

RESEARCH ARTICLE

Patient activation among patients with type 2 diabetes and its association with perception of care, perceived autonomy support, sociodemographic and clinical characteristics

Muzlifa Mohamed Yusoff^{1,2}, Syahnaz Mohd Hashim^{1,3*}, Norfazilah Ahmad^{3,4}

1 Department of Family Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia, **2** Kepala Batas Health Clinic, Ministry of Health, Penang, Malaysia, **3** Department of Public Health Medicine, Faculty of Medicine, Universiti, Kebangsaan Malaysia, Kuala Lumpur, Malaysia, **4** Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

* syahnaz@ukm.edu.my



Abstract

Background

Patient activation is an important aspect of self-management in type 2 diabetes (T2DM) and a key component of the Chronic Care Model, whereby patients should play an active role in their care. Past studies have yet to prove the exact factors influencing patient activation. Limited studies have examined patients' perceptions of care and whether healthcare providers are autonomy-supportive. This study primarily focused on determining factors associated with patient activation, including *sociodemographic and clinical characteristics, perception of care, and perceived autonomy support*.

Methods

A cross-sectional study was conducted among T2DM patients at the public primary care clinic, Kepala Batas Health Clinic, Penang, the northern part of Malaysia, between 2nd December 2024 and 30th April 2025. Participants were sampled through a systematic sampling method and were given a self-administered questionnaire, comprising sociodemographic and clinical characteristics, Patient Activation Measure, Patient Assessment of Chronic Illness Care and Health Care Climate Questionnaire.

Results

A total of 450 patients participated, with a response rate of 85.3%. Many were Malay (92.9%), had lower income (99.0%), attained a secondary level of education (62.0%) and were on oral hypoglycaemic agents only (OHA) (66.0%). The mean patient activation score was 59.54 (SD 14.58), and 66.7% were at a high level of activation. Multiple linear regression revealed that factors significantly associated with patient

OPEN ACCESS

Citation: Yusoff MM, Mohd Hashim S, Ahmad N (2026) Patient activation among patients with type 2 diabetes and its association with perception of care, perceived autonomy support, sociodemographic and clinical characteristics. PLoS One 21(5): e0348840. <https://doi.org/10.1371/journal.pone.0348840>

Editor: Yee Gary Ang, National Healthcare Group, SINGAPORE

Received: November 12, 2025

Accepted: April 21, 2026

Published: May 11, 2026

Copyright: © 2026 Yusoff et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data availability statement: The data in the current study are submitted together in the revised manuscript.

Funding: The author(s) received no specific funding for this work.

Competing interests: The authors have declared no competing interests.

activation were male ($\beta = 1.984$, [95% CI 0.629, 3.339], $p = 0.004$), age ($\beta = -0.089$ [95% CI: -0.161 , -0.017], $p = 0.015$), HbA1c ($\beta = -6.661$ [95% CI: -7.022 , -6.300], $p < 0.001$) and on OHA only ($\beta = -1.460$ [95% CI: -2.902 , -0.019], $p = 0.047$).

Conclusions

Patients tend to have lower activation when they are older, have higher HbA1c, and are on oral hypoglycaemic agents only. However, male patients exhibit higher activation. Interventions should focus on providing targeted, tailored support to those at risk of lower activation, to enhance their engagement in diabetes self-management and improve health outcomes.

Introduction

Type 2 Diabetes Mellitus (T2DM) is among the top ten major causes of morbidities and mortalities all over the world [1]. The rising number of T2DM cases globally has substantially strained the healthcare system [2,3]. In 2020, 445 million cases were reported and it is likely to increase to 730 million by 2050 [4]. The prevalence of diabetes in South Asia has increased from 11.29% in 2000–2004 to 22.30% in 2020–2024 [5], and in Southeast Asia, it is expected that 10.8% of adults, or one in ten, will have diabetes by 2050 [6]. Malaysia is following a similar trend, with 11.2% of adults affected in 2011 and 15.6% in 2023 [7]. Among Malaysian states, Penang has a significant number of adults with T2DM, with 106,402 individuals affected [7]. Despite extensive efforts by healthcare providers, only 34.38% of patients achieve good glycaemic control [8].

For many decades, there has been a call for a more efficient healthcare system to improve outcomes for chronic conditions, such as diabetes. Various models of care have been proposed and the most prominent is the CCM [9,10]. CCM identifies the vital components of a healthcare system that help to improve the outcomes of chronic illnesses [9,10], including Patient Activation, Goal setting, Problem-solving/Contextual Counselling, Delivery System Design/Decision Support, and Follow-up/Coordination [9,10]. A crucial component of CCM is patient activation, in which patients act as effective health managers, and to fulfil this role, they need knowledge, skills, and confidence [11,12]. The ability of patients to become health managers, i.e., 'patient activation' is assessed through a scale, the Patient Activation Measure (PAM) [11]. The total score of this scale can be computed and further categorised into four activation levels (levels 1–4) [11]. According to Hibbard et al. (2004), levels 1 and 2 are considered low activation, as individuals in these levels have inadequate knowledge and confidence to manage their illness. When patients reach level 3, they begin to self-manage, and at level 4, they can maintain self-management. Levels 3 and 4 are considered high activation, meaning patients are competent to become their own health managers [11]. A body of evidence showed that when patients are highly activated, their clinical outcomes, including glycaemic, lipid, and blood pressure control, improve [13–15]. This can enhance patients' quality of life, reduce hospitalisation and healthcare costs [15].

Past research across various populations found that more than half of patients with T2DM are at a high level of activation, with a mean patient score of 54–58 [16–20]. Similar research has not yet been conducted in the local setting, as the concept of patient activation has not been widely investigated in Malaysia. Nevertheless, a local study among patients with metabolic syndrome found that the mean patient activation score was 58.9, and most were at a high activation level [21]. Previous studies have also highlighted that factors associated with patient activation include younger age [22,23], higher education level [24,25], adequate literacy skills [26,27], employment [21,24,28], and less financial distress [24,29,30]. Apart from these, having good knowledge [24,31], positive coping [32,33], depression [34], and good glycaemic control [15,25] are also significant factors. However, the outcomes of the quantitative studies showed that Nagelkerke R^2 , a measure of variance (16% to 27%), was not large [17,34], suggesting that other factors remain unexplored.

It is possible that factors contributing to patient activation may not be solely based on patients' characteristics but also on the care they receive and the attitudes of healthcare providers [35]. This view has long been expressed through the Chronic Care Model (CCM), which emphasises that patient-centred care should be established at every level of primary care, with an effective delivery system, well-organised care, and a focus on self-management and decision support [9,10]. The CCM was then examined through research, and the evidence is sufficient to demonstrate that high-quality care and positive attitudes among healthcare providers influence patients' engagement and ability to manage their health [28,36]. In assessing patient's perception of care, the Patient Assessment of Chronic Illness Care (PACIC) scale has been widely utilised [37,38], including for diabetes care [39].

