From Symptoms to Diagnosis: Informing Health Promotion Strategies for Undiagnosed Diabetes Mellitus

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ABSTRACT
Diabetes mellitus remains a major global health concern, with a substantial proportion of cases remaining undiagnosed. Delayed detection is particularly problematic in countries with high disease burden, where individuals often present only after complications have developed. This study aimed to identify patient-recognizable "warning" indicators observed prior to formal diagnosis to inform health promotion and opportunistic screening strategies. This study used a qualitative case study approach, symptom experiences among previously undiagnosed individuals in Sleman, Yogyakarta, were explored and analyzed. The findings indicated that hypertension, neuropathic complaints (numbness and tingling), excessive daytime sleepiness, and persistent fatigue commonly preceded diagnosis. These manifestations function as pragmatic screening prompts when interpreted alongside established metabolic risk factors. In conclusion, diagnostic delay is effectively reduced by integrating symptom awareness into risk-based screening and structured referral pathways. Formalizing everyday symptom experiences as systematic entry points into healthcare services is essential to improve early detection for undiagnosed diabetes mellitus.
Keywords: diabetes mellitus prevention; health promotion; undiagnosed; screening

INTRODUCTION
Diabetes mellitus (DM) has emerged as a major global public health issue, principally due to the ongoing rise in the incidence of diabetes patients [1]. Globally, nearly half of those living with diabetes are unaware of their condition, and Indonesia currently ranks third globally for undiagnosed cases [2-6]. In the Special Region of Yogyakarta, DM remains a major public health concern. Data from 2024 indicate that 17,251 individuals in Yogyakarta City are living with DM, with a prevalence of 5.12% among individuals aged ≥15 years. Although healthcare services have been implemented in accordance with the standards mandated by the Ministry of Health Regulation No. 6 of 2024 (Indonesia), the relatively high prevalence reflects a substantial disease burden and underscores the need for more strategic approaches to early detection and health promotion [7,8].

Diabetes Mellitus (DM) may initially show no symptoms or only mild symptoms, and may go unrecognized, often leading sufferers to be unaware of how dangerous the disease is. The burden of diabetes is expected to escalate over time due to the significant incidence of prediabetes [9]. Diabetes, especially type 2 diabetes, develops very slowly and initially shows no symptoms. Even mild hyperglycemia can develop over years, so most people are unaware they have it until they begin to show classic signs of severe hyperglycemia, such as weight loss, blurred vision, frequent urination, and vomiting in the late stages of the disease. Manifestations of hyperglycemia can occur in various ways, including causing metabolic dysfunction in carbohydrates, fats, and proteins. Long-term hyperglycemia often leads to various microvascular and macrovascular diabetes complications, which account for most diabetes-related morbidity and mortality [10].

Diabetes Mellitus (DM) causes insulin resistance, which can prevent glucose from entering cells, often leading to energy deficiency in sufferers [11]. Vascular complications also contribute to 26.8% of deaths and disabilities related to DM globally [12]. Beside endangering the longevity and quality of life of diabetic patients, diabetic vascular problems burden public finances and healthcare systems worldwide [2]. Therefore, to develop new approaches for early intervention or prevention, healthcare professionals need to have a thorough understanding of vascular issues [2,13]. Additionally, the increasing prevalence of diabetes is also leading to a rise in neuropathy cases, necessitating improved identification and diagnostic methods, including screening, to prevent the disease from worsening [8].

Diabetes Mellitus (DM) may be detected and treated early in life by screening people who appear healthy, and complications related to the condition may be avoided or postponed [14]. Additionally, there is a widespread perspective among experts who believe that screening can provide far greater benefits than therapy [15]. Thus, screening for DM is an important first step for the successful implementation of diabetes prevention strategies, and effective diabetes care is crucial for preventing complications and death [9,16]. Additionally, the public's low level of knowledge about the symptoms and signs of diabetes often leads to them being indifferent to their complaints, causing them to completely avoid routine physical examinations even when bothersome symptoms have already appeared [17]. Currently, preventive screening efforts aimed at controlling the causes of diabetes include lifestyle improvements focused on managing nutrition and calorie intake, and increasing energy expenditure thru daily physical activity and regular aerobic exercise 3-5 days a week [18,19].

