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ARTICLE

Managing diabetes mellitus in underserved subjects of Western China using a telemedicine system— A clinical trial

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ABSTRACT

Objective: To evaluate the effectiveness of Internet and telephone-based telemedicine system managing on patients' glycemic index, blood pressure, and lipid level control in underserved subjects with type 2 diabetes in Western China. **Research designs and methods:** In a 3 years, randomized, controlled, single-blind, parallel-group treat-to-target study, 412 subjects with type 2 diabetes were randomized to telemedicine (Tel; n =208) group and usual care (control; n =204) group. We evaluated the effects of the intervention on blood sugar, blood pressure, and lipid levels at 1, 2, 3 years point, and investigated the cause of the loss during follow-up by phone call. **Results:** Intra-group comparison: in the Tel group, the FBS, 2HPG, HbA1c, and SBP at 1, 2, 3 years and DBP, TC, TG, BMI at 2, 3 years were significantly decreased compared with baseline level ($P<0.05$). Moreover, the Tel group had an obvious better control of their HbA1c at 2 and 3 years and 2HPG at 3 years of follow-up respectively compared with the outcomes at 1 year ($P<0.05$).Inter-group comparison: the FBS, 2HPG, and HbA1c of Tel group decreased significantly from the baseline to the 1 year more than those of control group ($P<0.05$ or $P<0.01$). In this analysis, all clinical measures of Tel group had a significant downward compared with the outcomes of Control group at 2 years, the FBS, HbA1c and BMI ($P<0.001$), the 2HPG and SBP ($P<0.01$) and DBP, TC, and TG ($P<0.05$) were statistically significant respectively. Logistic regression analysis showed that the subject loss during follow-up was associated with worse diabetes management (OR=3.842), low income (OR=3.201), low education level (OR=0.923), and greater distance to the hospital (OR=0.921).**Conclusions:** The study results indicated that the telemedicine may be a useful tool for managing diabetes mellitus.

1. Introduction

The increased incidence of type 2 diabetes (T2DM) and associated increases in mortality are important challenges facing the world [1]. Diabetes can damage the heart, blood vessels, eyes, kidneys and nerves, leading to foot amputation and related deaths. The World Health Organization predicts that diabetes-related mortality will double between 2005 and 2030 [2]. In China, the study found that the overall prevalence of diabetes in adults is estimated at 11.6%; of these, 12.1% of men and 11.0% of women [3]. The pre-diabetes prevalence rate of Chinese adults was 50.1%: 52.1% for men and 48.1% for women. It is worth noting that the pre-diabetes prevalence

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rate of rural residents is slightly higher than that of urban residents, especially men. In addition, pre-diabetes are more prevalent in economically underdeveloped areas and overweight and obese people. These studies suggest that the incidence of diabetes may reach alert levels among Chinese adults, and diabetes can lead to major epidemics of related complications, including cardiovascular disease, stroke and chronic kidney disease. If the Chinese government does not adopt effective state interventions, diabetes will be a serious problem in the near future. [3].

Diabetes patient education and interventions can improve patients' self-care activities, maintain metabolic stability, improve quality of life, and prevent or delay the development of complications [4]. In a systematic review of 41 studies involving 48,000 patients, the researchers described the effectiveness of professional guidance, organizational transformation, and patient-centered interventions for health professionals [5]. However, most of these studies have been selected in cities with good health care. In contrast, many patients, particularly the underserved do not attain these recommended levels of care, due to poverty, economic backwardness, and poor insurance. A lot of people with uncontrolled Type 2 diabetes do not achieve recommended targets including blood sugar, blood pressure, and lipid levels. Presently, diabetes management is seldom reported in underserved subjects of the economically underdeveloped area. We, therefore, implemented a telephone and internet-based system for offering professional care management for an underserved type 2 diabetes patients with or without medical insurance in poor areas of Western China.

