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Original Article

Relationship among Family Support, Mental Resilience and Diabetic Distress in Patients with Type 2 Diabetic Mellitus during COVID-19

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Abstract

Background: To promote the treatment effects and self-management behaviors of the patients with type 2 diabetes mellitus (T2DM) during the COVID-19 pandemic, this study empirically investigated the relationship among family support (FMS), mental resilience (MR) and diabetic distress (DD) in patients with T2DM.

Method: Overall, 256 patients with T2DM from the Department of Endocrinology, Jinhua People's Hospital, ZheJiang, China were selected and measured for their perceptions of FMS, MR and DD from 2019-2020. Based on the measurements, the difference and correlation matrix under different background variables were studied by one-way variance and correlation analysis. A structural equation was used to analyze the causal path among the measurements.

Results: Patients that differ in marital status, annual family income, medical insurance level, number of complications, and with/without insulin injection therapy were significantly different in their perception of FMS, MR and DD. FMS and MR had a significant negative correlation with DD. FMS used MR as an intermediary variable that affected DD.

Conclusion: Diabetes education, improved medical insurance levels, and targeted psychological consultation for patients could effectively improve their MR and alleviate DD.

Keywords: Type 2 diabetes mellitus; Diabetic distress; Family support; Mental resilience

Introduction

Diabetes is a chronic disease that requires long-term treatment and strict self-management to control blood sugar and complications. This disease could cause serious mental burdens on patients with type 2 diabetes mellitus (T2DM) (1). According to the International Diabetes Federation, the number of diagnosed diabetes patients may rise to 693 million in 2045 (2). If the patients' distressed state were not addressed, the treatment effect of the patients would be lowered (3).

During the COVID-19 pandemic, we observed a significant increase in the number of patients with T2DM who suffered diabetic distress (DD) in the Endocrinology Department, Jinhua People's Hospital (an A-grade hospital in eastern China). These DD are affected by family support (FMS) and mental resilience (MR) (4).

If the impacts of FMS and MR on DD could be understood, the corresponding psychological interventions could be implemented, thereby improving the treatment effects. To empirically study the relationship among FMS, MR and DD, we selected 256 patients with T2DM as the samples.

Literature Review

DD has several negative effects on patients' treatment compliance and self-management behavior (5). The related studies could be categorized into three streams.

The first stream focused on the influencing factors of DD. For example, the younger patients had high degrees of DD than older people (6). A long diabetes course could increase the complications, thereby aggravating the patient's DD (7). A significantly positive correlation existed between the patient's body mass index and DD (8). A high glycated hemoglobin level indicated high DD. This indicator had a significantly positive correlation with regimen-related distress (9, 10). Patients who used intensive insulin therapy had high degrees of DD (11). High sleep quality, physical exercise, diabetes education and diet control could alleviate the patients' DD (12-14).

The second stream focused on the impact of social support on the patients' DD. For example, a correlation existed between FMS and psychological results (e.g., the medical attitudes, hopes and needs) (15). The perception of FMS was positively correlated with the life quality and psychological status of patients (16,17). Supports from family members and peers could effectively reduce the patient's DD (18).

The third stream focused on the impacts of mental health and behavioral control on the patients' DD. For example, good self-psychological adjustment could significantly reduce DD (19). When the patient's self-efficacy level was high, the degree of DD was low (20). MR had a positive impact on alleviating the patients' DD (21, 22). Patients with low MR might have high levels of DD and poor blood sugar control (23).

The patients' MR and FMS are closely related to their DD. However, no complete framework exists to study the relationship among them. We aimed to examine the above issues and focused on the influencing mechanism and paths of relationship among FMS, MR and DD.

Methods

Data Source and Description

Overall, 312 patients with T2DM were selected from the department of endocrinology of the Jinhua People's hospital in eastern China during the COVID-19 (from Jan 2019 to Dec 2020). The patients were fully informed of the purpose of the survey. We excluded the patients with cancer and mental illness. Finally, we had 256 samples, with an effective rate of 82.05%. The age of the samples ranged from 25 to 78 years old. Totally, 109 were male and 147 were female (Table 1).

Research Methods

We first measured the FMS, MR and DD of the patients using the PSSS, CD-RISC and DDS17 scales. Secondly, ANOVA was used to calculate the in-group differences under different background variables. Thirdly, the Pearson correlation analysis was used to analyze the correlation among the FMS, MR and DD. Finally, the structural equation model was used to detect the causal path among them.

