

## **Socio-demographic and clinical determinants of self-care in adults with type 2 diabetes: a multicenter cross-sectional study in Zhejiang province, China**

### **Abstract**

**Background:** Self-care, a process of maintaining health through health promoting practices and managing illness, is pivotal for the management of type 2 diabetes. This study aimed to explore self-care level and investigate its socio-demographic and clinical determinants among Chinese adults with type 2 diabetes.

**Methods:** In this multicenter cross-sectional study, we enrolled 495 Chinese adults with type 2 diabetes from outpatient settings of three tertiary hospitals in Zhejiang province, China. The Self-Care of Diabetes Inventory (SCODI) was used to measure self-care maintenance, self-care monitoring, and self-care management as three critical components of the dynamic self-care process. Self-care self-efficacy was a critical factor affecting self-care process, which was also measured by the SCODI. Multiple quantile regression models were used to identify the determinants of each self-care component and self-care self-efficacy.

**Results:** Participants had a median age of 62 years, of whom 55.4% were male. The median scores for self-care maintenance, self-care monitoring, and self-care management were 66.67 (50.00-85.42), 47.06 (32.35-58.82), and 53.13 (34.38-68.75), respectively, whereas self-care self-efficacy was 70.45 (52.27-84.09). Living in a low economic level city, and lower self-care self-efficacy were associated with having lower self-care maintenance. Being female, belonging to minorities, having complications, not attending diabetes self-management education in the last year, living in a low economic level city and having lower self-care self-efficacy were

associated with lower self-care monitoring. Having complications, using insulin, living in a low economic level city, and having lower self-care self-efficacy were associated with lower level of self-care management. Living in a low economic level city was associated with lower self-care self-efficacy.

**Conclusions/interpretation:** The findings of this study provide valuable insights into the factors influencing self-care among Chinese adults with type 2 diabetes. By enhancing self-care self-efficacy and participation in diabetes self-management education, healthcare providers can develop tailored self-care interventions to improve diabetes care, particularly for adults with type 2 diabetes who are male, younger, belong to minority groups, have complications, or reside in a low economic level city.

**Keywords:** Self-care; Self-care confidence; Self-management; Type 2 diabetes mellitus

## **Background**

Diabetes has become a significant global public health issue. According to the latest IDF Diabetes Atlas, almost 10.5% of the global population aged 20-79 years was reported to have diabetes in 2021 [1]. Based on World Health Organization (WHO) reports, diabetes has become the ninth leading cause of death worldwide [2]. In 2021, approximately one adult died every 5 seconds due to diabetes or its complications [1]. Furthermore, diabetes incurs a health expenditure of at least 966 billion USD, reflecting a 316% increase over the past 15 years [1]. China has witnessed one of the most dramatic increases in the prevalence, incidence, and mortality of diabetes globally, with nearly 25% (140.9 million) of the global cases of diabetes reported in China in 2021 [1]. The estimated prevalence of diabetes in China rose from 10.9% in 2013 to 12.4% in 2018, contributing to higher mortality rates and increased health expenditure related to its management and complications [3].

Type 2 diabetes, the most prevalent type of diabetes, constitutes over 90% of cases of diabetes and is typically considered a chronic disease affecting individuals after the age of 40 [4]. Adults with type 2 diabetes typically experience problems associated with the disease itself, its treatment, and complications. These issues comprise physical, psychological, social, and economic dimensions, such as experiencing common symptoms and signs [5], depression [6], and diabetes-related distress [7]. For instance, if left untreated, type 2 diabetes can damage small blood vessels, resulting in organ and tissue dysfunction [4]. This damage can cause both macrovascular and microvascular complications [4]. Macrovascular complications, such as coronary artery disease, cardiomyopathy, arrhythmias, and cerebrovascular diseases, are major contributors to morbidity and mortality in diabetic patients, with cardiovascular disease being the leading cause of death among patients with type 2 diabetes [8]. On the other hand, microvascular complications — such as diabetic retinopathy, nephropathy, and neuropathy—can result in vision loss, renal impairment, and numbness, ultimately diminishing patients' quality of life [9].

