Original Article
The effect of experiential learning on attitude and willingness to insulin therapy in patients with type 2 diabetes

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Abstract: In this study we are designing to evaluate the influences of experimental learning theory towards the treatment attitudes and willingness of insulin usage in type 2 diabetic patients who treated with insulin. This is a quasi-experimental study. A total of 400 patients with type 2 diabetes without insulin injections' history were enrolled in this study by convenience sampling and were equally divided into experiential learning group (ELG) and control group (CG) according to their admission time. The CG received routine health education, while the ELG received the diabetes and insulin injection education based on the experiential learning theory. Using questionnaire survey to collect patients' general information, the attitudes towards insulin injection, the incidence of psychological resistance to insulin and the willing score of insulin injectionat baseline and 3 months after hospital discharge. After intervention, the insulin treatment attitude scores in both groups showed a decline, and the scores in ELG was significantly lower than CG (x^2=4.600, P=0.000). The incidence of psychological insulin resistance in ELG showed a significantly decline than CG (x^2=20.135, P=0.000). Both groups showed a rising in willing score of insulin injection, and those in ELG was significantly higher than those of CG (x^2=172.612, P=0.000). The intervention based on experiential learning theory can improve insulin treatment attitudes, reduce the incidence of psychological resistance to insulin and improve the willingness of insulin injection in patients with type 2 diabetes.

Keywords: Experiential learning, type 2 diabetes, insulin treatment, attitudes

Introduction

Diabetes mellitus, or simply diabetes, is a chronic disease characterized by raised glucose levels in the blood (known as hyper-glycaemia) that occurs when the pancreas is no longer able to make insulin, or when the body cannot make good use of the insulin it produces. Over the long-term high glucose levels are associated with damage to the body and failure of various organs and tissues. Diabetes is a growing health problem worldwide nowadays. It was estimated by the Inter-national Diabetes Federation (INF) that 382 million people live with diabetes around the world in the year of 2014, and by 2035, that number will surge to 592 million, and there are 145 million diabetes undiagnosed then [1]. It was reported in Xu's study [2] that the overall prevalence of diabetes in the Chinese adult population was estimated

to be 11.6%, and 12.1% in men, 11.0% in women; the prevalence of undiagnosed diabetes was 8.1%, 8.5% inmen and 7.7% in women; in addition, the prevalence of pre-diabetes was estimated to be 50.1%: 52.1% inmen and 48.1% in women. Retinopathy [3, 4], nephropathy [5], peripheral neuropathy [6], cardiovascular disease [7] and infections caused by diabetes seriously affected the life quality of patients with diabetes [8]. Sim-ultaneously, decreased life quality had a negative influence on patients' medication compliance, as a result, accelerated progress of diabetes and high risk of cardiovascular and cerebrovascular events would be happened [9, 10]. Diabetes mellitus still imposes a huge economic burden on nation-al health care systems globally: data from INF and Chinese Diabetes Society (CDS) indicates thatdirect medical costs caused by diabetes in China were about 124.2 billion to 222.6 billion, and
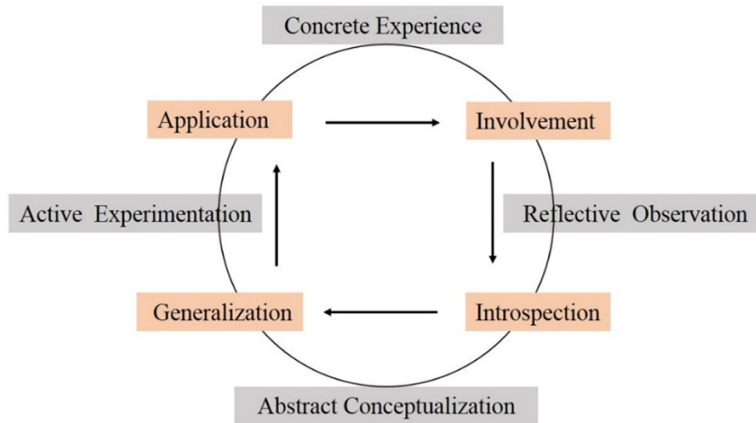
Figure 1. The dynamic cycle experiential learning theory.

the average consumption of diabetes were accounted for 13% of Chinese health resources in the year of 2010 [11].

