

## Comparison of Acute Effects of One Hour Brisk Walking On Blood Pressure and Glycemia in Hypertensive Patients with and without Diabetes and Healthy Controls

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### Abstract:

**Background:** Hypertension and type 2 diabetes mellitus frequently coexist and synergistically increase cardiovascular risk. Although the chronic benefits of aerobic exercise are well established, data comparing the acute hemodynamic and glycemic responses to exercise among hypertensive patients with and without diabetes and healthy individuals remain limited.

**Objective:** To compare the acute effects of one hour of brisk walking on blood pressure and fasting blood glucose among hypertensive patients with diabetes, hypertensive patients without diabetes, and healthy controls.

**Methods:** This prospective, observational, comparative study included 90 participants aged 30–60 years, divided into three groups: hypertensive patients (Group H, n=30), hypertensive patients with type 2 diabetes mellitus (Group HDM, n=30), and healthy normotensive non-diabetic controls (Group N, n=30). All participants performed one hour of moderate-intensity brisk walking. Systolic and diastolic blood pressure and fasting blood glucose were measured at baseline, immediately post-exercise, and at 1, 6, 12, and 24 hours post-exercise.

**Results:** Both hypertensive groups demonstrated significant reductions in systolic and diastolic blood pressure immediately after exercise, with maximal decreases observed at 6 hours post-exercise. Blood pressure values gradually increased thereafter but remained below baseline levels at 24 hours. The magnitude of post-exercise hypotension was greater in hypertensive participants than in healthy controls. Fasting blood glucose levels decreased in all groups following exercise, with the most pronounced and sustained reduction observed in hypertensive patients with diabetes, reaching a nadir at 6 hours post-exercise. Healthy controls exhibited minimal changes in blood pressure and glycemia.

**Conclusion:** A single session of one hour of brisk walking produces significant acute reductions in blood pressure and improves glycemic levels, particularly in hypertensive patients with diabetes. These benefits peak around 6 hours and persist up to 24 hours, highlighting brisk walking as a simple, safe, and cost-effective non-pharmacological intervention for immediate cardiovascular and metabolic risk reduction.

**Keywords:** Hypertension; Type 2 Diabetes Mellitus; Post-Exercise Hypotension; Glycemic Control; Aerobic Exercise; Lifestyle Modification.

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### Introduction

Hypertension and diabetes mellitus are among the most prevalent non-communicable diseases worldwide and frequently coexist, markedly increasing the risk of cardiovascular morbidity and mortality [1]. Both conditions share common pathophysiological mechanisms such as insulin resistance, endothelial dysfunction, autonomic imbalance, and chronic low-grade inflammation [2]. Lifestyle modification, particularly regular physical activity, remains a cornerstone in the prevention and management of both hypertension

and diabetes [3]. Aerobic exercise has been consistently shown to improve blood pressure control and glycemic regulation through multiple mechanisms, including enhanced insulin sensitivity, improved endothelial function, reduced sympathetic activity, and increased skeletal muscle glucose uptake [3,4]. Among various forms of physical activity, brisk walking is a simple, low-cost, and widely acceptable aerobic exercise that can be easily incorporated into daily routines, especially in low- and middle-income settings [5].

While the chronic benefits of regular aerobic exercise on blood pressure and glycemic control are well established [3,4], increasing attention is being directed toward the acute effects of a single bout of exercise. Acute exercise is known to produce post-exercise hypotension and transient improvements in glycemic control, effects that may contribute cumulatively to long-term cardiovascular benefits [4]. However, the magnitude and pattern of these acute responses may differ depending on the underlying metabolic and cardiovascular status of individuals.

Hypertensive patients with diabetes represent a particularly high-risk group, yet limited data are available comparing their acute hemodynamic and glycemic responses to exercise with those of hypertensive patients without diabetes and healthy individuals [4]. Understanding these differential responses is clinically relevant for tailoring exercise prescriptions and ensuring safety and effectiveness in diverse patient populations [3].

Therefore, the present study aims to compare the acute effects of one hour of brisk walking on blood pressure and glycemia among hypertensive patients with diabetes, hypertensive patients without diabetes, and healthy controls.

