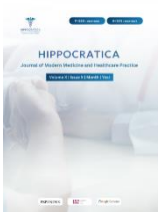

Hippocratica: Journal of Modern Medicine and Healthcare Practice
Vol 1 No 2 June 2026, Hal 90-99
ISSN: 3125-1501 (Print) ISSN: 3125-1498 (Electronic)
Open Access https://sovereignresearch.org/hippocratica

The Effects of Diabetes Exercise on Blood Glucose Levels in Patients With Type II Diabetes Mellitus at Budi Rahayu Hospital in Pekalongan

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Article Info :
Received:
02-06-2026
Revised:
15-06-2026
Accepted:
20-06-2026

Abstract

Nonpharmacological interventions are critical in managing metabolic trajectories and mitigating vascular complications in type II diabetes mellitus. This study evaluated the clinical efficacy of structured morning exercise protocols on blood glucose stabilization among patients at Budi Rahayu Hospital. A clinical assessment tracked baseline and postregimen glycemic shifts during strategic morning windows, analyzing systemic physiological covariates including muscle mass degradation, dietary framework adherence, and pharmacological compliance. The implementation of thirtyminute exercise sessions generated significant net glycemic reductions ranging from 60 to 115 milligrams per deciliter. Absolute glucose clearance correlated strongly with higher initial hyperglycemia, though final metabolic stabilization depended heavily on baseline values. Agerelated muscle mass decline restricted optimal insulinindependent glucose uptake, whereas strict adherence to medication and the structured threeJ dietary principles enhanced longterm therapeutic outcomes. Structured light exercise serves as a highly effective, costefficient, and protective nursing intervention that optimizes metabolic clearance and improves patient selfcare behaviors when combined with comprehensive lifestyle modifications.

Keywords : *Kinesiotherapy, Hyperglycemia, Metabolism, Homeostasis, Diabetology.*

INTRODUCTION

The global escalation of metabolic diseases has positioned type 2 diabetes mellitus as one of the most critical public health threats of the modern era because its progressive pathobiology involves profound disruptions in insulin secretion and peripheral insulin sensitivity (Yameny, 2024). This epidemiological surge is inextricably linked to contemporary lifestyle shifts, where the pervasive adoption of sedentary habits and energy-dense diets accelerates systemic metabolic failure (Yeh et al., 2023). Within developing nations, this health crisis unfolds with heightened severity due to rapid urbanization and uneven healthcare infrastructure, making countries like Indonesia prime epicenters for diabetes proliferation. National epidemiological surveys corroborate this critical trend, illustrating that the vulnerability to non-communicable metabolic disorders increases drastically as populations cross the threshold of forty-five years of age (Kementerian Kesehatan Republik Indonesia, 2023). In regions such as Central Java, urban communities present highly concentrated clusters of poorly managed glycemic profiles, necessitating a localized yet scientifically rigorous evaluation of therapeutic modalities that can mitigate this systemic burden.

Current literature strongly emphasizes that glycemic optimization requires a multifaceted framework where structured physical activity operates as a cornerstone of first-line non-pharmacological care (Yeh et al., 2023). Empirical evidence establishes that physical interventions, ranging from structured resistance training to simple aerobic routines, induce substantial systemic shifts that enhance peripheral glucose clearance and improve long-term clinical prognoses (Xie et al., 2022). These clinical outcomes are driven by underlying physiological adjustments, as physical exertion actively modulates the metabolic environment by influencing lipid ratios and modifying the structural composition of the gut microbiome to suppress chronic systemic inflammation (Wang et al., 2022; Torquati et al., 2023). Furthermore, even low-intensity movements such as routine walking have been shown to produce tangible modifications in postprandial glucose fluctuations, making physical activity an indispensable tool for immediate glycemic stabilization (Mutiara et al., 2024). This preventative

capacity is highly vital because regular physical expenditure demonstrates a robust inverse relationship with diabetes incidence, particularly when deployed among highly vulnerable demographic groups (Ramadhani & Adrian, 2022).