Insulin therapy is an important method to control high glucose in the blood, and indispensable for patients with type 1 diabetes. Insulin therapy may not be the foremost choice for patients with type 2 diabetes initially, but they have to depend on insulin to achieve and maintain recommended targets for glycemic control if oral agentsfailed or contraindications occurred to oral medication [12]. Many studies have shown that an early initiation of insulin treatment would present a better glycemic control, and was of great significance in reducing the risk of complications related to diabetes [13-15]. Chinese version of education management for the use of insulin in patients with diabetes mellitus described the best timing to initiate insulin treatment: type 1 diabetic patients need to be treated with insulin at the onset of the disease; insulin therapy should be initiated if the treatment combined by life style and oral agents failed to control the glycemic inpatients with type 2 diabetes [16].

Extensive research has showed that lowering HbA_1c levels in patients with Type 2 diabetes mellitus yields a significant reduction in diabetes-related complications and death. Despite the demonstrated efficacy of insulin therapy in achieving and maintaining glycemic control in people with type 2 diabetes, there is still reluctance from patients to initiate this form of therapy. This reluctance to initiate insulin therapy in a timely manner has been termed 'psychological insulin resistance' (PIR) by Leslie in 1994,

he also pointed out that PIR existed not only in patients but also physicians [17]. In the year of 2005, the Diabetes Attitudes, Wishes, and Needs (DAWN) study surveyed patients with type 2 diabetes not taking insulin (n=2061) and diabetes care providers (nurses=1109; physicians=2681) in 13 countries in Asia, Australia, Europe, and North America, the outcome is more than half of patients who had never used insulin expressed anxiety about starting insulin therapy. In China, a study [18] showed that 56.1% of patients with diabetes reluctant to start insulin therapy; another study [19] in 2011 investigated the prevalence of PIR in a community in Beijing, the results showed that 27% patients did not want to start insulin therapy. Negative attitudes toward initiation of insulin therapy were ascribed to following reasons by Peyrot [20]: 1) leads to poor outcomes including hypoglycemia, weight gain, and complications; 2) means the patient's diabetes is worse and the patient has failed; 3) means life will be more restricted and people will treat the patient differently; 4) will not make diabetes easier to manage. Anything else, Mu [21], a professor from China concluded several dominating factors related to PIR: family economic, severity of diabetes, attitude toward hypoglycemia, concerns on insulin injection skill, fears of pain which caused by injection, concerns on gain weight, etc. Mu believed that the factors above would change along with the time of insulin injection. In conclusion, all the factors which concluded by Peyrot and Mu can be attributed to the inadequate knowledgein insulin and issues related to insulin injection.

Experiential learning (EL) theory was developed by David Kolb in the 1970s based on experience learning of John Dewey, group dynamics theory of Kurt Lewinand genetic epistemology of Jean Piaget. It describes ideal learning as a dynamic cycle of four stages (**Figure 1**):