People with DM require effective primary care that includes prevention, early detection, and ongoing monitoring. Reduced monitoring of DM health can increase the risk of morbidity and mortality, leading to long-term implications such as the inability to recognize, prevent, and treat acute conditions [16]. By strengthening early detection of DM, especially through symptom recognition and health education, it is hoped that a preventive culture can be created and the prevalence of DM in Indonesia can be reduced [20]. Health education about diabetes has also been proven to improve public understanding of diabetes risk factors and increase public adherence to regular health checkups [21]. This study aims to identify patient-recognizable "warning" indicators observed prior to formal diagnosis and to examine their relevance for health promotion and opportunistic screening, specifically focusing on diagnostic trajectories in the Yogyakarta region.

METHODS
This study employed a qualitative embedded multiple-case study design to explore early symptom appraisal, interpretation processes, and diagnostic delay among individuals with previously undiagnosed DM. The study was theoretically informed by the Symptom Appraisal Model, which conceptualizes the pathway from bodily changes to healthcare consultation as a cognitive and social interpretative process. This theoretical lens guided both data collection and analysis by focusing on how individuals detect, interpret, normalize, or misattribute early symptoms prior to formal diagnosis.

The study was conducted at a primary healthcare facility in Sleman, Yogyakarta, Indonesia, between April 8 and December 16, 2025. The bounded context of the study was a structured community-based general health screening program delivered by trained healthcare professionals.

During the screening period, 117 adults attended the program. Among them, five individuals were newly identified as having glycemic levels consistent with DM despite having no prior diagnosis. These five individuals constituted the embedded cases examined in this study. The purpose was not to generalize prevalence but to deeply understand diagnostic trajectories within a real-world screening context.

Participants were selected using purposive criterion sampling. Inclusion criteria were: (1) age ≥18 years; (2) no prior diagnosis DM; (3) newly identified abnormal glycemic findings during screening; and (4) willingness to provide informed consent. All eligible individuals agreed to participate. In line with qualitative case study methodology, the focus was analytical depth rather than numerical adequacy. The inclusion of all newly identified cases within the defined context ensured completeness of case capture and strengthened internal coherence of the bounded system.

Data were collected through semi-structured, in-depth interviews conducted face-to-face in a private consultation room within the healthcare facility. Each interview lasted between 45 and 60 minutes. The interview guide was theoretically aligned with the Symptom Appraisal Model and explored: (1) initial recognition of bodily changes; (2) cognitive interpretation of symptoms; (3) perceived seriousness and vulnerability; (4) normalization or minimization processes; (5) social influences on interpretation; (6) decision-making regarding help-seeking; and (7) emotional response following diagnosis. All interviews were audio-recorded with participant consent and transcribed verbatim. Field notes documented contextual factors and non-verbal communication.

Data were analyzed using reflexive thematic analysis following Braun and Clarke's six-phase framework. Analysis combined inductive coding with theoretical sensitization derived from the Symptom Appraisal Model. Initial open coding allowed themes to emerge from participants' narratives. Subsequently, codes were examined in relation to theoretical constructs such as symptom detection, illness attribution, cognitive appraisal, and help-seeking triggers. Cross-case analysis was conducted to identify convergent and divergent diagnostic pathways across cases. Data saturation was considered achieved when iterative review of transcripts yielded no new conceptual categories and when thematic structures demonstrated coherence across cases.

Methodological rigor was ensured through multiple strategies. Credibility was enhanced through member checking, in which participants reviewed summaries of their narratives to confirm interpretive accuracy. Peer debriefing among the research team refined coding decisions and minimized individual analytic bias. An audit trail documented coding development, theme refinement, and theoretical integration, thereby supporting dependability and confirmability. Thick description of context, participant characteristics, and diagnostic trajectories was provided to enhance transferability. The study adhered to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines.

As researchers with a background in clinical medicine and public health, we were aware that our professional perspectives could influence how we interpreted the stories shared by participants. To ensure the findings remained grounded in the participants' actual experiences rather than our own medical assumptions, we practiced continuous reflexivity through personal journaling and frequent team discussions. Regarding ethics, we prioritized the dignity and rights of the participants throughout the process. Every individual provided written informed consent after a clear explanation of the study's purpose, and we ensured that their participation remained entirely voluntary. To protect their privacy, all data were strictly anonymized. Every step of this research was guided by the ethical spirit of the Declaration of Helsinki, focusing on the protection and confidentiality of those who shared their experiences with us.

