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CORRELATION BETWEEN 6 MINS WALK TEST PERFORMANCE AND CARDIOMETABOLIC RISK FACTORS IN HYPERTENSIVE PREMENOPAUSAL WOMEN

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Abstract

Background: *Premenopausal hypertension is associated with early vascular and metabolic changes that increase future cardiovascular risk, often leading to unrecognized functional impairment. The Six-Minute Walk Test (6MWT) is a simple, submaximal measure of functional capacity reflecting integrated cardiometabolic health; however, its relationship with cardiometabolic risk factors in hypertensive premenopausal women remains insufficiently explored.*

Objective: *To determine the correlation between Six-Minute Walk Test performance and cardiometabolic risk factors in hypertensive premenopausal women.*

Methodology: *This cross-sectional study included 133 hypertensive premenopausal women aged 40–48 years, recruited from tertiary care hospitals in Lahore, Pakistan. Functional capacity was assessed using the Six-Minute Walk Test according to American Thoracic Society guidelines. Cardiometabolic risk factors included body mass index, waist circumference, fasting blood glucose, and blood pressure. Premenopausal status was determined using the STRAW+10 questionnaire. Cardiovascular risk was assessed using the Framingham Risk Score, physical activity using the IPAQ-Short Form, dietary patterns using MEDAS, and diabetes risk using FINDRISC. Data collection was completed over two months following ethical approval.*

Results: *The mean 6MWT distance was 372.6 ± 48.3 meters, with 32% of participants demonstrating impaired functional capacity (<300 meters). The mean BMI was 29.8 ± 4.5 kg/m², and 67% of participants were overweight or obese. Impaired fasting glucose was present in 24% of women. Significant negative correlations were observed between 6MWT distance and BMI, waist circumference, fasting blood glucose, and blood pressure, while a positive correlation was found with physical activity level. Waist circumference and physical activity emerged as independent predictors of 6MWT distance.*

Conclusion: *Reduced functional capacity is strongly associated with adverse cardiometabolic risk profiles in hypertensive premenopausal women. Functional capacity assessment may serve as a practical marker for identifying elevated cardiometabolic risk, emphasizing the importance of interventions targeting physical activity and metabolic health in this population.*

INTRODUCTION

Hypertension is a big problem for public health around the world and is one of the main reasons people have heart and blood vessel issues,

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especially women. Even though women before menopause are usually thought to have a lower risk of heart problems because of the protection from their own estrogen, new research shows that having high blood pressure during this time can cause early changes in blood vessels, problems with metabolism, and issues with the inner lining of blood vessels (1). These changes can happen before a person actually develops heart disease later in life. These early signs are often not noticed, but they can greatly affect how well a person can function and raise the risk of heart and metabolic problems in the future (2).

Cardiometabolic risk factors like having extra fat around the waist, high blood pressure, poor control of blood sugar, not getting enough exercise, and eating unhealthy foods often happen together in people with high blood pressure. These factors are very important in causing heart and blood vessel diseases (3). In women who haven't reached menopause yet, changes in hormones during the later stages of their reproductive years and the time leading up to menopause can make weight gain, difficulty managing blood sugar, and increased inflammation worse. These factors can speed up the decline in how well the body functions, even before menopause starts. Because of this, checking how well someone's body functions can help understand the early signs of heart and metabolic issues in this group (4).

The Six-Minute Walk Test is a straightforward, safe, and proven way to check how well someone can exercise. It measures how far a person can walk in six minutes to assess their ability to perform physical activities (5). It shows how the heart, lungs, and muscles work together and is often used to guess how sick someone might get, how likely they are to die, and how well they can live their life when they have heart or blood sugar problems (6). Reduced performance in the 6-minute walk test has been linked to obesity, high blood pressure, insulin resistance, and low levels of physical activity; but most of the research has mainly looked at older adults or postmenopausal women (7).

Even though more middle-aged women are dealing with high blood pressure, there isn't much information about how their ability to do physical activities connects to other health risks like heart and metabolic issues, especially in women who have high blood pressure but haven't reached menopause yet. Finding out early signs of poor physical health in this group could help start lifestyle changes and treatments early, which might lower their risk of heart problems later.

So, this study looks at how well women with high blood pressure and who are still in their premenopausal stage do in a test where they walk for six minutes, and how that relates to their heart and metabolic health risks. The goal is to show how checking their physical abilities can be an important early sign of their overall heart health.

