RESEARCH ARTICLE

# Impact of regular walking duration on glycemic control and cardiometabolic health in type 2 diabetes: a field study in Al-Kadhimiyah, Iraq

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## ABSTRACT

**Introduction**: Evidence regarding the exact dose-response relationship of walking volume on type 2 diabetes mellitus (T2DM) in resource-limited urban settings remains scarce.

**Objective**: This study evaluated the impact of weekly walking duration on glycemic control and cardiometabolic health in adults with T2DM in Al-Kadhimiyah, Iraq.

**Methods**: This 12-week quasi-experimental field study evaluated 120 adults (aged 18–60) with T2DM divided into four groups (n = 30/group) based on monitored weekly walking duration: Control (< 60 min), Low (60–150 min), Moderate (151–300 min), and High Activity (> 300 min). Changes in HbA1c, fasting blood glucose (FBG), BMI, and blood pressure (SBP/DBP) were analysed using repeated measures ANOVA.

**Results**: Baseline characteristics were homogeneous across groups ($p > 0.05$). After 12 weeks, statistically significant, dose-dependent improvements were observed in active walkers compared to controls ($p < 0.05$). The High Activity group (> 300 min/week) demonstrated the greatest clinical benefits, achieving mean reductions in HbA1c of −0.60% ($\eta 2p = 0.24$), FBG of −25.6 mg/dl, BMI of −1.60 kg/m$^2$, SBP of −10.6 mmHg, and DBP of −6.1 mmHg. The Moderate Activity group (151–300 min/week) achieved comparable improvements (HbA1c: −0.50%), while the control group showed negligible metabolic changes.

**Conclusion**: Regular walking exhibits a clear, positive dose-response relationship with glycemic control and cardiovascular markers. Meeting or exceeding international targets (150–300 min/week) maximizes therapeutic outcomes, offering a highly scalable, safe, and cost-effective behavioural strategy for T2DM management in resource-constrained public health settings.

**Key words**: Type 2 Diabetes; Regular Walking; Glycemic Control; Cardiometabolic Risk; Iraq.

## INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a rapidly growing global health concern, with approximately 589 million people worldwide having been diagnosed with it, predicted to stand at 783 million adults by the year 2045.[1] Type 2 diabetes is considered very common in Iraq, with an estimated 2.67 million adults affected by T2DM. Contextual factors perpetuate this burden in Iraq. These include rapid urbanisation, limited access to recreation centres, and cultural or environmental factors that hinder physical activity.[2] Collectively, the factors contribute to individuals' sedentary lifestyles, which in turn worsen glycemic control and pose risks of developing complications of diabetes.[3]

Regular physical exercise is a core aspect of T2DM management and T2DM prevention. As we know, different aspects of exercise have different effects on health. It improves insulin sensitivity, promotes weight management and weight control, improves cardiovascular measures and health outcomes, and slows the onset of other diseases/consequences of diabetes.[4] Weight-loss studies suggest

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that aerobic exercise is often recommended, especially walking, because it is easy to take up, ecologically valid, inexpensive, and associated with very few to no adverse events. Walking is not only easy to participate in but also does not require any special equipment or skill. It can be employed in daily life, even for those with limited mobility.[5,6]

Even with those known benefits, inactivity remains common among patients with T2DM.[7] Recent studies show that fewer than 20% of urban patients reported regular physical activity, and identified barriers to physical activity, such as environmental limitations, low motivation, safety issues, and a lack of organised support.[8]

Emerging meta-analyses and randomised controlled trials suggest that structured walking interventions demonstrate significant improvements in glycemic control, lower HbA1c levels, and reduced cardiovascular risk factors in patients with T2DM.[9,10] Moreover, the evidence suggests that walking reduces postprandial glucose responses, contributing to relevant metabolic improvements even without substantial weight loss. Thus, the findings show that walking could support practical first-line behavioural strategies. However, research indicates metabolic benefits appear without weight loss. Additionally, results could show that this evidence supports behavioural approaches in T2DM.[11,12]