Besides the quality of care, promoting patients' autonomy has been shown to motivate them to engage in diabetes care [36,40,41]. Perceived autonomy support is vital in healthcare, as it promotes adherence to diabetes self-management [41–43]. This concurs with Self-Determination Theory, which posits that perceived autonomy is a fundamental element that motivates people to act [44]. The theory explains that people can thrive when they believe those in positions of authority, such as healthcare providers, allow them to make decisions about matters that are important to them, i.e., when those in authority are autonomy-supportive [44]. The concept of perceived autonomy is measured using the Health Care Climate Questionnaire (HCCQ) [40].

To date, there appears to be limited research examining the perception of care and perceived autonomy support as factors contributing to patient activation. Furthermore, efforts to assess patient activation among patients with T2DM in the local setting remain limited. Therefore, the general objective of this study was to determine the factors associated with patient activation among patients with T2DM, including *sociodemographic* and *clinical characteristics*, *perceptions of care*, and *perceived autonomy support*. Our secondary objective was to assess the proportions of patients with high and low levels of activation, and the mean scores for perception of care and perceived autonomy support. As Malaysia is currently experiencing a surge in T2DM cases, we hope this research will contribute to efforts to identify the most effective strategies to facilitate patient activation in diabetes self-management. Before developing an intervention, information is needed to identify potential factors, particularly from patients' perspectives on their care and healthcare providers' attitudes. This information is crucial, as high-quality, patient-centred diabetes care can only be delivered by a well-trained, efficient healthcare team.

Methods

Study design, setting and population

This cross-sectional study was conducted at Kepala Batas Health Clinic, a public primary care clinic, in the northern state of Peninsular Malaysia, Penang, from 2nd December 2024–30th April 2025. The inclusion criteria for this study were (i) patients with T2DM aged 18–70 years, (ii) able to read and write in Malay or English, (iii) diagnosed with T2DM for more than a year [36]. The criteria for having T2DM for more than a year were consistent with the finding that patient activation improved at one-year follow-up, when patients had sufficient time to engage with their healthcare providers [36]. The exclusion criteria were participants who had (i) an emergency condition during the visit to the clinic, (ii) cognitive or visual impairment, (iii) psychiatric illness, and (iv) physical impairment.

The sample size was calculated based on each study's objectives. The largest sample size obtained was 357, based on the single mean formula using Z-score of 1.96 with 95% confidence interval, a margin of error of 5% [45], and a standard deviation of 0.54 for the perception of care from a previous study [46]. Considering a 20% non-response rate, 448 samples were required for this study.

Data collection

Approval to conduct the study was obtained from the Medical and Research Ethics Committee, Faculty of Medicine UKM, Universiti Kebangsaan Malaysia (FF-2024–330) and the Ministry of Health Malaysia (NMRR ID-24–01860-YRL (IIR). Permission to perform the study was also obtained from the Penang State Health Department, the Seberang Perai Utara District Health Office, and the Family Medicine Specialist in charge.

A systematic sampling method was employed to recruit the participants. Patients with T2DM registered at the clinic's Non-Communicable Disease Unit were identified and numbered. The principal researcher would approach every second patient and screen them for eligibility criteria. When the participants fulfilled the criteria, they were invited to participate in the study. Participants were given an information sheet, and, once they agreed to participate, they were required to sign a written consent form. Confidentiality was maintained by not including the participant's identity. All data was entered into a password-protected computer, with the access data document restricted to the primary investigator. A self-administered questionnaire was then distributed.

Study instrument and variables

The study used a self-administered questionnaire in both Malay and English, consisting of **five** sections: A to E. **Section A** assessed sociodemographic characteristics (*age, gender, ethnicity, marital status, educational level, employment status, and monthly household income*). **Section B** measured clinical characteristics (*duration of T2DM, current treatment, presence of comorbidities, number of visits to doctors per year for diabetes treatment, and recent HbA1c*). Of note, the HbA1c result was obtained from the medical records.

Section C measured patients' perceptions of care received over the past six months using the short version of the PACIC scale [38]. The brief version of this questionnaire consists of 11 items, whereby the patients were required to rate each item on an 11-point scale: *none (score of 0%) to always (score of 100%)*. The overall score ranged from 0 to 1100, with higher scores reflecting a better perception of care received over the past six months. The PACIC scoring method was based on the original author's work [38]. Each participant's average score should be obtained by adding all responses and dividing by 11, since there are 11 items in the PACIC scale. The total average score is then computed to yield the PACIC mean score [38].

Section D measured the extent to which doctors have been autonomy-supportive over the last six months using the short version of the HCCQ scale [47]. The brief version of this scale consists of six items, with options on a seven-point Likert Scale: *1 (not at all true) to 7 (very true)*. The overall score ranged from 6 to 42, with higher scores reflecting a greater autonomy support over the past six months. According to the original author, each participant's average score should be calculated by summing all responses and dividing by six, since the HCCQ has six items [47]. The total average score is then computed to yield the mean HCCQ score [47,48].

Section E measured patient activation using the PAM scale. The scale consists of 13 items, with options on a 4-point Likert Scale: *1 (strongly disagree) to 4 (strongly agree)* [49]. The overall scores were calculated using a 0-to-100-point algorithm scale [50]. Levels 1 and 2 signified a low level of activation, whereas Levels 3 and 4 signified a high level of activation. The validated PAM-13 questionnaire is available in English [50] and Malay [51]. Permission had been obtained to use both versions.

The **independent** variables of this study are i) sociodemographic characteristics, ii) clinical characteristics, iii) mean score of perception of care measured by the PACIC scale and iv) mean score of perceived autonomy support measured by the HCCQ scale. The **dependent** variable is the patient activation score using the PAM scale.

Translation and validation of PACIC and HCCQ scales

The PACIC and HCCQ scales were originally developed in English and need to be translated into Malay. The translation and validation process begins with a panel of experts (*a family medicine specialist and a public health medicine specialist*) reviewing the original scale to assess its content for the local context. Next, two linguistic experts translated the English version into Malay, producing two translated Malay versions, which were then harmonised. The harmonised Malay version was subsequently translated into English by two other linguistic experts. The translated English version was then compared with the original one. The panel of experts reviewed each step of the forward and backward translations and agreed that the harmonised Malay version has a meaning similar to that of the original English. Permission was obtained from the original authors for the English version of the questionnaires and the translation of the Malay version.

Before the actual data collection, face validity was assessed in five patients with T2DM for both the English and Malay versions of the PACIC and HCCQ scales. All five patients provided feedback that both versions were well understood. Subsequently, a pilot study involving 60 T2DM patients was performed. Thirty patients completed the Malay version, while another 30 completed the English version of both the PACIC and HCCQ scales. Construct validity for the PACIC and HCCQ was assessed using independent t-test ($t = -1.95$, $df = 58$, p value = 0.056 and $t = -1.54$, $df = 58$, p value = 0.130), respectively. The reliability of both versions was determined using Cronbach's alpha, a measure of internal consistency for both the PACIC and HCCQ scales. For the PACIC scale, the Cronbach's alpha is 0.77 for Malay and 0.811 for English. For the HCCQ scale, the Cronbach's alpha is 0.80 for Malay, and 0.87 for the English version. These results showed that both versions of the PACIC and HCCQ scales have good internal consistency.

