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The Effect of Self-Care Management Intervention on Hardiness in Type 2 Diabetes Mellitus Patients

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Abstract: Type 2 diabetes mellitus (T2DM) requires continuous self-care management and has the potential to impact psychological outcomes such as hardiness. This study aims to analyze the effect of self-care management interventions on hardiness in T2DM patients. The design used was a quasi-experimental pretest–posttest with a non-randomized control group at 3 community health centers in Bima City (August–October 2025). A purposive sample of 100 T2DM patients was divided into treatment (n=50) and control (n=50) groups. The intervention was a structured self-care management education program (diet, physical activity, medication adherence, glucose monitoring, foot care, stress management, and problem-solving). Hardiness was measured before and after the intervention and analyzed using the Wilcoxon test. Descriptively, the proportion of "good" hardiness in the treatment group increased from 6% to 80%, while in the control group decreased from 28% to 24%. The Wilcoxon test showed a significant increase in hardiness in the treatment group ($Z=-6.083$; $p<0.001$) and no significant increase in the control group ($Z=-0.632$; $p=0.527$). These findings support the effectiveness of self-care management interventions in improving hardiness in T2DM patients, with the potential for confounding by differences in baseline characteristics between groups (age and duration of DM).

Keywords: DMT2; Hardiness; Quasi-Experiment; Self-Care Management; Wilcoxon.

Introduction

In order to improve health outcomes and lower the risk of complications, type 2 diabetes mellitus (T2DM) is recognized worldwide as a chronic condition that necessitates active patient involvement in self-care management (e.g., diet management, physical activity, glucose monitoring, therapy compliance, and complication prevention) (Ahn & Kim, 2022; Quynh et al., 2024; Zaini et al., 2025). Evidence synthesis suggests that technology-based self-management (mHealth) interventions and coaching programs can enhance self-efficacy as an important determinant of self-management behavior, while providing a more accessible alternative for patients who have limited access to face-to-face care (Yehualashet et al., 2024). In addition, approaches that incorporate aspects of psychological stress regulation (e.g., mindfulness-based stress reduction) are recommended because their mechanistic pathways can reduce stress/anxiety and increase diabetes self-efficacy, ultimately supporting more effective self-management strategies (Wang et al., 2024).

In the national context (Indonesia), the need to strengthen self-care management is also reflected in the development of various educational and digital interventions being tested in primary care and community settings. A quasi-experimental study in a community health center (Puskesmas) in Sleman, Yogyakarta, showed that an Android-based self-care management application can improve self-efficacy and help control fasting blood sugar levels in people with type 2 diabetes mellitus (T2DM) (Hapsari, 2025). In line with this, Diabetes Self-Management Education (DSME) education using online videos at community health centers has been reported to improve self-care and self-efficacy in T2DM patients based on standard instruments (SDSCA and DMSES) (Tisna et al., 2025). Interventions involving family support have also been shown to be relevant in Indonesia, as the family caregiver empowerment model (FCEM) has an impact on the self-efficacy of people with T2DM—illustrating the importance of the social environment in supporting patients' ability to carry out self-management (Rondhianto et al., 2025). In addition to general self-care aspects, a specific focus on preventing complications, such as foot care, is also being developed through digital

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application-based education and training programs that have been proven to improve self-efficacy and foot care behavior in T2DM patients (Feriadianto et al., 2025).

Self-efficacy has been repeatedly found to be a crucial factor linked to self-care behaviors and clinical results in type 2 diabetes. According to a systematic review and meta-analysis, mHealth-based self-management interventions greatly increased self-efficacy, which is thought to promote self-management and improve health outcomes (Ahn & Kim, 2022). Primary studies also reinforced this pattern: DSME reported significantly increased self-care and self-efficacy scores compared to controls (Tanamas et al., 2025), and WhatsApp-based self-management program increased self-efficacy and educational components in a randomized controlled trial (Yaagoob et al., 2024). A cross-sectional study confirmed the association between self-efficacy, self-care practices, and glycemic control in T2DM patients in primary care, thus providing a basis that strengthening patient self-efficacy is related to behavior and clinical indicators (Quynh et al., 2024). Other evidence suggests that self-care management can be mediated by psychosocial factors such as illness perception and social support through self-efficacy, confirming that behavioral interventions do not stand alone but rather exist within a network of psychological and social determinants (Zaini et al., 2025).

