



DIABETES SELF-MANAGEMENT BEHAVIORS AND INFLUENCING
FACTORS AMONG ELDERLY PATIENTS WITH TYPE 2 DIABETES IN POST
COVID-19 PANDEMIC WENZHOU, CHINA

WEIJING ZHANG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR MASTER DEGREE OF NURSING SCIENCE
(INTERNATIONAL PROGRAM)
IN ADULT NURSING PATHWAY
FACULTY OF NURSING
BURAPHA UNIVERSITY

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KEYWORDS: DIABETES SELF-MANAGEMENT BEHAVIORS/ ELDERLY PATIENTS/ SELF-EFFICACY/ POST-PANDEMIC CHINA

WEIJING ZHANG : DIABETES SELF-MANAGEMENT BEHAVIORS AND INFLUENCING FACTORS AMONG ELDERLY PATIENTS WITH TYPE 2 DIABETES IN POST COVID-19 PANDEMIC WENZHOU, CHINA. ADVISORY COMMITTEE: RUNGRAT SRISURIYAWET, Ph.D. SAIFONE MOUNGKUM, Ph.D. 2025.

This study aimed to investigate diabetes self-management behaviors among elderly patients with type 2 diabetes in post-pandemic Wenzhou, China, and to examine potential predictors including health literacy for chronic disease, perceived diabetes self-efficacy, and social support. Individual and family self-management theory guided this study. This study recruited 109 participants through purposive sampling from the diabetes outpatient department at the First Affiliated Hospital of Wenzhou Medical University. Researchers collected demographic and health data using standardized questionnaires. The study employed four validated instruments: the Diabetes Self-Management Behavior Scale ($\alpha=.681$), Health Literacy Management Scale for Chronic Diseases ($\alpha=.95$), Diabetes Self-efficacy Scale ($\alpha=.908$), and Social Support Rating Scale ($\alpha=.785$). Data analysis involved descriptive statistics and multiple linear regression.

The result showed elderly patients with type 2 diabetes in post-pandemic Wenzhou demonstrated poor diabetes self-management behaviors ($M=34.53$, $SD=9.65$). Diabetes self-efficacy emerged as a significant predictor of self-management behaviors ($\beta=.837$, $p<.001$). However, neither health literacy ($\beta=-.070$, $p=.377$) nor social support ($\beta=.045$, $p=.535$) showed significant predictive value. The regression model explained 65.8% of the variance in diabetes self-management behaviors.

The result indicates that higher self-efficacy strongly predicts improved diabetes self-management behaviors among elderly patients in post-pandemic China. These findings suggest that healthcare interventions should prioritize building patients' confidence in managing their condition. Future research should focus on enhancing self-efficacy within Chinese cultural contexts while exploring ways to better leverage health literacy and social support for this population.

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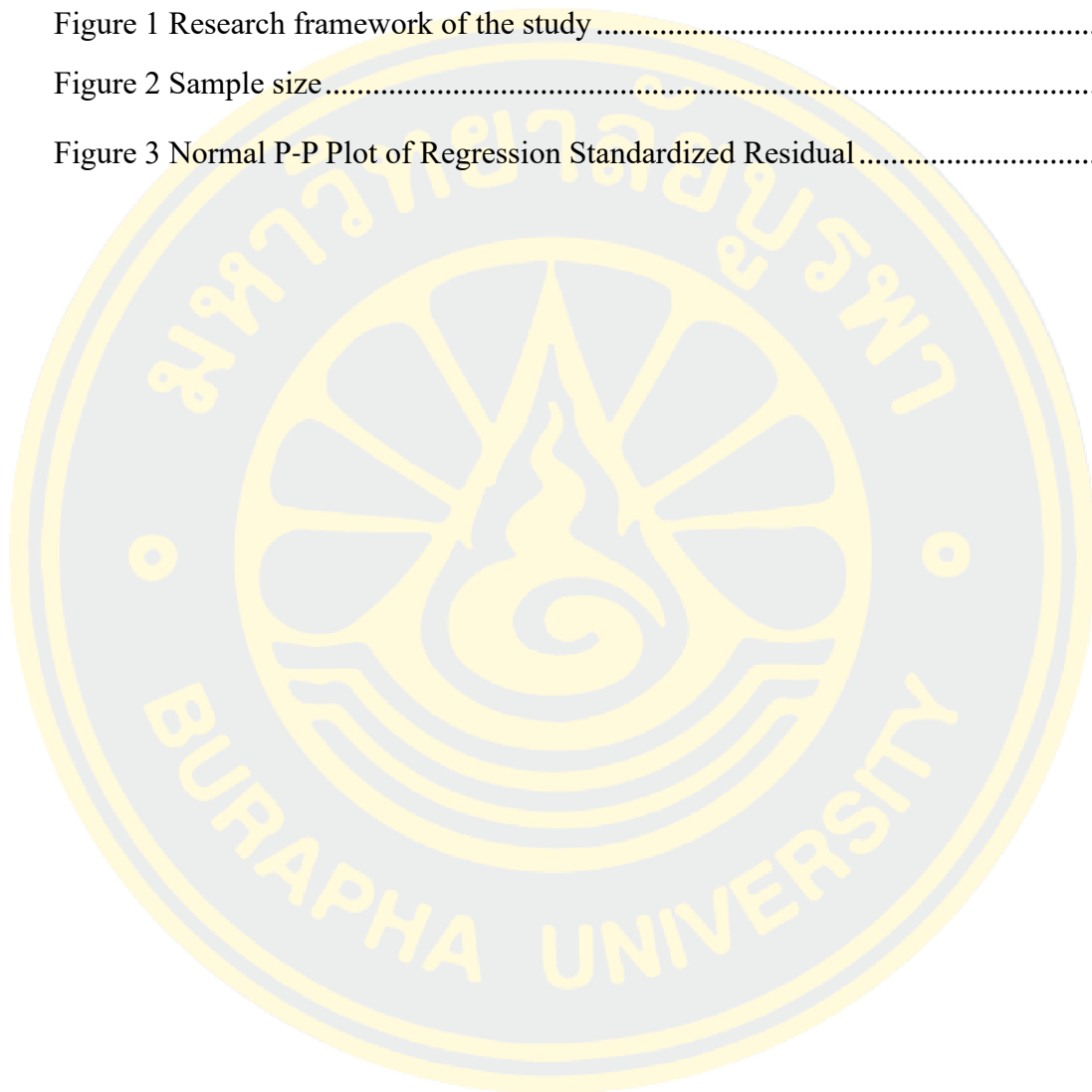
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CHAPTER 1

INTRODUCTION

Statement and significance of the problems

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease caused by a variety of causes and is the most common type of diabetes. Until now, it has remained a prominent global public health problem. International Diabetes Federation (IDF) Diabetes Atlas (2021) showed that T2DM accounted for over 90% of all diabetes worldwide. According to IDF (2021), there were around 536.6 million diabetics worldwide in 2021, and that number was projected to increase to 783.2 million by 2045, among which 260 million people affected will be in Western Pacific. China is the world's largest number of people with diabetes. Chinese Population Nutrition and Chronic Disease Status (2020) reported that the prevalence of Chinese adult diabetes was 11.9 persons per 100 population, and the number of Chinese adults with diabetes was up to 125 million (American Diabetes Association, 2023b; the National Bureau of Disease Control and Prevention, 2021).

Based on China's 2021 guidelines, elderly patients represent 40-50% of the total diabetic population in the country. The guidelines establish three age-based categories for elderly diabetic patients: young elderly (60-69 years), middle-aged elderly (70-79 years), and senior elderly (80 years and above) (National Geriatrics Center et al., 2021). The data reveals a consistent increase in diabetes prevalence with age among these groups. For the young elderly, the prevalence rate ranges from 20% to 25%. This rate rises to 25-30% in the middle-aged elderly group and reaches its highest level of 30-35% among the senior elderly population. These findings underscore the significant relationship between advancing age and diabetes risk in China's elderly population (Chinese Diabetes Society, 2021; National Geriatrics Center et al., 2021).

Glycosylated hemoglobin (HbA1c) <7.0% is considered a criterion for good management of T2DM (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Overall glycemic control in older Chinese patients with T2DM is poor, and management needs to be improved. In one study, 50.6 patients per 100 population were unable to achieve control of their diabetes (Yong-Ze Li et al., 2020). Corresponding to another study showed that only 30.8 patients per 100 population met the HbA1c level (Meng-Dan Zhang et al., 2020).

Poor management of diabetes significantly increased risks of macrovascular and microvascular complications. It also increased disability and mortality, and incurred high treatment costs (Wen-Ying Yang, 2018). A study found that the incidence of complications in patients with T2DM was 69.51 patients per 100 population, including 18.41 percent for macroangiopathy, 15.93 percent for diabetic nephropathy, 13.19 percent for peripheral vascular disease, 12.09 percent for retinopathy, and 9.89 percent for neuropathy (Fang Lu & Yuan Gao, 2021). Additionally, the National Cause of Death Surveillance Data Set reported an increase in diabetes mortality from 10.25 per 100,000 in 2010 to 17.58 per 100,000 in 2020. The mortality rate increased by 71.51 percent (National Center for Chronic and Noncommunicable Disease Control and Prevention et al., 2021; Yu Wang, 2012). Moreover, medical costs due to diabetes are also increasing (International Diabetes Federation, 2019, 2021). IDF (2021) estimates that total diabetes-related health spending will reach 1.03 trillion USD by 2030. The economic burden of disease for diabetic patients increased with the number of comorbidities (Yao Leng et al., 2018).

The cornerstones of attaining treatment objectives for people with diabetes are effective behavior management and psychological well-being (American Diabetes Association, 2020b). Diabetes self-management education and support (DSMES) is a critical element of care for all people with diabetes (Davis et al., 2022).

Diabetes self-management behaviors (DSMB) include diet, exercise, smoking management, blood glucose monitoring, foot care, medication, and psychosocial management (American Diabetes Association, 2018; Chinese Diabetes Society, 2021). Good DSMB can help diabetic patients to control blood glucose, control glycosylated hemoglobin levels, delay disease progression, reduce complications, improve medication compliance, improve quality of life, and improve diabetes knowledge, among others (Qiu-Guo Lin, 2022).

Patient-centered self-management interventions can result in significant reductions in HbA1c, and are also effective in improving dietary control, physical activity, and foot care for patients (Asmat et al., 2022). Several studies have shown that diabetic patients who completed more than 10 hours of DSMB had significantly lower mortality. According to estimates, DSMB reduces the risk of type 2 diabetic patients dying by 4 deaths per 1000 people per year (He et al., 2017). DSMB can improve glycemic control and reduce HbA1c levels. It can improve the quality of life of diabetic patients such as developing and implementing a healthy diet plan, engaging in regular physical activity, and participating in peer education activities. It is beneficial to relieve patients' anxiety and depression and reduce diabetes-related stress. Improve medication adherence and reduce healthcare costs (Qiu-Guo Lin, 2022; Rui- Feng Shi et al., 2021).

DSMB in China is still at a low to medium level (Jun Cao et al., 2019; Min Peng et al., 2019; Rui- Feng Shi et al., 2021). For example, a study reported that the level of SM knowledge, belief, and behavior of patients with T2DM was not satisfactory, with scores of self-management knowledge (68.42 ± 16.52), self-management attitude (72.71 ± 11.98) and behavior (52.64 ± 14.62) (Guo-Cai Liu et al., 2018b).

Afterwards that incident of the Covid-19, several studies have shown overall high blood glucose levels in patients with diabetes (Ai-Li Yang et al., 2020; Xiao-Xu Sun et al., 2020). At present, the Covid-19 in China has been controlled to a certain

extent and is in the post-epidemic era. The "post-epidemic era" does not mean that the epidemic has completely disappeared and everything is back to normal, but rather that the epidemic is fluctuating, with the possibility of small outbreaks at any time, return from foreign countries and seasonal episodes, and longer delays, with far-reaching effects on all aspects (Zhu-Li Wang, 2020). Noteworthy, in Zhejiang Province, China, it was found that self-management practices among older patients with T2DM was poor because of the impact of the post-epidemic era (Hui-Lan Yao et al., 2021; Teng-Teng Liu et al., 2021; Yun-Juan Wang & You-Ying Zhao, 2022).

Despite the gradual restoration of medical services, the strain on healthcare resources due to COVID-19 and the normalization of preventive and control measures continues to challenge the self-management behaviors of elderly diabetic patients. Many patients face difficulties in scheduling medical appointments and receiving timely follow-up consultations. In response, healthcare providers have increasingly promoted online service models, including telemedicine and Internet hospitals. These digital solutions reduce patient gatherings in hospitals, minimize the risk of cross-infection, and improve the accessibility and efficiency of healthcare services. However, this digital transformation presents a significant challenge for elderly diabetic patients. Their limited adaptability to digital services may lead to further deterioration of diabetes self-management behaviors. Additionally, long-term epidemic-related stress and psychological burden may reduce their self-confidence in diabetes self-management, resulting in resistance to maintaining proper DSMB.

Individual and Family Self-Management Theory (IFSMT) refers to the responsibility of the individual or family to cooperate with health care professionals in the self-management behaviors of disease. IFSMT proposed by Ryan and Sawin (2009) proposes that individuals and families are influenced by many different factors in three different dimensions. It ultimately leads to changes in the outcomes of SMB. Three dimensions consist context, process, and outcomes (Ryan & Sawin, 2009). Several

studies have shown that common influences on DSMB include social support, health literacy, diabetes distress, self-efficacy, diabetes knowledge, and depressed mood (Ji Liu, 2020; Pan-Pan Liu, 2020; Qian Ma, 2019; Qu Li, 2022). It was found that when the level of self-efficacy of diabetic patients increased, their SM behaviors could also be improved, glucose metabolic indexes decreased, and the incidence of complications decreased (Dong-Jing Li et al., 2020). Another study found that the higher the health literacy of T2DM patients, the higher their ability to self-manage (Dan Zhou, 2019). Good social support can reduce psychological stress reactions, relieve mental stress, reduce the generation of distress, and improve proactive disease management behaviors (Li-Li Zhao et al., 2019). These three factors were more significantly affected in the post-epidemic period. The spread of online diabetes education has placed greater demands on patients' health literacy. The new difficulties arising from the treatment process of diabetes have an impact on patients' self-efficacy. Also, the family members of elderly patients working outside the home had an impact on the social support of patients (Lu-Yi Wu, 2021). Therefore, this study examined the relevance of three factors, health literacy, self-efficacy, and social support, to DSMB in elderly patients with T2DM in the post-epidemic era.

Health literacy (HL) refers to the ability of people to make good judgments and decisions to change poor personal lifestyles and living conditions in order to maintain and promote their health after acquiring, understanding, and using health information and technology (Nutbeam, 2008). HL was positively correlated with DSMB and negatively correlated with HbA1c (Yan-Ling Dai et al., 2017). Many studies have shown that HL is an important indicator of DSMB (Rui-Jie Zhu & Li-Hua Zhou, 2022).

Self-efficacy was first introduced by Bandura, an American psychologist, and refers to the degree of confidence in people's own ability to adapt to the things that affect their lives (Bandura, 1977). Self-efficacy in DSM refers to the degree of

confidence that people with T2DM have in using their knowledge and skills to maintain glycemic control and prevent complications. A study showed that self-efficacy was positively associated with SMB in patients with T2DM (Xia Zhang, Shi-Ping Feng, et al., 2022). Self-efficacy is an important belief factor for SMB, i.e., the higher the patient's self-efficacy, the greater the confidence in disease management, the easier it is to develop and maintain healthy self-management behaviors, and the higher the quality of survival (De-Zheng Wang et al., 2018; Yuan-Yuan Yu et al., 2018).

Social support refers to the favorable and supportive resources that individuals receive from others or society, which can help individuals cope with problems and crises in their working life (Yan-Fei Wang, 2004). Social networks formed based on geography and blood relations, including material help, emotional support, and information support from family members, friends, relatives, and neighbors, which provide support for patients (Qiao-Lei Jiang & Zong-Hai Chen, 2021). Social support is considered to be an important external factor influencing patients to develop and maintain healthy behaviors, and a study showed that the higher the level of social support of patients, the higher their level of self-management and their knowledge, attitudes, and behaviors (Guo-Cai Liu et al., 2018a). Several studies have shown that the more family supportive, the higher the patient's awareness of diabetes, the more positive the attitude toward diabetes, and the less negative emotions generated (Jing Tang et al., 2019).

In recent years, many studies have examined the above three factors affecting DSMB, but the literature shows that there are inconsistent results across the studies, particularly in relation to HL and DSMB. That could be because the study was conducted in different settings or employed a different instrument to examine the same variables. The results of these studies cannot be fully applied to all cultures. The prevalence of diabetes among middle-aged and elderly people in Wenzhou community is high, with 19.64 per 100 people (Li-Li Wang et al., 2016). The urban prevalence of

diabetes was higher than in rural (Yong-Qiang Shao et al., 2015). These ethnic features may increase difficulty in the management and control of diabetes compared to other districts. Therefore, these factors might affect the Wenzhou population differently than in other districts. Religious beliefs in Wenzhou are mainly Catholic and Christian (Di Kai, 1989). Religious spirituality and beliefs may affect DSMB. Wenzhou people who go out for business often reduce care for the health of the elderly (Hong-Bo Xu et al., 2017). The food culture in Wenzhou is different from that in the north. The staple food is rice and a lot of seafood. Most traditional snacks are sweet flour products (Ming-Guang Huang, 2019).

