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Original Article

Effects of Messaging Framing on the Self-Management Activities and Self-Efficacies of Patients with Type 2 Diabetes Mellitus

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Abstract

Background: Message framing is a low-cost and effective intervention method to improve diabetics' health behaviors. The study aimed to investigate the impacts of positive and negative message framing interventions on the self-management activities and self-efficacy of patients with type 2 diabetes mellitus (T2DM).

Method: Overall, 102 T2DM patients from Jinhua People's Hospital of China were recruited and divided into three groups: positive and negative message framing intervention groups and a control group. A 12-week experiment was implemented on the first two groups. Then, the differences of the patients' self-management activities and self-efficacies were analyzed between the experimental and control groups. Finally, the mediating effect of self-efficacy between two types of message framing interventions and patients' self-management activities was investigated.

Results: Both positive and negative message framing interventions could significantly improve the T2DM patients' self-management activities in diet, blood glucose testing, foot care, and medication taking ($P<0.05$), meanwhile significantly improving their self-efficacies along the nutrition, physical exercise and weight, medical treatment, blood sugar, and feet check ($P<0.05$). Results of the difference analysis for both within-group and inter-group showed that, compared with the positive messaging framing intervention, the negative one had more significant effects on enhancing the patients' self-management activities and self-efficacy. Self-efficacy had only a mediating effect between negative messaging framing intervention and self-management activities ($\beta = 0.94$, 95% CI: 0.0934 – 0.456).

Conclusion: Negative messaging framing intervention could better enrich T2DM patients' diabetes knowledge through offering threatening information, thereby enhancing their self-efficacies, and ultimately improve their self-management activities.

Keywords: Message framing intervention; Positive and negative information; Type 2 diabetes mellitus; Self-management activity; Self-efficacy

Introduction

Diabetes mellitus is a typical chronic disease with many complications. Hence, lifelong treatment is required for the diabetics. Statistics from the International Diabetes Federation show that 451 million people with diabetes were diagnosed worldwide in 2017, and type 2 diabetes mellitus

(T2DM) cases accounted for more than 90% (1). T2DM greatly threatens the health of patients throughout the world. However, effective treatment plans for T2DM are still unavailable. Good self-management of T2DM patients is the main strategy to control the disease and improve quality of life (2). The HbA1c level of T2DM patients with good self-management behavior was 0.44%; the risks of cardiovascular disease and all-cause deaths were reduced by 35% and 39%, respectively (3); and the number of hospitalizations and medical expenses were significantly reduced (4). However, poor treatment effect, high cost of treatment, complications, and long-term self-management have brought serious psychological burden to T2DM patients, thus seriously affecting their self-management activities. Studies showed that the overall self-management status of patients was not optimistic (5). In China, only 5.6% of T2DM patients achieved their goals in controlling blood sugar, blood pressure, and blood lipid levels (6). In USA, only 23% of elderly T2DM patients had completed weekly exercise (7).

The American Diabetes Association (ADA) recommended providing T2DM patients with health information and supports that encourage them to promote self-management activities (8). ADA's recommendation was widely supported by studies in the field of health behaviors, which showed a strong link between health behaviors and health information (9). In recent decades, with the help of advanced digital technology, medical staff could provide patients with the knowledge of self-management improvement in a fast and low-cost way (10). However, studies from the field of message framing found that how information changed the patients' behaviors depends on the presentation of the information content (11, 12). Two types of message framing interventions exist: positive and negative. To promote patients' behavioral changes, the positive message framing emphasizes the positive consequences of insisting on healthy behaviors, while the negative one presents the negative consequences of not persisting in healthy activities. Several studies suggested that positive message framing was more effective than the negative one in maintaining diabetic patients' foot care behaviors (13). However, negative message framing intervention was better than the positive one in improving the T2DM patients' self-management activities such as physical exercises (14).

Self-efficacy was the critical factor that directly affect the changes of T2DM patients' self-management activities (15). When patients had a better understanding of nutrition, physical exercise, weight control, medical treatment, blood sugar, and feet checking, they would have a higher sense of self-efficacy and would have stronger self-management ability to improve their self-management activities (16), thereby resulting in lower blood glucose levels, fewer hospitalizations, and lower treatment costs (17, 18). The T2DM patients with high levels of self-efficacies would be more likely to accept positive message framing intervention (12). However, this study did not investigate the linkage between the message framing intervention and self-management activities. Some studies showed that T2DM patients with low levels of self-efficacies would like to stop self-management activities at the earlier stage (19). Both studies above implied that self-efficacy was the mediating variable rather than the moderating variable between the message framing intervention and self-management activities (12, 20, 21). It implied that, before using the message framing intervention, it was important to improve T2DM patients' self-efficacy by optimizing the presentation of information content so that they could conduct long-term self-management activities (22).