RESULTS

Respondent characteristics

The total sample size for this study was 17 people, all of whom underwent a General Check-Up from April 8, 2025, to December 16, 2025. From the total sample, thru criterion sampling, a total of 5 respondents were obtained, consisting of 2 men and 3 women aged 51-60 years. All five participants were newly identified with glycemic values exceeding diagnostic thresholds [15]. Additionally, the respondents' BMI also showed diversity, with 1 respondent being underweight, one respondent being normal, and three respondents being overweight. Five individuals newly identified with previously undiagnosed DM during a structured community screening program were included as embedded cases. Participants were aged 51–60 years and presented with random blood glucose values exceeding diagnostic thresholds. While clinical indicators such as elevated blood pressure and diverse BMI profiles were observed, the focus of this analysis centers on how participants experienced, interpreted, and acted upon early bodily changes prior to formal diagnosis.

Table 1. Distribution of respondent characteristics

Initial	Age	Gender	Blood Sugar	BMI (Asia)	Blood Pressure	Symptoms
TM	58	Female	270	22.7 (Normal)	145/82	Numbness on hands and feet
SA	57	Male	357	23.4(Overweight)	213/116	Excessive sleepiness and fatigue
TR	52	Male	401	23.4(Overweight)	147/91	Foot pain and tingling
WA	60	Female	201	16.4 (Underweight)	156/86	Excessive sleepiness and fatigue
SF	51	Female	234	23.3 (Overweight)	142/76	Numbness on hands and feet

Theme 1: Symptom normalization and everyday attribution

Participants described experiencing bodily changes such as numbness, tingling, excessive sleepiness, and persistent fatigue long before diagnosis. However, these sensations were not initially interpreted as illness-related. Instead, they were normalized within the context of aging, occupational fatigue, or daily stress. Neuropathic sensations were frequently attributed to physical workload or "normal aging." Excessive daytime sleepiness (EDS) was framed as a consequence of inadequate rest rather than a metabolic signal. Fatigue was considered part of routine exhaustion rather than a symptom requiring medical attention. From the perspective of the Symptom Appraisal Model, this reflects a prolonged appraisal phase characterized by cognitive minimization. Bodily cues were detected but not labeled as pathological. The normalization process functioned as a cognitive buffering mechanism that delayed help-seeking behavior. This theme suggests that the absence of diagnostic awareness does not necessarily stem from absence of symptoms, but from interpretive framing that neutralizes perceived threat. Participants described early symptoms in distinctly different ways, reflecting varied cognitive framing processes.

"Well… I'm already in my fifties. Feeling numb sometimes, I thought that's normal at this age." (P3, female, 58)

"I leave home early, come back tired. Of course I feel exhausted. I never thought it was something medical." (P2, male, 57)

"I did feel something strange, especially the tingling. But I wasn't sure if it was serious… maybe just circulation problems." (P1, male, 52)

Theme 2: Functional disruption as the threshold for care-seeking

Symptom presence alone did not trigger consultation. Instead, healthcare engagement occurred only when symptoms began interfering with daily functioning. Participants reported seeking screening when fatigue impaired productivity, when sleepiness disrupted work routines, or when neuropathic pain became functionally limiting. This indicates that the tipping point for action was not symptom detection but perceived functional decline. In theoretical terms, help-seeking occurred after crossing an internal threshold of functional impairment rather than at the stage of initial symptom appraisal. This suggests that individuals tolerate prolonged metabolic disturbance until daily performance is compromised.

Such findings reinforce the notion that health promotion strategies relying solely on symptom education may be insufficient unless linked to perceived functional consequences.