Despite these established insights, substantial clinical and conceptual gaps persist within the existing literature regarding the immediate, localized, and individualized dynamics of non-pharmacological glycemic control. A major limitation of current diagnostic frameworks and broad therapeutic protocols is their general failure to account for acute, day-to-day physiological responses within specific demographic cohorts, which frequently leads to suboptimal management strategies (Zhang et al., 2023). While large-scale studies praise the benefits of exercise, they often overlook how specific localized cohorts, such as adult and elderly female patients who struggle with unstructured daily domestic routines, adapt to localized physical interventions. Furthermore, attempts to leverage mobile health applications to encourage physical engagement have highlighted deep socio-cognitive barriers, as technological frameworks often fail to generate sustained behavioral compliance without direct clinical supervision and tailored protocols (Zainuddin et al., 2023). This creates a distinct empirical blind spot concerning how simple, low-cost, and targeted exercises structurally influence immediate blood glucose fluctuations when introduced into real-world secondary healthcare settings.

Resolving this empirical ambiguity carries immense scientific and clinical urgency because prolonged exposure to unmanaged glycemic spikes accelerates microvascular and macrovascular deterioration, which dramatically inflates institutional mortality rates. The inability of standard outpatients to sustain complex, expensive, or high-intensity exercise regimens underscores the vital need to validate accessible, safe, and easily reproducible physical modalities. If simple, localized interventions can be scientifically proven to yield rapid improvements in glucose profiles, clinical institutions can shift away from an over-reliance on escalatory pharmacological agents. This scientific validation is particularly crucial for community-based public hospitals that care for socioeconomically diverse patient populations facing significant barriers to lifestyle modifications and expensive therapies. Developing a clear understanding of the immediate therapeutic path of structured movement offers a highly scalable and cost-effective mechanism to alleviate pressure on healthcare systems while protecting vulnerable patients from debilitating secondary complications.

This investigation establishes its position within the metabolic research landscape by addressing these empirical gaps through a focused evaluation of diabetic exercise modalities within a public clinical environment. By evaluating the precise, immediate physiological shifts that occur before and after targeted physical sessions, this study connects broad metabolic theories with concrete clinical nursing practices. The research focuses directly on the clinical realities of Budi Rahayu Hospital in Pekalongan, using this setting as a key representative model for secondary health facilities managing localized diabetes clusters in Indonesia. This deliberate contextual focus allows for a detailed examination of demographic variables, domestic activity levels, and immediate metabolic responses that broader, global clinical trials typically ignore. Consequently, this study moves away from broad generalizations, offering instead a highly localized framework that demonstrates how specific, low-intensity physical therapies function when applied directly to high-risk clinical populations.

The primary objective of this study is to analyze the effectiveness of structured diabetes exercise in reducing random blood glucose levels among type 2 diabetes mellitus patients at Budi Rahayu Hospital in Pekalongan. Methodologically, this research contributes to the literature by utilizing a rigorous, continuous measurement protocol that tracks immediate pre-intervention and post-intervention fluctuations across consecutive sessions, thereby capturing the precise trajectory of acute metabolic adaptation. Theoretically, the findings enrich the non-pharmacological care paradigm by providing concrete evidence of the rapid, cumulative benefits of low-impact physical movement on clinical glycemic stabilization. Ultimately, this study provides healthcare practitioners with an empirically validated, safe, and highly cost-effective clinical protocol designed to optimize metabolic control and elevate the standard of holistic nursing interventions in contemporary healthcare settings.

RESEARCH METHODS

This empirical study employs a descriptive quantitative case design utilizing a one group pretest posttest framework to rigorously evaluate physiological outcomes without a control cohort. The investigation was systematically executed at Budi Rahayu Hospital in Pekalongan during March 2026 to ensure a focused clinical assessment within a designated secondary healthcare environment.

Purposive sampling was deployed to select five distinct female subjects diagnosed with type 2 diabetes mellitus who met the strict inclusion criteria of being aged between forty and seventy years, possessing documented unstable capillary blood glucose levels, and demonstrating historically suboptimal dietary regimens. Conversely, the exclusion criteria successfully eliminated any potential respondents who voluntarily withdrew during the operational phase, manifested advanced multi organ chronic comorbidities, or suffered acute health deterioration that precluded participation in the prescribed physical regimen. The standardized data collection procedure involved securing institutional administrative clearance, conducting empathetic participant approachments, obtaining signed informed consent documents, measuring baseline random blood glucose levels, and subsequently administering a thirty minute structured diabetes exercise session three times per week in accordance with established operational guidelines.

