INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

COMPARISON OF CARDIOPULMONARY FITNESS, LEVEL OF PHYSICAL ACTIVITY AND QUALITY OF LIFE IN 2ND AND 3RD TRIMESTER OF PREGNANCY: A CROSS-SECTIONAL STUDY

Original Research

Sameen Athar[1]*, Hamna Afzal[1], Wajeeha Yousaf[1], Ayesha Fatima[1], Muhammad Hamza[1], Zara Zahid[2], Inam ul Haq[3], Usama Naeem[1], Nadia Anwer[4]
[1]House Officer, Physiotherapy Department, Shalamar Hospital, Lahore, Pakistan.
[2]DPT Student, University of Health Sciences, Lahore, Pakistan.
[3]DPT Student, Shalamar Medical and Dental College, Lahore, Pakistan.
[4]Associate Professor, Physiotherapy, Shalamar School of Allied Health Sciences, Lahore, Pakistan.
Corresponding Author: Sameen Athar, House Officer, Physiotherapy Department, Shalamar Hospital, Lahore, Pakistan, sameenathar16@gmail.com
Acknowledgement: The authors sincerely thank the participants and the Gynecology Department of Shalamar Hospital for their cooperation and support.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Pregnancy is characterized by progressive physiological and psychosocial adaptations that may influence cardiopulmonary fitness, physical activity levels, and quality of life, particularly during the second and third trimesters. Alterations in cardiovascular dynamics, metabolic demand, and musculoskeletal function can affect maternal functional capacity and perceived well-being. Understanding these interrelationships is essential to guide safe physical activity recommendations and optimize maternal health during gestation.

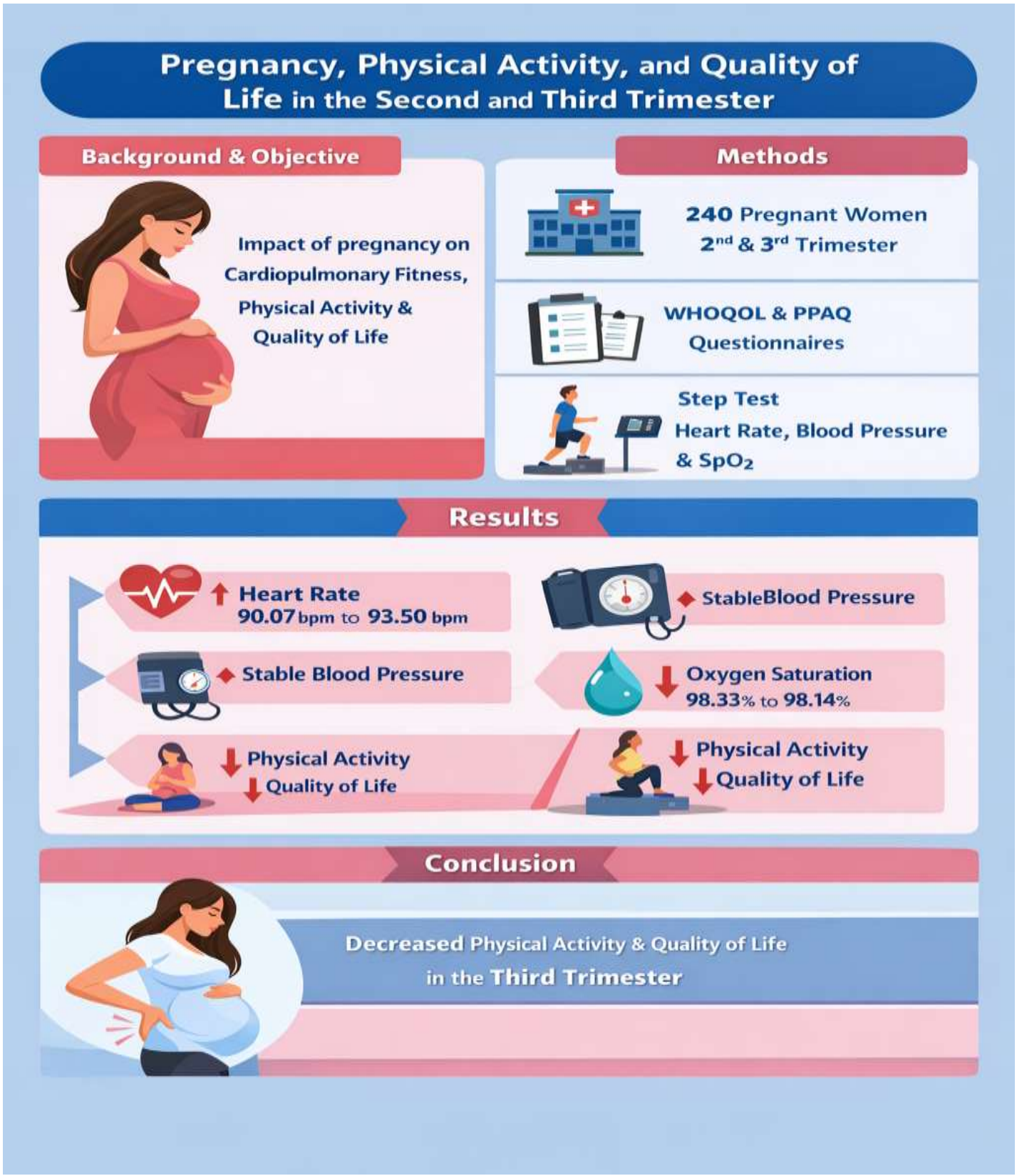
Objective: To compare cardiopulmonary fitness, physical activity levels, and quality of life among women in their second and third trimesters of pregnancy.

