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Original Research Article

Effects of Regular Moderate Exercise on Cardiovascular Parameters in Young Adults

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Abstract:

Background: Regular moderate physical activity is known to influence cardiovascular function, yet evidence among young adults remains variable. This study evaluated the impact of sustained moderate-intensity exercise on key cardiovascular parameters in healthy individuals aged 18–25 years.

Material and Methods: A cross-sectional analytical study was conducted among 100 young adults. Participants were categorized into an exercise group (n = 50), comprising individuals performing ≥150 minutes/week of moderate activity for at least six months, and a sedentary group (n = 50) with no structured physical activity. Anthropometric indices and cardiovascular measurements—including resting heart rate, systolic and diastolic blood pressure, mean arterial pressure, and rate pressure product—were recorded under standardized conditions. Group comparisons were performed using independent-sample t tests, with significance set at $p < 0.05$.

Results: Both groups were comparable in age, height, weight, and BMI, with no statistically significant differences in baseline characteristics. Resting heart rate was significantly lower in the exercise group compared to sedentary participants (69.1 ± 7.4 vs. 77.6 ± 8.2 beats/min; $p < 0.001$). Systolic blood pressure (114.6 ± 8.3 vs. 121.3 ± 9.1 mmHg; $p < 0.001$) and diastolic pressure (72.8 ± 6.4 vs. 77.1 ± 7.0 mmHg; $p = 0.002$) were also lower among regular exercisers. Mean arterial pressure showed a similar trend (86.7 ± 5.8 vs. 91.8 ± 6.2 mmHg; $p < 0.001$). The rate pressure product, an indirect marker of myocardial oxygen demand, was substantially reduced in the exercise group (7908 ± 1024 vs. 9423 ± 1131; $p < 0.001$).

Conclusion: Young adults engaging in routine moderate exercise exhibit significantly improved cardiovascular parameters compared to sedentary individuals. These findings underscore the importance of incorporating regular moderate physical activity as a preventive measure for long-term cardiovascular health.

Keywords: Moderate Exercise; Young Adults; Blood Pressure; Heart Rate; Rate Pressure Product.

Introduction

Cardiovascular disease (CVD) remains the leading cause of global mortality, yet its antecedent risk factors often emerge much earlier in life. Low cardiorespiratory fitness and the clustering of traditional risk factors during young adulthood are associated with progression to hypertension, dyslipidaemia, diabetes and, ultimately, clinical CVD in later decades. Longitudinal data indicate that poorer fitness in young adults predicts the development of adverse cardiometabolic outcomes, underscoring the importance of primordial prevention during this life stage [1].

Physical activity exerts pleiotropic effects on cardiovascular physiology and risk. Habitual exercise modifies body composition, insulin sensitivity and lipid metabolism, and favourably shifts autonomic balance toward greater parasympathetic tone; these changes translate into lower resting heart rate (RHR) and improved blood pressure (BP) profiles in many populations [2]. The magnitude of effect may vary by exercise modality, intensity and baseline risk, but an accumulating body of observational and interventional evidence supports a role for regular moderate-intensity activity in lowering resting haemodynamic indices and reducing long-term cardiovascular risk [3].

Resting heart rate is an accessible surrogate of autonomic tone and cardiovascular load. Higher RHR in young adults has been linked to greater odds of developing hypertension and adverse

cardiovascular outcomes later in life, making RHR a simple but meaningful target for early preventive strategies [4]. Blood pressure also responds to physical training: contemporary systematic analyses and large-scale evaluations report modest but clinically relevant reductions in systolic and diastolic BP following structured exercise programmes and habitual activity, particularly when sustained over weeks to months [5,6].

Beyond single measures of heart rate and pressure, composite indices such as the rate pressure product (RPP; heart rate × systolic BP) provide an indirect estimate of myocardial workload and oxygen demand. RPP has been used in exercise physiology and cardiac risk assessment to characterise cardiac workload at rest and during stress, and changes in RPP after training reflect alterations in the integrated haemodynamic burden on the myocardium [5]. Despite these well-recognized associations, data specifically examining the relationship between routine moderate activity and resting cardiovascular parameters among otherwise healthy young adults remain heterogeneous, with variability arising from differences in subject selection, activity quantification and measurement protocols.

Given the potential for early lifestyle modification to alter lifetime cardiovascular trajectories, targeted studies in young, healthy populations are needed to quantify the haemodynamic correlates of regular moderate exercise and to inform public-health advice. The present investigation aimed to compare resting heart rate, blood pressure, mean arterial pressure and rate pressure product between young adults who perform sustained moderate-intensity activity and age-matched sedentary peers.

Material And Methods

Study Design and Setting: A cross-sectional analytical study was conducted in a tertiary-care teaching hospital. The study compared cardiovascular parameters between young adults who reported engaging in regular moderate-intensity exercise and those without any structured physical activity.