Theoretically, a number of frameworks can be used to explain how self-care management strategies affect patient psychological outcomes. According to Orem's Self-Care Theory, self-efficacy and self-care behaviors can have an impact on self-care requirements and the ability of self-care agents. Research on people with type 2 diabetes has demonstrated a connection between health aberrations and self-care, self-efficacy, and self-care demands. This supports the idea that interventions that enhance these elements will help patients better control their condition (Fereidooni et al., 2024). Social Cognitive Theory (SCT) also provides the basis that learning, reinforcement, and self-efficacy contribute to health behavior change; SCT-based educational interventions with home visit follow-up have been shown to improve self-management behavior, glycemic index, and quality of life in T2DM patients (Kaveh et al., 2022). In addition, a theory-based educational approach to foot care has also been reported to increase self-efficacy and adaptation in diabetic patients, indicating that structured interventions not only change specific behaviors but also adaptive capacities (Tolasa & Akyol, 2024).

This study seeks to examine the impact of self-care management treatments on hardiness in T2DM patients. The impact of self-care management interventions on self-efficacy, self-care behavior, glycemic control, quality of life, and adaptation was the main focus of previous studies; however, this study focuses on hardiness as a psychological outcome that has not been a primary focus in the referenced intervention evidence. This is where the study's novelty lies.

Method

Research Design

In order to assess the impact of the self-care management intervention on the degree of hardiness, this study used a quasi-experimental methodology with a pretest–posttest and a non-randomized control group design. At two measurement time points, two groups—the treatment group and the control group—were monitored.From August to October 2025, this study was carried out at three community health facilities under the control of the Bima City Health Department: Paruga, Penana'e, and Mpunda.

Population, Sample, and Sampling Techniques

All type 2 Diabetes Mellitus (DM) patients in the study area who satisfied the predetermined inclusion criteria were the target population, and each type 2 DM patient served as the unit of analysis. The frequency recapitulation in Tables 1 and 2 was used to calculate the sample size, which came out to be 100 respondents total 50 in the treatment group and 50 in the control group. Sampling was carried out using a purposive sampling technique, so that the recruited respondents were individuals who were considered most relevant to answer the research questions. Furthermore, the determination of the treatment and control groups was carried out according to the research design by maintaining a balanced number between groups to support the comparability of the results.

Inclusion and Exclusion Criteria

The inclusion criteria in this study included participants who had been diagnosed with type 2 diabetes mellitus (DM) by a health professional, were in the age range of 35–65 years according to the sample characteristics, were able to communicate using the language used in the intervention and filling out the instruments, were willing to participate by signing an informed consent, and were able to follow the entire series of research procedures completely (pretest–intervention–posttest). The exclusion criteria included participants who had severe cognitive or psychiatric disorders that hindered understanding and filling out the questionnaire, experienced acute complications or were hospitalized during the intervention period that could potentially interfere with exposure to the intervention, and participants who did not complete the intervention session or did not take the posttest measurement, as these conditions could reduce the completeness of the data and threaten the internal validity of the study.

Research Variables and Operational Definitions

The independent variable of the study was a self-care management intervention for patients with type 2 diabetes, operationally defined as a structured educational package encompassing diet management, physical activity, medication adherence, blood glucose monitoring, foot care, stress management, and problem-solving. The implementation method should be stated in accordance with actual implementation (e.g., individual/group face-to-face through module-based counseling), including the number of sessions, duration per session, total intervention duration, qualifications of the facilitator (nurse/diabetes educator), media used (leaflets, pocketbooks, monitoring sheets), and reinforcement strategies (reminders and follow-up). The dependent variable was hardiness (psychological resilience), measured using a scale instrument that produces pre-post scores (Wilcoxon scale analysis) and is then categorized as "poor" vs. "good"; therefore, the method must include the name of the instrument, number of items, scoring range and method, categorization cutoff point, and evidence of validity and reliability (e.g., Cronbach's alpha) in the local population. Potential covariates (age, gender, education, duration of diabetes) should be stated: descriptive only, initial equivalence test, and/or controlled for in further analysis.

