

Ambulatory Type 2 Diabetes Mellitus Patients' Experience of Severe Hypoglycemia Events. A Qualitative Grounded Theory Study in Bali, Indonesia

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Abstract

Introduction: Hypoglycemia is a significant challenge in the treatment of diabetic patients, so a deep understanding of this phenomenon is crucial. This study aimed to develop a theoretical framework related to variables that induce hypoglycemia in ambulatory T2DM patients based on their experience, including signs and symptoms that appear and their perception of the hypoglycemia event.

Methods: The participants in this qualitative grounded theory study were ambulatory T2DM patients who were living in Bali Province in 2024. The patients were selected using purposive sampling. The data were collected using individual interviews. The collected data were analyzed using Qualitative Data Analysis (QDA) Miner Lite from Provalis Research.

Results: Patients shared their experiences with severe hypoglycemia. According to them, the factors that induce hypoglycemia were divided into four themes, namely, low nutrient intake, medication-related, lifestyle-related, and comorbid-related hypoglycemia. Patients have an incorrect or partial perception of hypoglycemia events. The phenomenon of patients experiencing hypoglycemia events indicates that they were at risk of experiencing recurrent severe hypoglycemia in the future.

Conclusion: Factors that potentially affected hypoglycemic symptoms were extracted in this study: Ambulatory diabetes medication, inadequate dietary consumption during diabetes management, detrimental lifestyle choices, and diabetes-related comorbidities. Health workers are required to carry out promotive and preventive efforts to prevent hypoglycemia in outpatients.

Keywords: Grounded Theory, Qualitative research, Hypoglycemia, Diabetes mellitus, Metabolic Diseases

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Introduction

Patients with type 2 diabetes mellitus (T2DM) sufferers, especially in Indonesia, were reported to have increased from year to year. Currently, Indonesia is ranked 5th with the highest number of DM sufferers in the world. This figure is predicted to continue to increase (1). The World Health Organization (WHO) predicts that in 2030, Indonesia will experience an increase in the number of DM sufferers, up to 2.5 times the number of sufferers in the previous three decades (2).

Management of T2DM therapy in Indonesia still relies on insulin and Sulfonylurea (SU) as the first choice of treatment (3,4). This therapy is still widely used in Indonesia because insulin and SU have been proven safe, are cost-effective, and are easily accessible to remote areas. Clinicians in medical facilities also encourage the use of insulin and SU to achieve therapy targets (HbA1c < 7%) (3–5).

Problems also arise from the use of these medications when patients are discharged. Patients in Indonesia,

especially in the Province of Bali, lack education and supervision of the use of these drugs by health workers. This situation affects patient behavior in the treatment process. Poor patient behavior has an impact on therapy failure and the occurrence of adverse drug reactions (ADRs), such as hypoglycemia (3–7). Hypoglycemia is an acute event that is at risk of causing death. Hypoglycemia is associated with increased mortality and morbidity of the disease (8–10).

Most studies have addressed hypoglycemic symptoms using a quantitative approach. However, the literature review highlights the need for a detailed analysis of these symptoms. Therefore, qualitative research, with its unique capabilities, can explore and identify the conditions in which psychological and social processes occur, potentially revealing the social conditions and variables that influence behaviors. To this end, the present study adopted a grounded theory approach, which is particularly useful when there is insufficient knowledge about a given phenomenon. Furthermore, this approach



provides valuable and in-depth information in qualitative studies. Thus, instead of relying on existing theories, the grounded theory approach enables the researcher to formulate theories based on data from real-world contexts. Hence, the present study was conducted to investigate a theoretical framework about variables that precipitate hypoglycemia in ambulatory T2DM patients, informed by patient experiences, encompassing the signs and symptoms that manifest and their interpretation of the hypoglycemic episode. This study report can then be used as evidence to begin to improve issues involving the relationship between patients, caregivers, health workers, and local governments. Ultimately, the principle of patient safety can be achieved as a sustainable development goal.

