnson blood sugar measuring instrument (USA), and the HbA1c was measured with the Johnson in2it monitoring instrument (USA), while the Body Mass Index (BMI) was measured and calculated by the following formula: weight (kg)/length (m^2).

Complications (calculated through inquiry, medical records, and doctor visits to hospitals, community clinics, and emergency services): cases of diabetic ketoacidosis, hypoglycaemia, and infections (skin, lung, intestine, urinary tract, and foot) were inquired. Cases of hypertension were defined according to the diagnostic criteria of the Chinese Hypertension Prevention Guidance; Cases of diabetic nephropathy were defined according to the following diagnostic criteria; consecutive urine protein >0.5 g/24 h for three months, in the absence of other chronic glomerulonephritis, glomerular disease, or urinary tract infection; Cases of diabetic retinopathy were diagnosed by comprehensive mydriatic fundus examination by ophthalmic professionals and was evaluated according to the diagnostic staging criteria of diabetic retinopathy. Cases of diabetic neuropathy were diagnosed by comprehensive neurological examination by specialists and were diagnosed according to the criteria of the MDNS classification [20]. Diabetic macro vascular complications included at least one of the following: changes in the myocardial enzyme spectrum or dynamic electrocardiogram findings, clinical coronary heart diseases (such as angina pectoris and myocardial infarction) diagnosed by coronary angiography and color doppler ultrasound, cerebral infarction diagnosed by cranial magnetic resonance imaging and computed tomography, and cerebral haemorrhage, artery atherosclerosis, stenosis, or occlusion confirmed by limb vascular color doppler ultrasound or 320-slice computed tomography-angiography [21].

Medical costs (inquired through the medical-insurance system): the costs of clinical services and hospitalization were determined, and were subsequently calculated as the cost per capita/year (in RMB).

Statistical analysis

A database was established and all data were analysed with SPSS v. 11.5 software. The percentages, means, and standard deviations (x ± S) of the various factors were calculated. Comparisons of categorical data were performed using the χ^2 test; the mean ± SEM of 2 samples were analysed. Where appropriate, statistical significance was assessed by unpaired Student's t-tests or one-way ANOVA followed by Dunnett's test for multiple group comparisons. For all analyses, P<0.05 was considered to indicate statistical significance.

Results

There were no significant differences in the case number, sex, age, educational level, occupation, disease duration, household income, diabetes knowledge level, FBG, 2h-PBG, HbA1c, serum TC, triglycerides, BMI, blood pressure, and the drug dosage between the two groups (P>0.05). During the long-term follow-up, it was found that the patients exhibited better compliance in the first year after the diagnosis of diabetes, while many patients went back to their original lifestyles thereafter.

Comparison of the self-management skills

There was no statistically significant difference in the comparison of the general clinical data and dropout rate between the two groups (χ^2=0.000, P>0.05); the cases lost to follow-up did not significantly impact the results of this study.

The 5- and 10-year results of whether the patients could select an appropriate diet structure according to the disease requirements (i.e., could rationally apply the "Chinese diet pagoda" (Chinese Diet Balance Index (DBI) based on the current Chinese Dietary Guidelines and Food Guide Pagoda) for the rational integration of carbohydrates, fats, and proteins), adhere to a daily exercise routine (exercise for at least 30 min, 5-7 times per week), adhere to self-monitoring (blood glucose was monitored every week), and perform foot care were better in the experimental group than in the control group (P<0.01 for all) as shown in Table 1.

Comparison of glycolipid metabolism

The 5- and 10-year results of the HbA1C, TC, triglycerides, FBG, 2h-PBG, and BMI in the experimental group were significantly better than in the control group (P<0.01 for all) as shown in Table 2.

Comparison of acute and chronic complications

The 5- and 10-year rates of diabetic ketoacidosis, hypoglycaemia, infections, hypertension, diabetic retinopathy, diabetic nephropathy, diabetic neuropathy, and macroangiopathy were significantly lower in the experimental group than in the control group (P<0.01 for all) as shown in Table 3.

Comparison of medical costs

The 5- and 10-year annual medical costs were significantly lower in the experimental group than in the control group (P<0.01 for both) as shown in Table 4.

Table 1. *Comparison of self-management before and after the education.*

Observation indicator	Control group (n=621)			Experimental group (n=622)		
	Before	5 years later	10 years later	Before	5 years later	10 years later
Select the diet structure according to the disease requirements	237	414	394	214	563**	525**
Adhere to the daily exercise	207	498	479	224	505*	467
Adhere to the self-monitoring of BG changes	187	375	355	194	573**	526**
Perform the foot care according to the requests	148	276	306	165	389*	330*

Note: Intragroup comparison, P<0.05, P<0.01; compared with the control group, *P<0.05, ** P<0.01.