2. Research Design and Methods

2.1. Patients

The study protocol was approved by an independent ethics committee at each center, based on the Helsinki Declaration and Clinical Practice Guidelines. All volunteers provided written consent before the study [6]. We conducted a randomized, controlled, single-blinded, paralleled-group study to test the hypothesis that an internet and telephone-based communication systems of diabetes care will allow more patients to reach individualized target blood glucose level when compared with usual care. Each patient obtained an ID using a computer-based random number generator on internet system, and then had adequate allocation concealment using serially numbered sealed opaque envelopes. Statistical outcomes were interpreted blindly by a statistician. There are five basic elements in research design: education and behavioral guidance, development of treatment plans, care management, team care methods, and physician leadership. Develop all the details of the study, including clinic staff and leadership training, patient process protocols and a detailed description of the budget.

2.2. Inclusion and Exclusion Criteria

Population of people from ten counties and districts of remote areas in the West of China were studied. Volunteers were recruited from county-level hospitals, community activity centers, medical affiliated hospitals, and medical centers. The inclusion criteria are: a. Diagnose patients with T2DM, b. Adults between the ages of 20 and 65, c. Ability to live independently, d. Ability to complete the questionnaire independently, e. Informed and agreed to participate in the study and sign an informed consent form.. The exclusion criteria were: a. patients who were pregnant, planning a pregnancy, or currently lactating during the study, b. patients with severe diabetic complications and c. patients with liver and kidney dysfunction. Eventually the eligible 412 subjects were randomly divided into two groups based on telemedicine: telemedicine (Tel) group with 208 people and control group with 204 people (usual care).

2.3. Organization Training

Patients in telemedicine management (telephone group) receive diabetes-related care management, including diabetes education, self-management, and medication guidance, which consists of nurse administrators and doctors at research centers. In addition, telemedicine subjects have received training in telemedicine use. Control subjects (control group) were provided with data from their baseline assessment and instructed to contact their primary caregiver for further care. No further intervention was provided for the control subjectsDue to local funding needs and the willingness of employees to participate in diabetes quality improvement training, intervention clinics and follow-ups were purposefully selected. All costs from baseline to final follow-up of biochemical and serological tests for the eligible 412 subjects relied on the local funding. The cost of drug and other tests from baseline to final follow-up relied on medical insurance or fee-paying.

2.4. Follow-up

412 patients were followed up, each telemedicine patient was followed up once every three months by the professional nurse and once every six months by the professional physician alternately, excluding the exit patients. While the nurse called patient via telemedicine system to provide diabetic care, the physician gave instruction on

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the treatment, the nurse ask physician for help. Overview of care for people with diabetes, such as medication use, diet planning, exercise, blood glucose monitoring, dietary restrictions, medication adherence, foot care and smoking cessation[7]. Diabetes and quality of life, such as diabetes condition control, treatment satisfaction, social life and sexual function[8]. Subsequently each patient was seen at a follow-up visit at least once every 1 year and the indicator for further observation was completed at the research center. The clinical goals of the telemedicine program include raising hemoglobin A1c levels to 7.0%, blood pressure (BP) to below 140/90 mmHg, and triglyceride (TG) levels to below 150 mg/dL. When the patient's hemoglobin A1c, blood pressure and TG levels are higher than the clinical target, the doctor will increase the patient's medication regimen, including current medication metrology adjustments and new oral medications or insulin.

2.5. Data Entry

Each patient receives an ID from a random number generator on the Internet. The staff then collected the patient's experimental data using standard procedures at baseline, 1 year, 2 years, and 3 years. Includes demographic characteristics such as age, gender, insurance, duration of diabetes, height, weight (calculated BMI), and blood pressure. Blood samples were obtained by venipuncture and fasting blood glucose was measured using standard laboratory procedures, hemoglobin A1c, total cholesterol, triglycerides, low density lipoprotein (LDL), high density lipoprotein (HDL), aspartate aminotransferase (AST), alanine aminotransferase (ALT) and creatinine. 2h-post-meal plasma glucose (2hPG) was performed after the meal.

2.6. Statistical Analysis

The analysis was performed by SAS 8.1 (SAS Institute Inc., Cary, NC) and GraphPad Prism 5 (GraphPad Software, Inc., San Diego, USA). Results were presented as mean ± SD. Chi-square tests were adopted for comparing differences among the groups. Logistic regression was used to estimate the odds ratio (OR) and 95% confidence interval (CI) of the reason for the loss during follow-up , including diabetes management, income level, education level, and the distance to the hospital. A P value of less than 0.05 was considered statistically significant.