1) Concrete experience, where the topic is approached through personal involvement; 2) Reflective observation, where the topic is evaluated through varying perspectives; 3) Abstract conceptualization, where the topic is analyzed
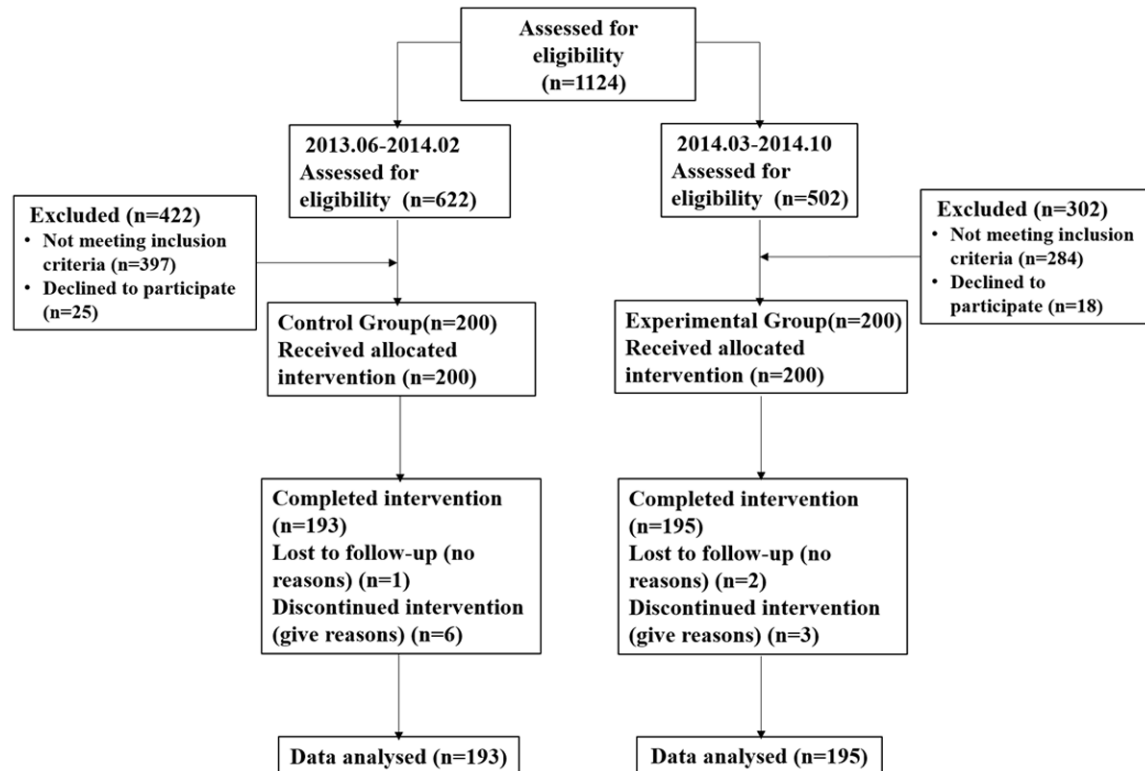
Figure 2. Recruitment and follow-up of participants in the study.

through logic and planning; 4) Active experimentation, where understanding of the topic is influenced through participation and testing.

These four learning modes fall onto two orthogonal dimensions, experience-grasping and experience-transforming. Concrete experience and abstract conceptualization lie at opposite ends of the experience-grasping dimension; reflective observation and active experimentation fall at opposite ends of the experience-transforming dimension [22]. ELT now has become an important teaching method in collegiate pedagogy, and is widely used in school teaching [23-25], as well as clinical teaching for medical students [26-28] and rehabilitation training for patients [29], favorable effects have been received in all the studies above.

We are aiming to apply EL theory to the education for patients with type 2 diabetes who did not have an insulin injection history previously. The main objective of this study is to determine the influence of education based on EL theory on insulin treatment attitude and the incidence of PIR in patients with type 2 diabetes.

Materials and methods

Ethical considerations

This study has been carried out in accordance with the ethical committee of the fifth people's hospital of shanghai, Fudan university. Formal written consent was obtained from each participant before data collection.

Study participants

This study was conducted in the endocrinology department of the Fifth People's Hospital of Shanghai, Fudan University, using a quasi-experimental design. In order to avoid cross contamination, participants in the intervention group (Experiential learning group, ELG) were enrolled from June, 2013 to February, 2014 (**Figure 2**), and the participants in the control group (CG) were recruited from March to October, 2014 (**Figure 2**). The inclusion criteria for participants were:

1) Medical diagnosed of type 2 diabetes; 2) Without insulin injections' history before; 3) Need insulin injection after discharged and do

the injection by themselves; 4) Fully cognitive and behavioral ability; 5) Express willingness to participate.