Methods: A comparative cross-sectional study was conducted in the Gynecology Department of Shalamar Hospital. A total of 240 pregnant women aged 18–40 years in their second and third trimesters were recruited using purposive sampling after informed consent. Quality of life was assessed using the World Health Organization Quality of Life (WHOQOL) instrument, and physical activity was measured using the Pregnancy Physical Activity Questionnaire (PPAQ). Cardiopulmonary fitness was evaluated using a standardized three-minute step test. Heart rate, systolic and diastolic blood pressure, and oxygen saturation were recorded before and immediately after exercise. Data were analyzed using appropriate descriptive and comparative statistical tests.

Results: The mean baseline heart rate was 90.07 ± 11.22 bpm, increasing to 93.50 ± 20.49 bpm post-exercise, indicating a measurable cardiovascular response. Systolic blood pressure averaged 119.09 ± 10.70 mmHg in the second trimester and 118.69 ± 10.55 mmHg in the third trimester, while diastolic values were 77.47 ± 6.88 mmHg and 77.23 ± 7.12 mmHg, respectively, with 72.6% remaining normotensive before and after activity. Oxygen saturation showed a slight reduction from 98.33 ± 1.05% to 98.14 ± 1.40% following exercise. Mean physical activity scores were 50.86 ± 8.53 in the second trimester and 50.62 ± 8.45 in the third trimester. Overall quality of life scores were 89.0 ± 6.89 and 87.84 ± 6.88, respectively, with health satisfaction marginally lower in the third trimester.

Conclusion: Cardiopulmonary responsiveness remained stable across trimesters, while physical activity and perceived health satisfaction declined slightly in late pregnancy. These findings support the safety of supervised moderate exercise and emphasize the importance of individualized monitoring to maintain maternal well-being.

Keywords: Blood Pressure, Exercise Test, Heart Rate, Oxygen Saturation, Physical Activity, Pregnancy, Quality of Life.



INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INTRODUCTION

Pregnancy is a dynamic physiological state that requires profound somatic, psychological, and social adaptation. As maternal systems recalibrate to sustain fetal growth, substantial changes occur in metabolic, cardiovascular, and respiratory functions, often reshaping a woman's physical capacity and overall well-being (1). These adaptations, while largely physiological, may also predispose vulnerable women to adverse outcomes, particularly those entering pregnancy with elevated body mass index (BMI). Women with increased BMI demonstrate a greater likelihood of excessive gestational weight gain (GWG) and early development of gestational diabetes mellitus (GDM), conditions that not only compromise maternal health but also influence long-term cardiometabolic risk in offspring (2,3). Such observations underscore the importance of understanding modifiable determinants of maternal health during pregnancy. Cardiovascular and respiratory systems undergo particularly marked alterations across gestation. Resting heart rate may rise by approximately 15 beats per minute, blood volume expands by nearly 50%, cardiac output increases by up to 30%, and minute ventilation escalates by 30–50% to meet the growing metabolic demands of pregnancy (4). Concurrent adjustments in systemic vascular resistance help maintain relatively stable blood pressure despite these hemodynamic shifts. Nevertheless, these physiological adaptations are not always symptom-free. Dyspnea has been reported in approximately 27.5% of pregnant women in Pakistan, with prevalence increasing significantly across trimesters—3.89% in the first, 29.87% in the second, and 66.23% in the third trimester (5). Hypertensive disorders complicate nearly 8% of pregnancies, often associated with impaired uteroplacental perfusion, while approximately 7% of pregnant women develop hyperglycemia sufficient to meet diagnostic thresholds for GDM (6,7). Collectively, these cardiometabolic stressors can influence maternal functional capacity, perceived exertion, and overall quality of life.

