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Cardio Vascular Alterations Following Life Style Modifications: An Electrophysiological Aspect

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SUMMARY

Background

Cardiovascular diseases (CVDs) are increasingly affecting younger populations due to modern sedentary lifestyles and stress. Autonomic dysfunction is a key precursor to cardiovascular morbidity and mortality. Baroreflex Sensitivity (BRS), an early electrophysiological marker of autonomic imbalance, plays a crucial role in cardiovascular regulation. Yoga, known for its mind-body benefits, has been shown to improve autonomic tone, reduce sympathetic activity, and enhance parasympathetic functions trough electrophysiological mechanisms, thus offering a non-pharmacological intervention to maintain cardiovascular health.

Novelty

Most existing studies have focused on yoga's effects in diseased or elderly populations. This study uniquely investigates the impact of yoga-based lifestyle intervention on BRS and cardiovascular electrophysiology in healthy young adults- a relatively unexplored area. Early identification and correction of autonomic dysfunction using yoga may prevent the onset of cardiovascular diseases through electrophysiological involvement throughout in life.

Objectives

1. To evaluate the effects of yoga-based lifestyle intervention on baro-reflex sensitivity in healthy young adults.
2. To assess associated changes in cardiovascular electrophysiological parameters such as heart rate, blood pressure, and ECG-derived indices.

METHODS

A longitudinal study will be conducted with 40 healthy participants aged 25–35 years, divided into intervention and control groups. The intervention group will undergo 12 weeks of supervised yoga-based lifestyle training. Pre and post intervention assessments of BRS and cardiovascular parameters will be conducted using standard electrophysiological techniques.

Expected Outcome

The study is expected to demonstrate significant improvement in BRS and cardiovascular function in the yoga group, highlighting yoga's potential as a preventive strategy for cardiovascular diseases using electrophysiological status in young populations.

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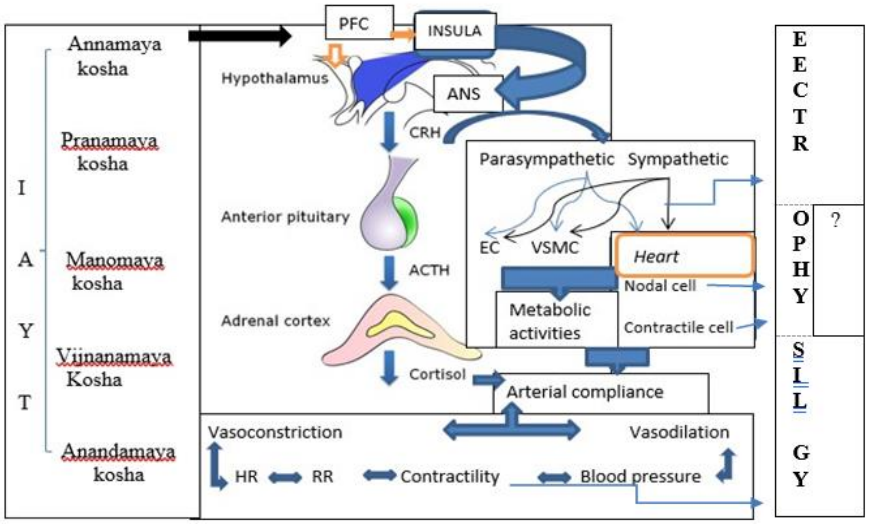
Summary (Diagrammatic approaches):



Keywords: Baro-reflex Sensitivity, Yoga Intervention, Cardiovascular Health, Autonomic

Nervous System, Young Adults

INTRODUCTION

Back ground of the Study

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, with early- life risk factors significantly contributing to adult morbidity[1]. Although young adults are generally considered at low immediate risk, emerging evidence suggests that subtle cardiovascular dysfunctions, such as altered autonomic regulation, can begin during early adulthood due to sedentary lifestyles, poor dietary habits, stress at home and work place, and insufficient physical activity[2]. Electrophysiological markers such as heart rate variability (HRV) and baroreflex sensitivity (BRS) are reliable, non-invasive indices used to assess autonomic function and cardiovascular adaptability[3]. Among these, BRS specifically measures the reflexive capacity of the autonomic nervous system to regulate blood pressure via heart rate modulation and is considered a strong predictor of cardiovascular health[4].

