Research Paper

# Predictors of Fatigue Among Community-Dwelling Patients With Type 2 Diabetes Mellitus

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## ABSTRACT

**Background:** Compelling evidence indicates that fatigue is a common and debilitating symptom among individuals with type 2 diabetes mellitus (T2DM). Fatigue impairs daily functioning, self-care behaviors, and glycemic control, making early identification essential. This study determined the predictors of fatigue among patients with T2DM receiving care at the Diabetes Clinic of Ban Dong Wai Health Promoting Hospital, Tha Muang Subdistrict, Selaphum District, Roi Et Province, Northeastern Thailand, in 2025.

**Methods:** This study used a descriptive, cross-sectional, correlational design. A total of 150 patients with T2DM attending scheduled follow-up visits were selected through a probability-based random sampling method without the use of substitution. Data were collected using 6 validated self-administered questionnaires: the sociodemographic information questionnaire, the fatigue assessment scale (FAS), the depression anxiety stress scales (DASS), the social support questionnaire (SSQ), the family APGAR (adaptability, partnership, growth, affection, and resolve) questionnaire, and the Thai version of the Pittsburgh sleep quality index (T-PSQI). The data were analyzed in SPSS software, version 19. Regression analysis was done to identify predictors of fatigue. P<0.05 was considered statistically significant for all analyses.

**Results:** Most patients had moderate levels of fatigue (87.0%). Among patients with T2DM, predictors of fatigue were depression (P=0.000), hemoglobin A1C (HbA1C) (P=0.000), and sleep quality (P=0.003).

**Conclusion:** This study emphasizes the necessity for primary care providers to detect fatigue early in community-dwelling patients with T2DM, even among those not seeking care, to allow timely intervention and improve quality of life (QoL).

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## Highlights

- Fatigue is a prevalent problem among community-dwelling patients with T2DM and may remain unrecognized, especially in those not actively seeking healthcare services.
- Early detection of fatigue among community-dwelling patients with T2DM is essential to guide timely interventions and improve overall QoL.
- The current study found that fatigue among patients with T2DM was moderate.
- Multiple factors, including depression, HbA1c, and sleep quality, predict fatigue among patients with T2DM.

## Plain Language Summary

Poor fatigue management among patients with T2DM can negatively affect daily functioning and quality of life (QoL). This study examined the predictors of fatigue among community-dwelling adults with T2DM. Most patients experienced moderate fatigue (87.0%). Three main factors, including depression, three-month blood sugar (HbA1c), and sleep quality, significantly predicted fatigue. Depression, poor glycemic control, and inadequate sleep quality were identified as the most important contributors to fatigue among patients with T2DM.

## Introduction

Diabetes is one of the most common chronic diseases affecting health worldwide. The number of patients with diabetes is estimated to reach 578.4 million by 2030, with type 2 diabetes mellitus (T2DM) accounting for 90% of all cases (Saeedi et al., 2019). This trend has also been observed in Thailand. According to the Thai national health examination surveys, diabetes prevalence among adults increased from 7.5% in 2004 to 10.1% in 2020 (Aekplakorn et al., 2025). Diabetes is a leading cause of early death worldwide (WHO, 2024). Therefore, understanding the prevalence and determinants of fatigue among community-dwelling patients with T2DM is essential to inform timely interventions and improve overall quality of life (QoL) (Ba et al., 2021; Kuo et al., 2021).

Patients with diabetes experience serious health challenges affecting the physical, psychological, and social dimensions of their lives (Alwhaibi, 2024). The definition of fatigue in patients with T2DM is relatively unclear (Kalra & Sahay, 2018). Moreover, diabetic fatigue syndrome refers to generalized fatigue in patients with T2DM; it is a multidimensional phenomenon that may persist despite adequate glycemic control and can arise from physiological processes, treatment regimens, and long-term diabetes-related complications (Ba et al., 2021; Kuo et al., 2021). Absolutely, fatigue among patients with diabetes can negatively impact physical, psychological, and social functioning and is associated with an increased risk of T2DM-related complications compared with the general population (Bi et al., 2021). Although fatigue is a major concern, many diabetes therapists often overlook its management and underlying factors (Romadlon et al., 2022).