In addition, most of the studies are aimed at elderly patients over 60 years old, and the aging of our country is prominent, the average life expectancy of the population extends obviously. As a result, our country also divided elderly patients into three age groups, the young elderly (60-69 years old), the middle-aged elderly (70-79 years old) and the senior elderly (80 years old and above). Each age group has different characteristics in physical, psychological, and social aspects. Younger older adults have relatively better physical functioning and the incidence of chronic diseases (e.g., diabetes, hypertension) begins to rise. Beginning to adapt to retirement life and relatively stable psychological state, but some may face challenges of role transition. Higher social participation and may continue to engage in part-time or voluntary activities. Family roles gradually change from primary breadwinner to supporter (e.g., caring for grandchildren) (Weijing, 2024). The Chinese Guidelines for the Diagnosis and Treatment of Diabetes Mellitus in the Elderly (2021 Edition) stated that the 60-69 year olds were a key population for early intervention of chronic diseases (National Geriatrics Center et al., 2021).

More specifically, the "Healthy China 2030" plan emphasizes the need for comprehensive management of chronic diseases, prevention of complications, and functional maintenance in this age group. Elderly individuals in this demographic

experience significant declines in physical functioning, increased risks of disability and dementia, and prominent challenges with malnutrition and compromised immunity. Multiple chronic conditions and the use of multiple medications (multimorbidity and polypharmacy) are common among this population. Their dependence on family and society increases as they age, accompanied by heightened psychological vulnerability. Social participation becomes extremely limited, with primary reliance shifting to family and community care systems. The demand for long-term care and medical services has increased significantly. Healthcare providers should focus on delivering personalized medical care, maintaining quality of life, and preventing disability and falls (Weijing, 2024).

The young elderly (60-69 years old) represents a critical period for diabetes management and prevention. During this stage, individuals benefit significantly from early screening protocols and timely interventions, which enable healthcare providers to detect diabetes in its initial phases. These early detection efforts, combined with proactive health education, create valuable opportunities to establish and maintain healthy lifestyle practices. This age group's relative vitality and cognitive capability make it an optimal time for implementing comprehensive diabetes management strategies.

Therefore, this study focuses on the young elderly group (aged 60-69 years). The emphasis on this early aging period aligns with identifying interventions and support needs as individuals begin their transition into the elderly demographic. This age range represents a critical window for implementing preventive measures and establishing effective health management strategies that can influence outcomes in later years. In most of the literature, although there are a few studies on SMB of diabetic patients in the Wenzhou urban area, there are no studies on SMB related factors of type 2 diabetic patients aged 60-69 year in the post-epidemic era. The results of this study may help support and guide the effective SMB of elderly T2DM patients in Wenzhou

in the post-epidemic period. This information may be useful for nurses and health care providers and for future intervention studies with this patient population.

Research Objectives

The objectives of this study were as follows:

- 1) To describe the diabetes self-management behaviors among elderly patients with type 2 diabetes in Post-Covid-19 pandemic Wenzhou, China.
- 2) To examine predictors of diabetes self-management behaviors like Health literacy (HL) for chronic disease, perceived self-efficacy of diabetes, and social support among elderly patients with type 2 diabetes in Post-Covid-19 pandemic Wenzhou, China.

Research hypothesis

HL for chronic diseases, diabetes self-efficacy, and social support combined could predict diabetes self-management behaviors among elderly patients with type 2 diabetes in Post-Covid-19 pandemic Wenzhou, China.

Scope of the study

This study conducted with sample of male and female elderly patients (age range of 60-69 years old) with T2DM mellitus, who came to visit at the First Affiliated Hospital of Wenzhou Medical University in the Wenzhou metropolitan area. The outpatient unit of chronic diabetes disease was the target setting in the study. The data was obtained from January 2024 to September 2024.

Conceptual framework

The study was guided by the individual and family self-management theory [IFSMT](Ryan & Sawin, 2009) combined with literature reviews. Ryan and Sawin

(2009) proposed that SM is a complex dynamic phenomenon consisting of three dimensions: context, process, and outcomes, with each dimension making up of different factors. And there is a close relationship between the three dimensions. The context dimension contains factors of condition specific, physical and social environment, and individual and family, which have influence on process dimension as well as directly on outcome dimension. The process dimension includes knowledge and beliefs, self-regulation skills and abilities, and social facilitation, which can be changed and then affect the outcome dimension. The outcome dimension is divided into proximal and distal outcomes. Together with symptom management and pharmaceutical treatments, the proximal outcome is real participation in SM activities specific to a condition, risk, or transition. Cost associated with healthcare use is a proximate outcome. Proximal outcomes that are successfully achieved are partially correlated with distal outcomes. These results of distal outcomes can be divided into three main groups: health status, quality of life or perceived well-being, and direct and indirect health costs. The outcome dimension is affected by both context and process dimensions, with the achievement of proximal outcomes causing, at least in part, distal outcomes. The focus of interventions are the factors in the context and process dimensions. When the factors are changed well, it aids patients in taking charge of their illness and participating in self-management tasks that are expected of them.

The current study explored the effect of health literacy (HL) for chronic disease, diabetes self-efficacy, and social support on diabetes self-management behaviors. The context dimension includes HL for chronic disease. The process dimension includes diabetes self-efficacy and social support. HL for chronic disease, diabetes self-efficacy, and social support may have an impact on diabetes self-management behaviors by participating in self-management activities. These variables might be able to predict DSMB, the dependent variable, as shown in figure 1.

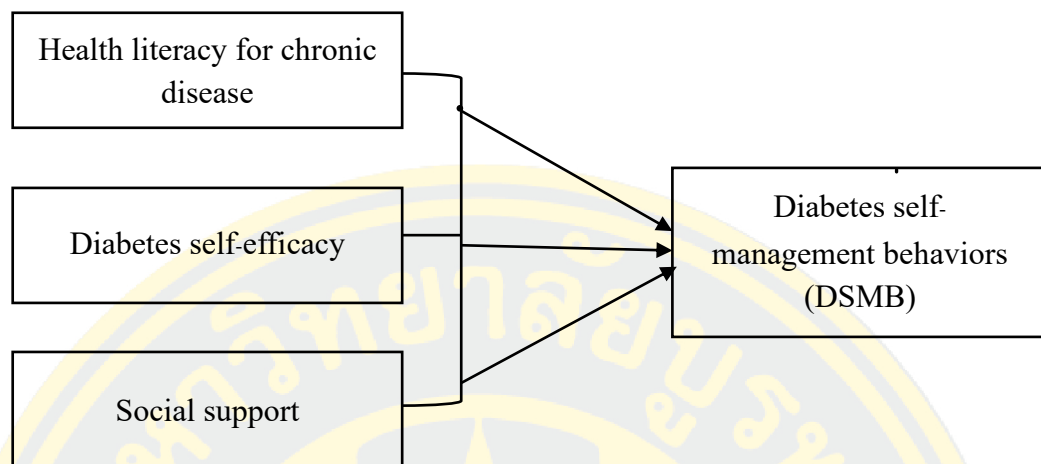


Figure 1 Research framework of the study

Definition of terms

Elderly patients with type 2 diabetes refer to patients with T2DM who are between the age range of 60 to 69 years old, who have been diagnosed with T2DM for at least 6 months and who come to the First Affiliated Hospital of Wenzhou Medical University in the Wenzhou metropolitan area.

Diabetes self-management behaviors refer to preventive and therapeutic activities undertaken by patients with T2DM and their families, with the support of medical staff, to control blood glucose and prevent complications. This includes adherence to a diet plan, regular exercise, blood glucose monitoring, and medication compliance. DSM was measured by the Diabetes Self-Management Behavior Scale (SDSCA) based on the Chinese translation of the Diabetes Self-Management Behaviour Scale developed by Toobert et al (Qiao-Qin Wan et al., 2008).

Health literacy (HL) for chronic disease refers to the knowledge and skills of patients with chronic disease about health. It includes not only the health knowledge and skills possessed by patients with chronic diseases, which are influenced by literacy, but also the ability of patients with chronic diseases to have health information aids,

such as the ability to acquire more knowledge based on existing knowledge (Haolin et al., 2012). It was measured by the Health Literacy Management Scale for Patients with Chronic Diseases (HeLMS) questionnaires compiled by Australian Professor Jordan et al and adapted and modified by Chinese scholar Hao-Lin Sun et al (Hao-Lin Sun et al., 2012).

Diabetes Self-efficacy refers to the subjective judgment of a person with diabetes about the magnitude of his or her ability to perform a particular behavior, i.e., the person with diabetes self-efficacy in his or her ability to perform a particular behavior and achieve the desired outcome. The stronger the perceived expectation of efficacy, the harder the person with diabetes will try to take steps to solve the problem (Qiaoqin & Shaomei, 2009). It was measured by Diabetes Self-efficacy Scale (DSES) developed by Hurley and Shea (1992), and translated and modified by Jing-Xuan Wang from Taiwa (Jingxuan et al., 1998), translated into the Simplified Chinese version based on the Traditional Chinese version in Taiwan by Qiao-Qin Wan et al (Qiaoqin & Shaomei, 2009).

Social support refers to two types of support resources that individuals receive in social interactions. One type is objective support, which includes direct material assistance and the existence and participation in social networks and group relationships, such as the size and availability of stable social relationships, such as family, marriage, friends, and coworkers, as well as unstable ties, such as informal groups or transient social interactions, which are independent of the individual's feelings and are objective realities. The other category is subjective support, which refers to the emotional experience of respect, support, and understanding that an individual feel in society, as well as the degree of satisfaction with these social supports, and is closely related to the individual's subjective feelings. It was measured by Social Support Rating Scale (SSRS) developed by Shui-Yuan Xiao (Shui-Yuan Xiao, 1994).

CHAPTER 2

LITERATURE REVIEWS

This chapter presents the T2DM, Self-management of patients with T2DM and related theories, and the factors influencing diabetes self-management behavior. The contents are as follows.

1. Type 2 diabetes mellitus [T2DM] in Elderly
2. Self-management in patients with T2DM
 - 2.1 Definition
 - 2.2 The individual and family self-management theory [IFSMT]
 - 2.3 Self-management behaviors among patients with T2DM
3. Factors influencing self-management in patients with T2DM
 - 3.1 Health literacy [HL] for chronic disease
 - 3.2 Diabetes Self-efficacy
 - 3.3 Social support
4. Contexts of DM care in china after Covid-19 pandemic
5. Summary

Type 2 diabetes mellitus [T2DM] in Elderly

The prevalence of T2DM is rising globally and T2DM accounts for more than 90% of all diabetes (International Diabetes Federation, 2021). IDF (2021) predicts that the number of people with diabetes will increase by 50% globally in 2045 compared to 2021, and the number of people with T2DM in the Western Pacific is expected to increase by 27%. Diabetes causes 4.2 million deaths in 2019 and 6.7 million adult deaths from diabetes in 2021 (International Diabetes Federation, 2019, 2021). Although China is not one of the top 10 countries in terms of prevalence, it ranks first in the world in terms of number of patients (Sun et al., 2022).

Since the end of the 20th century, China began to enter the aging society, the aging degree has been deepening, and it is one of the fastest-aging countries in the world. China's aging population is usually defined as those aged 60 or above accounting for more than 10% of the total population. By the end of 2022, China's population aged 60 or above reached 280 million, accounting for 19.8 percent of the total population (State Statistics Bureau, 2023). It is expected that by 2035, the proportion of the population aged 60 and above will exceed 30% (China Development Foundation, 2020). There are regional differences in the degree of aging in China, with the degree of aging in the eastern coastal areas and some big cities being relatively high, while the degree of aging in the central and western regions is relatively low (Office of the Seventh National Census Leading Group of The State Council, 2021).

According to the Chinese Population Nutrition and Chronic Disease Status (2020), the prevalence of diabetes in Chinese adults was 11.9 persons per 100 population. The prevalence of diabetes in the elderly aged 60 and above in China is about 20.2%, which is significantly higher than that of young people (Chinese Diabetes Society, 2021). The elderly in China were divided into three age groups, the young elderly (60-69 years old), the middle-aged elderly (70-79 years old) and the senior elderly (80 years old and above). In China, the prevalence of diabetes is approximately 18.5% among individuals aged 60-69, 22.3% among those aged 70-79, and 25.8% among those aged 80 and above, indicating an increasing trend with age (Li et al., 2020). The prevalence of diabetes in the eastern region of China reached 12.2%. Although the prevalence of diabetes in both urban and rural areas is increasing, the gap is narrowing. However, the prevalence is still higher in urban area (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022; Yong-Ze Li et al., 2020).

There are differences in the health impact of diabetes on older adults of different ages. Younger older adults have relatively better physical functioning with

diabetes, but diabetes may lead to poor glycemic control and an increased risk of cardiovascular disease, nephropathy and retinopathy. Lifestyle and medication management need to be emphasized. They may be psychologically stressed about disease management, but are more likely to accept and adapt to new treatment regimens and lifestyle changes than those over 70 years of age. The social support system is relatively well developed. Middle-aged older adults with diabetes mellitus experience a further decline in physical functioning and an increased incidence of diabetic complications such as neuropathy and foot ulcers. There may be coexistence of multiple chronic diseases such as hypertension and hyperlipidemia, which complicates the management of diabetes. Psychological adaptation may be diminished. Older adults with diabetes experience a significant decline in physical functioning and more severe diabetes complications, which may require long-term medical intervention and care. Cognitive decline may make it difficult to understand and implement complex treatment programs. The disease exposes them to possible loneliness and social isolation (Qiang 2022; Wei, 2023). The prevalence of diabetes in China is rising rapidly among 60-69 year olds (Chinese Diabetes Society, 2021). Those aged 60-69 years have more advantages and plasticity in their state of mind, learning ability, and self-management ability.

Definition

Type 2 diabetes mellitus (T2DM) previously referred to as “noninsulin-dependent diabetes” or “adult-onset diabetes”. It is a chronic metabolic lifelong disease caused by a decrease in insulin's ability to regulate glucose metabolism (insulin resistance, IR) and a deficiency in the function of pancreatic beta cells. It results in insufficient or relatively reduced insulin secretion and leads to elevated blood glucose and other metabolic abnormalities (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Patients with T2DM have relative (rather

than absolute) insulin deficiency and have peripheral insulin resistance (American Diabetes Association, 2020a).

Risk factors of T2DM

Environmental and genetic factors are important risk factors leading to T2DM. Most people with T2DM are affected by genetic factors, coupled with unhealthy lifestyle factors such as irregular diet and insufficient exercise, which eventually lead to the disease (Chinese Diabetes Society, 2021). Genetic factors refer not to inherited diabetes, but to susceptibility of diabetes. This means that people with a family history of diabetes, are more susceptible to the disease than others when they under environmental factors. Environmental factors including lack of exercise, sedentary lifestyle, weight gain, increased BMI, obesity, smoking, alcohol consumption, and unbalanced diet are all predisposing factors for T2DM (Hu Cheng & Wei-Ping Jia, 2018; U.S. Department of Health and Human Services Centers for Disease Control and Prevention, 2020). A family history of T2DM and BMI are associated with increased HbA1c, which leads to T2DM (Halalau et al., 2023). Poor eating habits like a single diet and overeating are important influencing factors for big blood sugar fluctuations (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Active smoking increases the risk of T2DM and the higher the amount smoked, the higher the risk (Chinese Diabetes Society, 2021).

Signs and symptoms of T2DM

Typical symptoms in T2DM include polydipsia, polyuria, polyphagia and weight loss (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Other signs include fatigue, blurred vision, slow wound healing, frequent infections, and numbness or tingling in the hands and feet. These symptoms are often less marked. As a result, the disease may be diagnosed after complications have already arisen (WHO, 2022).

Diagnosis of T2DM

According to ADA (2023), T2DM is diagnosed as per either of the following criteria:

1. Fasting plasma glucose (FPG) ≥ 126 mg/dL. Fasting is defined as no caloric intake for at least 8h.
2. 2-hour plasma glucose (2-h PG) ≥ 200 mg/dL during oral glucose tolerance test (OGTT). The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.
3. A1C ≥ 6.5 %. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.
4. In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random blood sugar (RBS) ≥ 200 mg/dL.

In the absence of unequivocal hyperglycemia, diagnosis requires two abnormal test results from the same sample or in two separate test samples (American Diabetes Association, 2023a).

Complications

If the patient cannot effectively control the blood glucose level for a long time, his HbA1c level may rise to 7%, which can cause a variety of complications. These complications do significantly more harm than the disease itself (Li Wang et al., 2020). Diabetic complications are the most important cause of increased mortality and disability in diabetes. Diabetes is the illness with the highest number of known complications, according to the World Health Organization, with more than 100 kinds (EO Intelligence & Baidu Health, 2020). The long-term raised blood sugar caused by diabetes will cause damage to large blood vessels and micro vessels, and endanger the heart, brain, kidneys, peripheral nerves, eyes, and feet, which can be life-threatening in severe cases (Chinese Diabetes Society & National Office for Primary Diabetes Care, 2022). Complications of diabetes include acute and chronic. Acute complications refer

to acute metabolic abnormalities in the body associated with blood glucose from any cause, including diabetic ketoacidosis (DKA) and hyperglycemic hyperosmolar status (HHS). Chronic complications refer to a series of life-threatening pathological processes in which prolonged hyperglycemia causes damage to blood vessels, corresponding organ tissues and cells, and even leads to failure. Chronic complications mainly include macrovascular and microvascular lesions (Chinese Diabetes Society & National Office for Primary Diabetes Care, 2022; Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022).

1. Macrovascular complications

Diabetic macroangiopathy is mainly atherosclerosis in medium or large arteries, mainly involving the aorta, coronary arteries, cerebral arteries, and renal arteries. Endothelial damage caused by blood glucose fluctuations is the initiating step in atherosclerosis. Blood glucose fluctuations are involved in the development of chronic vascular complications of diabetes through mechanisms such as activation of oxidative stress, damage to the vascular endothelium, activation of the inflammatory response and coagulation (Qun-Ting Qin & Wen-Sheng Lu, 2017). The risk of cardiovascular disease in patients with T2DM is more than twice that of non-diabetic patients. Atherosclerotic Cardiovascular Disease (ASCVD) including cardiovascular disease, cerebrovascular disease and peripheral vascular disease due to atherosclerosis, is a major cause of disability and death in older T2DM patients (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022; National Geriatrics Center et al., 2021).