Based above research background, this study raises two questions: (i) Does the message framing intervention improve the T2DM patients' self-efficacies and self-management behaviors? Which type of message framing intervention performs better—positive or negative? (ii) Is the improvement of patients' self-management activities due to the factor that message framing intervention enhances the patients' self-efficacies? To address these two questions, this study recruited 102 T2DM patients from the department of endocrinology of Jinhua People's Hospital in China.

These patients were randomly divided into positive and negative message framing groups, and control group. A 12-week experiment was implemented to investigate the influences of the two types of message framing interventions on the patients' self-management activities and self-efficacies, as well as the mediating effect of self-efficacy between the message framing intervention and patients' self-management activities.

Methods

Data Source

The samples in this study were collected from T2DM patients hospitalized at the Department of Endocrinology of Jinhua People's Hospital in China from January to December 2021.

This study was approved by the Ethics Committee of Jinhua People's Hospital (approval no. IRB-20230001-R).

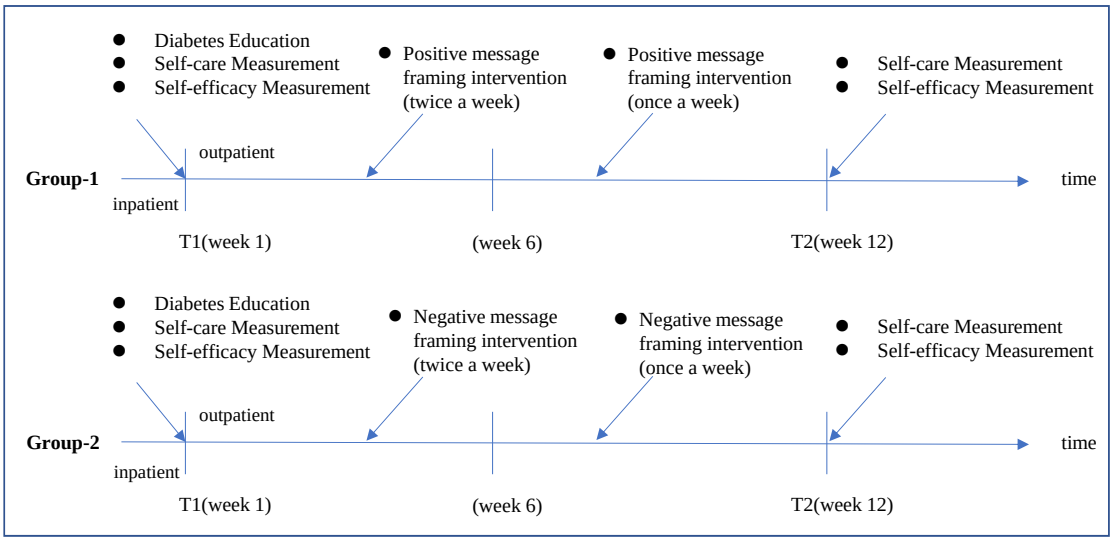
The patients were enrolled based on the following criteria: 1) more than 18 years old, 2) with a diabetic course of more than 1 year, 3) able to use WeChat, 4) not pregnant or breastfeeding, 5) without malignant tumors or serious diabetic complications, 6) without obvious cognitive or mental disorders, and 7) without hearing or visual impairments. A total of 102 participants were recruited and randomly divided into three groups (Group 1, 2 and 3) with 34 participants in each group. The experiment was conducted from January to August 2022, during which 18 participants dropped out (5 from Group1, 6 from Group 2, and 7 from Group 3). The final sample number of the study was 84, which met the minimum sample size requirement for statistical testing. The demographic characteristics of the samples were described as shown in Table 1.