The study may have lost follow-up, and if some random participants are not within the scope of the analysis, the estimated intervention may be biased. This kind of missing imbalance between groups may indicate bias. Intent-to-treat (ITT) analysis aims to randomly include all participants in the trial, regardless of what happens next. In this study, the "last observation" was implemented to assume that no changes occurred; ITT and each protocol (PP) analysis were performed.

3. Results

3.1. Clinical Outcomes

The study was conducted over a 3-year period and we recruited 450 subjects. Out of the total number of the subject recruited, 26 declined to participate in the study after screening process and 12 did not complete screening process. Figure 1 showed a flow diagram of the recruiting process. The sugar, fat, blood pressure and BMI metabolic parameters of four groups were observed at 1, 2, and 3 years. Because of the loss in number of control group exceeded 15%, it was a failure comparison in 3 years.

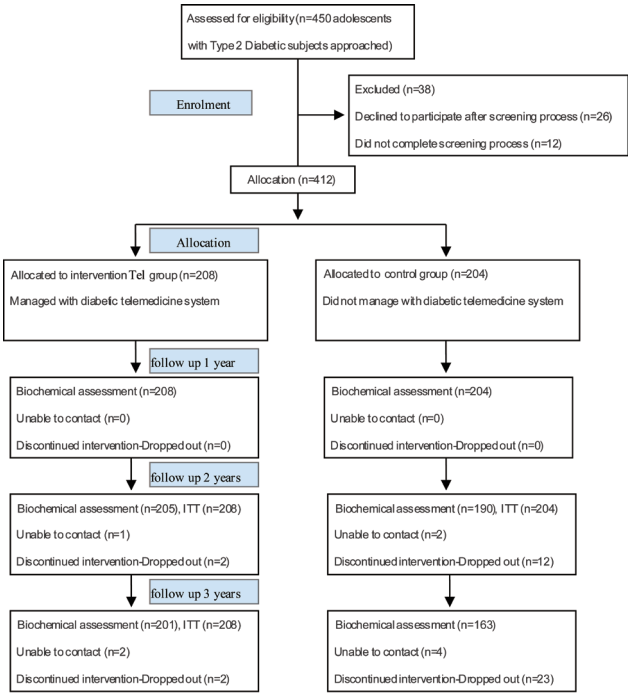

Figure 1. Subject flow diagram. The number of patients at baseline, the frequency of follow-up visits, reasons for withdrawal,number of patients completing the study and the number of ITT. ITT, intention to treat analysis.

As shown in Table 1, there were no statistical significant differences in demographic characteristics or mean clinical parameters at baseline between patients in the intervention and control practices. Sixty-one percent were male, more than 77% had low family incomes at or near the poverty level, and 25% completed high school. Diabetic patients using insulin constituted 13% of the study subjects.

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Table 1. Baseline characteristics of participants by group