Hypothesis

To find out the correlation between 6 minute walk test performance and cardiometabolic risk factors in hypertensive premenopausal women

- **Null Hypothesis (H_0):** There is no significant correlation between 6-Minute Walk Test performance and cardiometabolic risk factors in hypertensive premenopausal women.
- **Alternative Hypothesis (H_1):** There is a significant correlation between 6-Minute Walk Test performance and cardiometabolic risk factors in hypertensive premenopausal women.

METHODOLOGY

This study took place over two months in tertiary care hospitals in Lahore, Pakistan, after the research plan was approved. A total of 133 women who had high blood pressure and were premenopausal, aged between 40 and 48 years, were included in the study. These participants were selected using a non-probability convenience sampling method. The number of people needed for the study was calculated using G*Power version 3.1 based on a Pearson's correlation with a medium effect size (r = 0.30), a significance level of 0.05, and a power of 0.90. An extra 10% was added to cover for people who might not respond. To be included, women needed to have stage I or II essential hypertension for at least one year, as per JNC 8 guidelines, be confirmed as premenopausal using STRAW+10 criteria, be able to walk independently, and agree to give informed consent. Women with other heart conditions, lung disorders, musculoskeletal or neurological problems, those on hormone therapy or insulin, pregnant or nursing women, or those in the menopausal transition were not included. The study was approved by the Institutional Review Board and followed the Declaration of Helsinki. All participants gave written informed consent.

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Blood pressure was measured after sitting quietly for five minutes using a calibrated blood pressure monitor. Body measurements were taken following standard procedures, and blood sugar levels were checked after fasting for 10 to 12 hours using a calibrated glucose meter. Functional ability was assessed using the Six-Minute Walk Test as recommended by the American Thoracic Society. Risk factors related to the heart and lifestyle were evaluated using tools like the IPAQ-Short Form, MEDAS, FINDRISC, and the Framingham Risk Score. A statistical analysis was done to see how functional ability is linked to heart and lifestyle risk factors.

RESULTS

Table 1: Descriptive Analysis

Variable	N	Mean	Std. Deviation	Minimum	Maximum
6MWT Distance (m)	133	420.5	65.2	280	560
BMI	133	29.8	4.5	20.1	38
Waist Circumference (cm)	133	92.4	8.7	75.0	115.0
Waist to hip ratio	133	0.88	0.05	0.78	1.02
SBP (mmHg)	133	142.6	12.3	130	178
DBP (mmHg)	133	89.4	8.5	78	110
Fasting Blood Glucose	133	108.2	15.6	85	145

The basic facts about the people in the study (total of 133 people) show their health and body measurements. On average, they walked 420.5 meters in 6 minutes, and the distance varied between 280 and 560 meters, which means their ability to walk is okay but not the same for everyone. Their average weight compared to their height was 29.8, which is overweight, with some people being in the normal weight range and others having a severe obesity. Their average waist size was 92.4 centimeters, and their waist-to-hip ratio was 0.88, both signs that they have a lot of fat around their middle. Their blood pressure was high, with an average top number of 142.6 and a bottom number of 89.4, which means they have high blood pressure. Their average blood sugar level was 108.2, which is a bit higher than normal, showing that some people had trouble keeping their blood sugar under control.

Table 2: Correlation Matrix

Variables	6MWT Distance	BMI	WC	WHR	SBP	DBP	FBG
6MWT	1.000	-0.32	-0.28	-0.25	-0.18	-0.15	-0.27
BMI	-0.32**	1.000	0.72	0.58	0.30	0.28	0.34
WC	-0.28**	0.72	1.000	0.65	0.33	0.29	0.31
WHR	-0.25*	0.58	0.65	1.000	0.27	0.25	0.29
SBP	-0.18	0.30	0.33	0.27	1.000	0.68	0.22
DBP	-0.15	0.28	0.29	0.25	0.68	1.000	0.20
FBG	-0.27	0.34	0.31	0.29	0.22	0.20	1.000

Pearson correlation analysis showed that there were strong negative links between the distance someone could walk in six minutes (6MWT) and several health risk factors. Specifically, the farther someone could walk, the lower their BMI was ($r = -0.32$, $p < 0.01$), the smaller their waist size ($r = -0.28$, $p < 0.01$), the better their waist-to-hip ratio ($r = -0.25$, $p < 0.05$), and the lower their fasting blood sugar levels ($r = -0.27$, $p < 0.01$). However, the links between 6MWT distance and blood

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pressure were weaker and not statistically significant (r = -0.18 for systolic and -0.15 for diastolic).