We selected the dimension of FMS in the PSSS scale developed by Zimmet et al. (2001) to measure the patient's perception of FMS (24). There are four items in this dimension, and a seven-point Likert scale was used (1 for "strongly disagree" and 7 for "strongly agree"). The total score was higher than 16, which denoted that the patient received an acceptable level of FMS. The Cronbach's α was 0.885, the KMO was 0.828, and the Bartlett test result was $\chi^2 = 572.765$, df = 6, $p = 0.000 < 0.05$, indicating that the scale had good reliability and validity. The total FMS score of the samples in this study was 20.78 ± 5.17, among which the scores of items 1, 2, 3, and 4 were 5.22 ± 1.270, 5.57 ± 1.152, 5.17 ± 1.342, and 5.59 ± 1.148, respectively. Table 2 shows the statistical description of the FMS.

Table 1: Description of the statistical characteristics of the sample

Variable	*Group*	*Samples*	*Variable*	*Group*	*Samples*
Gender	Female	147	Annual income	<3000	68
	Male	109	($/year)	3000~5000	123
Age(yr)	> 60	163		5000~10000	46
	<=60	93		>10000	19
Diabetes duration	<5	34	Insulin Injection	Yes	145
(yr)	>5	222	Oral-hypoglycemic	Yes	234
Education level	Illiteracy	12	Glycemic control status	Good	71
	Primary or Middle School	103		Average	161
	Senior High School	95		bad	24
	Bachelor or above	46	Diabetic complications	0~1	159
Marital status	Married	154		2~3	76
	Separated	17		4~5	21
	Unmarried	23	Medical insurance level	High	23
	Widowed	18		Middle	179
	Divorced	44		Low	54

Table 2: Statistical description of FMS measurement of the patients (avg±std)

Item	*Sample*	*Gender*		*Education Level*			
	n	Male	Female	Illiteracy	Primary & Middle School	Senior High School	Bachelor or above
n	256	109	147	12	103	95	46
FMS	20.8±5.17	21.9±5.11	20.0±4.86	18.3±5.08	20.6±4.80	20.9±5.02	21.4±5.05
Item		Marital Status				Diabetes duration (year)	
	Married	Separated	Unmarried	Widowed	Divorced	<5	>5
n	154	17	23	18	44	34	222
FMS	22.6±5.01	15.6±4.75	18.9±4.94	18.2±4.94	18.5±4.84	21.9±4.97	20.6±4.89
Item		Annual income			Medical Insurance Level		
	<3k	3k~5k	5k~10k	>10k	High	Middle	Low
n	68	123	46	19	23	179	54
FMS	18.9±5.14	20.7±4.91	22.2±5.06	24.9±5.02	23.9±4.92	21.2±4.80	18.2±4.82
Item	Glycemic control status			Diabetic complications			
	Good	Average	bad	0~1	2~3	4~5	
n	71	161	24	159	76	21	
FMS	22.6±5.15	20.3±4.87	18.4±5.06	21.7±4.97	19.8±4.99	17.2±5.14	

We selected the CD-RISC scale developed by (25) to measure the patient's MR. The scale consisted of 25 items in three dimensions, namely, tenacity (TEN), self-improvement(SI) and optimism (OPT). A five-point Likert scale was used (0 for "never" and 4 for "almost always"). A high score indicated a strong MR. The Cronbach's αwas 0.902, the KMO was 0.915. The Bartlett

test result was $\chi^2 = 3572.765$, df = 270, $P = 0.000 < 0.05$, indicating that the scale had good reliability and validity. The total score of MR was 63.87 ± 13.974. The scores for tenacity, strength and optimism were 31.42 ± 2.130, 22.16 ± 3.748, and 11.14 ± 3.122, respectively. Table 3 shows the statistical description of the samples' MR. The average MR score of the samples was larger than 2.5 and less than 3, indicating that the MR of the patients was above average.