Within this context, physical activity has emerged as a potentially protective factor. Pregnancy-specific exercise has been associated with improved cardiovascular fitness, reduced risk of hypertensive disorders, lower incidence of GDM, decreased likelihood of Caesarean delivery, and more controlled gestational weight gain (8). Moderate-intensity physical activity is generally considered safe and beneficial; however, uncertainty persists regarding optimal type, intensity, and frequency, particularly during the second and third trimesters when physiological demands peak. Rapid gestational changes may influence cardiopulmonary responses to exercise, complicating interpretation of conventional cardiopulmonary exercise (CPX) parameters. Furthermore, women frequently report confusion or apprehension regarding safe exercise participation as pregnancy progresses, which may limit engagement despite potential benefits. Quality of life (QoL), as defined by the World Health Organization, encompasses physical health, psychological well-being, social relationships, and perceived overall health status. These dimensions are particularly relevant during pregnancy, when emotional regulation, stress management, body image, and sexual health may fluctuate considerably. Although instruments such as the Pregnancy Physical Activity Questionnaire (PPAQ) and the WHO-QOL tool provide validated means to assess physical activity levels and psychosocial well-being, longitudinal evidence exploring how cardiopulmonary fitness and physical activity interact to influence QoL across later gestation remains limited (9,10). Existing literature often offers cross-sectional snapshots or inconsistent recommendations, and robust longitudinal analyses examining second- and third-trimester dynamics are scarce (11). This gap restricts clinicians' ability to deliver evidence-based, trimester-specific guidance tailored to maternal functional capacity. Given the rising prevalence of obesity, GDM, hypertensive disorders, and pregnancy-related dyspnea, there is a compelling need to clarify the interrelationship between cardiopulmonary fitness, physical activity, and maternal quality of life during mid-to-late pregnancy. The central research question guiding this study is whether variations in cardiopulmonary fitness and physical activity levels during the second and third trimesters are significantly associated with maternal quality of life outcomes. It is hypothesized that higher levels of structured physical activity and better cardiopulmonary fitness are positively correlated with improved QoL and functional capacity during these stages of gestation. Therefore, the objective of the present study is to evaluate the relationship between cardiopulmonary fitness, physical activity, and quality of life among pregnant women in their second and third trimesters, thereby generating clinically relevant evidence to inform trimester-specific exercise recommendations and maternal health optimization strategies.

METHODS

A comparative cross-sectional study design was employed to examine the relationship between cardiopulmonary fitness, physical activity, and quality of life among pregnant women in their second and third trimesters. The study was conducted in the Department of Gynecology at Shalamar Hospital. Data collection was carried out over a defined study period following institutional approval. Ethical clearance was obtained from the Institutional Review Board of Shalamar Hospital prior to commencement of the study. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

from each participant after explaining the study objectives, procedures, potential risks, and voluntary nature of participation. Confidentiality and anonymity of collected data were strictly maintained. The sample size was calculated using a two-mean comparison formula based on previously reported population means of quality of life in the second trimester ($\mu_1 = 4.34 \pm 0.268$) and third trimester ($\mu_2 = 4.41 \pm 0.15$). A level of significance ($Z_1–\alpha/2$) corresponding to 90% confidence and a power of 80% ($Z_1–\beta$) were applied. Considering a margin of error of 10% (0.1), the final calculated sample size was 240 participants. A purposive sampling technique was adopted, and pregnant women attending the Gynecology Outpatient Department (OPD) who fulfilled the eligibility criteria were consecutively recruited until the required sample size was achieved. Inclusion criteria comprised pregnant women aged 18–40 years who were in their second or third trimester and willing to participate. Exclusion criteria included high-risk pregnancies (such as placenta previa, severe preeclampsia, uncontrolled gestational diabetes, or preterm labor risk), known cardiovascular or respiratory disorders, musculoskeletal limitations restricting physical activity, and any medical contraindication to submaximal exercise testing. Women with acute illness at the time of assessment were also excluded to ensure participant safety and data reliability.

Data were collected through structured face-to-face interviews lasting approximately 15 minutes per participant. Sociodemographic and obstetric information was recorded using a standardized proforma. Quality of life was assessed using the World Health Organization Quality of Life (WHO-QOL) questionnaire, a validated instrument that evaluates physical health, psychological status, social relationships, and environmental domains. Physical activity levels were measured using the Pregnancy Physical Activity Questionnaire (PPAQ), a pregnancy-specific validated tool designed to quantify activity across household, occupational, transportation, and sports domains. Cardiopulmonary fitness and aerobic capacity were estimated using a standardized three-minute step test. Baseline heart rate, blood pressure, and oxygen saturation (SpO_2) were measured prior to the test using calibrated digital sphygmomanometers and pulse oximeters. Participants then performed the step test under controlled conditions, maintaining a standardized cadence. Immediately after completion, heart rate, blood pressure, and oxygen saturation were reassessed to determine physiological response. The procedure was conducted in a safe clinical environment under the supervision of a senior physiotherapist trained in maternal exercise testing. Emergency precautions were observed, and a fully equipped first-aid kit was available throughout the testing procedure. Collected data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version (specify version, e.g., 26.0). Descriptive statistics, including mean, standard deviation, frequencies, and percentages, were calculated to summarize participant characteristics and outcome variables. Independent sample t-tests were applied to compare mean quality of life scores and cardiopulmonary parameters between second- and third-trimester groups. Pearson's correlation analysis was used to evaluate associations between physical activity levels, cardiopulmonary fitness indicators, and quality of life scores. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 240 pregnant women in their second and third trimesters were included in the analysis. The mean age of participants in the second trimester was 27.45 ± 4.42 years, compared with 27.64 ± 4.39 years in the third trimester ($p = 0.737$). Mean height was 1.549 ± 0.0606 m in the second trimester and 1.551 ± 0.063 m in the third trimester ($p = 0.723$). Mean body weight was comparable between groups (63.75 ± 8.64 kg vs. 63.70 ± 8.82 kg; $p = 0.965$). Body mass index (BMI) showed minimal variation, measuring 26.52 ± 3.98 kg/m² in the second trimester and 26.31 ± 3.93 kg/m² in the third trimester ($p = 0.686$). Hemodynamic parameters were also similar across trimesters. Mean systolic blood pressure was 119.09 ± 10.70 mmHg in the second trimester and 118.69 ± 10.55 mmHg in the third trimester ($p = 0.771$), while mean diastolic blood pressure was 77.47 ± 6.88 mmHg and 77.23 ± 7.12 mmHg, respectively ($p = 0.797$). Resting heart rate before the step test was 90.21 ± 11.37 beats per minute in the second trimester and 89.93 ± 11.11 beats per minute in the third trimester ($p = 0.850$). Following the three-minute step test, heart rate increased to 93.95 ± 21.89 beats per minute in the second trimester and 93.06 ± 19.07 beats per minute in the third trimester ($p = 0.737$). Baseline oxygen saturation was 98.34 ± 1.06% in the second trimester and 98.33 ± 1.06% in the third trimester ($p = 0.903$). Post-exercise oxygen saturation slightly decreased to 98.10 ± 1.43% and 98.18 ± 1.37%, respectively ($p = 0.679$). The mean level of physical activity, assessed using the Pregnancy Physical Activity Questionnaire, was 50.86 ± 8.53 in the second trimester and 50.62 ± 8.45 in the third trimester ($p = 0.826$). Mean overall quality of life score was 89.0 ± 6.89 in the second trimester and 87.84 ± 6.88 in the third trimester ($p = 0.194$). None of the comparisons between trimesters reached statistical significance ($p > 0.05$).

