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# Lifestyle Practices in Reducing Cardiovascular Diseases: A Prospective Cohort Study from Pakistan

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ABSTRACT

**Background:** Cardiovascular diseases (CVD) remain the leading cause of global mortality, especially in individuals with comorbidities like type II diabetes and hypertension. While pharmacological therapies are vital, lifestyle interventions may offer additional benefits in reducing CVD risk. This article aims to evaluate the impact of lifestyle practices, specifically aerobic exercise, dietary modifications, and stress management, on cardiovascular risk factors and the incidence of major adverse cardiovascular events (MACE) over nine months.
**Methods:** This prospective cohort study enrolled 1000 adult patients (aged 30–60) with either type II diabetes or essential hypertension at a tertiary care hospital in Islamabad, Pakistan. Participants were categorized into two groups based on lifestyle adherence: (1) the exposed group, comprising individuals who regularly engaged in aerobic exercise and received dietary and psychological counseling, and (2) the non-exposed group, who did not adopt such practices. Baseline and 9-month follow-up data were collected on BMI, blood pressure, lipid profile, HbA1c, and incidence of MACE.
**Results:** Participants in the exposed group demonstrated significantly greater reductions in BMI, systolic/diastolic blood pressure, LDL, and HbA1c, and significantly higher increases in HDL ($p<0.01$). MACE incidence was 0.4% in the exposed group versus 4.8% in the non-exposed group. Correlation analysis showed significant associations between BMI, blood pressure, HbA1c, lipid levels, and MACE.
**Conclusion:** Combining lifestyle interventions with pharmacologic therapy can significantly improve cardiovascular outcomes in high-risk patients. Our findings support integrating structured lifestyle counseling into routine care for patients with diabetes or hypertension.

## 1. Introduction

Cardiovascular diseases (CVD) are the leading cause of global mortality, accounting for approximately 17.8 million deaths in 2017 [1]. The burden is especially significant in low- and middle-income countries, where modifiable lifestyle risk factors are often under-addressed. Among these risk factors, poor diet, physical inactivity, and psychological stress contribute substantially to disease progression in patients with comorbidities such as type II diabetes and hypertension [2, 3].

While pharmacological treatments remain a mainstay in CVD management, lifestyle interventions—particularly aerobic exercise, dietary improvements, and mental health support—have shown potential in reducing risk factors and adverse outcomes [4, 5].

However, there is a paucity of prospective data from South Asia examining the long-term effectiveness of such exposures when applied in real-world clinical settings. This study aimed to evaluate the effects of sustained lifestyle exposures on cardiovascular risk factors and incidence of MACE over 9 months in a Pakistani cohort of adults with type II diabetes or essential hypertension.

## 2. Methodology

### 2.1. Study Design and Setting

This was a monocentric prospective cohort study conducted at the Department of Internal Medicine, KRL Hospital, Islamabad, Pakistan, between January and September 2022. Ethical approval was obtained from the Institutional Review Board, and the study

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was conducted in accordance with the Declaration of Helsinki. A STROCSS 2021 checklist is provided in the supplementary file.

### 2.2. Study Participants

A total of 1000 patients aged 30–60 years with a diagnosis of either type II diabetes or essential hypertension (but not both concurrently) were enrolled. Informed consent was obtained from all participants.

### 2.3. Inclusion Criteria

Participants included in the study were adults diagnosed with either type II diabetes, defined as having an HbA1c level greater than 6.5% for at least six months, or essential hypertension, defined as a blood pressure reading of ≥ 140/90 mmHg on three consecutive clinical visits. Eligibility also required the presence of at least one modifiable cardiovascular risk factor such as obesity, poor dietary habits, or a sedentary lifestyle. Additionally, participants had to express a willingness to participate in a 9-month follow-up period to be eligible for enrollment in the study.

### 2.4. Exclusion Criteria

Participants were excluded if they had a concurrent diagnosis of both type II diabetes and essential hypertension, a known history of previous major adverse cardiovascular events (MACE), or if they were unable or unwilling to provide informed consent for participation in the study.

Participants were non-randomly classified into two naturally occurring groups based on their self-reported adherence to lifestyle practices. The exposed group (n = 500) consisted of individuals who engaged in at least 30 minutes of daily aerobic exercise and attended dietary and psychological counseling sessions every three months. In contrast, the non-exposed group (n = 500) included individuals who did not participate in structured physical activity or receive any form of dietary or stress-related counseling. As this was a prospective observational cohort study rather than an interventional trial, no procedures for randomization, allocation concealment, or blinding were applied.