Methods

Qualitative Approach and Research Paradigm

The qualitative approach used in this study was grounded theory. Charmaz's approach, as a systematic method in qualitative studies, deeply explores patients' experiences, behaviors, and symptoms. Researchers describe the experiences of ambulatory type 2 diabetes mellitus (T2DM) patients who have a history of severe hypoglycemia. These patient experiences were then synthesized into a theory in the form of a thematic framework that explains the patients' points of view. The research paradigm used in this study was constructivism/naturalistic inquiry. The research was conducted to understand the problem from the perspective of ambulatory T2DM patients. This study aimed to understand the participants' views of the hypoglycemia experience as much as possible.

Researcher Characteristics and Reflexivity

The researchers were a group of four individuals who work at an educational institution/university. The researchers were also clinical pharmacist practitioners. All researchers have had experience practicing as clinical pharmacists with patients in health services for more than five years. The qualifications of the researchers consist of one professor in the field of clinical pharmaceutical pharmacology, two associate professors in the field of clinical and community pharmacy, and one PhD student who studied the field of clinical and community pharmacy. The relationship between researchers and patients was between users and service providers. No reflexivity was considered to influence patient statements in the interview process. Patients can freely share their experiences without intervention or pressure from the interviewer.

Study Context

The research setting in this study was a hospital, more specifically, an outpatient pharmacy installation. Patients who undergo monthly health check-ups will consult a doctor at the polyclinic and then pick up their medication at the outpatient pharmacy installation. When patients were about to receive dispensing services, the clinical pharmacist communicated, provided information, and

educated them before the patient was discharged. During this dispensing service, the respondent recruitment process was carried out.

Participant Recruitment and Sampling Strategy

In the initial stage, all diabetes mellitus patients recorded in the system who were consulting a doctor at the polyclinic were traced for their medical history through electronic medical records at the outpatient pharmacy installation. Patients with a history of severe hypoglycemia were invited to be part of the study with the following inclusion and exclusion criteria. The inclusion criteria for this study were: 1) ambulatory T2DM patients who were recorded as having a history of severe hypoglycemia, 2) a history of antidiabetic drug intake, and 3) a medical record consisting of at least age, gender, body mass index (BMI), duration of DM, blood sugar profile for the last three months, list of drugs taken home, and complications. Exclusion criteria were patients who were unwilling to participate in the study. Convenience sampling was used to identify potential participants according to the study criteria. The first author carried out the interviews in a patient-pharmacist counseling room (closed room) in a hospital outpatient pharmacy installation during office hours from August to September 2024.

Data Collection Methods

The data collection method used was direct interviews. The interview questions were open-ended, with probing questions to gather in-depth responses about patients' experiences, perceptions, opinions, feelings, and knowledge of hypoglycemia. Researchers prepared a questionnaire for personal use related to hypoglycemia events to ensure that no patient experiences were missed for exploration. Data collected as primary outcomes were signs and symptoms of hypoglycemia that they experienced, patient experiences that induced hypoglycemia, and their perceptions of hypoglycemia events that they had experienced. Supporting data used to collect data were patient electronic medical record data to obtain information according to the established inclusion criteria. The sampling continued until data saturation was achieved. The technique relied on the formation and subsequent saturation of concepts, categories, and subcategories. The saturation was evaluated based on the distribution of coding frequencies established by the study team during a plenary conference.

Data Collection Instruments and Technologies

The instrument used to support data collection was an Android-based audio recorder with data synchronized with the cloud. The voice recorder helped in the verbatim transcription process. The software used to process the data was QDA Miner Lite from Provalis Research.

Data Processing

The data processing stages include audio-recorded interviews, followed by verbatim transcription, checking

the transcripts by all researchers, reading thoroughly in online meetings, followed by the coding stage using QDA Miner Lite, determining theming, and ending with the synthesis thematic framework stage. Interviews lasted from 15 to 25 minutes.

Data Analysis

Data were analyzed and presented descriptively. Some important patient statements were presented in their original form. Percentages and total data were presented in tabular form for patient demographic data, signs and symptoms of hypoglycemia experienced by patients, the results of the thematic framework synthesis, and patient perceptions of hypoglycemia events. The theoretical approach found in the study was presented in diagram form.

Techniques to Enhance Trustworthiness

The technique used to increase the trust and credibility of the data analysis was the member-checking method. Each author verified all stages, starting with transcription verbatim, coding theming, and synthesis individually. The verification results were discussed online until the forum results were obtained. All discussion results were recorded and can be archived as auditable documents. Peer checking, extended engagement, member checks, and researcher triangulation.