Characteristics	Tel group (n=208)	Control group(n=204)	P
Age, years	50.0 (14.9)	51.1 (14.2)	0.5615
Sex			
Male	128	122	
Female	80	82	
Diabetes duration, years	6.1 (5.0)	6.0 (4.9)	0.7612
Height, cm	165.0 (11.2)	168.0 (10.8)	0.0536
Weight, kg	70.6 (10.5)	71.0 (10.7)	0.2906
BMI, kg/ m2	25.1 (2.5)	25.0 (2.6)	0.4261
Systolic blood pressure, mmHg	132.8 (17.2)	130.9 (19.0)	0.1833
Diastolic blood pressure, mmHg	79.0 (8.5)	78.3(9.0)	0.8356
Fasting plasma glucose, mg/dL	146.3 (38.4)	145.0 (39.2)	0.9244
Postprandial 2-h glucose, mg/dL	230.5 (66.6)	227.8 (67.4)	0.7578
A1C, %	8.4 (1.5)	8.4 (1.6)	0.5093
Total cholesterol, mg/dL	165.6 (37.7)	163.5(39.2)	0.2832
Triglyceride, mg/dL	145.2 (58.0)	146.7(57.1)	0.2870
HDL cholesterol, mg/dL	51.4 (10.5)	51.1 (9.7)	0.2204
LDL cholesterol, mg/dL	107.5(25.5)	106.7(23.9)	0.5503
Aspartate aminotransferase, IU/L	22.6 (9.1)	22.3 (8.5)	0.2934
Alanine aminotransferase, IU/L	25.7 (13.1)	25.3 (11.9)	0.7761
Serun creatinine, mg/dL	1.16 (0.25)	1.13 (0.20)	0.1228
Medication for glucose control			
None, n (%)	13(6.3)	13(6.4)	0.7993
Sulfonylurea, n (%)	81(38.9)	77(37.7)	0.7097
Metformin, n (%)	100(48.1)	99(48.5)	0.5037
Thiazolidinedione, n (%)	18(8.7)	19(9.3)	0.3580
a-Glucosidase inhibitor, n (%)	41(19.7)	37(18.1)	0.6306
Dipeptidyl peptidase 4, n (%)	11(5.3)	12(5.9)	0.7921
Insulin, n (%)	22(10.6)	21(10.3)	0.8737
Education level			0.9250
Primary school, n (%)	59(28.4)	65(32.0)	
Junior high school, n (%)	95(45.7)	94 (46.2)	
High school, n (%)	54(25.9)	45(21.8)	
Income			0.9791
low income, n (%)	162 (77.8)	165 (80.8)	
medium income, n (%)	38(18.5)	31(15.30)	
high income, n (%)	8(3.7)	8(3.9)	

Note: Data are presented as mean (SD) or number of participants (%).

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Anthropometric and biochemical parameters after 1, 2, and 3 years of follow-up are summarized in Table 2.

3.2. Intra-group Comparison

In the Tel group, FBS, 2HPG, HbA1c, and SBP (Figure 2 A, B, C, and D) decreased significantly at 1, 2, and 3 years of follow-up, and DBP, TC, TG, BMI (Figure 2E,F,G, and H) also reduced significantly at 2 and 3 years compared with baseline level (P<0.05). Moreover, the Tel group had an obvious better control of their