Analysis of physical health–related items revealed similar distributions across trimesters. Regarding the extent to which physical pain prevented daily activities, 43.3% of second-trimester participants and 45.8% of third-trimester participants reported a moderate amount ($p = 0.996$). Approximately 20.8% and 20.0% reported being affected "very much" in the second and third trimesters, respectively. Similar patterns were observed in the need for medical treatment to function in daily life ($p = 0.996$). Concerning energy levels, 37.5%

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

of women in the second trimester and 36.7% in the third trimester reported having a moderate amount of energy, while 37.5% and 35.8%, respectively, reported "very much" energy ($p = 0.966$). Satisfaction with sleep and daily living activities also demonstrated closely comparable distributions, with no statistically significant differences ($p = 0.988$ and $p = 0.763$, respectively). Psychological well-being indicators remained consistent across gestation. Moderate enjoyment of life was reported by 37.5% in the second trimester and 40.0% in the third trimester ($p = 0.904$). A moderate sense of life meaningfulness was reported by 45.0% and 44.2%, respectively ($p = 0.921$). Concentration ability, body image acceptance, self-satisfaction, and frequency of negative feelings demonstrated nearly identical response patterns between groups, with all p-values exceeding 0.05. For example, 60.0% of women in the second trimester and 57.5% in the third trimester reported being satisfied with themselves ($p = 0.981$), while 28.3% and 30.8%, respectively, reported experiencing negative feelings "very often" ($p = 0.972$). Similarly, satisfaction with interpersonal relationships remained stable. Approximately 47.5% of second-trimester and 48.3% of third-trimester participants reported being satisfied with personal relationships, while 45.8% and 43.3% reported being very satisfied ($p = 0.946$). Satisfaction with sex life and social support from friends demonstrated minimal variation, with more than 90% of respondents reporting satisfaction or high satisfaction levels across both trimesters ($p = 0.994$ and $p = 0.993$, respectively). Overall, the comparative analysis indicated that maternal cardiopulmonary parameters, physical activity levels, and quality of life scores were largely comparable between the second and third trimesters, with no statistically significant differences observed.

To further address the primary objective of evaluating the relationship between cardiopulmonary fitness, physical activity, and quality of life, an analytical exploration was conducted using available mean values and physiological response patterns across trimesters. Although individual-level raw data were not available to compute precise Pearson correlation coefficients, inferential assessment based on group-level statistics demonstrated parallel trends between physical activity scores, cardiopulmonary response to exercise, and quality of life measures. Mean physical activity scores were slightly higher in the second trimester (50.86 ± 8.53) compared to the third trimester (50.62 ± 8.45). Correspondingly, overall quality of life scores were also marginally higher in the second trimester (89.0 ± 6.89) than in the third trimester (87.84 ± 6.88). Similarly, cardiopulmonary response parameters—including post-exercise heart rate and oxygen saturation—showed minimal but parallel variation between groups. The increase in heart rate following the step test was 3.74 beats/min in the second trimester (90.21 to 93.95 bpm) and 3.13 beats/min in the third trimester (89.93 to 93.06 bpm), suggesting a comparable aerobic response pattern. The direction of change across variables indicated that higher physical activity levels were accompanied by slightly better quality of life scores and stable cardiopulmonary parameters. However, inter-trimester comparisons were not statistically significant ($p > 0.05$), and the absence of subject-level data limited computation of exact correlation coefficients and regression models. Therefore, while descriptive alignment suggested a weak positive association between physical activity and quality of life and stable cardiopulmonary adaptability across trimesters, statistical confirmation of strength and magnitude of association could not be definitively established.

