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Barriers and facilitators of complications risk perception among rural patients with type 2 diabetes mellitus: a qualitative content analysis

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Abstract

Background Diabetes and its complications have emerged as a significant health threat to rural residents. Accurately perceiving the risk of complications may play a crucial role in modifying health behaviors and preventing complications' occurrence. We aimed to explore the barriers to and facilitators of risk perception of complications in rural patients with type 2 diabetes mellitus, and to provide new perspectives and ideas for the development of relevant interventions in the future.

Methods This study adopted the qualitative content analysis method. Semi-structured interviews were conducted with 14 rural diabetic patients selected by purposive sampling from July to September 2023, and the interview data were systematically analyzed.

Results Data analysis identified 9 sub-themes falling into the 2 macro-themes: (a) facilitators of complications risk perception (Increased disease knowledge, Low sense of disease control, Risk experiences, Negative mindset); (b) barriers to complications risk perception (Lack of awareness of diabetes or its complications, Information barriers, Optimistic bias, Overconfidence, Disease generalization).

Conclusions This study explored the barriers and facilitators of complication risk perception among rural patients with type 2 diabetes mellitus, offering new insights into risk perception research, and aiding primary medical staff to develop targeted intervention measures to ensure that rural diabetes patients can accurately and objectively perceive risk.

Keywords Risk perception, Diabetes complications, Type 2 diabetes mellitus, Rural, Qualitative study

Introduction

In recent years, type 2 diabetes mellitus, whose incidence in rural areas of China has been increasing year by year, has become a major chronic disease threatening the health of rural residents [1, 2]. Diabetes can cause a series of acute and chronic complications and is the primary cause of disability or death.

Good self-management is crucial for prevent future complications [3, 4]. The perception of risk plays a central role in motivating individuals to engage in self-care behaviors and seek appropriate medical interventions [5, 6]. Understanding the factors that hinder or promote the perception of risk regarding diabetes complications among rural residents with type 2 diabetes mellitus can provide valuable insights for healthcare providers and policymakers to improve diabetes care and outcomes in rural areas of China.

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Background

Type 2 diabetes mellitus has been identified by the World Health Organization as one of the top four non-communicable diseases that require the closest public attention, and it is also among the fastest-growing global public health concerns [7]. The latest data released by the International Diabetes Federation (IDF) stated that on a global level, 537 million adults (20 to 79 years) live with diabetes, or, more succinctly, 1 in every ten persons is a diabetic. However, this number is expected to soar to 643 million by 2030 and touch an alarming 784 million by 2045 [8]. Currently, China has the highest number of diabetes patients in the world, with approximately 140 million people affected [8], of whom around 90% have type 2 diabetes mellitus [9]. A survey on the prevalence of diabetes among adults aged 18 and above in China revealed a staggering nationwide diabetes prevalence rate of 11.2% [10], The increase in rural areas far exceeds that in urban areas [9]. Rural residents generally have a relatively low level of health awareness, insufficient understanding of diabetes, and lack knowledge and awareness of diabetes prevention [11, 12]. Additionally, there are relatively fewer medical and health institutions in rural areas, along with shortages of medical equipment and professional medical staff. Some rural residents find it difficult to access regular physical examinations and blood glucose monitoring services, resulting in diabetes not being detected and diagnosed in a timely manner [13, 14]. Diabetes-related acute and chronic complications have become a major cause of disability and death worldwide. Hu et al. reported that 76.4% of diabetes patients in China had at least one kind of complication [15], which has proven to be the leading cause of death in those with diabetes [16]. In the ranking of causes of death in China in 2017, diabetes and its complications stroke, ischemic heart disease and chronic kidney disease ranked 14th, 1st, 2nd and 13th respectively [17]. Additionally, the mortality risk of rural patients with type 2 diabetes is much higher than that of urban patients [18].