In recent research, interval walking (IWT), which combines periods of high-intensity walking (≥70% of peak aerobic capacity) with slower phases of walking for recovery, provides significant empirical support for improvements not only in glycemic control but also in motor function in adults with T2DM.[13] Moreover, the important evidence indicates that a randomised crossover study examined whether walking influences fasting glucose levels in individuals with type 2 diabetes, particularly in low-income settings where fasting glucose is commonly used to assess glycaemic control. Furthermore, the study demonstrates that participants walked on a treadmill at a fixed speed of 4.5 km/h for one hour during one visit and remained at rest during another, allowing direct comparison between the two conditions. Thus, the findings show that the study included 45 adults who completed both phases, with a median age of 51 years, and that nearly half were women. However, glucose measurements taken during and after walking are comparable to those recorded during rest. Given that the small differences observed were not statistically significant, the results could indicate that moderate, prolonged walking did not substantially alter fasting glucose levels.[14]

A systematic review of 8 studies found that walking exercises improve glycemic control and body composition in patients with prediabetes and type 2 diabetes. Overall, it appears that through structured walking programs, these two factors have a positive correlation when performing activities that influence metabolic parameters. A few studies measured reductions in HbA1c levels, and many measured valid reductions in body mass index (BMI). The majority of the experimental groups performed their weekly walking/sitting sessions for 30-60 minutes, three to five days a week, and set step-count goals. The low-impact nature of this type of physical activity also makes it easy to do continually. This information indicates that walking is a feasible method for improving glycemic biomarkers and body composition by increasing healthy lifestyle behaviours.[15]

Recent evidence suggests that walking speed is linked to a significant risk of developing type 2 diabetes. Moreover, a meta-analysis that pooled the important findings from ten cohort studies has examined this relationship in large population samples. Furthermore, the results indicated that individuals who walked faster than 6.4 km/h had a nearly 39% lower incidence of type 2 diabetes than slower walkers. However, each additional 1 km/h increase in pace is associated with an estimated 9% reduction in risk. Given that walking intensity appears more influential than total walking time, gait speed serves as a simple and practical indicator when designing strategies for diabetes prevention.[16]

Given the public health implications and the increasing prevalence of diabetes, the need for regionally specific solutions is more urgent than ever. This study seeks to provide practical and realistic solutions by evaluating the effect of a controlled dose-response and regular walking program on key blood glucose levels in adults with type 2 diabetes in Al-Kadhimiyah, Iraq. In addition, this study seeks to identify a clinically meaningful physical activity regimen by examining different weekly walking durations. Despite resource constraints, this study can recommend a regimen to improve diabetes outcomes..

## METHODS

**Setting and Study Design**: The present study investigated the association between walking duration per week and glycemic control in persons with type 2 diabetes mellitus using a large pre-post test controlled-groups design. Participants were recruited by purposive sampling in the outpatient diabetes clinic of Al-Imamain Al-Kadhimain Teaching Hospital. However, since data collection took place from February 2025 to April 2025, the participants were assigned to 1 control group and 3 intervention groups. Consequently, each intervention group showed different levels of walking per week.

**Ethical considerations**: Participants were informed of the study's purpose, methods, benefits, and potential risks, and they provided informed, voluntary consent to participate. Each was allowed to leave the study at any time if they were dissatisfied or under any coercion. Moreover, confidentiality and privacy were respected by ensuring that personal data and other data were used only for research purposes. Since the patients were recruited from a single centre and the sampling was non-probability, the study is a quasi-experiment rather than an RCT. Trained professionals performed all clinical procedures to ensure patient safety, and the walking program was carefully tailored to participants' physical condition and aimed at reducing risk.

**Study Population and Sampling**: The target population consisted of male and female patients aged 18 to 60 years with a confirmed diagnosis of T2DM for at least 3 months, all receiving care at public health centres in Al-Kadhimiyah.

**Inclusion and exclusion Criteria**: Inclusion criteria were as follows:

- Age between 18 and 60 years
- Diagnosis of T2DM for at least 3 months
- Regular use of oral diabetes medications without any change in consumption
- Physically able to walk regularly with no significant mobility restrictions.

***Exclusion criteria*** included:

- Type 1 diabetes or pregnancy at present
- Acute cardiovascular disease or high blood pressure.
- Any other co-morbid physical illness that would contraindicate regular physical activity.

**Group Allocation and Intervention**: The study included 120 eligible participants (4 groups, 30 per group) selected from these outpatient diabetes clinics using a purposive sampling approach. In addition, participants in both the walking intervention and the control groups were randomly assigned. Participants assigned to the walking intervention or control group based on their baseline self-reported walking activity (duration) were confirmed using pedometers and activity logs during the monitoring phase of the walking intervention population. All investigators decided to use a randomised design to describe the community's actual walking behaviours, thereby increasing the likelihood of practical, acceptable interventions. In addition, self-reported weekly walking duration was initially obtained through a validated physical activity questionnaire. However, these reports were confirmed during the monitoring periods. According to the, participants were categorised into four groups.