Table 2. Change of clinical measures at 1, 2 and 3 years follow up by group

Clinical Parameters	Tel group	Control group
FPG (mg/dL) 0 years	146.3 (38.4) (n=208)	145.0 (39.2) (n=204)
1 years	138.1 (34.0) (n=208)	146.1 (38.5) (n=204)
2 years	133.1 (27.0) (n=205) /133.2 (27.1) (n=208,ITT)	147.3(39.0) (n=190) /147.0(38.9) (n=204,ITT)
3 years	132.3(26.9) (n=201) /132.5 (26.8) (n=208,ITT)	- (n=163)
2HPG(mg/dL) 0 years	230.5 (66.6) (n=208)	227.8 (67.4) (n=204)
1 years	216.1 (53.0)(n=208)	230.1 (68.6) (n=204)
2 years	208.9(45.5) (n=205) /202.0(43.6) (n=208,ITT)	230.0 (69.5) (n=190) /229.2(69.5) (n=204,ITT)
3 years	202.2(41.2) (n=201) /203.3(41.6) (n=208,ITT)	- (n=163)
A1C (%) 0 years	8.4 (1.5) (n=208)	8.4 (1.6) (n=204)
1 years	8.0 (1.0) (n=208)	8.4(1.5) (n=204)
2 years	7.6 (0.9) (n=205) /7.7 (0.9) (n=208,ITT)	8.4(1.6) (n=190) /8.5(1.5) (n=207,ITT)
3 years	7.5 (0.8) (n=201) /7.6 (0.8) (n=208,ITT)	- (n=163)
SBP (mmHg) 0 years	132.8 (17.2) (n=208)	130.9 (19.0) (n=204)
1 years	128.8 (17.0) (n=208)	131.1 (19.8) (n=204)
2 years	126.3 (16.4) (n=205) /126.7 (16.3) (n=208,ITT)	131.0 (19.6) (n=190) /131.1(20.2) (n=204,ITT)
3 years	125.1(15.6) (n=201) /125.2(15.7) (n=208,ITT)	- (n=163)
DBP (mmHg) 0 years	79.0 (8.5) (n=208)	78.3(9.0) (n=204)
1 years	78.4 (8.0) (n=208)	78.1 (9.8) (n=204)
2 years	76.1 (7.6) (n=205) /76.3 (7.6) (n=208,ITT)	78.3 (9.9) (n=190)/78.2 (9.8) (n=204,ITT)
3 years	75.3(7.6) (n=201) /75.5(7.6) (n=208,ITT)	- (n=163)
TC(mg/dL) 0 years	165.6 (37.7) (n=208)	163.5(39.2) (n=204)
1 years	162.1 (35.0) (n=208)	164.1 (39.0) (n=204)
2 years	156.7 (30.5) (n=205) /156.9 (30.6) (n=208,ITT)	163.7 (39.1) (n=190) /163.8(39.1) (n=204,ITT)
3 years	155.3(29.9) (n=201) /156.0(29.8) (n=208,ITT)	- (n=163)
TG (mg/dL) 0 years	145.2 (58.0) (n=208)	146.7(57.1) (n=204)
1 years	138.5 (52.4) (n=208)	147.1 (57.8) (n=204)
2 years	132.7 (45.5) (n=205) /133.0(45.6) (n=81,ITT)	145.0 (56.9) (n=190) /145.5(57.0) (n=204,ITT)
3 years	130.3(43.0) (n=201) /130.5(43.1) (n=81,ITT)	- (n=163)
BMI (kg/m^2) 0 years	25.1 (2.5) (n=208)	25.0 (2.6) (n=204)
1 years	24.7 (2.6) (n=208)	25.1 (2.5) (n=204)
2 years	24.3(2.5) (n=205) /24.2 (2.5) (n=208,ITT)	25.2(2.5) (n=190) /25.2(2.4) (n=204,ITT)
3 years	23.9(2.5) (n=201) /24.0(2.5) (n=208,ITT)	- (n=163)
Results are expressed as the mean ± SD. - no statistical data (Loss of follow-up rate was more than 20%). ITT: intention to treat		
Analysis (last observation carried forward). FPG , fasting plasma glucose;2HPG , postprandial 2-h glucose; HbA1c, hemoglobin A1c;		
SBP , systolic blood pressure; DBP , diastolic blood pressure; TC, total cholesterol; TG, triglyceride; BMI, body mass index.		

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HbA1c (Figure2C) at 2 and 3 years and 2HPG (Figure2B) at 3 years of follow-up respectively compared with the outcomes at 1 year (P<0.05).

In addition, the FBS, 2HPG, HbA1c, SBP, DBP, TC, TG, and BMI (Figure2A,B,C,D,E,F,G, and H) of Control group had a slight upward trend from baseline to 2 years, however, this was not statistically significant (P>0.05).

All ITT and PP analysis revealed similar results in Figure 2 (Intention to treat -last observation carried forward data set).