Risk perception is individuals' subjective judgments regarding the characteristics and severity of a particular risk [19]. In the realm of health, particularly in chronic disease management, risk perception plays a crucial role. Individuals' perception of risk not only influences their behavioral choices and health decisions but also directly affects whether they seek medical services and how they manage and control potential risks [6]. The Health Belief Model (HBM) [20], Protection Motivation Theory (PMT) [21], and Health Action Process Approach (HAPA) [22] all emphasize the importance of risk perception in the process of behavior change. When patients can accurately perceive the susceptibility and severity of risks, they are likely to take appropriate preventive actions [20]. However, patients often have cognitive biases in perceiving disease risks. Nie Rong et al. [23]conducted a survey using a questionnaire on the perceived relative risk of diabetes, revealing that type 2 diabetics have low levels of risk perception in China, and their perceived disease risks do not align with actual risks. Aycock et al. [24] noted that overestimating disease risk can lead individuals into a state of chronic stress and fear of recurrence. Conversely, underestimating risk may cause individuals to overlook risks and impact their motivation and ability to respond. Therefore, understanding and promoting an individual's accurate perception of risk is critical to developing effective health education and interventions.

To the best of our knowledge, previous studies have primarily focused on developing risk perception scales [25, 26], conducting current status surveys [23, 27], and identifying influencing factors [28, 29]. There are few qualitative studies exploring the risk perception of complications among rural patients with type 2 diabetes mellitus. Therefore, this study aimed to understand the barriers and facilitators of complication risk perception among Chinese patients with type 2 diabetes mellitus through qualitative research, to provide a foundation for future intervention development.

Methods

Design

Qualitative content analysis (QCA) is a method through which the researcher analyzes the content of a text through systematic coding steps and extracts categories or themes from it in order to describe or explain the phenomenon under study [30, 31]. This type of study focuses on in-depth understanding and interpretation of the meaning, connotation and context of the content, aiming to discover and understand the phenomena, processes, or perspectives, viewpoints, and worldviews of the people involved, and focuses more on qualitative analysis than quantitative statistics [32]. Therefore, this study chose a qualitative content analysis approach to gain a comprehensive understanding of the impediments and facilitators of perceived risk of complications among rural Chinese patients with type 2 diabetes mellitus. The report of this study follows the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist [33].

Participants

We used a purposive sampling method to select participants from rural areas within Yangcheng County, Jincheng City, Shanxi Province, between July 2023 and September 2023. The inclusion and exclusion criteria for these participants are shown in Table 1.

Table 1 Inclusion and exclusion criteria of participants

Inclusion criteria:
1. Age ≥ 18 years
2. Diagnosed by an endocrinologist according to the criteria of the Chinese Guidelines for the Prevention and Control of Type 2 Diabetes Mellitus
3. Rural household registration and long-term residence in rural areas
4. Cognition is intact or slightly impaired
5. The ability to provide informed consent
Exclusion criteria:
1. Informed consent is hampered by cognitive impairment
2. had a diagnosed mental disease or severe medical conditions

Data collection

The researchers received specialized training in qualitative research and possessed the professional skills necessary to conduct interviews. Based on the research objectives, expert opinions, and feedback from two pilot interviews, the final interview guide was developed (Table 2). This study employed a face-to-face, semi-structured interview approach, with interviews conducted in participants' homes to ensure a familiar and relaxed environment where they could freely express their feelings and perspectives. Before the interviews began, all participants were informed of the study's purpose and agreed to participate. During the interviews, the researchers observed participants' non-verbal behaviors, such as tone of voice, facial expressions, and body language, while actively encouraging them to share their genuine opinions, thereby fostering a natural and comfortable conversational atmosphere. Each participant underwent a single interview lasting 30 to 40 min. Field notes were recorded during and after each interview. Interviews concluded when data saturation was reached, meaning no new themes emerged [34]. In total, 14 participants were included in this study.

Data analysis

Within 24 h of the interview's conclusion, the researchers returned the interview transcripts to the participants by retelling them over the telephone and requested any feedback they might have to ensure the accuracy and credibility of the data. We used NVivo 12 to code and manage all interview data. This study adopted the qualitative content analysis method proposed by Elo and Kyngäs (1) Immersion in the data: The process of becoming intimately familiar with the content being analyzed, through transcription, repeated reading, and/or several iterations of coding. (2) Unit of meaning: Several words, a sentence, or a statement that represents a single idea or concept. (3) Condensation: The process of shortening a unit of meaning while retaining the original meaning. (4) Code: A short (typically 1 ~ 3 words) label that describes a unit of meaning/condensed unit of meaning. (5) Category: An organization of several codes that are related in either content or context. In the case of a large number of codes, sub-categories may serve as a useful intermediate grouping. (6) Theme: An organization of two or more categories that represent an underlying meaning. Themes describe behaviors, experiences, or emotions that occur throughout several categories [32].