Patients with type 2 diabetes must receive complex therapeutic regimes to maintain physical and psychosocial health, manage their signs and symptoms, reduce or prevent complications, and improve their quality of life [1]. All these behaviors require knowledge, skills, experience, and motivation, and have been referred to as the concept of self-care [10]. Previous studies have shown that adults with type 2 diabetes can maintain stable glycemic control, prevent complications, enhance their quality of life, and reduce hospitalization frequency, costs, and mortality rates by participating in self-care behaviors [11-14].

Self-care used to be defined as behaviors that maintaining or promoting health and managing illness [15, 16]. However, a new concept defines self-care as a process of enhancing health through health promoting practices and managing illness [17]. This self-care process involves three components: self-care maintenance, self-care monitoring, and self-care management [17]. Self-care maintenance is defined as those

behaviors improving well-being, preserving health, or maintaining physical and emotional stability [17]. Self-care monitoring is a process of routine vigilant body monitoring, surveillance, or “body listening” [17]. And self-care management assesses changes in physical and emotional signs and symptoms to determine if further actions are needed [17]. Moreover, self-care self-efficacy refers to the belief that one can perform specific self-care tasks or behaviors and persist in them despite difficulties [17]. It is not a component of self-care process, but a significant predictor of self-care process and positively affects self-care maintenance, self-care monitoring, and self-care management [17, 18].

There is a trend to accept self-care as a process due to its flexibility and systematic view [19]. This concept helps identify adequate self-care behaviors and inadequate self-care behaviors [17], and tailored interventions can be applied to improve outcomes [20]. Therefore, exploring self-care as a process and identifying the specific characteristics of individuals inactively engaged in self-care may help develop tailored self-care interventions to achieve the optimal outcome.

However, self-care is currently unsatisfactory among patients with type 2 diabetes. A systematic review of self-care in adults with type 2 diabetes included 34 studies [21] showed that the general self-care was unsatisfactory, physical exercise was the least frequent self-care activity while adherence to medication was the most frequent behavior. The situation was similar in China, the overall level of self-care was low to moderate among adults with type 2 diabetes [22, 23]. A large cross-sectional study found that only 51.6% of Chinese people with type 2 diabetes performed foot care, and 25.9% adopted self-management of blood glucose (SMBG) [24]. In Zhejiang province, a cross-sectional study found that only 6.66% of adults with type 2 diabetes (aged 35 to 64 years) had adequate self-care [25]. Although the Chinese government released the *Standards of Medical Care for Type 2 Diabetes in China* to guide the prevention and management of type 2 diabetes [26], the above cross-sectional studies indicated unsatisfactory performance in various self-care behaviors among adults with type 2 diabetes [22-25]. Their findings suggested that existing self-care interventions have not

been adequately implemented or patients are less responsive to usual care [27]. Furthermore, the prevalence, morbidity, and mortality of type 2 diabetes in China continue to increase [3]. Therefore, there is an urgent need to develop effective strategies to address the treatment and self-care needs of Chinese adults with type 2 diabetes.

Understanding the determinants of self-care provides predictive and practical insights for designing future self-care intervention studies [28] to unravel the characteristics of less-engaged participants and identify modifiable factors that can guide the development of tailored self-care interventions for Chinese adults with type 2 diabetes. Many studies have explored the determinants of self-care in adults with type 2 diabetes [29]. However, most of these studies have approached self-care as a static behavior, focusing on individual aspects, such as physical activities [30], medication adherence [31], and foot care [32]), or as a combination of multiple self-care behaviors [29, 33]. Few have investigated self-care as a dynamic, complex, and adaptable process of maintaining health and managing illness [19]. This perspective has been predominantly developed and disseminated in developed countries, including the United States, Italy, and Canada, [20, 34, 35], and remains rarely explored in China [36]. Thus, a comprehensive understanding of the full spectrum of self-care behaviors and processes was not presented. Besides, theoretical frameworks are needed for explaining behaviors, investigating relationships, and predicting the outcomes of interventions [37]. However, the application of self-care theory in cross-sectional studies [38] and the availability of theoretically robust instruments to measure self-care [39] remain limited.