Table 3: Statistical description of MR evaluation of the patients (avg±std)

Item	***Sample*** **n**	***Gender***		***Education Level***			
		Male	Female	Illiteracy	Primary & Middle School	Senior High School	Bachelor or above
n	256	109	147	12	103	95	46
MR	63.9±13.97	63.2 ±13.77	64.4 ±13.89	61.0 ±13.80	62.6 ±13.61	64.3 ±13.88	66.6±13.7
TEN	31.4 ±2.13	31.1 ±1.96	31.6 ±1.83	30.8 ±2.08	30.9 ±1.71	31.3 ±1.88	33.0 ±1.86
SI	22.2 ±3.75	21.9 ±3.64	22.4 ±3.71	20.8 ±3.35	21.2 ±3.65	22.2 ±3.48	24.6 ±3.29
OPT	11.1 ±3.12	11.1 ±2.81	11.2 ±2.86	10.3 ±2.80	11.0 ±3.05	11.2 ±3.00	11.6 ±2.66
Item		Marital Status				Diabetes duration (yr)	
	Married	Separated	Unmarried	Widowed	Divorced	<5	>5
n	154	17	23	18	44	34	222
MR	65.3 ±13.60	57.3 ±13.58	62.1 ±13.47	61.8 ±13.63	63.2 ±13.50	68.3 ±13.61	63.2 ±13.65
TEN	32.1 ±1.70	29.8 ±1.67	30.3 ±1.76	31.5 ±1.84	30.2 ±1.90	33.1 ±1.85	31.2 ±2.11
SI	23.1 ±3.35	19.7 ±3.74	20.2 ±3.73	20.2 ±3.45	21.6 ±3.74	23.1 ±3.40	22.0 ±3.34
OPT	11.8 ±3.03	9.1 ±2.89	10.3 ±2.69	10.6 ±2.85	10.3 ±2.83	11.7 ±3.10	11.1 ±2.94
Item		Annual income			Medical Insurance Level		
	<3k	3k~5k	5k~10k	>10k	High	Middle	Low
n	68	123	46	19	23	179	54
MR	60.1 ±13.50	64.7 ±13.49	66.0 ±13.52	66.7 ±13.53	65.8 ±13.89	63.9 ±13.84	63.0 ±13.60
TEN	29.8 ±1.73	31.1 ±2.03	32.6 ±1.81	36.6 ±1.89	33.3 ±2.01	32.1 ±1.69	28.3 ±2.01
SI	20.1 ±3.47	22.6 ±3.33	23.7 ±3.43	23.1 ±3.49	24.1 ±3.36	22.8 ±3.52	19.4 ±3.32
OPT	10.5 ±2.99	11.1 ±2.70	11.8 ±2.96	12.4 ±3.04	12.0 ±2.76	11.3 ±2.76	10.3 ±3.12
Item		Glycemic control status			Diabetic complications		
	Good	Average	bad		0~1	2~3	4~5
n	71	161	24		159	76	21
MR	66.9 ±13.55	63.4 ±13.67	58.3 ±13.76		64.4 ±13.48	63.3 ±13.55	62.3 ±13.79
TEN	32.7 ±1.72	30.7 ±1.70	32.4 ±1.98		32.1 ±1.72	31.2 ±1.96	27.5 ±2.00
SI	23.1 ±3.60	22.7 ±3.37	16.0 ±3.59		22.8 ±3.49	21.7 ±3.74	19.0 ±3.69
OPT	12.1 ±2.64	11.0 ±2.96	9.2 ±2.88		12.0 ±3.06	10.6 ±2.79	6.6 ±2.66

We selected the DDS17 scale developed by (26) to measure the patient's DD. It comprised a six-point Likert scale (1 for "no problem" and 6 for "severe"). The Cronbach's α was 0.9897, the

KMO was 0.924, and the Bartlett test result was $\chi^2 = 2572.765$, df = 176, $P = 0.000 < 0.05$, indicating that the scale had good reliability and validity. The total DD score (DDS) of the samples was 32.16 ± 12.126. The scores of emotional burden (EB), physician-related distress (PD), regimen-related distress (RD) and interpersonal distress (ID) were 12.15 ± 5.17, 5.82 ± 4.12, 10.341 ± 3.242, and 4.81 ± 2.654 respectively. Table 4 shows the statistical description of the DD of the samples. Ninety-seven patients had moderate distress, whereas 52 had severe distress. According to the evaluation standards (27), 58.2% of the patients surveyed in this study had a relatively high degree of mental distress.