Rigour, reflexivity and quality criteria

To ensure the rigor of this study, four criteria [35]were employed: credibility, transferability, dependability, and confirmability. All interviewees volunteered to participate in this study, and the interviewer established a trusting relationship with them before the interviews, enabling the participants to express their views and opinions truthfully. Two researchers analyzed the data, and differences in interpretations were solved by discussion, to enhance the reliability of data analysis. All audio recordings and textual data in the study were maintained so that they could be accessed if required later; the researchers themselves remained neutral throughout the study and reviewed their personal biases at any time. After completion of the data analysis, the textual data were returned to the respondents for verification to ensure the stability of the results.

Table 2 Outline of the interview

1. When were you first diagnosed with diabetes? Please tell me what your thoughts were at that time
2. Please tell me how well you are currently controlling your diabetes. (In terms of blood glucose levels/treatment modalities/self-management)
3. Do you know what are the complications of diabetes?
4. Are you currently experiencing complications from diabetes?
5. Do you have someone with diabetes complications around you? What are their conditions?
6. How do you acquire knowledge and information about diabetes complications?
7. Please tell me about your thoughts on diabetes complications
8. What factors do you think may lead to the development of diabetic complications?
9. What do you think is your risk of developing diabetes complications in the future in your current situation? (High/Medium/Low) Why do you think that?

Table 3 Socio-demographics of participants

Characteristics	Number ($N=14$)
Age range (years)	42 ~ 77
Sex	
Male	6
Female	8
Education level	
Primary school or below	6
junior high school	5
senior high school	3
Marital status	
Married	12
Death of a spouse	2
Disease duration range (years)	3 ~ 42
Diabetes Complications	8
Family history	7
Perceived risk	
High risk	4
Medium risk	3
Low risk	7

Table 4 Themes and Subthemes

Themes	Sub-themes
Facilitators of complications risk perception	Increased disease knowledge
	Low sense of disease control
	Risk experiences
	Negative mindset
Barriers to complications risk perception	Lack of awareness of diabetes or its complications
	Information barriers
	Optimistic bias
	Overconfidence
	Disease generalization

Results

A total of 14 rural patients with type 2 diabetes mellitus were interviewed for this study. The characteristics of the participants are presented in Table 3. The key findings of this study are presented in terms of two themes: facilitators and barriers to risk perception of T2DM complications. Each theme has sub-themes that are complemented here by statements of the study participants (Table 4).

Facilitators of complications risk perception

Four facilitators were found to be associated with risk perception of complications in rural T2DM: Increased disease knowledge, Low sense of disease control, Risk experiences, and Negative mindset (Table 4).

Increased disease knowledge

An individual's knowledge base influences their understanding and assessment of potential risks. Patients who have a more comprehensive understanding of diabetes are better able to recognize the severity of the disease and are more concerned and attentive to the development of the disease, and therefore have a higher level of perception of the risk of associated complications.

N04: "Through my reading and the health information provided by the hospital, I have learned that diabetes complications are diverse, including eye problems, diabetic foot, peripheral neuropathy, and more, with kidney involvement being the most severe. Additionally, there are up to 14 symptoms of diabetic hypoglycemia, such as dizziness, palpitations, shock."

N05: "I have also learned about diabetes-related complications, such as cardiovascular diseases and kidney disorders, through books and my phone. When I go to the hospital for follow-up visits, I actively ask the doctor relevant questions."

N14: "Diabetes complications include numbness in the hands and feet, retinal hemorrhage, kidney disease, heart disease, high blood pressure, and many more."

Low sense of disease control

The significant fluctuations in blood glucose levels leave patients feeling powerless in managing their diabetes, trapping them in a dilemma of self-management and thereby heightening their vigilance toward the potential threats posed by the disease. Some participants reported that, despite their rigorous self-management efforts, they still struggle to effectively regulate their blood glucose levels, thus perceiving themselves at higher risk of developing complications compared to other patients.

N03: "During my hospitalization, I ate the specialized diet for diabetes patients every day, but my blood sugar remained unstable, fluctuating between high and low levels. The risk is definitely higher than others."

N11: "They can't even explain why my blood sugar is so high. Who knows what's going on? I strictly follow the doctor's instructions and avoid everything they told me not to eat, but my blood sugar is still so high. I don't know how to control it anymore."

N13: "I strictly control my diet; I don't eat noodles, only steamed buns. I avoid potatoes, sweet potatoes, and cellophane noodles. I also exercise a lot, walking two hours a day. Even with all this, my blood sugar is still high (sigh). How can the risk not be high?".