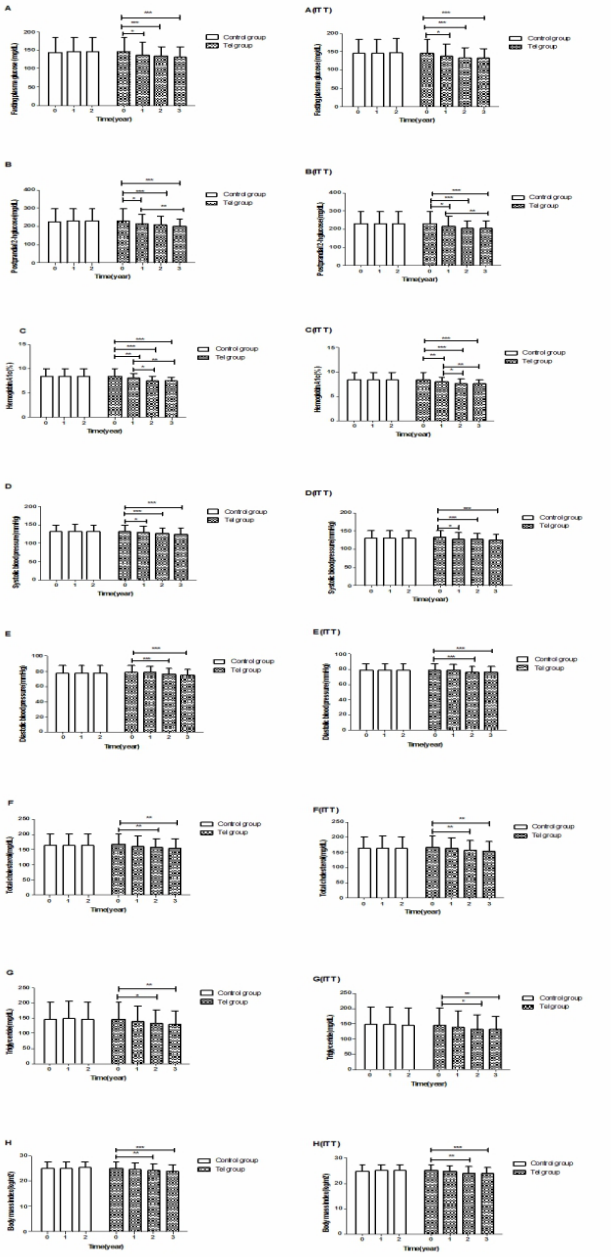


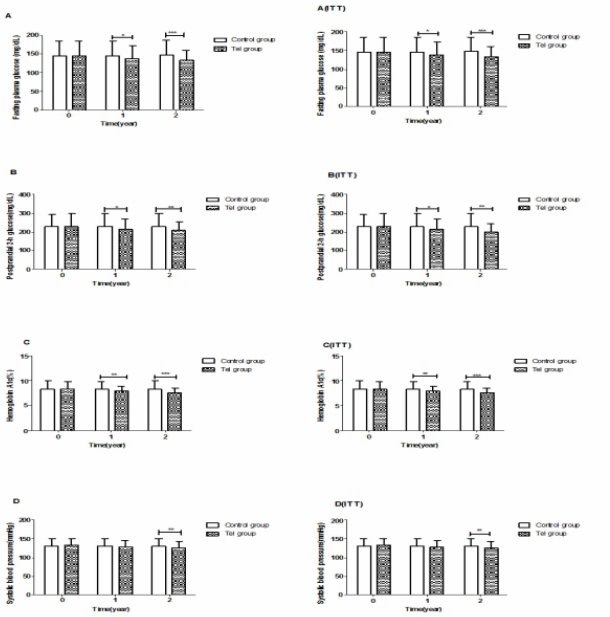
Figure 2. Intra-group comparison of different follow-up times

Note: A: FPG levels of four groups at different follow-up times; B: 2HPG levels of four groups at different follow-up times; C: HbA1c levels of four groups at different follow-up times; D: SBP levels of four groups at different follow-up times; E: DBP levels of four groups at different follow-up times; F: TC levels of four groups at different follow-up times; G: TG levels of four groups at different follow-up times; H: BMI levels of four groups at different follow-up times. A(ITT), B(ITT), C(ITT), D(ITT), E(ITT), F(ITT), G(ITT), and H(ITT): Corresponding index levels of four groups at different follow-up times by ITT. ITT-LOCF: intention to treat analysis-last observation carried forward. Results ara expressed as the mean ± SD. * P<0.05, **P<0.01, ***P<0.001 for comparisons between conditions.

3.3. Inter-group Comparison

As shown in Figure3, the FBS, 2HPG, and HbA1c (Figure 3A,B, and C) of Tel group decreased significantly from the baseline to the 1 year more than those of control group (P<0.05 or P<0.01). In this analysis, all clinical measures (Figure3A,B,C,D,E,F,G, and H) of Tel group had a significant downward compared with the outcomes of Control group at 2 years, the FBS, HbA1c and BMI (Figure 3A, C and H, P<0.001), the 2HPG and SBP (Figure 3B and D, P<0.01) and DBP, TC, and TG (Figure 3E, F and G, P<0.05) of the Tel group decreased more than those of the control group at 2 years, and it were statistically significant respectively.

All ITT and PP analysis revealed similar results in Figure 3 (Intention to treat-last observation carried forward data set).