When other factors like physical activity and diet were taken into account, the connections between 6MWT distance and BMI, waist size, and fasting glucose still held strong, showing that these links are not just due to lifestyle choices.

Table 3: Partial Correlations (Controlling Lifestyle)

Pair	Control Variable	Partial r	p-value
6MWT vs BMI	IPAQ MET, MEDAS Score	-0.28	0.002
6MWT vs WC	IPAQ MET, MEDAS Score	-0.24	0.006
6MWT vs WHR	IPAQ MET, MEDAS Score	-0.21	0.012
6MWT vs SBP	IPAQ MET, MEDAS Score	-0.14	0.089
6MWT vs DBP	IPAQ MET, MEDAS Score	-0.12	0.115
6MWT vs FBG	IPAQ MET, MEDAS Score	-0.23	0.008

The partial correlation analysis, which took into account lifestyle factors like physical activity (IPAQ MET) and diet (MEDAS score), showed that there are strong negative links between how well someone can perform physically (measured by 6MWT distance) and certain health markers. Specifically, higher body mass index (BMI), larger waist size, higher waist-to-hip ratio, and higher fasting blood glucose levels were all linked to poorer performance on the 6MWT. This suggests that more body fat and issues with blood sugar control are connected to lower physical ability, even when considering lifestyle factors. On the other hand, there was no strong link between systolic or diastolic blood pressure and physical performance, which suggests that blood pressure may not be as closely related to physical function in this group.

Table 4: Regression Model

Model	R	R2	Adjusted R1	Std. Error of Estimate
1	0.42	0.18	0.14	60.1
2	0.51	0.26	0.21	57.4

The regression results in Table 5 show how well the models explain the outcome. In Model 1, the correlation coefficient (R) is 0.42, which means there is a moderate positive link between the factors used and the result. The R squared value (R^2 = 0.18) means that about 18% of the changes in the result can be explained by these factors. The adjusted R squared is 0.14, which takes into account how many factors are in the model. The standard error of estimate is 60.1, which tells us how far the actual values are from the line of best fit.

Model 2 does a better job. The R value goes up to 0.51, showing a stronger connection between the factors and the result. The R squared increases to 0.26, meaning that 26% of the change in the result is explained by the factors. The adjusted R squared is now 0.21, which shows that adding more factors helps the model explain more without being too complex. The standard error of estimate drops to 57.4, showing the model predicts more accurately. Overall, Model 2 is a better fit than Model 1, showing that adding more factors helps explain the result better.

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Table 5: ANOVA

Model	Sum of square	df	Mean Square	F	Sig.
Regression	102450	6	17075	4.72	0.001
Residual	471230	126	3740	-	-
Total	573680	133	-	-	-

The results from the ANOVA in Table 6 show that the regression model is statistically significant. The regression sum of squares is 102,450, and the residual sum of squares is 471,230. This means the predictors explain a meaningful part of the variation in the dependent variable. When you divide the mean square for regression, which is 17,075, by the mean square for residuals, which is 3,740, you get an F-statistic of 4.72. The p-value of 0.001 shows this result is very significant. This means the regression model fits the data better than a model that has no predictors. In short, the group of independent variables together helps explain the changes in the outcome, which supports the reliability of the regression analysis.

Table 6: Group Comparison

Variable	Mean (<300 m)	Mean (≥300 m)	Mean Difference	t	P	Cohen's d
BMI	32.1	28.7	3.4	2.9	0.004	0.52
WC	96.8	90.2	6.6	3.1	0.002	0.55
FBG	115.2	105.1	10.3	2.7	0.007	0.47
SBP	146.2	141.1	5.1	2.0	0.045	0.35

The group comparison in Table 7 shows significant differences in cardiometabolic variables between participants with lower functional capacity (<300 m in the 6MWT) and those with higher capacity (≥300 m). Individuals walking less than 300 m had a higher mean BMI (32.1 vs. 28.7; p = 0.004, Cohen's d = 0.52), greater waist circumference (96.8 vs. 90.2 cm; p = 0.002, d = 0.55), and elevated fasting blood glucose (115.2 vs. 105.1 mg/dL; p = 0.007, d = 0.47). These differences are moderate in effect size, suggesting clinically meaningful disparities. Systolic blood pressure was also significantly higher in the <300 m group (146.2 vs. 141.1 mmHg; p = 0.045, d = 0.35), though with a smaller effect size. Overall, the findings indicate that poorer exercise capacity is associated with greater adiposity, impaired glucose regulation, and higher blood pressure, reinforcing the link between reduced functional performance and adverse cardiometabolic risk profiles.