Study Population: Participants were healthy young adults aged 18–25 years recruited from undergraduate health-science programs. Individuals with a history of hypertension, diabetes, cardiovascular disease, chronic medication use, smoking, or alcohol dependence were excluded to avoid potential confounding influences on cardiovascular measurements.

Sample Size Determination: The sample size was estimated using an expected mean difference of 5 mmHg in resting systolic blood pressure between active and inactive groups, with a standard deviation of 8 mmHg, 80% statistical power, and 5% type-I error. The calculation yielded a minimum sample of 45 participants per group. To compensate for non-response, a total of 100 subjects were included—50 regular exercisers and 50 sedentary individuals.

Definition of Moderate Exercise: Moderate exercise was defined according to the American College of Sports Medicine criteria as physical activity performed for at least 150 minutes per week at an exertion level equivalent to 3–6 metabolic equivalents (METs). Participants in the exercise group had maintained this level of activity for a minimum of the preceding six months.

Anthropometric Assessment: Height was measured using a stadiometer with 0.1 cm precision. Body weight was recorded using a calibrated digital scale with 0.1 kg accuracy. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2).

Cardiovascular Parameters: Resting heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were the primary outcome variables.

- **Heart Rate:** Measured after 10 minutes of seated rest using an automated pulse monitor.
- **Blood Pressure:** Recorded using a validated automated sphygmomanometer. Three readings were taken at one-minute intervals, and the average of the last two readings was considered for analysis.
- **Rate Pressure Product (RPP):** Derived as SBP × heart rate to estimate myocardial workload.

Exercise Status Verification: A structured questionnaire assessed weekly exercise duration, frequency, and type. Only participants meeting the predefined moderate-exercise criteria were placed into the active group.

Procedure: After obtaining informed consent, each participant underwent anthropometric and cardiovascular evaluation in a quiet room maintained at a standard ambient temperature. For consistency, all measurements were performed during morning hours, at least two hours after a light meal. Participants were advised to avoid caffeine and strenuous physical activity for 12 hours before the assessment.

Statistical Analysis: Data were analyzed using SPSS software. Continuous variables were expressed as mean ± standard deviation. Between-group comparisons were performed using the independent-samples t test. A p-value <0.05 was considered statistically significant.

Results

A total of 100 young adults were included in the analysis, with 50 participants each in the exercise and sedentary groups. The baseline characteristics of the two groups were comparable (Table 1). There

were no statistically meaningful differences in age, height, weight, or BMI, indicating that the groups were well matched. The mean age was 20.8 ± 1.9 years in the exercise group and 21.1 ± 2.1 years among sedentary participants (p = 0.48). Similarly, BMI values did not differ significantly between the two groups (p = 0.11).

Evaluation of cardiovascular variables demonstrated significant differences in resting hemodynamic status between the groups (Table 2). Participants engaged in regular moderate activity exhibited a lower resting heart rate compared to sedentary individuals (69.1 ± 7.4 vs. 77.6 ± 8.2 beats/min, p < 0.001). A similar trend was observed in blood pressure values. Mean systolic pressure was lower in the exercise group (114.6 ± 8.3 mmHg) compared with the non-exercising group (121.3 ± 9.1 mmHg, p < 0.001). Diastolic pressure also differed significantly, with lower readings among those who exercised routinely (72.8 ± 6.4 vs. 77.1 ± 7.0 mmHg, p = 0.002). Mean arterial pressure demonstrated a comparable pattern, with significantly reduced values in the active group (p < 0.001).

The calculated rate pressure product, an indirect estimate of myocardial oxygen demand, was notably lower among regular exercisers (7908 ± 1024) than sedentary participants (9423 ± 1131), reflecting a more favourable cardiovascular workload profile (p < 0.001).

Exercise behaviour among the active group is summarized in Table 3. Participants reported an average of 176 ± 29 minutes of weekly moderate activity performed on approximately 4.6 ± 0.9 days. Brisk walking was the most common form of exercise, followed by jogging, cycling, and structured aerobic workouts.

Table 1: Baseline Characteristics of Study Participants (N = 100)

Parameter	Exercise Group (n = 50)	Sedentary Group (n = 50)	p-value
Age (years)	20.8 ± 1.9	21.1 ± 2.1	0.48
Height (cm)	167.3 ± 8.2	166.5 ± 7.9	0.62
Weight (kg)	62.4 ± 9.1	64.2 ± 8.6	0.29
BMI (kg/m²)	22.2 ± 2.7	23.1 ± 2.9	0.11

Table 2: Comparison of Cardiovascular Parameters

Parameter	Exercise Group (n = 50)	Sedentary Group (n = 50)	p-value
Resting Heart Rate (beats/min)	69.1 ± 7.4	77.6 ± 8.2	<0.001
Systolic BP (mmHg)	114.6 ± 8.3	121.3 ± 9.1	<0.001
Diastolic BP (mmHg)	72.8 ± 6.4	77.1 ± 7.0	0.002
Mean Arterial Pressure (mmHg)	86.7 ± 5.8	91.8 ± 6.2	<0.001
Rate Pressure Product (SBP × HR)	7908 ± 1024	9423 ± 1131	<0.001

