ORIGINAL RESEARCH

Correlation Analysis of Hypoglycemic Fear and Psychological Well-Being and Family Support Function in Older Adults Diabetic Patients

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Background: Aging diabetic patients have an increased incidence of hypoglycemia due to long disease history, multiple medications, and other factors. The higher the frequency of hypoglycemia, the greater the fear of it, and the heavier the psychological burden. This fear can have a significant negative impact on the patient's personal psychological distress related to the disease, self-care, and the quality of life of other family members. Therefore, analyzing the factors contributing to the fear of hypoglycemia is crucial for finding effective ways to overcome them.

Objective: To analyze the correlation between hypoglycemic fear (FOH), psychological well-being, and family support function in older adults patients with diabetes mellitus (DM).

Methods: Seventy-eight older adults patients with DM were recruited from the community for the study. The Chinese version of the hypoglycemia fear survey scale (CHFSII-WS), WHO-5 happiness index scale and family support function scale were used to analyze the influencing factors of FOH in older adults DM patients to clarify the correlation between FOH, psychological well-being, and family support function.

Results: Low academic qualification, long course of disease, the frequency of hypoglycemia episodes > 2 in the last one year were the risk factor for FOH in older adults DM patients, and hypoglycemia prevention education, psychological well-being and family support function were protective factors. Family support function had a mediating effect.

Conclusion: Older adults patients with DM have higher levels of FOH, which has many influencing factors, and family support function has an obvious mediating effect between FOH and psychological well-being. High-intensity FOH can be improved by actively developing hypoglycemia prevention education for patients and caregivers and improving family support function and psychological well-being.

Keywords: fear of hypoglycemia, old age, psychological happiness, family support function

Introduction

Fear of hypoglycemia is a common emotional response in diabetic patients who experience hypoglycemia. Normal FOH is a protective mechanism that helps to improve patient's adherence to treatment and protects them from hypoglycemia-induced underlying clinical symptoms and diseases associated with autonomic nervous system stimulation. Abnormal FOH leads to persistent anxiety, emotional stress, discomfort, and insecurity, in particular, feeling of impending death. This fear may lead to limited social activity and blood glucose management tends to maintain high levels, thus increasing the instability of blood glucose control. This instability further aggravates the degree of fear, generating vicious cycle, which in turn leads to a significant reduction in self-assessed quality of life in diabetes.[1] The emotions of insecurity and guilt generated by high level of FOH encourage patients to adopt negative coping methods, thus affecting their self-management level through psychological pain level. The latest study shows that 44.8% of the older adults DM patients

have fear of hypoglycemia, more than 50% of PWT 1 D patients have a certain degree of FOH, while 37% to 64% of patients with type 2 diabetes have experienced different degrees of hypoglycemia,[2] and people with type 2 diabetes appear to be more impacted by night-time'symptomatic episodes' person-reported hypoglycaemia (PRH) than people with type 1 diabetes.[3] For older adults patients with DM, due to decreased patient response regulation mechanism, the long duration of the disease and the effects of de-intensified diabetes medication, some older adults may not be aware that the strict glycemic control with sulfonylureas or insulin increases the risk of hypoglycemia, and cost-related non-adherence is common,[4] and the risk of FOH occurring is higher.Studies have shown that clinical attention to patient psychological care and education can effectively relieve anxiety, fear and other negative emotions, and increase patients' trust in the nursing team.[5] It is clear that psychological intervention is very necessary to alleviate FOH. Given the importance of home care in chronic diseases, how to intervene with high levels of FOH in the home setting is particularly important. The findings show that FOH is an important influencing factor of psychological well-being in DM patients.[6] Respondents wanted to share hypoglycemia-specific information as well as emotional support with their families so that others would recognize that their lives were severely limited by hypoglycemia, that the episodes were never intentional, and that they therefore did not deserve to be blamed, misunderstood, and judged for their relapses,[7] while the intimate relationship and mutual support among family members are key factors in maintaining mental health.[8] At this stage, clinical research on FOH in older adults DM patients mainly focuses on quality of life or influencing factors such as sleep, physical activity, work, interpersonal relationships, emotional health, dietary freedom, and the correlation with psychological well-being and family support function has not been conclusively investigated. Therefore, this study investigates the relationship between FOH and psychological well-being and family support function in older adults DM patients, in order to provide a necessary reference for the early prevention and support needs of FOH in older adults DM patients.