A literature review identifies factors associated with fatigue in patients with diabetes. Firstly, it mentions older age (Vasilaki et al., 2023), hypoglycemia or hyperglycemia (Kalra & Sahay, 2018; Bi et al., 2021), having above and below normal body mass index (Bi et al., 2021), psychological factors such as depression and anxiety (Kalra & Sahay, 2018; Darwish et al., 2018), sleep quality (Zhu et al., 2020), comorbidities (Bi et al., 2021), and duration of disease (Kuo et al., 2021). Lastly, social support and family support (Wang et al., 2023; Kuo et al., 2021). Furthermore, social support is crucial in disease management (Wang et al., 2023). However, although increasing evidence from international studies has emphasized the influence of psychosocial factors, particularly family and social support, on fatigue among patients with T2DM, no published studies have examined the prevalence of fatigue or its predictive factors, including family and social support, among patients with T2DM in Thailand, including its Northeastern region.

According to the Roi Et Provincial Health Office survey, Koh Kaew Sub-District, which is part of Sela Phum District in Roi Et Province, Northeastern Thailand, re-

ported T2DM prevalence rates of 10.22%, 8.48%, and 11.11% in 2023, 2024, and 2025, respectively (Ministry of Public Health [MOPH], 2025). Therefore, the number of patients with T2DM in this community has increased, and the university is located in this community. The university has emphasized promoting public health in line with its strategic plan to enhance the population's QoL. Consequently, this study aimed to determine the prevalence of fatigue and identify the associated predictive factors among community-dwelling people in Koh Kaew Sub-District, Northeastern Thailand. These results can inform comprehensive early assessment of fatigue, enabling timely, appropriate care planning and interventions. These strategies may support effective self-management and improve QoL among patients with T2DM.

## Materials and Methods

### Design, setting and sample

The study used a cross-sectional correlational design. The researchers assessed the sample over a specific period (June to August 2025) for a defined population. The study was conducted at the Diabetes Mellitus Clinic of the Subdistrict Health Promoting Hospitals in Selaphum District, Roi Et Province, Northeastern Thailand. The clinic averaged 60 patient visits per week. Individuals diagnosed with T2DM who were 18 years or older and were conscious and able to communicate were included in the study.

### Sampling procedure

The study used instruments including structured surveys and face-to-face interviews. The required sample size was determined using G*Power 3.1.9.2 (Faul et al., 2007) for a multiple linear regression model, with a power of 90 and an effect size of 0.15 (Cohen, 1988). Using a statistical significance level of 0.05, a sample size of 136 was obtained. This number was increased by 10% to account for incomplete survey questionnaire data, resulting in a final sample size of 150 participants. A probability-based random sampling process was used to select participants, without replacement. Adults aged 18 years or older who had T2DM for at least 1 year according to the Selaphum registry data, could converse in Thai, and were alert, able to communicate, and willing to participate met the inclusion criteria.

### Data collection

The study collected data from June to August 2025 using 6 self-report questionnaires that were reviewed and pretested prior to the study.

Section A was a researcher-made questionnaire that examined participants' sociodemographic information.

Section B was the fatigue assessment scale (FAS). This scale allows individuals to self-assess various fatigue symptoms. The scale is a Thai-adapted and translated version of the Piper Fatigue Scale by Nara Kulwawanwijit (Piper et al., 1998; Nara, 2006). The instrument consisted of 22 items, each rated on a 10-point scale from 1 to 10, with 1 indicating "strongly disagree" and 10 indicating "strongly agree." The total scores of all items were categorized into three levels of fatigue based on the mean: mild fatigue (1.00-3.99), moderate fatigue (4.00-6.99), and severe fatigue (7.00-10.00). The questionnaire was validated before use. The Cronbach α was 0.85.