2. Microvascular complications

Microvascular complications include kidney disease, retinopathy, and neuropathy. Diabetic foot is one of the common manifestations of neuropathy.

Diabetic kidney disease (DKD) is defined as chronic kidney diseases (CKD) caused by diabetes, whose lesions can involve the whole kidney including glomeruli,

tubules, and renal interstitium. Approximately 20-40% of people with diabetes develop CKD as a result of diabetes and will progress to end-stage renal disease (ESRD) requiring dialysis or kidney transplantation (American Diabetes Association, 2023d). Currently, DKD is the main cause of ESRD. DKD is insidious in its onset, and once it enters the stage of massive proteinuria, the rate of progression to ESRD is significantly accelerated. So early diagnosis, prevention and delay of the development of DKD are important to improve the survival rate and quality of life of diabetic patients (Guo-Yu Tong & Da-Long Zhu, 2017).

Diabetic retinopathy (DR) is commonly thought of as a microvascular disease of the retina and is the leading cause of vision impairment in adults (Flaxel et al., 2020). DR often leads to vision loss, visual field defects, vitreous hemorrhage, and in severe cases, even detachment of the retina, leading to blindness. As the quality of life improves, the prevalence of DR is increasing (Yi Shao & Qiong Zhou, 2019). Worldwide, the prevalence of DR is estimated at 34.6% (93 million people) (Flaxel et al., 2020). Strict control of blood glucose and lipids is effective in improving microcirculatory disorders, abnormalities in body metabolism and preventing the occurrence and development of DR (Xue Li & Ping Zhang, 2019).

Diabetic neuropathy includes central and peripheral neuropathy, with the latter being particularly common. Diabetic peripheral neuropathy (DPN) is defined as the symptoms or signs associated with peripheral nerve dysfunction in people with diabetes, when other causes are excluded. Common symptoms are numbness, pain, burning or other abnormal sensations in the limbs (Chao-Hui Fang et al., 2017). Distal symmetrical multiple neuropathy (DSPN) is the most representative form of diabetic peripheral neuropathy, accounting for approximately 75% of diabetic neuropathy and is an important risk factor for diabetic foot ulcers. There is no effective treatment available and glycemic control is the main tool to prevent DSPN and slow its progression (National Geriatrics Center et al., 2021). Diabetic foot refers to foot

infection, ulceration, and even deep tissue destruction caused by distal lower limb neuropathy and vascular disease in diabetic patients, which can lead to amputation and death in severe cases. The total amputation rate of diabetic foot patients in China is 19.03% (Peripheral Vascular Disease Professional Committee of Chinese Association of Integrative Medicine, 2019).

DM and its related complications have high disability and mortality rates, high medical costs, and long treatment courses, which have an impact on the lives of patients and their families. Therefore, it is important to find the influencing factor of T2DM to slow down the process of DM.

Elderly with diabetes may experience increased metabolic disturbances, accelerated organ function decline, impaired immune function, and cognitive and psychological effects. In terms of metabolism, high blood glucose leads to imbalance in energy metabolism, accelerates protein and fat breakdown, triggers weight loss, muscle atrophy, and further impairs mobility (Zhang & Yibibai·Yusufu, 2024). At the same time, insulin resistance overlaps with aging-related hormonal changes (e.g., decreased growth hormone), exacerbating blood glucose fluctuations (Su & Zang, 2023). In terms of organ function, it can negatively affect the cardiovascular, renal and nervous systems. Hyperglycemia damages the endothelium of blood vessels and promotes atherosclerosis, thereby increasing the risk of myocardial infarction and stroke (Shen & Wu, 2024). In addition, the elderly are often accompanied by hypertension and hyperlipidemia, forming a metabolic syndrome that further accelerates cardiovascular and cerebrovascular pathologies (Zhang et al., 2013). On the renal side, glomerular filtration rate (GFR) naturally declines in old age, and diabetic nephropathy is more likely to progress to end-stage renal disease (ESRD), which may require dialysis treatment (Chinese Medical Doctor Association Nephrology Branch, 2023; Ge & Dai, 2019). Neurologically, peripheral neuropathy can cause numbness and pain in the limbs, while autonomic disorders can cause constipation, urinary retention,

or postural hypotension, all of which increase the risk of falls (An & Zhang, 2022; Liu et al., 2024). In terms of immune function, hyperglycemia suppresses leukocyte function, making the elderly more susceptible to infections (e.g., pneumonia, urinary tract infections, foot ulcers) and slow to recover from infections, which may induce ketoacidosis or hyperosmolar coma (Lee et al., 2024). Cognitively and psychologically, diabetes increases the risk of Alzheimer's disease and vascular dementia, with declines in memory and executive functioning that affect self-management (e.g., missed medications) (Zhang & Xu, 2023). At the same time, the long-term burden of disease is prone to anxiety and depression, forming a vicious circle of “poor glycemic control leads to increased psychological stress”.

Diabetes in the elderly is characterized by its insidious onset and delayed diagnosis. Typical symptoms such as polydipsia, polyphagia, polyuria, and weight loss are often less pronounced, with initial manifestations frequently including fatigue, blurred vision, or recurrent infections, which are easily mistaken for natural signs of aging. As a result, complications are often already present at the time of diagnosis (Guo & Liu, 2024). Due to reduced liver and kidney function affecting drug metabolism, the risk of hypoglycemia is significantly increased (e.g., with sulfonylureas or insulin), and the use of multiple medications (e.g., steroids, diuretics) may interfere with blood glucose stability, making glycemic control more challenging (Chen et al., 2023; Gangopadhyay & Singh, 2017). Furthermore, complications progress rapidly, including microvascular complications (e.g., a 2-fold higher risk of blindness from retinopathy within 5 years compared to younger patients (Zhang & Xu, 2023), and accelerated progression to end-stage renal disease (Ge & Dai, 2019)), macrovascular complications (a 3- to 5-fold higher risk of cardiovascular events within 10 years compared to non-diabetic peers (Shen & Wu, 2024)), and lower extremity complications (a 25% incidence of foot ulcers and an 8-fold increased risk of amputation due to peripheral

vascular disease and neuropathy (An & Zhang, 2022)), all of which pose serious threats to health.

Therapeutic Management of T2DM

HbA1c is one of the main indicators of the level of glycemic control. For most non-pregnant adult T2DM patients, a reasonable HbA1c control target is lower than 7%. However, the glycemic control target should be individualized. T2DM patients with younger age, shorter disease duration, longer life expectancy, no complications, and no combined cardiovascular disease can adopt a more stringent HbA1c control target in the absence of hypoglycemia and other adverse effects, and vice versa, adopt a relatively lenient HbA1c target. However, acute hyperglycemic symptoms or complications associated with them should be avoided due to overly relaxed control criteria (American Diabetes Association, 2023c; Chinese Diabetes Society, 2021).

The UK Prospective Diabetes Study (UKPDS) showed that improved glycemic control from diagnosis is essential to minimize the long-term risk of glycemic complications. Each 1% decrease in HbA1c reduces the risk of myocardial infarction (MI) by 15%. The results of the UKPDS follow-up study showed that the risk of MI was still 15% lower in the intensive glucose lowering group 10 years after the end of intensive glucose lowering treatment ($p < 0.05$) and the risk of all-cause mortality (ACM) was 16% lower ($p < 0.05$), suggesting a long-term benefit of good early glycemic control (Lind et al., 2021). ADA (2022), National handbook for the prevention and control of diabetes in primary care (2022), and Clinical Guidelines for Prevention and Treatment of T2DM in the Elderly in China (2022) indicate that the management of T2DM includes medication management and lifestyle management, which includes medication, nutritional management, physical activity, and management of psychosocial issues, among others. The specific management is as follows:

1. Pharmacological management

When diet and exercise fail to bring glycemic control up to standard, pharmacological treatment should be promptly applied. Drug therapy is based on the two main pathophysiological changes of elevated blood glucose, namely insulin resistance and impaired insulin secretion. As the course of T2DM progresses, the function of pancreatic β -cells gradually decreases, and the reliance on exogenous means of blood glucose control gradually increases. Clinical treatment with oral hypoglycemic agents and injectable hypoglycemic agents is often required (Chinese Diabetes Society, 2021). Choosing a dosing pattern that is simplified, easy to follow and with low risk of hypoglycemia improves adherence. In principle, glucose-lowering drugs are selected according to the stage of development of T2DM. It is recommended to choose monotherapy mode for $\text{HbA1c} < 7.5\%$, dual or triple drug combination mode for $\text{HbA1c} \geq 7.5\%$, and consider combination insulin therapy for $\text{HbA1c} \geq 9.5\%$. According to the stratification of HbA1c level, the earlier combination therapy has better glycemic control effect than the stepped glycemic control mode (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Three guidelines, the ADA (2022), the Chinese Clinical Guidelines for the Management of T2DM in the Elderly (2022), and the National Primary Care Diabetes Management Manual (2022), recommend the use of the following glucose-lowering medications (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022):

1.1 Oral medication

1.1.1 Biguanides: Biguanides is the representative drug. It lowers blood glucose and improves peripheral insulin resistance through mechanisms such as inhibition of hepatic glycogenolysis, increased glucose utilization in peripheral tissues and anaerobic enzymes. The main adverse effects are gastrointestinal reactions. Based

on its superior cost-effectiveness ratio and safety, it is the preferred and long-term (except renal insufficiency) hypoglycemic agent for elderly patients with T2DM.

1.1.2 SGLT2 inhibitors: The representative drugs are dagliflozin, enagliflozin and kagliflozin. It lowers blood glucose by inhibiting the glucose reabsorption function of SGLT2 in the proximal tubule of the kidney and increasing glucose excretion in the urine. The main adverse effects are urinary and genital infections and adverse reactions associated with blood volume deficiency. It also helps to lower blood pressure. It does not increase the risk of hypoglycemia when used alone, but in combination with insulin or sulfonylureas may increase the risk of hypoglycemia. Patients with T2DM who have heart failure (HF) and diabetic kidney disease (DKD) may benefit more.

1.1.3 DPP-4 inhibitors: The representative drugs are sitagliptin and saxagliptin. It lowers blood glucose by increasing insulin secretion and inhibiting glucagon secretion. The overall incidence of adverse reactions is low. However, saxagliptin can increase the risk of heart failure.

1.1.4 Sulfonylureas: The representative drugs are glibenclamide, glipizide, gliclazide, and gliquidone. It lowers blood glucose by promoting insulin release from pancreatic β -cells, and poor pancreatic β -cell function can lead to secondary drug failure. The main adverse effects are hypoglycemia and weight gain. It is inexpensive, has a strong hypoglycemic effect, and is effective in reducing microvascular risk.

1.1.5 Thiazolidinedione (TZDs): Includes rosiglitazone and pioglitazone. It lowers blood glucose by increasing insulin sensitivity in muscle and fat cells. It has a low risk of hypoglycemia, is inexpensive, and is beneficial in reducing the progression of cardiovascular atherosclerotic lesions, but has a risk of weight gain, edema, increased HF, and increased osteoporosis (fractures). It is indicated for older patients with newly diagnosed diabetes with IR as the main feature.

1.1.6 Meglitinides: This includes Repaglinide and Nateglinide. It lowers blood sugar by promoting insulin release from pancreatic beta cells. Common adverse effects are hypoglycemia and weight gain, but the risk and extent of hypoglycemia are less severe than with Sulfonylureas.

1.1.7 α - Glucosidase inhibitors: Includes acarbose, voglibose, and miglitol. It slows down the rise of postprandial blood glucose by inhibiting the activity of intestinal glycosidases and delaying the absorption of carbohydrates in the upper part of the small intestine. The main adverse effects include gastrointestinal reactions such as abdominal distention and increased gas. Hypoglycemia does not usually occur with this class of drugs taken alone.

1.1.8 GLP-1RA: Stimulates insulin secretion and inhibits glucagon secretion by activating GLP 1 receptors in a glucose concentration-dependent manner, and exerts hypoglycemic effects by increasing glucose uptake in muscle and adipose tissue and inhibiting hepatic glucose production, as well as delaying gastric emptying and suppressing appetite, etc. Major adverse reactions: gastrointestinal reactions, including diarrhea, nausea, abdominal distention, vomiting, etc.

1.2 Insulin

After 3 months of combined lifestyle and oral hypoglycemic therapy, patients with T2DM should start insulin therapy promptly if their blood glucose still does not reach the control target (Chinese Diabetes Society & National Office for Primary Diabetes Care, 2022). Insulin is the most effective hypoglycemic drug and is necessary to save the lives of patients with severe hyperglycemia, but it can trigger the side effects of hypoglycemia and weight gain. Insulin can be divided into animal insulin, genetically synthesized human insulin and insulin analogues, depending on the source and chemical structure (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Depending on the characteristics of action, insulins can be divided into ultra-short-acting insulin analogues, short-acting insulins,

medium-acting insulins, long-acting insulins, long-acting insulin analogues, premixed insulins, premixed insulin analogues, and double insulin analogues. The choice is based on the patient's islet beta-cell function and blood glucose changes (Chinese Diabetes Society & National Office for Primary Diabetes Care, 2022). In insulin therapy, weight control and diet management should be observed, and the dose should not be >50 U/d. Greater than this dose indicates the presence of IR and increases the risk of progression of AS and retinal and renal microangiopathy. Also avoid excessive blood glucose fluctuations which will aggravate the risk factors of vascular damage and hypoglycemia (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022).

2. Lifestyle management

Lifestyle interventions are the basic treatment for T2DM and should be used throughout the course of diabetes treatment. The main components include diabetes self-management education and support (DSMES), medical nutrition therapy (MNT), routine physical activity, tobacco cessation counseling when needed, health behavior counseling, and psychosocial care (American Diabetes Association, 2023b).

2.1 Diabetes self-management education and support (DSMES)

DSMES includes two components, Diabetes Self-Management Education (DSME) and Diabetes Self-Management Support (DSMS). The main objective is to provide people with diabetes with the knowledge, skills and confidence to take responsibility for self-management and better self-care (Chinese Diabetes Society, 2021; Ting Liang, 2022). The ADA (2023) recommends that patients with diabetes should receive DSMES services upon diagnosis. This has been shown to improve HbA1c in diabetic patients (Ting Liang, 2022).

2.2 Medical nutrition therapy (MNT)

MNT refers to special interventions for nutritional problems in T2DM, including individualized nutritional assessment, nutritional diagnosis, development of

appropriate nutritional intervention plans, and implementation of monitoring over a certain period of time (Chinese Diabetes Society, 2021). For example, the total daily calories were calculated based on the patient's height, weight (ideal and measured weight), exercise, gender, and age. According to whether the patient has a combination of abnormal fat metabolism (TG level) and purine metabolism (blood uric acid level), the proportion of the three major energy-supplying nutrients is assigned, and the actual weight of specific cereals and potatoes, proteins and fats is converted through an isoenergetic (90 kcal/serving) food conversion table and three meal allocation recommendations are given (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). MNT helps to lower HbA1c, improve glucose tolerance, and reduce the incidence of chronic complications.

2.3 Physical activity

Exercise therapy for T2DM patients requires a balance between glycemic control and good physical fitness, and moderate exercise is more beneficial to the adjustment of metabolic and psychological balance in elderly patients than diet control alone. At the same time, the exercise management of elderly patients needs to be more individualized, and the exercise program should be formulated according to the patient's diabetes duration, severity, complications, age, personal condition, family status, exercise environment, living habits, economy, cultural background and other factors (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). Regular exercise helps control blood sugar, reduce cardiovascular risk factors, lose weight, and improve well-being (Chinese Diabetes Society & National Office for Primary Diabetes Care, 2022). However, exercise should be done sensibly. Avoid vigorous exercise as well as avoiding exercise on an empty stomach. Do preparatory activities before exercise, prevent hypoglycemia, falls and fractures during exercise, and perform recovery exercises and check the feet after exercise (Geriatric

Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022).

2.4 Psychosocial care

Complex environmental, social, family, behavioral, and emotional factors, known as psychosocial factors, influence living with diabetes and achieving optimal health outcomes and psychological well-being (American Diabetes Association, 2023b). Psychosocial care should be provided to all people with diabetes, with the goal of optimizing health-related quality of life and health outcomes (American Diabetes Association, 2023b). When indicated, refer to mental health professionals or other trained health care professionals for further assessment and treatment for symptoms of diabetes distress, depression, suicidality, anxiety, treatment-related fear of hypoglycemia, disordered eating, and/or cognitive capacities. Such specialized psychosocial care should use age appropriate standardized and validated tools and treatment approaches (American Diabetes Association, 2023b). A systematic review and meta-analysis showed that psychosocial interventions modestly but significantly improved A1C (standardized mean difference -0.29%) and mental health outcomes (American Diabetes Association, 2023b).

Both medication management and lifestyle management require individualized management. They both require the cooperation of the patient, family, and medical staff to accomplish. They have an important role in delaying the course of T2DM.

The management of diabetes in elderly patients should holistically integrate their health status, complication risks, and quality of life, with individualized glycemic targets tailored to their specific conditions. For healthier elderly patients, fasting blood glucose (FBG) should be maintained at 6.1–7.8 mmol/L and 2-hour postprandial blood glucose (PPG) at 7.8–10.0 mmol/L, while targets should be relaxed for those with frailty or multiple chronic conditions to prioritize safety and minimize hypoglycemia

risks. Emphasis must be placed on regular screening for complications (e.g., retinopathy, nephropathy, cardiovascular disease) and selecting glucose-lowering agents with low hypoglycemic potential, such as metformin or SGLT-2 inhibitors, alongside personalized regimens for patients with comorbidities like cardiovascular disease, heart failure, or chronic kidney disease. Additionally, structured lifestyle interventions—including balanced nutrition, glycemic-index-aware diets, and regular physical activity (e.g., resistance training, and aerobic exercise)—are critical to improving metabolic health, reducing disability and mortality rates, and preserving patients' dignity and overall quality of life (Chinese Medical Doctor Association Nephrology Branch, 2023; Shen & Wu, 2024).