Table 3: Exercise Pattern in the Active Group (n = 50)

Variable	Value
Duration of exercise per week (minutes)	176 ± 29
Days of exercise per week	4.6 ± 0.9
Type of activity	Brisk walking (46%), Jogging (32%), Cycling (14%), Aerobic workouts (8%)

Discussion

This study found that young adults who engaged in regular moderate-intensity exercise had significantly lower resting heart rate, systolic and diastolic blood pressure, mean arterial pressure, and rate pressure product (RPP) compared with age-matched sedentary peers. These differences are consistent with prior evidence that habitual physical activity produces favourable resting haemodynamic adaptations even in otherwise healthy populations [7].

The observed reduction in resting heart rate among exercisers aligns with systematic reviews showing that regular endurance-type activity lowers resting heart rate, a finding attributed to training-related shifts in autonomic balance and intrinsic sinoatrial node properties. Lower resting heart rate in active individuals is commonly interpreted as increased cardiac parasympathetic (vagal) modulation and/or a relative reduction in sympathetic drive, both of which are well described consequences of sustained aerobic training [7].

Our blood pressure results—mean reductions in both systolic and diastolic pressures in the exercise group—mirror pooled estimates from exercise-training meta-analyses that document modest but clinically meaningful decreases in resting blood pressure following aerobic and dynamic resistance programmes [8,9]. These training-induced BP reductions have been observed across a range of

baseline levels, including in normotensive and prehypertensive cohorts, and are likely to translate into meaningful long-term reductions in cardiovascular risk at the population level.

The RPP, calculated as systolic blood pressure multiplied by heart rate, was substantially lower among regular exercisers in our cohort. RPP serves as an index of myocardial oxygen demand and integrated cardiac workload; reductions in RPP following habitual activity or structured exercise training have been reported in both experimental and observational settings, reflecting decreased myocardial workload at rest and during submaximal tasks [10]. Lower RPP in active young adults therefore suggests a more favourable cardiac energetic profile that could have implications for exercise tolerance and cardiac reserve.

Mechanistic explanations for our findings are multifactorial. Autonomic remodelling with enhanced vagal tone and improved baroreflex sensitivity is a central pathway through which training reduces resting heart rate and blunts pressor responses [11,12]. Meta-analytic and experimental data indicate training increases indices of cardiac parasympathetic modulation and augments vagally mediated heart-rate dynamics, particularly in previously sedentary individuals—effects that emerge over weeks to months of regular exercise.

Vascular adaptations also contribute importantly to lower resting blood pressure and RPP. Repeated haemodynamic shear stress during aerobic activity improves endothelial function (increasing nitric oxide bioavailability and reducing endothelin-1), reduces arterial stiffness, and favourably remodels peripheral resistance vessels—changes that reduce systemic vascular resistance and thus resting arterial pressure [13,14]. Studies in healthy subjects and patient groups have demonstrated improvements in flow-mediated dilation and reductions in vasoconstrictor mediators after aerobic training, lending biological plausibility to the blood pressure differences observed here.

Type, dose and duration of activity influence the magnitude of haemodynamic change. While our definition targeted moderate-intensity activity (≥150 min/week), evidence suggests that both higher volumes and specific modalities (e.g., dynamic endurance vs. combined training) may produce larger cardiovascular gains; isometric training has also been reported to elicit meaningful BP reductions in some meta-analyses [15]. Thus, the moderate but consistent activity reported by participants in our exercise group plausibly produced the intermediate-sized yet statistically robust differences documented.

Strengths of the current study include careful matching of baseline anthropometry between groups and standardized measurement protocols. Nonetheless, several limitations deserve acknowledgement. The cross-sectional design precludes causal inference; although the directionality between habitual activity and improved resting haemodynamics is biologically plausible and supported by intervention trials, cohort or randomized designs would more definitively establish causation. Exercise exposure was self-reported and therefore subject to recall and social-desirability biases; objective activity monitoring (accelerometry) would strengthen future work. We did not perform autonomic function tests (e.g., heart-rate variability indices, baroreflex sensitivity) or direct endothelial assessments (flow-mediated dilation), which would have provided mechanistic confirmation of the pathways proposed. Finally, the study sample—healthy university-aged adults—limits generalizability to older or clinical populations.

Conclusion

Regular engagement in moderate-intensity physical activity was associated with a more favourable cardiovascular profile in young adults. Individuals who exercised routinely demonstrated lower resting heart rate, blood pressure, and rate pressure product compared to their sedentary peers, suggesting improved autonomic balance and reduced myocardial workload. These findings highlight the potential of sustained moderate exercise as an effective, non-pharmacological strategy to promote cardiovascular health even in early adulthood. Encouraging structured physical activity at a young age may contribute to long-term prevention of lifestyle-related cardiovascular risk.

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