Table 4: Statistical description of DD evaluation in the patients (avg±std)

Item	***Sample***	***Gender***		***Education Level***			
	n	Male	Female	Illiteracy	Primary & Middle School	Senior High School	Bachelor or above
n	256	109	147	12	103	95	46
DDS	32.2±12.1	31.8±11.3	32.5±10.6	35.3±12.2	32.6±11.7	31.7±10.9	31.4±9.85
EB	12.15±5.17	11.4±4.64	12.7±6.2	13.6±6.3	12.55±4.8	12.18±4.7	10.36±3.3
PD	5.82±4.12	5.66±3.36	5.94±4.39	5.92±4.56	5.89±4.19	5.78±3.89	5.72±3.75
RD	10.34±3.24	10.0±2.12	10.58±3.33	11.34±4.31	10.98±3.43	10.81±3.05	7.68±3.15
ID	4.81±2.65	4.32±2.19	5.17±3.16	5.23±3.38	5.02±2.81	4.78±2.45	4.29±2.25
Item		Marital Status				Diabetes duration (year)	
	Married	Separated	Unmarried	Widowed	Divorced	<5	>5
n	154	17	23	18	44	34	222
DDS	30.3±10.13	38.2±14.6	34.9±12.6	34.9±12.13	33.9±12.15	31.34±13.45	32.33±12.12
EB	10.67±5.19	17.66±4.49	15.93±5.38	14.85±5.19	12.12±5.29	12.12±5.05	12.15±5.19
PD	5.7±4.00	6.18±4.42	5.95±4.16	5.82±4.32	6.03±4.12	5.77±3.42	5.83±4.22
RD	10.15±2.99	11.21±3.64	10.76±3.33	10.89±3.51	10.22±3.74	10.15±3.00	10.37±3.45
ID	4.659±2.75	5.46±2.37	5.23±2.66	5.37±2.45	4.64±2.34	4.247±2.42	4.90±2.62
Item		Annual income			Medical Insurance Level		
	<3k	3k~5k	5k~10k	>10k	High	Middle	Low
n	68	123	46	19	23	179	54
DDS	33.3±10.03	32.5±10.5	30.8±10.07	29.89±9.23	29.87±8.23	31.12±10.53	36.77±11.24
EB	13.17±5.88	12.17±4.73	11.21±5.55	10.65±4.24	10.24±4.72	11.98±4.99	13.53±5.24
PD	6.03±4.35	5.89±4.17	5.54±4.22	5.29±4.50	5.77±4.64	5.81±4.14	5.87±4.04
RD	11.09±4.33	10.22±3.29	10.01±2.79	9.23±3.25	10.19±4.12	10.23±3.88	10.77±4.21
ID	5.34±2.84	4.75±2.75	4.51±2.48	4.03±2.11	4.62±2.76	4.85±2.36	4.76±2.88
Item	Glycemic control status			Diabetic complications			
	Good	Average	bad	0~1	2~3	4~5	
n	71	161	24	159	76	21	
DDS	30.87±9.45	32.42±10.23	34.66±8.93	31.74±10.05	32.76±9.46	33.66±10.41	
EB	11.23±5.00	12.07±5.58	15.41±4.23	11.67±4.76	12.66±4.83	13.94±4.33	
PD	5.77±4.88	5.83±4.25	5.90±4.82	5.74±4.28	5.91±4.66	6.10±4.74	
RD	9.79±4.12	10.45±3.35	11.23±2.35	10.06±3.35	10.55±2.63	11.70±4.21	
ID	4.32±2.35	4.99±2.75	5.05±2.35	4.71±2.22	4.94±2.15	5.10±3.36	

Results

Difference analysis of FMS, MR, and DD under different background variables

We used a one-way analysis of variance to analyze the differences in the scores of FMS, MR and DD of patients under 11 background variables, including gender, age, education level, marital status, and family income (Table 5). The results were showed as follows:

1. Differences in marital status, family annual income, and medical insurance level led to significantly differences in FMS. The patients' age, education level, diabetes course, blood sugar control status, insulin injections, and oral hypoglycemic drugs taken were not highly correlated with FMS. (i) The patients in the married group felt the highest degree of FMS. The ones in the married but separated group had the lowest FMS. No significant differences were found in the perception of FMS in the other groups. (ii) The perception of FMS among patients in the group with an annual family income of more than $10,000 was the highest. (iii) A high medical insurance level led to high perception of FMS.

2. The patients with different education levels, annual family incomes, and medical insurance levels significantly differed in MR. (i) A high education level and high annual family income led to high MR. (ii) The level of medical insurance was only related to the dimension of patient's optimism.