Self-management in patients with T2DM

Diabetes is a lifelong disease and cannot be cured. After the disease is controlled in the hospital, it is important to return to life. In life, control of the disease depends most of the time on the ability of the patient and family to manage and care for the disease (Ryan & Sawin, 2009). It is therefore the responsibility of the patient and family to improve their ability to manage the disease, delay the course of the disease, and improve quality of life under the professional guidance of health care professionals to achieve optimal treatment and maintenance outcomes.

Definition

Self-management (SM) is the process by which individuals actively apply cognitive and behavioral strategies to manage their own thinking, emotions, behaviors, and the environment in order to manage their goals (Xiao-Min Sun & Gang Xue, 2008). With the increase of chronic diseases and the trend of younger patients, China's policy promotes the transformation of chronic disease treatment to health management, and the management of chronic diseases and healthy lifestyle changes have become the

responsibility of the individuals and families concerned. With the joint efforts of individuals, families and health care professionals, patients with chronic diseases can receive more comprehensive and systematic health management.

When experiencing one or more chronic conditions, patients self-manage by gaining the confidence and ability to perform the medical management, role management and emotional management and adjust to changes in their condition in order to manage chronic conditions or risk factors (Ji Liu, 2020; Ryan & Sawin, 2009). Self-management includes six self-management skills: problem solving, decision making, resource utilization, the formation of a patient-provider partnership, action planning, and self-tailoring (Lorig & Holman, 2003). Corbin and Strauss proposed that self-management behaviors include three aspects: 1. Treatment management: refers to the ability of patients to manage their illness, such as taking medication as required, testing of disease-related indicators, reasonable diet and reasonable exercise, etc.; 2. Emotion management: refers to the ability of patients to deal with negative emotions such as fear and depression caused by the illness and maintain a good state of mind. 3. Role management: refers to the ability of patients to Maintain normal roles in work, family, and intercourse (Corbin & Strauss, 1989).

SM in patients with T2DM emphasizes individualized patient-centered management, which is important for controlling blood glucose levels, preventing or delaying complications and maintaining quality of life (Davies et al., 2022). The higher the level of self-management, the better the quality of survival of patients with diabetes. A study of self-management in DM patients in six Chinese provinces found that after a 2-month diabetes self-management group, physical health scores at 2-year follow-up improved compared to those before self-management, with statistically significant differences ($Z=-2.53$, $P=0.011$) (Xia Zhang, Ying-Ying Jiang, et al., 2022). A study shows a negative association between dietary self-management behaviors and glycated hemoglobin in diabetic patients (Dong-Jing Li et al., 2020). Another study showed that

personalized self-management interventions were effective in controlling metabolic indicators such as BMI, FBG, 2 hPBG, and HbA1c in patients with T2DM ($P < 0.05$), improving self-management and preventing complications (Ming-Juan Hu et al., 2021).

In this study, self-management refers to glycemic management by patients with T2DM through regular review, medication compliance, diet control and reasonable exercise, with the aim of controlling blood glucose levels (HbA1c) and preventing diabetes-related complications.

There are distinct differences in diabetes self-management between adults and elderly patients. Adults, with stronger cognitive abilities, can quickly grasp monitoring and medication knowledge. However, high-intensity work schedules, reliance on high-salt, high-fat takeout meals, and sedentary habits often lead to irregular eating patterns and disrupted exercise routines. They need to balance glycemic control goals with daily rhythms through digital tools (e.g., glucose management apps) and fragmented health strategies (timed reminders, short exercise sessions), while addressing anxiety caused by workplace stress. Elderly patients, despite higher treatment adherence, face challenges such as cognitive decline and traditional dietary preferences (e.g., porridge, refined carbohydrates) that exacerbate glucose fluctuations. Their management prioritizes safety—relaxing targets, avoiding hypoglycemia and fall risks, adopting low-intensity exercises (Tai Chi), and easily digestible high-protein diets (Kirkman et al., 2012). They rely on community healthcare (large-print educational materials, simplified pre-filled insulin pens) and family support (medication supervision by children, fall-proof home modifications) to overcome operational barriers (American Diabetes Association, 2023e; Wang et al., 2017). In China, adults must navigate the conflict between modern lifestyles and metabolic stress, while elderly patients contend with empty-nest loneliness and traditional dietary constraints. Strengthening community interventions (e.g., nutrition education, mental health assessments for seniors) and leveraging technology (e.g., online health communities for adults) in

healthcare resource allocation are critical. This approach achieves a dual adaptation of “precision glycemic control” and “humanistic care,” tailored to the sociocultural and physiological realities of each group.

The Individual and Family Self-Management Theory (IFSMT)

Individual and family SM includes the purposeful incorporation of health-related behaviors into an individual or family’s daily functioning (Ryan & Sawin, 2009). The individual and family assumes responsibility for individual and family SM and it may occur in collaboration with healthcare professionals. (Ryan & Sawin, 2009).

The IFSMT proposes that SM is a complex dynamic phenomenon consisting of 3 dimensions: context, process, and outcomes. Factors in the contextual dimension influence individual and family engagement in the process of SM as well as directly impact outcomes. Enhancing the individual’s and families’ SM processes results in more positive outcomes. The third dimension of the theory relates specifically to outcomes. Outcomes are proximal or distal. While the outcomes of concern are those related to individuals and families, improvement of individual and family outcomes translate to improved outcomes for healthcare practitioners and systems (Ryan & Sawin, 2009).

1. Context dimension

Context dimension includes risk or protective factors that affect the SM process or outcome. It includes condition-specific factors, physical and social environments, and individual and family characteristics (Ryan & Sawin, 2009). Condition-specific factors are those physiological, structural, or functional characteristics of the condition, its treatment, or prevention of the condition that impact the amount, type, and nature of behaviors needed for SM. Examples of condition specific factors are complexity of condition or treatment, trajectory, physiological stability, or physiological transitions. Environmental factors are physical or social and include factors such as access to healthcare, transition from one healthcare provider or

setting to another, transportation, neighborhood, work, school, culture, or social capital. Individual or family factors are those characteristics of the individual and family directly (Ryan & Sawin, 2009). Examples include personal age, cognitive state, viewpoint, literacy level, learning ability, information processing ability, family structure and functioning. Environmental factors are physical or social and include factors such as access to health care, transition from one health care provider or setting to another, transportation, community, work, school, culture, or social capital.

2. Process dimension

The process dimension is the process of self-management, including Knowledge and beliefs, Self-regulation, and Social facilitation. According to this descriptive theory, persons will be more likely to engage in the recommended health behaviors if they have information about and embrace health beliefs consistent with behavior, if they develop self-regulation abilities to change their health behaviors, and if they experience social facilitation that positively influences and supports them to engage in preventative health behaviors (Ryan & Sawin, 2009).

Knowledge is the personalized information that patients acquire about their health; beliefs are patients' perceptions of specific health conditions or health behaviors, including three components of self-efficacy, outcome expectancy, and goal congruence. Knowledge and beliefs impact behavior-specific self-efficacy, outcome expectancy, and goal congruence (Clark et al., 2015; Ryan & Sawin, 2009). Self-efficacy refers to the degree of confidence people have in their ability to successfully engage in a behavior under normal and stressful circumstances. Outcome expectancy is a belief that participation in a particular behavior leads to a desired outcome. Goal congruence is a person's ability to resolve confusion and anxiety arising from conflicts related to health goals (Xin-Ying Li, 2021). For example, many women whose goal is to lose or maintain weight and increase calcium intake may choose to increase their calcium intake by

increasing their dairy intake, but the high calorie content of dairy products can make it difficult to accomplish their weight loss or maintenance goals (Ryan et al., 2009).

Self-regulation is the process used to change health behaviors by setting clear and achievable goals, using effective strategies to achieve them, and evaluating one's success in achieving them. It includes goal setting, self-monitoring and reflective thinking, decision-making, planning and engagement in specific behaviors, self-evaluation, and management of physical, emotional, and cognitive responses related to health behavior change (Ryan & Sawin, 2009).

Social facilitation includes the concepts of social influence, social support, and negotiated collaboration between individuals and families and healthcare professionals (Ryan & Sawin, 2009). The goal is to help or promote the active participation of individuals and families in healthy behaviors.

3. Outcome dimension

The outcome dimensions include immediate outcomes (self-management behaviors, health care costs, etc.) and long-term outcomes (health status, quality of life, etc.). The immediate outcome is when individuals begin to change their lifestyles and adopt healthy behaviors, which is an achievable goal in the short term. Long-term outcomes are goals that can be achieved in the short term. Long-term outcomes are goals that can be achieved by maintaining healthy behaviors and improving health status. The achievement of the immediate goal can bring immediate satisfaction to the individual, and its motivational enhancement is more than the postponed sense of achievement generated by the expectation of the long-term goal, which becomes the intrinsic motivation to achieve the next goal and promotes the maintenance of healthy behaviors (Howardson & Behrend, 2015; Ryan & Sawin, 2009).

The IFSMT along with support of evidences from the literature reviews about diabetes self-management will help to guide this study.

Self-management behaviors among patients with T2DM

Diabetes self-management behaviors is important for effective management of T2DM and prevention or mitigation of complications. It mainly includes behavior and lifestyle changes, such as diet management, exercise management, blood glucose monitoring, foot care, medication compliance, and mood management. It also includes gaining the knowledge and skills to perform self-management activities and to make informed decisions about one's treatment options. The American Diabetes Guidelines identify four key time points for diabetes self-management education and assessment of patient management. These are: at diagnosis, every year, when a complex situation arises (e.g., change in disease status, change in lifestyle, occurrence of mood state fluctuations, etc.), and change in care model (American Diabetes Association, 2023b). In this study, self-management was based on changing behaviors and lifestyles, including blood glucose monitoring, reasonable exercise, regular review, diet control, and medication compliance. Several studies have shown changes in these health behaviors and lifestyles above in diabetic patients during the new crown epidemic pandemic, which may lead to loss of control of blood glucose levels in diabetic patients. Therefore, these activities were chosen as representatives of self-management for the study.

1. Blood glucose monitoring

Blood glucose monitoring is an important part of diabetes management, which helps to assess the glucose metabolism, to understand the level of the patient's disease, the effect of treatment, or to adjust the treatment plan. At present, the following methods of glucose monitoring are commonly used in clinical practice, including: capillary monitoring, continuous glucose monitoring (CGM), HbA1c and glycated albumin (GA) monitoring, etc. (American Diabetes Association, 2023c).

Capillary glucose monitoring is the most basic and effective tool for the daily management of diabetic patients. It reflects real-time blood glucose levels and assesses

the effects of life events (diet, exercise, emotions, and stress, etc.) as well as diseases and medications on blood glucose. CGM refers to the technique of continuously monitoring the changes of glucose concentration in subcutaneous interstitial fluid through glucose sensors, which can provide more comprehensive information on blood glucose and understand the characteristics of blood glucose changes.

Glycated hemoglobin HbA1c is a product formed by the non-enzymatic reaction of the amino group (lysine, valine, or arginine) of hemoglobin with glucose or other sugar molecules. The higher the blood glucose concentration and the longer it lasts, the higher the HbA1c level and the greater the percentage of the total hemoglobin. Usually, the life span of red blood cells is about 120 d. Therefore, HbA1c can reflect the average blood glucose level in the past 2~3 months and is currently an accepted standard for assessing the long-term blood glucose control status of diabetic patients and an important basis for adjusting the glucose-lowering treatment plan. It is recommended to test it at least once every 3 months at the beginning of treatment, and once the treatment goal is reached, it can be checked once every 6 months (American Diabetes Association, 2023c). However, HbA1c test results have a "delayed effect" on the assessment after treatment adjustment and cannot accurately reflect the risk of hypoglycemia or the characteristics of blood glucose fluctuation. Glycated albumin (GA) monitoring can reflect the average blood glucose level of diabetic patients in the 2-3 weeks before the test, and GA is more sensitive to short-term blood glucose changes than HbA1c, which is a good indicator to evaluate the short-term glucose metabolism control of patients. However, when combined with certain diseases such as nephrotic syndrome and liver cirrhosis, which affect the rate of albumin renewal, GA test results are not reliable.

A study in Shandong Province showed that less than 30% of people performed self-monitoring of blood glucose, and more in urban areas (31.87%) than in rural areas (19.71%) ($P < 0.05$) (Kai-Yi Han, 2018). Yan-Li Wu et al. found that 78.5% of 610

diabetic patients in Chaoyang District, Beijing, underwent SMBG, which was higher in urban areas (83.8%) than in rural areas (73.1%), but the SMBG frequency attainment rate was only 4.8% (Yan-Li Wu et al., 2019). A study in Guangzhou province showed that improving compliance with blood glucose monitoring increased patient self-efficacy and promoted self-care (Zi-Yu Zhao et al., 2019).

2. Reasonable exercise

Reasonable exercise is very positive for improving the physiological function of diabetic patients, reducing the incidence of pre-diabetes, and improving the metabolic function of diabetic patients (Mei Wang et al., 2019). Many individuals with T2DM do not meet the recommended exercise level per week (150 min) (American Diabetes Association, 2023b). Exercise failure was mainly associated with advanced age ≥ 75 years (OR=3.999, 95% CI:1.178-13.583), and comorbidities (OR=2.007, 95% CI:1.210-3.330) ($p < 0.05$) (Man-Fang Zuo et al., 2020). People with diabetes should perform aerobic and resistance exercise regularly. Aerobic activity bouts should ideally last at least 10 min, with the goal of ~ 30 min/day or more most days of the week for adults with T2DM. Daily exercise, or at least not allowing more than 2 days to elapse between exercise sessions, is recommended to decrease insulin resistance, regardless of diabetes type (American Diabetes Association, 2023b).

The total score of exercise compliance in Mud City community in Pudong, Shanghai was 109.35 ± 19.36 , accounting for 66.27% of the total score 165 (Shi-Jun Wang et al., 2018). Our community survey showed that 51.5% of patients met the recommended standards of the Chinese Diabetes Exercise Treatment Guidelines (Man-Fang Zuo et al., 2020). In a cross-sectional study in Beijing's Dongcheng District, only 31.9% of people with DM had regular exercise habits (Hong-Mei Shi et al., 2021). It may be influenced by the culture, economy and education level between regions, and there are differences in exercise adherence among DM patients in different regions, but in general, exercise adherence among DM patients in China is still at a low level.

3. Diet control

Medical nutrition therapy is considered to be a priority in the prevention and treatment of T2DM. Individualized diet prescriptions are configured according to the patient's age, height, weight, metabolic index, and organ function to ensure physiological needs and reduce metabolic burden. Carbohydrates (50% to 55%) should be the main energy supplying nutrient, and foods with high energy density, rich in dietary fiber and low glycemic index (GI), vegetables and an appropriate proportion of low-sugar fruits should be selected. Protein intake is recommended to be 1.0~1.5 g/(kg·d), mainly high-quality protein, which can improve IR and reduce age-related muscle wasting (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022). In a 6-month trial, hemoglobin A1c decreased by 0.19%-0.33% in the low-carbohydrate group, while A1c levels decreased by only 0.02%-0.10% in the normal diet group. The low-carbohydrate diet group showed a greater decrease in hemoglobin A1c, weight loss, and lower fasting glucose levels (Dorans et al., 2022).

Diabetic patients' dietary self-management behaviors were negatively associated with glycosylated hemoglobin. A domestic study showed that interventions on dietary self-management behaviors of elderly diabetic patients in different regions could significantly improve self-management and promote the achievement of glycemic and glycated hemoglobin targets (Dong-Jing Li et al., 2020). After the low-carbohydrate diet intervention, FPG, HbA1c, and 2hPG levels of patients were lower than before the intervention ($P<0.05$) (Ping Cheng, 2022).

4. Medication compliance

When glycemic control is poor under the management of lifestyle changes, medical personnel need to tailor individualized medication regimens to the patient's disease course and condition. Therefore, medication compliance is the key to glycemic management. Several studies have shown a negative correlation between medication

adherence behavior and HbA1c levels (Ping Wu & Nai-Feng Liu, 2017). Diabetic patients with high medication adherence had lower glycosylated hemoglobin indices, and improved adherence could reduce hospitalization and all-cause mortality rates in diabetic patients. Under rational medication guidance, medication adherence was higher in the observation group (71.43%) than in the control group (33.33%), and FBG, 2hPG and HbA1c control rates were lower than before the intervention ($P < 0.05$) (Tao Zhang & Ke-Ling Pei, 2022).

Poor medication adherence was associated with multiple medication use, depression, frailty and reduced ability to perform activities of daily living ($P < 0.05$); co-morbid patients had better medication adherence than mono-morbid patients ($P < 0.05$) (Qiu-Mei Wang et al., 2018). The medication adherence rate of 398 elderly patients in Shanghai was only 37.19%. Factors such as gender, age, education level, importance of the disease, importance of medication and knowledge of the hazards of not taking medication as prescribed, number of drug categories, number of medication dosage forms, number of medication modes and adverse drug events had some influence on patients' medication adherence (Xu-Qin Li et al., 2017).

Studies have shown that effective self-management behaviors are important for controlling blood glucose levels and lowering HbA1c, which is the key to prevent or alleviate T2DM. However, the level of self-management behaviors among patients with T2DM in the eastern region of China is not high.

Effective glycemic management through adherence to glucose-lowering medications is an important activity in diabetes self-management, but there is evidence that Bhutanese patients with diabetes perform poorly in terms of adherence to glucose-lowering medications and glycemic control.