### 2.5. Exposure

The exposure in this study consisted of three key components: aerobic exercise, dietary counseling, and stress management. The exercise regimen consisted of brisk walking or light jogging for 30 minutes per day, five to six days a week, with intensity tailored to each participant's body mass index (BMI) and baseline fitness level. Dietary counseling was provided by certified nutritionists who advised participants to increase their consumption of fruits, vegetables, legumes, and whole grains while reducing the intake of saturated fats and processed foods. Recommendations also included individualized portion control and balanced caloric distribution. Stress management was addressed through quarterly counseling sessions conducted by trained clinical psychologists, focusing on coping strategies, mindfulness techniques, and behavioral activation.

### 2.6. Outcome Measures

The primary outcomes of this study included changes in key cardiovascular risk markers such as body mass index (BMI), systolic and diastolic blood pressure (BP), glycated hemoglobin (HbA1c), low-density lipoprotein (LDL), and high-density lipoprotein (HDL) measured from baseline to the 9-month follow-up. Additionally, the incidence of major adverse cardiovascular events (MACE), defined as the first occurrence of myocardial infarction, stroke, or coronary heart disease, was assessed.

The secondary outcomes focused on comparing these changes between the exposed and non-exposed groups at the end of the 9-month follow-up period, to evaluate the differential impact of lifestyle practices on cardiovascular risk.

### 2.7. Data Collection

Baseline and 9-month follow-up measurements were taken by trained assistants blinded to group categorization. Blood samples were collected after overnight fasting and analyzed using certified laboratory equipment (Integra 400 plus for HbA1c; UniCel DxC 800 for lipid profile). MACE events were validated through hospital records and confirmed by independent cardiologists.

### 2.8. Statistical Analysis

Analyses were conducted using SPSS v23. Paired and independent t-tests were used to compare changes within and between groups. Point biserial correlation was used to assess the associations between MACE and continuous variables. Missing data were handled through complete-case analysis. A formal power analysis, based on an estimated effect size of 0.3, a 95% confidence level, and 80% power, yielded a required sample size of 880, allowing for a 10% dropout rate.

## 3. Results

Out of 1000 enrolled patients (500 in each group), 482 participants in the lifestyle-adherent group and 470 in the non-adherent group completed the 9-month follow-up, yielding a total retention rate of 95.2%. Participants in the lifestyle-adherent (exposed) group had a mean age of 45.1 ± 8.9 years, while the non-adherent (non-exposed) group had a mean age of 46.4 ± 9.2 years. At baseline, the exposed group had a significantly lower BMI (mean 25.3 ± 3.8 kg/m²) compared to the non-exposed group (mean 35.4 ± 5.3 kg/m²; p<0.001). Other significant baseline differences included HbA1c (7.9% vs. 9.7%; p<0.001), systolic blood pressure (142.7 ± 14.2 mmHg vs. 172.2 ± 18.5 mmHg; p<0.001), and LDL levels (177.27 ± 23.41 mg/dL vs. 168.55 ± 21.73 mg/dL; p<0.001). These differences were acknowledged as inherent to the observational design and addressed in the limitations. See (**Table 1**).

After 9 months, the lifestyle-adherent group exhibited substantial improvements in all measured cardiovascular risk factors. BMI in this group decreased by a mean of 5.04 ± 1.12 kg/m² (to 20.26 ± 2.7), compared to a reduction of 1.51 ± 0.93 kg/m² (to 33.89 ± 4.5) in the non-adherent group (p<0.001). Systolic blood pressure fell to 132.55 ± 11.9 mmHg in the exposed group, while it decreased only slightly to 169.71 ± 15.3 mmHg in the non-exposed group. Similarly, HbA1c decreased to 6.7 ± 0.6% in the exposed group versus 8.6 ± 0.9% in the non-exposed group. LDL levels in the exposed group decreased dramatically to 130.24 ± 17.42 mg/dL, representing a 47.03 mg/dL drop, whereas the non-exposed group experienced only a 9.42 mg/dL decrease (final LDL 159.13 ± 20.85 mg/dL). HDL improved significantly in the exposed group by 20.31 ± 3.72 mg/dL (final HDL 49.8 ± 5.2 mg/dL) compared to only 2.01 ± 1.73 mg/dL in the non-exposed group (final HDL 34.41 ± 4.9 mg/dL).

The incidence of major adverse cardiovascular events (MACE) was significantly lower in the lifestyle-adherent group, with only 2 events (0.4%) versus 24 events (4.8%) in the non-adherent group (p < 0.001). Point biserial correlation analysis showed statistically significant associations between MACE and baseline BMI (r = 0.171, p<0.0001), systolic BP (r = 0.165, p<0.0001), HbA1c (r = 0.155, p<0.0001), LDL (r = 0.161, p<0.0001), and an inverse correlation with HDL (r = –0.157, p<0.0001), reinforcing the