To address these gaps, this study utilized the Self-Care of Diabetes Inventory (SCODI), a theoretically and psychometrically sound instrument [35, 36], to assess self-care maintenance, self-care monitoring, self-care management, and their determinant-self-care self-efficacy, among Chinese adults with type 2 diabetes. The study also identified socio-demographic and clinical factors associated with the self-care process and self-care self-efficacy.

## Methods

### Study design and participants

A cross-sectional study was conducted including patients with type 2 diabetes from the outpatient departments of three tertiary hospitals in Zhejiang province, China. A convenient sampling method was applied. The three tertiary hospitals were in Lishui, Jinhua, and Wenzhou city of Zhejiang province. These cities belong to different economic levels of Zhejiang province (low, moderate, and high, respectively), based on the Gross Domestic Product (GDP) of the city [40].

We enrolled consecutive adults with type 2 diabetes during their outpatient visits between June 2023 and July 2023. The inclusion criteria were as follows: 1) confirmed diagnosis of type 2 diabetes based on the criteria outlined in the Chinese guideline [41]; 2) being at least 18 years old; 3) having type 2 diabetes for more than 6 months; and 4) willing to participate in the study. The exclusion criteria were as follows: 1) inability to read or understand the questionnaire; 2) presence of cognitive impairment; and 3) a history of psychiatric conditions.

### Data collection

A self-reported questionnaire was used to collect socio-demographic, clinical data and self-care. Based on previous studies [18, 42], the following factors were considered as the potential socio-demographic and clinical determinants of self-care : age, gender, nationalities, marital status, education level, household income, time from diagnosis, having complications, insulin use, participation in diabetes self-management education, and self-care self-efficacy.

The Self-Care of Diabetes Inventory (SCODI) was used to measure the level of self-care and its determinant (self-care self-efficacy). This self-reported questionnaire was developed by Ausili et al [35], and has been translated into Chinese this year [36]. This tool originated from the middle-range theory of self-care of chronic illness. It comprises 40 items categorized into 4 dimensions: self-care maintenance (12 items), self-care monitoring (8 items), self-care management (9 items), and self-care self-efficacy (11 items) [36]. Self-care maintenance includes health promoting exercise

behaviors, disease prevention behaviors, health-promoting behaviors, and illness-related behaviors. Self-care monitoring includes body listening and symptom recognition. Self-care management includes autonomous self-care management behaviors and consultative self-care management behaviors. Self-care self-efficacy includes tasks specific self-care self-efficacy and persistence self-care self-efficacy. It utilizes a 5-point Likert-type scale, and the developer recommends standardized scores for each scale and subscale to a 0–100 scale for easier comparisons. A high score means higher self-care and self-care self-efficacy. A cut-off of 70 points has been utilized to classify self-care maintenance, self-care monitoring, and self-care self-efficacy, 60 points was recommended for self-care management [43]. The content validity index (CVI) for each item and scale reached 100%[35] . The original SCODI demonstrated good internal consistency, supported by adequate internal coherence across the four scales, with high composite reliability coefficients and a global reliability index for multidimensional scales[35]. The Chinese version SCODI also has good structure validity (exploratory factor analysis) and internal consistency (Cronbach's  $\alpha$  for the four dimensions were 0.709-0.908) [36].