Statistical analysis

All data collected were analysed using the IBM SPSS software version 27. Categorical data were described as frequency (n) and percentage (%). Numerical data were described as the mean with standard deviation (SD) or the median with interquartile range (IQR). Statistical significance was set at $p < 0.05$. Simple linear regression was performed first to examine the association between patient activation and each of the independent variables (*age, gender, ethnicity, marital status, education level, employment status, monthly income, duration of diabetes, type of treatment, HbA1c, comorbidity status, number of visits, PACIC and HCCQ*). Multiple linear regression was then performed, including all independent variables. Backward, forward, and stepwise methods were employed to obtain the best model. The model was reasonably well. There were no interactions among the independent variables. No multicollinearity was detected and variance inflation factors are below 10. Model assumptions were fulfilled.

Results

Sociodemographic and clinical characteristics

A total of 533 T2DM patients were invited to participate, of whom 455 agreed. Hence, the response rate was 85.3%. Five incomplete questionnaires needed to be excluded. Thus, only 450 questionnaires were included in the analysis. [Fig 1](#) details the study flow chart. [Table 1](#) shows that the participants' mean age was 53.84 years (SD 9.37). The majority were Malay (92.9%), married (91.0%), and had a low monthly income (99.0%). More than half were female (57.8%), had attained up to secondary education (62.0%), and were unemployed (58.7%). Many had other comorbidities (90.0%) and 66.0% took oral hypoglycaemic agents (OHA) only. The mean duration of diabetes was 7.57 years (SD 5.53), with an average of 3.50 (SD 1.45) clinic visits for diabetes. The mean HbA1c was 8.15% (SD 1.90).

Patient activation and level

The mean score of patient activation is 59.54 (SD 14.58). Out of 450 patients, 300 (66.7%) were at high activation level, Level 3 and 4, as demonstrated in [Table 2](#).

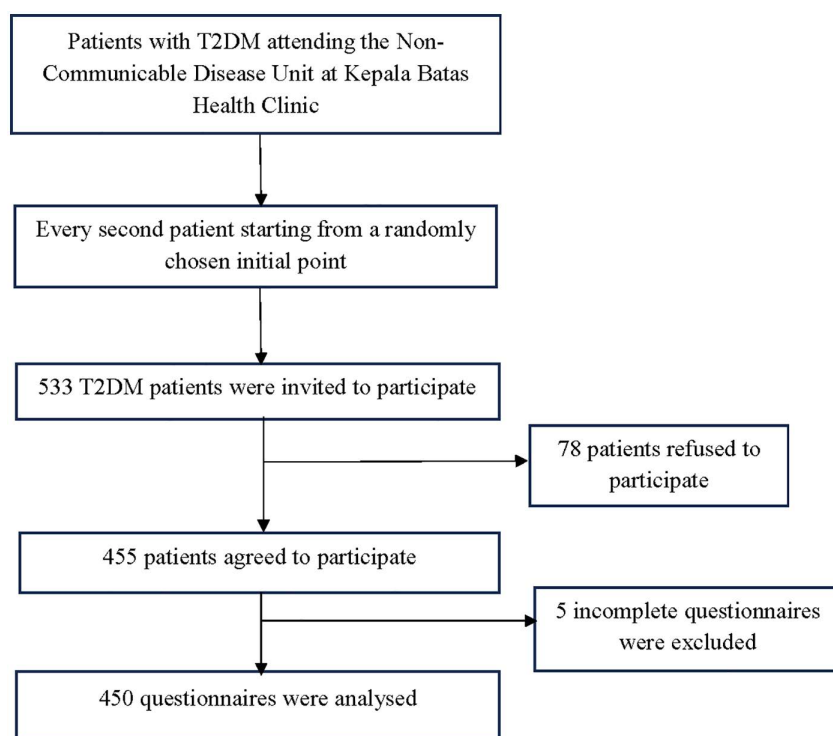


Fig 1. The study flow chart.

<https://doi.org/10.1371/journal.pone.0348840.g001>

Perception of care and perceived autonomy support

The mean scores for perception of care and perceived autonomy support were 65.23 (SD 14.89) and 5.54 (SD 0.98), respectively, as displayed in [Table 2](#).

Factors associated with patient activation

[Table 3](#) presents the preliminary factors significantly associated with patient activation, including male, Malay, tertiary education, duration of diabetes, use of OHA (oral hypoglycaemic agents) only, use of both OHA and insulin, HbA1c, absence of comorbidity, number of clinic visits, perception of care, and perceived autonomy support.

[Table 4](#) presents the final four factors that were significantly associated with patient activation. Older patients have a lower patient activation, of 0.089 [(95% CI −0.161, −0.017), $p=0.015$], while males exhibit a higher patient activation [$\beta=1.984$ (95% CI 0.629, 3.339), $p=0.004$] compared to females. Those with higher HbA1c have a lower patient activation score, of 6.661 [(95% CI −7.022, −6.300), $p<0.001$]. Similarly, patients on OHA only had a lower patient activation [$\beta=1.460$ (95% CI −2.902, −0.019), $p=0.047$] compared to those on lifestyle modification. The model explains 75.9% of the variance of the mean patient activation in patients with T2DM (adjusted $R^2=0.759$).

Discussion

Patient activation score and level

The current study is among the initial local efforts to assess patient activation among patients with T2DM and provides insight into factors contributing to it at a primary care setting. Our results demonstrated a mean patient activation score of 59.54, consistent with another local study reporting a score of 59.4 [21]. The figure is also close to other Asian studies

Table 1. Sociodemographic and clinical characteristics (N=450).

Characteristics		n	%	Mean (SD)
Age (years)				53.84 (9.37)
Age (categories)	18-29	5	1.1	
	30-44	69	15.3	
	45-59	233	51.8	
	60-70	143	31.8	
Gender	Male	190	42.2	
	Female	260	57.8	
Ethnicity	Malay	418	92.9	
	Chinese	8	1.8	
	Indian	24	5.3	
Marital status	Single	15	3.3	
	Married	410	91.0	
	Divorced/Widow	25	5.6	
Education level ¹	Primary	34	7.6	
	Secondary	280	62.0	
	Tertiary	136	30.2	
Employment status	Unemployed	264	58.7	
	Employed	186	41.3	
Monthly income (MYR) ²	Low	445	99.0	
	High	5	1.1	
Duration of DM (years)				7.57 (5.53)
Type of treatment	Lifestyle	16	3.6	
	OHA ³ only	298	66.0	
	OHA ³ + Insulin	136	30.2	
HbA1c (%)				8.15 (1.90)
Comorbidity status ⁴	No	45	10.0	
	Yes	405	90.0	
No. of visits				3.50 (1.45)

¹Primary: no formal education & primary school, Secondary: secondary school, Tertiary: diploma, college, matriculation, degree, masters, PhD. ²Low: those with monthly income of <RM5,250, High: those with monthly income of ≥ RM5,250, Based on Department of Statistics Malaysia 2025. ³OHA: oral hypoglycaemic agents. ⁴Comorbidity status: having other chronic illnesses besides diabetes.