The exclusion criteria were:

1) Gestational diabetes mellitus or women planning to have a baby recently; 2) Patients intent to go out for a long time (nearly 1-2 months); 3) Patients with severe diabetes complications and comorbidities, diabetic ketoacidosis, stroke, myocardial infarction, or malignancy, etc.

Intervention

Intervention practitioner: Intervention practitioners were nurses in endocrinologydepartment of our hospital. A total of four nurses were needed in our study to implement the intervention, the inclusion criteria for the intervention nurses were as following:

1) Five years working experience in endocrinologydepart-ment; 2) Bachelor's degree or above; 3) Excellent communication and expression skills.

Four nurses were selected based on the inclusion criteria above in our ward; all of the four are nursing clinical teachers in our hospital and have rich experience in patients' health education. Before the study started, the researcher performed a systematic training and assessment for the eligible intervention nurses.

Intervention contents: Patients in CG accepted routine health education related to diabetes and insulin injection after their admission, the routine health education includes:

1) Watching a short video about the insulin injection in the first day; 2) Health education on diabetes related knowledge and insulin injection were provided by the intervention practitioners at the time of hospitalization; 3) After hospital discharged, patients will be invited to the weekly diabetes health education center in the outpatient.

In addition to the routine health education related diabetes, patients in ELG would accept interventions based on experiential learning theory by the intervention practitioners. The main components of the experiential learning intervention are as following:

1) We made a specialized box for insulin injection (SBFII) before the study started, the box can be used to place patients' insulin pen and other materials related to insulin injection. Patients' general information (name, gender, age, bed number, admission number), species, frequency and dosage of insulin injection were written on the surface of the box, moreover, a paper which drawn the steps of insulin injection were paste inside. And in the intervention, the specialized box for insulin injection was placed on the bedside stands. 2) The first day of hospital admission (Theory-study): The intervention nurse explained to the patients in detail about the installation and usage of insulin pen, the storage of opened insulin, the methods of insulin injection and the methods of needle replacement. Then the nurse did the insulin injection for the patients as an example. And the manual of insulin injectioneducation which wassend to each patient in this section. 3) The next three days (Concrete experience): The patients accomplished the insulin injection by themselves under the supervision of the intervention nurse during these days, and inaccurate details would be reported back as soon as the injection completed. What is more, the nurse taught the patients again patiently and carefully especially the parts which mistakenwere made by the patients. 4) The fifth day (Reflective observation): In this section, the intervention nurse launched a group session on a small scale of patients she responsible for. The primary topic of the group session was the insulin injection skills, and also the patients could have some time to express their views. 5) The day of hospital discharge (Abstract conceptualization): The patients were asked to describe the key points in insulin injection, and summary all the mistakes they have made during the hospitalization. And at last, the intervention nurse made a particular prompting card to each patient when they discharged. 6) Days after hospital discharge (Active experimentation): Monthly group session associated with insulin injection skills education would be held by intervention nurses after patients discharged. In the session, patients were the main speakers and played an important role in the following discussion.

Measurements

At enrollment, a research assistant administered a baseline questionnaire to patients that

included questions about demographic characteristics, gender, age, occupation, education, marriage, years with a diagnosis of diabetes, kinds of complications. In addition, the research assistant measured participants' height (using a tape measure and right angle) and weight (using a calibrated portable scale) to calculate body mass index (BMI).

Outcomes

The priori primary outcomes were the insulin treatment attitudes and incidence of PIR from enrollment to the end of the study. Secondary outcomewas the change in the willingness score of insulin injection from enrollment to the end of the study.