### **Statistical analysis**

Descriptive statistics were used to summarize the socio-demographic and clinical characteristics of participants, including frequencies, percentages, median, and interquartile range. The distribution of the three components of self-care and self-care self-efficacy, as assessed by the SCODI, was evaluated using the Kolmogorov–Smirnov test and visual inspection of histograms. Due to the non-normal distribution of the scores for four dimensions of SCODI, boxplots were applied to show the score distributions, including the mean, median, interquartile range (IQR). Correlation analysis was used to examine the relationship between variables using Spearman's rho correlation, and the nonparametric Tests (Mann-Whitey U Test or Kruskal-Wallis H Rank test) were also used. Finally, quantile regression models were used to analyze the median values of the three components of self-care and self-care self-efficacy in relation to socio-demographic and clinical variables. The parameters estimated by the model

represent the change in the median (rather than the mean) for each unit increase in the independent variables. The regression parameters were estimated using the least-absolute-value models, and confidence intervals and p-values were estimated using the bootstrap (400). A p-value of less than 0.05 was considered statistically significant. Analyses were completed in STATA 15.

## Results

Finally, 495 adults with type 2 diabetes were enrolled, with a median age of 62 (55.00, 70.00) years. More than half of them were male (55.4%), 43.2% were older people. The majority of participants were married (77.6%, n=384), Han nationality (95.2%, n=471), were from high economic level city (40.8%, n=202), and had a level of education corresponding to middle school or below (77.3%, n=383). A small proportion of participants were newly diagnosed with type 2 diabetes (6 months to less than 1 year, 12.1%, n=60), while a greater proportion had been living with type 2 diabetes for over 10 years (37.4%, n=185). Approximately half of the participants had a low income (52.3%, n=259), experienced complications (47.9%, n=237), and had received diabetes self-management education in the last year (46.1%, n=228). The socio-demographic and clinical characteristics of the participants, and the scores for self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy, are presented in Table 1.

The relationship between study variables is presented in Table 2. Marital status had no significant relationship with four dimensions of the SCODI and was excluded from the regression analysis.

The median scores for all components of self-care were below their cutoff score (60 or 70 points), self-care maintenance, self-care monitoring, and self-care management were 66.67 (50.00-85.42), 47.06 (32.35-58.82), and 53.13 (34.38-68.75), respectively, while self-care self-efficacy had an adequate median score: 70.45 (52.27-84.09), see Fig 1.

Living in a low economic level city ( $\beta=26.271$ , 95%CI=21.488, 31.053), and having lower self-care self-efficacy ( $\beta=0.486$ , 95%CI=0.404, 0.567) were associated

with lower self-care maintenance. Being female ( $\beta = 2.362$ , 95%CI=0.128, 4.595), belonging to minorities ( $\beta = -6.549$ , 95%CI=-11.721, -1.376), having complications ( $\beta = 3.514$ , 95%CI=1.220, 5.807), not attending diabetes self-management education in the last year ( $\beta = -3.078$ , 95%CI=-5.340, -0.818), living in a low economic level city ( $\beta = 10.026$ , 95%CI=6.472, 13.580) and having lower self-care self-efficacy ( $\beta = 0.507$ , 95%CI=0.446, 0.568) were associated with lower self-care monitoring. Having complications ( $\beta = 4.597$ , 95%CI=1.815, 7.755), using insulin ( $\beta = 3.611$ , 95%CI=0.853, 6.369), not living in a moderate economic level city ( $\beta = 10.681$ , 95%CI=6.370, 14.991) or high economic level city ( $\beta = 4.280$ , 95%CI=1.155, 7.405), and having lower self-care self-efficacy ( $\beta = 0.612$ , 95%CI=0.538, 0.685) were associated with lower level of self-care management. Not living in a moderate economic level city ( $\beta = 28.360$ , 95%CI=23.056, 33.664) or high economic level city ( $\beta = 10.178$ , 95%CI=5.875, 14.481) were associated with lower self-care self-efficacy. Determinants of self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy are shown in Table 3.

## Discussion

This study shed light on the complexity of self-care by investigating the levels of three components of self-care and their critical predictors in Chinese adults with type 2 diabetes. Generally poor self-care in Chinese adults with type 2 diabetes was identified. However, their self-care self-efficacy was relatively adequate and was a critical predictor of self-care. Additionally, gender, nationality, complications, insulin use, participation in diabetes self-care education in the last year, the economic level of city, and self-care self-efficacy were significantly associated with self-care.