Table 1: Statistical characteristics and baseline comparison of the demographic and biochemical indicators of the samples

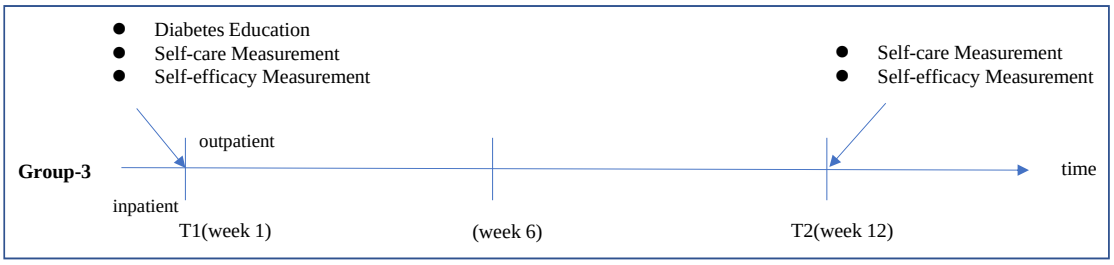
Variable		*Group-1*	*Group-2*	*Group-3*	*statistics value*	*P*
Age(yr)		54.46±7.12	56.55±8.27	55.22±7.29	0.958	0.509
Gender	Male	12	14	10	0.654	0.363
	Female	17	14	17		
Course (yr)		8.82±3.25	9.82±4.35	8.90±5.49	1.652	0.168
Marital status	Married	19	16	18	3.458	0.856
	Separated	3	4	2		
	Unmarried	0	0	0		
	Widowed	4	5	5		
	Divorced	3	3	2		
Annual income ($/year)	<3k	8	7	9	4.61	0.355
	3k~5k	12	11	10		
	5k~10k	8	8	7		
	>10k	1	2	1		
Insulin Injection		24	22	22	1.525	0.681
Oral-hypoglycemic		29	28	27	1.89	0.559
Diabetic complications	0	12	13	12	3.527	0.587
	>=1	17	15	15		
Medical insurance level	High	1	2	2	1.264	0.652
	Middle	24	24	23		
	Low	4	2	2		
Smoking	Yes	5	6	8	2.19	0.347
Drinking	Yes	9	12	10	1.189	0.539

Research Method

To investigate the impacts of message framing intervention on the T2DM patients' self-management activities and self-efficacies, Groups 1 and 2 were the positive and negative message framing intervention groups, respectively. Group 3 was the control group. The experimental process was divided into two timing points: T1 was the timing of patient's hospital discharge, and T2 was 6 weeks after discharge. The experiment started from T1, and nine information modules were sent to Groups 1 and 2. The information modules were videos that introduced the causes of T2DM and information on diet, smoking, exercise, weight control, hypoglycemia management, blood sugar testing, foot care, and medication taking. The diagram of the experiment was illustrated in Fig. 1.



(a) Message framing intervention for intervention groups



(b) Experimental process for the control group

Fig. 1: Experimental processes for control and intervention groups

The detailed experimental processes were as follows:

1) At time T1: The medical staff educated the patients on diabetic knowledge, such as diet control, exercise, foot care, insulin usage, and complication control for all three groups. The patients' self-management activities were measured by the summary of diabetes self-care activities scale (SDSCA), which had six dimensions and 13 items. Each item was scored 1 to 7, with "1" being very poor and "7" being very good (23). The patient's self-efficacy was assessed by the Chinese version of the diabetes management self-efficacy scale (C-DMSES), which had four dimensions and 20 items. Each item was scored 1 to 5, with "1" being very poor and "5" being very good (24). The data collected in T1 served as the baseline.

2) Time T1 to T2: From weeks 1 to 6, positive and negative messages were sent to Groups 1 and 2, respectively, 2 times a week through the WeChat. From weeks 7 to 12, messages were sent only once a week. To ensure that the patients understood the message contents, they were required to answer the corresponding questions after watching each video.

3) At time T2: The self-management activities and self-efficacies were measured again for three groups. Compared with the baseline, the statistical differences could be distinguished for each group after interventions.

Results

To ensure the comparability between the control and intervention groups, this study first compared the baselines of variables in three groups (see the right two columns in Table 1). Then, the patients' self-management activities in each group were measured at time T1 along five dimensions (e.g., diet, excise, blood glucose testing, foot care, and medication taking), as shown in Table 2. Table 3 shows the patients' self-efficacy in each group, measured along four dimensions (e.g., nutrition, physical exercise and weight, medical treatment, and blood sugar and feet check). Repeated ANOVA measurements showed no statistically significant differences between the three groups in terms of demographic indicators, self-management activities, and self-efficacies. It meant that the samples in three groups were suitable for analyzing the effect of the message framing intervention. As shown in Tables 2 and 3, the self-management activities and self-efficacies of the patients in three groups at time T1 were at a low level.