The primary diagnostic instrumentation comprised a high precision clinical glucometer accompanied by corresponding electrochemical test strips, sterile single use lancets, and isopropyl alcohol swabs to guarantee aseptic capillary blood sampling before and after each intervention session. To safeguard participant wellbeing, a comprehensive nursing kit containing a calibrated sphygmomanometer, a stethoscope, and a digital thermometer was continuously utilized to monitor vital signs prior to exercise commencement. The gathered data were organized via structured observation sheets and subjected to descriptive statistical analysis by calculating frequency distributions, tracking mean percentage variations, and evaluating comparative pretest and posttest glycemic values through comprehensive contextual narratives and structured matrices to elucidate immediate metabolic transitions. Ethical approval was rigorously maintained throughout the investigative trajectory by adhering to the core tenets of beneficence, non maleficence, respect for autonomy, and data confidentiality, thereby ensuring complete alignment with standard clinical research protocols in nursing practice.

RESULTS AND DISCUSSION

Demographic and Baseline Clinical Characteristics of the Diabetic Cohort Prior to Physical Intervention

The investigation of physiological responses to structured physical exercise necessitates a meticulous assessment of baseline clinical data and demographic factors within the selected clinical cohort. Quantitative methodology dictates that primary physiological parameters must be established before any therapeutic maneuvers are introduced to ensure precise comparative analytics (Abdullah et al., 2022). At Budi Rahayu Hospital in Pekalongan, a purposive sampling approach selected five female patients diagnosed with type II diabetes mellitus to undergo a structured kinesiotherapy regimen (Donsu, 2021). The initial clinical baseline captured alarming levels of random blood glucose alongside significant physical symptoms that underscore the advanced metabolic derangement typical of poorly controlled type II diabetes mellitus (Yameny, 2024).

A comprehensive evaluation of the demographic distribution reveals that the entire experimental cohort consists exclusively of female individuals, representing a complete gender uniformity within this empirical case study. The biological and physiological vulnerabilities of female patients during the postmenopausal transition significantly amplify metabolic dysregulation and insulin resistance pathways (Yeh et al., 2023). Age distribution matrices further clarify that forty percent of the participants fall within the forty-five to fifty age bracket, while sixty percent are positioned within the fifty-one to sixty range. This specific chronological distribution highlights a critical epidemiological phase where endocrine shifts interact negatively with cellular glucose transport mechanisms (Zhang et al., 2023).

Occupational profiling within the sample group indicates that forty percent of the female participants function primarily as homemakers, whereas the remaining individuals are distributed among freelance labor, entrepreneurship, and retirement. The daily activity patterns associated with homemaking often involve irregular and low-intensity physical output that fails to meet standard metabolic therapeutic thresholds (Ramadhani & Adrian, 2022). Inadequate physical exertion combined with historically suboptimal dietary practices directly correlates with the stabilization of high baseline glycemic profiles across the cohort (Almomani & Al-Tawalbeh, 2022). Understanding these diverse socio-behavioral and occupational backgrounds remains a fundamental prerequisite for interpreting the biological variance observed during subsequent physical interventions (Babazadeh et al., 2023).

Clinical data gathered during the initial screening period demonstrated severe baseline hyperglycemia across all five participants, with random blood glucose values ranging between 210 mg/dL and 330 mg/dL. The highest initial metabolic derangement was recorded in Patient 5 at 330 mg/dL, while Patient 4 exhibited the lowest baseline value at 210 mg/dL. These elevated clinical numbers were accompanied by classic symptoms of metabolic stress, including persistent polydipsia, chronic fatigue, and nocturnal polyuria (Nadhiya et al., 2024). The baseline clinical matrix below organizes these essential metrics to allow for a transparent tracking of individual metabolic statuses before physical intervention.