### Methodology

**Study Design:** This was a prospective, observational, comparative study conducted to assess the acute effects of one hour of brisk walking on blood pressure and glycemic parameters among hypertensive patients with and without diabetes and healthy controls.

**Study Setting and Duration:** The study was carried out in the Department of Medicine at tertiary care teaching Hospital over a period of 3 months.

**Study Population and Grouping:** A total of 90 participants were enrolled and divided into three equal groups of 30 subjects each:

- Group H: Patients with essential hypertension only
- Group HDM: Patients with essential hypertension and type 2 diabetes mellitus
- Group N: Healthy normotensive, non-diabetic individuals (control group)

### Inclusion Criteria

- Age between 30 and 60 years
- Group H: Diagnosed essential hypertension
- Group HDM: Diagnosed essential hypertension with type 2 diabetes mellitus
- Group N: Apparently healthy individuals with normal blood pressure and normal fasting blood glucose

- Stable medical therapy for at least 3 months
- Willingness and ability to perform one hour of brisk walking

### Exclusion Criteria

- Secondary hypertension
- Type 1 diabetes mellitus
- Uncontrolled hypertension (SBP  $\geq$ 180 mmHg or DBP  $\geq$ 110 mmHg)
- Known ischemic heart disease, heart failure, arrhythmias, or cerebrovascular disease
- Chronic kidney disease or other systemic illnesses
- Musculoskeletal or neurological conditions limiting physical activity
- Pregnant or lactating women

**Baseline Assessment:** All participants underwent detailed clinical evaluation, including history and physical examination. Baseline parameters recorded included:

- Age and sex
- Resting systolic and diastolic blood pressure
- Fasting blood glucose levels

**Exercise Protocol:** All participants were instructed to perform one hour of brisk walking at a moderate intensity on a flat surface. Brisk walking was defined as walking at a pace sufficient to increase heart rate and breathing while still allowing conversation. The exercise session was conducted under similar environmental conditions for all participants, and participants were advised to avoid strenuous physical activity prior to the study.

### Outcome Measures

**Blood Pressure Measurement:** Systolic and diastolic blood pressure were measured using a calibrated sphygmomanometer with the participant in a seated position after adequate rest. Blood pressure was recorded at the following time points:

- Pre-exercise (baseline)
- Immediately after completion of brisk walking
- 1-hour post-exercise
- 6 hours post-exercise
- 12 hours post-exercise
- 24 hours post-exercise

**Glycemic Assessment:** Fasting blood glucose levels were measured using a standardized glucometer at same intervals.

**Ethical Considerations:** The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrolment.

### Results

**Table 1: Baseline Characteristics**

Parameter	Group H	Group HDM	Group N
AGE (years)	52.1 ± 8.3	53.4 ± 7.9	51.5 ± 8.0
MALE/FEMALE	17/13	16/14	15/15
SBP (mmHg)	148.6 ± 9.5	151.4 ± 10.2	119.2 ± 7.5
DBP (mmHg)	93.2 ± 6.4	95.1 ± 6.7	77.8 ± 5.2
Fasting Blood Glucose (mg/dl)	96.8 ± 8.5	142.3 ± 26.4	88.2 ± 6.9

A total of 90 participants were included in the study, with 30 subjects in each group. The mean age was comparable among Group H (52.1 ± 8.3 years), Group HDM (53.4 ± 7.9 years), and Group N (51.5 ± 8.0 years). Gender distribution was similar across the three groups. At baseline, systolic and diastolic blood pressures were

significantly higher in Group H and Group HDM compared to Group N. Fasting blood glucose levels were markedly elevated in Group HDM compared to Group H and Group N, while Group H and Group N showed values within the non-diabetic range. Baseline demographic and clinical characteristics are summarized in Table 1.