3. Significant differences were found among patients with different annual family incomes, medical insurance levels, numbers of complications, and with/without insulin injections. (i) A high annual family income resulted in low degree of DD. (ii) A high medical insurance level led to low emotional burden. (iii) A high number of complications resulted in low (high) RD. (iv) Patients treated with insulin injection had a higher degree of DD, whereas oral hypoglycemic drugs had no obvious impact on DD.

Table 5: Differences in FMS, MR and DD of patients under different background variables (F value)

	FMS	***CD-Resilience Scale***				***Diabetes Distress Scale***				
		RISC	TEN	SI	OPT	DDS	EB	PD	RD	ID
Gender	3.1274	7.1065	8.1529	4.9867	5.1241	13.1843	5.1652	4.1713	4.2231	7.1234
Age	2.7753	10.2372	7.1283	5.1242	5.6124	11.2384	6.1234	3.8942	4.8874	7.9982
EL	2.8652	*8.126****	*8.275****	*5.671***	*6.239***	12.8734	10.6529	8.2971	3.8221	10.2631
MS	*12.233****	7.2124	6.1295	7.2394	7.294	11.2934	11.2861	9.2934	8.8274	8.8753
AFI	*11.751***	*4.418****	*4.167****	*2.781***	*4.317****	*21.283****	*10.267****	*8.134****	*12.293****	*11.13****
DDR	12.186	7.0156	5.4507	7.0481	6.6207	11.9555	9.9130	8.0675	3.5536	9.5701
MIL	*15.753***	2.781*	2.9524	2.923*	*3.561***	*12.165****	3.1827*	3.1762	5.1651	7.6139
GCS	12.568	3.8795	4.7475	3.5552	3.8479	11.5452	9.3080	7.2311	3.4917	9.3279
DCs	10.287	3.1311	3.7742	3.4639	3.1466	*17.183****	*20.985****	3.652*	*11.653****	17.123
Insulin	9.592	6.3788	5.2183	6.1378	6.6021	6.2582	9.7367	4.6199**	7.4057**	8.9729
OHG	10.052	11.1654	9.4685	7.4141	2.8744	9.8212	10.2655	8.7695	6.5391	9.8182

EL=Education Level; MS = Marital Status; AFI = Annual Family Income; DDR = Diabetes Duration; MIL = Medical Insurance Level; GCS = Glycemic Control Status; DCs = Diabetic complications; OHG = Oral-hypoglycemic; *** = P <0.001; ** = P <0.05; * = P <0.1

Correlation analysis among FMS, MR and DD

We used Pearson correlation analysis to examine the correlation among FMS, MR and DD. The results are shown in Table 6. (i) FMS was significantly and positively correlated with MR (r = 0.418) and was significantly negative correlated to DD (r = -0.421). (ii) MR was significantly and negatively correlated with DD. The highest negative correlation with EB was r = -0.682.

Table 6: Correlation coefficient matrix among FMS, MR and DD

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1.FMS	1									
2.TEN	0.386**	1								
3.SI	0.253**	0.825**	1							
4.OPT	0.371**	0.662**	0.676**	1						
5.RISC	0.418**	0.811**	0.910**	0.772**	1					
6.EB	- 0.291**	- 0.682**	- 0.703**	- 0.501**	- 0.661**	1				
7.PD	-0.152*	- 0.415**	- 0.291**	- 0.210**	- 0.307**	0.424**	1			
8.RD	- 0.267**	- 0.503**	- 0.554**	- 0.395**	- 0.621**	0.763**	0.472**	1		
9.ID	- 0.522**	- 0.311**	- 0.342**	- 0.349**	- 0.349**	0.426**	0.369**	0.451**	1	
10.DD	- 0.421**	- 0.617**	- 0.658**	- 0.475**	- 0.612**	0.901**	0.722**	0.891**	0.661**	1

Analysis of the influence path between FMS, MR and DD

We used the structural equation model to analyze the influencing path between FMS, MR and DD. Taking FMS as a dominant variable and the MR and DD as latent variables, the path analysis results between the three variables are shown in Fig. 1.