Life style interventions, particularly mind-body practices such as yoga or yoga therapy (IAYT), have shown potential in modulating autonomic balance by enhancing parasympathetic tone and reducing sympathetic overactivity[5]. Yoga integrates physical postures (asana), breathing techniques (pranayama), and meditation, all of which have been associated with improved cardiovascular parameters, including lowered blood pressure, enhanced HRV, and increased BRS[6]. In healthy individuals, especially young adults, yoga may serve as a preventive strategy to promote cardiovascular resilience and autonomic stability[7].

Recent studies have reported that even short-term yoga interventions can significantly improve BRS and other autonomic indices in both healthy and clinical populations. These changes are often attributed to improved vagal activity and reduced allostatic load resulting from regular yoga practice[8,9]. However, despite these

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promising findings, there is limited research that focuses on the electrophysiological mechanisms underlying these benefits, especially in healthy young adults who are at a critical age for establishing long-term cardiovascular health trajectories.

Researching "cardiovascular alteration in lifestyle modification in young individuals aged 25 to 35 years: an electrophysiological aspect" is crucial due to the rising incidence of cardiovascular diseases (CVD) among young adults. Understanding how lifestyle changes impact heart functions at the electrophysiological level can provide insights into early prevention strategies [10-27], easily avoided by general physicians.

Why focus on young adults?

Recent studies indicate a significant increase in CVD risk factors among young adults by:

a) **Rising Prevalence of Risk Factors**: In the U.S., the prevalence of obesity in young adults aged 20 to 44 years increased from 32.7% in 2009 to 40.9% in 2020.

b) **Early Onset of Atrial Fibrillation (A Fib)**: A Fib, traditionally associated with older adults, is now increasingly diagnosed in individuals under 65, with nearly 25% of cases in this age group.

c) **Sedentary Lifestyle and Poor Diet**: Modern lifestyles characterized by physical inactivity and unhealthy diets contribute significantly to the early development of CVD.

Importance of Electrophysiological Studies:

Electrophysiological assessments, such as heart rate variability (HRV), offer valuable insights into autonomic nervous system functions and overall cardiac health. A study involving individuals aged 25-35 found that a healthier life style correlates with improved HRV, indicating better autonomic function. General physician must accept this as an important common process for men and women.

Benefits of Lifestyle Modification: Implementing lifestyle changes can lead to significant improvements in cardiovascular health:

Weight Management: Preventing weight gain in young adulthood is associated with better cardiovascular risk profiles.

Comprehensive Lifestyle Improvements: Adopting a combination of healthy behaviors- such as regular physical activity, a balanced diet, and stress management-can reduce the risk of CVD and all-causes of mortality.

Taking a prime role on investigating the electrophysiological effects of lifestyle modifications in young adults is essential for early detection and prevention of cardiovascular diseases. Such researches can inform targeted interventions, promoting long-term heart health in this vulnerable age group (25-25 years).

Therefore, studying the impact of yoga-based lifestyle modifications on cardiovascular electrophysiology, particularly baroreflex sensitivity, in healthy young adults is vital. Such investigations could provide early biomarkers of cardiovascular adaptability and offer evidence-based support for non-pharmacological preventive interventions in this age group.

REVIEW OF LITERATURE

JyotsanaRB et al. (2003)[10] conducted a comparative study to assess the impact of long-term yoga practice on cardiovascular function. The study included 50 control subjects who did not engage in any formofphysicalexercise and 50 individuals who had been practicing yoga for five years. Result sindicatedasignificantreductioninpulserateamongtheyogapractitioners. Additionally, the differences in meansystolic and diastolic blood pressure between the yoga group and the controlgroup were statistically

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significant. The findings suggest that although cardiovascular parameters tend to change with age, these changes may occur more gradually in individuals who practice yoga regularly.

Krishna BH et. al. (2014)[11] investigated the effects of 12 weeks of yoga therapy on heart failure patients. Sixty-five patients received yoga along with standard medical treatment, while another 65 received only standard therapy. After 12weeks, the yoga groups had significant reduction in heart rate and blood pressure. The study concluded that yoga, when combined with medical therapy, helps reduce cardiovascular load in heart failure patients.

Choudary S et al. (2018)[12]conducted a study on 100 healthy volunteers aged 17–26 years to assess the effects of yoga on cardiac autonomic activity. Participants practiced Asanas, Pranayama, and relaxation techniques for one hour daily over three months. The study concluded that yoga training improved autonomic functions in healthy individuals.

Pandya NH et al.(2020)[13]conducted a study on 50 healthy individuals aged 30 to 60 years to evaluate the effects of yoga on cardiovascular parameters, including pulse rate, systolic blood pressure, and diastolic blood pressure. Participants showed a highly significant reduction in all three parameters after practicing yoga. The researchers concluded that regular yoga practice improves cardiovascular function and may help lower the risk of cardiovascular diseases.