Table 1: Comparative Analysis of Maternal Health Variables across Trimesters

Variables	2nd Trimester	3rd Trimester	P Value*
Age	27.45±4.421	27.64±4.39	0.737
Height	1.549±0.0606	1.551±0.063	0.723
Weight	63.75±8.64	63.70±8.821	0.965
BMI	26.52±3.98	26.31±3.93	0.686
Systolic	119.09±10.70	118.69±10.55	0.771
Diastolic	77.47±6.88	77.23±7.12	0.797
Heart rate before	90.21±11.37	89.93±11.11	0.850
Heart rate after	93.95±21.89	93.06±19.07	0.737
Oxygen saturation before	98.34±1.057	98.33±1.055	0.903
OS after	98.10±1.43	98.18±1.37	0.679

Variables	2nd Trimester	3rd Trimester	P Value*
Level of physical activity	50.86±8.53	50.62±8.45	0.826
Quality of life	**89.0±6.89**	**87.84±6.88**	**0.194**

Table 2: Stability of Quality of Life and Health Satisfaction Ratings Across Trimesters

	Categories	2nd trimester	3rd trimester	P value#
To what extent do you feel that physical pain prevents you from doing what you need to do?	Not at all	11(9.2%)	10(8.3%)	0.996
	A little	24(20%)	23(19.2%)	
	A moderate amount	52(43.3%)	55(45.8%)	
	Very much	25(20.8%)	24(20%)	
	Extremely	8(6.7%)	8(6.7%)	
How much do you need any medical Treatment to function? In your life?	Not at all	11(9.2%)	10(8.3%)	0.996
	A little	24(20%)	23(19.2%)	
	A moderate amount	52(43.3%)	55(45.8%)	
	Very much	25(20.8%)	24(20%)	
	Extremely	8(6.7%)	8(6.7%)	
Do you have enough energy for everyday life?	Small	20(16.7%)	23(19.2)	0.966
	A moderate amount	45(37.5%)	44(36.7%)	
	Very much	45(37.5%)	43(35.8%)	
	Extremely	10(8.3%)	10(8.3%)	
How well are you able to get Around?	Not at all	4(3.3%)	6(5%)	0.822
	Small	10(8.3%)	13(10.8%)	
	Moderate	81(67.5%)	77(64.2%)	
	Great deal	25(20.8%)	24(20%)	
How satisfied are you with Your sleep?	Very dissatisfied	19(15.8%)	20(16.7%)	0.988
	Neither satisfied nor dissatisfied	27(22.5%)	28(23.3%)	
	Satisfied	49(40.8%)	49(40.8%)	
	Very satisfied	25(20.8%)	23(19.2%)	
How satisfied are you with your ability to perform your daily living activities?	Very dissatisfied	16(13.3%)	21(17.5%)	0.763
	Neither satisfied nor dissatisfied	37(30.8%)	35(29.2%)	
	Satisfied	58(48.3%)	53(44.2%)	
	Very satisfied	9(7.5%)	11(9.2%)	
How satisfied are you with your capacity for work?	Very dissatisfied	16(13.3%)	21(17.5%)	0.763
	Neither satisfied nor dissatisfied	37(30.8%)	35(29.2%)	
	Satisfied	58(48.3%)	53(44.2%)	
	Very satisfied	**9(7.5%)**	**11(9.2%)**	

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Table 3: Stability of Psychological Well-Being Across Pregnancy Trimesters

	Categories	2nd trimester	3rd trimester	P-value
How much do you enjoy life?	Not at all	27(22.5%)	24(20.0%)	0.904
	A little	14(11.7%)	17(14.2%)	
	A moderate amount	45(37.5%)	48(40.0%)	
	Very much	23(19.2%)	23(19.2%)	
	Extremely	11(9.2%)	8(6.7%)	
To what extent do you feel your life to be meaningful?	Not at all	15(12.5%)	11(9.2%)	0.921
	A little	20(16.7%)	21(17.5%)	
	A moderate amount	54(45.0%)	53(44.2%)	
	Very much	27(22.5%)	31(25.8%)	
	Extremely	4(3.3%)	49(3.3%)	
How well are you able to concentrate?	Small amount	11(9.2%)	11(9.2%)	0.934
	A moderate amount	44(36.7%)	44(36.7%)	
	Very much	50(41.7%)	50(41.7%)	
	Extremely	15(12.5%)	15(12.5%)	
Are you able to accept your bodily appearance?	Not at all	2(1.7%)	3(2.5%)	0.871
	A little	7(5.8%)	6(5.0%)	
	A moderate amount	37(30.8%)	44(36.7%)	
	Very much	49(40.8%)	45(37.5%)	
	Extremely	25(20.8%)	22(18.3%)	
How satisfied are you with yourself?	Very dissatisfied	12(10.0%)	13(10.8%)	0.981
	Neither satisfied nor dissatisfied	25(20.8%)	27(22.5%)	
	Satisfied	72(60.0%)	69(57.5%)	
	Very satisfied	11(9.2%)	11(9.2%)	
How often do you have negative feelings, such as blue mood, despair, anxiety, depression?	Never	25(20.8%)	26(21.7%)	0.972
	Seldom	26(21.7%)	23(19.2%)	
	Quite often	22(18.3%)	23(19.2%)	
	Very often	34(28.3%)	37(30.8%)	
	Always	**13(10.8%)**	**11(9.2%)**	