Section C was the depression anxiety stress scales (DASS). The Thai-translated and adapted version of the hospital anxiety and depression scale (Thai HADS), developed by Nilchaikovit et al. (1996), consists of 14 items. It includes 7 items assessing anxiety symptoms and 7 items assessing depression symptoms. Each item is rated on a Likert-type scale ranging from 0 to 3. The total scores were categorized into 3 levels of anxiety and depression based on the score ranges: no anxiety and no depression (0–7), moderate anxiety and moderate depression (8–10), and severe anxiety and severe depression (11–21). Before use, the questionnaire was evaluated. The Cronbach α was 0.89.

Section D was the social support questionnaire (SSQ). The researcher refined the Thai-translated and adapted version of the SSQ, developed by Chuen-im (Chuen-im, 2007), to ensure its relevance and alignment with the study objectives. Content validity was evaluated using the content validity index (CVI) by a panel of three experts who were nursing faculty members with specialized expertise in gerontological nursing and chronic disease care. A CVI value of 0.80 or higher was considered indicative of adequate content validity. The reliability of the instrument was subsequently assessed using the Cronbach α coefficient, with values exceeding 0.85 reflecting satisfactory internal consistency. The instrument comprised 16 items. The SSQ comprises 4 domains, all reflecting positive aspects of social support: emotional support, tangible and instrumental support, appraisal and esteem support, and informational support. Each item is

rated on a Likert-type scale ranging from 0 to 3. Mean scores were categorized into 3 levels of social support based on the following ranges: low social support (1.0–1.6), moderate social support (1.7–2.3), and high social support (2.4–3.0).

Section E was the family APGAR. The Thai-translated and adapted family APGAR questionnaire, developed by Malathum and colleagues (Malathum et al., 2009), consists of 5 items (adaptability, partnership, growth, affection, and resolve). Participants rated each item on a 5-point scale from 1 to 5, with 1 indicating "strongly disagree" and 5 indicating "strongly agree." The mean scores were categorized into three levels of family functioning based on the following ranges: low family support (0–6), moderate family support (7–13), and high family support (14–20). The questionnaire was validated before use. Cronbach's α was 0.80.

Sleep quality was assessed using the Thai version of the Pittsburgh sleep quality index (T-PSQI) (Buysse et al., 1989; Sitasuwan et al., 2014), a self-administered instrument designed to evaluate individuals' perceived sleep quality and sleep-related problems during the previous month. The questionnaire consists of 19 items that are summarized into 7 components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. These components comprise 1, 2, 1, 3, 9, 1, and 2 items, respectively.

Each component is scored from 0 to 3, with higher scores indicating more severe sleep-related difficulties. The global T-PSQI score is obtained by summing the 7 component scores, yielding a total score ranging from 0 to 21, where higher scores reflect poorer subjective sleep quality. Habitual sleep efficiency was calculated as the ratio of total sleep time to the difference between get-up time and usual bedtime, multiplied by 100. Sleep disturbances were derived from items assessing difficulties such as waking during the night or early morning, needing to use the bathroom, breathing discomfort, coughing or loud snoring, feeling excessively cold or hot, experiencing bad dreams, and having pain. Higher scores indicated greater sleep disturbance. Daytime dysfunction was evaluated using items related to sleep medication use frequency and difficulty maintaining alertness during activities such as driving, eating, or social interactions. Higher scores represented more pronounced daytime impairment. Participants with a global T-PSQI score greater than 5 were classified as having poor sleep quality, whereas those with scores of 5 or below were considered to have good sleep quality. The Cronbach α was 0.84.

### Data analysis

SPSS software, version 20 (IBM Corporation, Armonk, NY, USA) was used to analyze the data. Normality of the data was determined using the Kolmogorov-Smirnov test. The significance level for all inferential statistics was set at 0.05. Regression analysis was performed to determine factors that could predict fatigue. Descriptive statistics for demographic variables and influencing factors were presented as frequencies and percentages.

## Results

Table 1 presents the various sociodemographic characteristics of the 150 study participants. A high proportion of participants were female (63.4%), and the most frequent age group was 60-69 years (39.8%). Meanwhile, 68.30% were married, and 76.4% had primary school education. More than half of participants had been suffering from T2DM for less than 5 years (48.00%) and had hypertension (86.2%). Most participants had hemoglobin A1C (HbA1C) <7.0% (62.6%) and a body mass index (BMI) within the normal range of 18.5–24.9 (81.3%).