<https://doi.org/10.1371/journal.pone.0348840.t001>

Table 2. Patient Activation, Perception of Care and Perceived Autonomy Support.

Variables	n	%	Mean (SD)
Patient Activation (PAM score)			59.54 (14.58)
Low Patient Activation level (1&2)	150	33.3	
High Patient Activation level (3&4)	300	66.7	
Perception of care (PACIC score)			65.23 (14.89)
Perceived autonomy support (HCCQ score)			5.54 (0.98)

<https://doi.org/10.1371/journal.pone.0348840.t002>

Table 3. Preliminary Factors Associated with Patient Activation.

Factors		Simple Linear Regression			
		β	95% CI	t	p-value
Age (years)		-0.006	-0.151, 0.138	-0.088	0.930
Gender	Female (reference)				
	Male	3.615	0.899, 6.331	2.615	0.009*
Ethnicity ¹	Non-Malay (reference)				
	Malay	7.949	2.742, 13.157	3.000	0.003*
Marital status ²	Single/ Divorced/Widow (reference)				
	Married	-3.484	-8.223, 1.255	-1.445	0.149
Education level	Primary (reference)				
	Secondary	-1.789	-4.572, 0.995	-1.263	0.207
	Tertiary	4.633	1.721, 7.545	3.127	0.002*
Employment status	Unemployed (reference)				
	Employed	2.141	-0.597, 4.879	1.537	0.125
Monthly income (MYR) ³	Low (reference)				
	High	4.931	-7.957, 17.819	0.752	0.452
Duration of DM (years)		-0.351	-0.593, -0.108	-2.840	0.005*
Type of treatment	Lifestyle modification (reference)				
	OHA ⁴ only	3.268	0.426, 6.110	2.260	0.024*
	OHA + Insulin	-4.347	-7.263, -1.431	-2.930	0.004*
HbA1c (%)		-6.637	-6.995, -6.278	-36.389	<0.001*
Comorbidity status	Yes (reference)				
	No	8.011	3.567, 12.455	3.543	<0.001*
No. of visits		-1.300	-2.225, -0.375	-2.761	0.006*
Mean PACIC score		0.236	0.147, 0.324	5.249	<0.001*
Mean HCCQ score		2.393	1.034, 3.753	3.460	<0.001*

¹Ethnicity: Chinese and Indian were categorised into non-Malay. ²Marital status: single/divorced/widow were categorised into single. ³Low: those with monthly income of <RM5,250, High: those with monthly income of $\geq$ RM5,250, Based on Department of Statistics Malaysia 2025. ⁴OHA: oral hypoglycaemic agents *Significant at $p < 0.05$. Simple Linear Regression: (Normality and equal variances assumptions for all variables were met and independent random samples were drawn for the construction of data).

<https://doi.org/10.1371/journal.pone.0348840.t003>

Table 4. Final Factors Associated with Patient Activation among T2DM Patients.

Factors		Multiple Linear Regression			
		β	95% CI	t	p-value
Age (years)		-0.089	-0.161, -0.017	-2.442	0.015*
Male (reference: female)		1.984	0.629, 3.339	2.877	0.004*
Taking OHA only (reference: lifestyle modification only)		-1.460	-2.902, -0.019	-1.991	0.047*
HbA1c (%)		-6.661	-7.022, -6.300	-36.235	<0.001*

⁴OHA: oral hypoglycaemic All predictor variables are included for variable selection in the multiple linear regression. *Significant at $p < 0.05$ Backward Multiple Linear Regression was applied. The model fits reasonably well. Model assumptions were fulfilled. There was no interaction among the independent variables. No multicollinearity was detected. Adjusted $R^2 = 0.759$.

<https://doi.org/10.1371/journal.pone.0348840.t004>

in Singapore (58.8) [26] and Saudi Arabia (55.9) [25]. However, findings from the United States and Finland have shown that the mean patient activation score is higher, 63.2 [14] and 69.9 [25], respectively. Although our mean patient activation score is not remarkably high, more than half of the participants (66%) are at a high activation level, corresponding to Levels 3 and 4. The result aligns with prior research [21,25,26], indicating that patients with T2DM strive to acquire a high level of knowledge, skills, and confidence to self-manage. This is significant, as highly activated patients would know their needs, likely be engaged, and be empowered to self-manage [11,12,18]. Consequently, the healthcare system would become more patient-centred, higher-quality and cost-effective. Patient activation has been recognised as a cornerstone of modern chronic care models, empowering individuals to move from passive recipients of medical services to active partners in the healthcare system [11,12].

Factors associated with patient activation

In this study, four factors were significantly associated with patient activation: **age, male gender, taking OHA only, and HbA1c**. These four factors account for 75.9% of the variance in patient activation, a figure higher than that reported in other research [17,34]. The final analysis revealed that as age increases, the patient activation score decreases. Our findings appear to replicate those of previous studies, suggesting that elderly patients may be less able to manage their diabetes [26,29]. They may have multiple health issues that can affect their physical capacity and motivation to engage in diabetes self-care [52–54]. Furthermore, older patients may have inadequate financial resources, as some choose to retire after reaching 65 or 70 years of age [55,56]. As a result, they may lack the capacity to serve as effective health managers and are unable to handle any unexpected problems related to diabetes. This is concerning, as in our local setting, elderly patients often lack sufficient financial resources to purchase a glucometer for blood sugar monitoring or to attend frequent visits to check for the development of target organ damage [2,57]. All these aspects can influence their activation in diabetes self-management.

The current study also demonstrated that males exhibit better patient activation than females. The finding is consistent with studies reporting that men are more confident and more likely to be engaged in managing their diabetes [58,59]. They appear to be adopting a “proactive health manager” approach, actively monitoring blood glucose and integrating self-care into their daily routines [60,61]. This behaviour may result from their determination to remain healthy, as they need to fulfil their role as the breadwinner.

Apart from the above factors, we found that patients on oral medications had lower activation than those on lifestyle modification. The result is similar to previous research that linked patient activation to treatment regimens [25,62]. Perhaps the complexity of the treatment regimens contributed to the patient’s limited understanding, confidence, and ability to self-manage diabetes [63–66]. Past research has shown that patients may not adhere to medication regimens when the dose and schedule are too complex [63,65].

Based on our analysis, glycaemic control, as measured by HbA1c, emerged as a significant factor associated with patient activation. It has been demonstrated that higher HbA1c levels are associated with lower patient activation scores, consistent with other studies [25,67]. Patients with poor glycaemic control are likely to be less adherent to self-care tasks, such as dietary recommendations and blood glucose monitoring [25]. Meanwhile, those with better control have higher activation, as they are more likely to take an active role and feel confident and knowledgeable about managing their diabetes. Nevertheless, the relationship between HbA1c and patient activation may be bidirectional, with patient activation influencing HbA1c. This opinion is based on a published work stating that a high level of patient activation is associated with better HbA1c [67].