Object and Method
Study subjects

The sample size was roughly estimated according to the Kendall method, which was 5 to 10 times the dimensions of the questionnaire included in the study. The study scale had 15 dimensions, and the sample size ranged from 75 to 150 cases. Using the convenience sampling method, 78 older adults DM patients in a community in Fenyang from 2022.8 to 2023.8 who diagnosed in Fengyang hospital and registered in the community hospital were selected as the research objects. (1) Inclusion criteria: diagnosed with type 2 diabetes mellitus with reference to the relevant criteria of the 2012 Diabetes Diagnosis and Treatment Guidelines; age ≥60 years; DM duration no shorter than 1 year; history of hypoglycemia within the last six months; normal communication ability, able to independently complete the questionnaire or fill in the questionnaire concerned; informed consent to the content of this study. (2) Exclusion criteria: combination of serious complications; combination of malignant tumors or other cardiovascular and cerebrovascular diseases; combination of serious mental illnesses; recent psychological trauma due to emergencies. 78 older adults DM patients, 38 males and 40 females, aged 60–85 years, mean (73.07 ± 10.31) years, Body Mass Index(BMI) 19–24 kg / m^2, Mean (22.04 ± 1.68) kg/m^2

Method
Research Tools

(1) General questionnaire: a general questionnaire for patients made by the researcher after consulting relevant literature. Data included data of gender, age, BMI, family history of DM, educational background, whether living alone, monthly income and other social demographic data, the course of DM disease, whether the patient used insulin, whether there were complications, and the number of asymptomatic hypoglycemic episodes in the past 1 year.

(2) Chinese version of the adult hypoglycemia fear questionnaire (CHFSII): CHFSII was compiled by Cox et al[9] and translated into Chinese by the Chinese scholar Mu Chun.[10] There are 23 items on the CHFSII-WS scale (13 items) and -BS scale (10 items), mainly used to evaluate the anxiety and behavior of diabetic patients due to fear of hypoglycemia. The CHFSII-WS scale (13 items) was used to evaluate the patient's FOH degree this time. Each item was scored according to the patient's feelings in the last half a year using Likert 5-level scoring method. "never", "rarely",

"sometimes", "often", "always like this" corresponds to 0~4 points, the full score is 52 points, and the score is proportional to the degree of fear. Cronbach's α coefficient was 0.84 with good reliability and validity of the scale.

(3) WHO-5 Well-being Index Table (WHO-5):[11] The WHO-5 scale is used to assess patients' psychological well-being in the past 2 weeks. The WHO-5 scale contains 5 items, and each item is assessed by the Likert 6 level method (0~5 points). The total score is 0–100 points, and the score is directly proportional to the patient's psychological well-being. The Cronbach's α coefficient of this scale was 0.85 in this study.

(4) Family support function: Family Support Function Scale (FSFS)[12] assessing family support function of patients with chronic diseases. This scale consists of five items, each item evaluated on a scale of 0–2 points, and the total score is 0–10 points. A higher score indicates a higher level of family support function of patients. The reliability and validity of this scale were good (Cronbach's α coefficient was 0.88).

Quality Control

① Pre-investigation was carried out before the start of this investigation: 10 older adults DM patients who met the inclusion criteria were conveniently selected as pre-investigation objects before the formal study. After obtaining the informed consent of the patients, the study subjects were pre-investigated by using the survey tools of various scales. The content of general data survey and the reliability and validity of each scale can be further improved and modified through the pre-survey.

② The questionnaire survey was completed by the same team using unified guidelines. All questionnaires were completed within two days and filled in when the patient's condition was stable. The investigator explained the purpose and the confidentiality principle of the survey to the patient before filling in the questionnaire and conducted an anonymous survey after obtaining the informed consent of the patient. After the questionnaire was issued, patients filled out independently. The questionnaire was collected on the spot, and the investigator should check carefully to ensure the completeness and accuracy of the questionnaire results.