**Table 2: Time wise Systolic Blood Pressure (SBP) comparison**

Time	Group H	Group HDM	Group N
Pre-exercise	148.6 ± 9.5	151.4 ± 10.2	119.2 ± 7.5
Immediately Post	140.2 ± 8.8	142.8 ± 9.5	115.6 ± 6.8
1 Hour	138.6 ± 8.3	140.7 ± 9.0	114.2 ± 6.5
6 Hours	136.1 ± 8.2	138.9 ± 8.6	115.0 ± 6.3
12 Hours	140.5 ± 8.7	143.2 ± 8.9	116.8 ± 6.5
24 Hours	145.2 ± 9.1	147.0 ± 9.5	118.2 ± 6.9

At baseline, mean systolic blood pressure was highest in Group HDM (151.4 ± 10.2 mmHg), followed by Group H (148.6 ± 9.5 mmHg), and lowest in Group N (119.2 ± 7.5 mmHg). Immediately after one hour of brisk walking, systolic blood pressure decreased in all three groups. The reduction persisted at 1 hour and 6 hours post-exercise in Group H and Group HDM, with the lowest mean values observed at 6 hours

post-exercise. At 12 and 24 hours, systolic blood pressure showed a gradual rise toward baseline levels but remained lower than pre-exercise values. In Group N, a modest reduction in systolic blood pressure was observed following exercise, with relatively stable values over the 24-hour observation period. Time-wise systolic blood pressure changes are presented in Table 2.

**Table 3: Time wise Diastolic Blood Pressure (DBP) comparison**

Time	Group H	Group HDM	Group N
Pre-exercise	93.2 ± 6.4	95.1 ± 6.7	77.8 ± 5.2
Immediately Post	88.4 ± 5.8	89.8 ± 6.1	75.0 ± 5.0
1 Hour	86.7 ± 5.5	87.9 ± 5.8	74.4 ± 4.9
6 Hours	85.3 ± 5.3	86.8 ± 5.5	75.2 ± 5.0
12 Hours	88.9 ± 5.6	90.2 ± 5.9	75.6 ± 5.1
24 Hours	91.8 ± 5.9	93.5 ± 6.2	76.8 ± 5.2

Baseline diastolic blood pressure was higher in Group HDM (95.1 ± 6.7 mmHg) and Group H (93.2 ± 6.4 mmHg) compared to Group N (77.8 ± 5.2 mmHg). Following brisk walking, diastolic blood pressure decreased immediately in all groups. The maximum reduction was observed at 6 hours post-exercise in Group H and Group HDM.

Similar to systolic blood pressure, diastolic blood pressure values showed a gradual increase at 12 and 24 hours but did not return to baseline levels within the 24-hour period. Group N demonstrated minimal fluctuations in diastolic blood pressure throughout the study duration. Time-wise diastolic blood pressure comparison is shown in Table 3.

**Table 4: Time wise Fasting Blood Glucose (FBS) comparison**

Time	Group H	Group HDM	Group N
Pre-exercise	96.8 ± 8.5	142.3 ± 26.4	88.2 ± 6.9
Immediately Post	94.1 ± 7.9	130.6 ± 24.1	86.5 ± 6.4
1 Hour	93.2 ± 7.6	124.7 ± 22.8	85.9 ± 6.3
6 Hours	92.6 ± 7.4	122.1 ± 22.1	86.2 ± 6.3
12 Hours	94.0 ± 7.7	128.9 ± 23.5	86.9 ± 6.4
24 Hours	95.8 ± 7.9	136.8 ± 25.2	87.5 ± 6.5

At baseline, fasting blood glucose levels were significantly higher in Group HDM ( $142.3 \pm 26.4$  mg/dL) compared to Group H ( $96.8 \pm 8.5$  mg/dL) and Group N ( $88.2 \pm 6.9$  mg/dL).

Following one hour of brisk walking, fasting blood glucose levels decreased in all three groups. The reduction was most pronounced in Group HDM, with the lowest mean value observed at 6 hours post-exercise. Thereafter, glucose levels showed a gradual increase at 12 and 24 hours but remained below baseline values.

Group H and Group N showed smaller reductions in fasting blood glucose levels with relatively stable values across the 24-hour period. Time-wise fasting blood glucose changes are detailed in Table 4.