Lumbani A et al. (2020)[14]conducted a study in this department (Department of Physiology) to assess vascular status and sympathetic reactivity across different BMI categories as a predictive tool for early lifestyle intervention. A total of 105 normotensive individuals were grouped into normal, overweight, and obese categories (35 each) per WHO classification. Carotid-femoral Pulse Wave Velocity (cf-PWV) was measured before, during, and after the Cold Pressor Test (CPT).Results showed baseline cf-PWV increased with BMI. While sympathetic response was most prominent in the normal BMI group, significant cf-PWV augmentation during CPT was noted in over weight and obese groups. CPT was recommended as a screening tool for early cardiovascular risk detection.

Bhunia S et al.(2022)[15]investigated the long-term effects of Integrated Approach to Yoga Therapy (IAYT) on noninvasive cardiovascular responses in rural healthy males. Twenty participants were divided into young (<40 years, Group A) and older (>50 years, Group B) groups. Both groups underwent a 6-week IAYT program, with Group C serving as the control. Parameters measured included Pulse Wave Velocity (PWV), Arterial Stiffness Index (ASI), and Reflection Index (RI). Significant reductions inPWV and ASI were observed, especially in younger adults, while ABI, BMI, and blood pressure parameters showed no significant changes. IAYT was found more effective than yoga or brisk walking alone in reducing ASI, highlighting its potential for CVD prevention.

Vaidya D, et al.(2023)[16] investigated the effects of elevated blood sugar on EC G lead II vectors in rural males aged 45–50 years conducted from January to October2022, Participants were divided into a study group (medicated for six weeks) and a control group. Baseline and post-test measurements included BMI, pulse wave velocity (PWV), and arterial stiffness index (ASI). The study group showed significant increases in heart rate, PWV, and ASI, with a reduced R- R interval. No significant changes were found in blood pressure, BMI, or weight. Therefore, they concluded ECG was deemed limited but valuable in managing diabetic patients in low- resource settings.

Vaidya D, et al. (2023)[17]studied the short-term effects of Integrated Approach to Yoga Therapy (IAYT) on ECG lead-II vectors in rural males aged 35–50. Forty subjects were divided into two intervention groups (A & B) and a control group (pre-IAYT). The study group underwent a six-week IAYT program. Baseline and post-intervention measurements included BMI, pulse wave velocity (PWV), and arterial stiffness index (ASI).Significant improvements were observed in heart rate, R-R interval, PWV, and ASI in the IAYT groups, but no significant changes in BP, BMI, or other ECG leads. IAYT promoted parasympathetic dominance.

Bhunia S et al. (2023)[18]examined the long-term effects of Integrated Approach to Yoga Therapy (IAYT) on

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noninvasive cardiovascular responses in rural males. Twenty healthy participants were divided by age into two groups (A & B), and all underwent six weeks of IAYT. Significant reductions were observed in Pulse Wave Velocity (PWV) and Arterial Stiffness Index (ASI), with a more pronounced ASI reduction in younger adults. No significant changes were found in Ankle-Brachial Index (ABI),BMI, or blood pressure parameters (SBP, DBP, PP).The study concluded that IAYT is more effective than yoga or brisk walking alone in lowering ASI and reducing CVD risk.

Our laboratory has reported several findings on electrophysiological aspects of IAYT. Some more findings are to be required to get finale conclusions and finale conclusions will depend upon the lifestyle modifications in young healthy subjects..

Novelty of the research

1. **Underexplored Age Group**: While cardiovascular studies often focus on older populations, young adults (25–35years) are experiencing rising rates of cardiovascular risk factors such as obesity and hypertension. However, this demographic remains under represented in cardiovascular research, particularly concerning electrophysiological assessments.
2. **Electrophysiological Focus**: Most lifestyle intervention studies emphasize behavioral outcomes or general cardiovascular metrics. Focusing on electrophysiological parameters, like heart rate variability (HRV), offers a more nuanced understanding of autonomic nervous system function and early cardiac alterations.
3. **Integration of Lifestyle Factors**: Examining the combined effects of various lifestyle modifications—such as diet, exercise, and stress management—on electrophysiological markers provides a comprehensive view of how these factors synergistically influence cardiac health.
4. **Potential for Early Intervention**: Identifying electrophysiological changes in response to lifestyle modifications can serve as early indicators of cardiovascular improvement or deterioration, enabling timely interventions in a population that may not yet exhibit overt symptoms.