"When my legs hurt so much I couldn't stand long at work, that's when I got worried." (P1, male, 52)
"Actually, I didn't plan to check. My wife insisted because I kept sleeping during the day." (P4, female, 60)
"I only checked because there was a screening event. Otherwise, I wouldn't." (P5, female, 51)

Theme 3: Hypertension as an incidental entry node into metabolic detection

All participants presented with elevated systolic blood pressure during screening. Importantly, none perceived hypertension as directly connected to diabetes risk prior to diagnosis. Hypertension functioned not as a consciously recognized warning sign, but as an incidental detection node within a broader metabolic clustering context. Blood pressure measurement during routine or opportunistic encounters created an entry point into glucose testing. Rather than conceptualizing hypertension as a symptom of diabetes, the data suggest it serves as a pragmatic screening trigger within community settings. Participants did not attribute elevated blood pressure to metabolic dysfunction, illustrating a disconnect between cardiovascular risk awareness and glycemic risk perception. This theme highlights the importance of integrating blood pressure screening with metabolic risk assessment, particularly in community-based programs. Although all participants presented with elevated blood pressure during screening, none interpreted hypertension as related to diabetes risk prior to diagnosis. However, the narratives revealed different degrees of awareness and detachment. One participant viewed hypertension as an isolated condition:

"Yes…., I knew my blood pressure was high before. But I thought that's a separate issue. I didn't think it had anything to do with sugar." (P2, male, 57)
"They told me my blood pressure was high a few times, but I felt fine. So I didn't worry about it." (P5, female, 51)
"I've heard that people with hypertension can get other diseases, but I didn't connect it specifically to diabetes." (P3, female, 58)
"They checked my blood pressure first, then suggested checking my sugar too. That's how I found out." (P4, female, 60)

These accounts suggest that hypertension functioned less as a patient-recognized warning sign and more as a system-activated entry node. The detection pathway was initiated not by cognitive risk appraisal but by procedural integration within the screening environment. All respondents also showed systolic blood pressure above 140 mmHg, with a range of 142 mmHg – 213 mmHg, which is in line with diagnostic standards for hypertension [27]. Data also shows that diabetes significantly increases the severity of hypertension and often allows sufferers to develop type 2 hypertension, indicating that diabetes plays a crucial role in the severity of hypertension, even more so than sociodemographic and lifestyle factors [28]. The results of this study indicate that high blood pressure is present in all respondents diagnosed with diabetes.

Theme 4: Neuropathic complaints as retrospective recognition signals

Neuropathic manifestations numbness, tingling, leg pain were prominent across cases. However, their significance was only recognized retrospectively, after glycemic abnormalities were identified. Prior to diagnosis, these symptoms were attributed to musculoskeletal strain, circulation issues, or aging. After diagnosis, participants reinterpreted these sensations as related to diabetes. This retrospective reattribution suggests that neuropathic symptoms may represent prolonged undetected hyperglycemia rather than early recognized warning signs. In other words, neuropathy may signal delayed diagnosis rather than early detection.

The coexistence of neuropathic symptoms with hypertension and overweight status in several cases further supports the concept of metabolic clustering rather than isolated symptom progression. Neuropathic symptoms were described with varying intensity and duration, yet consistently interpreted as benign or unrelated prior to diagnosis. One participant described progressive discomfort:

"It started as mild tingling in my toes. I ignored it at first. Later it became more frequent, but I still thought it was just poor circulation." (P1, male, 52)
"Sometimes my hands felt numb at night. I wondered about it, but I didn't think it was serious enough to see a doctor." (P3, female, 58)
"My legs hurt, especially after standing long hours. I assumed it was because of work." (P1, male, 52)
"Now I realize the tingling might have been from high sugar. Before, I never made that connection." (P2, male, 57)