The intervention groups participated in a walking program at approximately 3.5–4.5 km/h, aiming to reach 60–70% of their maximum heart rate. The intervention lasted 12 consecutive weeks, with each participant in the intervention group receiving a pedometer and recording daily walking time and steps. Compliance and progress were assessed weekly by the research staff via an in-person visit or phone call.

The four groups show comparable baseline characteristics in terms of age, sex distribution, body mass index, and documented diabetes duration. Moreover, glycemic parameters, including HbA1c and fasting blood glucose, suggest similar metabolic profiles across groups, indicating no initial metabolic imbalance. Additionally, blood pressure measurements show no statistically significant differences between groups. Nevertheless, findings suggest group comparability before outcome assessment. Given that no baseline heterogeneity was apparent, appropriate comparability appears established. Table 1 presents baseline demographic and clinical characteristics across walking-duration groups.

**Outcomes**:

**Primary outcome measures**:

- Fasting Blood Glucose (FBG): Whole blood from a draw at least 8-10 hours after the last meal was used to measure Fasting Blood Glucose (FBG) and sent, as venous blood samples, to the Central Laboratory ofAl-Imamain Al-Kadhimain Teaching Hospital for analysis. Plasma glucose concentrations were measured by an Abbott ARCHITECT analyser, using an enzyme (hexokinase-based assay); the assay was calibrated following the manufacturer's guidelines before running all samples, and two methods of Internal Quality Control were utilised. Al-Imamain Al-Kadhimain Teaching Hospital participates in External Quality Assessment Programmes to ensure both analytical accuracy and precision. All measurements were taken by Certified Laboratory Technologists who were blinded to the participants' groups.
- Glycated haemoglobin (HbA1c): An Abbott ARCHITECT i1000SR analyser was used to assess the level of glycosylated haemoglobin (HbA1c) via chemiluminescence microplate immunoassay (CMIA). HbA1c measurements were obtained using reagents and calibrators supplied by the assay manufacturer and according to established operating procedures. The analyser was calibrated prior to the collection of the sample/s, and internal quality control was conducted using control materials at two levels. The laboratory participates in external analytical quality assurance programmes to verify the analytical accuracy and reproducibility of results. HbA1c was measured by certified laboratory technologists who were unaware of participants' group allocation.

**Secondary outcome measures**:

- Body weight and height: The participants' weight was measured using a calibrated digital scale accurate to 0.1 kg, and height was measured using a wall-mounted stadiometer to the nearest 0.1 cm, according to standardised anthropometric measurement methods. Moreover, all participants were measured while barefoot and in light clothing. Furthermore, the calibration of all instruments was regularly checked in accordance with the institution's protocol, ensuring the reliability of the measurement process. Given that accuracy was critical, BMI has been calculated as weight (kg) divided by height ($m^2$). Notwithstanding these precautions, BMI was calculated from measurements taken by nursing staff who were unaware of participants' group assignment.
- Systolic BP and Diastolic BP: A

**Table 1** | Intervention Groups by Walking Duration and Type of Support

| Group | Weekly Walking Duration | Description of Intervention |
|---|---|---|
| Group 1 (Control) | < 60 minutes | Usual care; no structured walking activity |
| Group 2 (Low Activity) | 60–150 minutes | Participants engaged in walking levels lower than the minimum international physical activity guidelines. |
| Group 3 (Moderate Activity) | 151–300 minutes | Participants achieved the recommended level of moderate-intensity physical activity through regular walking and were encouraged to maintain their routine. |
| Group 4 (High Activity) | >300 minutes | Participants exceeded the global recommendation and followed an extended walking routine aimed at enhancing metabolic and functional outcomes. |