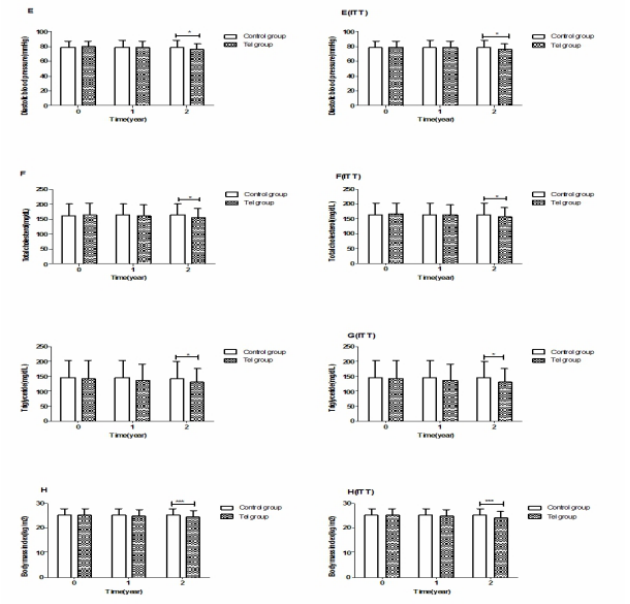


Figure 3. Inter-group comparison of same follow-up times

Note: A: FPG levels of four groups at same follow-up times; B: 2HPG levels of four groups at same follow-up times; C: HbA1c levels of four groups at same follow-up times; D: SBP levels of four groups at same follow-up times; E: DBP levels of four groups at same follow-up times; F: TC levels of four groups at same follow-up times; G: TG levels of four groups at same follow-up times; H: BMI levels of four groups at same follow-up times. A(ITT), B(ITT), C(ITT), D(ITT), E(ITT), F(ITT), G(ITT), and H(ITT): Corresponding index levels of four groups at same follow-up times by ITT. ITT-LOCF: intention to treat analysis-last observation carried forward. Results ara expressed as the mean ± SD. * P<0.05, **P<0.01, ***P<0.001 for comparisons between conditions.

3.4. Logistic Regression Results

The results of the logistic regression model are given in Table 3, which examines the changes from baseline to final follow-up and the probability of loss. In this analysis, the reason for the loss in follow-up was associated with worse diabetes management (OR=3.842), low income (OR=3.201), low education level (OR=0.923), and greater distance to the hospital (OR=0.921).

Table3. Logistic regression results

Effect	regression coefficient	Odds ratio	95% Wald confidence limits		P-value
No diabetes management	1.171	3.842	1.741	1.957	0.009
Low income	1.163	3.201	1.074	9.533	0.037
Education level	–0.079	0.923	0.875	0.977	0.006
The distance to the hospital	–0.083	0.921	1.18	1.50	0.001

Notes: The reason of the lost to follow-up N =48.

4. Discussion

This study is a 3-year RCT that examined a telephone and Internet- based diabetes education intervention for diabetes control in a underserved population of Western China. Studies have shown that there are significant barriers to achieving good care and good clinical outcomes in low-income patients[9, 10]. Parchman et al[11]and Stange[12] how primary care physicians are struggling to cope with competitive demands when attempting to address elevated levels of hemoglobin A1c. Our redesign studies have shown that diabetes care can be effectively managed even in resource-constrained settings.. Because the use of cell phone is ubiquitous, most of the subjects preferred it as a means of communication. Each telemedicine patient was followed up once every three months by the professional nurse and once every six months by the professional physician alternately, excluding the exit patients. The nurse provided diabetic care, the physician gave instruction on the treatment by telemedicine system. Bray et al. For African-American patients who have established diabetes interventions, they are provided with professional care strategies that can ideally control blood glucose based on rural primary care service charges[13]. Our research shows that chronic diabetes management can be done through a professional team and long-term follow-up. In this study, we found that redesigning diabetes care to combine professional care management resulted in significant improvements in blood sugar, blood lipids, and blood pressure. These findings were consistent with those of Johansson et al[14, 15] and Glazier et al[16]. A recent study showed that diabetes and its complications in patients with type 2 diabetes in Taiwan have a combined effect on antidiabetic drugs, lifestyle adjustments, and social and psychological support, as well as diabetes education, compared with a 12.5% drop in HbA1c levels in the control group. The group fell by 26.7%. This indicates the significant role of education and related care in patients with type 2 diabetes [17]. However, these studies did not mention further concern about the reason for the loss in follow-up.