Analytical Indicators

① analysis of FOH in 78 older adults DM patients; ② Univariate analysis of general data affecting the occurrence of FOH in older adults DM patients; ③ The value of influencing factors of FOH in older adults DM patients; ④ Logistic regression analysis of influence on FOH occurrence in older adults DM patients; ⑤correlation between FOH and psychological well-being and family support function in older adults DM patients.

Statistical processing

The questionnaire was input into the EoiData3.0 database and imported into SPSS26.0 software after the data was verified to be accurate. The counting data is described in example (%), the comparison between groups is carried out x^2Test, the measurement data was described by example ($\bar{x} \pm s$) and t test is used to test the differences among groups. The influencing factors were analyzed by Logistic regression. Pearson Parameter was used to analyze the correlation between FOH and psychological well-being and family support function in older adults DM patients. $P < 0.05$ was considered to be statistically significant. The structural equation model of the relationship between FOH, psychological well-being, and family support function in DM patients was established by AMOS 7.0. The mediation effect analysis program was used to examine the mediating effect of family support function between FOH and psychological well-being. Deviation correction Bootstrap method was used to detect the significance of the mediating effect, and $P < 0.05$ was considered statistically significant.

Result

CHFSII-WS score of 78 older adults DM patients

A total of 78 questionnaires were sent out, and 78 valid questionnaires were finally recovered, with an effective rate of 100.00% (78/78). There were 78 older adults DM patients with CHFSII-WS total score (27.98 ± 4.05), and 28 were divided into a critical value, >28 were divided into a high FOH group and ≤ 28 were divided into a low FOH group,

including 32 patients with high FOH (41.03%) and 46 patients with low FOH (58.97%). Details of the CHFSII-WS scores of 78 patients are shown in Table 1.

Single factor analysis of FOH general data affecting older adults DM patients

The proportion of high FOH group with education background of junior high school or below was significantly higher than that of low FOH group (P < 0.05), as shown in Table 2.

Univariate analysis affecting FOH disease data in older adults DM patients

The duration of DM in the higher FOH group was significantly longer than that in low FOH, the frequency of hypoglycemic episodes in the past year was significantly higher than that in low FOH group, and the proportion of hypoglycemia prevention education, WHO-5 score, and FSFS score in lower FOH group was significantly lower (P < 0.05), as shown in Table 3.

Assignment of FOH influencing factors in older adults

DM patients were based on the level of FOH in older adults DM patients as the dependent variable (high FOH = 1, low FOH = 0), and independent variables (educational background, duration of DM, frequency of hypoglycemia onset in recent 1 year, hypoglycemia prevention education, WHO-5 score, FSFS score), as shown in Table 4.

Table 1 CHFS-WS Score of the 78 Older Adults DM Patients

Item	Score (score)
Avoid visiting relatives and friends	2.51±0.26
Faint in public places	1.16±0.17
Be sure to go out with someone	2.09±0.21
Limit exercise or physical activity	2.05±0.33
Reduce trips or travel	2.84±0.23
Hypoglycemia occurs during sleep	1.42±0.15
Hypoglycemia occurs while driving riding a bicycle	2.29±0.24
When hypoglycemia occurs, there is no one around to help	1.47±0.16
Keep my fasting blood sugar above 8mmol / L	2.23±0.24
To avoid hypoglycemia, I always carry candy or carbohydrates	2.75±0.28
When I am about to have hypoglycemia, I do not realize it	2.38±0.31
Eat these as soon as I feel signs of hypoglycemia	2.84±0.29
The occurrence of hypoglycemia can disrupt something important that I am doing	1.91±1.84
Total score	27.98±4.05

Table 2 Univariate Analysis of general Data Affecting FOH in Older Adults DM Patients [Number of Cases (n), $(\overline{X} \pm S)$]