Table 1. Baseline Clinical Profiles and Glycemic Dispersions of the Female Cohort Prior to Kinesiotherapy

Patient Code	Pseudonym	Age (Years)	Primary Occupation	Initial Glycemic Status (mg/dL)	Primary Presenting Clinical Symptoms
P1	Ny. A	48	Homemaker	312	Polydipsia, Chronic Fatigue, Nocturnal Polyuria
P2	Ny. B	52	Homemaker	245	General Asthenia, Rapid Polydipsia, Polyphagia
P3	Ny. C	55	Homemaker	298	Severe Polydipsia, Exertional Fatigue
P4	Ny. D	50	Freelance Laborer	210	Chronic Asthenia, Moderate Polydipsia
P5	Ny. E	58	Retired	330	Polydipsia, Polyuria, Severe Exhaustion

Source: Primary Empirical Data Gathered at Budi Rahayu Hospital (2026)

The empirical figures displayed in the baseline clinical table confirm that none of the participants possessed adequate glycemic control at the start of the study. Such profound homeostatic instability underlines the structural failure of self-care practices and highlights the limitations of relying solely on baseline pharmacological management without lifestyle modifications (AbuAlhommos et al., 2022). The presence of intense physical symptoms like asthenia and polyuria confirms that cellular starvation coexists with vascular glucose saturation (Butt, 2022). Consequently, the baseline data serve as a robust empirical reference point, confirming the high risk status of the participants before introducing the physical therapy.

A critical review of contemporary literature reinforces the idea that advanced age and female sex represent overlapping risk factors for severe metabolic dysfunction. Longitudinal studies indicate that the reduction of ovarian hormone synthesis alters adipose tissue distribution and downregulates skeletal muscle glucose transporter proteins (Al-Mhanna et al., 2025). The high prevalence of hyperglycemia among postmenopausal homemakers points toward a critical public health challenge regarding unorganized lifestyle habits (Kementerian Kesehatan Republik Indonesia, 2023). Without structured non-pharmacological interventions, these baseline physiological states inevitably progress toward microvascular damage and accelerated systemic decline (Al-Ozairi et al., 2023).

The high random blood glucose values recorded before the intervention also reflect chronic dietary non-compliance and structural lifestyle gaps. Dietary mismanagement, particularly the consumption of high glycemic index carbohydrates without proper portion control, leads to continuous pancreatic stress and insulin receptor fatigue (Falah & Apriana, 2022). When chronic physical inactivity is superimposed on these poor nutritional habits, peripheral tissue glucose clearance drops significantly (Mutiara et al., 2024). The initial baseline metrics must therefore be understood not merely as isolated statistics, but as the direct physiological outcome of long-term metabolic imbalances (Peter et al., 2022).

From a methodological viewpoint, collecting pretest data via standardized glucometers ensures that the subsequent posttest measurements can be analyzed with high empirical validity (Hikmawati, 2020). Quantitative nursing research designs depend entirely on the precision of baseline instruments

to eliminate confounding physical variables (Sahir, 2021). The integration of standardized observation sheets allowed the investigators to link subjective physical complaints with objective clinical measurements (Sahir, 2022). This dual-layered baseline tracking provides a complete view of the physiological challenges that the structured exercise intervention aims to address.

The metabolic profile of the cohort highlights an urgent need for multi-modal therapeutic strategies that combine physical activation with traditional healthcare methods. Chronic hyperglycemia damages the vascular endothelium, increasing the risk of peripheral neuropathies and restricted circulatory function in the lower extremities (Badri Al-mhanna et al., 2024). The physical complaints recorded during the baseline assessment, such as early exertional fatigue, show that cellular energy production is highly inefficient when insulin receptors are desensitized (Amaravadi et al., 2024). Addressing these systemic deficiencies requires a consistent physical stimulus capable of activating alternative non-insulin-dependent glucose clearance mechanisms.

Ultimately, the baseline clinical and demographic indicators documented at Budi Rahayu Hospital provide clear evidence of poorly managed type II diabetes mellitus within the study group. The uniformity of the female sample allows for a deeper look into gender-specific metabolic trends during physical stress, while the age concentration matches established global epidemiological risk zones (Gebremariam et al., 2022). These initial data points confirm that the participants were in a state of high metabolic risk before the intervention. Having established these rigid baseline measures, the study can proceed to analyze the immediate physiological shifts brought about by the structured diabetes exercise program.