Table 2: Baseline comparison of self-care activities of the samples in three groups

Dimensions	*Group 1*	*Group 2*	*Group 3*	*t*	*P*
Diet	3.52±1.21	3.67±1.45	3.71±1.46	0.238	0.712
Excise	4.21±2.23	4.10±1.56	4.04±2.31	-0.521	0.438
Blood-glucose testing	2.52±2.10	2.49±1.77	2.56±1.69	-0.392	0.821
Foot care	2.03±1.82	2.11±2.26	1.98±1.72	-0.768	0.255
Medication taking	5.70±1.56	5.62±1.85	5.75±1.12	0.421	0.753
SDSCA Score	17.98±4.39	17.99±3.47	18.04±4.22	0.347	0.682

* According to the research in (23), smoking dimension is excluded from the SDSCA score. A seven scale is used to measure the items in the above five dimensions. SDSCA score is aggregated by the scores of five dimensions.

Table 3: Baseline comparison of self-efficacy of the samples in three groups

Dimensions	*Group 1*	*Group 2*	*Group 3*	*t*	*P*
Nutrition	3.26±1.21	3.38±1.07	3.15±1.46	0.41	0.667
Physical exercise & weight	3.16±1.08	3.12±1.15	3.09±1.31	-0.168	0.235
Medical treatment	3.75±0.98	3.49±1.37	3.66±1.19	-0.122	0.621
Blood sugar and feet check	2.13±1.56	2.22±1.74	2.30±1.34	-0.383	0.155
C-DMSES Score	12.3±2.85	12.21±3.06	12.2±3.01	0.319	0.268

This study re-measured the patients' self-management activities at time T2 and compared them with the baseline at time T1. The within-group and inter-group differences of self-management activities were shown in Tables 4 and 5.

1) Within-group results showed that both positive and negative message framing had statistically significant impacts on diet, foot care, and

SDSCA score when compared with the baseline (P<0.05, cf. the last columns in Table 4 in the Group 1 and 2 rows). However, both types of message framing had no significant impact on the patients' self-management activities in the control group between T1 and T2, cf. the last column in Table 4 in the Group 3 row).

2) Inter-group results showed that, compared with Group 3, statistical differences in SDSCA score existed between the experimental and control groups (P<0.05). Compared with the time T1, the patients' self-management activities along five dimensions were greatly improved after adopting both types of message framing interventions. The improvement of means in Group 2 was much better than that in Group 1.

Table 4: Baseline comparison of self-care activities within-groups after intervention

Group	*Dimension*	*T1*	*T2*	*t*	*P*
Group 1	Diet	3.52±1.21	4.19±1.09	0.138	0.015*
	Excise	4.21±2.23	4.57±1.26	-0.253	0.362
	Blood-glucose testing	2.52±2.10	3.07±1.08	-0.392	0.131
	Foot care	2.03±1.82	2.72±2.01	-0.158	0.023*
	Medication taking	5.70±1.56	5.91±0.93	0.421	0.753
	SDSCA Score	17.98±4.39	20.46±2.72	0.347	<0.001*
Group 2	Diet	3.67±1.45	4.92±1.13	0.632	0.001*
	Excise	4.10±1.56	4.35±1.51	-0.351	0.07
	Blood-glucose testing	2.49±1.77	3.98±1.63	-0.685	0.018*
	Foot care	2.11±2.26	3.11±1.58	-0.523	0.002*
	Medication taking	5.62±1.85	6.05±0.77	0.356	0.001*
	SDSCA Score	17.99±3.47	22.41±1.98	0.539	<0.001*
Group 3	Diet	3.71±1.46	3.64±1.52	0.264	0.476
	Excise	4.04±2.31	4.11±1.72	-0.588	0.908
	Blood-glucose testing	2.56±1.69	2.49±1.96	-0.642	0.755
	Foot care	1.98±1.72	2.08±1.67	-0.932	0.179
	Medication taking	5.75±1.12	5.67±1.82	0.428	0.611
	SDSCA Score	18.04±4.22	17.99±4.66	0.521	0.622

Table 5: Comparison of self-care activities among groups after intervention

Dimension	*Group-1*	*Group-2*	*Group-3*	*t*	*P*
Diet	4.19±1.09	4.92±1.13	3.64±1.52	0.385	0.015*
Excise	4.57±1.26	4.85±1.51	4.11±1.72	-0.623	0.248
Blood-glucose testing	3.07±1.08	3.48±1.63	2.49±1.96	-0.445	0.078
Foot care	2.72±2.01	3.11±1.58	2.08±1.67	-0.158	0.013*
Medication taking	5.91±0.93	6.05±0.77	5.67±1.82	0.421	0.084
SDSCA Score	20.46±2.72	22.41±1.98	17.99±4.66	0.369	0.003*

The patients' self-efficacies for each group were measured at time T2. The differences within-group and intergroup were calculated and given in Tables 6 and 7.