Standard Reporting

The reports of this study were presented based on the Standards for Reporting Qualitative Research (SRQR) guidelines for qualitative study design (11).

Results

A total of 50 patients who passed the screening stage and met the study criteria were invited to participate in this study. A total of 12 people stated that they were not willing to participate, and 38 patients who were willing to be part of the study were then interviewed in depth regarding their experiences of having suffered from severe hypoglycemia. The characteristics of the patients involved in the study are shown in Table 1.

Patients reported that they experienced at least three signs and symptoms of hypoglycemia before their presentation to the emergency department. The signs and symptoms they reported are described in Table 2.

The top five signs and symptoms of hypoglycemia experienced by patients in this study were shaking, heart palpitations, feeling tired or weak, sweating, and feeling anxious or irritable. This statement is supported by a statement from one of the respondents, which is considered attractive to quote.

“At first, I didn’t know what hypoglycemia was. All I knew was that I felt very uncomfortable shortly after using insulin. My heart was beating fast, and I was sweating profusely. This condition made me really anxious until my family took me to the emergency unit in a weak state. I was told that my blood sugar in the

Table 1. Characteristics of T2DM Patients Involved in the Study

No.	Patient's Characteristics	Value (n = 38)
1	Gender	
	Male (n %)	23 (60.53)
	Female (n %)	15 (39.47)
2	Age (Year)	
	30-45 (n %)	10 (26.31)
	46-55 (n %)	12 (31.58)
	56-65 (n %)	11 (28.95)
	> 65 (n %)	5 (13.16)
3	BMI (kg/m ²)	
	Underweight (n %)	2 (5.26)
	Normal (n %)	10 (26.32)
	Overweight (n %)	16 (42.10)
	Obese (n %)	10 (26.32)
4	T2DM Duration (Year)	
	> 5 (n %)	18 (47.37)
	≤ 5 (n %)	20 (52.63)
5	BG (A1C, FG, PG, RG)	
	Uncontrolled	30 (78.95)
	Controlled	8 (21.05)
6	Comorbidities and Complications	
	CKD (n %)	15 (39.47)
	DM Neuropathy (n %)	11 (28.95)
	CVD (n %)	22 (57.89)
	DM retinopathy (n %)	2 (5.26)
	DMDF (n %)	3 (7.89)
	DM Gastropathy (n %)	3 (7.89)
	Hypertension (n %)	24 (63.16)
7	Dyslipidemia (n %)	17 (44.74)
	Diabetes Medication	
	Insulin (n %)	31 (81.58)
	SU (n %)	7 (18.42)
	Biguanide (n %)	16 (42.11)
	DPP-4 Inhibitor (n %)	3 (7.89)
	AGI (n %)	5 (13.16)
	SGLT-2 Inhibitor (n %)	4 (10.53)

n: Number; BMI: Body mass index; T2DM: Type 2 diabetes mellitus; BG: Blood glucose; A1C: HbA1C; FG: Fasting glucose; PG: Prandial glucose; RG: Random glucose; CKD: Chronic kidney diseases; CVD: Cardiovascular diseases; DMDF: Diabetes mellitus diabetic foot; SU: Sulfonylureas; DPP4: Dipeptidyl peptidase 4; AGI: Alpha glucosidase inhibitor; SGLT2: Sodium glucose co-transporter 2

emergency room was 40 mg/dL.”

(Interview 1. Patient experiences of signs and symptoms of hypoglycemia)

Exploration was continued to find out things that were suspected of inducing hypoglycemia events based on patient experience and perception. All important patient variables were translated into coding form to synthesize the thematic framework and then to obtain a comprehensive picture of hypoglycemia-related problems from the patient experience aspect. The thematic framework that

has been formulated is shown in Table 3.

Several patient statements regarding their experiences of variables that trigger hypoglycemia events that are considered essential to convey and discuss further are as follows.