Table 2. *Comparison of metabolic indicators of the 2 groups before and after the education.*

Observation indicator	Control group (n=621)			Experimental group (n=622)		
	Before	5 years later	10 years later	Before	5 years later	10 years later
HbA1C	10.9 ± 1.5	7.7 ± 1.1	7.9 ± 1.2	11.2 ± 1.7	6.9 ± 1.2*	7.0 ± 1.1*
TC	6.9 ± 1.5	5.8 ± 1.4	6.0 ± 1.5	7.3 ± 1.4	4.2 ± 0.8**	4.6 ± 0.9**
TG	2.8 ± 1.5	2.0 ± 1.0	2.1 ± 1.1	3.0 ± 1.4	1.4 ± 0.5**	1.5 ± 0.08**
FBG	9.8 ± 2.8	8.2 ± 1.4	8.0 ± 1.9	9.9 ± 3.4	6.1 ± 1.5**	6.7 ± 1.8**
2 hPBG	15.3 ± 5.5	12.2 ± 2.8	11.9 ± 2.4	15.7 ± 5.9	8.0 ± 3.4**	9.0 ± 2.8**
BMI	23.9 ± 2.2	23.4 ± 2.1	23.2 ± 2.5	24.4 ± 2.5	24.1 ± 2.0	21.8 ± 1.5**

Note: Intragroup comparison, P<0.05, P<0.01; compared with the control group, *P<0.05, ** P<0.01.

HbA1c: Glycosylated Haemoglobin; TC: Serum Cholesterol; TG: Triglycerid; FBG: Fasting Blood Glucose; 2hPBG: 2h Postprandial Blood Glucose; BMI: Body Mass Index.

Table 3. *Comparison of the acute and chronic complications of the 2 groups.*

Observation indicator	Control group (n=621)	Experimental group (n=622)

	5 years later	10 years later	5 years later	10 years later
DKA	20	19	2	10
Hypoglycaemia	148	118	58*	49
Infection	177	138	78*	77
Hypertension	269	312	248	289
Diabetic nephropathy	135 (21.3)	175 (28.1)	55 (8.8)	78 (12.5)
Retinopathy	250	277	210	225
Neuropathy	220	296	180	217
Macroangiopathy	72	98	78	86

Note: Intragroup comparison; DKA: Diabetic Ketoacidosis; P<0.05, P<0.01; compared with the control group, *P<0.05, **P<0.01.

Table 4. *Comparison of medical costs of the 2 groups before and after the education.*

Observation indicator	Control group			Experimental group		
	Before	5 years later	10 years later	Before	5 years later	10 years later
Annual medical costs	4325.05 ± 2593.21	3528.15 ± 2162.13	3461.29 ± 2293.75	4473.31 ± 2689.62	3128.15 ± 1994.28*	3291.53 ± 1862.15

Note: Intragroup comparison, P<0.05, P<0.01; compared with the control group, *P<0.05, **P<0.01.

Discussion

Diabetes is a chronic disease that can be successfully self-managed. As the treatments are complex, the patients need to make numerous self-management decisions every day, and the management hence needs to be patient-centered, and the education method of the patients' needs to be based on the chronic disease care model. In fact, diabetic self-management education and continuous self-management support can directly affect the efficacy of the diabetes treatment [22]. Effective self-management emphasizes that the patient initiatively undertakes the responsibility of self-management, caring about his/her health to maintain and improve the quality of life, actively monitoring the disease condition, maintaining life quality, and actively cooperating to complete the treatment [23,24]. At the same time, the patient must also adjust his/her behaviour and emotions. The self-management support includes the continuously changing treatment procedures by the primary health care system and also the patients' self-management method promoted by social organizations. Through such self-management support, the patient can be helped to understand the questions formed and the relevance of the disease.

In this study, the results of the 5- and 10-year clinical comparisons showed that extending the health education towards the education of self-management and self-management support was better than the traditional health education, with significant improvements observed in the self-management skills, glycolipid metabolism, occurrence of acute and chronic complications, and medical costs of the patients (P<0.01).

In short, the success of blood glucose management in diabetic patients is closely related to the establishment of a reasonable lifestyle, and the establishment of effective self-management behaviours is particularly important for diabetes education [25]. Meanwhile, timely application of communication software should be used to manage and intervene, and for achieving immediate education and follow-up, between doctors and patients. The diabetic image-dialogue educational tool and the insulin-usage interview kit can be used to improve the educational experience. Moreover, through establishing a "diabetes club," the diabetes-related knowledge, beliefs, and behaviours of the patients can be enhanced. Our results indicate that an empowerment-based approach to diabetes self-management support is promising for improving and/or sustaining diabetes-related health outcomes, particularly glycaemic control.

There are some limitations to this study that need to be acknowledged. First, due to funding constraints, we were unable to use a randomized controlled trial design for this study. Second, detailed information of the treatment changes (e.g., types of medication or dosage) was not collected. Therefore, the unique influence of the provider behaviour could not be examined.

Conclusion

This study achieved remarkable results of improving the diabetes self-management skills, controlling the level of glycolipid metabolism, reducing the incidence of acute and chronic complications, reducing the medical costs, and other aspects through the extension from long-term systemic strengthened educational interventions towards diabetes self-management support. Moreover, the extension implementation of health education to diabetes self-management support was verified to be feasible and effective.

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