**Table 2** | Demographic and Clinical Characteristics of Participants by Walking Duration Groups

| Characteristic | Group 1 (Control) < 60 min (n = 30) | Group2 (Low) 60–150 min (n = 30) | Group 3 (Moderate) 151–300 min (n = 30) | Group 4 (High) > 300 min (n = 30) | Total (n = 120) | p-value |
|---|---|---|---|---|---|---|
| **Age (years), mean ± SD** | 48.2 ± 8.1 | 49.0 ± 7.5 | 47.8 ± 8.3 | 48.5 ± 7.9 | 48.4 ± 7.9 | 0.655 |
| **Sex — Male, n (%)** | 14 (46.7) | 16 (53.3) | 15 (50.0) | 17 (56.7) | 62 (51.7) | 0.820 |
| **Sex — Female, n (%)** | 16 (53.3) | 14 (46.7) | 15 (50.0) | 13 (43.3) | 58 (48.3) | |
| **BMI (kg/m²), mean ± SD** | 30.4 ± 2.1 | 30.1 ± 2.3 | 30.0 ± 2.0 | 30.3 ± 2.2 | 30.2 ± 2.2 | 0.596 |
| **Diabetes duration (years), mean ± SD** | 6.2 ± 3.1 | 6.5 ± 3.4 | 6.1 ± 2.9 | 6.3 ± 3.0 | 6.3 ± 3.1 | 0.189 |
| **HbA1c (%), mean ± SD** | 8.1 ± 0.6 | 8.0 ± 0.5 | 8.1 ± 0.4 | 8.0 ± 0.5 | 8.05 ± 0.5 | 0.220 |
| **Fasting blood glucose (mg/dL), mean ± SD** | 174.6 ± 22.1 | 175.0 ± 21.8 | 176.5 ± 23.4 | 174.9 ± 20.6 | 175.3 ± 22.0 | 0.714 |
| **Systolic BP (mmHg), mean ± SD** | 138.2 ± 8.6 | 137.4 ± 9.1 | 138.5 ± 7.9 | 138.0 ± 8.0 | 138.0 ± 8.4 | 0.621 |
| **Diastolic BP (mmHg), mean ± SD** | 86.0 ± 6.3 | 85.5 ± 6.5 | 86.2 ± 6.1 | 85.8 ± 6.4 | 85.9 ± 6.3 | 0.583 |

Data are presented as mean ± standard deviation (SD) for continuous variables and number (percentage) for categorical variables. Between-group comparisons for continuous variables were performed using one-way analysis of variance (ANOVA), while categorical variables were analysed using the chi-square test. All tests were two-tailed, and p-values < 0.05 were considered statistically significant. No statistically significant baseline differences were observed between the groups. Abbreviations: BMI, body mass index; HbA1c, glycated haemoglobin; BP, blood pressure.

validated automated upper-arm digital sphygmomanometer (Omron HEM-7120) was used to measure systolic and diastolic blood pressures in a sitting position, after at least 5 minutes of rest. All measurements were performed with the subject's back supported and their feet placed flat on the ground. Properly sized blood pressure cuffs were placed at heart level and secured. Two blood pressure readings were obtained 1-2 min apart, with the average of the two being used for analysis. The sphygmomanometer was regularly calibrated according to the manufacturer's instructions, and all measurements were obtained by a trained nurse unaware of each subject's group assignment.

Measurement schedule:

- At baseline (pre-intervention): At the Week 0 time point
- Post-intervention (endpoint): At the Week 12 time point

All tests were carried out under normal conditions in the same clinical area by trained personnel to promote consistency and value throughout the study.

**Data Collection**: Data were collected using a mixture of structured clinical interviews, standard physical assessment, and validated surveys. Demographic data and clinical background data (e.g., age, sex, histories of diabetes, lifestyle behaviours) were collected through face-to-face interviews. FBG and HbA1c were measured at the Al-Kadhimain Hospital's central laboratory, and anthropometric and blood pressure measurements were taken on site at the diabetes clinic. Walking activity was tracked through a combination of participant self-report, pedometer data, and weekly follow-up forms.

## RESULTS

A total of 120 participants (30 per group) completed the 12-week intervention, and baseline characteristics were comparable across all groups ($p > 0.05$), Table 2. After 12 weeks, significant within- and between-group differences were observed in glycemic control markers (HbA1c and fasting blood glucose), as well as in BMI and systolic/diastolic blood pressure.