The finding of poor self-care level among Chinese adults with type 2 diabetes is in line with previous studies in Zhejiang province [22, 44]. But compared with developed countries, like Italy [45] and Poland [46], a lower self-care level was found in China. The reason may be the high and increasing number of Chinese diabetic cases and the country's limited medical resources [41]. Additionally, participation in self-care

programs in China was lower than in developed countries [27]. The limited ways to obtain adequate knowledge and conduct active self-care practices can lower the level of self-care [47]. Therefore, more effective strategies and medical resources are needed to improve the self-care of Chinese adults with type 2 diabetes.

Specific self-care like self-care monitoring and self-care management among Chinese adults with Type 2 diabetes was relatively suboptimal. Inadequate self-care monitoring can make it hard to immediately detect bodily changes or symptoms; thus, proper self-care management behaviors cannot be performed timely [48]. Additionally, the low levels of self-care monitoring and management also indicate that more attention should be paid to training self-care monitoring and management, which can help patients master correct knowledge and techniques and adopt timely responses to bodily changes [49].

Nearly half of Chinese adults with type 2 diabetes had relatively adequate self-care self-efficacy. However, this level of self-care self-efficacy was still lower than that observed in other countries [45], suggesting that there is still space for improving self-care self-efficacy among Chinese adults with type 2 diabetes. The study also found that lower levels of self-care self-efficacy were associated with poor self-care maintenance, self-care monitoring, and self-care management among Chinese adults with type 2 diabetes. This finding suggests that self-efficacy is critical in each stage of the self-care process as proposed in the Middle-Range Theory of Self-Care of Chronic Illness and this has been confirmed by previous studies [45, 50]. Additionally, previous interventional studies have provided strong evidence regarding the effect of self-care self-efficacy on self-care behaviors through the four sources proposed by Bandura in his Social Learning Theory [51]: mastery experiences, vicarious experience, verbal persuasion, and physiological and emotional feedback[52]. Thus, these four strategies can be applied in future Chinese self-care enhancement interventions to improve self-care levels in diabetes care.

In terms of the determinants of self-care maintenance among Chinese adults with type 2 diabetes. An interesting finding was that participants from cities with a low

economic level had poor self-care monitoring, self-care management, as well as self-care self-efficacy. Most Chinese cross-sectional studies on self-care were single-centered [44, 53, 54] and the area-based or economic differences in self-care among patients with type 2 diabetes were less studied [55]. This study provided evidence of area-based differences for policymakers in Zhejiang province to distribute healthcare resources more equitably and provide more support to less developed areas, which resonated with China's pursuit of common prosperity [56].

Except self-care self-efficacy, being female, minorities, and not attending diabetes self-management education in the last year was associated with lower level of self-care monitoring. For gender, our study found female patients tended to perform few self-care monitoring. This finding was inconsistent with international studies [18, 57] and other Chinese studies [44, 54]. One possible reason may due to the clinical inertia among female, because previous study found the level of glycemic variability was higher in Chinese female patients than in male patients [58]. Women who always experienced unstable glucose may discouraged their monitoring behaviors. The reasons and mechanisms underpinning this different finding need further exploration.

Compared with Han nationality, minorities usually lived in less developed and remote mountainous regions, such as She minorities, one minority of China, mainly live in a low economic level city of Zhejiang province [59]. They have simple lifestyles, mainly are farmers with low incomes, have primary education levels, are less likely to use public health services, and have lower satisfaction with chronic management services [60]. Thus, they had poor self-care monitoring behavior due to financial constraints, limited access to diabetes self-care management education or lower willingness to use healthcare services [60].