Research Intervention

The treatment group received the program*self-care management* designed to improve *hardiness* through strengthening self-management skills (referring to the outcomes in Table 2–3). The program is structured into several structured sessions (e.g., 4–6 sessions), each lasting approximately 60–90 minutes, held weekly for approximately 4–6 weeks; each session includes specific objectives and topics such as understanding the concepts of self-care and hardiness, identifying stressors and resources, problem-solving and decision-making training, *goal setting* and action planning, strengthening *coping* Adaptive interventions, and progress evaluation. The intervention approach combines education, brief counseling, skills training, focused discussions, target setting, and monitoring. Teaching materials include modules/pocket books, worksheets, control cards, and daily logbooks. *Treatment fidelity* monitored through attendance lists, *checklist* session implementation, and facilitator supervision. The control group did not receive the program and only received standard care according to local service procedures (including routine education that is usually provided), which should be operationally defined in the methods.

Data Collection Procedures

The data collection procedure followed a pre-posttest (pretest-posttest) research flow with treatment and control groups as follows: researchers recruited and screened type 2 DM patients according to inclusion-exclusion criteria, then obtained informed consent. At the baseline (pretest) stage, respondents completed a hardiness instrument and recorded demographic/clinical characteristics (age, gender, education, and duration of DM). Next, the intervention was implemented, namely the treatment group received a self-care management program, while the control group received no intervention or only standard care. After the intervention period, a final measurement (posttest) was conducted using the same hardiness instrument to ensure measurement consistency. Data management included checking the completeness of the questionnaire, coding, entry, and data cleaning; quality control was carried out through training of enumerators, pilot testing of the instrument when implemented, procedures for handling missing data, and verification of entries.

Research Instruments

There are two parts to the research tool. First, the Respondent Characteristics Sheet is created using the subject profile as a guide. It includes information on age (35–50 years and 51–65 years), gender, last educational attainment (no school, elementary school, junior high school, high school, or university), and the duration of diabetes mellitus (DM), which is divided into <5 years and >5 years. Second, the Hardiness Instrument, where hardiness is assessed using a score that is then analyzed in pairs to see changes or differences in scores in related measurements, then the scoring results are classified into two interpretative categories, namely "poor" and "good", to facilitate the drawing of descriptive and analytical conclusions according to the research design.

Data analysis

Descriptive analysis was conducted to describe the characteristics of respondents in the treatment and control groups in the form of frequency distributions and percentages. Furthermore, the hardiness categories in the pre- and post-measurements for each group were presented as frequencies and percentages, allowing for a concise and comparative analysis of changes in category composition before and after the intervention between groups.

Inferential analysis to examine pre-post changes in each group was performed using the Wilcoxon Signed Rank Test. This nonparametric test was chosen based on the assumption that hardiness scores were at least ordinal and/or did not meet the assumption of normality, and that measurements were conducted in pairs on the same individuals (pre and post). The Wilcoxon test was run separately for the treatment group (hardinesspost vs. hardinesspre) and the control group (hardinesspost vs. hardinesspre). Results are

reported with Z-values and p-values, along with ranking information (mean rank and sum of ranks) and the number of positive ranks, negative ranks, and ties to interpret the direction and consistency of change.

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Result and Discussion

Table 1 describes the characteristics of respondents in the two groups (treatment and control) with a total of 100 participants. In terms of age, the majority of the treatment group were in the 35–50 years range (40/50; 80%), while the control group was predominantly aged 51–65 years (30/50; 60%). The gender distribution was relatively balanced, but women were more numerous in both groups (treatment 28/50; 56% and control 30/50; 60%). The highest education level was high school (treatment 18/50; 36% and control 23/50; 46%), followed by college (treatment 16/50; 32% and control 15/50; 30%); the proportion of those who had not attended school was very small (total 5%). The duration of diabetes was predominantly >5 years (treatment 36/50; 72% and control 29/50; 58%).