**Changes in Glycemic Control:** The most dramatic changes in glycemic variables were noted in participants who exercised in Groups 3 and 4 (walking 151–300 min/week and >300 min/week, respectively). In Group 4, the mean change in HbA1c was −0.6% ($p < 0.001$); in Group 3, HbA1c only dropped by −0.5%; in Group 2, only by −0.3%; and in the control group, there was no statistically significant change. In this same analogy, FBG levels also decreased in Group 4 by an average of − 25 mg/

**Table 3** | Changes in HbA1c and FBG after 12 weeks of intervention

| Group | Δ HbA1c (%) | | Δ FBG (mg/dL) | | Between-Group | |
|---|---|---|---|---|---|---|
| | Mean ± SD | 95% CI | Mean ± SD | 95% CI | p-value | Partial η² |
| **G1 – Control (<60 min)** | - 0.10 ± 0.20 | - 0.17 to - 0.03 | - 2.3 ± 5.7 | - 4.4 to −0.2 | Reference | – |
| **G2 – Low (60–150 min)** | - 0.30 ± 0.30 | - 0.41 to - 0.19 | −10.1 ± 7.4 | −12.8 to −7.4 | 0.042 | 0.08 |
| **G3 – Moderate (151–300 min)** | - 0.50 ± 0.40 | - 0.64 to - 0.36 | - 20.2 ± 8.8 | −23.4 to −17.0 | <0.001 | 0.18 |
| **G4 – High (>300 min)** | - 0.60 ± 0.50 | - 0.78 to - 0.42 | −25.6 ± 9.1 | −28.9 to −22.3 | <0.001 | 0.24 |

- Interpretation of effect size:η²p = 0.01 (small), 0.06 (moderate), 0.14 (large)
- Values represent mean change (Δ) from baseline to week 12 ± SD. Between-group comparisons were performed using repeated measures ANOVA with Tukey post-hoc correction. Partial eta squared (η²p) is reported as a measure of effect size. Confidence intervals (95% CI) reflect the precision of the mean difference. A p-value < 0.05 was considered statistically significant.

dl, see Table 3, Figure 1, and 2.

**Changes in Body Mass Index and Blood Pressure**: Participants in Group 4 who walked more than 150 minutes per week showed a substantial, statistically significant reduction in body mass index (BMI), reaching −1.6 ± 0.3 kg/m² during the 12-week intervention period. The group that walked the most showed the greatest decrease in BMI, demonstrating that longer walking sessions with higher volume produce the best weight-loss results for type 2 diabetes patients. Group 3, which walked 91-150 minutes per week, and Group 2, which walked 60-90 minutes per week, showed moderate decreases in BMI of −0.8 ± 0.25 and −0.3 ± 0.2, respectively. Still, the control group, which walked less than 60 minutes per week, had a statistically non-significant change of −0.10 ± 0.15.

The evaluation of blood pressure metrics indicated that Groups 3 and 4 demonstrated significant improvements, with SBP showing the greatest reduction. Group 4 participants displayed an average SBP decrease of −10.6±2.5 mmHg, while Group 3 showed an average reduction of −8.3±2.2 mmHg. The decreases in blood pressure occurred within clinically relevant limits and matched the antihypertensive responses to aerobic exercise documented in meta-analyses. The structured walking program resulted in significant reductions in diastolic blood pressure (DBP), with Group 4 showing an average decrease of 6.1 ± 2.0 mmHg, demonstrating cardiovascular benefits for this population. Table 4 and figures 3,4,and 5.

**Summary of Statistical Significance**: Statistical analysis revealed significant differences between groups using One-way ANOVA for all the main results (p < 0.05). The Post Hoc Tukey test demonstrated that both HbA1c and FBG reductions were statistically significantly different from the control group in Groups 3 and 4. The body mass index and blood pressure decreased significantly more than in the other groups in the group with the increased activity levels. The high-activity group showed statistically significantly greater decreases than all other groups (p < 0.05) in body mass index and both systolic and diastolic blood pressure, demonstrating a clear dose–response relationship with total walking time