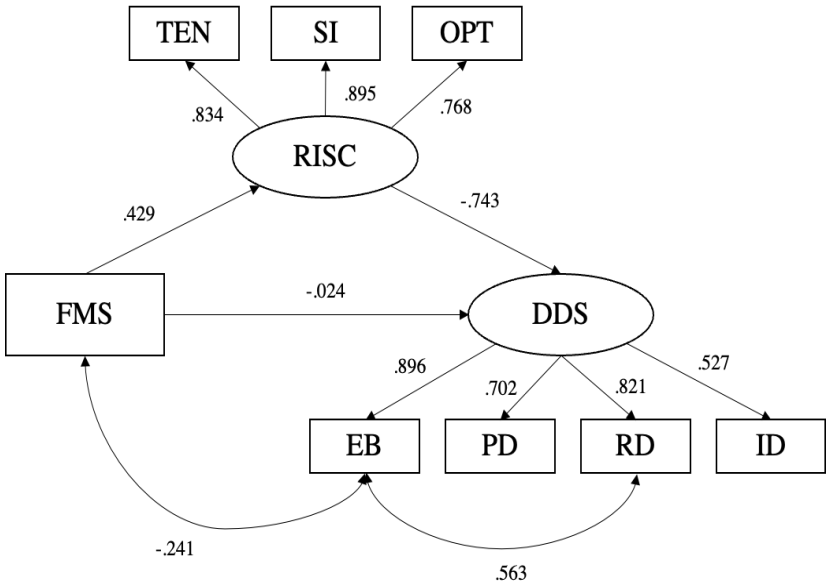

Fig. 1: Structural equation causal path diagram of FMS, MR and DD

First, the initial model of Fig. 1 was modified twice by using the modification indices. χ^2/df = 1.724 < 2, GFI = 0.957 > 0.9, and AGFI = 0.912 > 0.9 showed that the causal path diagram model in Fig. 1 fitted well with the actual data. RMSEA = 0.057 < 0.08, CFI = 0.933 > 0.9, IFI = 0.962 > 0.9 and NNFI = 0.936 > 0.9 showed that the model's fitness in Fig. 1 was good

Second, Fig.1 showed that the path coefficients of FMS to MR, MR to DD, and FMS to DD

were 0.429, -0.743 and -0.024, respectively. The Bootstrap test showed that the confidence interval of the total effect was (-0.423, -0.104) < 0, P = 0.001, the indirect effect was (-0.381, -0.143) < 0, P = 0.001, and the direct effect was (-0.146, 0.035), P = 0.287, indicating that the FMS did not directly affect DD, but had an impact on DD through the mediation of MR.

Discussion

The T2DM patient's perception of FMS was highly correlated with the marital status. The married group had the highest degree of FMS, and the "married but separated" group had the lowest perception of FMS. The "married with spouse" group had the best health status. The result showed that a high perception of FMS had a significant contribution to the patient's health.

The patient's MR is most affected by education level, annual family income, and medical insurance level. (i) The MR levels of the patients in the "junior college and above" and "senior high school or technical secondary school" groups were significantly higher than the other groups. The patients in the former two groups had better adaptability when facing difficulties. (ii) The patients with poor (good) family financial status had low (high) levels of MR. (iii) The patients with high (low) level of medical insurance had the highest (lowest) levels of MR.

The patient's DD is significantly impacted by the medical insurance levels and diabetes courses. (i) The patients with high medical insurance have significantly lower DD than those with low medical insurance. (ii) The patients with long disease course had significantly high levels of DD. (iii) Insulin injection therapy had a significant impact on the patient's DD, whereas oral hypoglycemic drugs had no significant impact on the patient's DD.

A significant positive (negative) correlation existed between FMS and MR (DD). A significant negative correlation was found between MR and DD. The FMS did not directly affect DD. MR was an important intermediary variable between FMS and DD. The results showed that if the patients can improve MR, then they can alleviate DD. This conclusion was similar to another study (28). MR strategies can help control the blood sugar levels of patients with diabetes and significantly improve the self-management behavior and physical and mental health of patients.

Conclusion

During the COVID-19 pandemic, the marital status, family income, medical insurance level, number of complications, and insulin injection therapy of patients with T2DM had significant impacts on the their FMS, MR, and DD. FMS had a significant positive correlation with MR and a significant negative correlation with DD. MR had a significant negative correlation with DD, and MR completely mediated the relationship between FMS and DD. When the patients' family income and medical insurance levels cannot be improved, the following actions are recommended. (i) The medical staff should educate the patients on insulin injection therapy and help them understand methods of reducing diabetes complications, which can significantly reduce the patients' DD. (ii) Patients with family or marital problems and low MR need to seek help from a counsellor to reduce their DD level.

Ethical 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.

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Conflict of interest

The authors declared that they have no competing interests.

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