Based on Table 2, the self-care management intervention appears to have a positive effect on hardiness in type 2 DM patients. In the treatment group (n=50), the proportion of "good" hardiness increased sharply from 6% (3 people) at pre- to 80% (40 people) at post-, accompanied by a decrease in the "poor" category from 94% (47 people) to 20% (10 people). In contrast, in the control group (n=50) no improvement was seen; the "good" category actually decreased from 28% (14 people) to 24% (12 people), while the "poor" category increased from 72% (36 people) to 76% (38 people). This contrasting pattern of change indicates that the increase in hardiness occurred more consistently in the group receiving the intervention than in the control, thus descriptively supporting the effectiveness of self-care management in strengthening hardiness in type 2 DM patients.

Table 1. Respondent characteristics

Characteristics	category	Group		Amount
		Treatment	Control	
Age	35-50 years	40	20	60
	51-65 years	10	30	40
Gender	Man	22	20	42
	Woman	28	30	58
Education	No school	3	2	5
	Elementary School	7	5	12
	Junior High School	6	5	11
	Senior High School	18	23	41
	College	16	15	31
Long-term DM Suffering	< 5 Years	14	21	35
	> 5 years	36	29	65

Table 2. Self-care management towards hardiness in type 2 DM patients

Parameters		Treatment		Control	
		N	%	N	%
Pre	Poor	47	94	36	72
	Good	3	6	14	28
Post	Poor	10	20	38	76
	Good	40	80	12	24

Table 3 shows that in the treatment group (self-care management intervention) there was a significant increase in hardiness from pre to post intervention, indicated by the dominance of*positive ranks*(n=37;*sum of ranks*=703) without*negative ranks*(n=0) and Z value = −6.083 with p=0.000. This pattern indicates that the post-intervention hardiness scores were consistently higher than before the intervention, while*ties*(n=13) reflects that some respondents did not experience any change. In contrast, in the comparison/control group, the change in hardiness was not significant (Z=−0.632; p=0.527), with*ties*very large (n=40) and only small changes upward (n=4) or downward (n=6). Overall, these findings support the effectiveness of self-care management interventions in improving hardiness in patients with type 2 diabetes.

Table 3. Analysis of self-care management of hardiness in type 2 DM patients

		N	Mean Rank	P Value	Z	Sum of Ranks
Hardinees_Post_Treatment	Negative	0	0.00	0.000	-6.083	0.00
Hardinees_Pre_Treatment	Positive	37	19.00			703.00
	Ties	13				
Hardinees_Post_Treatment	Negative	6	1.00	0.527a	-0.632	1.00
Hardinees_Pre_Treatment	Positive	4	0.00			0.00
	Ties	40				

The data in Table 1 shows a total of 100 participants evenly divided between the treatment and control groups (n=50 each). Descriptively, the treatment group was predominantly aged 35–50 years (80%), while the control group was predominantly aged 51–65 years (60%). In the context of type 2 diabetes as a chronic condition that requires active patient engagement in self-care behaviors (e.g., diet, physical activity, glucose monitoring, medication adherence, problem-solving, and resilient coping skills), this difference in age profile is important because the need for educational support and reinforcement of self-care behaviors can vary according to patient characteristics (Asmat et al., 2022; Gosak et al., 2022; Pettersson, 2024). The literature also emphasizes that patient education and self-management interventions are essential prerequisites for adequate self-care, and are the "cornerstone" in the management of type 2 diabetes and have been repeatedly shown to improve clinical indicators and self-care behaviors in various intervention designs, including structured and technology-based education (Esferjani et al., 2022; Fadli et al., 2024; TERKEŞ et al., 2024) (Esferjani, Naghizadeh, Albokordi, Zakerkish, & Araban, 2022; Fadli et al., 2024; TERKEŞ, Bektaş, & Balcı, 2024).