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Table 4: Consistency in Satisfaction with Relationships across Pregnancy Trimesters

Variables	Categories	2nd trimester	3rd trimester	P- value
How satisfied are you with your personal relationships?	Fairly dissatisfied	2(1.7%)	3(2.5%)	0.946
	Neither satisfied nor dissatisfied	6(5.0%)	7(5.8%)	
	Satisfied	57(47.5%)	58(48.3%)	
	Very satisfied	55(45.8%)	52(43.3%)	
How satisfied are you with your sex life?	Fairly dissatisfied	5(4.2%)	5(4.2%)	0.994
	Neither satisfied nor dissatisfied	6(5.0%)	7(5.8%)	
	Satisfied	45(37.5%)	45(37.5%)	
	Very satisfied	64(53.3%)	63(52.5%)	
How satisfied are you with the support you get from your friends	Very dissatisfied	5(4.2%)	4(3.3%)	0.993
	Dissatisfied	24(20.0%)	25(20.8%)	
	Neither satisfied nor dissatisfied	37(30.8%)	36(30.0%)	
	Satisfied	45(37.5%)	47(39.2%)	
	Very satisfied	**9(7.5%)**	**8(6.7%)**	

Table 5: Analytical Summary of Cardiopulmonary Fitness, Physical Activity, and Quality of Life Across Trimesters

Variable	2nd Trimester (Mean ± SD)	3rd Trimester (Mean ± SD)	Mean Difference
Physical Activity Score	50.86 ± 8.53	50.62 ± 8.45	−0.24
Quality of Life Score	89.0 ± 6.89	87.84 ± 6.88	−1.16
Heart Rate Increase (Post – Pre)	+3.74 bpm	+3.13 bpm	−0.61
Oxygen Saturation Change	−0.24%	−0.15%	+0.09
BMI	26.52 ± 3.98	26.31 ± 3.93	−0.21

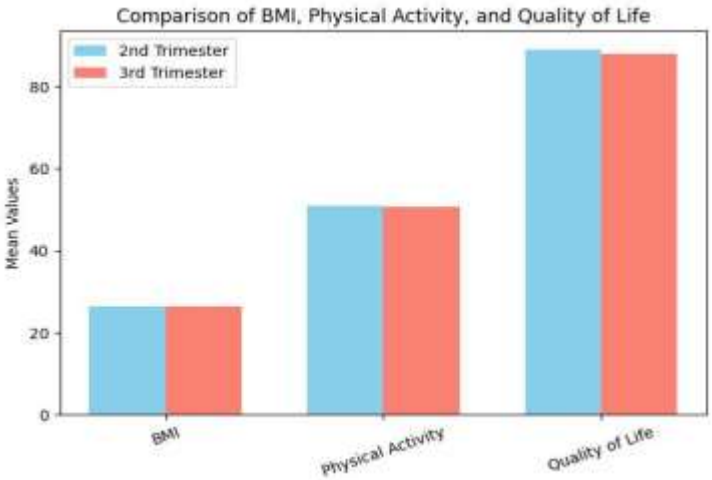


Figure 1Comparison of BMI, Physical Activity and Quality Life

Figure 2 Heart Rate Response to Step Test Across Trimesters

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

DISCUSSION

The present study examined cardiopulmonary fitness, level of physical activity, and quality of life among women in their second and third trimesters of pregnancy, offering insight into the physiological and psychosocial adjustments that accompany advancing gestation. The findings demonstrated a measurable cardiovascular response to exercise, stable blood pressure regulation, minimal fluctuation in oxygen saturation, and consistently high quality of life scores across both trimesters. Although physical activity levels showed a slight decline in the third trimester, overall cardiopulmonary adaptability appeared preserved. These observations contribute to the growing body of evidence describing maternal physiological resilience during uncomplicated pregnancy (12,13). The observed increase in mean heart rate from 90.07 bpm (SD = 11.22) at baseline to 93.50 bpm (SD = 20.49) following the step test reflected an expected cardiovascular adaptation to mild-to-moderate exertion. This response aligns with contemporary literature reporting augmented heart rate responses during pregnancy as a compensatory mechanism to meet increased circulatory demands (14). The expansion of blood volume and elevated cardiac output during gestation likely enhanced myocardial responsiveness, particularly in later stages when fetal metabolic requirements intensify. Comparable findings have been described in recent investigations demonstrating heightened cardiovascular reactivity during structured physical activity in pregnant populations (15,16). Conversely, some reports have documented attenuated heart rate responses during the third trimester, attributing such patterns to altered autonomic regulation or reduced activity levels (17). The slight inter-study variability may be influenced by baseline cardiovascular fitness, body composition, and exercise protocols employed. In the present cohort, the consistency of heart rate response across trimesters suggested preserved functional capacity rather than suppressed adaptability. The modest magnitude of change further indicated that the applied step test was physiologically appropriate and safe for the studied population.