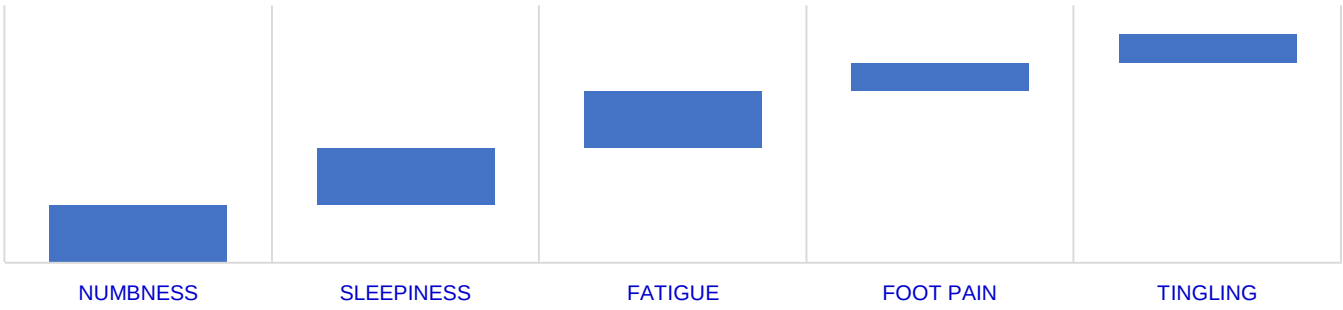

Figure 1. Symptoms distribution

Respondents admitted to having several symptoms that were considered truly bothersome during the examination, namely: numbness in the feet and hands was reported by two respondents, excessive sleepiness was reported by two respondents, fatigue was reported by two respondents, leg pain and tingling were each reported by one respondent, with a total of seven report from five respondents (Figure 1).

Theme 5: Non-specific symptoms as cognitive activation points

Respondents reported excessive sleepiness and fatigue as symptoms that disrupted their daily activities. Respondents SA and WA, 40% of the total respondents, reported the same complaints. Excessive daytime sleepiness and persistent fatigue emerged as recurrent complaints. Although non-specific and multifactorial, these symptoms functioned as experiential disturbances that eventually prompted screening participation. Participants did not interpret these symptoms as indicative of diabetes; however, when combined with incidental screening opportunities, they became cognitive activation points moments where symptom experience intersected with health system access. This finding underscores an important conceptual distinction: non-specific symptoms may not guide self-diagnosis, but they can facilitate engagement with screening pathways when appropriate systems are accessible. Sleepiness and fatigue were among the most functionally disruptive complaints. However, their interpretation varied substantially across participants.

"I sleep late because of family responsibilities. So feeling sleepy during the day felt normal." (P4, female, 60)
"Work is demanding. Everyone feels tired. I didn't think it was illness." (P2, male, 57)
"It wasn't just tired. It felt different. I would wake up already exhausted." (P3, female, 58)
"I kept telling myself to rest more first. I didn't immediately think about checking my blood sugar." (P5, female, 51)

Cross-theme synthesis: From silent experience to system-triggered diagnosis

Across cases, diagnosis did not occur through proactive symptom interpretation. Instead, it emerged from the intersection of three elements: persistent but normalized bodily change, functional disruption reaching a tolerability threshold, and opportunistic screening within community or primary care contexts. This pattern suggests that undiagnosed diabetes may persist not because individuals lack symptoms, but because symptom meaning is socially and cognitively reframed as non-pathological. The findings reposition "warning indicators" not as diagnostic markers, but as latent experiential cues that require structured screening ecosystems to translate into formal detection.

Although most participants normalized their symptoms, one case demonstrated partial early suspicion of metabolic disturbance. This participant reported sensing that something was "not usual," yet delayed testing due to emotional hesitation rather than cognitive misattribution.

Actually, I did feel something wasn't right. The tingling felt different. But I was afraid to check. I thought, what if it turns out to be something serious?" (P2, male, 57)

Unlike other participants who attributed symptoms to aging or work strain, this individual entertained the possibility of illness but postponed screening due to anticipatory anxiety. The delay was therefore not driven by normalization but by avoidance behavior. This deviant case complicates the overall pattern. It suggests that diagnostic delay may arise from different psychological mechanisms: Cognitive normalization (majority cases), and Emotional avoidance (deviant case)

DISCUSSION

DM is widely described as asymptomatic or minimally symptomatic in its early stages, contributing to delayed diagnosis [9,14]. While epidemiological evidence supports the notion that hyperglycemia may progress silently, the present findings suggest that diagnostic delay is not solely attributable to physiological subtlety. Rather, it reflects a complex interplay between symptom experience, cognitive interpretation, and health system responsiveness. Participants in this study reported experiencing neuropathic sensations, persistent fatigue, EDS, and elevated blood pressure prior to diagnosis. However, these bodily disturbances were cognitively reframed as normal consequences of aging, occupational strain, or lifestyle-related exhaustion. Thus, the primary barrier to early detection was not the absence of symptoms, but the absence of illness attribution. Within the framework of the Symptom Appraisal Model, bodily changes are filtered through cognitive and social interpretations before being labeled as illness. In this study, normalization and misattribution dominated this appraisal stage, delaying help-seeking behavior. These findings extend existing screening literature [9,15] by demonstrating that undiagnosed diabetes represents both a biological and an interpretive gap.