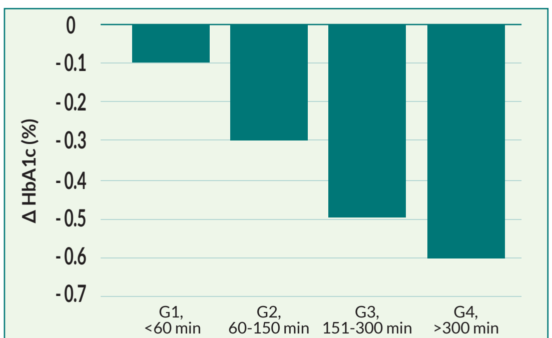


**Figure 1** | Change in HbA1c After 12 Weeks.

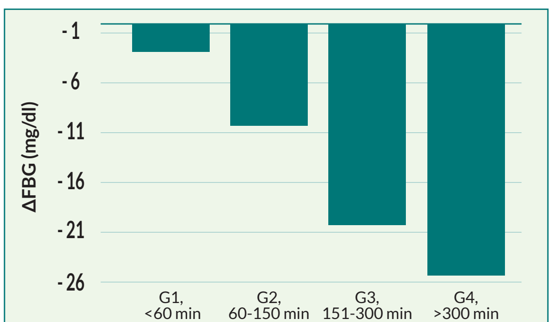


**Figure 2** | Change in Fasting Blood Glucose After 12 Weeks.

**Table 4** | Changes in BMI and Blood Pressure after 12 weeks

| Group | Δ BMI (kg/m²) | 95% CI | Δ SBP (mmHg) | 95% CI | Δ DBP (mmHg) | 95% CI | Between-Group p-value | Partial η² |
|---|---|---|---|---|---|---|---|---|
| **G1 – Control** | −0.10 ± 0.15 | −0.15 to −0.05 | −0.70 ± 1.8 | −1.3 to −0.1 | −0.40 ± 1.4 | −0.9 to 0.1 | Reference | – |
| **G2 – Low** | −0.30 ± 0.20 | −0.37 to −0.23 | −3.60 ± 2.0 | −4.3 to −2.9 | −1.60 ± 1.5 | −2.1 to −1.1 | 0.031 | 0.10 |
| **G3 – Moderate** | −0.80 ± 0.25 | −0.89 to −0.71 | −8.30 ± 2.2 | −9.1 to −7.5 | −4.70 ± 1.8 | −5.4 to −4.0 | < 0.001 | 0.22 |
| **G4 – High** | −1.60 ± 0.30 | −1.71 to −1.49 | −10.60 ± 2.5 | −11.5 to −9.7 | −6.10 ± 2.0 | −6.8 to −5.4 | < 0.001 | 0.29 |

Values represent mean change (Δ) from baseline to week 12 ± SD. Between-group comparisons were performed using a repeated-measures ANOVA with Tukey post hoc correction. Partial eta squared ($\eta^2p$) is reported as a measure of effect size. Confidence intervals (95% CI) reflect the precision of the mean difference. A p-value < 0.05 was considered statistically significant.

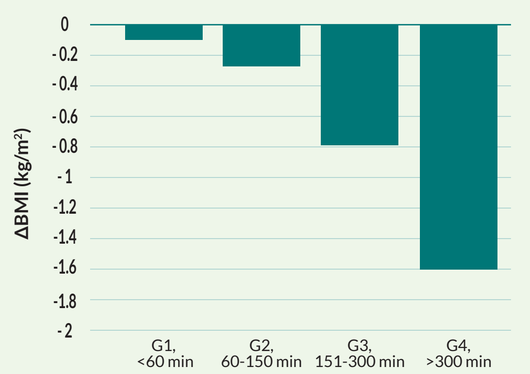


**Figure 3** | Change in BMI After 12 Weeks of Walking Intervention

and improvements in glycemic control and cardiovascular risk markers in patients with type 2 diabetes.

## DISCUSSION

This study demonstrates that walking exercise can lead to meaningful improvements in glycemic control and cardiovascular risk factors. Furthermore, there are clear dose–response effects, in that individuals with the highest daily walking time incurred larger improvements in mean HbA1c, fasting blood glucose, body mass index (BMI), systolic blood pressure (SBP) and diastolic blood pressure (DBP) than those with the shortest walking prescriptions. In fact, the group with the highest exercise "dose" achieved the greatest declines in HbA1c and SBP, whereas the minimal-walking group showed only modest changes. These findings indicate that each incremental increase in walking time yielded proportionally greater metabolic benefit.