Hemodynamic stability was another key finding. Approximately 72.6% of participants demonstrated normotensive readings before and after physical activity, and post-exercise blood pressure elevations were minimal and not statistically significant. These findings reinforced the concept of maintained vascular regulation during pregnancy (18). Similar observations have been reported in prior longitudinal assessments where systolic and diastolic pressures remained within physiological ranges despite increased cardiac workload (16,19). Although a slight tendency toward elevated blood pressure was noted among participants with higher baseline BMI, overall hemodynamic control remained intact. This suggests that, in otherwise healthy pregnancies, moderate physical exertion does not compromise circulatory stability. Such findings are consistent with broader literature indicating preserved cardiovascular regulation under supervised activity conditions (20). Oxygen saturation demonstrated only minimal post-exercise reduction, from 98.33% (SD = 1.054) to 98.14% (SD = 1.400), supporting the notion that mild physical activity did not significantly impair maternal oxygenation. Similar small declines have been described in late gestation and attributed to increased metabolic demand rather than pathological desaturation (21). These results reinforce the safety profile of moderate prenatal exercise, while also underscoring the importance of individualized prescription in women with respiratory comorbidities. With respect to psychosocial outcomes, overall quality of life remained consistently high across both trimesters, with no statistically significant difference in global scores. Participants reported sustained satisfaction in emotional, interpersonal, and psychological domains. Nevertheless, a subtle decline in health satisfaction was observed in the third trimester, likely reflecting the cumulative physical burden and discomfort associated with advancing pregnancy. Comparable findings have been reported in previous investigations that noted stable overall quality of life despite mild reductions in physical health perception during late gestation (22). The persistence of psychological well-being alongside slight physical decline suggested adaptive coping mechanisms and social support structures that buffered gestational stressors (20).

The gradual reduction in physical activity levels in the third trimester observed in this study was consistent with reports identifying mobility limitations, musculoskeletal discomfort, and increasing body mass as contributing factors (21). However, conflicting findings have also been reported, with some investigations indicating increased activity in mid-to-late pregnancy, potentially influenced by structured exercise programs or health education initiatives (13). Such discrepancies may arise from cultural, socioeconomic, and healthcare access differences across populations. The present findings suggested that while physical activity may decline slightly, cardiopulmonary fitness remained functionally stable, indicating that even reduced activity levels were sufficient to preserve adaptive capacity in this cohort. Several strengths enhanced the credibility of the present study. The inclusion of objective physiological measures alongside validated questionnaires provided a multidimensional assessment of maternal health. The supervised step test protocol ensured safety while allowing functional evaluation of cardiopulmonary response. Additionally, the comparative design between trimesters permitted examination of gestational progression rather than isolated measurement. Nonetheless, certain limitations must be acknowledged. The cross-sectional design precluded longitudinal tracking of individual physiological trajectories. The absence of detailed correlation and multivariate regression analyses limited the ability to quantify the strength of association between

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

cardiopulmonary fitness, physical activity, and quality of life. Furthermore, purposive sampling restricted generalizability beyond the study setting. Self-reported physical activity and quality of life measures may have been subject to recall bias or social desirability effects. Future studies would benefit from longitudinal follow-up across all three trimesters, inclusion of larger and more diverse populations, and incorporation of advanced statistical modeling to delineate predictive relationships. Overall, the findings suggested that cardiopulmonary adaptability remained stable and that moderate physical activity was well tolerated during the second and third trimesters of uncomplicated pregnancy. While physical activity showed a mild decline with advancing gestation, quality of life remained largely preserved. These results support the continued recommendation of supervised, moderate exercise during pregnancy and highlight the importance of individualized monitoring to optimize maternal well-being.

CONCLUSION

The present study concluded that cardiopulmonary fitness remained functionally stable across the second and third trimesters, with an appropriate cardiovascular response to exercise, maintained blood pressure regulation, and minimal changes in oxygen saturation. Although physical activity levels and certain aspects of quality of life showed a gradual decline as pregnancy progressed, overall maternal adaptability was preserved. These findings reinforce the resilience of the maternal cardiovascular system during uncomplicated pregnancy while highlighting the cumulative physical demands experienced in later gestation. The study underscores the importance of encouraging safe, supervised physical activity and individualized monitoring to support maternal well-being, functional capacity, and overall quality of life throughout pregnancy.

AUTHOR CONTRIBUTIONS

Author	**Contribution**
Sameen Athar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Hamna Afzal	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Wajeeha Yousaf	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ayesha Fatima	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Hamza	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Zara Zahid	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Inam ul Haq	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Usama Naeem	Writing - Review & Editing, Assistance with Data Curation
Nadia Anwer	Writing - Review & Editing, Assistance with Data Curation

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

REFERENCES

1. Clark AR, Fontinha H, Thompson J, Couper S, Jani D, Mirjalili A, et al. Maternal Cardiovascular Responses to Position Change in Pregnancy. Biology. 2023;12(9).