Functional disruption as the threshold for care seeking

A consistent pattern emerged across cases: participants sought medical evaluation only when symptoms interfered with functional capacity. Fatigue, neuropathic discomfort, and excessive sleepiness became clinically meaningful when they impaired work performance, mobility, or daily responsibilities. Although fatigue and neuropathic symptoms are well documented among individuals with diabetes [36,37], their mere presence did not prompt early screening. Instead, healthcare engagement was triggered by perceived disruption of social and occupational roles. This finding suggests that individuals may tolerate progressive metabolic disturbances as long as functional integrity remains intact.

From a health promotion perspective, this has important implications. Risk communication strategies that focus exclusively on long-term complications may lack immediacy and behavioral relevance. Messaging that emphasizes tangible functional consequences, such as decreased energy, impaired productivity, or reduced mobility may be more effective in encouraging earlier screening uptake.

Hypertension as an incidental entry node into metabolic detection

In this study, the data show that all respondents included in the study's inclusion criteria had blood pressure above 140 mmHg. Diabetes and hypertension are common metabolic disorders that often occur simultaneously in the same individual, significantly worsening the patient's overall condition, particularly in relation to the risk of vascular disease and organ dysfunction [29]. The majority of people, including in Indonesia, often do not prioritize health screenings. Random or incidental screenings frequently reveal that many people with undetected diabetes, which often manifests as high systolic blood pressure, are not identified. Data indicates that many people are still reluctant or have never had their blood sugar or blood pressure checked at all, citing the absence of significant symptoms that disrupt their activities [29,30]. Even though people are aware of their DM diagnosis, they often don't realize how important regular health screenings are, especially since diabetes can be asymptomatic. Monitoring and screening of blood pressure and blood sugar in the community are considered capable of raising widespread public awareness about the risks of diabetes, including its complications and the risks that occur during the course of the disease [30]. Screening is also a necessary preventive step to avoid and stop the progression of worsening public health conditions in the future [31].

Hypertension and DM frequently coexist and share overlapping pathophysiological mechanisms [29]. Nevertheless, participants conceptualized hypertension as a separate and unrelated condition. This fragmentation of cardiometabolic risk perception reflects limited integration of metabolic literacy at the community level. Importantly, hypertension did not function as a self-recognized warning sign of diabetes. Instead, it operated as a procedural gateway within the structured screening environment. Measurement of elevated blood pressure prompted glucose testing, thereby facilitating diagnosis. This finding underscores the importance of integrating glycemic screening within existing hypertension programs. Diagnostic standards for hypertension are well established [27], and opportunistic screening strategies are recommended for high-risk populations [9,14]. Evidence from Indonesia further indicates that screening uptake is influenced by awareness and health-seeking behaviors [30]. Therefore, positioning elevated blood pressure as a pragmatic trigger for glucose testing may reduce diagnostic delay more effectively than symptom-based education alone.

Neuropathic complaints as retrospective recognition signals

Respondents complained of numbness, leg pain, and tingling, which are classic symptoms of neuropathy, particularly Distal Symmetric Polyneuropathy (DSPN), the most common type of neuropathy in pre-diabetic and diabetic patients. The severity of DSPN varies between individuals, occurring in approximately 30% of diabetic patients [8,32]. TR respondents simultaneously complained of two events as bothersome: leg pain and tingling, while TF and SM respondents both complained of numbness in their feet and hands. Numbness in the feet and hands, as well as leg pain, is also known as 'stocking and glove' and is a common manifestation of DSPN, often described as a complaint in chronic diabetes patients [8]. These symptom patterns may reflect prolonged metabolic exposure; however, duration cannot be established within this qualitative design. These patterns suggest potential experiential cues that may warrant further investigation.