The results highlighted that most T2DM patients have a moderate level of perception of care, with a mean PACIC score of 65.23 (SD 14.89). The finding aligns with other local surveys, indicating that the care delivered to patients with T2DM has not yet achieved its optimal level [46,68]. More effort is needed to ensure that our local patients receive well-structured diabetes care, with an effective delivery system and treatment plan. This fact has been emphasised by many

scholars from other parts of the world [69–72]. The current study is among the initial efforts to investigate the relationship between patient activation and perception of care among patients with T2DM. In contrast to past studies [28,46], our study found no link between patient activation and patient perception of care, as measured by the PACIC scale. Perhaps this contrasting result is due to the different scales used: the current study utilised the shorter PACIC scale (11 items), whereas the studies employing the 20-item scale [28,46].

In the current study, participants perceived their healthcare providers as autonomy-supportive, as indicated by a high overall mean HCCQ score, consistent with other research [43,73,74]. This finding is important to us, as it reveals that patients viewed healthcare providers as respectful, listened to their opinions, and tried to understand their views and choices. These aspects are crucial for building trust and empowering patients to manage diabetes [43,73,74]. Although the link between perceived autonomy and diabetes self-management was evident in a study by Chen et al. (2022), our study found the opposite [43]. Perhaps having autonomy over one's own health is not sufficient for patient activation; rather, a high level of knowledge and self-efficacy in self-management are key elements of activation.

Strengths, limitations and research recommendations

One notable strength of this study is that it represents an early local effort to explore factors associated with patient activation among patients with T2DM, offering valuable insights into a relatively understudied area. However, several limitations should be considered when interpreting the findings. Firstly, the study was conducted at a single centre, which may limit the generalisability of the results to wider populations or diverse healthcare settings. Secondly, the cross-sectional design of the study limits the ability to draw causal conclusions about the examined variables.

Future research employing longitudinal designs would be beneficial in clarifying the temporal and potentially causal nature of these associations. To enhance the applicability and relevance of findings, future research should consider nationwide studies employing a multicentre design that includes a more diverse population across various healthcare settings.

Conclusion and implications for clinical practice

Based on our study, most patients with T2DM exhibit a high level of activation. Factors significantly associated with patient activation include *age*, *male gender*, *taking oral hypoglycaemic agents only* and *HbA1c*. These findings highlight the significant influence of demographic and clinical characteristics on patient engagement in diabetes self-management. Certain aspects, such as age, gender, glycaemic control, and the complexity of treatment regimes, play a crucial role in determining patient activation. Therefore, it is essential to provide targeted, tailored support to groups at risk of lower activation, particularly older adults, women, individuals with poor glycaemic control, and those on complex treatment regimens. Such personalised interventions could help enhance their engagement, improve self-care practices, and ultimately lead to better health outcomes.

Supporting information

S1 File. Data in excel.
(XLSX)

Acknowledgments

The authors would like to express our appreciation to the Medical and Research Ethics Committee, Faculty of Medicine UKM, Universiti Kebangsaan Malaysia (FF-2024–330), for supporting this research and the Ministry of Health Malaysia, for approval to conduct this study (NMRR ID-24–01860-YRL (IIR)). We wish to thank the Director-General of Health, Ministry of Health Malaysia, for his permission to publish this paper. The authors thank all study participants, the staff of Kepala

Batas Health Clinic, the Seberang Perai Utara District Health Office, and the Penang State Health Department for their cooperation throughout the study.

Author contributions

Conceptualization: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Data curation: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Formal analysis: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Funding acquisition: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Investigation: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Methodology: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Project administration: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Resources: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Software: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Supervision: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Validation: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Visualization: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Writing – original draft: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

Writing – review & editing: Muzlifa Mohamed Yusoff, Syahnaz Mohd Hashim, Norfazilah Ahmad.

References

1. World Health Organization. Diabetes: Key facts. 2024. Available from: <https://www.who.int/en/news-room/fact-sheets/detail/diabetes>
2. Ganasegeran K, Hor CP, Jamil MFA, Loh HC, Noor JM, Hamid NA, et al. A Systematic Review of the Economic Burden of Type 2 Diabetes in Malaysia. *Int J Environ Res Public Health*. 2020;17(16):5723. <https://doi.org/10.3390/ijerph17165723> PMID: 32784771
3. Global Burden of Disease Study 2023 (GBD 2023) Data Resources. Available from: <https://ghdx.healthdata.org/gbd-2023/code>
4. Guzman-Vilca WC, Carrillo-Larco RM. Number of People with Type 2 Diabetes Mellitus in 2035 and 2050: A Modelling Study in 188 Countries. *Curr Diabetes Rev*. 2024;21(1):e120124225603. <https://doi.org/10.2174/0115733998274323231230131843> PMID: 38231048
5. Ranasinghe P, Rathnayake N, Wijayawardhana S, Jeyapragasam H, Meegoda VJ, Jayawardena R, et al. Rising trends of diabetes in South Asia: A systematic review and meta-analysis. *Diabetes Metab Syndr*. 2024;18(11–12):103160. <https://doi.org/10.1016/j.dsx.2024.103160> PMID: 39591894
6. IDF Diabetes Atlas 11th Edition 2025. Available from: <https://diabetesatlas.org/data-by-location/region/south-east-asia/>
7. Institute for Public Health. National health and morbidity survey (NHMS) 2023: Non-communicable diseases and healthcare demand: Technical report. Institute for Public Health. 2024.
8. Ministry of Health Malaysia. National Diabetes Registry Report 2023. Available from: https://www2.moh.gov.my/moh/resources/Penerbitan/Laporan/Ummum/NDR_Report_2023_Final.pdf
9. Wagner EH, Austin BT, Von Korff M. Organizing care for patients with chronic illness. *Milbank Q*. 1996;74(4):511–44. <https://doi.org/10.2307/3350391> PMID: 8941260
10. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness: the chronic care model, Part 2. *JAMA*. 2002;288(15):1909–14. <https://doi.org/10.1001/jama.288.15.1909> PMID: 12377092
11. Hibbard JH, Stockard J, Mahoney ER, Tusler M. Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. *Health Serv Res*. 2004;39(4 Pt 1):1005–26. <https://doi.org/10.1111/j.1475-6773.2004.00269.x> PMID: 15230939
12. Saude J, Baker ML, Axman LM, Swider SM. Applying the Chronic Care Model to Improve Patient Activation at a Nurse-Managed Student-Run Free Clinic for Medically Underserved People. *SAGE Open Nurs*. 2020;6:2377960820902612. <https://doi.org/10.1177/2377960820902612> PMID: 33415266
13. Almutairi N, Hosseinzadeh H, Gopaldasani V. The effectiveness of patient activation intervention on type 2 diabetes mellitus glycemic control and self-management behaviors: A systematic review of RCTs. *Prim Care Diabetes*. 2020;14(1):12–20. <https://doi.org/10.1016/j.pcd.2019.08.009> PMID: 31543458