SIGNIFICANCE OF THE RESEARCH

1. **Personalized Health Strategies**: Understanding individual electrophysiological responses to lifestyle changes can inform personalized health recommendations, enhancing the effectiveness of preventive strategies.
2. **Public Health Impact**: Insights from this research can guide public health policies aimed at reducing the burden of cardiovascular diseases by promoting lifestyle modifications in young adults.
3. **Foundation for Future Studies**: This research can lay the ground work for longitudinal studies tracking the long-term effects of lifestyle changes on cardiac electrophysiology and overall cardiovascular health.

AIMS AND OBJECTIVES

Aims

1. **Assess the Impact of Lifestyle Modifications on Cardiac Autonomic Function:** Evaluate how interventions such as increased physical activity, improved diet and stress management affect HRV & ECG parameters in individuals aged 25–35 yrs.
2. **Identify Early Electrophysiological Markers of Cardiovascular Alterations:** Determine specific HRV & ECG changes that precede clinical manifestations of cardiovascular diseases, facilitating early detection and prevention strategies.
3. **Establish Correlations between Lifestyle Factors and HRV Metrics:** Analyze how variables like exercise intensity, dietary patterns, and stress levels correlate with HRV &ECG indices, providing a comprehensive understanding of lifestyle impacts on cardiac function.

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Objectives

Quantify Baseline HRV in the Target Demographic

Measure standard HRV parameters (e.g.,SDNN, RMSSD, LF/HF ratio) in a cohort of healthy individuals aged 25–35 to establish normative data.

Implement Lifestyle Intervention Programs

Design and administer structured programs focusing on physical activity, nutrition, and stress reduction to observe resultant changes in HRV.

Conduct Longitudinal Monitoring

Track HRV changes over time to assess the sustainability and long-term effects of lifestyle modifications on cardiac autonomic regulation.

Analyze Gender and Individual Variability

Investigate differences in HRV responses to lifestyle changes between genders and among individuals to tailor personalized intervention strategies.

Develop Predictive Models for Cardiovascular Risk

Utilize collected data to create models that predict cardiovascular risk based on lifestyle factors and HRV metrics, aiding in early intervention efforts.

This research addresses a critical gap by focusing on a demographic often over looked in cardiovascular studies. By elucidating the relationship between lifestyle factors and electrophysiological markers, the study aims to inform preventive strategies and promote cardiovascular health from a young age. The findings could lead to the development of targeted interventions and public health policies aimed at reducing the burden of cardiovascular diseases.

MATERIALS AND METHODS

Study design:

- Type: Prospective, longitudinal cohort study.
- **Study Area**: Department of Physiology, UPUMS, Saifai and nearby areas.
- Duration: 6–12 months to assess both short-term and long-term effects of lifestyle modifications.
- Setting: Community health centers, Universities, or corporate wellness programs.
- Ethical Approval: Obtain from a recognized institutional review board (IRB).
- A controlled, longitudinal study design is recommended where participants are evaluated at baseline, subjected to a structured lifestyle intervention, and then reassessed at pre-determined intervals (e.g., 12 weeks, 6 months). An interventional study allows for the direct observation of electrophysiological changes in response to specific lifestyle modifications.

Intervention Protocol

- Randomization& Control: If resources permit, incorporating a randomized controlled trial (RCT) design can strengthen causal inferences. Participants can be randomly assigned to:
- Intervention Group: Receive tailored lifestyle modifications (diet, exercise, stress management).
- Control Group: Receives/remains on the unusual habits.

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- Lifestyle Modification Program:
    - Dietary Changes: Implement a balanced diet focusing on reducing saturated fats, sugars, and increasing fiber intake.
    - Physical Activity: Encourage atleast150 minutes of moderate-intensity aerobic exercise per week.
    - Stress Management: Introduce techniques such as mind fullness, yoga, or cognitive-behavioral strategies.
    - Sleep Hygiene: Promote7–9 hours of quality sleep per night.
- Frequency: Weekly sessions for the first month, followed by bi-weekly sessions.
- Support: Regular follow-ups through phone calls or digital platforms to monitor adherence (Table-1).