Pain in neuropathy often describes burning, stabbing, or even electric shock-like sensations, frequently accompanied by hyperalgesia or an excessive response to painful stimuli [33]. The increasing incidence of polyneuropathy in diabetic patients highlights the urgent need for neuropathic pain screening tools, including for further diagnostic evaluation. This also indicates that screening prediabetic patients reporting symptoms of DSPN should be considered in clinical practice to simultaneously reduce the prevalence of diabetes and DSPN[33]. All three respondents were also reported to have hypertension, and respondents TR and SF were also classified as overweight. DSPN also frequently occurs and is often exacerbated in individuals with metabolic disorders such as obesity and hypertension [8,34].

The development of neuropathy in pre-diabetic and diabetic patients often occurs slowly, starting from the distal sides of the toes and feet as a whole, gradually moving upwards and eventually involving the fingers and hands. Diabetes screening should recognize these 'warning' signs more carefully, and more attention should be paid to the distal condition of the feet in individuals suspected of having diabetes, including an assessment of the integumentary system, articulations, and vascular statuses [32].

Peripheral neuropathy, particularly distal symmetric polyneuropathy (DSPN), is a recognized complication of diabetes and may be present at or near the time of diagnosis [8,32,33]. In this study, neuropathic complaints including numbness, tingling, and leg pain were frequently reported. However, these symptoms were initially attributed to musculoskeletal strain or aging rather than metabolic dysfunction. Only after diagnosis did participants reinterpret neuropathic sensations as diabetes-related. This retrospective reappraisal suggests that neuropathy in undiagnosed individuals may signal prolonged hyperglycemic exposure rather than serve as an early detection trigger. Although neuropathic screening and evaluation are clinically recommended [33], symptom ambiguity at the community level limits their effectiveness as standalone indicators. These findings highlight the need for public education that improves not only symptom awareness but also symptom interpretation, particularly in individuals with concurrent metabolic risk factors [8,34].

Non-specific symptoms as cognitive activation points

EDS has been reported among individuals with type 2 diabetes and is associated with metabolic and behavioral factors [35]. Similarly, fatigue is a multidimensional symptom linked to glycemic dysregulation, psychological burden, and diminished self-management capacity [36,37]. Despite their prevalence, both EDS and fatigue are non-specific and highly common in the general population. In this study, participants attributed these symptoms primarily to workload or sleep habits. This normalization underscores the limitations of symptom-based detection strategies. Rather than positioning EDS and fatigue as diagnostic indicators, a more scientifically defensible approach is to frame them as activation cues within risk-based screening models. When these symptoms coexist with established risk factors such as hypertension, overweight status, or advancing agethey should prompt opportunistic testing within accessible screening systems [9,14,20,21].

EDS is a very common symptom found in type 2 DM patients, exceeding the incidence in normal individuals. Data even records that more than a quarter of diabetic patients experience excessive sleepiness, especially during the day, indicating a significant correlation between excessive sleepiness and diabetes [35]. This data aligns with the complaints reported by respondents in this study; 2 out of 5 patients complained of excessive sleepiness as a symptom that interfered with their activities, making EDS one of the 'warning' signs that can be found in diabetic patients. EDS is strongly associated with a decrease in self-motivation, particularly regarding daily physical activity, which can even lead to mood/emotional instability, thus directly hindering diabetes management and causing an increase in glycosylated hemoglobin and microvascular complications [35].). Rapid identification of these symptoms, especially in the early stages of diabetes, can reduce the prevalence of complications and provide opportunities for diabetes patients to manage themselves more effectively [20,35].

Fatigue, both physical and mental, is a clinically subjective perception that is common and experienced by diabetes patients. This symptom has been shown to cause a decline in physical function, increase the burden of diabetes, and also increase the incidence of type 2 diabetes complications [36]. Diabetes causes insulin resistance, which can prevent glucose from entering cells, often leading to energy deficiency in sufferers [11]. Persistent fatigue, a multidimensional symptom caused by uncontrolled blood sugar levels, psychological factors, and lifestyle, is strongly correlated with poor self-management in diabetic patients, which can lead to an increased incidence of depression, reduced sleep quality, and overall patient health [37]. This indicates that fatigue should be considered a 'warning' and a sign of diabetes in patients. Recognizing these symptoms in patients who have not yet been diagnosed with diabetes will increase the likelihood of more appropriate treatment for patients. Interventions for fatigue in patients need to be developed, including combining diabetes self-management with depression symptom management and sleep management, with the goal of improving patients' overall health [37].