“At the beginning of using this post-meal insulin (rapid-acting), 1 to 1.5 hours after the meal, I definitely experienced those signs and symptoms (hypoglycemia). I felt weak all day, hungry, and wanted to eat all the time. There was a day in the past when the symptoms made my heart beat fast, I had cold sweats, and my mouth tasted bitter. Finally, I found out from the doctor that this insulin is one of the drugs that can cause low blood sugar, and those symptoms appear. The doctor also said

Table 2. Signs and symptoms of hypoglycemia that occurred during severe hypoglycemic episodes in T2DM patients in the study

No	Sign and Symptoms	Number of Patients Experiencing (n = 38)
1	Feeling hungry	27 (71.05%)
2	Feeling dizzy	22 (57.89%)
3	Feeling anxious or irritable	29 (76.32%)
4	Sweating	31 (81.58%)
5	Shaking	35 (92.11%)
6	Tingling lips	4 (10.53%)
7	Heart palpitations	35 (92.11%)
8	Feeling tired or weak	33 (86.84%)
9	Blurred vision	2 (5.26%)
10	Feeling confused	8 (21.05%)
11	Have a seizure	1 (2.63%)
12	Become unconscious	12 (31.58%)

n: Number

that I should go to the emergency unit immediately if I experienced those signs and symptoms (hypoglycemia), either severe or mild, after using insulin.”

(Interview 2. Patient using basal-bolus insulin)

The important thing that can be seen from the patient's statement in interview 2 was the medication regimen and nutritional intake that needed to be reviewed. Furthermore, the patient does not know the first aid to overcome hypoglycemia. The distance between the patient's home and the emergency unit may not always be reached quickly. The patient has the potential to experience severe hypoglycemia before reaching the emergency unit.

I have been using glimepiride 2 mg once a day in the morning for one month. I always have a regular breakfast with a plate of rice with side dishes and vegetables. I actually experienced signs and symptoms of hypoglycemia in the afternoon before lunch. At first, I did not know that the medication was the cause. I thought that the symptoms were a sign that I was not in good condition. Recently, I learned from the pharmacist that the drug (Sulfonylurea) was the cause of the signs and symptoms (hypoglycemia). The dose was finally adjusted to 1 mg once a day, and the symptoms no longer appeared as often as before.

(Interview 3. Patient using sulfonylurea)

The essential thing that can be seen from the patient's statement in interview 3 was that the SU regimen needs to be reviewed. Furthermore, the patient does not know the terminology of hypoglycemia, how to deal with it in an emergency, and the misperception between hyperglycemia and hypoglycemia.

Table 3. Thematic Framework on factors potentially leading to severe hypoglycemia events from patient experience

No.	Thematic Category	Codes	Number of Patients Experiencing (n = 38)
1	Medication-related hypoglycemia	After taking a rapid-acting insulin.	31 (81.58%)
		After taking a long-acting insulin.	25 (65.79%)
		After taking SU.	7 (18.42%)
		Taking beta blockers along with diabetes medications, especially insulin and SU.	12 (31.58%)
		Taking herbal medicine along with diabetes medications, especially insulin and SU.	8 (21.05%)
Average code frequency			17 (43.68%)
2	Low nutrition intake	Skip snacks.	33 (86.84%)
		Not finishing the main course.	22 (57.89%)
		Extreme calorie deficit diet.	11 (28.95%)
		Changes in eating patterns due to religious fasting.	15 (39.47%)
Average code frequency			20 (53.29%)
3	Lifestyle-related hypoglycemia	Increased physical activity beyond regular conditions.	28 (73.68%)
		Smoking after taking diabetes medication.	6 (15.79%)
		Taking alcohol before/after taking diabetes medication.	3 (7.89%)
		Stress due to daily work.	17 (44.74%)
Average code frequency			14 (35.53%)
4	Comorbid-related hypoglycemia	When GERD recurs.	3 (7.89%)
		When CKD is uncontrolled.	10 (26.32%)
Average code frequency			7 (17.11%)

n: Number

*I was born and raised in a family with the belief that all diseases can be cured with medicines provided by nature. My family and I have a history of diabetes. Initially, we did not look for medical treatment. We relied on herbal medicines such as insulin leaves (*Smallanthus sonchifolius*). Finally, this disease spread to the heart and caused me to have to look for medical treatment. The doctor gave me insulin during discharge. After that, I used insulin with a combination of insulin leaves. The problem arose when I used both drugs, and I showed signs and symptoms (hypoglycemia) until I was unconscious. I woke up in the emergency unit.*

(Interview 4. Patient using herbal medicine)

The main thing that can be known from the patient's statement in interview 4 was the existence of a family culture using herbal medicine. This belief is, in fact, very difficult to change. The use of herbal medicine, together with therapeutic management from medical facilities, has a high potential for a synergistic effect that increases the risk of hypoglycemia in patients.