Insulin treatment attitudes and incidence of PIR

The Insulin treatment attitude scale (ITAS) is an established instrument for the measurement of incidence of psychological insulin resistance in patients with type 2 diabetes by Xiaoying Ding [30]. This scale consisted of 20 items that covered 3 dimensions, dimension 1 indicates patients' misunderstanding to diabetes and insulin treatment, and concerns about views from others (item 1-8); dimension 2 indicates patients' view to the effect of insulin treatment (item 9-12); dimension 3 indicates fear and restriction related to insulin injection (item 13-20). Responses for each item ranged from 1 (strongly disagree) to 5 (strongly agree). The total scores ranged from 20 to 100, high scores indicated a high possibility of psychological insulin resistance. It would be regarded as a psychological insulin resistance if total scores greater than 60. Overall, there was a good internal consistency of this scale, total Cronbach's alpha coefficient was 0.88, Cronbach's alpha coefficient for each dimension ranged from 0.67 to 0.76, and thus, this scale can be considered a reliable and valid scale.

Willing score of insulin injection

The digital assessment scale which designed by the researcher of this study would be used to evaluate patients' willingness to insulin injection. There are only 11 numbers (ranged from 0 to 10) on the scale, which represent score 0 to 10. Patients can express their willingness to insulin injection by pointing the figure which

they thought could represent their real thoughts. The lowest score (0) indicates strong unwillingness, and the highest score (10) indicates strong willingness to insulin injection, and the rest figures can be viewed in the same manner.

Data collection

Data were collected at baseline and 3 months later for both groups. The purpose and procedures of the study were explained to all the participants. Written consent was obtained from all the participants. The data of baseline, including demographic information, insulin treatment attitude, incidence of PIR, and willing score of insulin injectionwere collected after admission in the wards. On the day of discharge, the researcher told all the participants to go to the demonstration classroom of endocrinology department in our hospitalthree months later to complete the questionnaires and HbA_1C assessment. At the corresponding time-point, three months later, the researcher would remind the participants by telephone to back to the hospital to finish the survey.

Statistical analysis

The sample size calculation was based on the pilot of this study, and a clinically relevant difference of 16.8% for the change in incidence of PIR in the experimental groupwas obtained. Inconsideration of the factor that patients would be dropped out, we decided to recruit 20% more patients in each group. And finally 200 patients in each group gave 90% power at α level of 0.05 to confirm the benefits of health education based on experiential learning theory on incidence of PIR.

Complete survey data were entered into the SPSS22.0 software for statistical analysis. Dichotomous and ordinal variables, as gender, marriage, occupation and incidence of PIR were examined using chi-square tests. The normal distribution and homogeneity of variance were examined before the statistical analysisfor continuous measures, and then independent t test or rank sum test would be used. Baseline clinical and demographic data of the intervention group were compared to assess their effectiveness. *P*-values of less than 0.05 were considered as significant (two tailed).

Table 1. Baseline characteristics participants allocated to experimental group and control group

Characteristics	ELG (n=193)	CG (n=195)	x^2/t	P
Gender [n (%)]				
Male	109 (56.48%)	10 (51.79%)	0.856	0.355
Female	84 (53.52%)	94 (48.21%)		
Age (M ± SD)	58.66±10.30	60.36±11.60	1.521	0.129
Education [n (%)]				
Primary school or below	32 (16.58%)	29 (14.87%)	0.271	0.897
Middle school	140 (72.54%)	14 (73.85%)		
College or above	21 (10.88%)	22 (11.28%)		
Occupation [n (%)]				
Employed	61 (31.61%)	58 (29.74%)	2.568	0.277
Unemployed	110 (56.99%)	123 (63.08%)		
Retired	22 (11.40%)	14 (7.18%)		
Marriage [n (%)]				
Rnmarried	16 (8.29%)	28 (14.36%)	4.709	.194
Married	133 (68.91%)	13 (68.21%)		
Divorce	36 (18.65%)	29 (14.87%)		
Widowed	8 (4.15%)	5 (2.56%)		
Disease duration (M ± SD)	9.20±6.95	8.53±8.51	-0.852	0.395
Complications (kinds) [n (%)]				
Non	52 (26.94%)	47 (24.10%)	4.524	0.34
1	39 (20.21%)	44 (22.56%)		
2	67 (34.72%)	55 (28.21%)		
3	21 (10.88%)	33 (16.92%)		
≥4	14 (7.25%)	16 (8.21%)		
BMI (M ± SD)	26.74±6.71	26.71±6.61	-0.048	0.962
HBA$_1$C (M ± SD)	7.59±1.28	7.48±0.92	0.754	0.385
Insulin treatment attitudes (M ± SD)	63.60±5.51	62.97±7.55	3.84	0.05
Incidence of PIR (n (%))	118 (61.1%)	124 (63.5%)	0.248	0.618
Willing score of insulin injection (M±SD)	7.59±1.28	7.29±2.22	0.588	0.443