1) Within-group results showed that positive message framing had statistically significant impacts on nutrition, medical treatment, and C-DMSES score when compared with the baseline (P<0.05). Negative message framing had statistically significant impacts on all dimensions when compared with the baseline (P<0.05 cf. the Table 6). However, both message framing had no significant impacts on the patients' self-management activities in the control group between T1 and T2 (P>0.05, cf. the Table 6).

2) Inter-group results showed that, compared with Group 3, statistical differences of C-DMSES score existed between the experimental and control groups (P<0.05, cf. the Table 7). Compared with the time T1, the means of patients' self-efficacies along five dimensions greatly improved after adopting both types of message framing interventions. The improvement of means in Group 2 was much better than that in Group 1.

Table 6: Baseline comparison of self-efficacy within groups after intervention

Group	*Dimensions*	*T1*	*T2*	*t*	*P*
Group 1	Nutrition	3.26±1.21	3.86±1.15	0.469	0.002*
	Physical exercise & weight	3.16±1.08	4.03±1.02	-0.361	0.27
	Medical treatment	3.75±0.98	4.15±0.98	-0.122	0.001*
	Blood sugar and feet check	2.13±1.56	3.13±1.16	-0.399	0.553
	C-DMSES Score	12.3±2.85	15.17±2.85	0.296	<0.001*
Group 2	Nutrition	3.38±1.07	4.12±0.96	0.566	0.001*
	Physical exercise & weight	3.12±1.15	4.09±0.93	-0.521	0.003*
	Medical treatment	3.49±1.37	4.49±0.84	-0.685	<0.001*
	Blood sugar and feet check	2.22±1.74	3.22±1.13	-0.399	0.004*
	C-DMSES Score	12.21±3.06	15.92±2.17	0.594	<0.001*
Group 3	Nutrition	3.15±1.46	3.35±1.19	0.7673	0.769
	Physical exercise & weight	3.09±1.31	3.12±1.37	-0.68	0.255
	Medical treatment	3.66±1.19	3.87±1.22	-0.529	0.152
	Blood sugar and feet check	2.30±1.34	2.27±1.96	-0.663	0.658
	C-DMSES Score	12.2±3.01	12.61±2.74	0.345	0.411

Table 7: Comparison of self-efficacy among groups after intervention

Dimensions	*Group 1*	*Group 2*	*Group 3*	*t*	*P*
Nutrition	3.86±1.15	4.12±0.96	3.35±1.19	0.293	0.013*
Physical exercise & weight	4.03±1.02	4.09±0.93	3.12±1.37	-0.361	0.128
Medical treatment	4.15±0.98	4.49±0.84	3.87±1.22	-0.122	0.005*
Blood sugar and feet check	3.13±1.16	3.22±1.13	2.27±1.96	-0.399	0.083
C-DMSES Score	15.17±2.85	15.92±2.17	12.61±2.74	0.296	<0.001*

Table 8 showed the results of the mediating effect of self-efficacy between two types of message framing interventions and self-management activities. Both message framing interventions had significant effects on the patients' self-management activities because the bootstrap 95% confidence intervals (95% CI) did not contain a zero value (0.1369–3.452; 0.098–3.687). However, self-efficacy only mediated the negative message framing intervention and self-management

activities, because the bootstrap 95% CI did not contain a zero value (0.0934 to 0.456). The mediating route of self-efficacy between negative message framing and self-care activities is shown in Fig. 2.