I am a DM sufferer who is still active and productive at work. I am a user of basal and bolus insulin. I often experience this problem (hypoglycemia) during the day when I don't finish my main course or skip snacks. Sometimes, when I am stressed with work, this problem occurs (hypoglycemia). Basically, I don't understand the term hypoglycemia, but I know the signs and symptoms that you mentioned earlier (hypoglycemia).

(Interview 5. Patient on low nutritional intake)

The essential thing that can be seen from the patient's statement in interview 5 was the reduced nutritional intake from regular intake while the medication dose remained the same. The patient did not understand that there was a risk of hypoglycemia that faced them when they did not get enough nutritional intake, especially when using fast-acting insulin. Patients who are still productive need to be educated regarding nutritional intake when using insulin. Problems related to this were often reported.

I have been a DM sufferer for more than five years. Symptoms of hypoglycemia occur to me throughout the year. What I think is unique to share regarding this is that when I use insulin during regular activities, I have never

experienced hypoglycemia. However, hypoglycemia occurs when my activities exceed regular activities. For example, when there is a religious ceremony that makes me active all day, excessive exercise, or vacation trips, I have to readjust my insulin dose regimen.

(Interview 6. Patient on lifestyle-related hypoglycemia)

The essential thing that can be known from the patient's statement in interview 6 was the patient's admission that hypoglycemia symptoms always occur when there is increased physical activity outside of the usual rhythm.

"I have GERD. The signs and symptoms (hypoglycemia) also appear together with my GERD relapse. I don't know for sure if it is hypoglycemia because I don't have a glucometer and have never operated it myself. However, I felt the signs and symptoms (hypoglycemia) were more severe when my GERD relapses."

(Interview 7. Patient on comorbid-related hypoglycemia)

The interesting thing found from the patient's statement in interview 7 was the patient's confession that hypoglycemia symptoms appeared when there was a relapse in his GERD. The patient stated that the signs and symptoms of hypoglycemia were more severe when GERD appeared.

"I have had severe hypoglycemia in the past. I have DM with CKD. At that time, I missed my hemodialysis (HD) schedule and used insulin according to the HD dose. This caused me to lose consciousness because my blood sugar dropped to 33 or 30 mg/dL; I forgot exactly. I woke up and found myself in the emergency unit."

(Interview 8. Patient on comorbid-related hypoglycemia)

The important thing found from the patient's statement in interview 8 was that patients who have kidney problems were basically at risk of experiencing hypoglycemia, especially if they were on ongoing therapy with insulin or SU. Patients with kidney problems will have many comorbidities and the complexity of their therapy management, so these patients are recommended to get special medical services to control all the comorbidities they suffer from.

Based on the results of interviews with respondents in the study, it was found that they had varying perceptions

Table 4. Patient Perception of Hypoglycemia Event

No.	Perception	Number of Patients with Similar Perceptions (n=38)	Perception Assessment
1	Potent effects of diabetes medication.	15 (39.47%)	Partial Correct
2	Signs that my blood sugar is high.	12 (31.58%)	Incorrect
3	Signs that I need additional glucose in my daily diet.	28 (73.68%)	Incorrect
4	Signs that I need to increase my DM medication doses.	24 (63.16%)	Incorrect
5	There is something wrong with the therapy regimen, or my way of undergoing ambulatory therapy is not appropriate.	4 (10.53%)	Correct
6	This is a sign that the medicine from the health facility is not good.	9 (23.68%)	Incorrect
7	Conditions caused by insulin use.	30 (78.95%)	Partial Correct
8	The condition where my illness has worsened.	8 (21.05%)	Incorrect
9	Life-threatening condition.	23 (60.53%)	Partial Correct
10	Situations where I need to go to the emergency unit immediately.	38 (100%)	Partial Correct

n: Number

and views on hypoglycemia events. Table 4 presents a description of patient perceptions of hypoglycemia events.