14. Gimbel RW, Rennert LM, Crawford P, Little JR, Truong K, Williams JE, et al. Enhancing Patient Activation and Self-Management Activities in Patients With Type 2 Diabetes Using the US Department of Defense Mobile Health Care Environment: Feasibility Study. *J Med Internet Res*. 2020;22(5):e17968. <https://doi.org/10.2196/17968> PMID: [32329438](https://pubmed.ncbi.nlm.nih.gov/32329438/)
15. Almutairi N, Gopaldasani V, Hosseinzadeh H. The Effect of a Patient Activation Tailored Intervention on Type 2 Diabetes Self-Management and Clinical Outcomes: A Study from Saudi Arabian Primary Care Settings. *J Diabetes Res*. 2023;2023:2074560. <https://doi.org/10.1155/2023/2074560> PMID: [38059208](https://pubmed.ncbi.nlm.nih.gov/38059208/)
16. Hendriks M, Rademakers J. Relationships between patient activation, disease-specific knowledge and health outcomes among people with diabetes; a survey study. *BMC Health Serv Res*. 2014;14:393. <https://doi.org/10.1186/1472-6963-14-393> PMID: [25227734](https://pubmed.ncbi.nlm.nih.gov/25227734/)
17. Bos-Touwen I, Schuurmans M, Monnickhof EM, Korpershoek Y, Spruit-Bentvelzen L, Ertugrul-van der Graaf I, et al. Patient and disease characteristics associated with activation for self-management in patients with diabetes, chronic obstructive pulmonary disease, chronic heart failure and chronic renal disease: a cross-sectional survey study. *PLoS One*. 2015;10(5):e0126400. <https://doi.org/10.1371/journal.pone.0126400> PMID: [25950517](https://pubmed.ncbi.nlm.nih.gov/25950517/)
18. Sacks RM, Greene J, Hibbard J, Overton V, Parrotta CD. Does patient activation predict the course of type 2 diabetes? A longitudinal study. *Patient Educ Couns*. 2017;100(7):1268–75. <https://doi.org/10.1016/j.pec.2017.01.014> PMID: [28159442](https://pubmed.ncbi.nlm.nih.gov/28159442/)
19. Laranjo L, Dias V, Nunes C, Paiva D, Mahoney B. Translation and Validation of the Patient Activation Measure in Portuguese People with Type 2 Diabetes Mellitus. *Acta Med Port*. 2018;31(7–8):382–90. <https://doi.org/10.20344/amp.9072> PMID: [30189166](https://pubmed.ncbi.nlm.nih.gov/30189166/)
20. Tusa N, Kautiainen H, Elfving P, Sinikallio S, Mäntyselkä P. Relationship between patient activation measurement and self-rated health in patients with chronic diseases. *BMC Fam Pract*. 2020;21(1):225. <https://doi.org/10.1186/s12875-020-01301-y> PMID: [33148185](https://pubmed.ncbi.nlm.nih.gov/33148185/)
21. Bahrom NH, Ramli AS, Isa MR, Abdul-Hamid H, Badlishah-Sham SF, Baharudin N, et al. Factors Associated with High Patient Activation Level among Individuals with Metabolic Syndrome at a Primary Care Teaching Clinic. *J Prim Care Community Health*. 2020;11:2150132720931301. <https://doi.org/10.1177/2150132720931301> PMID: [32507012](https://pubmed.ncbi.nlm.nih.gov/32507012/)
22. Paukkonen L, Oikarinen A, Kähkönen O, Kaakinen P. Patient activation for self-management among adult patients with multimorbidity in primary healthcare settings. *Health Sci Rep*. 2022;5(4):e735. <https://doi.org/10.1002/hsr2.735> PMID: [35873391](https://pubmed.ncbi.nlm.nih.gov/35873391/)
23. Syed W, Menaka M, Parimalakrishnan S, Yamasani VV. A study on diabetes-related self-care plan and its determinants among diabetes patients in a Warangal region, Telangana, India. *Braz J Pharm Sci*. 2022;58:e21266.
24. Almomani MH, Al-Tawalbeh S. Glycemic Control and Its Relationship with Diabetes Self-Care Behaviors Among Patients with Type 2 Diabetes in Northern Jordan: A Cross-Sectional Study. *Patient Prefer Adherence*. 2022;16:449–65. <https://doi.org/10.2147/PPA.S343214> PMID: [35221675](https://pubmed.ncbi.nlm.nih.gov/35221675/)
25. Almutairi N, Gopaldasani V, Hosseinzadeh H. Relationship Between Patient Activation and Type 2 Diabetes Mellitus Self-management and Clinical Outcomes in Saudi Arabian Primary Care Setting. *Am J Health Promot*. 2024;38(6):767–77. <https://doi.org/10.1177/08901171231224889> PMID: [38146875](https://pubmed.ncbi.nlm.nih.gov/38146875/)
26. Huang LY, Lin YP, Glass GFJ, Chan EY. Health literacy and patient activation among adults with chronic diseases in Singapore: A cross-sectional study. *Nurs Open*. 2021;8(5):2857–65.
27. AlSharit BA, Alhalal EA. Effects of health literacy on type 2 diabetic patients' glycemic control, self-management, and quality of life. *Saudi Med J*. 2022;43(5):465–72. <https://doi.org/10.15537/smj.2022.43.5.20210917> PMID: [35537729](https://pubmed.ncbi.nlm.nih.gov/35537729/)
28. Aung E, Donald M, Coll JR, Williams GM, Doi SAR. Association between patient activation and patient-assessed quality of care in type 2 diabetes: results of a longitudinal study. *Health Expect*. 2016;19(2):356–66. <https://doi.org/10.1111/hex.12359> PMID: [25773785](https://pubmed.ncbi.nlm.nih.gov/25773785/)
29. de Leon EB, Campos HLM, Santos NB, Brito FA, Almeida FA. Patient activation levels and socioeconomic factors among the Amazonas population with diabetes: a cross-sectional study. *BMC Health Serv Res*. 2024;24(1):169. <https://doi.org/10.1186/s12913-023-10529-0> PMID: [38321433](https://pubmed.ncbi.nlm.nih.gov/38321433/)
30. Zeidalkilani JM, Milhem YA, Shorafa RN, Taha S, Koni AA, Al-Jabi SW, et al. Factors associated with patient activation among patients with diabetes on hemodialysis: a multicenter cross-sectional study from a developing country. *BMC Nephrol*. 2024;25(1):232. <https://doi.org/10.1186/s12882-024-03674-z> PMID: [39033115](https://pubmed.ncbi.nlm.nih.gov/39033115/)
31. van Vugt HA, de Koning EJP, Rutten GEHM. Association between person and disease related factors and the planned diabetes care in people who receive person-centered type 2 diabetes care: An implementation study. *PLoS ONE*. 2019; 14(7): e0219702.
32. Duke N. Type 2 diabetes self-management: spirituality, coping and responsibility. *J Res Nurs*. 2021;26(8):743–60. <https://doi.org/10.1177/17449871211026958> PMID: [35251282](https://pubmed.ncbi.nlm.nih.gov/35251282/)
33. Ranjbaran S, Shojaeizadeh D, Dehdari T, Yaseri M, Shakibazadeh E. The effectiveness of an intervention designed based on health action process approach on diet and medication adherence among patients with type 2 diabetes: a randomized controlled trial. *Diabetol Metab Syndr*. 2022;14(1):3. <https://doi.org/10.1186/s13098-021-00773-x> PMID: [34983628](https://pubmed.ncbi.nlm.nih.gov/34983628/)
34. Ahn YH, Kim BJ, Ham OK, Kim SH. Factors associated with Patient Activation for Self-management among Community Residents with Osteoarthritis in Korea. *J Korean Acad Community Health Nurs*. 2015;26(3):303. <https://doi.org/10.12799/jkachn.2015.26.3.303>
35. Alexander J, Hearld L, Mittler JN. Patient-physician role relationships and patient activation: the moderating effects of race and ethnicity. *Med Care Res Rev*. 2014;71(5):472–95. <https://doi.org/10.1177/1077558714541967> PMID: [25027408](https://pubmed.ncbi.nlm.nih.gov/25027408/)
36. Parchman ML, Zeber JE, Palmer RF. Participatory decision making, patient activation, medication adherence, and intermediate clinical outcomes in type 2 diabetes: a STARNet study. *Ann Fam Med*. 2010;8(5):410–7. <https://doi.org/10.1370/afm.1161> PMID: [20843882](https://pubmed.ncbi.nlm.nih.gov/20843882/)