Table-1: Schedule for IAYT(Integrated Approach to Yoga Therapy)

Program	Description
Loosening exercises	toe, ankle , knee, waist, wrist, shoulder, neck rotation and Bending (10 round each) Saktivikasaka sukshmayayama for wrists, palms, fingers,elbows,
Yogasanas (15–20min)	ardhakaticakrasana , ardha cakrasana, padahastasana, bhujangasana, salabhasana, dhanurasana, sarvangasana,matsyasana, viparitakarani, halasana, cakrasana, sasankasana, vakrasana, ardha matsyendrasana, ustrasana, instant relaxation technique (1 min), quick relaxation technique (3min), deep relaxation technique(3min)
Pranayama & Kriyas	kapalbhati (40–120 strokes/min), sectional breathing (5rounds), Surya and candra anuloma villoma pranayama (21 rounds), cooling & bhramari pranayama (9 rounds)
Meditation (3min)	Cyclic meditation (3min), Nadanusandhana (3min), OM meditation (10min)
Maitri Milan	Geeta chanting& main lecture of the day in yogic principles from the Bhagwat Geeta
Breakfast&Lunch	Sattvicfood

Electrophysiological Assessment

- Heart Rate Variability (HRV) Measurement:
    - Equipment: Use of 24-hour Holter ECG monitors or wearable devices like WHOOP or First beat.
    - Parameters:
        - Time-domain: SDNN, RMSSD, pNN50.
        - Frequency-domain: LF, HF, LF/HF ratio.
        - Non-linear: Poincaré plot analysis.
- Data Collection:
    - Baseline: Prior to intervention.

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- Follow-up: At 3, 6, and 12 months.

- Environmental Control: Ensure consistent measurement conditions (e.g., same time of day, similar posture) to minimize variability.

Additional Cardiovascular Assessments

- Blood Pressure: Measure using an automated sphygmomanometer at regular intervals.
- Resting Heart Rate: Record at baseline and during follow-ups.
- Lipid Profile: Obtain fasting blood samples to assess total cholesterol, LDL, HDL,and triglycerides.
- BodyComposition: Use bioelectrical impedance analysis (BIA) or dual-energy X-ray absorptiometry (DXA) for body fat percentage.

Data Analysis

- Statistical Methods
  - Descriptive Statistics: Mean, standard deviation for baseline characteristics.
  - Inferential Statistics: Paired t-tests or Wilcoxon signed-rank tests for within- group comparisons; ANOVA or Kruskal-Wallis tests for between-group comparisons.
  - Correlation Analysis: Assess relationships between HRV parameters and lifestyle factors using Pearson or Spearman correlation coefficients.

- Software: Utilize SPSS, R, or Python for data analysis.

Reliability and Validity Considerations

- Measurement Consistency: Ensure inter-rate reliability for manual measurements and intra-rater reliability for repeated assessments.
- Device Calibration: Regular calibration of HRV measurement devices to maintain accuracy.
- Participant Compliance: Monitor adherence to the intervention through self-reports and device data.

LIMITATIONS

- Generalize ability: Findings may be specific to the study population and not applicable to broader groups.
- Adherence Variability: Differences in participant commitment to lifestyle changes could affect outcomes.
- Measurement Constraints: Potential in accuracies in HRV measurements due to device limitations or participant movement.

Sample size determination:

At 90% Power

Sample size is calculated on the basis of variation in most significant Cardiovascular Autonomic Function parameter using the formula$\left(z+z \right)^{2}\left(\sigma^{2}+\sigma^{2} \right)\ n=k$

α β 1 2

D^{2}

Where σ_1= 5.45, The SD of most significant Cardiovascular Autonomic Function parameter before the

lifestyle modification

σ_2= 4.4, The SD of most significant Cardiovascular Autonomic Function parameter after the lifestyle modification

d=mean (σ_1,σ_2), the difference considered to be clinically significant

k=1.5, the design effect adjusting for gender

type I errorα=5% corresponding to 95% confidence level

type II error β=10%fordetectingresultswith90% power of study So the minimum required sample size ***n*=40**

Inclusion Criteria

1. Age Range: Participants must be between 25 and 35 years old at the time of enrollment.
2. Health Status: Individuals must be in generally good physical and mental health, with no acute or chronic conditions that would contraindicate participation in yoga.
3. Consent: Willingness to participate and provide written informed consent.
4. Language Proficiency: Ability to understand and communicate in the language used for study materials (e.g., English).
5. Availability: Must be available to attend scheduled yoga sessions and assessments for the full duration of the study.
6. Physical Capability: Must be physically able to perform basicyoga postures (as assessed during screening).
7. Lifestyle Stability: Should not have any major upcoming lifestyle changes (e.g., relocating, starting a new job) that could affect participation.
8. No Prior Regular Yoga Practice: Must not have practiced yoga regularly (e.g., more than once per week) in the past 6 months, if the study is evaluating beginners.
9.