Group	Number of Cases	Gender (Male/ Female)	Age (Year)	BMI (kg/m^2)	Family History of DM (yes no/)	Education (Junior High School or Below/ Above)	Living Alone (Yes / No)	Monthly Income (Below 3000/Above 3000)
High FOH group	32	16/16	73.34±8.16	22.26±2.35	19/13	27/5	17/15	21/11
Low FOH group	46	22/24	72.89±7.98	21.89±2.29	25/21	26/20	24/22	28/18
χ^2/t	–	0.036	0.242	0.694	0.194	6.723	0.007	0.183
P	–	0.850	0.809	0.490	0.660	0.001	0.934	0.669

Table 3 Univariate Analysis of the FOH Disease Data in Older Adults DM Patients [Number of Cases (n), ($\overline{x}\pm$ s)]

Group	Number of Cases	Duration of DM (Years)	Whether to Use insulin (Yes/No)	Without Complications (Yes/No)	Number of Hypoglycemic Episodes in the Last 1 Year (≤2 Times /> 2 times)	Hypoglycemia Prevention Education (yes/no)	WHO-5 Rating (Score)	FSFS Score (Score)
High FOH group	32	16.03±2.06	12/20	6/26	23/9	5/27	59.67±10.34	4.03±0.56
Low FOH group	46	12.09±1.38	19/27	10/36	43/3	17/29	76.01±8.22	6.31±1.02
χ^2/t	-	10.123	0.114	0.103	6.766	4.241	7.763	11.483
P	-	0.000	0.736	0.748	0.009	0.039	0.000	0.000

Table 4 Description of the Assigned Factors Influencing FOH in Older Adults DM Patients

Independent Variable	Assignment Situation
Educational background	Junior high school and below =1, junior high school and above =0
Course of DM	14 years =1, <14 years =0
Frequency of hypoglycemic episodes in recent 1 year	> 2 times =1, and 2 times =0
Hypoglycemic prevention education	No =1, with =0
The WHO-5 score	60 points =1, <60 points =0
FSFS grade	5 points =1, <5 points =0

Logistic regression analysis affecting FOH in older adults

DM patients: frequency of hypoglycemic episodes >2 times in the past 1 year is a risk factor for FOH in older adults DM patients. Hypoglycemia prevention education, WHO-5 score ≥60, and FSFS score ≥5 are protective factors for FOH in older adults DM patients, as shown in Table 5.

Correlation between FOH, psychological well-being, and family support function in older adults DM patients

Correlation analysis of Pearson parameter showed that the total score of CHF□-WS in older adults DM patients was significantly negatively correlated with WHO-5 and FSFS scores (P < 0.05), as shown in Table 6.

Analysis of the mediating effect of family support function between FOH and psychological well-being in older adults DM patients

This study took CHFS II score as independent variable, FSFS score as the mediating variable, and WHO-5 score as dependent variable. Bootstrap self-sampling 5000 times validation analysis shows that, the Bootstrap 95% confidence interval of the indirect effect of mediation variables on psychological well-being did not include 0, family support function had an obvious mediation effect on FOH and psychological well-being in older adults DM (P < 0. 05), as shown in Table 7 and Figure 1.

Table 5 Multivariate Logistic Regression Analysis of Influence on FOH in Older Adults DM Patients

Variable	β	SE	Waldχ^2	P value	OR	95% CI
The frequency of hypoglycemia attacks was> 2 times in recent 1 year	1.623	0.273	35.344	0.000	5.068	2.968~8.655
Hypoglycemic prevention education	−0.821	0.195	17.726	0.000	0.440	0.300~0.645
WHO-5 score ≥60 points	−0.611	0.105	33.861	0.000	0.543	0.442~0.667
FSFS score≥5 points	−0.746	0.127	34.504	0.000	0.474	0.370~0.608
Constant term	−10.397	2.365	19.327	0.000	-	-

Table 6 Correlation of FOH with Psychological Well-Being and Family Support Function in Older Adults DM Patients