Results

Recruitment

Between June 2013 to October 2014, there were a total of 1124 potentially eligible patients, 60.6% (n=681) did not meet the inclusion criteria. Of the 443 eligible patients, 9.7% (n=43) declined to participate, the rest 400 were consented and allocated into EL group (n=200) and control group (n=200). Of the 400 allocated patients, 388 successfully completed data analysis at 3 months (**Figure 1**). Loss to follow-up was not different between the two groups: there are 5 patients loss to follow-up in the control group and 7 in the EL group x^2=0.344, P=0.558, and was not associated with clinical or demographic variables. The reasons for dropping out included time conflicts with work, relocation, etc. Patients who dropped out (n=12) did not otherwise differ significantly in clinical or demographic variables from patients remaining in the study (n=388). So we only analyzed only the data for those patients who completed the whole trial.

Demographic characteristics of subjects

Patient characteristics and baseline laboratory values of the two groups are presented in **Table 1**. The majorities of patients were overweight, were married, were retired, were middle-aged male, and had middle degree education level. The mean age in EL group and control group were 58.66±10.30, 60.36±11.60 respectively. The mean course of diabetes in EL group and

Table 2. Insulin treatment attitude scores of the participants at baseline and 3 months (M ± SD)

	N	Baseline	3 months	t/x^2	P
CG	195	62.97±7.55	61.91±6.05	1.178	0.278
ELG	193	63.60±5.51	59.21±5.49	7.828	0.000
t/x^2		3.84	4.600		
P		0.05	0.000		

Table 3. Incidence of PIR in participants at baseline and 3 months (n (%))

	N	Baseline	3 months	x^2	P
CG	195	124 (63.5)	131 (67.1)	0.554	0.457
ELG	193	118 (61.1)	86 (44.5)	10.61	0.001
x^2		0.248	20.135		
P		0.618	0.000		

Table 4. Willing score of insulin injection of participants at baseline and 3 months (M ± SD)

	N	Baseline	3 months	x^2	P
CG	195	7.29±2.22	7.48±1.76	0.11	0.74
ELG	193	7.58±1.70	9.62±0.71	191.53	0.000
x^2		0.588	172.612		
P		0.443	0.000		

control group were 9.20±6.95, 8.53±8.51 respectively. 26.94%, 20.21%, 34.72%, 10.88% and 7.25% indicates respectively the proportion of patients in the PS group of no complication related to diabetes, 1 kind, 2 kinds, 3 kinds and ≥4 kinds. And 24.10%, 22.56%, 28.21%, 16.92% and 8.21% indicates respectively of the control group. Patients in EL group had a mean HbA1C level of 7.59±1.28, while 7.48± 0.92 was the mean level for patients in control group. The mean insulin treatment attitude score in EL group was 63.60±5.51, and that in control group was 62.97±7.55; 61.1% of patients in EL group and 63.5% patients in control group had PIR, the willing score of insulin injection in two groups were 7.59±1.28 and 7.29± 2.22 respectively. In general, there were no significant differences in baseline characteristics and laboratory values between groups (**Table 1**).