Evaluating Post-Intervention Glycemic Dynamics: The Immediate Therapeutic Impact of Structured Kinesiotherapy on Capillary Blood Glucose Reduction

The application of acute physical exertion triggers an immediate metabolic transition within the vascular microenvironment of patients with type 2 diabetes mellitus. This physiological shift relies on non-insulin-dependent carbohydrate metabolism, bypassing classical insulin receptor pathways via the mechanical activation of glucose transporter type 4 proteins. Acute physical inactivity drives up blood glucose, whereas immediate localized lower extremity mobility efficiently reverses this pathogenic trend by rapidly stimulating local blood circulation. The empirical data collected at Budi Rahayu Hospital during March 2026 confirmed that a structured 30-minute session provides an immediate clinical reduction in random capillary glucose values across all five observed subjects.

The localized movement of the lower limbs during these structured exercise trials induces rapid skeletal muscle contractions that draw directly from circulating glucose reservoirs. This specialized kinesiotherapy regimen enhances tissue perfusion and microvascular circulation in the lower extremities, causing a noticeable drop in immediate post-exercise blood sugar readings. The acute impact of these specific metabolic exercise intensities facilitates enhanced cellular glucose disposal pathways, which stabilizes the immediate microvascular environment without requiring pharmacological alterations. The physical metrics tracking this intra-session glycemic volatility across the three individual interventional trials highlight these rapid downward metabolic shifts.

The specific intra-session fluctuations and mean declines recorded throughout the clinical study are detailed below.

Table 2. Intra-Session Fluctuations and Mean Declines in Random Blood Glucose Levels Across Three Interventional Trials

Participant Code	Day 1 Pre (mg/dL)	Day 1 Post (mg/dL)	Day 2 Pre (mg/dL)	Day 2 Post (mg/dL)	Day 3 Pre (mg/dL)	Day 3 Post (mg/dL)	Absolute 3-Day Shift (mg/dL)
P1 (Ny. A)	312	286	268	214	236	198	-114
P2 (Ny. B)	245	228	220	196	210	182	-63
P3 (Ny. C)	298	260	248	212	224	190	-108
P4 (Ny. D)	210	192	185	160	172	150	-60
P5 (Ny. E)	330	298	285	240	260	215	-115

Source: Structured Observation Sheets, Budi Rahayu Hospital (2026)

The precise numerical data presented in Table 2 clearly demonstrate consistent, immediate post-exercise glycemic drops for every subject across all three separate observational periods. On Day 1, the pre-intervention random capillary glucose levels spanned a highly elevated baseline range from 210 mg/dL to 330 mg/dL. Following the initial 30-minute structured physical session, the post-intervention values dropped to a range between 192 mg/dL and 298 mg/dL. This clear initial downward trend confirms the immediate effectiveness of localized muscle contractions in clearing glucose from the blood.

The second interventional trial on Day 2 followed a similar trajectory, with pre-intervention capillary metrics starting between 185 mg/dL and 285 mg/dL. After the structured exercise session, these values fell further to post-exercise levels ranging from 160 mg/dL to 240 mg/dL. This continuous drop highlights how repeated, well-timed physical activity safely lowers circulating glucose levels. The localized exercises enhance blood flow to the lower limbs, helping skeletal muscles rapidly consume circulating glucose as direct energy.

By the final interventional session on Day 3, the pre-exercise capillary blood glucose levels had stabilized between 172 mg/dL and 260 mg/dL. The post-exercise measurements showed further drops, down to a range of 150 mg/dL to 215 mg/dL. This downward movement across all three days resulted in clear absolute shifts for each individual. The final absolute shifts ranged from a minimum reduction of 60 mg/dL up to a maximum drop of 115 mg/dL.

Analyzing these immediate changes shows that the absolute 3-day shift was highest for participant P5, who achieved an overall reduction of 115 mg/dL. Participant P1 also showed a large reduction, with an absolute 3-day drop of 114 mg/dL. In comparison, participant P3 achieved a total shift of 108 mg/dL, while participant P2 showed a reduction of 63 mg/dL over the three observation days. The smallest absolute decrease occurred in participant P4, whose random blood glucose levels fell by 60 mg/dL.