Our results are consistent with already published research and current guidelines. Research conducted by Fitri and colleagues in 2024 demonstrated that regular walking activities significantly lowered blood glucose measurements in diabetic subjects.[7] Yamazaki and team found in their study that intense interval-walking sessions increased HDL cholesterol levels, although their intervention failed to achieve meaningful

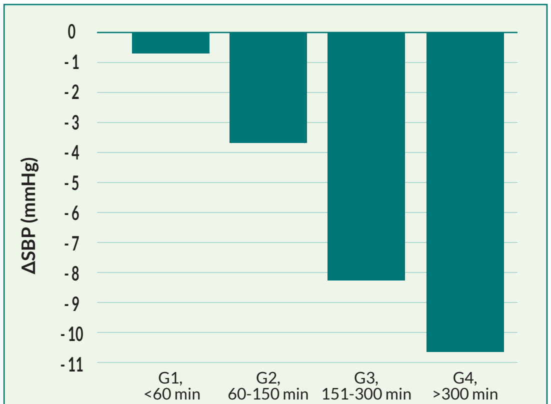


**Figure 4** | Change in Systolic Blood Pressure After 12 Weeks.


**Figure 5** | Change in Diastolic Blood Pressure After 12 Weeks.

reductions in HbA1c.[15] These discrepancies between the studies may be attributable to differences in study design or to different populations. Regardless, the strong dose–response we observed in our cohort supports recommendations from the American Diabetes Association and the WHO: both organisations recommend that adults with type 2 diabetes participate in at least 150–300 minutes per week of moderate-intensity aerobic activity (plus resistance training).[17,18] Our data suggest that achieving the upper end of these guidelines is needed to lower HbA1c and blood pressure maximally. These results closely mirror the optimal physical activity "dose" identified in a recent meta-analysis—1,100 METs-min/week (≈244 min/week of moderate-intensity exercise), which was associated with HbA1c reductions of up to 1.0 %, and FBG decreases of 20–25 mg/dl.[19] Likewise, a Southeast Asian intervention comparing daily versus thrice-weekly walking reported a 20.25 mg/dL drop in FBG with daily sessions ($p < 0.001$), underscoring the benefit of higher exercise frequency on glycemic outcomes.[20]

The medical evidence confirms that walking functions as an easily available, non-drug treatment that works alongside medication. The rise in walking activity likely improved insulin function and increased energy use, leading to better glucose metabolism, improved weight management, and enhanced blood vessel health. Public health outcomes would significantly benefit from implementing daily walking programs in Al-Kadhimiyah, Iraq, a community with limited resources. Our research shows a direct link between walking duration and improved blood sugar control and blood pressure levels. The study confirms exercise recommendations in diabetes treatment while demonstrating that gradual increases in walking duration are an effective approach for managing blood sugar levels and heart disease risk.

**Limitations**: The study lasted only 12 weeks, which was enough to see significant improvements in glycemic and cardiometabolic markers, but not enough to conclude the long-term sustainability of those improvements. Since diabetes is a chronic disease that requires ongoing management, further studies are needed to determine whether individuals continue to adhere to walking programs and benefit from improvements in their metabolic profiles over time.

Even though pedometers were used to monitor walking, some of the information came from individuals' own walking records. Self-reported walking will always be subject to recall error and to problems with responding to questions in socially acceptable ways. Therefore, it is likely that self-reported walking will report higher levels of physical activity than was actually performed. The use of more accurate measurement devices, such as accelerometers, will allow researchers to make more precise measurements in future studies.

## CONCLUSION

The medical evidence confirms that walking functions as an easily available, non-drug treatment that works alongside medication. The increase in walking activity likely improved insulin sensitivity and increased energy expenditure, resulting in improved glucose metabolism, better weight management, and enhanced blood vessel health. Public health outcomes would significantly benefit from implementing daily walking programs in Al-Kadhimiyah, Iraq, a community with limited resources. Our research shows a direct link between walking duration and improved blood sugar control and blood pressure levels. The study confirms exercise recommendations in diabetes treatment while demonstrating that gradual increases in walking duration are an effective approach for managing blood sugar levels and heart disease risk.

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**Abbreviations list**: Analysis of variance (ANOVA), Blood pressure (BP), Body mass index (BMI), Centimetre (cm), Chemiluminescence microplate immunoassay (CMIA), Confidence intervals (CI), Coronavirus disease 2019 (COVID-19), Diastolic blood pressure (DBP), Fasting Blood Glucose (FBG), Glycated haemoglobin (HbA1c), Interval walking (IWT), Kilogram (kg), Kilometre per hour (km/h), Partial eta squared ($\eta^2p$), Standard deviation (SD), Systolic blood pressure (SBP), Type 2 Diabetes Mellitus (T2DM), Weight divided by square height ( $Kg/m^2$).

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