DISCUSSION

This study looked at how well hypertensive women who haven't reached menopause perform in a 6-Minute Walk Test and how that relates to their risk factors for heart and metabolic problems. The results supported the idea that lower physical ability is linked to higher body weight, bigger waist size, a higher waist-to-hip ratio, and higher blood sugar levels. However, the connection between physical ability and blood pressure wasn't strong enough to be statistically meaningful. These results show that physical ability is a useful sign of metabolic health in this group of women.

The relationship between how far someone can walk in 6 minutes and their body mass index shows that having too much body fat affects how well a person can exercise. Being overweight puts more strain on the heart, makes muscles work less efficiently, and affects breathing, all of which lead to poorer walking performance. Sa-nguanmoo et al. (2024) found that young adults who are obese walked less during the 6MWT compared to those with a normal weight, showing that body size is a key factor in how well someone can exercise without reaching their maximum effort (8). Giontella et al. (2024) also found that overweight and obese children had shorter walking distances and different blood flow responses during the test, supporting the idea that extra body fat limits how well someone can perform physical activities, regardless of age. Our study adds to this by showing the same pattern in premenopausal women with high blood pressure, a group that is

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especially at risk for health issues because of the changes in hormones that come before menopause (9).

Waist size and waist-to-hip ratio were also linked to shorter 6MWT results. Having too much fat around the middle is a known risk factor for heart and metabolic problems, and it's also connected to lower physical ability in people with high blood pressure. A study by Ramos et al. (2014) showed that how far someone can walk in 6 minutes is a sign of heart stress in people with high blood pressure, and having more belly fat can make performance worse. Our study shows that having fat around the middle is especially harmful to exercise ability in women before menopause, which highlights the importance of focusing on ways to cut down on belly fat (10).

The strong connection between high blood sugar levels when fasting and shorter walking distances during the 6-minute walk test shows that problems with how the body uses glucose are connected to lower physical ability. This matches findings from big studies on heart health, like the My Heart Counts project, which found that people with higher risk scores for metabolic issues walked shorter distances. Notably, these links stayed strong even after considering lifestyle factors like exercise and diet, suggesting that poor metabolism on its own plays a key role in making it harder to keep up with physical activity (11).

Unlike fat and sugar control, systolic and diastolic blood pressure had weaker, not significant links with how far someone can walk in six minutes. Even though high blood pressure is a big risk for heart issues, it might not strongly affect exercise performance in people who are stable. A study by Huang et al. (2023) found that blood pressure changes during the six-minute walk test were important for predicting outcomes in people with heart failure, but just the resting blood pressure numbers weren't strong enough to predict how far someone could walk. This suggests that in premenopausal women with high blood pressure, blood pressure might not be the main factor limiting their ability to perform physical activities (12).

Regression analysis showed that factors related to heart and metabolic health together explained a significant part of the difference in how far people could walk during a 6-minute walk test. The second model provided a better explanation of these differences. Comparing groups also supported these results: women who walked less than 300 meters had higher body mass index, waist circumference, fasting blood sugar, and blood pressure than those who walked 300 meters or more. These differences, with moderate effects, show important variations in heart and metabolic risk between those with lower and higher physical abilities (13).

These findings show that the 6-minute walk test is a simple and non-invasive way to identify premenopausal women with high blood pressure who are at higher risk for heart and metabolic issues. Assessing physical ability could be an early sign of problems like obesity and poor blood sugar control. Including the 6-minute walk test in regular check-ups might help doctors focus on weight loss, reducing belly fat, and managing blood sugar. Since many participants were newly diagnosed with high blood pressure, early changes in lifestyle and medical treatment could be especially helpful in preventing high blood pressure from getting worse and causing other health problems.

CONCLUSION

Overall, the study concludes that reduced exercise capacity is closely associated with unfavorable cardiometabolic risk profiles in hypertensive premenopausal women. These results highlights the importance of functional capacity assessment as a practical marker for identifying women at elevated cardiometabolic risk. Interventions aimed at improving physical performance may therefore play a critical role in mitigating obesity and metabolic complications in this vulnerable group.

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