**Table 1:** Baseline Characteristics of Study Participants

| Variable | Lifestyle-Adherent Group (n = 500) | Non-Adherent Group (n = 500) | p-value |
|---|---|---|---|
| Age (years) | 45.1 ± 8.9 | 46.4 ± 9.2 | 0.07 |
| Gender (M/F) | 256 / 244 | 260 / 240 | 0.72 |
| BMI (kg/m²) | 25.3 ± 3.8 | 35.4 ± 5.3 | <0.001 |
| HbA1c (%) | 7.9 ± 0.7 | 9.7 ± 1.2 | <0.001 |
| Systolic BP (mmHg) | 142.7 ± 14.2 | 172.2 ± 18.5 | <0.001 |
| Diastolic BP (mmHg) | 92.1 ± 10.8 | 104.7 ± 12.3 | <0.001 |
| LDL (mg/dL) | 177.27 ± 23.41 | 168.55 ± 21.73 | <0.001 |
| HDL (mg/dL) | 29.49 ± 3.02 | 32.4 ± 3.5 | <0.001 |

M, Male; F, Female; BMI, Body Mass Index (kg/m$^2$); HbA1c, Hemoglobin A1c; BP, Blood Pressure; LDL, Low-Density Lipoprotein (mg/dL); HDL, High-Density Lipoprotein; n, Number of participants.

**Table 2:** Post-Intervention Outcomes at 9 Months

| Outcome Variable | Lifestyle-Adherent Group | Non-Adherent Group | p-value |
|---|---|---|---|
| Final BMI (kg/m²) | 20.26 ± 2.7 | 33.89 ± 4.5 | <0.001 |
| Final HbA1c (%) | 6.7 ± 0.6 | 8.6 ± 0.9 | <0.001 |
| Final Systolic BP (mmHg) | 132.55 ± 11.9 | 169.71 ± 15.3 | <0.001 |
| Final Diastolic BP | 85.7 ± 9.6 | 102.1 ± 10.8 | <0.001 |
| Final LDL (mg/dL) | 130.24 ± 17.42 | 159.13 ± 20.85 | <0.001 |
| Final HDL (mg/dL) | 49.8 ± 5.2 | 34.41 ± 4.9 | <0.001 |
| MACE Incidence (%) | 0.4% (2 events) | 4.8% (24 events) | <0.001 |

BMI, Body Mass Index; HbA1c, Hemoglobin A1c; BP, Blood Pressure; LDL, Low-Density Lipoprotein; HDL, High-Density Lipoprotein; MACE, Major Adverse Cardiovascular Events

relevance of modifiable cardiovascular risk factors in predicting adverse outcomes. See **(Table 2)**.

## 4. Discussion

This prospective cohort study highlights the critical role of sustained lifestyle interventions, including aerobic exercise, dietary modification, and stress management, in improving cardiovascular health and reducing MACE incidence in patients with type II diabetes or hypertension. Over 9 months, participants who adhered to recommended lifestyle practices demonstrated significantly greater improvements in BMI, blood pressure, lipid profiles, and glycemic control compared to those who did not, despite all patients receiving standard pharmacological treatment. The MACE incidence was notably lower in the lifestyle-adherent group, supporting the hypothesis that modifiable behavioral factors are powerful determinants of cardiovascular outcomes.

These findings are consistent with global evidence supporting lifestyle changes as effective non-pharmacologic strategies in CVD prevention [6, 7]. The results demonstrate that participants who engaged in daily physical activity, attended regular dietary and psychological counseling, and adhered to healthier habits experienced clinically meaningful improvements in BMI (mean reduction of 3.2 kg/m²), systolic blood pressure (-15.7 mmHg), HbA1c (1.3%), and LDL cholesterol (-41 mg/dL). Moreover, the incidence of major adverse cardiovascular events (MACE) was notably lower in the exposed group (3.6%) compared to the non-exposed group (7.2%). These findings align with previous literature, which shows a strong link between lifestyle factors and cardiovascular outcomes. For instance, Polemiti et al. [8] and Gray et al. [9] found positive associations between elevated BMI and increased cardiovascular risk in diabetics, whereas others, such as Owusu et al. [10] and Liu et al. [11] reported inverse or non-significant associations, possibly due to differing cohort characteristics or retrospective designs that introduce bias. Freisling et al. [12], in a large-scale cohort, similarly emphasized the protective role of healthy lifestyle practices, reinforcing our findings. The relationship between blood pressure and MACE risk has also been well documented; Bergmark et al. [13] demonstrated increased risk with higher systolic BP and overly low diastolic BP, possibly due to impaired coronary perfusion during diastole. Regarding glycemic control, Turgeon et al. [14] and Yap et al. [15] demonstrated that optimal HbA1c levels (6–7%) in individuals with diabetes were associated with a reduced incidence of cardiovascular events, consistent with our findings. Similarly, HDL and LDL levels were found to be predictive of MACE in analyses by Wang et al. [16] and Ray et al. [17], highlighting the lipid-lowering benefits observed in our intervention group. Exercise, a core component of our intervention, is recognized for its anti-atherogenic, autonomic-regulating, and anti-inflammatory properties [18]. Furthermore, Galán et al. [19] have demonstrated that even brief, regular exercise improves cardiovascular parameters in older adults. Dietary impacts were corroborated by Feingold et al. [20], who noted protective effects of diets rich in fruits, vegetables, and whole grains.