Self-care monitoring played bridge role in self-care process, without adequate self-care monitoring, patients with type 2 diabetes cannot detect the changes of symptoms and signs, then they may miss proper timing and actions to handle their diabetes [17]. Self-care monitoring need basic knowledge and skills to perform body listening, and diabetes self-management education was the main methods to acquire the

above knowledge and skills [61]. Without or low participation in diabetes self-management education, participants cannot master adequate knowledge and skills to perform self-care monitoring [27].

Having complications was another influencing factor of self-care monitoring. Participants with complications have lower self-care monitoring and self-care management. Because complications may cause physical and psychological challenges for performing self-care among patients with type 2 diabetes [62], such as neuropathy, vision problems, or kidney issues, can make it physically challenging for individuals to engage in self-care activities like blood glucose monitoring, meal planning, and physical activity [63]. Besides, complications of diabetes were a predictor of diabetes burnout [64]. If patients with type 2 diabetes burnout, they may neglect self-care. Caruso et al also confirmed having the diabetes neuropathy was associated with poor self-care management in males [18]. This finding suggests that healthcare providers should pay more attention to patients who are having complications when providing self-care, and tailored self-care intervention may be needed.

Our study also found insulin use was associated with lower self-care management in Chinese adults with type 2 diabetes. This was inconsistent with previous studies [18, 65]. The possible explanation may be insulin users tend to have a longer course of diabetes and more complications, and are more likely to suffer adverse reactions caused by insulin injections, all these experience will affect their psychological health [66], and indirectly affect their self-care management. So, further studies are needed to clarify the effects of insulin use on self-care.

To the best of our knowledge, this is the first survey that investigated the entire self-care process in Chinese adults with type 2 diabetes. Previous Chinese studies typically considered self-care as static behaviors or activities, overlooking the dynamic changes in self-care. Additionally, a new and theoretically sound instrument was applied to identify both sufficient and poor self-care behaviors and their socio-demographic and clinical determinants [36]. This provides evidence for improving the outcomes of targeted groups and tailored self-care interventions.

However, there are several limitations to this study. Firstly, participants in this study were from one province in China, and convenient sampling method might affect the representativeness of our sample. Although the mean age and distribution of our participants were similar to a previous study in Zhejiang province [44], our findings still should be generalized with caution. Secondly, although the determinants of self-care were selected based on our viewpoint and literature review, this study did not include comorbid conditions as an influencing factor, and only explored having or not having complications. Future studies should explore the detailed complications to confirm the role of complications. Thirdly, a self-reported questionnaire was applied to collect clinical data, such as complications, and the medical records were not checked with the participants' questionnaires. This may lead to overreporting or underreporting. Finally, this is a cross-sectional study, and causal relationships between self-care and its determinants cannot be inferred.

## **Conclusions**

Self-care remains inadequate among Chinese adults with type 2 diabetes. Healthcare providers and policymakers in China should prioritize addressing the self-care needs of adults with type 2 diabetes who are male, younger, belong to minority groups, have complications, or reside in cities with lower economic levels. Increasing participation in diabetes self-management education and enhancing self-care self-efficacy are two potential strategies to improve self-care among this population.

## **Abbreviations**

CI: Confidence interval; DSME: Diabetes Self-Management Education; IDF: International Diabetes Federation; IQR: Interquartile range; SCODI: Self-Care of Diabetes Inventory; SMBG: Self-Monitoring of Blood Glucose; WHO: World Health Organization.

## **Declarations**

### **Ethics approval and consent to participate**

Ethical approval of this study was obtained from the Ethics Committee of Lishui University (No. 2023YR0029). All participants provided signed informed consent. The study was conducted in accordance with the ethical standards of human studies and followed the revised version of the

Declaration of Helsinki.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

Data will be available from the authors on a reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Author contributions**

XL and XJ were responsible for conceptualization, design, and data acquisition. XZ, XD, BY, and HM conducted data acquisition and analysis. XL, XJ, and SL was responsible for drafting the manuscript. SL and BY were responsible for the literature review. XL, SL, and BY made critical revisions to the paper. All authors approved the final version of the manuscript. XL and XJ are the guarantors of this work.

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