Effectiveness of the intervention

Tables 2-**4**, show the primary outcomes in this study at baseline and 3 months. The insulin treatment attitude scores at 3 months showed a significant decline from that at baseline (x^2=7.828, P=0.00), but the score in control group at 3 months showed no significant differences from baseline (t=1.178, P=0.278). The incidence of PIR for patients at 3-month in the EL group was 44.5%, it reduced significantly from baseline along the study period (P=0.001). The incidence of PIR in the CG was 67.1% at 3 months, but there is no significant difference from baseline. The willing score of insulin injection improved in both groups, while it just improved significantly in EL group [mean (95% CI)=2.04 (1.85, 2.22), P=0.000].

Discussion

Insulin therapy is an important treatment for glucose control, especially for patients with type 1 diabetes or type 2 diabetic patients who had a poor response to oral hypoglycemic agents. While, in our country, patients with diabetes had a bad acceptance for insulin treatment because of the poor knowledge to diabetes [31]. As we know, psychological insulin resistance delays the initiation of insulin therapy [32, 33], causing bad glucose control and high risk of diabetes related complications [34]. Li Y [35] points out that the attitude of insulin therapy negative predicted the satisfaction and compliance of insulin therapy. This suggests that health care workers should pay more attention to the evaluation and intervention for insulin treatment during the management for patients with diabetes, in order to improve patients' glucose control and self-management ability. EL theory emphasizes that an individual to form their personalized understanding of specific knowledge during a specific experience, then verify the understanding in the following experience and apply them to solve problems in practical work. On the basis of this, a study circle of "experience-feedback-adjustment-experience" generated and kept revolving, developing in practice [36]. In this study, the EL theory was applied to the education for patients with initial insulin injection, and results showed that the intervention could reduce the incidence of PIR and improve the willingness score of insulin injection. It indicates that according to the continuous practice on insulin injection, patients had a better comprehension on diabetes knowledge, insulin injection methods, and handling methods of

adverse effects. Good comprehension stimulated patients' resonance on diabetes self-management, which led to skilled insulin injection operation and reduced fear for pain in patients.

The results of this study showed a significant difference in insulin treatment attitude scores between EL group and control group, and the score in EL group was significant lower than that in control group. The incidence of PIR declined significantly in EL group when compared with control group at 3 months and the willing score or insulin injection at 3 months was significant higher in EL group than that in control group. It indicates that the experimental learning intervention could improve diabetic patients' attitude towards insulin treatment, and is beneficial to the disease treatment.

The participants recruited in this study were inpatients who need insulin therapy but without insulin injection history in the past time, and they all had a good control in bloodglucose when discharged from hospital because of the treatment during hospitalization. The results of this study showed a reduction in HbA_1C level in both groups, and we considered that there is a possibility that the reduction had something with the hospitalization. Results also showed a significant reduction in HbA_1C in EL group, but not in control group. Above all, we believed that better self-management was performed by patients in EL group during the follow-up which were benefit by the EL intervention, and finally they got a better glucose control.

Limitations of this study

There are also several major limitations in this study. Firstly, the follow-up for the intervention, we just followedthe participants three months after discharge, therefore, it was not clear that how long the effectiveness of our intervention would be continued. The second limitation was that the data were all collected from just one hospital, which might affect the representation of the sample. As a conclusion, more high quality, large-scale studies are expectedin the future to confirm the effectiveness of intervention based on EL theory.

Conclusions

We searched articles published in English and Chinese which focused on psychological insulin resistance in the database, the amounts of prevalence studies [19, 21, 37] and reviews [38-44] have an advantage over experimental studies [45]. And just several studies have mentioned interventions to reduce the incidence of PIR, the EL was not included. In fact, we didn't find studies which researched the effectiveness of EL intervention for reducing the incidence of PIR in patients with type 2 diabetes.

In our study, the EL intervention significantly improved the insulin treatment attitude, reduced the incidence of PIR and improved the willing score of insulin injection in patients with type 2 diabetes. The results of this study provide a new idea for the health education in patients with diabetes, and it demonstrates that EL theory can be used in the health education for patients with diabetes in the future.

Disclosure of conflict of interest

None.

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