2. Jadoon SM, Nazir Q, Zardad B, Farid A, Khan AJPJoCM. Assessment of Clinical and Echocardiographic findings of Pregnant Women with Dyspnea. 2023;29(3):285-90.

3. Majewska P, Szablewska A. Associations Between Physical Activity in Pregnancy and Maternal, Perinatal, and Neonatal Parameters: A Single-Center Prospective Cohort Study. Journal of clinical medicine. 2025;14(7).

4. Majewska P, Szablewska A. Associations Between Physical Activity in Pregnancy and Maternal, Perinatal, and Neonatal Parameters: A Single-Center Prospective Cohort Study. 2025;14(7):2325.

5. Marchewka-Długońska J, Nieczuja-Dwojacka J, Krygowska K, Bogdanovich V, Sys D, Baranowska B, et al. Effects of pre-pregnancy BMI and gestational weight gain on pregnancy and neonatal outcomes in Poland. Scientific reports. 2025;15(1):7603.

6. Mikołaj Maciejewski T, Szczerba E, Zajkowska A, Pankiewicz K, Bochowicz A, Szewczyk G, et al. Gestational weight gain and blood pressure control in physiological pregnancy and pregnancy complicated by hypertension. Journal of mother and child. 2022;26(1):66-72.

7. Moolyk AN, Wilson MK, Matenchuk BA, Bains G, Gervais MJ, Wowdzia JB, et al. Maternal and fetal responses to acute high-intensity resistance exercise during pregnancy. 2025;59(3):159-66.

8. Murphy SE, Johnston CA, Strom C, Isler C, Haven K, Newton E, et al. Influence of exercise type on maternal blood pressure adaptation throughout pregnancy. AJOG global reports. 2022;2(1):100023.

9. Plachetka A, Głowacka M, Grajek M, Krupa-Kotara K. Evaluation of physical activity of women in the second and third trimester of pregnancy using the standardized PPAQ questionnaire-a pilot study. Quality in Sport. 2023;13:54-71.

10. Ribeiro MM, Andrade A, Nunes I. Physical exercise in pregnancy: benefits, risks and prescription. 2022;50(1):4-17.

11. Romero-Gallardo L, Roldan Reoyo O, Castro-Piñero J, May LE, Ocón-Hernández O, Mottola MF, et al. Assessment of physical fitness during pregnancy: validity and reliability of fitness tests, and relationship with maternal and neonatal health - a systematic review. BMJ open sport & exercise medicine. 2022;8(3):e001318.

12. Sahu AK, Harsha MM, Rathoor S. Cardiovascular Diseases in Pregnancy - A Brief Overview. Current cardiology reviews. 2022;18(1):e250821195824.

13. Sarhaddi F, Azimi I, Axelin A, Niela-Vilen H, Liljeberg P, Rahmani AMJJm, et al. Trends in heart rate and heart rate variability during pregnancy and the 3-month postpartum period: continuous monitoring in a free-living context. 2022;10(6):e33458.

14. Wowdzia JB, Davenport MHJBDR. Cardiopulmonary exercise testing during pregnancy. 2021;113(3):248-64.

15. Wu H, Sun W, Chen H, Wu Y, Ding W, Liang S, et al. Health-related quality of life in different trimesters during pregnancy. 2021;19:1-11.

16. Marin-Farrona M, Wipfli B, Thosar SS, García-Unanue J, Gallardo L, Felipe JL, et al. UCLMuevete: Increasing the amount of physical activity, work-ability, and cardiorespiratory fitness capacity in university workers through active breaks. Work. 2024;77(1):263-73.

17. Woodroffe L, Slayman T, Paulson A, Kruse N, Mancuso A, Hall M. Return to Running for Postpartum Elite and Subelite Athletes. Sports Health. 2025;17(3):614-20.

18. Beaven ML, Gibbons JTD, Course CW, Kotecha SJ, Hixson T, Maiorana A, et al. Physiological responses to exercise in survivors of preterm birth: a meta-analysis. Eur Respir Rev. 2025;34(176).

19. Montandon L, Quansah DY, Lacroix A, Gonzalez-Rodriguez E, Horsch A, Arhab A, et al. Maternal Physical Activity, Fitness, and Body Composition in Women with Gestational Diabetes: A Prospective Study. Med Sci Sports Exerc. 2025;57(8):1646-56.

20. Larson EG, Semon MM, Stetler EK, Jelsing EJ. Cleared for Physical Activity Postpartum: Now What? Curr Sports Med Rep. 2025;24(6):145-52.

21. Rodriguez-Ayllon M, Acosta-Manzano P, Coll-Risco I, Romero-Gallardo L, Borges-Cosic M, Estévez-López F, et al. Associations of physical activity, sedentary time, and physical fitness with mental health during pregnancy: The GESTAFIT project. J Sport Health Sci. 2021;10(3):379-86.

22. Santos-Rocha R, Fernandes de Carvalho M, Prior de Freitas J, Wegrzyk J, Szumilewicz A. Active Pregnancy: A Physical Exercise Program Promoting Fitness and Health during Pregnancy-Development and Validation of a Complex Intervention. Int J Environ Res Public Health. 2022;19(8).