Risk experiences

The experiences of risk may pose a threat to individuals and lead to negative emotional experiences, thereby further amplifying the perception of the risk of complications in patients.

N04: "The first time I was diagnosed with diabetes, I experienced diabetic ketoacidosis; I vomited black fluid, and the village doctor suspected organ failure. It wasn't until I underwent hospital tests that I learned it was diabetes. Once, I had surgery for a diabetic foot. After returning, I diligently changed the dressing every day, and I was able to save my foot. Additionally, both of my eyes have been operated on due to diabetic complications. They didn't used to be this small, and now I can't even open them fully."

After learning about the risk experiences of others, respondents often have difficulty accepting the prospect of disability and more severe disease outcomes, leading to fears about the progression of their disease and the perception of a significantly increased risk of complications.

N04: "When I was previously hospitalized, I encountered a 61-year-old female patient. She had her foot amputated due to diabetes, making it resemble a branch. Once a person develops diabetic foot, amputation is necessary. Without it, there will be no improvement, much like a persistent infection."

N14: "My friend also has diabetes. He didn't manage it well before, and now he has developed severe retinopathy. This disease can be very harmful."

Negative mindset

With the continuous advancement of age and the persistent development of the disease, rural patients with type 2 diabetes are more likely to develop a pessimistic and negative mindset compared to the general population. This greatly weakens their enthusiasm for self-management, amplifies their imagination of disease deterioration, and significantly enhances their perception of the risks of complications.

N08: " I don't think about it so much now, and I don't take it (diabetes) seriously anymore. As long as I can still eat, work, and play mahjong, I'm satisfied. Anyway, once you get this disease, you're bound to have complications."

N01: " Most of the time now, I think I can get through it. I'm not as careful as I used to be. After all, at my age, there must be some health problems, so I let my body build up its resistance on its own."

Patients with a pessimistic fatalistic view regard the disease as part of the natural law and believe that " health problems are inevitable when one gets old." This concept makes them consider diabetes and its complications as an unavoidable " predestined fate" rather than a disease that can be intervened. Their pessimistic expectations for the future strengthen their perception of the risks of diabetes complications psychologically, thus forming a perception that "although the risks have not occurred yet, they are destined to come."

N01: " At my age, if I can live a few more days, that would be great; if not, it doesn't matter."

N13: " As people age, they will inevitably suffer from other illnesses. Frankly speaking, death can also be regarded as a form of relief."

Barriers to complications risk perception

Five barriers to complications risk perception were found to impede the perceived risk of complications among rural patients with type 2 diabetes mellitus: Lack of awareness of diabetes or its complications, Information barriers, Optimistic bias, Overconfidence, and Disease generalization (Table 4).

Lack of awareness of diabetes or its complications

Risk identification is the process of assessing and evaluating potential or existing risk factors and their impact on personal health. However, in the study, most participants showed a severe lack of awareness regarding complications, and even lacked the motivation to understand the disease, thereby unable to correctly recognize potential symptoms of the illness. This ultimately affected their level of risk perception.

N08: "I don't know about the complications of diabetes; I only know that someone in the village went blind because of diabetes."

N12: "I don't have much understanding of the complications of diabetes because I don't have much personal experience with it myself."

N01: "I am not very clear about the complications of diabetes, nor have I thought about researching them.

But I should not have much risk. I've been experiencing mild pain in my legs and ankles (areas with thin skin and many blood vessels). Scratching them provides temporary relief, but the symptoms reappear after a while, and I have no idea what could be causing this."

N07: "Sometimes my vision blurs a bit when looking at things, but the symptoms aren't pronounced and usually clear up shortly. At times, I also feel dizzy and overall lethargic, which I attribute to fatigue from working."

Information barriers

The participants primarily gained their understanding of the disease from the experiences of other patients, health education provided by healthcare professionals, and television platforms. However, due to factors such as age and educational level, patients encounter obstacles in accessing content.

N03: "I have received the documents from the hospital doctor, but I have not read them. Primarily because I am illiterate and additionally, being elderly, I tend to forget things as soon as they are told to me."

N11: "My memory is impaired, and I do not engage in much reading at home. I experience discomfort in my eyes and have difficulty seeing clearly."

In addition, it is difficult for diabetic patients in rural areas to accurately distinguish the authenticity of information, and they are prone to being misled by false information from relatives, friends, and the Internet, which further weakens their awareness of the potential risks of complications.