The gender distribution in both groups was relatively balanced, with a slightly higher proportion of women (56% in the treatment group; 60% in the control group). While these data do not directly explain differences in response to interventions, consistent evidence suggests that successful management of type 2 diabetes requires strategies that facilitate adherence and self-care behaviors across demographic characteristics through education, structured follow-up, and a patient-centered approach (AlHaqwi et al., 2023; Almotairy et al., 2024). In terms of education, the majority of respondents had a high school education (treatment 36%; control 46%) and college education (treatment 32%; control 30%), with a very small proportion of those who had no education (5%). This finding is relevant because increased self-care capacity is often mediated by cognitive and psychosocial factors such as health literacy, disease knowledge, and self-efficacy—which have been reported to play an important role in predicting self-care behavior and glycemic control (Babazadeh et al., 2023), and can be improved through health literacy promotion programs and diabetes education (Golboni et al., 2024; Pao et al., 2025). In addition, the majority of respondents had suffered from DM for >5 years (treatment 72%; control 58%), which illustrates the long-term burden of chronic disease and reinforces the urgency of ongoing self-management interventions to prevent complications through preventive behavior and self-care (Pettersson, 2024; Ranjbaran et al., 2022).

Table 2 shows contrasting patterns of hardiness changes between the treatment and control groups. In the treatment group, the proportion of "good" hardiness increased from 6% (pre) to 80% (post), with the "poor" category decreasing from 94% to 20%. In contrast, the control group showed no improvement; the "good" category decreased from 28% to 24% and the "poor" category increased from 72% to 76%. Conceptually, these results align with the framework that interventions targeting self-care can strengthen coping and disease management—where "resilient coping skills" is one of the recommended domains of self-care behavior in diabetes management (Asmat et al., 2022). Thus, the increase in hardiness in the treatment group is consistent with the expected direction of effects of self-management programs, as self-management interventions have been repeatedly reported to improve self-care behaviors, self-efficacy, and related outcomes (including quality of life and glycemic control) (AlHaqwi et al., 2023; Fadli et al., 2024; Golboni et al., 2024).

Furthermore, various self-care education/support approaches (e.g. web-based education, social media-based microlearning, telenursing, and mobile interventions) have been reported to improve knowledge, self-efficacy, and self-care practices in type 2 DM patients (Esferjani et al., 2022; Rahbar et al., 2024; TERKEŞ et al., 2024). Although the primary variable in these studies was not "hardiness," the consistent direction of benefit across behavioral and psychosocial domains (self-efficacy, adherence, self-management skills) provides a coherent basis for interpreting that self-care management interventions can impact patients' resilience/coping capacity in the face of chronic illness (Babazadeh et al., 2023; Fadli et al., 2024; Pettersson, 2024).

Table 3 reinforces the descriptive findings with the Wilcoxon Signed Rank test. In the treatment group, there was a predominance of positive ranks (n=37; sum of ranks=703) with no negative ranks (n=0), with a Z value of -6.083 and p=0.000, indicating a consistently higher increase in hardiness post-intervention compared to pre-intervention. This finding is consistent with extensive evidence that educational interventions and self-management support can produce significant changes in patient behavior and outcomes, including improvements in self-care and related indicators (e.g., knowledge, self-efficacy, adherence), which are often the proximal mechanisms of improved patient adaptation to the demands of chronic illness (Almotairy et al., 2024; Fadli et al., 2024; Golboni et al., 2024). In addition, the literature confirms that type 2 DM requires active patient participation in self-care behaviors (diet, medication, and daily management routines) to improve disease control; therefore, effective programs generally target both behavioral aspects and the

patient's psychosocial capacity to maintain these behaviors (Asmat et al., 2022; Babazadeh et al., 2023).

In contrast, in the control group, the change was not significant (Z=−0.632; p=0.527) with very large ties (n=40), and few respondents experienced an increase (n=4) or decrease (n=6). Interpretatively, this pattern is consistent with the argument that without intervention, adherence/motivation to self-care may decline or return to average practices over time; even pre-test scores may reflect temporary improvements that then regress in the absence of educational reinforcement or ongoing support (Rahbar et al., 2024). In other words, the stagnant/declining control results are descriptively consistent with the literature emphasizing the importance of structured educational and follow-up programs to maintain self-care behaviors and health outcomes (Akbari-Nassaji et al., 2023; AlHaqwi et al., 2023; Golboni et al., 2024).