Around 90% of patients have an inaccurate perception regarding the occurrence of hypoglycemia. They may feel the impact but still misunderstand the phenomenon that occurs. This problem was stated in the statements of several respondents:

“I didn’t know what hypoglycemia was, but after you (the researcher) explained it, I understood it because I experienced it. I always thought hypoglycemia signs and symptoms occurred because of the high level of glucose in my blood (hyperglycemia)”.

(Interview 9. Patient perception of hypoglycemia)

Patients basically do not understand what hypoglycemia is. For them, hypoglycemia signs and symptoms appear due to a condition where their blood sugar is high, and they feel the dose of their diabetes medication needs to be increased to improve the existing condition. This condition is undoubtedly very dangerous because the patient’s misunderstanding can have a fatal impact on their medical condition. They do not realize that there is a threat of death that may occur in the final phase of hypoglycemia.

The findings in this study were synthesized into a conceptual framework that links all essential variables to be more easily understood both from the patient’s point of view and the gaps that health workers can utilize to ensure patient safety. The conceptual framework is presented in Figure 1.

Discussion

According to the patient experience of events that trigger hypoglycemia, four main domains were found, namely low nutrition intake-related, medication-related, lifestyle-related, and comorbid-related hypoglycemia. In the medication-related domain, many studies have reported that the use of agents such as insulin and SU causes hypoglycemia if the regimen and method of use of the drug are not appropriate (3,12–15). In developed countries, the use of insulin and SU as diabetes mellitus therapy has been abandoned. The management of treatment has been a shift in the use of diabetes medication to direct incretin mimetic agents (GLP-1), indirect agents such as DPP4 inhibitors, or SGLT2 inhibitors (16). Developing countries such as Indonesia still rely on insulin and SU as blood sugar controllers for patients because they are cost-effective, covered by national health insurance, and have easy access to remote areas (3,4,17). Beta-blocker drugs and several antibiotics have also been reported to induce hypoglycemia (6,8,9). An interesting finding is in patients who were used to using herbal medicines. Herbal medicines have many components that may interact agonistically with diabetes drugs from health facilities (9,18,19).

Low nutrient intake was the most frequent problem causing hypoglycemia in patients who were ongoing therapy with diabetes drugs, especially insulin and SU (10,20). Those who skip snacks, do not finish their regular main course portions, fast, and follow extreme calorie restriction diets are things that trigger hypoglycemia