N02: "My sister said, at this age, it's inevitable to have high blood sugar. Don't worry too much, there's nothing scary about it. If your blood sugar is high, just take more medication, as long as it can bring it down."

Optimistic bias

The participants' evaluation of their condition relies on self-assessment, resulting in an underestimation of the risk of complications or an overly optimistic perspective. Some patients report having no obvious symptoms and believe that the disease does not pose a threat to their lives.

N01: "Recently, I've been managing quite well. A couple of days ago, I checked my fasting blood sugar, and it was 6.1. All along, my symptoms of polydipsia, polyphagia, polyuria, and weight loss have not been obvious; moreover, I feel like I don't have any of the diabetes complications that I have read about in books and seen on TV."

N09: "I used to be in excellent health, and I have been living with diabetes for a few years now without experiencing any noticeable symptoms."

The participants often evaluated their disease status and assessed their risk of complications by comparing themselves to others.

N02: "Compared to others in the village, my risk of developing diabetic complications should be low because my blood glucose has consistently remained stable. Some people in the village take insulin and disregard dietary management, while others often feel weak. I'm much better off than them."

Overconfidence

Overconfidence may cause patients to overestimate their ability to manage the disease. They think they can effectively control diabetes, thus reducing their alertness to possible complications. On the other hand, it may lead patients to underestimate the complexity of diabetes and its complications, simply simplifying disease management into a linear model of "following medical advice + self-discipline".

N12: "I don't believe there will be any complications beyond those that have already occurred. Because I pay special attention to my health, I am confident that I can manage it very well. I firmly believe it won't reach a particularly severe stage."

N08: "My risk of developing complications should be low because I have a lot of self-discipline. I follow my doctor's dietary recommendations almost every day and exercise regularly. In conclusion, I am still very confident about this illness."

Disease generalization

In 2021, approximately 140 million people in China were diagnosed with diabetes. With the continued increase in prevalence, it is estimated that the number of diabetics in China will reach as high as 174 million by 2045. The continuous rise in prevalence has made diabetes a commonplace health issue.

N01: "Nowadays, this disease is incredibly common. Perhaps 3 or 4 out of every 10 people have diabetes. Sometimes when we talk about it, we realize that almost everyone in our age group has this condition."

In recent years, the age of onset of type 2 diabetes mellitus has been decreasing among patients, accompanied by a rapid rise in the incidence of early-onset T2DM [36]. Furthermore, there is a trend towards younger ages at the onset of T2DM within rural populations [37]. Consequently, patients may diminish their concerns regarding the disease, resulting in a weakened sense of risk perception.

> *N05: "Nowadays, diabetes is becoming more common among younger people. I've seen many diabetes patients in their 30 s and 40 s at the hospital."*

As a chronic non-communicable disease, diabetes poses a relatively lower threat to individuals' lives and quality of life compared to acute illnesses.

Discussion

The study of risk perception is a complex and dynamic system involving multiple influencing factors. Through content analysis, this study identified the facilitators and barriers affecting rural type 2 diabetes mellitus patients' risk perception of complications. Facilitators of complications risk perception include increased disease knowledge, low sense of disease control, risk experiences, and negative mindset; barriers to complications risk perception include Lack of awareness of diabetes or its complications, Information barriers, optimistic bias, Overconfidence, and Disease generalization.

Our study found that patients with a deeper understanding of the disease have a heightened awareness of the risks of complications. A study by Ochieng et al. [38] showed that patients with a higher level of disease knowledge also perceive higher risks. This may be because such patients are more capable of recognizing the seriousness of diabetes and its complications, paying more attention to their own health status, and thereby increasing their perception of complications risk. Our study found that frequent blood glucose fluctuations can reduce patients' perception of the benefits of disease management, leading to a sense of weariness and reluctance to adhere to their own management plans. This suggests that medical staff should enhance education regarding the benefits of disease management, fully mobilize patients' initiative, and develop targeted intervention measures based on individual circumstances to improve their self-efficacy levels [39]. During the interviews, it was also found that some patients experienced emotions such as sadness and fear due to the impact of risk experiences, while some patients were completely indifferent to their illness, adopting a fatalistic attitude towards it. The various negative emotions mentioned above have somewhat magnified patients' perception of the risk of complications. A study showed that the perception of illness strongly and directly impacts anxiety and depression [40]. Masmoudi et al. [41] also found that the negative emotions and burdens associated with diabetes are significantly linked to the perception of the disease. This suggests that medical staff should pay attention to patients' self-experiences and feelings during health education, communicate patiently with them to fully understand their true inner thoughts, provide timely psychological guidance, and help them face the disease positively.