### Discussion

The present study evaluated the acute effects of a single session of one hour of brisk walking on blood pressure and glycemic parameters in hypertensive patients with and without diabetes and in healthy controls.

The findings demonstrate that even a single bout of moderate-intensity aerobic exercise produces significant and sustained reductions in systolic and diastolic blood pressure, along with improvement in glycemic levels, particularly in hypertensive patients with diabetes [6,7].

**Effect of Brisk Walking on Blood Pressure:** In the present study, both hypertensive groups (Group H and Group HDM) showed a consistent reduction in systolic and diastolic blood pressure immediately after exercise, with the maximum decline observed at 6 hours post-exercise. This phenomenon is consistent with post-exercise hypotension (PEH), a well-recognized acute response to aerobic exercise [8].

The mechanisms underlying PEH include reduced peripheral vascular resistance, enhanced endothelial nitric oxide-mediated vasodilation, suppression of sympathetic nervous system activity, and improved baroreflex sensitivity [8,9].

These effects tend to be more pronounced in individuals with elevated baseline blood pressure, explaining the greater magnitude of reduction observed in hypertensive patients compared to healthy controls [10]. The gradual rise in blood pressure values at 12- and 24-hours post-exercise, without complete return to baseline, suggests a prolonged antihypertensive effect of a single exercise session, supporting the role of daily moderate-intensity physical activity in blood pressure management [11].

**Comparison between Hypertensive Patients with and Without Diabetes:** Although both hypertensive groups exhibited similar patterns of

blood pressure reduction, hypertensive patients with diabetes (Group HDM) demonstrated slightly higher absolute blood pressure values throughout the study period. This may be attributed to diabetes-associated arterial stiffness, endothelial impairment, and altered autonomic regulation, which can blunt vasodilatory responses to exercise [12]. However, the persistence of PEH in this group indicates that diabetes does not negate the acute antihypertensive benefits of aerobic exercise, emphasizing the safety and efficacy of brisk walking even in this high-risk population [6,10].

**Effect of Brisk Walking on Glycemic Control:** A significant reduction in fasting blood glucose levels was observed following brisk walking, particularly in Group HDM. The maximum decline at 6 hours post-exercise, followed by a gradual rise at 12 and 24 hours, reflects enhanced glucose uptake and improved insulin action following physical activity [7]. Acute reductions in glycemia are primarily mediated by insulin-independent glucose uptake in skeletal muscle via exercise-induced GLUT-4 translocation [9]. Furthermore, improvements in insulin sensitivity can persist for several hours after exercise, contributing to sustained glycemic control [7]. In contrast, hypertensive patients without diabetes and healthy controls demonstrated minimal changes in glucose levels due to normal baseline glycemic regulation.

**Clinical Implications:** The results highlight brisk walking as a practical, low-cost, and easily implementable intervention capable of producing immediate cardiovascular and metabolic benefits [11]. The persistence of reduced blood pressure and improved glycemia up to 24 hours post-exercise suggests that regular daily activity may provide continuous therapeutic effects and enhance overall cardiovascular risk reduction [6,8]. This is particularly valuable in low-resource settings, where non-pharmacological interventions play a central role in chronic disease management.

**Limitations:** The study has limitations, including a relatively small sample size and single-centre design, which may limit external validity. Long-term outcomes and mechanistic biomarkers such as insulin sensitivity indices or endothelial function were not assessed. Future multicentre and longitudinal studies are needed to confirm these findings and explore underlying mechanisms.

### Conclusion

The present study demonstrates that a single session of one hour of brisk walking produces significant acute reductions in systolic and diastolic blood pressure as well as improvement in glycemic levels, particularly in hypertensive patients with diabetes mellitus. The maximum beneficial effects were observed approximately 6 hours post-

exercise, with sustained reductions persisting up to 24 hours.

These findings highlight the effectiveness of brisk walking as a simple, safe, and cost-effective lifestyle intervention that can provide immediate cardiovascular and metabolic benefits.

Incorporating regular brisk walking into daily routine may play a crucial role in the non-pharmacological management of hypertension, especially in patients with coexisting diabetes.

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