Factors influencing self-management behaviors (SMB) in patients with T2DM

Research suggests that DSMB in people with T2DM may be influenced by multiple factors, and that changing and intervening in these factors can lead to desired and effective self-management. According to the literature review, diabetes health literacy (HL), diabetes self-efficacy, and social support have an impact on DSMB. One study found that self-management behavior was positively correlated with social support ($r=0.295$, $P<0.01$) and health literacy ($r=0.399$, $P<0.01$). Social support and health literacy had some parallel mediating effects between disease pain and self-management behavior, among which the mediating effect of social support in disease pain and self-management behavior ($\beta=-0.287$, $P<0.01$) accounted for 9.51%, and the mediating effect of health literacy in disease pain and self-management behavior ($\beta=-0.334$, $P<0.01$) accounted for 22.01% (Qu Li, 2023). Another study found that self-efficacy ($\beta=0.220$, $P<0.01$) and social support ($\beta=0.553$, $P<0.01$) significantly affected the level of SMB (Guo-Cai Liu et al., 2018a).

Health literacy

According to the World Health Organization, Health literacy represents the personal knowledge and competencies that accumulate through daily activities, social interactions and across generations (Nutbeam & Muscat, 2021). Health literacy (HL) for Diabetes refers to the ability of patient with T2DM to obtain, read, understand, and use healthcare information in order to make appropriate health decisions which benefit to control T2DM and prevent further complications and follow instructions for treatment. Nutbeam classifies health literacy into 3 levels: functional health literacy, interactive health literacy and critical health literacy (Nutbeam, 2000).

Basic or functional literacy refers to basic enough literacy skills to be able to work effectively in everyday life (Nutbeam, 2000). For diabetes, this includes the ability to read and understand diabetes-related health information at a basic level,

numeracy, and the ability to apply diabetes-related knowledge and acquire basic skills (Yun-Xia Ni & Su-Zhen Liu, 2015). For example, knowledge of diabetic diet, exercise and medication, calculation of calorie intake and exercise, insulin injection and blood glucose monitoring skills, etc.

Communicative or interactive literacy refers to more advanced cognitive and literacy skills that, along with social skills, acquire, extract information and acquire meaning from different forms of communication and apply new information to changing contexts (Nutbeam, 2000). For diabetes, this includes the patient's ability to extract information from interactions with others, especially the ability to communicate with medical staff about the disease. For example, the ability to accurately and comprehensively describe disease manifestations, answer health-related questions and ask questions truthfully, etc. (Xue Jiang et al., 2020; Yun-Xia Ni & Su-Zhen Liu, 2015).

Critical literacy refers to more advanced cognitive skills that, together with social skills, can be used to critically analyze information and use it to exert greater control over life events and situations (Nutbeam, 2000). For diabetes, people with diabetes can use critical thinking to process the health information they receive and choose the most appropriate way to maintain and promote their health according to their condition. For example, not to listen to friends' recommendations and various advertisements to buy sugar-lowering drugs, etc. (Yun-Xia Ni & Su-Zhen Liu, 2015).

In Ryan and Sawin (2009) IFSMT, in the Context dimension, Basic or functional literacy is influenced by the patient's general literacy level, which is a unique characteristic of the individual patient. In the process dimension of self-management, patients and families aggregate and analyze the health information they receive and make decisions that benefit health by changing self-management behaviors to improve health (Ryan & Sawin, 2009).

The results of several studies have shown that the level of education (educational attainment) is an important influencing factor in the level of HL of people

with T2DM. With increasing education, the better the knowledge and skills of patients with diabetes, the higher the level of health literacy, and the difference was statistically significant ($P < 0.01$) (Hong-Yan Niu et al., 2022; Na Li et al., 2021; Teng-Teng Liu et al., 2021; Yan-Ling Dai et al., 2017). DM knowledge was positively correlated with self-management level, and those with better knowledge of DM had higher self-management level (Jin Huang et al., 2013).

The vast majority of T2DM patients' DM knowledge and SMB are at a low to moderate level, with large inter-individual differences that need to be improved (Jin Huang et al., 2013). While the recommendation of diabetes education via the Internet in the post-epidemic era has an impact on older patients with T2DM learning DM knowledge, which may lead to less-than-ideal DSM (Cui-Cui Meng et al., 2020; Li-Nong Ji et al., 2020).

Self-efficacy

Self-efficacy was first introduced by Bandura, and refers to the degree of confidence in people's own ability to adapt to the things that affect their lives (Bandura, 1977). Diabetes Self-efficacy refers to the degree of confidence that the patients with T2DM have in using their knowledge and skills to maintain glycemic control and prevent complications. The development of a sense of self-efficacy is influenced by a number of factors, which are referred to as self-efficacy information. According to Bandura (1994), self-efficacy can develop from four sources of information which includes task mastery, vicarious experience, verbal persuasion and emotional arousal (Bandura, 1977).

Personal experiences of success or failure: These are direct experiences of one's own abilities that are gained through one's own personal actions. Successful experiences increase self-efficacy and give individuals confidence in their own abilities. Conversely, repeated failures can reduce the assessment of one's own abilities and lead to a loss of confidence.

Vicarious experience: This refers to gaining knowledge about the possibilities of the self by observing the behaviour and outcomes of others. Alternative experiences are important for the development of self-efficacy. When a person sees someone at a similar level of success to him or herself, he or she can increase his or her self-efficacy judgments and confidence in his or her ability to perform similar behavioural actions. Conversely, when a person sees someone who is not as good as he or she is and fails despite great effort, his or her sense of self-efficacy is reduced.

Verbal persuasion: This refers to encouragement, evaluation, advice, counseling, etc. from others. Verbal persuasion is a means of further strengthening people's beliefs about their own abilities. In particular, when an individual is struggling to overcome difficulties, it is easier to enhance self-efficacy if someone from the outside expresses' confidence in him or her or a positive evaluation of him or her. Conversely, self-efficacy can be reduced.

Emotional and physiological: A person's emotional state and physiological state can sometimes affect the level of self-efficacy. For example, physiological fatigue, pain, and strong emotional reactions can easily affect an individual's judgement of self-efficacy and reduce self-efficacy (Wen-Xia Zhou & Gui-Pin Guo, 2006).

In IFSMT, self-efficacy is an important process factor that can have an impact on self-management behavior in the outcome dimension (Ryan & Sawin, 2009). For example, when people with diabetes are successful in managing their behavior through what they have learned, it boosts the patient's confidence to continue to improve their diabetes self-management behavior.

Also, self-efficacy indirectly influences other self-management factors such as diabetes knowledge and diabetes distress, which have an impact on SMB (Hui-Wen Xu et al., 2019; Yun-Juan Wang & You-Ying Zhao, 2022). High self-efficacy in the post-epidemic era makes patients more confident in disease management and stimulates their intrinsic initiative and potential to consciously develop good self-management

behaviors, while conversely, it weakens patients' management behaviors and makes the harms of diabetes complications appear earlier or worsen.

Social support

Social support refers to the favorable and supportive resources that individuals receive from others or society, which can help individuals cope with problems and crises in their working life (Yan-Fei Wang, 2004). Social support in T2DM refers to the perception of help given by family members, friends, relatives, neighbors and health care professionals during the management of DM. The higher the level of family and social support for older people, the better the quality of life and the better the outcome of diabetes management (Geriatric Endocrinology and Metabolism Branch of the Chinese Society of Geriatrics et al., 2022).

The poorer the self-rated health status of older patients with diabetes, the poorer the utilization of social support ($r = -0.249$, $p < 0.01$) (Ya-Chi Gong et al., 2020). This may be due to the fact that patients with high social support, who live in a more welcoming and pleasant environment, are able to seek help from it and are more positive and optimistic in facing the disease (Guo-Cai Liu et al., 2018a). During the new coronary epidemic, older people with diabetes are in greater need of social support to engage in more active and effective SMB.

From the literature review, the four variables chosen are found to influence SMB of T2DM in varying degrees in many studies. Therefore, this study used these variables to examine in post-COVID-19 pandemic Wenzhou, China whether these variables could predict DSMB in elderly patients with type 2 diabetes.

Contexts of DM care in China after covid-19 pandemic

In the post-pandemic era, diabetes care in China is transitioning from a "hospital-centric" model to "technology-enabled whole-life cycle management" (Zhang et al., 2024), yet the elderly population must balance technological innovation (e.g., AI-driven tools, remote monitoring) with age-friendly support (simplified interfaces,

community-based guidance) to achieve care goals that equally prioritize precision (tailored glycemic control) and humanization (emotional well-being, dignity). This shift reflects efforts to integrate digital solutions with sociocultural adaptability, addressing both the metabolic complexities of aging and the unique challenges of China's rapidly graying society.

During the pandemic, traditional in-person diabetes care models were disrupted, as many patients reduced visits to healthcare facilities due to infection concerns. This accelerated the shift toward hybrid online-offline telemedicine models. Remote health interventions have gradually gained traction in diabetes care (Zhang et al., 2024). However, these models may be less accessible to older adults, who often lack familiarity with digital devices.

Meanwhile, advancements in technology have not only enhanced the efficiency and personalization of diabetes care but also alleviated the workload of caregivers. Key applications of AI technology across the full cycle of diabetes management, including early screening, complication prediction, and management, demonstrate its potential to improve the efficiency of disease treatment and personalize care (Sheng et al., 2024). Tools such as mobile health apps and wearable devices provide elderly patients with convenient self-management solutions, enabling real-time monitoring of blood glucose, diet, and physical activity to improve glycemic control. Nevertheless, the widespread adoption of technology faces challenges, including ensuring equitable access, addressing ethical concerns, and improving elderly acceptance and proficiency in using new technologies.

Summary of the literature review

Health literacy for chronic disease, self-efficacy, and social support can directly or indirectly influence diabetes self-management behaviors in elderly patients with type 2 diabetes, which is supported by Ryan & Sawin's (2014) IFSMT. Improving the self-management behaviors of elderly patients with type 2 diabetes by improving

their ability to self-manage their disease can lead to the prevention or delay of diabetes complications. This requires a collaborative effort between patients, families, and health care providers. Successful and effective diabetes self-management can improve disease prognosis, reduce mortality and disability rates, reduce pressure on the healthcare system, reduce healthcare expenditures, and improve health.

Elderly patients with type 2 diabetes have been affected after the new crown epidemic pandemic, but there is a lack of research on the self-management of elderly patients with type 2 diabetes and related factors in Wenzhou during this period. There is a lack of certain research data to target and help guide the self-management behaviors of elderly patients with type 2 diabetes in the post-epidemic period.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter describes the research methodology of the study which includes information of research design, population and sampling, setting of the study, research instruments, protection of human rights, data collection, and data analysis process used in the study.

Research design

A predictive correlational study was used for the study. The objectives of the study were examining predictors of diabetes self-management behaviors like HL for chronic disease, perceived self-efficacy of diabetes, and social support among elderly patients with type 2 diabetes in Post-Covid-19 pandemic Wenzhou, China.

Population and sample

Population

The population of the study was elderly patients with type 2 diabetes aged between 60-69 years old who visited the diabetes outpatient department (OPD) at the First Affiliated Hospital of Wenzhou Medical University in the Wenzhou metropolitan area.

Sample

The study sample was selected from elderly patients with type 2 diabetes aged between 60-69 years old who attended the diabetes OPD at the First Affiliated Hospital of Wenzhou Medical University, based on the following inclusion criteria:

1. Diagnosed with diabetes type 2 for at least 6 months.
2. Had the ability to understand and communicate in Chinese. Only need to be able to speak Chinese, not necessarily the ability to read and write Chinese.
3. No history of acute metabolic complications. No records of diabetic ketoacidosis (DKA), hyperosmolar hyperglycemic syndrome (HHS), severe hypoglycemic coma (blood glucose <2.8 mmol/L with impaired consciousness), or lactic acidosis within the past 6 months.

4. No severe cognitive impairment. Confirmed by medical records as no diagnosis of dementia or Alzheimer's disease.

5. No physical disabilities affecting self-management. Exclude individuals with severe motor dysfunction, wheelchair dependency, or long-term bedridden status based on medical records.

6. No end-stage organ damage. Exclude patients with end-stage renal diseases, decompensated cirrhosis (Child-Pugh Class C), or Class III–IV heart failure (NYHA classification).

Sample size

The sample size was calculated by the G*power 3.1.9.7. The linear multiple regression analysis was chosen as the type of statistical test. The sample size was increased using a small effect size of .12 (Gray & Grove, 2020) and was calculated using an alpha of .05, a power of .80 and number of predictors of 3. According to the power analysis, an appropriate sample size for this study needed to have at least 95 participants. Considering missing or incomplete data, the sample size was increased by 15% to reduce the error. Therefore, the total sample size was 109.

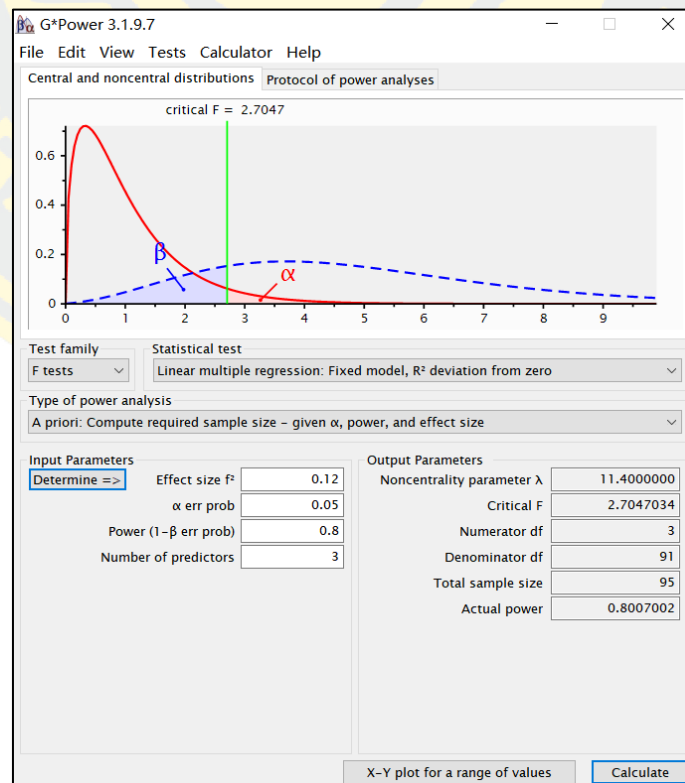


Figure 2 Sample size

Sampling technique

A purposive sampling method was used to select eligible participants for this study. This method ensured that sampling was closely related to the purpose of research, so that what characteristics the sample had could be determined by practical needs.

Before starting the research project, researcher asked for permission to collect data from the physicians who cared for the patients. Introduction posters were posted at the sign-in desk of the diabetes OPD and at the main entrance of the hospital. At the same time, researcher screened patients in the diabetes OPD. When met the screening criteria, researcher sent invitations to the patients and introduced the research project.

Setting of the study

This study was conducted at the diabetes OPD of the First Affiliated Hospital of Wenzhou Medical University. The First Affiliated Hospital of Wenzhou Medical University was Grade A Class Three hospital with medical services radiating to nearly 30 million people in southern Zhejiang, northern Fujian, and eastern Ganzhou. The hospital was ranked 68th in the China Hospital Science and Technology Influence Ranking. It was the largest hospital in Wenzhou with two campuses and was able to cover the majority of patients attending for diabetes. It was also moderately located, reflecting the overall situation of the Wenzhou metropolitan area. There were approximately 150,000 outpatient visited and about 6000 inpatient visited per year in the diabetes OPD and inpatient departments. The diabetes OPD offers a telemedicine support approach by putting up posters. Patients and their families can upload their blood glucose data through WeChat applets, and doctors adjust their treatment plans remotely. The diabetes OPD has an education clinic, especially for elderly patients. The education clinic provides one-on-one guidance by diabetes specialist nurses, including blood glucose measurement and monitoring, insulin injection techniques, hypoglycemia management, dietary guidance, medication use, exercise advice, psychological counseling, and so on, which adopts age-appropriate educational methods such as food modeling, face-to-face explanations, and real-life operational demonstrations, and provides one-on-one guidance to ensure that elderly patients fully understand and master their knowledge. For the characteristics of cognitive function decline in the elderly, repeat reinforcement and family assistance are used to ensure the effectiveness of education. Therefore, it had a good representation.

Research instruments

The questionnaire contained the following five sections as follows:

Part1. The demographic data questionnaires (DDQ)

The DDQ was developed by the researcher specifically for this study. The DDQ was divided into two parts. The first part contained background characteristics (measures of socioeconomic and demographic background), including sex, age, ethnicity, height, weight, marital status, education, residence, occupation, income, health welfare or health insurance, and information about lifestyle habits (smoking, alcohol consumption, mental health, etc.). The second part contained health information from previous medical records, including blood pressure level, duration of diagnosis, family history of diabetes, complications, comorbidity, medication, HbA1c, FBS and 2-hour postprandial glucose level.

PART 2. Diabetes Self-care Activities (SDSCA)

The study used the Diabetes Self-care Activities (SDSCA) based on the Chinese translation of the Diabetes Self-care Activities developed by Toobert et al (Qiao-Qin Wan et al., 2008; Toobert et al., 2000).

The post-translation scale consisted of 11 items consisting of 6 aspects, including general diet, special diet, exercise, blood glucose monitoring, foot care, and medication. 10 items were positive questions and 1 item (the 4th item) was a negative question, each item was scored on an 8-point scale from 0 to 7 (positive questions like 0 points = 0 days, 1 points = 1 day, 2 points = 2 days ... 7 points = 7 days, and the reverse scale was reversed), with a total score of 0-77, with higher scores indicating better self-management behavior. The score of each aspect was calculated by adding the scores of each item in each aspect and dividing by the number of items in each aspect. Scores ≤ 4.1 were classified as poor, 4.2 ~ 5.5 as medium, and ≥ 5.6 as good. The scale showed good internal consistency. The overall Cronbach's α for the scale was 0.62, with a Cronbach's α of 0.89 for the 2 items on general diet, 0.22 for the 2 items on exercise, 0.79 for the 2 items on blood glucose monitoring, and 0.70 for the 2 items on foot care. The retest reliability of the scale after 2 weeks was 0.83 ($p < 0.01$) (Qiao-Qin Wan et al., 2008).