37. Glasgow RE, Wagner EH, Schaefer J, Mahoney LD, Reid RJ, Greene SM. Development and validation of the Patient Assessment of Chronic Illness Care (PACIC). *Med Care*. 2005;43(5):436–44. <https://doi.org/10.1097/01.mlr.0000160375.47920.8c> PMID: [15838407](#)
38. Gugiu PC, Coryn C, Clark R, Kuehn A. Development and evaluation of the short version of the Patient Assessment of Chronic Illness Care instrument. *Chronic Illn*. 2009;5(4):268–76. <https://doi.org/10.1177/1742395309348072> PMID: [19933249](#)
39. Glasgow RE, Whitesides H, Nelson CC, King DK. Use of the Patient Assessment of Chronic Illness Care (PACIC) with diabetic patients: relationship to patient characteristics, receipt of care, and self-management. *Diabetes Care*. 2005;28(11):2655–61. <https://doi.org/10.2337/diacare.28.11.2655> PMID: [16249535](#)
40. Williams GC, Freedman ZR, Deci EL. Supporting autonomy to motivate patients with diabetes for glucose control. *Diabetes Care*. 1998;21(10):1644–51. <https://doi.org/10.2337/diacare.21.10.1644> PMID: [9773724](#)
41. Graffigna G, Barelllo S, Bonanomi A, Menichetti J. The Motivating Function of Healthcare Professional in eHealth and mHealth Interventions for Type 2 Diabetes Patients and the Mediating Role of Patient Engagement. *J Diabetes Res*. 2016;2016:2974521. <https://doi.org/10.1155/2016/2974521> PMID: [26881243](#)
42. Kors JM, Paternotte E, Martin L, Verhoeven CJ, Schoonmade L, Peerdeman SM, et al. Factors influencing autonomy supportive consultation: A realist review. *Patient Educ Couns*. 2020;103(10):2069–77. <https://doi.org/10.1016/j.pec.2020.04.019> PMID: [32471798](#)
43. Chen M, Yun Q, Lin H, Liu S, Liu Y, Shi Y, et al. Factors Related to Diabetes Self-Management Among Patients with Type 2 Diabetes: A Chinese Cross-Sectional Survey Based on Self-Determination Theory and Social Support Theory. *Patient Prefer Adherence*. 2022;16:925–36. <https://doi.org/10.2147/PPA.S335363> PMID: [35418746](#)
44. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. 2000;55(1):68–78. <https://doi.org/10.1037//0003-066x.55.1.68> PMID: [11392867](#)
45. Gogtay NJ. Principles of sample size calculation. *Indian J Ophthalmol*. 2010;58(6):517–8. <https://doi.org/10.4103/0301-4738.71692> PMID: [20952836](#)
46. Nordin N, Hairon SM, Yaacob NM, Hamid AA, Isa SAM, Hassan N. Perceived quality of care among people with type 2 diabetes mellitus in the north east region of peninsular Malaysia. *BMC Public Health*. 2021;21(1):268. <https://doi.org/10.1186/s12889-021-10320-y> PMID: [33568119](#)
47. Czajkowska Z, Wang H, Hall NC, Sewitch M, Körner A. Validation of the English and French versions of the Brief Health Care Climate Questionnaire. *Health Psychol Open*. 2017;4(2):2055102917730675. <https://doi.org/10.1177/2055102917730675> PMID: [29379621](#)
48. Matin H, Nadrian H, Jahangiri L, Sarbakhsh P, Shaghghi A. Psychometric properties of the Persian Health Care Climate Questionnaire (HCCQ-P): assessment of type 2 diabetes care supportiveness in Iran. *Patient Prefer Adherence*. 2019;13:783–93. <https://doi.org/10.2147/PPA.S201400> PMID: [31190760](#)
49. Hibbard JH, Mahoney ER, Stockard J, Tusler M. Development and testing of a short form of the patient activation measure. *Health Serv Res*. 2005;40(6 Pt 1):1918–30. <https://doi.org/10.1111/j.1475-6773.2005.00438.x> PMID: [16336556](#)
50. Insignia Health. PAM survey. Available from: <https://www.insigniahealth.com/pam/>
51. Mohd Hashim S, Idris IB, Sharip S, Bahari R, Jahan N. The Malay Version of Patient Activation Measure: An Instrument for Measuring Patient Engagement in Healthcare. *JSM*. 2020;49(10):2487–97. <https://doi.org/10.17576/jsm-2020-4910-14>
52. Ong-Artborirak P, Seangpraw K, Boonyathee S, Auttama N, Winaiprasert P. Health literacy, self-efficacy, self-care behaviors, and glycemic control among older adults with type 2 diabetes mellitus: a cross-sectional study in Thai communities. *BMC Geriatr*. 2023;23(1):297. <https://doi.org/10.1186/s12877-023-04010-0> PMID: [37193967](#)
53. Wu C, Xu R, Cao J, Wang S, Peng S, Wang C, et al. Barriers and facilitators of self-management for older adults living with type 2 diabetes mellitus: A qualitative study in China. *Sci Diabetes Self Manag Care*. 2024;50(1):44–55.
54. Zhang Z-C, Du Q-H, Jia H-H, Li Y-M, Liu Y-Q, Li S-B. A qualitative study on inner experience of self-management behavior among elderly patients with type 2 diabetes in rural areas. *BMC Public Health*. 2024;24(1):1456. <https://doi.org/10.1186/s12889-024-18994-w> PMID: [38822296](#)
55. Walker RJ, Garacci E, Campbell JA, Harris M, Mosley-Johnson E, Egede LE. Relationship Between Multiple Measures of Financial Hardship and Glycemic Control in Older Adults With Diabetes. *J Appl Gerontol*. 2021;40(2):162–9. <https://doi.org/10.1177/0733464820911545> PMID: [32167406](#)
56. Mosen DM, Fitzpatrick SL, Keast EM, Dickerson JF, Ertz-Berger BL, Banegas MP. Association of social needs with diabetes outcomes in an older population. *J Am Board Fam Med*. 2025;38(1):125–32.
57. Tey SW, Rajiah K, Maharajan MK, Zakaria NB, Ishak NHB. Equitable Healthcare Access for Type 2 Diabetes Patients Under a Low-Income Group Health Care Scheme: A Sustainable Development Goal Perspective. *Int J Environ Res Public Health*. 2025;22(6):817. <https://doi.org/10.3390/ijerph22060817> PMID: [40566245](#)
58. Mathew R, Gucciardi E, De Melo M, Barata P. Self-management experiences among men and women with type 2 diabetes mellitus: a qualitative analysis. *BMC Fam Pract*. 2012;13:122. <https://doi.org/10.1186/1471-2296-13-122> PMID: [23249410](#)
59. Baroni I, Caruso R, Dellafiore F, Ausili D, Barelllo S, Vangone I, et al. Self-care and type 2 diabetes mellitus (T2DM): a literature review in sex-related differences. *Acta Biomed*. 2022;93(4):e2022277. <https://doi.org/10.23750/abm.v93i4.13324> PMID: [36043961](#)
60. Collins MM, Bradley CP, O'Sullivan T, Perry IJ. Self-care coping strategies in people with diabetes: a qualitative exploratory study. *BMC Endocr Disord*. 2009;9:6. <https://doi.org/10.1186/1472-6823-9-6> PMID: [19232113](#)