Exclusion Criteria

Current or Recent Yoga Practice

Individuals who have engaged in regular yoga practice (e.g., more than once a week) in the past 3–6 months, unless the study is targeting experienced practitioners.

Medical Conditions

Any history of chronic illnesses, such as cardiovascular diseases (CVD), respiratory disorders, uncontrolled hypertension, epilepsy, or recent major surgeries that could interfere with physical activity or yoga practices.

Musculoskeletal Injuries

Current or recent (within the last 6 months) musculo-skeletal injuries or disorders (e.g., herniated disc, severe joint issues) that may be aggravated by physical activity.

Psychiatric or Neurological Disorders

Diagnosed mental health conditions or neurological disorders (e.g., severe anxiety, depression, schizophrenia, seizure disorders) unless the study is designed to examine yoga's effects on these conditions and proper medical oversight is in place.

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Pregnancy

Pregnant individuals or those planning pregnancy during the study period.

Substance Use

Current or recent history of substance abuse (alcohol or drugs) that may impact participation or study outcomes.

Medication Use

Taking medications that could affect physiological or psychological parameters relevant to the study (e.g., beta-blockers, antidepressants), unless explicitly included as part of the research.

Non-Adherence Risk

Individuals with a history of poor compliance in previous studies or who indicate an inability to commit to the full duration of the intervention and follow-up.

Participation in Other Studies

Currently participating in another interventional research study that may interfere with the current project.

Other related information's

Recruitment Methods

- Advertising in community centers, universities, social media platforms, and primary care clinics.
- Screening via questionnaires and initial clinical evaluations.

Materials

Equipment for Electrophysiological Monitoring

Electrocardiography (ECG) Devices

- 12-lead ECG machines for static measurements.
- Portable or ambulatory ECG/ Holter monitors for extended recordings.

Heart Rate Variability (HRV) Analysis Tools

- Software capable of time-domain (e.g., SDNN, RMSSD) and frequency-domain (e.g., LF/HF ratio) analyses.

Anthropometric and Biochemical Tools

Measurement Tools

- Digital weighing scales, stadio meters, measuring tapes for body mass index (BMI) and waist circumference.

Biochemical Assays

- Blood sampling kits for lipid profiles, fasting glucose, and inflammatory markers (e.g., CRP) if secondary cardiovascular risk factors are assessed.

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Lifestyle Modification Resources

Physical Activity Monitors

- Wearable fitness trackers or pedometers to objectively record exercise intensity and duration.

Dietary Assessment Instruments:

- Validated food frequency questionnaires (FFQs) or 24-hour dietary recalls.

Stress and Well-being Questionnaires

- Standardized tools (e.g., Perceived Stress Scale) to evaluate psychological stress.

Intervention Materials

- Educational materials, access to nutritional counseling, and structured exercise programs (e.g.,supervised sessions or guided home-based routines).

Data Collection &Management

Electronic Data Capture Systems

- Software to collect, store, and analyze participant data securely.

Statistical Analysis Software

- SPSS, SAS, or R for data processing, enabling comparisons (pre-vs. post- intervention) and multivariate analyses.

METHODS

BaselineAssessment

Clinical and Demographic Evaluation

- Collect demographic information, medical history, and baseline lifestyle habits.
- Obtain informed consent and perform a physical exam.

Electrophysiological Measurements

- Record baseline ECG to obtain HRV metrics.

ECG machine

ECG of each subject will be recorded by 12 Lead ECG machine. Electrocardiogram remains a very vital investigation to assess the cardiovascular system. It provides information about heart rate and rhythm and shows if there is enlargement of the heart due to high blood pressure (hypertension) or evidence of a previous heart attack (myocardial infarction). However, it does not show whether you have asymptomatic blockages in your heart arteries or predict your risk of a future heart attack.

ECG of each subject will be recorded by ECG machine. It will be ensured that the subject is comfortable, with their head and neck supported by a pillow and is lying flat or in a semi recumbent positionofapproximately45°withtheir arms and legs relaxedby their sides. Skinpreparation is oftenrequired inorderto producethe most accurate and artifact free ECG recording byminimizing the skinto electrode impedance. Limb electrodes should be placed on the wrists and ankles whenever possible.

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The ECG recorded will be evaluated for the following parameters:

1. Heart rate
2. P wave
3. PR interval
4. QRS complex
5. QT interval
6. QTc interval
7. ST segment
8. T wave

Ensure recordings are taken under standardized conditions (e.g., resting state, controlled room temperature, similar time of day).

Anthropometric and Biochemical Baselines

Measure BMI, waist circumference, and blood pressure.