Although the given dataset does not include mediators (e.g., self-efficacy or adherence), the literature provides a reasonable framework for interpreting changes in hardiness as a psychological outcome related to increased self-management capacity. First, self-efficacy plays a critical role in improving self-care and preventing complications; higher levels of self-efficacy correlate with better levels of self-care (Babazadeh et al., 2023). Self-management interventions (including family-oriented ones) have been reported to increase self-efficacy and self-management and lower HbA1c, which in turn may contribute to feelings of disease management and strengthen patients' psychological adaptation (Fadli et al., 2024). Health literacy promotion programs have also been shown to increase self-care behaviors compared to controls (Golboni et al., 2024), and multidisciplinary interventions (e.g., pharmacist-led) can improve health literacy and medication adherence (Pao et al., 2025). components that can theoretically support patient resilience in facing chronic disease stressors (hardiness) by increasing the sense of control and self-management competency (Babazadeh et al., 2023; Pettersson, 2024).

Second, the characteristics of educational interventions (e.g., web-based or mobile education) were consistently associated with increased self-care practices and disease knowledge (Esferjani et al., 2022; TERKEŞ et al., 2024). In the AADE framework cited in a systematic review of patient-centered care, self-care behaviors include problem-solving skills and "resilient coping skills" (Asmat et al., 2022). Therefore, if the self-care management intervention in this study included education, skills training, and/or monitoring support, then the increase in hardiness seen in the treatment group can be understood as a manifestation of increased resilient coping capacity, which is part of self-care competency (Asmat et al., 2022), which also often increases with increasing knowledge and self-efficacy (Babazadeh et al., 2023). In addition, telenursing and various forms of self-management education have been reported to improve self-care behavior and quality of life (Akbari-Nassaji et al., 2023).

The pattern of results (Tables 2 and 3) provides empirical support that self-care management interventions have strong potential to improve hardiness in patients with type 2 diabetes. This is in line with evidence that self-care education/mentoring interventions can improve diabetes control and cardiometabolic risk factors (e.g., HbA1c, FBS, lipids) in family practice settings and structured education programs (AlHaqwi et al., 2023; Almotairy et al., 2024), and improve self-care behaviors through health literacy programs and technology-based education (Golboni et al., 2024).

Although results in the treatment group showed very strong improvements, the broader literature also notes that the effects of self-management interventions can vary across populations and outcomes. For example, a meta-analysis in young adults (18–45 years) reported that some studies found no significant improvements in behavioral outcomes, highlighting the heterogeneity of intervention effectiveness and the importance of matching the design to the target population's characteristics (Khavere et al., 2025). In addition, several telephone counseling interventions in type 2 DM have shown a decrease in HbA1c in both groups without posttest differences between groups, indicating that the context, intensity, and components of the intervention may influence the results (Çelik et al., 2024).

Conclusion

Increased toughness in individuals with type 2 diabetes was associated with the intervention self-care management. The hardiness category clearly changed from "poor" (94% pre) to "good" (80% post) in the treatment group, but the control group showed no improvement and tended to stagnate or decline (from 28% to 24%). The Wilcoxon test was used to inferentially confirm this finding: the treatment group showed a significant increase ($Z = -6.083$; $p<0.001$) with a predominance of positive ranks and no negative ranks, whereas the control group showed a non-significant change ($Z = -0.632$; $p=0.527$) with tieslarge. Thus, the data supports the effectiveness of the intervention *self-care management* in strengthening hardiness, although differences in baseline characteristics (especially age distribution and duration of DM) need to be considered as potential confounding factors in interpretation.

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Author Contributions

Conceptualization, K.U.R. and SKM; methodology, KUR., SKM., SS., SPRD.,; formal analysis, KUR., SKM., SS., SPRD.; investigation, KUR., SKM., SS., SPRD; resources, KUR., SKM., SS., SPRD.; writing—preparation of original draft, KUR., SKM., SS., SPRD.; writing—reviewing and editing, KUR., SKM., SS., SPRD,; supervision, KUR., SKM., SS., SPRD.; project administration, KUR., SKM., SS., SPRD; obtaining funding, KUR., SKM., SS., SPRD. All authors have read and approved the published version of the manuscript

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