The magnitude of LDL reduction observed in our exposed group (mean decrease of 47 mg/dL) appears larger than typically expected from lifestyle interventions alone. While no lipid-lowering medications were prescribed as part of the study protocol, we acknowledge that undocumented statin use cannot be entirely ruled out and may partially explain the observed effect size.

Unlike randomized controlled trials, our observational cohort design inherently carries the risk of baseline imbalances and selection bias. Indeed, participants in the non-adherent group had significantly higher baseline BMI, HbA1c, and blood pressure, possibly reflecting motivational or socioeconomic differences that were not captured in the dataset. While statistical adjustments were applied, residual confounding remains a limitation. Smoking status, a major cardiovascular risk factor, was not recorded, which may have further influenced MACE outcomes.

Adherence to the intervention was self-reported through structured logs and interviews during counseling sessions. Although this allowed for feasible implementation in a real-world clinical setting, self-reporting bias is a potential concern. Additionally, as the intervention included multiple components such as diet, exercise, and stress counseling, it is not possible to determine which specific element had the greatest effect. This multifactorial exposure is a strength in terms of external validity but limits mechanistic interpretation.

The study duration of 9 months may be considered short for assessing hard cardiovascular outcomes such as MACE. Nonetheless, we observed a statistically significant reduction in event incidence, suggesting that even short-term interventions may yield early cardiovascular benefits. However, long-term follow-up would be essential to determine whether these improvements are durable. Importantly, this study provides region-specific data from a South Asian population, contributing valuable evidence in a setting where lifestyle interventions are underutilized and health systems are overburdened.

Despite these encouraging findings, several limitations warrant discussion. The 9-month follow-up period may underestimate the long-term incidence of MACE, and the monocentric nature of the study limits generalizability. While adherence was self-reported and partially monitored, variations in compliance may have influenced the results. The multifaceted nature of the intervention (exercise, diet, and stress management) makes it challenging to isolate the effect of any single component. Residual confounding, such as unmeasured socioeconomic factors or smoking status (not captured in our data), may also influence outcomes. Additionally, substantial baseline differences between groups necessitated statistical adjustment, but unmeasured confounders may persist. Nonetheless, this study adds valuable regional insight into the role of lifestyle interventions in high-risk populations. It underscores the potential of non-pharmacological strategies to complement standard care in preventing cardiovascular events. Future studies should aim to assess implementation models, cost-effectiveness, and longer-term adherence in broader populations. Our findings strongly support the integration of structured lifestyle counseling into standard care for patients with diabetes or hypertension. Such non-pharmacologic interventions, when implemented early and maintained consistently, can produce meaningful clinical improvements and reduce the burden of cardiovascular disease in high-risk populations.

## 5. Conclusion

Patients with type 2 diabetes or hypertension who adhered to regular aerobic exercise, dietary guidance, and stress counseling over 9 months experienced clinically meaningful reductions in cardiovascular risk markers, including a 1.2% drop in HbA1c, 47 mg/dL reduction in LDL, 10 mmHg decrease in systolic BP, and 5 kg/m² decrease in BMI compared to those without such exposure. Most notably, the incidence of major adverse cardiovascular events was significantly lower in the exposure group (0.4%) than in the non-exposed group (4.8%), highlighting the potential of structured lifestyle modifications as a powerful tool in reducing cardiovascular morbidity.

### Conflicts of Interest

All authors declare that they have no conflict of interest of any sort regarding the content of this paper.

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### Institutional Review Board (IRB)

All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript. The Ethics Committee of KRL Hospital granted ethical approval for this study with approval number KRL-ERC-2025-045-4367, dated December 28, 2021. All authors report that they have no conflicts of interest.

### Large Language Model

The authors confirm that no Large Language Models (LLMs) were used in the writing, editing, analysis, or interpretation of this manuscript.

### Authors Contribution

HS contributed to conceptualization, methodology, investigation and writing the original draft. MS was involved in conceptualization, supervision, project administration and writing in review and editing. MI handled data curation, formal analysis and validation. SY conducted investigation, provided resources and collected data. MA managed data curation, visualization and writing in review and editing. HAS contributed to formal analysis, statistical analysis and methodology. UA performed literature search, writing in review and editing and validation. MNK was responsible for investigation, patient recruitment and data collection. SA provided resources, project support and data collection. HM contributed to methodology, supervision and writing in review and editing.

### Data Availability

The data used in this study are available upon reasonable request from the corresponding author.

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