PART 3. The Health Literacy Management Scale (HeLMS) for Patients with Chronic Diseases Questionnaires

The Health Literacy Management Scale (HeLMS) for Patients with Chronic Diseases Questionnaires compiled by Australian Professor Jordan et al (Jordan et al., 2010) and adapted and modified by Chinese scholar Hao-Lin Sun et al (Hao-Lin Sun et al., 2012).

The adapted and modified questionnaire was comprised of 28 items in 8 dimensions: attitudes towards health, understanding, social support, socioeconomic factors, access to general health services, communication with health service providers, proactivity and use of health information. The 5-point Likert scale was used and could be completed either orally or in writing, with an average score of less than 3 on each dimension indicating that the individual lacked competence in the respective dimension. The response scale was a 5-point Likert format ranging from 1 (very difficult or very reluctant definitely no) to 5 (no difficulty or very willing). The results showed that the Cronbach's α of the scale was 0.894 and the Cronbach's α of each dimension of the questionnaire was 0.857-0.940, and the retest reliability was also good. (Hao-Lin Sun et al., 2012). A high score on the HeLMS scale indicates that individuals have excellent performance in multiple dimensions of health literacy (information acquisition, decision-making, behavior, communication, self-management) and strong health management ability. This ability helps individuals cope better with health problems, reduce the risk of disease, and improve overall health. It is more suitable as a demonstration object of health education.

PART 4. Diabetes Self-efficacy Scale (DSES)

The Diabetes Self-efficacy Scale (DSES) was developed by Hurley and Shea (Hurley & Shea, 1992), and translated and modified by Jing-Xuan Wang from Taiwan (Jingxuan et al., 1998), translated into the Simplified Chinese version based on the Traditional Chinese version in Taiwan by Qiao-Qin Wan et al (Qiao-Qin Wan & Shao-Mei Shang, 2009).

The DSES scale translated by Qiao-Qin Wan et al was consisted of 26 items. Each item was scored on a 5-point scale ranging from 1 to 5, and the total score ranged from 26 to 130, with higher scores indicating better self-efficacy. In this study, the mean scores of the entries were used to classify the high and low levels of self-efficacy: 0 to 2, 2 to 4, and 4 to 5 represent three different levels of low, medium, and high, respectively. High score means patients have a high level of confidence in their ability to manage their diabetes and are able to actively implement self-management behaviors. The overall Cronbach's alpha of the scale was 0.91, and the retest reliability was 0.85 ($p < 0.01$), which was also good (Qiao-Qin Wan & Shao-Mei Shang, 2009).

PART 5. Social Support Rating Scale (SSRS)

The Social Support Rating Scale (SSRS) was designed and compiled by Shui-Yuan Xiao (Shui-Yuan Xiao, 1994) on the basis of foreign scales (like SSQ, ISSI and so on) and in accordance with the actual situation in China (Henderson, 1981; Henderson et al., 1980; Sarason et al., 1983). The scale had 10 items, including three dimensions of objective support (2, 6, 7 items), subjective support (1, 3, 4, 5 items) and utilization of social support (8, 9, 10 items). The scoring method for items of 1 to 4 and items of 8 to 10: each items have four options 1, 2, 3, and 4. 1 = 1 point, 2 = 2 points, 3 = 3 points, and 4 = 4 points. Item of 5 is divided into four types of family members: A, B, C, D and E. Each family member has four options, 1 = 1 point, 2 = 2 points, 3 = 3 points and 4 = 4 points. In the items of 6 and 7, if answer is "no source", it will get 0 points, and if answer is "the following sources", it will get several points if you have several sources. Higher total scores indicate higher levels of social support. SSRS had been used in many domestic applications since 1986 and had been translated into Japanese for an international collaborative study. From the feedback, the design of the questionnaire was basically reasonable, the entries were easy to understand without ambiguity, and it had good reliability and validity. In a research application, the total score consistency $R = 0.92$ ($p < 0.01$) and the consistency R_{1-10} of each item ranged from 0.89 to 0.94, indicating that the questionnaire has good retest reliability. In this study, the overall Cronbach's α for the scale was 0.785.

Psychometric properties of instruments

The Chinese versions of all the instruments were used for the study, which were tested and validated by researchers in many previous studies. This meant that all the instruments had good validity. The reliability of all the instruments were found to be optimal as shown by the Cronbach's alpha in previous studies. In this study, 30 participants were used to examine the reliability of the tools, and a test-retest reliability for SDSCA was tested again. The results showed that the Diabetes Self-Management Behavior Scale ($\alpha=0.681$), Health Literacy Management Scale for Chronic Diseases ($\alpha=0.95$), Diabetes Self-efficacy Scale ($\alpha=0.908$), and Social Support Rating Scale ($\alpha=0.785$). After 2 weeks, the correlation coefficient "r" of the SDSCA was 0.89 ($P<0.01$). This meant that all the instruments had good validity as before.

Protection of human rights

The study was conducted only after the research proposal was approved by the Institutional Review Board (IRB) of Burapha University (Acceptance Number: G-HS072/2566) and the Research Ethics Committee of the First Affiliated Hospital of Wenzhou Medical University (Acceptance Number: KY2023-235). The data collection process began only after the First Affiliated Hospital of Wenzhou Medical University allowed the investigator to collect data in a hospital setting. The Research Ethics Committee of the First Affiliated Hospital of Wenzhou Medical University approved the document on October 28, 2023.

During the process of data collection, all potential participants were informed of the following steps:

1. The purpose of the study and the procedures involved in the data collection process.
2. The participants' right to consent or not to consent to participate in the study.
3. Participants' refusal to participate in the study would not affect the quality of care they received from the hospital.
4. The right to change their mind during the study and decide not to participate in this study.

5. No names or identification documents that might be able to track and identify participants were used in the data collection and documentation process.

During the collection process, data were collected only from those patients who were willing to participate in the study after obtaining informed written consent. Patients' names or other identifying information could not be disclosed on all data collection forms or in the study report at the end of the study. All paper files containing data were locked in a secure location, and all electronic data were password protected. Only the researcher had access to it. Unauthorized individuals had no access. All documents pertaining to data collection will be destroyed one year after the publication of the study.

Data collection

The data for this study were collected as follows:

1. The researcher asked for a letter from the Faculty of Nursing, Burapha University addressed to the First Affiliated Hospital of Wenzhou Medical University to seek permission to collect data from the research setting.

2. After receiving permission from the hospital to collect data, the process of data collection was explained to staff of the diabetes OPD and permission for data collection was sought from the staff. The researcher spoke with the staff and physicians beforehand to explain the data collection to them in advance and the collection of data did not affect patient visits.

3. The research assistants screened the target participants and introduced them to the research project. Then, they asked them for written informed consent.

4. Patients who voluntarily agreed to participate in the study were interviewed one-on-one in an adjacent empty room at the end of the outpatient consultation.

5. The data for the study were collected using self-report (51 patients) or interview (58 patients) guideline questionnaire written in Chinese. Both self-report and interview have limitations in studies. For self-report, some elderly patients had difficulty completing the questionnaire independently due to limitations in literacy, vision or manipulation. For interview, it may result in biased data or reduced quality due to leading questions, subjective interpretations by the interviewer and patient tension, privacy concerns, fatigue effects, and distraction. Therefore, to minimize bias

in data collection and reduce patient burden, the following improvements were made in the data collection process. For the self-report, a questionnaire with large font size and clear layout was used and completed in sections to reduce fatigue. For the interview, a standardized process was used and the patient's wishes were respected (allowing skipping of sensitive questions or pausing the interview). In addition, the accuracy of patients' self-reported information was verified by medical records (e.g., glucose monitoring data, medication records).

The researcher used structured interview method to collect the data in this study because the elderly may have had vision limitations and reading difficulties. Uniform instructional language was used in the research process, and the questionnaire was completed and retrieved on site. The interview took approximately 30 minutes per person.

6. Patient's physical measurements such as blood pressure, height, weight and so on were recorded from the patient's medical record.

7. The researcher checked if the questionnaire was completed before patients left the room. The participants received a small gift as compensation for time spent on questionnaires.

Data analysis

The data was analyzed using SPSS Statistics 17.0 software. The alpha (α) level of statistical significance was set at 0.05. The data was analyzed using the following statistical functions:

1. Descriptive statistics including frequency, percentage, mean and standard deviation were used to explain the demographic characteristics of the sample and the variables.

2. Various functions of the statistics were used to test the assumptions of multiple regression. These included tests for normality of variables, linearity, homogeneity of variance, outliers, correlation, and multicollinearity.

3. Enter Method in Linear Multiple Regression was performed to identify the predicting factors of diabetes self-management among elderly patients with T2DM in Wenzhou.

CHAPTER 4

RESULTS

This chapter presents the results of the study. The objectives of this study were to describe the diabetes self-management behaviors and examine predictors of diabetes self-management behaviors like HL for chronic disease, perceived self-efficacy of diabetes, and social support among the elderly with T2DM in the post Covid-19 pandemic in Wenzhou, China. The results of the study is presented as follows:

1. Description of participant characteristics
2. Health information of the participants
3. Description of independent and dependent variables
4. Factors influencing diabetes self-management among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, china

Description of participant characteristics

As shown in table1, a total number of 109 patients with type 2 diabetes mellitus who attended the diabetes clinic of the First Affiliated Hospital of Wenzhou Medical University participated in this study. Among them, 51 (46.8%) were male and 58 (53.2%) were female. The age of the participants ranged from 60 to 69 years with a mean age of 64.28 years. More than half (57.8%) of participants were in normal weight and 36.7% were overweight. All participants were The Han Nationality. More than half of the participants (62.4%) were unemployed. Most of the participants (94.5%) were married and lived with family or friends (92.7%). Almost half of the participants had completed primary education (41.3%), while a small percentage (5.5%) had a bachelor's degree or higher. The majority of participants had a monthly household income (74.3%) and monthly personal income (97.3%) of less than 10,000 RMB. More than half of the participants (52.3%) had new rural cooperative medical insurance, which has a moderate reimbursement rate. The vast majority of participants were able to take care of themselves (92.7%). Some participants were currently drinking alcohol (27.5%) and smoking (21.1%).

Table 1 Demographic characteristics of participants (n = 109)

Characteristics	Number (n)	Percentage (%)
Gender		
Male	51	46.8
Female	58	53.2
Age ($M = 64.28$, $SD = 3.138$, Min = 60, max = 69)		
60-64	59	54.1
65-69	50	45.9
BMI ($M = 24.15$, $SD = 3.03$, Min = 18.07, max = 33.17)		
Lose weight (less than 18.5)	1	0.9
Normal weight (between 18.5 to 24.9)	63	57.8
Overweight (between 25 to 29.9)	40	36.7
Obesity (more than 30)	5	4.6
Nationality		
汉族 (The Han Nationality)	109	100
少数民族 (Minority)	0	0
Occupation		
Employed	41	37.6
Unemployed	68	62.4
Marital status		
Single	1	0.9
Married	103	94.5
Widowed	5	4.6
Living arrangements		
Living alone	8	7.3
Living with family or friends	101	92.7

Table 1 (Continued)

Characteristics	Number (n)	Percentage (%)
Education		
Less than Primary school	45	41.3
Primary school	25	22.9
Secondary/High school	33	30.3
Bachelor degree and higher	6	5.5
Monthly personal income		
< 5000 RMB	80	73.4
5000-10000 RMB	26	23.9
10000-30000 RMB	3	2.8
> 30000 RMB	0	0
Monthly family income		
<5000 RMB	41	37.6
5000-10000 RMB	40	36.7
10000-30000 RMB	28	25.7
>30000 RMB	0	0
Medical insurance		
Basic medical insurance for urban employees (reimbursement ratio is max)	21	19.3
New rural cooperative medical insurance (reimbursement ratio is medial)	57	52.3
Basic medical insurance for urban residents (reimbursement ratio is minimal)	31	28.4
Activities of daily life abilities		
Independently (ADL= 100)	101	92.7
Needs some help (ADL> 60)	5	4.6
Needs a lot of help (ADL 40-60)	3	2.8

Table 1 (Continued)

Characteristics	Number (n)	Percentage (%)
Alcohol drinking		
Currently	30	27.5
Ever and quit	9	8.3
Never	70	64.2
Smoking		
Currently	23	21.1
Ever and quit	14	12.8
Never	72	66.1

Health information of the participants

As shown in table 2, the data revealed significant patterns in participants' diabetes history and management. Among the participants, 42.2% had diabetes for 11-20 years, 29.4% for less than 10 years, and 28.4% for 21-30 years. Regarding family history, 44% of participants reported having relatives with diabetes, with 28.4% having one family member affected and 15.6% having two or more affected family members.

Medical follow-up patterns in the past year showed that most participants (69.7%) attended appointments irregularly (<4 time per year), while only 30.3% maintained regular follow-up schedules (>4 time per year). Hospital admission rates were notably high, with 97.2% of participants having experienced at least one hospitalization. Treatment complexity was evident, as 99.1% of participants (n=108) required multiple treatment plans.

The prevalence of additional health conditions was substantial. Comorbidities, including hypertension, hyperlipidemia, and heart disease, affected 91.7% of participants. Furthermore, 60.6% of participants experienced diabetes-related complications such as retinopathy, nephropathy, and neuropathy.

Only 14.7% of participants maintained normal HbA1c levels (below 7%), while 64.2% had severely uncontrolled HbA1c ($\geq 8\%$). The blood glucose measurements revealed that 88.1% of participants had abnormal fasting blood sugar

levels, and 89% showed elevated 2-hour postprandial blood glucose levels. Regarding blood pressure control, 70.6% of participants maintained normal levels, while 29.4% had elevated blood pressure readings.

Table 2 Health information of the participants (n = 109)

Health information	Number (n)	Percentage (%)
Diagnosis duration ($M = 12.62$, $SD = 7.110$, Min = 1, max = 30)		
≤ 10	32	29.4
11-20	46	42.2
21-30	31	28.4
History of family with DM		
Yes	48	44.0
No	61	56.0
Family number of cases		
None	61	56.0
1	31	28.4
≥ 2	17	15.6
Number of visit to diabetic clinic in the past year ($M = 3.43$, $SD = 3.599$, Min = 1, max = 16)		
< 4 times per year	76	69.7
4-16 times per year	33	30.3
Hospitalized		
Never	3	2.8
Ever	106	97.2
Treatment		
One treatment plan	1	0.9
More than one treatment plan	108	99.1

Table 2 (Continued)

Health information	Number (n)	Percentage (%)
Comorbidities		
None	9	8.3
Have	100	91.7
Complications		
None	43	39.4
Have (top three complications)	66	60.6
Neuropathy	43	39.4
Retinopathy Moderate	31	28.4
Nephropathy	15	13.8
Latest HbA1c (%) (National Center for Gerontology et al., 2024)		
Not available	2	1.8
Controlled (< 7.0%)	16	14.7
Mild Uncontrolled (7.0%- 7.5%)	8	7.3
Moderate Uncontrolled (7.5%- 8.0%)	13	11.9
Severe Uncontrolled ($\geq$ 8.0%)	70	64.2
Latest FBS (mmol/L) (normal range 3.9-6.1)		
Normal	13	11.9
Abnormal	96	88.1
Latest 2h postprandial blood glucose (mmol/L) (normal range <7.8)		
Normal	12	11.0
Abnormal	97	89.0
Latest blood pressure		
Controlled blood pressure (SBP < 140 and DBP < 90 mmHg)	77	70.6
Uncontrolled blood pressure (SBP > 140 or DBP > 90 mmHg)	32	29.4

Description of independent and dependent variables

As shown in table 3, the studied variables in this study were diabetes self management behaviors, health literacy for diabetes, diabetes self-efficacy and social support. As shown in Table 3, the overall score of diabetes self-management behavior ranged from 1.27 to 5.55 (on a scale of 0 to 7) with a mean of 3.14 (SD=0.88). Considering each behavior, taking medicine had the highest mean score of 6.34 (SD=1.39), followed by dietary control (M=3.37, SD=1.16), foot care (M=2.96, SD=2.06), and glucose management (M=2.66, SD= 2.03). Physical activity had the lowest mean score (M=1.73, SD =1.37). As a result, diabetes self-management behaviors of participants were poor.

The score is calculated by adding the scores of each item and dividing by the number of items. The score less than or equal to 4.1 in each aspect are classified as poor. 4.2 ~ 5.5 as medium, and be equal or greater than 5.6 as good.

Table 3 Mean and standard deviation of diabetes self-management behavior (dependent variables) (n = 109)

Self-management behaviors	Possible score	Actual score	M	SD	interpret
Diabetes self-management behavior	0-77	14-61	34.53	9.65	poor
Dietary control	0-7	0-7	3.37	1.16	poor
Physical activity	0-7	0-7	1.73	1.37	poor
Glucose management	0-7	0-7	2.66	2.03	poor
Foot care	0-7	0-7	2.96	2.06	poor
Taking medicine	0-7	0-7	6.34	1.39	good

Table 4 Mean and standard deviation of the independent variables (n = 109)

Independent variables	Possible score	Actual score	M	SD
Health literacy for diabetes	28-140	44-137	90.02	20.08
Diabetes self-efficacy	26-130	41-127	82.65	15.86
Social support	12-66	22-48	33.03	5.13

The score is calculated by adding the scores of each item.

As shown in table 4, scores of diabetes health literacy ranged from 44 - 137 with a mean of 90.02 (SD = 20.08). The self-efficacy levels of the participants ranged from 41 - 127 with a mean score of 82.65 (SD = 15.86). Social support scores ranged from 22 - 48 with a mean of 33.03 (SD = 5.13).