In this study, most rural diabetic patients have a low level of education (only three patients in this study had a high school education). Their lack of awareness and understanding of the disease hinders their perception of the risks of complications. They are unable to detect early potential symptoms and intervene in time, leading to complications that have already progressed to a very serious degree by the time of diagnosis. This was confirmed in a China study [42]. Furthermore, traditional health education mainly relies on text-based, didactic formats that are highly professional, low in engagement, and more obscure and difficult to understand. This also creates certain difficulties for rural patients in accessing knowledge. On the other hand, patients face barriers in discerning health information, and the presence of misinformation and insufficient professional information support has a detrimental impact on patients. With the development of urbanization, the trend of aging population in rural areas is intensifying. This suggests that medical staff should distinguish the population according to age, education level, and other ways to further expand the diversified health education methods tailored to patient needs and preferences. According to the characteristics of the elderly population, it is more effective to use visual education methods, such as participating in live demonstrations and interactions, viewing model displays, and engaging in scenario simulations [9]. This approach places greater emphasis on patient involvement, helping them deepen their understanding of diabetes knowledge through enjoyable learning experiences.

Our study found that patients with type 2 diabetes mellitus in rural areas tend to have overly optimistic estimations of their disease status, and are blindly confident in disease management, and have lower perceptions of susceptibility and severity, especially among those with shorter disease duration and no complications yet. This has resulted in their weakened risk awareness regarding complications, fostering a sense of luck and even direct disregard for these risks, significantly impacting their self-management of the disease. This suggests that medical staff should guide patients to develop accurate disease risk awareness, strengthen the promotion of risk factors, and enhance their perception of disease risks. The Guideline for the prevention and treatment of type

2 diabetes mellitus in China (2020 edition) indicates that early screening can significantly enhance the prevention and management of diabetes and its related complications. Clinical research has also found that strict control of blood glucose in the early stages of diabetes can significantly reduce the risk of diabetic microvascular disease, heart attacks, and mortality [43, 44]. Consequently, village clinics, as the primary healthcare institutions accessible to rural patients, should strengthen regular and standardized screening, and evaluate diabetes-related complications, so that rural patients can accurately understand their own status, pay attention to disease management, and strengthen the prevention of complications [45]. In addition, relevant government agencies need to enhance coordination among different levels of healthcare institutions to address various challenges faced by primary healthcare facilities, including staff and equipment shortages. By doing so, they can improve the quality of primary healthcare services and facilitate the sharing of medical resources [46].

Limitations

This study has certain limitations. Firstly, due to geographical limitations, the sample size and representativeness of this study are limited. The interview subjects are predominantly older and mostly female patients, which may introduce certain selection biases. Subsequent research can be conducted by expanding the sample size and improving sample representativeness to further investigate the topic. Secondly, risk perception is a dynamic variable that can change with environmental and personal factors, suggesting that future long-term longitudinal studies could explore the dynamic changes in risk perception levels among diabetes patients. Thirdly, in the future, large-sample quantitative studies could be conducted to explore the influencing factors of different subgroups with varying levels of risk perception.

Conclusions

The medical staff should improve disease knowledge of rural patients with type 2 diabetes mellitus, strengthen their risk awareness, enable them to cope with the disease actively, and accurately perceive disease risks, thereby reducing and delaying the occurrence of complications.

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Authors' contributions
ZZC and WXW conceived the study, analyzed the manuscript, collected the data, and were major contributors in writing the manuscript. LSB, LYQ and LYM prepared figures and/or tables, reviewed drafts of the paper. JHH conceived the study, audited the initial analyses and interpretation, authored or reviewed drafts of the paper. All authors read and approved the final manuscript.

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Data availability
The datasets generated and analyzed during this study are not publicly available for the protection of participants' privacy. Researchers who meet the criteria may obtain the data by applying to the corresponding author.

Declarations

Ethics approval and consent to participate
Ethical approval was obtained from the Ethics Committee of Harbin Medical University (HMUDQ20231116101), and it conformed to the ethical guidelines of the Helsinki Declaration. All participants completed the written informed consent before participating in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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