Table 8: Mediating effect of self-efficacy between message framing and self-care activities

Mediating route	*β±std*	*95% CI*
Positive framing → Self-care	1.524±0.076	0.1369~3.452
Positive framing → Self-efficacy→ Self-care	0.054±0.016	-0.143~2.369
Negative framing → Self-care	1.891±0.124	0.098~3.687
Negative framing → Self-efficacy →Self-care	0.194±0.105	0.0934~0.456

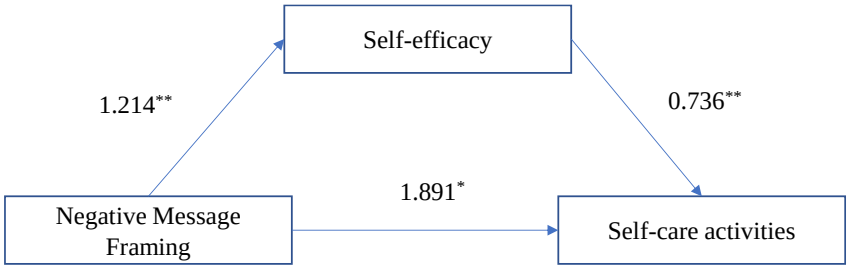


Fig. 2: Mediating route of self-efficacy between negative message framing and self-care activities

Discussion

This study verified the effectiveness of the message framing intervention on T2DM patients' self-management activities and self-efficacies. The findings were discussed as follows.

Impacts of message framing intervention on self-management activities

Compared with the control group, both message framing interventions could improve the patients' self-management activities with different effects.

1) Both types of message framing interventions had significant impacts on patients' diet management (P<0.05), and the improvement in this dimension was much higher than that in the other four dimensions. This result occurred because, according to most patients' diabetes knowledge, dietary imbalance was the primary factor that causes T2DM, and their consensus was control diet (25). In addition, the experiment found that negative message framing with threatening information (such as "excessive carbohydrate intake would cause hyperglycemia") had a better intervention effect on patients' diet management activities (the improvement rate is 34.6%). This finding well supported the research results of (26), which stated that message framing interventions could increase patients' intake of vegetables and fruits.

2) Although both types of message framing interventions could improve the scores in the exercise dimension, no statistically significant results were obtained. This result partially supported the findings in (14), that was, "reading both types of information can increase the amount of exercise of patients." The reason might be that the experiment was conducted during the COVID-19 pandemic, and the outdoor activities of patients were seriously hindered.

3) Compared with the positive message framing intervention, the negative intervention had a more statistically significant improvement effect in three dimensions (e.g., blood glucose testing, foot care, and medication taking). This result did not fully support the findings in literature (13) and (21), that was, "the self-management activities change of patients who

received positive information framework intervention lasted longer." This might be the result of cultural differences between the East and the West; threatening information could more attract the psychological attention of Chinese T2DM patients.

Impacts of message framing intervention on self-efficacy and the mediating role of self-efficacy

1) Both message framing interventions could improve patients' self-efficacies. Compared with the positive intervention, the negative message framing could better improve the self-efficacy level (i.e., C-DMSES Score increased by 30.4%), and it was statistically significant in the four dimensions of C-DMSES. This conclusion was inconsistent with the findings of (27), which stated that positive message framing intervention could improve the self-efficacy of T2DM patients. However, this finding was similar to that of (20), which showed that negative information was more persuasive for the patients with higher levels of self-efficacy. In this study, however, at a higher baseline self-efficacy, negative message framing was more threatening and could prompt the participants to take active actions to manage their diabetes.

2) Negative message framing intervention affected patients' self-management activities through the mediating variable of self-efficacy. This finding was similar to that of (27). The negative information with fear factors made patients more aware of the seriousness of the problem, thus giving them a better focus of attention and further improving their preventive psychology (28). In this study, the patients had limited diabetes knowledge. Negative message framing could better increase their attention to threatening content and hence improved their knowledge of diabetes. This approach in turn enhanced their self-efficacies and further promoted their self-management activities.

Limitations

This study had two limitations. First, the mediating role of diabetes knowledge in improving patients' self-efficacies in message framing intervention was not studied. How message framing intervention affects patients' diabetes knowledge would be worthy of further study. Second, the same set of information modules were used in each intervention during the 12-week experiment. However, the same set of information would increase the information fatigue of patients, which might reduce the effect of message framing interventions.

Conclusion

Both types of message framing intervention could significantly improve the T2DM patients' self-efficacies and self-management behaviors, while the negative intervention has better effects than the positive one. Negative message framing intervention affects patients' self-management activities through self-efficacy as an intermediary variable. To increase patients' awareness and improve their diabetes knowledge, more negative information with threatening contents could be provided, because the negative information can better enhance the patients' self-efficacies. Message framing intervention is a low-cost method to prompt diabetic patients to change their healthy behaviors, improve their quality of life and reduce social comprehensive medical care and economic burden.

Journalism Ethics considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Conflict of Interest

The authors declare that there is no conflict of interests.

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