Factors influencing diabetes self-management among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, China

The assumptions of multiple regression were tested. First, for example, normality of variables, linearity, homogeneity of variance, no outlier, no correlation and no multicollinearity. The normality test done with Kolmogorov-Smirnov test showed the variables (diabetes self management behavior, health literacy for diabetes, diabetes self-efficacy and social support) were distributed normally at the significant level of .05. The chi-square test of Mahalanobis distance ($\alpha=0.05$, $df=3$, $P<0.005$) showed that $\chi^2<12.84$, so there were no multivariate outliers. The absence of multicollinearity was determined by looking at the VIF value which were all less than 5 and by correlation test which showed that no correlation among the variables were greater than .85.

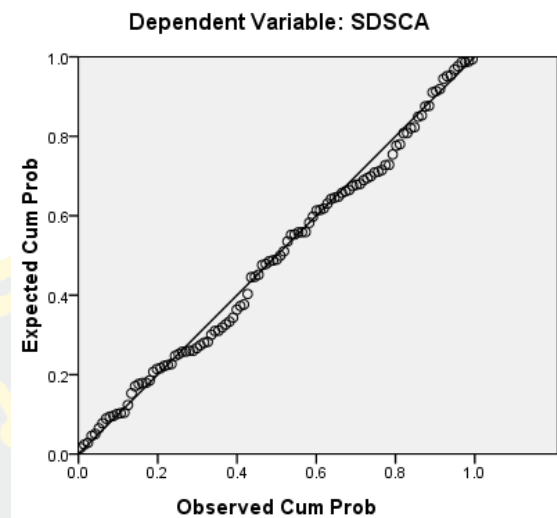


Figure 3 Normal P-P Plot of Regression Standardized Residual

The Pearson's correlation test was used to check the relationship among the variables that were studied. A multiple linear regression was employed to check whether health literacy for diabetes, diabetes self-efficacy and social support was able to predict diabetes self-management behavior. Table 5 illustrates the correlation matrix among the variables studied.

Table 5 Correlation matrix among the independent and dependent variables (n = 109)

	Diabetes self- management behavior	Health literacy	Self-efficacy	Social support
Diabetes self- management behavior	1			
Health literacy	.433**	1		
Self-efficacy	.815**	.568**	1	
Social support	.343**	.614**	.409**	1

** Correlation is significant at the 0.01 level (2-tailed).

From the correlation matrix, diabetes self-management was positively and significantly correlated with health literacy ($r = .433$, $p < .001$), self-efficacy ($r = .815$, $p < .01$) and social support ($r = .343$, $p < .01$).

As shown in table 6, the results of the multiple linear regression analysis indicated that health literacy for diabetes, diabetes self-efficacy and social support explained 65.8% in the variance of diabetes self-management among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, China (Adj $R^2 = 65.8\%$, $F(3, 105) = 70.12$, $p < .001$). The analysis also showed that diabetes self-management among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, China was significantly predicted by diabetes self-efficacy ($\beta = .837$, $p\text{-value} < .001$). However, health literacy for diabetes ($\beta = -.070$, $p\text{-value} = .377$) and social support ($\beta = .045$, $p\text{-value} = .535$) could not predict the diabetes self-management significantly.

Table 6 Summary of regression analysis for variables predicting diabetes self-management among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, China (n = 109)

Predicting variables	B	SE	β	t	p-value
Health literacy	-0.034	0.038	-0.07	-0.887	0.377
Self-efficacy	0.509	0.042	0.837	12.176	0.000
Social support	0.084	0.135	0.045	0.622	0.535
Constant	-7.299	3.878		-1.882	0.063
$R^2 = .667$, Adj $R^2 = .658$, $F(3, 105) = 70.12$, $P\text{-value} < .001$, $S.E. = 5.648$					

CHAPTER 5

CONCLUSION AND DISCUSSION

This chapter begins by examining how the findings address each research question. This is followed by theoretical and practical implications, study limitations, and recommendations for future research. The chapter concludes with final remarks on the study's contribution to the field.

Summary of the study

This study aimed to explore diabetes self-management behaviors among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, China, and to investigate the predictors of diabetes self-management. The study was guided by IFSMT(Ryan & Sawin, 2009). A purposive sampling method was used to recruit 109 participants from the diabetes OPD of the First Affiliated Hospital of Wenzhou Medical University. Data for the study was collected using self-reported questionnaires or structured interviews conducted in Chinese. The assessment tools included demographic data questionnaires, the Diabetes Self-Management Behavior Scale (Toobert et al., 2000; Wan et al., 2008), the Health Literacy Management Scale (HeLMS) for Patients with Chronic Diseases (Haolin et al., 2012), the Diabetes Self-efficacy Scale(Qiaoqin & Shaomei, 2009), and the Social Support Rating Scale (Xiao, 1994).

The study participants (N=109) were predominantly female (53.2%), married (94.5%), and unemployed (62.4%), with a mean age of 64.3 years. Most participants lived with family or friends, had independent daily living skills, low literacy levels, and monthly family incomes below 10,000 RMB. Regarding health status, 36.7% were overweight and 4.6% were obese, with 27.5% currently drinking alcohol and 21.1% smoking.

Most participants (70.6%) had diabetes for over 10 years, with 91.7% having comorbidities and 60.6% experiencing complications. Most had a history of diabetes-related hospitalization, and 69.7% did not maintain regular clinic visits. Nearly all

participants used multiple treatments, and most showed abnormal readings in their latest HbA1c, FBS, and 2-hour postprandial blood glucose tests.

The mean score and standard deviation of diabetes self-management behaviors were 34.53 and 9.65, respectively, indicating that participants' diabetes self-management behaviors were poor. The mean scores across different dimensions of diabetes self-management behaviors revealed poor performance in dietary control, physical activity, blood glucose management, and foot care ($M = 1.73-3.37$). However, the mean score for medication adherence ($M = 6.34$) was significantly higher than other dimensions of diabetes self-management behavior.

Multiple linear regression analysis revealed that only diabetes self-efficacy significantly predicted diabetes self-management among elderly type 2 diabetes patients in post-COVID-19 Wenzhou ($\beta=0.837$, $p<.001$). Neither health literacy ($\beta=-.070$, $p=.377$) nor social support ($\beta=.045$, $p=.535$) were significant predictors.

Discussion

The results of the study were discussed according to the objectives and hypotheses of the study. The first objective was to explore the diabetes self-management behaviors of the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou, China. The second objective was to investigate the predictors of diabetes self-management behaviors like HL for chronic disease, perceived self-efficacy of diabetes, and social support among elderly patients with T2DM in the post Covid-19 pandemic in Wenzhou, China.

The diabetes self-management behaviors

The results of the study showed that diabetes self-management behaviors were poor among the elderly with type 2 diabetes in the post covid-19 pandemic in Wenzhou ($M = 34.53$, $SD = 9.65$). The reason for this result can be explained by IFSMT (Ryan & Sawin, 2009). Complexity in the post covid-19 pandemic in Wenzhou, physical factors and personal factors (e.g., age, degree of education, income, comorbidities, and complications) directly influence self-management outcomes.

During the post covid-19 pandemic in Wenzhou, the elderly with type 2 diabetes have lacked the appropriate coping ability when facing new medical technologies, particularly the internet applications. As the 5G network has become

widely used in post-pandemic Wenzhou, endocrinologists can now promote and educate about diabetes care through WeChat, the Internet, newspapers, magazines, and medical apps (Ying et al., 2020). However, the participants in this study were elderly (mean age 64.28 years) and had generally low educational levels. Therefore, the use of Internet technology presents a significant challenge for these elderly patients. Additionally, patients have needed to gradually adjust their behaviors and mindset developed during the COVID-19 pandemic as they transition to the post-pandemic period in Wenzhou. These adaptations are undoubtedly complex for elderly patients and have impacted their ability to self-manage their condition.

The poor level of patient self-management can be explained by examining the broader environmental context. Although most participants were married (94.5%) and lived with family or friends (92.7%), multiple factors have affected their care. In post-COVID-19 Wenzhou, China's aging population and economic pressures have created significant challenges for families. Adult children are facing mounting responsibilities as they strive to balance caring for elderly parents, raising their own children, and maintaining employment (Chen et al., 2024). This situation has resulted in reduced time available for managing their elderly parents' health needs.

As a result, elderly patients primarily manage their diabetes as couples, with guidance and supervision from hospital healthcare staff. However, diabetes self-management requires a sustained long-term commitment, and professional supervision alone has proven insufficient to maintain patients' motivation and self-awareness in adhering to management protocols.

The economic characteristics of the participants may also contribute to their poor self-management behaviors. In this study, 62.4% of participants were unemployed, and 73.4% had a personal monthly income of less than 5,000 RMB. Research has shown that physical and social environments, including employment status, are associated with self-management levels (Ryan & Sawin, 2009). Monthly personal income has been identified as a significant predictor of self-management among elderly patients with type 2 diabetes, with higher income levels correlating with better self-management (Yang, 2024). The participants' low monthly income limited their ability to maintain long-term stable treatment regimens due to cost barriers. Furthermore, only 19.3% of participants had Basic Medical Insurance for Urban Employees, which offers the

maximum reimbursement ratio. The resulting economic stress can lead to decreased patient motivation for self-management.

Poor patient self-management levels can also be attributed to educational factors. The ability to read, write, and comprehend text affects patients' self-management both directly and indirectly (Ryan & Sawin, 2009). More educated patients demonstrate stronger comprehension abilities (Jin, 2024). They can effectively acquire and learn about disease progression, treatment measures, and health guidance through books, the Internet, and other resources, enabling them to actively engage in self-management. However, 41.3% of study participants had not received primary education. Their limited reading, writing, and text comprehension abilities made independent self-management challenging, making long-term adherence more difficult compared to those with higher educational levels.

According to Individual and Family Self-Management theories, specific conditioning factors (such as diagnosis duration) may influence changes in self-management levels both directly and indirectly (Ryan & Sawin, 2009). This study found that 70.6% of participants had lived with diabetes for 11-30 years. Extended diabetes management can lead to laxity and fatigue, requiring high levels of perseverance for consistent self-management, presenting a significant challenge. Furthermore, patients' failure to master diabetes self-management in the early stages can result in poor self-management outcomes.

The uncontrolled blood glucose and HbA1c levels observed in most participants appear to be primarily related to their low levels of self-management. The cultural dietary habits in Wenzhou include consuming high-carbohydrate meals three times daily and showing a preference for desserts and fried food (Huang, 2019). Such overeating patterns can lead to excessive weight gain, as evidenced by the 41.3% of study participants who were overweight. Additionally, a significant portion of participants continued smoking (21.1%) and consuming alcohol (27.5%). Furthermore, 69.7% of participants failed to maintain regular follow-up appointments. These findings indicate that few participants maintained proper and holistic self-management practices.

Factors predicting diabetes self-management behaviors

This study found that diabetes self-efficacy was a significant predictor of diabetes self-management behaviors among elderly patients with type 2 diabetes during

the post-COVID-19 pandemic in Wenzhou, China ($\beta = 0.837$, $p < .001$), aligning with the study's purpose. However, neither diabetes health literacy ($\beta = -.070$, $p = .377$) nor social support ($\beta = .045$, $p = .535$) emerged as significant predictors of diabetes self-management behaviors, contrary to the study's hypotheses. The identified predictors explained 65.8% of the variance in diabetes self-management behaviors.

Consistent with this study's hypotheses, diabetes self-efficacy was found to be a significant predictor of diabetes self-management behaviors among elderly patients with type 2 diabetes during the post-COVID-19 pandemic in Wenzhou, China. Diabetes self-efficacy is defined as the degree of confidence that individuals with T2DM have in using their knowledge and skills to maintain glycemic control and prevent complications (Zhang, Feng, et al., 2022). According to Individual and Family Self-Management Theory, diabetes self-efficacy primarily influences the proximal outcome of self-management.

Bandura suggests that self-efficacy is shaped by patients' practical successes, vicarious experiences, verbal persuasion, and emotional and physical states. Research indicates that practical successes represent the most significant contributing factor. Specifically, successes increase efficacy expectations, while repeated failures decrease them (Liu & Li, 2024; Zhang et al., 2023). As an individual's efficacy expectations increase, their likelihood of making greater efforts also increases. When patients with diabetes are convinced, their condition is manageable and they feel competent in their ability to self-manage, the probability of improved self-management increases.

Findings from multiple research studies corroborate our results regarding the relationship between self-efficacy and diabetes management. A comprehensive investigation involving 489 type 2 diabetes patients revealed self-efficacy's dual impact: it can both directly influence patient behavior and indirectly affect outcomes through its role in self-management skill development (Zhang et al., 2023). This relationship between self-efficacy and health outcomes was further substantiated by a longitudinal study, which demonstrated that diabetes patients who developed stronger self-efficacy achieved measurably better physical health outcomes following a two-year period of self-management interventions (Zhang, Jiang, et al., 2022).

Health literacy (HL) encompasses an individual's ability to make informed health decisions and modify lifestyle behaviors by effectively acquiring, understanding,

and applying health information and technology (Nutbeam, 2008). While previous research has established HL as a predictor of self-management capability, this study found that it did not significantly predict diabetes self-management behaviors among elderly patients with type 2 diabetes during the post-COVID-19 pandemic in Wenzhou, China. This finding contradicts both our research hypothesis and existing literature, which suggests that patients with higher health literacy demonstrate better acquisition, mastery, and application of diabetes knowledge, leading to more effective disease management (Li, 2022).

The lack of predictive relationship between HL and diabetes self-management behaviors in our study population may be attributed to the distinct characteristics of elderly patients with type 2 diabetes in Wenzhou. The predominantly low educational levels among these elderly patients likely contributed to their correspondingly low health literacy levels. Consequently, their limited learning and comprehension capabilities may have prevented HL from emerging as a significant predictor of diabetes self-management behaviors in this specific population context.

Social support encompasses favorable and supportive resources that individuals receive from others or society, enabling them to cope with challenges in their daily lives (Wang, 2004). In our study, participants' perceived social support levels were moderate and did not significantly predict diabetes self-management behaviors among elderly patients with type 2 diabetes during the post-COVID-19 pandemic in Wenzhou, China. This finding contradicts previous research, including a study demonstrating that social support positively and significantly predicted health self-management levels among elderly patients with type 2 diabetes, with higher social support correlating with better self-management (Yang, 2024).

The absence of a predictive relationship between social support and diabetes self-management behaviors may be explained by traditional Chinese cultural factors. Although extended families typically live together, older Chinese generations often struggle with emotional expression, while their adult children face competing demands from work and family responsibilities, resulting in limited support for their parents' self-management. Additionally, modern community housing arrangements have led to reduced neighborhood connections (Gui & Huang, 2006; Zhang & Cao, 2021). These

cultural and social factors may explain why social support failed to emerge as a significant predictor of diabetes self-management behaviors in our study population.

Conclusion

This study investigated the predictors of diabetes self-management behaviors among elderly patients with type 2 diabetes during the post-COVID-19 pandemic in Wenzhou, China. The findings revealed that diabetes self-efficacy emerged as the sole significant predictor of self-management behaviors, while health literacy and social support did not demonstrate predictive relationships. These results provide valuable insights for healthcare professionals and policymakers working to improve diabetes management among elderly patients.

The study identified several critical challenges affecting diabetes self-management in this population. These include limited technological adaptation in the post-pandemic healthcare environment, economic constraints, educational limitations, and cultural factors that influence family support dynamics. Particularly noteworthy was the finding that traditional Chinese family structures, while appearing supportive, may not translate into effective diabetes management support due to generational communication barriers and changing social patterns.

The participants demonstrated poor self-management behaviors across multiple dimensions, including dietary control, physical activity, blood glucose management, and foot care, though medication adherence showed better compliance. This pattern suggests a need for targeted interventions that focus on building patients' confidence and capability in comprehensive self-management practices.

Implications for nursing practice

The findings of this study offer valuable insights across three key areas:

Nursing Practice: This research provides comprehensive data on diabetes self-management behaviors and their predictors among elderly patients with type 2 diabetes during the post-COVID-19 pandemic in Wenzhou, China. These insights enable healthcare providers to develop personalized nursing interventions focused on enhancing self-efficacy, strengthening self-management motivation, and addressing management barriers. Such targeted interventions can help improve diabetes self-

management behaviors, optimize blood glucose control, slow disease progression, and reduce complications among elderly patients.

Nursing Education: The study findings enhance nursing educators' ability to convey current understanding of diabetes self-management behaviors and their primary predictors to nursing students, specifically regarding elderly patients with type 2 diabetes during the post-COVID-19 pandemic in Wenzhou, China. This knowledge will strengthen future healthcare providers' preparation for managing diabetic care in elderly populations.

Health Policy: This research highlights specific economic and social challenges faced by elderly patients with type 2 diabetes in Wenzhou regarding self-management. These insights can guide health organizations in developing appropriate policies and strategies to enhance diabetes and chronic disease management. By integrating chronic disease management more effectively into patients' and families' daily lives, these policies can contribute to broader societal health improvement.

Recommendations for future research

Given that this study was conducted in a specific setting, the results may not fully represent the characteristics of elderly patients with diabetes across China. To enhance the generalizability of these results to the broader Chinese elderly diabetic population, we recommend conducting similar studies across multiple settings. Future research should explore effective methods for improving self-efficacy in elderly diabetes patients, particularly within the context of Chinese cultural and social structures. Furthermore, investigations into how health literacy and social support might be better leveraged to support self-management behaviors in this population would be valuable.

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APPENDIX



APPENDIX A
Questionnaires in English

Questionnaires in English

1. Demographic data questionnaire (DDQ)

Instruction: The following questions are to obtain your general information and disease-related information. This questionnaire has 2 parts. Part 1 has 14 items and part 2 has 10 items. Please carefully listen to the questions in part 1 and part 2 and answer honestly. Please write “√” in the answer box or information in the space provided.