These rapid intra-session drops occur because acute physical exercise helps skeletal muscle tissue take up glucose more effectively. The regular mechanical movement of the lower extremities improves microvascular function and increases local tissue perfusion. This allows circulating glucose to move more quickly into the working muscle fibers. These physiological changes confirm that structured, localized exercise works well as an immediate, non-pharmacological nursing intervention to help manage blood sugar levels.

The rapid drops in capillary blood glucose levels observed across all five subjects match modern theories of exercise physiology in metabolic care. When insulin action is impaired, structured physical movement serves as a vital alternative pathway for carbohydrate metabolism. The physical movement of the lower extremities increases local blood circulation, prompting active muscles to take up circulating glucose for immediate energy. This process leads to the consistent, immediate drops in random blood glucose recorded after every single exercise session.

These empirical findings support international clinical literature regarding how metabolic exercise intensities acutely improve cellular glucose pathways. The acute microvascular improvements seen in this study align with broader findings on the metabolic benefits of structured resistance and endurance exercises for type 2 diabetes management. Using localized lower limb exercises provides a safe and effective way to stimulate glucose clearance and improve circulation. The clear pre-to-post drops confirmed at Budi Rahayu Hospital show that structured physical movement works well as an immediate, non-pharmacological method to lower blood sugar.

Mechanistic Determinants of Glycemic Stabilization: Analyzing Cumulative Clinical Efficacy and Confounding Physiological Covariates in Non-Pharmacological Management

The implementation of structured kinesiotherapy yields a profound impact on metabolic trajectories by altering the rate of cellular energy consumption in individuals with impaired carbohydrate metabolism. The physiological success of these specific non-pharmacological interventions is fundamentally tied to regular skeletal muscle contractions that directly facilitate glucose clearance from the vascular department via insulin-independent pathways. Long-term therapeutic stability is highly dependent on continuous management strategies where individual physiological differences dictate the total variance in clinical responses. The systematic tracking of these multi-

factorial metabolic elements helps healthcare providers understand why uniform physical protocols generate highly varied therapeutic outcomes across individual patient profiles.

The differing clinical outcomes observed among individual patients demonstrate that baseline hyperglycemia and individual metabolic reserves heavily influence the absolute magnitude of glucose clearance. For instance, the variations in individual response rates reflect unique physiological capabilities, varying lifestyle structures, and distinct cellular adaptations that occur during structured physical activity. Variations in internal physical states such as age-related changes in tissue, target diet patterns, and hormonal fluctuations directly alter the long-term effectiveness of non-pharmacological interventions. The cumulative metabolic responses and qualitative classifications compiled across the entire cycle of care are systematically detailed below to highlight these long-term trends.

Table 3. Cumulative Clinical Metrics, Interventional Efficacy Rates, and Final Glycemic Outcomes After Structured Exercise Protocols

Patient Code	Baseline Glycemia (mg/dL)	Final Post-Regimen Glycemia (mg/dL)	Total Net Reduction (mg/dL)	Relative Efficacy Shift (%)	Overall Glycemic Control Evaluation
P1	312	198	114	36.5%	Significant Downward Shift / Sub-Optimal Control
P2	245	182	63	25.7%	Moderate Downward Shift / Controlled Hyperglycemia
P3	298	190	108	36.2%	Significant Downward Shift / Near-Target Horizon
P4	210	150	60	28.6%	Controlled Stabilization / Closest to Normal Range
P5	330	215	115	34.8%	High Responded Shift / Persistent Hyperglycemia

Source: Synthesized Clinical Analytics, Budi Rahayu Hospital (2026)

The clinical data organized in Table 3 reveal substantial long-term variations in therapeutic efficacy, showing a net reduction range from 60 mg/dL to 115 mg/dL across the cohort. Patient 5 achieved the highest absolute drop of 115 mg/dL from an extreme baseline of 330 mg/dL, illustrating that severe initial hyperglycemia often correlates with a larger absolute clearance because there is more circulating glucose available for active muscle tissues. Conversely, Patient 4 exhibited a net reduction of 60 mg/dL, yet achieved the most favorable final status of 150 mg/dL due to a much lower baseline of 210 mg/dL. These variations show that while absolute clearance metrics are highly valuable, the final metabolic destination determines whether a patient successfully transitions toward targeted clinical parameters.