Group	WHO-5 Score		FSFS Score		Total CHFS-WS Score	
	R	P	R	P	R	P
Total CHFS-WS score	−0.362	0.000	−0.314	0.000	1.000	0.000
WHO-5 score	1.000	0.000	0.426	0.000	−0.362	0.000
FSFS score	0.426	0.000	1.000	0.000	−0.314	0.000

Table 7 Mediating Effect of Family Support Function in FOH and Psychological Well-Being in Older Adults Patients with DM

Predictive Variable	Outcome Variable	Who-5 Score		Indirect Effect	
		Regression Coefficient	P	Regression Coefficient	Bootstrap 95% Confidence Interval
FOH	Family support function	−1.387	0.000	-	-
FOH	Psychological well-being	−0.476	0.000	-	-
Family support function	Psychological well-being	0.482	0.000	-	-
	Psychological well-being	−1.265	0.000	−0.685	(−0.953~−0.467)

Note: The total effect of the family support function is-1.265, the direct effect is-0.423, and the intermediate effect is-0.685, so the family support function is the intermediary.

Discussion

Diabetes is one of the biggest global health issues, with over 300 million people suffering from it.[13] The aging population is one of the groups with the highest prevalence of diabetes. Data shows that in our country, the incidence rate among the older adults has increased from 16.4% to 19.6% over the past three years, and the incidence of hypoglycemic coma is as high as over 30%. The fear of such high incidence of acute complications not only causes emotional fluctuations in patients, such as guilt, depression, dependency on others, loss of control, and increased stress, but also negatively affects
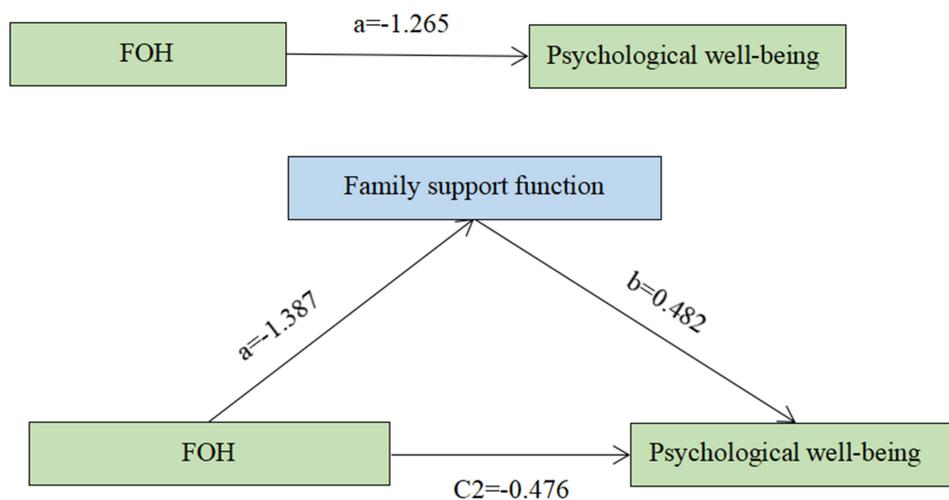
Figure 1 The mediating effect of family support function on FOH and psychological well-being.

disease management, metabolic control, and the ability to maintain a normal life.[14] At the same time, fear of hypoglycemia is the greatest barrier to starting insulin treatment, severely hindering clinical treatment decisions and progress.[15] This also puts significant psychological pressure on family members, worrying about decreased treatment compliance in patients, increased risk of complications, and safety issues when alone. FOH involves psychological, physiological, and social aspects.