If applicable, collect blood samples for biochemical markers.

Lifestyle Intervention Implementation

Dietary Modification

Implement a nutrition plan emphasizing whole food, reduced processed foods, and balanced macronutrients.

Provide nutritional counseling sessions and educational materials.

Exercise and Physical Activity

Develop an exercise regimen tailored to the participant's baseline fitness, aiming for moderate-intensity aerobic exercise (e.g., brisk walking, cycling) and resistance training.

Monitor physical activity with wearable devices.

Stress Management:

Introduce stress-reduction techniques such as mindfulness, yoga, or cognitive behavioral strategies.

Offer group sessions or individual counseling as needed.

Duration and Monitoring:

An intervention period (e.g.,12 weeks) with ongoing monitoring. Encourage participants to keep activity and dietary logs.

Post-Intervention & Follow-Up Assessments

Repeating Electrophysiological Measurements:

Reassess HRV parameters and other ECG indices under the same standardized conditions as the baseline.

Compare pre-and post-intervention data to identify changes attributable to lifestyle modifications.

Re-evaluation of Lifestyle Factors:

Use the same questionnaires to assess changes in physical activity levels, diet, and stress.

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- Measure anthropometric and biochemical parameters again to capture broader cardiovascular improvements.

Data Analysis

Statistical Methods:

Descriptive Statistics:

Summarize baseline demographics and electrophysiological parameters.

Inferential Statistics:

- Use paired t-tests or non-parametric equivalents tocompare pre-and post-intervention HRV parameters.
- Analysis of covariance (ANCOVA) can be employed to control or confounding factors.
- Regression analyses to determine predictors of changes in HRV.
- Sub group Analyses: Examine variations based on gender or baseline risk factors.

The detailed materials and methods outlined above combine state-of-the-art electrophysiological monitoring with comprehensive lifestyle assessments to quantify the cardiovascular benefits of lifestyle modifications. By systematically capturing pre- and post- intervention data (using ECG/HRV parameters, anthropometric measurements, and validated lifestyle questionnaires), researchers can better understand the early electrophysiological changes associated with lifestyle improvements in young adults. This approach not only aids in early detection of cardiovascular alterations but also provides a basis for designing targeted interventions to reduce the long-term risk of cardiovascular diseases.

This structured research frame work reflects a synthesis of current best practices and emerging trends in cardiovascular and lifestyle intervention studies.

Study Protocol In Brief:

After completing all inclusion and exclusion criteria consent will be taken from study participants as well as control groups

After taking detailed history of each participant of both control and study groups, ECG, Blood Pressure and BRS will be measured.

Subjects of study group will be asked to do Physical activity, Dietary changes, Sleep Hygiene, stress management for 3-12 months

Study participants both control and study group will be asked to come for ECG, BP and BRS measurements.

Data from control as well as study groups will be collected and will be analyzed, and interpretation will be done especially on electrophysiological implications.

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Ethicalissues

1. The research procedure followed will be in accordance with the approved ethical standards of U.P.U.M.S. Saifai, Etawah.
2. Informed and written consent will be taken from each subject.
3. The study will be conducted after having the ethical clearance from the Institutional Ethics Committee (IEC).
4. Nature &Purpose of study will be well explained to the subject.
5. Subject will be explained & assured that the data obtained from them will be kept confidential and that their privacy will be respected.
6. Detailed narration will be done to the subject about the data to be obtained from them for study.

Expected Outcomes

1. Enhanced baroreceptor sensitivity and autonomic balance
2. Personalized lifestyle modifications. Better cardiac autonomic regulation (ECG)
3. Modification strategies based on electrophysiological markers.

Limitation of the Study:

1. Limitation will be appreciable when study will be conducted.
2. Confounding variables such as comorbid conditions, medication use and lifestyle factors could potentially influence the observed results.

GANTTCHART

YEARS	**2025**										**2026**							
Activity/Months	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Synopsis Preparation and Approval																		
Information Collection and Permission																		
Preparation and tool development																		
Methodology finalizationand writing																		