Part 1: Personal profile

1. Gender ☐ Male ☐ Female
2. Age: _____ Years
3. Weight: _____ Height: _____
4. Race: _____
5. Occupation: _____
6. Marital Status ☐ Single ☐ Married ☐ Divorced ☐ Widowed
7. Living arrangement ☐ Living alone ☐ Living with family members or friends
8. Highest level of education
☐ Less than primary ☐ Primary school ☐ Secondary school ☐ Graduate and up
9. Average individual income (income/month in RMB)
☐ Less than 5000 ☐ 5000 - 10,000 ☐ 10,000 – 30,000 ☐ More than 30,000
10. Average family income (income/month in RMB)
☐ Less than 5000 ☐ 5000 - 10,000 ☐ 10,000 – 30,000 ☐ More than 30,000
11. Medical insurance
☐ Basic medical insurance for urban employees
☐ New Rural Cooperative Medical Insurance
☐ Basic medical insurance for urban residents
☐ Medical insurance for retired cadres
12. Assistance required by you from others to carry out daily activities at home
☐ None ☐ Minimal ☐ Moderate ☐ Maximum
13. Alcohol drinking status
☐ Current alcohol drinker: Duration _____ years; Quantity _____ glass/day
☐ Former alcohol drinker: Duration _____ years;
Quantity (in the past) _____ glass/day

☐ No history of drinking alcohol

14. Smoking status

☐ Current tobacco smoker: Duration _____ years;

Quantity _____ cigarettes/day

☐ Former tobacco smoker: Duration _____ Years;

Quantity (in the past) _____ cigarettes/day

☐ No history of smoking

Part 2: Health Information (To be collected by the researcher from patient records)

1. Duration of diagnosis of T2DM (in years) _____

2. Family history of diabetes _____

3. Frequency of visits to diabetes clinic (in 1 year) _____

4. Last date of admission to hospital due to T2DM (if applicable) _____

5. Treatment Plan

☐ Diet control ☐ Diet control + Insulin ☐ Diet control + Oral medication

☐ Diet control + Oral medication + Insulin

6. Co-morbidities

☐ None ☐ Hypertension ☐ Chronic kidney disease

☐ Heart diseases ☐ Others, specify _____

7. Diabetes-related complications

☐ None

☐ Retinopathy ☐ Mild ☐ Moderate ☐ Severe

☐ Nephropathy

☐ Neuropathy

☐ Others, specify _____

8. Latest HbA1c _____ % (Date: ____/____/____)

9. Latest FBS _____ and 2 hours PP _____ mg/dl

(Date: ____/____/____)

10. Latest blood pressure _____ mmHg (Date: ____/____/____)

2. Diabetes Self-Management Behavior Scale (SDSCA)

Instruction: The following is to understand your diabetes self-management behaviors. Find out if you are self-managing according to your doctor's instructions. This questionnaire has 11 items. Please recall how many days you have done the following activities in the past 7 days. Fill in the number of days in the space provided following the corresponding item.

1. In the recent 1 week, the number of eating days was reasonably arranged according to the dietary requirements of diabetes mellitus. _____
2. In the past 1 month, an average of several days per week were reasonably arranged according to the dietary requirements of diabetes mellitus. _____
3. In the recent 1 week, the number of days with intake of 5 or more kinds of fruits and vegetables in one day. _____
4. In the recent 1 week, the number of days with intake of fatty foods or full-fat dairy products. _____
5. In the recent 1 week, the number of days that taking physical activity for more than 30 min (such as walking, etc.). _____
6. In the recent 1 week, the number of days that taking moderate intensity activities (including fast walking, climbing, cycling, etc.). _____
7. In the recent 1 week, the number of days that monitoring blood glucose. _____
8. In the recent 1 week, the number of days that monitoring blood glucose as required by the doctor. _____
9. In the recent 1 week, the number of days that checking your feet carefully for problems. _____
10. In the recent 1 week, the number of days that checking the inside of your shoes for foreign bodies, smooth, comfortable conditions. _____
11. In the recent 1 week, the number of days that taking medication or injecting insulin correctly as required. _____

3. The Health Literacy Management Scale (HeLMS) for Patients with Chronic Diseases Questionnaires

Instruction: The following questions are to understand your health literacy level which may influence your ability of diabetes self-management. This questionnaire has 5 sections and 28 items. Please carefully listen to the questions and recall your level of ability to do the following things. Please write “√” in the answer box that best matches your abilities.

No difficulty = 1, A little difficulty = 2, Some difficulty = 3, Very difficult= 4, Completely incapable = 5.	1	2	3	4	5
1) Read health brochures from hospitals or clinic					
2) Make health decisions based on the information provided by the doctor					
3) If it is difficult to read written information					
4) Understand the health information you are exposed to in your daily life					
5) Follow your doctor's advice (e.g., take medication as ordered by your doctor)					
6) Change bad habits according to the doctor's advice					
7) Go to a hospital alone to see a doctor (such as a Class III hospital)					
8) Get the information you need by communicating with your doctor					
9) Pay for medical treatment					
10) Fill out a separate medical form (such as an outpatient card)					
11) Pay for the cost of managing your own health					
12) Find the information you need from a lot of information					
13) Choose a different hospital or doctor for better service					
Never=1, Rarely=2, Occasionally=3, Often=4, Always=5.	1	2	3	4	5
14) If you don't know anything about your health, will you actively seek answers?					

No difficulty = 1, A little difficulty = 2, Some difficulty = 3, Very difficult= 4, Completely incapable = 5.	1	2	3	4	5
15) Do you ask your family or friends to help you understand health information that you do not understand?					
16) Do you often participate in healthy activities (such as physical exercise and health lectures) with your fellow patients?					
17) Do you prepare for each doctor visit (think of questions to ask the doctor in advance)?					
18) Do you often discuss your health with anyone other than your doctor?					
Have never thought=1, Thought but did not act=2, Seldom=3, Occasionally=4, Often=5.	1	2	3	4	5
19) To what extent have you considered putting into practice the health information you receive in your daily life?					
20) To what extent do you want to ask your doctor about aspects of the treatment that you do not understand					
21) Sometimes the doctor does not understand, to what extent do you continue to ask?					
22) To what extent have you considered asking a family member or friend to accompany you to a doctor's appointment?					
23) Have you considered getting more health information?					
Very reluctant=1, Be unwilling to=2, It doesn't matter=3, Be willing to=4, With pleasure=5.	1	2	3	4	5
24) Are you willing to invest time in health issues?					
25) Whether you are willing to pay attention to your own health needs (information resources, health resources, etc.)					
26) Are you willing to spend energy to improve your health?					
27) Are you willing to make lifestyle changes to improve your health?					
Be unfamiliar with=1, Not familiar with=2, Medium degree=3, Know better=4, Very familiar with=5.	1	2	3	4	5

No difficulty = 1, A little difficulty = 2, Some difficulty = 3, Very difficult = 4, Completely incapable = 5.	1	2	3	4	5
28) Are you familiar with the working time and place of community doctors?					

4. Diabetes Self-efficacy Scale (DSES)

Instruction: The following questions are to understand your confidence status when performing the following activities. This questionnaire has 28 items. On a scale of 1 to 5, representing none to all confidence. Please write “√” on the corresponding number (1= not confident at all 2= less confident 3= moderately confident 4= quite confident 5= absolutely confident).

	1	2	3	4	5
1) I usually eat in accordance with the principles of the diabetes diet.					
2) I was able to follow the diabetic diet when I went out to eat in a familiar place (like a friend's house).					
3) I was able to follow the diabetic diet when I ate in an unfamiliar place.					
4) Even on holidays, birthdays, or when I went out, I was able to follow the diabetic diet.					
5) Within the same food group, I can replace foods according to calories.					
6) I can eat on time every day.					
7) I'm able to maintain a regular exercise routine.					
8) Even on weekends and holidays, I'm able to go and do exercise.					
9) when I don't feel like exercising, I'm able to exercise for my diabetes.					
10) Even though I'm busy, I was able to make time for exercise.					
11) I was able to take my diabetes medication or my insulin at the time that my healthcare provider told me.					

12) When I'm out of the house, I'm able to take my diabetes medication or insulin shots on time.					
13) I was able to take the medication or inject insulin correctly according to the dosage given by the medical staff.					
14) I can usually measure my blood sugar or urine sugar at the time instructed by my doctor.					
15) I still measure my blood sugar or urine sugar when I'm out and about					
16) When I'm not feeling well, I can measure my blood sugar or urine sugar more often than usual.					
17) I record the results of each measurement of blood sugar or urine sugar.					
18) I usually wear shoes and socks suitable for diabetic patients as required.					
19) I can still choose the right shoes and socks when I'm traveling or socializing.					
20) I am able to perform proper foot self-examination and care as recommended by my doctor.					
21) I can trim the toenails correctly according to the foot care requirements of diabetic patients.					
22) When there is a foot problem, I can find it in time and call the doctor.					
23) When the blood sugar control is not good, I can detect it in time and call the doctor for treatment.					
24) When low blood sugar occurs, I can recognize it in time and take proper self-treatment measures.					
25) When my blood sugar is higher than usual (e.g., I feel thirsty, urinate too much, etc.), I can immediately take the right self-treatment measures.					
26) When I exercise, I prevent hypoglycemic reactions as recommended by my doctor.					

5. Social Support Rating Scale (SSRS)

Instruction: The following questions are intended to understand the support you had received in society. This questionnaire has 10 items. Please listen and write “√” on the corresponding item.

1. How many close friends do you have that you can rely on for support and help?

(Select only 1 item) (1) None (2) 1 or 2 (3) 3~5 (4) 6 or more

2. In recent years you: (only select one)

(1) Being away from family. I live alone in one room.

(2) Moving around a lot, living with strangers most of the time.

(3) Living with classmates, colleagues, or friends.

(4) Live with family.

3. You and your neighbors: (Select only one)

(1) Never care about each other, just nodding friends.

(2) Encounter difficulties may be a little concerned.

(3) Some neighbors care about you.

(4) Most neighbors care about you.

4. You and your colleagues: (Select only one)

(1) Never care about each other, just nodding friends.

(2) Encounter difficulties may be a little concerned.

(3) Some colleagues care about you.

(4) Most colleagues care about you.

5. Get support and care from family members (Please put “√” in the appropriate box)

	None	Seldom	Normal	Full support
A. Husband and wife (lovers)				
B. Parents				
C. Children				
D. Brothers and sisters				
E. Other members (four searches)				

6. In the past, when you were in a difficult situation, the sources of financial support or help to solve a practical problem were:

(1) No source.

(2) The following sources (optional)

A spouse, B other family members, C friends,

D relatives, E colleagues, F Work unit,

G Party, league, trade union and other official or semi-official organizations,

H religion, social groups and other non-official organizations,

I others (please list) _____

7. In the past, when you encountered difficult situations, the comfort and concern you once received were:

(1) No source.

(2) The following sources (optional)

A spouse, B other family members, C friends,

D relatives, E colleagues, F Work unit,

G Party, league, trade union and other official or semi-official organizations,

H religion, social groups and other non-official organizations,

I others (please list) _____

8. The way you talk when you are troubled: (Select only 1 item)

(1) Never complain to anyone.

(2) Only to 1-2 people who are very close to you.

(3) If a friend asks you, you will speak up.

(4) Take the initiative to express your annoyance in order to gain support and understanding.

9. How to help you when you are troubled: (Select only 1 item)

(1) Only police themselves and do not accept help from others.

(2) Rarely asks for help.

(3) Sometimes ask others for help.

(4) Often ask for help from family members, relatives and friends, and organizations when in trouble.

10. For groups (such as party groups, religious organizations, unions, student unions, etc.) to organize an event, you: (Select only 1 item)

- (1) Never attend
- (2) Occasionally attend
- (3) Attend regularly
- (4) Take part in and be active



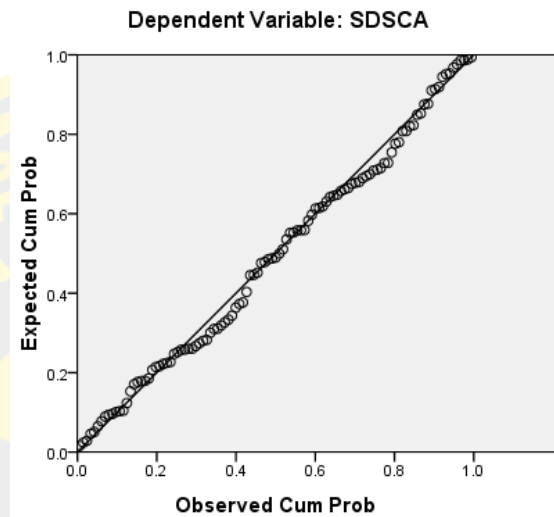


APPENDIX B

Additional information about dependent and independent variables

1. Normal P-P Plot of Regression Standardized Residual (Figure 3)

The scatter plot of the residuals (Figure 3) showed that the assumption of linearity and homoscedasticity were met.





APPENDIX C

Participant information sheet and consent form

Participant Information Sheet

Research protocol code:

Research Title: Diabetes self-management behaviors and influencing factors among elderly patients with type 2 diabetes in Post-CCovid-19 pandemic Wenzhou, China

Dear participants,

I am Miss Weijing Zhang, a graduate student at the Faculty of Nursing, Burapha University Thailand. I would like to invite you to participate in a reach project, entitled “Diabetes Self-management Behaviors and Influencing Factors among Elderly Patients with Type 2 Diabetes in Post-covid-19 Pandemic Wenzhou, China”. Before agreeing to participate in this project, the details of the projects are as follows:

The objectives are to examine the diabetes self-management behaviors and examine the factors (like HL for chronic disease, self-efficacy of diabetes, and social support) influencing diabetes self-management behaviors among elderly patients with T2DM who come to visit at the First Affiliated Hospital of Wenzhou Medical University in the Wenzhou metropolitan area in Post-covid-19 Pandemic Wenzhou, China.

If you agree to voluntarily participate in this study, the researcher will introduce the research project to you. Then, the researcher will ask you for written informed consent. You will write questionnaires if you can read them, otherwise, you will be interviewed one by one in an adjacent empty room at the end of the outpatient consultation. The researcher will use a structured interview method to ask questions and collect the data. The questionnaire will be completed and retrieved on-site by the researcher according to the patient’s answers. It is expected that the interview will take 30 minutes per person. During the interview, if the patient is tired, the patient will be given a rest periodically. Then your physical measurements such as blood pressure, height, weight, and so on will be recorded from the patient's medical record.

After finishing the interview, small gifts as a thank you to the patients to compensate for the questionnaire survey. Even though you will not get any direct benefits from this study, the information gathered from this study may be valuable in guiding the development of diabetes care models and interventions that can help hospitals and healthcare workers provide more advanced and better care for patients

with T2DM in order to minimize diabetes-related complications and improve their quality of life.

You have the right to terminate your participation in this study at any time without notice to the researcher and it will not affect the quality of services you receive from the diabetes OPD.

Any information collected from this study will be kept confidential. An anonymous questionnaire will be used. The results of the study will be presented through a group of participants and no specific information about any participant will be disclosed. All data will be available only to the researcher and will be destroyed one year after publication of the results. If you wish, you will receive a further explanation of the nature of the study once it has been completed.

The research will be conducted by Miss Weijing Zhang under the supervision of my major advisor, Assoc. Prof. Dr. Rungrat Srisuriyawate. If you have any questions, please contact me at my mobile number: +86 15857713929, or by email at 1072810716@qq.com, and/or my advisor's e-mail address rungrat@go.buu.ac.th. If the researchers do not follow the research protocol as stated in the Participant Information Sheet, please contact Burapha University Institutional Review Board Office, Burapha University (Division of Research and Innovation), Tel. +66 038- 102620. The email address of the Burapha University Institutional Review Board Office is buuethics@buu.ac.th.

Weijing Zhang

PARTICIPANT'S CONSENT FORM

Research Code:

Research Title: Diabetes self-management behaviors and influencing factors among elderly patients with type 2 diabetes in Post-CCovid-19 pandemic Wenzhou, China

Date of data collection Month Year

Before signing the consent form for this research participation, I was provided the information about the purposes and the processes of the research in the participant information sheet, which the researcher has given to me. I have fully understood the preceding explanation and the researcher has undertaken to answer my questions willingly and without concealment to my satisfaction.

I voluntarily agree to participate in this research project. I understand I can withdraw from the research project at any time without giving a reason, without it affecting any benefits that I am entitled to.

I have been given the explicit guarantees that my information and identity will be kept confidential and will be shared only in the summary of research results. Disclosure of my information to the relevant authorities requires my permission.

I have read and fully understood the above statements in all respects and have signed this consent document willingly.

In the case that I cannot read or write, the researcher has read the statement in the consent form to me until I fully understand it well. Therefore, I willingly signed or stamped my thumb on this consent form.

Participant's signature

(.....)

Researcher's signature

(.....)

Note: If the participant gave thumbprint as their consent, witness signature will be needed.



APPENDIX D

Miscellaneous

Research Project

Title: Diabetes Self-management and Influencing Factors among the Elderly with Type 2 Diabetes in the Post Covid-19 Pandemic in Wenzhou, China



NO COST TO JOIN THE PROJECT

Volunteer Qualifications:

- (1) Diagnosed with diabetes type 2 for at least 6 months.
- (2) Age 60-69 years old.
- (3) Have the ability to communicate in Chinese.

If you are interested, contact Weijing Zhang tel:15857713929 (time: 8:00-16:00).

Address: Diabetes Clinic, The First Affiliated Hospital of Wenzhou Medical University, Wenzhou, China

BIOGRAPHY

NAME WEIJING ZHANG

DATE OF BIRTH 05 February 1999

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