The inclusion of a deviant case revealed an alternative pathway of diagnostic delay; unlike participants who normalized their symptoms, this individual suspected illness but postponed testing due to fear of a serious diagnosis. This finding introduces emotional avoidance as a secondary mechanism contributing to delayed detection, as screening initiatives often emphasize knowledge deficits, however, emotional barriers, such as fear, anxiety, or perceived consequences, may also inhibit engagement. Effective screening programs must therefore address both cognitive

literacy and emotional readiness, incorporating supportive communication strategies that reduce anticipatory anxiety. Across themes, diagnosis occurred at the intersection of three interrelated processes: persistent but normalized bodily symptoms, functional disruption exceeding tolerance thresholds, and structured screening integration linking blood pressure and glucose testing.

These findings suggest that undiagnosed diabetes is neither solely an individual-level failure nor exclusively a system-level deficiency; rather, it emerges from the interaction between cognitive appraisal processes and health system infrastructure. Community-based screening initiatives in Indonesia demonstrate potential for improving early detection [20,21,30], but fragmentation between hypertension and diabetes services may limit effectiveness. Reducing diagnostic delay requires integrated cardiometabolic screening platforms, risk-based protocols [9,14,15], clear confirmatory pathways, and strengthened linkage-to-care systems. This study advances understanding of undiagnosed DM by integrating symptom appraisal theory with public health screening frameworks, reframing warning indicators not as standalone diagnostic markers but as experiential cues requiring structured translation into confirmatory care.

By highlighting the roles of normalization, functional tolerance, fragmented risk perception, and emotional avoidance, this study shifts the focus from passive symptom recognition to system-enabled activation within integrated detection pathways. The embedded case design enabled in-depth exploration of cognitive and behavioral processes underlying delayed diagnosis within a real-world screening context. However, the limited sample size and single-site setting restrict transferability. Retrospective recall may also influence participants' reinterpretation of pre-diagnostic experiences. Future research should explore sociocultural influences on symptom normalization, gender-based differences in appraisal processes, and structural determinants of screening uptake across diverse populations.

CONCLUSION

This study identifies hypertension, neuropathic complaints, excessive daytime sleepiness, and persistent fatigue as critical patient-recognizable "warning" indicators that precede the formal diagnosis of DM. While these manifestations are not diagnostic in isolation, they function as pragmatic screening prompts that facilitate earlier symptom appraisal and healthcare engagement in real-world contexts. Importantly, the findings highlight how these early symptom experiences shape diagnostic trajectories, particularly in the Yogyakarta setting, where delayed care-seeking remains a significant challenge. Reducing diagnostic delay therefore depends on the health system's capacity to integrate these patient-recognizable cues into structured, risk-based screening and referral pathways. To strengthen health promotion strategies, clinical approaches should shift from isolated symptom messaging toward coordinated detection models that explicitly connect everyday bodily experiences with metabolic risk assessment. Reframing symptom experiences as a systematic gateway to early detection offers a context-sensitive strategy to improve diagnostic pathways. Although limited in scope, this study provides a conceptual foundation for enhancing the effectiveness of community-based screening and improving early detection strategies for undiagnosed DM, particularly in similar resource-constrained settings

Ethical consideration, competing interest and source of funding

-The study was approved by the Health Research Ethics Committee of Universitas Muhammadiyah Yogyakarta (No. 080/EC-KEPK FKIK UMY/IV/2026) and was conducted in accordance with the ethical principles of the Declaration of Helsinki. Although this research involved no clinical intervention or invasive procedures, the researchers strictly adhered to ethical standards by ensuring all participants provided written informed consent prior to data collection. Participation was entirely voluntary, and participants were informed of their right to withdraw at any stage without penalty. To protect privacy, all data were anonymized, and no identifiable personal information is disclosed in this report.
-The authors declare that there are no competing interests or financial conflicts regarding the publication of this manuscript.
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