The findings showed that 87.0% of the participants experienced moderate fatigue, while 12.2% experienced mild fatigue (Table 2).

The study found that sleep quality was positively and significantly correlated with fatigue (r=0.557, P<0.01). HbA1C was also positively and significantly correlated with fatigue (r=0.563, P<0.01). Additionally, depression showed a positive and significant correlation with fatigue (r=0.656, P<0.01), as presented in Table 3.

Regression analysis showed a positive correlation (R=0.764) between fatigue and depression variables (P=0.000), HbA1C (P=0.000), and sleep quality (P=0.003) (Table 4).

## Discussion

The results showed that most patients with T2DM experienced moderate fatigue (87.0%). This finding underscores the importance of early fatigue assessment in community and primary care settings, as timely identification of fatigue may facilitate the development of effective nursing interventions to improve patient outcomes and QoL. Similarly, previous studies assessing fatigue among patients with T2DM found that participants experienced moderate fatigue (Wang et al., 2023). As a result, the evidence indicates that moderate fatigue is a common

**Table 1.** Sociodemographic characteristics of the participants

| Variables | | No. (%) |
|---|---|---|
| Age (y) | 50-59 | 48(39.0) |
| | 60-69 | 49(39.8) |
| | 70-79 | 21(17.1) |
| | ≥ 80 | 5(4.1) |
| Gender | Male | 45(36.6) |
| | Female | 78(63.4) |
| Marital status | Single | 1(0.8) |
| | Married | 84(68.3) |
| | Widowed | 32(26.0) |
| | Divorced | 5(4.1) |
| | Separated | 1(0.8) |
| Education level | No formal education | 5(4.1) |
| | Primary school | 94(76.4) |
| | Junior high school | 11(8.9) |
| | Senior high school | 6(4.9) |
| | Diploma or Bachelor | 7(5.7) |
| Comorbidities | Hypertension | 106(86.2) |
| | Dyslipidemia | 94(76.4) |
| | Coronary artery disease | 17(13.8) |
| | Chronic kidney disease | 7(5.7) |
| Duration of T2DM (y) | <5 | 59(48.0) |
| | 5-10 | 25(20.3) |
| | >10 | 39(31.7) |
| HbA1C level (%) | <7.0 | 77(62.6) |
| | 7.0–8.9 | 45(36.6) |
| | ≥9.0 | 1(0.8) |
| BMI (kg/m$^2$) | <18.5 | 4(3.3) |
| | 18.5–24.9 | 100(81.3) |
| | 25.0–29.9 | 18(14.6) |
| | ≥30.0 | 1(0.8) |

Abbreviations: T2DM: Type 2 diabetes mellitus; HbA1C: Hemoglobin A1C; BMI: Body mass index. Client- Centered Nursing Care

**Table 2.** Level of fatigue among patients with T2DM using the FAS

| Level | Score | No. (%) |
|---|---|---|
| Mild fatigue | 1 – 3.99 | 15(12.2) |
| Moderate fatigue | 4 – 6.99 | 107(87.0) |
| Severe fatigue | 7 - 10 | 1(0.8) |

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experience in this population and should not be overlooked in routine diabetes care. In addition, this study found significant positive correlations between fatigue and sleep quality, HbA1C, and depression, underscoring the combined influence of physiological and psychological factors on fatigue in individuals with T2DM. Therefore, healthcare providers should integrate regular fatigue screening into diabetes management protocols and interventions that address physical, psychological, and social factors contributing to fatigue, aiming to enhance overall patient well-being and self-management capacity (Kuo et al., 2021).