The analysis comparing intervention group to control group patients showed striking differences in response. The telemedicine management can decreased significantly blood sugar, blood pressure and blood lipid compared with control group. The results demonstrated that the telemedicine management was effective in glycemic index, blood pressure, and lipid level control in underserved subjects with type 2 diabetes in Western China. The results of the study are consistent with the benefits of telemedicine, especially among Hispanic Americans, which have the dual qualifications of Medicare and Medicaid, so drug

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costs should not be a problem compared to other populations [18]. However, the Austrian disease management plan implemented through statutory health insurance can improve the quality of the process and increase weight, but it does not significantly improve the metabolic control of patients with type 2 diabetes [19]. The reason for opposite result could be some risk of bias remains. we tried to achieve a study design free of bias, and worked out a randomized, controlled, single-blind, parallel-group treat-to-target study. Meanwhile, perfect diabetes management was a prerequisite for good quality health care delivery, and it could enable more diabetic patients to obtain blood sugar, blood pressure, and blood lipids to standard [20]. Ngo-Metzger et al. found that there is an economic burden for the treatment of diabetes, and because of cost reasons, patients are likely to not adhere to medication. Poor drug compliance is directly related to poor control of diabetes, such as an increase in HbA1c. However, having health insurance does reduce the economic pressure on health care [21]. Therefore, the results of telemedicine management could be more reliable.

In this study, BMI was significantly lower at 2 years than at baseline level in the Tel group, and it was statistically significant($P<0.05$). In addition, the BMI of Tel group decreased more than those of control group at 2 years ($P<0.05$). These findings were consistent with those of Mohamed et al [22] and Delahanty et al [23]. The American Association of Diabetes Educators recommends seven self-care behaviors as new examples of diabetes education, including healthy eating, physical exercise, monitoring, adherence to drugs, problem solving, mitigation and risk reduction [17]. The subjects of Tel group showed weight loss through healthy eating and physical activity, which also reduced the blood sugar. However, BMI of control group had a slight upward trend , but have no prominent difference($P>0.05$). This further proved the telemedicine management is effective to metabolic control.

In addition, 412 patients were followed up, a small number of subjects were lost during the 2 years follow- up period, and ITT and PP analysis revealed similar results, consequently, drawing the conclusion that it was reliable. However, because the lost subjects in control group exceeded 15%, it was failure comparison in 3 years, but the lost subjects of Tel group was less than 5%. Further investigation on the cause of the loss during follow-up by phone-call showed that the four main reasons were referring to worse diabetes management, lower income, lower education level, and greater distance to the hospital; this population with poor sugar control was especially vulnerable to disengagement. West China is regarded as the poorest with the backward areas, subjects have less economic development as they live on low income for a longtime, with poor diabetes care and lower education level. These might be the major cause of loss of subjects during follow-up. Furthermore, these results suggested that it was important to note that increasing the telemedicine management coverage for more subjects received point-of-care diabetes education, self-management coaching, and medication adjustment. Therefore, perfect diabetes telemedicine management might optimize glycemic control and improve compliance leading to reduction of diabetes complications, decreased rates of hospitalization, and mortality.

5. Conclusions

In conclusion, diabetes telemedicine management intervention can decrease blood sugar, blood pressure and blood lipid compared with usual care , and may still improve compliance to reduce the loss during follow-up. Consequently, diabetes telemedicine may be a useful tool for managing diabetes mellitus.

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Author Contributions

Conceived and designed the experiments: YL . Performed the experiments: YL WGM CQX JB YYH . Analyzed the data: YL JB WGM .Contributed reagents/materials/analysis tools: YL WGM CQX JB YYH. Wrote the manuscript: YL .

Competing Interests

There are no conflicts of interest which it is considered would have been likely to influence the content of this paper.

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