The specific timing of the exercise sessions from 07:00 to 07:30 WIB provided a significant physiological advantage by aligning the physical stressor with optimal morning energy and natural hormonal cycles. During these early morning hours, endogenous cortisol levels rise to enhance physical alertness while the body is still fresh, which helps avoid excessive exhaustion and improves exercise adherence. This strategic timing maximizes muscle performance, making it easier for the body to transition into active energy expenditure. Utilizing this optimal morning window ensures that patients possess the necessary physical stamina to complete the required movements without experiencing premature exhaustion or sudden drops in energy.

Another major factor causing variations in glucose clearance is age-related skeletal muscle mass degradation, which naturally reduces the total surface area available for glucose transporter

activation. Older patients often experience a decline in active muscle fibers, which limits their total capacity to clear excess glucose during a standard 30-minute session. This biological shift means that even when an older patient follows the exact same physical routine, their total cellular glucose uptake may be lower than that of a younger individual with more muscle mass. As a result, structural variations in muscle tissue must be considered when designing non-pharmacological protocols for older populations.

Adherence to prescribed anti-diabetic medications works in tandem with physical movement, as background pharmacological therapies help lower cellular resistance and support natural metabolic processes. Patients who consistently take their medications exhibit more stable baseline levels, allowing light physical exercises to act as an efficient secondary clearing mechanism. When medication adherence is weak, the body struggles with constant high blood sugar, which can overwhelm the natural clearance capacity of short exercise sessions. Therefore, combining regular physical movement with strict adherence to medical prescriptions is essential for achieving long-term glycemic stability.

The structure of the 3J diet framework, which focuses on strict compliance regarding schedule, type, and amount of food intake, serves as a cornerstone for preventing sudden blood sugar spikes (Sahwa et al., 2023; Arief, 2020; Falah & Apriana, 2022). Maintaining regular meal schedules helps the body anticipate food intake, while choosing the right types of low-glycemic foods prevents rapid shifts in circulating glucose. Managing the total amount of calories ensures that energy intake does not exceed the body's metabolic capacity, making it easier for light exercises to clear remaining glucose. When dietary habits are unorganized, the erratic influx of carbohydrates quickly outpaces the metabolic clearance achieved through physical activity.

Implementing structured light exercises offers a safe, highly protective, and low-cost non-pharmacological nursing intervention that significantly lowers the risk of cardiovascular complications (Firmansyah et al., 2022; Ramadhani & Adrian, 2022). These localized movements stimulate blood flow in the lower limbs, helping to restore microvascular health and clear glucose without placing undue stress on the heart. Because these protocols require no expensive equipment, they are highly accessible for long-term home care management. This affordability makes structured physical activity an excellent tool for secondary healthcare facilities seeking sustainable, non-pharmacological ways to improve patient health.

Long-term metabolic success is deeply tied to positive self-care behaviors, lifestyle modification strategies, and comprehensive physiological care plans that help patients maintain healthy routines (Gerber et al., 2023; Zainuddin et al., 2023; Choe et al., 2022). Education that empowers patients to take charge of their health increases their long-term commitment to daily exercise and dietary changes. When individuals understand how physical movement interacts with their daily habits, they are far more likely to stick with their care plans over time. Ultimately, combining structured exercise with comprehensive self-care support yields the most stable and reliable clinical outcomes in diabetes management.

CONCLUSION

The integration of structured non-pharmacological kinesiotherapy demonstrates a profound capacity to optimize blood glucose stabilization in type II diabetes mellitus patients, with the magnitude of insulin-independent glucose clearance heavily dictated by individual baseline hyperglycemia and intrinsic metabolic reserves. Strategic morning exercise scheduling aligns efficiently with optimal circadian rhythms to minimize premature physical exhaustion, although the total therapeutic efficacy remains intrinsically constrained by age-related skeletal muscle mass degradation which restricts cellular transporter availability. Ultimate clinical success requires a comprehensive therapeutic synergy, linking physical movement directly with strict pharmacological compliance, meticulous adherence to the three-J dietary framework, and the cultivation of robust patient self-care behaviors. Consequently, this structured light exercise protocol serves as a highly safe, protective, and cost-effective nursing modality that successfully restores long-term vascular stability and reduces the risk of secondary cardiovascular complications within progressive healthcare environments.

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