Furthermore, the study found that the majority of participants were aged 60–69 years and female, which aligns with global and national data indicating that the incidence of T2DM is higher among older adults and continues to increase alongside the aging population (Saeedi et al., 2019; WHO, 2024; Aekplakorn et al., 2025). Increasing age is associated with declines in energy metabolism and organ function, which may contribute to fatigue in this patient population (Kuo et al., 2021; Khalaf et al., 2025). In addition, multiple comorbidities may further increase the burden of healthcare management and reduce the energy available for daily activities (Lin et al., 2024).

Similarly, Kalra and Sahay (2018) reported that the presence of multiple comorbidities such as hypertension and dyslipidemia can increase physiological burden, affecting the circulatory system and the body's oxygen utilization, which is consistent with the study sample, where participants had comorbidities of hypertension (86.2%) and hyperlipidemia (76.4%). These comorbidities further increase patients' risk of fatigue. Moreover, most participants had only primary education (76.4%), which may affect their ability to understand health information, manage their condition, and perceive fatigue. Previous studies have indicated that patients with diabetes who have a lower educational level often face challenges in self-care and are at increased risk of experiencing fatigue (Kuo et al., 2021; Bi et al., 2021). This demographic pattern further highlights the need for fatigue assessment and interventions among older adults with T2DM, par-

**Table 3.** Correlations among the study variables

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fatigue | 1.00 | | | | | | | | | | |
| Age | 0.239* | 1.00 | | | | | | | | | |
| Duration of T2DM | 0.243** | 0.691** | 1.00 | | | | | | | | |
| Family support | −0.137 | −0.112 | 0.027 | 1.00 | | | | | | | |
| Sleep quality | 0.557** | 0.213* | 0.182* | −0.072 | 1.00 | | | | | | |
| Anxiety | 0.044 | −0.077 | −0.159* | −0.136 | 0.166 | 1.00 | | | | | |
| Social support | −0.097 | 0.047 | 0.142 | 0.148 | −0.172* | −0.521** | 1.00 | | | | |
| BMI | −0.090 | −0.055 | −0.064 | 0.176* | −0.017 | 0.007 | −0.028 | 1.00 | | | |
| HbA1C | 0.563** | 0.070 | 0.113 | −0.171* | 0.413** | −0.026 | 0.045 | 0.036 | 1.00 | | |
| Comorbidities | −0.278** | −0.009 | −0.237** | 0.095 | −0.384** | −0.022 | 0.106 | −0.006 | −0.317** | 1.00 | |
| Depression | 0.656** | 0.162 | 0.199* | −0.070 | 0.487** | 0.148 | −0.139 | −0.163* | 0.361** | −0.220* | 1.00 |

*P<0.05, **P<0.01.

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**Table 4.** Regression analysis of factors influencing fatigue among patients with T2DM

| Predictor | Unstandardized Coefficients | | Standardized Coefficients | t-test | P | 0.95% Confidence | |
|---|---|---|---|---|---|---|---|
| | B | Std. Error | Beta | | | Lower | Upper |
| (Constant) | 55.652 | 5.516 | | 10.089 | 0.000 | 44.729 | 66.574 |
| Depression | 1.559 | 0.246 | 0.438 | 6.332 | 0.000 | 1.071 | 2.046 |
| HbA1c | 3.220 | 0.672 | 0.317 | 4.791 | 0.000 | 1.889 | 4.550 |
| Sleep quality | 8.474 | 2.818 | 0.213 | 3.007 | 0.003 | 2.894 | 14.054 |

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Note: Dependent variable: fatigue. Predictors: (Constant), depression, hemoglobin A1C, Sleep quality. $R^2$=0.584; Adjusted $R^2$=0.574.

ticularly women and those with multiple comorbidities, to improve self-management and QoL. However, studies on patients with T2DM are limited, and comparisons were made between participants with different medical conditions. Therefore, further confirmatory studies are needed.