We found higher levels of FOH in older adults DM patients, which is similar to Anarte et al[16] finding that being older than 40 years of age increases the risk of FOH in T1D patients. Castellano-GuerreroA[17] found that 46–65 years old was a risk factor for FOH in T1D patients, and ZhangHui[18] found that FOH was more prominent in DM patients, especially older adults DM patients, The conclusion is consistent, and high-intensity FOH is classified as an anxiety disorder which negatively affects the management of DM. In addition, the body function of the older adults is weakened, and there are some misunderstandings in the process of self-management, resulting in weak self-management ability.[19] Living alone, number of hypoglycemic episodes in the past year, the number of severe hypoglycemic episodes in the past year and duration of insulin use were related to FOH as recently shown by Huang J.[20] This is consistent with our finding that the frequency of hypoglycemic > 2 times in nearly 1 year is a risk factor for FOH in older adults DM patients. In conclusion, FOH is a common psychological warning during the blood glucose management in older adults DM patients, and how to regulate FOH in older adults DM patients at home has attracted much attention. This study suggests that patients with more than 2 episodes of hypoglycemia in recent one year should be paid more attention to in clinical care, hypoglycemia fear screening should be carried out in these groups, and hypoglycemia prevention training should be conducted for patients and family members. Second, psychological well-being and family support function as protective factors that may provide reference for the management of FOH at home in older adults DM patients.

The study of N. Nikolakakis[21] showed that stressful life events were identified as factors that negatively affecting well-being, Higher FOH was associated with lower quality of life, impaired emotional health and higher psychological distress,[22] FOH includes anxiety disorders of patients and their families, which result from hypoglycemia and related behavioral changes that affect blood glucose management,[23] The literature emphasizes that patients with hypoglycemia experience have significantly higher FOH than those without hypoglycemia experience, and the psychological trauma caused by a severe hypoglycemia experience is more difficult to repair, Huang Wenzhen[24] Studies showed that there was a clear negative association between FOH and psychological well-being in DM patients. Patients need psychological support to manage their fear and anxiety associated with the risk of hypoglycemia, to cope with misunderstandings and accusations associated with hypoglycemia, and to increase the psychological well-being closely related to an individual's quality of life, life value, and self-realization.[25] In the process of home convalescence of patients, caregivers can more effectively manage their own feelings and behaviors to support patients, which can effectively balance the psychological burden of the older adults and improve the psychological well-being and the quality of life.

Psychological well-being and family support function have always been important projects to improve the ability of patients with chronic diseases to fight against diseases, Zhao Jifeng[26] confirmed that the degree of family care of older adults patients with chronic diseases is closely related to psychological happiness. DM, as a lifelong chronic disease, most patients need to be prevented and treated at home. A patient's family support function is directly related to the blood glucose control effect and mental health status.[27] Our study shows that psychological well-being and family support function can provide personalized emotional value for older adults DM patients at home. In addition, the results of this analysis suggest that family support function has an obvious mediating relationship between FOH and psychological well-being in older adults DM patients. It suggests that family support function mediates the relationship between FOH and psychological well-being to a certain extent, which provides medical personnel with a new perspective for clinical intervention, focusing on FOH specific information and training of patients' families, timely prevention of high levels of FOH, management of patients with hypoglycemia and empathy, and strengthening the improvement of family support function and psychological well-being in older adults DM patients. It has positive implications for the prevention and treatment of FOH.

Conclusion

Low academic qualification, long course of disease, increased frequency of hypoglycemia in the past 1 year, and lack of hypoglycemia prevention education are the risk factors for FOH in older diabetic patients. The rehabilitation and recuperation of most chronic diseases are carried out in the family environment. The clear mediation effect of family support function in FOH and psychological well-being in older adults DM, Family member support is not only a buffer to reduce high levels of FOH in older adults DM patients but also a catalyst to regulate patients' anxiety and fear. It affects the physical and mental health of patients through multiple factors such as behavior and ideas.

These findings provide new ideas for clinical guidance of home management for patients with chronic diseases and help community healthcare teams plan personalized intervention programs for these patients. Including psychological counseling and the implementation of health education to strengthen the health management of patients, such as regular patient exchange and sharing lectures in the community, health lectures, exercise prescription customization and adjustment programs, to assist the orderly diabetic patients to minimize the high level of FOH.

Ethics Approval and Consent to Participate

This study has been reviewed and approved by the Ethics Committee of the Fenyang College of Shanxi Medical University. The ethics acceptance number is 202107. Patients were consented by an informed consent process that was reviewed by the Ethics Committee of the Fenyang College of Shanxi Medical University and certified that the study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki.

Author Contributions

Xia Ren and Zhaoxia Tian contributed equally to this work and are co-first authors. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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