61. Hendriks SH, Blanker MH, Roelofsen Y, van Hateren KJJ, Groenier KH, Bilo HJG, et al. Gender differences in the evaluation of care for patients with type 2 diabetes: a cross-sectional study (ZODIAC-52). *BMC Health Serv Res*. 2018;18(1):266. <https://doi.org/10.1186/s12913-018-3086-x> PMID: [29636042](#)
62. Yee KC, Said SM, Manaf RA. Identifying self-care behaviour and its predictors among type 2 diabetes mellitus patients at a district of Northern Peninsular Malaysia. *Mal J Med Health Sci*. 2018;14(2):17–29.
63. Luzuriaga M, Leite R, Ahmed H, Saab PG, Garg R. Complexity of antidiabetic medication regimen is associated with increased diabetes-related distress in persons with type 2 diabetes mellitus. *BMJ Open Diabetes Res Care*. 2021;9(1):e002348. <https://doi.org/10.1136/bmjdr-2021-002348> PMID: [34598934](#)
64. Abdullah NF, Khuan L, Theng CA, Sowtali SN. Prevalence and reasons influenced medication non-adherence among diabetes patients: A mixed-method study. *J Diabetes Metab Disord*. 2022;21(2):1669–78. <https://doi.org/10.1007/s40200-022-01118-9> PMID: [36404839](#)
65. Ab Rahman N, Lim MT, Thevendran S, Ahmad Hamdi N, Sivasampu S. Medication Regimen Complexity and Medication Burden Among Patients With Type 2 Diabetes Mellitus: A Retrospective Analysis. *Front Pharmacol*. 2022;13:808190. <https://doi.org/10.3389/fphar.2022.808190> PMID: [35387353](#)
66. Khayyat SM, Ali RSA, Alrammaal HH, Khayyat SMS, Alqurashi WA, Alsaedi R, et al. Predictors of medication regimen complexity and its impact on hemoglobin a1c in type 2 diabetes patients: a retrospective analysis in ambulatory care in Makkah City. *Ann Saudi Med*. 2024;44(5):296–305. <https://doi.org/10.5144/0256-4947.2024.296> PMID: [39368115](#)
67. Milo RB, Ramira A, Calero P, Georges JM, Pérez A, Connelly CD. Patient Activation and Glycemic Control Among Filipino Americans. *Health Equity*. 2021;5(1):151–9. <https://doi.org/10.1089/heq.2020.0075> PMID: [33937600](#)
68. Abdul-Razak S, Ramli AS, Badlishah-Sham SF, Haniff J, EMPOWER-PAR Investigators. Validity and reliability of the patient assessment on chronic illness care (PACIC) questionnaire: the Malay version. *BMC Fam Pract*. 2018;19(1):119. <https://doi.org/10.1186/s12875-018-0807-5> PMID: [30025525](#)
69. Gijis E, Zuercher E, Henry V, Morin D, Bize R, Peytremann-Bridevaux I. Diabetes care: Comparison of patients' and healthcare professionals' assessment using the PACIC instrument. *J Eval Clin Pract*. 2017;23(4):803–11. <https://doi.org/10.1111/jep.12720> PMID: [28251768](#)
70. Simonsen N, Koponen AM, Suominen S. Patients' assessment of chronic illness care: a validation study among patients with type 2 diabetes in Finland. *BMC Health Serv Res*. 2018;18(1):412. <https://doi.org/10.1186/s12913-018-3206-7> PMID: [29871638](#)
71. Frølich A, Nielsen A, Glümer C, Eriksen CU, Maindal HT, Kleist BH, et al. Patients' assessment of care for type 2 diabetes: Results of the Patient Assessment of Chronic Illness Care scale in a Danish population. *BMC Health Serv Res*. 2021;21(1):1069. <https://doi.org/10.1186/s12913-021-07051-6> PMID: [34627257](#)
72. Akan G, Kartal A. The association between Patient Assessment of Chronic Illness Care Scores and quality of life in type 2 diabetes patients. *J Res Nurs*. 2023;28(3):199–211. <https://doi.org/10.1177/17449871221144899> PMID: [37332311](#)
73. Koponen AM, Simonsen N, Laamanen R, Suominen S. Health-care climate, perceived self-care competence, and glycemic control among patients with type 2 diabetes in primary care. *Health Psychol Open*. 2015;2(1):2055102915579778. <https://doi.org/10.1177/2055102915579778> PMID: [28070353](#)
74. Grønnegaard C, Varming A, Skinner T, Olesen K, Willaing I. Determinants of glycaemic control among patients with type 2 diabetes: testing a process model based on self-determination theory. *Heliyon*. 2020;6(10):e04993. <https://doi.org/10.1016/j.heliyon.2020.e04993> PMID: [33083586](#)