The results showed that depression significantly predicted fatigue. This finding suggests that depression leads to reduced energy levels and diminished motivation. Consequently, patients exhibit poorer self-care behaviors, such as reduced physical activity, poor medication adherence, and inadequate blood glucose monitoring (Darwish et al., 2018). In addition, depression symptoms negatively affect individuals' perceptions of their own health and their confidence in disease management, resulting in a more negative perception of disease control (Gonzalez et al., 2018). Additionally, HbA1C was a statistically significant predictor of fatigue. Although participants in northeastern Thailand exhibited relatively good glycemic control, chronic hyperglycemia may impair cellular energy metabolism, increase systemic inflammation, and disrupt muscle function, leading to greater perceived fatigue (MacDonald et al., 2020). Moreover, HbA1C reflects long-term glycemic exposure and the physiological burden of diabetes, both of which are associated with reduced physical functioning and poorer QoL, which contribute to fatigue (Shao et al., 2022). These findings suggest that fatigue can occur even in patients without severely uncontrolled blood glucose and emphasize the importance of assessing fatigue alongside glycemic control in the comprehensive management of patients with diabetes.

Furthermore, this study found that poor sleep quality significantly predicted fatigue. A similar previous study found that perceived sleep quality is significantly associated with fatigue levels (Kishi et al., 2023). Importantly, poor sleep the previous night was shown to increase next-day fatigue in older adults (Kishi et al., 2023), and a similar association was found in adults with T2DM (Zhu et al., 2020), further supporting the role of sleep disturbances in daily fatigue.

Variables that did not significantly predict fatigue included age, disease duration, family support, anxiety, social support, BMI, and comorbidity. First, correlations between these variables and fatigue were generally low or not significant; for example, family support, anxiety, and social support showed weak associations with fatigue. These low correlations suggest that these factors may have limited direct influence on fatigue in this population. The findings on fatigue in patients with T2DM indicate that age does not directly affect fatigue levels (Kuo et al., 2021; Bi et al., 2021). Similarly, family function or social support did not consistently predict fatigue levels in this population, particularly when psychological factors such as depression and sleep quality exert stronger effects (Kuo et al., 2021). Second, the correlation among independent variables may have contributed to these results. Diabetes duration, comorbidities, and age were correlated, which can reduce the predictive power of individual variables in regression models (Tabachnick & Fidell, 2019). Although other studies have associated illness duration and comorbidities with fatigue in univariate analyses, when controlling for stronger predictors such as depression, sleep quality, and glycemic control, these variables become less influential, and the stronger predictors show greater significance and predictive ability. Lastly, BMI was not a significant predictor in this study, which may reflect sample characteristics. Therefore, anxiety did not independently predict fatigue, possibly because its effect overlaps with depression, which was a stronger and more consistent predictor in the regression model.

It is recommended that the healthcare team, particularly nurses, carefully assess predictive and associated factors identified in this study when caring for patients with T2DM. Appropriate measures should be implemented to enable early screening and evaluation of fatigue, allowing timely interventions to improve patient outcomes and QoL.

## Conclusion

Fatigue in this study was moderate. Depression, poor sleep quality, and elevated HbA1C were identified as significant predictors of fatigue. These findings emphasize the combined impact of physiological and psychological factors on fatigue and underscore the importance of regular fatigue assessment. Interventions that improve sleep quality and mental health are therefore crucial.

## Ethical Considerations

### Compliance with ethical guidelines

We followed the ethical principles for human medical research in accordance with the Declaration of Helsinki.

Ethical approval for this research was granted by the Roi Et Rajabhat University Research Ethics Committee (Code: 060/2568). Written informed consent was secured from participants with an assurance of confidentiality. In addition, before the data-gathering process began, participants were informed of the research purposes and procedures and provided written consent. Interviews were then conducted to establish a detailed case history for each participant, after which the questionnaire survey was administered. Participants who lacked sufficient education to complete the questionnaire were provided with assistance. No time limit was set for completing the questionnaire survey. This research was carried out in June-August 2025.

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### Authors' contributions

Conceptualization, data collection, investigation, and writing the original draft: Palama Sobut; Review & editing: Sattawas Udonsat and Thanyalak Wangmuanklang; Data analysis: Palama Sobut and Sattawas Udonsat; Methodology, data interpretation, and final approval: All authors; Supervision: Thanyalak Wangmuanklang.

### Conflict of interest

The authors declared no conflict of interest.

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