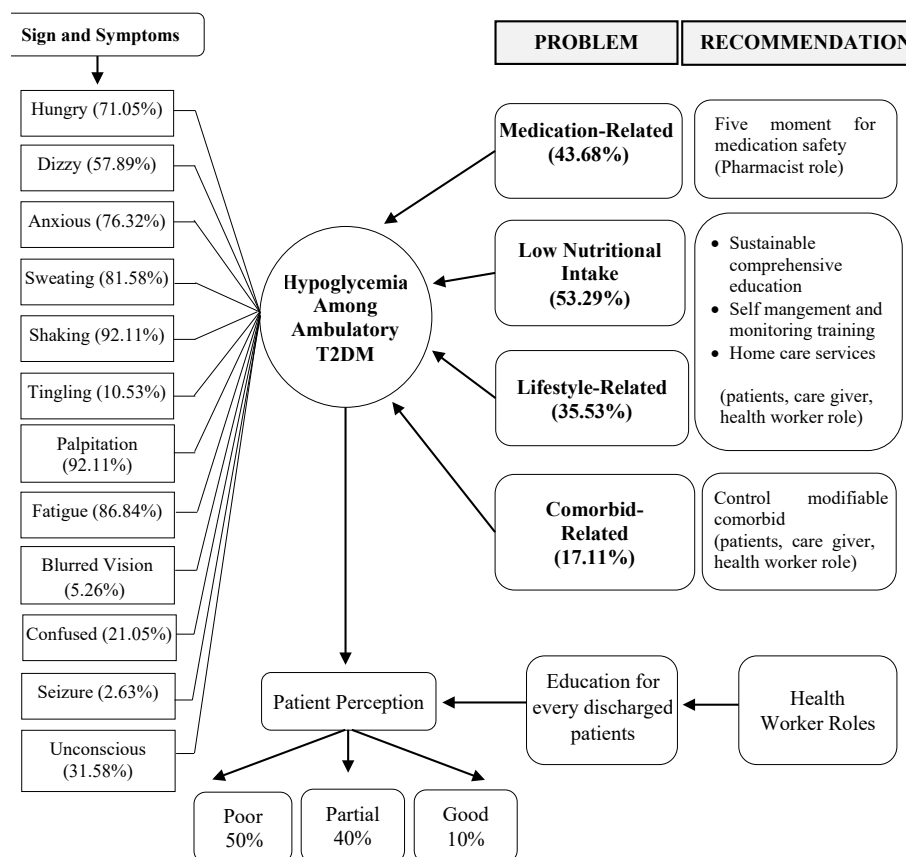


Figure 1. Theoretical Framework of T2DM Ambulatory Patients' Experiences of Severe Hypoglycemia

(6–8,21).

Increasing physical activity was reported to increase the risk of hypoglycemia in patients with insulin and SU therapy (22). The effects of physical activity on your blood glucose will vary depending on how long the patient is active and many other factors. Physical activity can lower blood glucose for up to 24 hours or more and make the body more sensitive to insulin. Reviewing the medication regimen is a matter of concern that must be done if the patient is going to do activities outside of their routine (3,13,15,22). In several studies, smoking and alcohol consumption were found to be correlated with the occurrence of hypoglycemia (13,21,23). This situation is relevant to what was experienced by the patients in this study. Stress was also found to be a variable that was considered to trigger hypoglycemia from patient experience in this study. The stress system consists of a complex neuroendocrine structure involving the central nervous system and the periphery (9,10,23–25).

Patients with renal dysfunction stated that when they missed their hemodialysis (HD) schedule, they experienced hypoglycemia more often, especially after using insulin. Missing the schedule will have an impact on the prolongation of the elimination half-life of insulin, which is normally excreted through the kidneys (4,12,13,26).

There was a confession of several patients who experienced signs and symptoms of hypoglycemia but could not be sure whether it was really due to their GERD. They experience more severe signs and symptoms when their GERD recurs. GERD is not directly related to hypoglycemia. This meta-analysis suggests that patients with DM were at greater risk of GERD than those who do not have DM (OR: 1.61; CI 95%: 1.36-1.91) (5,26,27). What was suspected to happen in patients is that blood sugar levels that were not fully controlled induced GERD (10,17,26).

Researchers assessed that no more than 10% of respondents had the right perception of hypoglycemia. Patients who have the wrong perception for too long will form habits and mindsets that are difficult to change (6,25,26). Overall, the results of this study indicate that the condition of diabetic patients undergoing ambulatory therapy was currently at risk of experiencing severe hypoglycemia at any time. Comprehensive medication reviews, monitoring drug side effects, educating patients on using drugs, storing drugs, disposing of drugs, and obtaining drugs through official channels, as well as communicating with other health workers when drug-related problems are found, were critical things for a pharmacist to do (21,24).

The limitations of this study were the limited subjects and research locations. These limitations can affect the generalizability of the findings. This study only looks at the patients' experience, where the perspective of the health workers who provide services was not explored. This limitation has an impact on the bias in the reality of health services carried out by health workers with

information from patients.

Conclusion

Ambulatory T2DM patients experience signs and symptoms of hypoglycemia even though they initially do not sufficiently understand the terminology of hypoglycemia. There were four domains found related to the occurrence of hypoglycemia that occurs in them, including low nutrition intake-related, medication-related, lifestyle-related, and comorbid-related hypoglycemia. The number of patients who had an inaccurate perception regarding the occurrence of hypoglycemia in the study was very large. Health workers are required to take promotive and preventive measures to prevent hypoglycemia in ambulatory patients.

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Competing Interests

[The paper was written independently. All authors disclose no financial or personal relationships with other people or organizations that could inappropriately influence the study.]

Ethical Approval

[Approval was granted by the Ethics Commission of the Faculty of Medicine, Udayana University, Bali (Ethical Approval code: 1165/UN.14.2.2.VII.14/LT/2024).]

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