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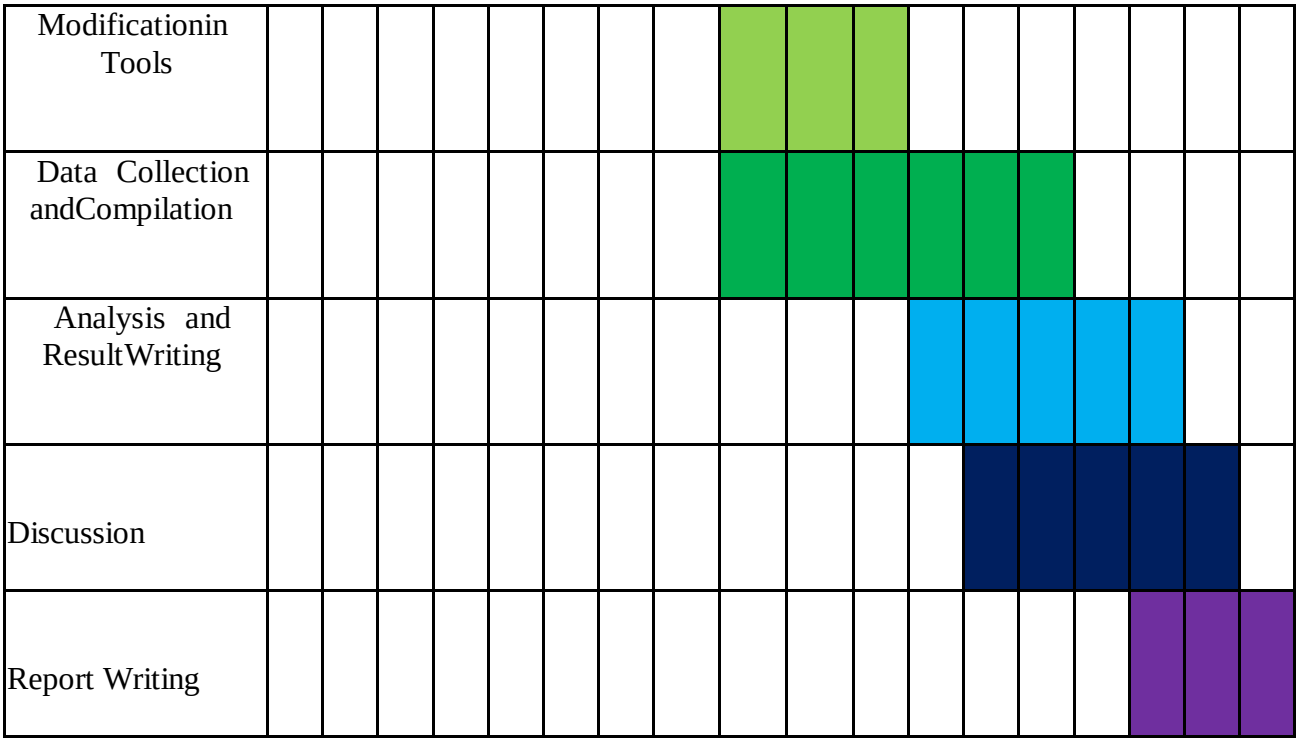

Institutional Support:

All necessary information and guidance is provided by my guide, co- guide and seniors.

All the technical and non-technical staff of department of physiology are fully supportive; the technicians provide all the necessary assistance that will be required during the study.

Budget: Self-Funded

RESEARCH QUESTIONS

Here are several research questions that could guide a study on "cardiovascular alterations following lifestyle modification in young individuals aged 25to35years: an electrophysiological aspect":

What is the impact of lifestyle modifications on heart rate variability (HRV) among young adults aged 25–35?

- This question aims to assess how changes in lifestyle factors such as diet, exercise, and stress management influence HRV, a keyindicatorofautonomic nervous system function and cardiovascular health.

How do specific lifestyle interventions (e.g., increased physical activity, dietary changes, stress reduction techniques) affect electrophysiological markers of cardiac function in this age group?

- This explores the relationship between targeted lifestyle changes and electrophysiological parameters, providing insights into how such modifications can alter cardiac autonomic regulation.

Are there gender differences in electrophysiological responses to lifestyle modifications among individuals aged 25–35?

- Investigating potential gender-based variations can help tailor lifestyle interventions more effectively for different populations.

Can early electrophysiological changes detected through HRV analysis predict long-term cardiovascular outcomes in young adults undergoing lifestyle modifications?

- This question seeks to determine the prognostic value of early HRV changes in forecasting future cardiovascular health, emphasizing the importance of early intervention.

What is the relationship between stress levels, as measured by HRV, and the effectiveness of lifestyle modification programs in improving cardiovascular health in young adults?

Understanding this relationship can highlight the role of stress management in cardiovascular health and the utility of HRV as a monitoring tool.

These research questions aim to deepen the understanding of how lifestyle modifications influence cardiovascular health at the electrophysiological level in young adults, potentially guiding more effective prevention strategies for cardiovascular diseases.

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