"HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA, AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL"

Thesis Submitted to

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

(Deemed-to-be -University)

[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]

Accredited 'A^{+}' Grade by NAAC (3rd Cycle)

Placed in Category 'A' by MoE (GoI)

For the award of the degree of

Doctor of Philosophy

In the Faculty of Physiotherapy

By

PEEYOOSHA GURUDUT

(Registration No: KLEU/Ph.D./2020 - 2021/DO1220031)

Under the Guidance of

Dr. SANJIV KUMAR MPT, Ph.D., FIAP

Principal & Professor,

KLE Institute of Physiotherapy, Belagavi

Co-Guide

Dr. ASHWIN PATIL, MBBS, MD (Radiology)

Professor, Dept. of Radiology, J. N. Medical College, Belagavi

KAHER Institute of Physiotherapy,

Belagavi - 590010, Karnataka, India

2025

UNDERTAKING

I, **PEEYOOSHA GURUDUT** hereby declare that the information and the data mentioned in my thesis entitled **"HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL"** belongs to me and is original.

I am aware of the definition of plagiarism as detailed below:

- An act or instance of using or closely imitating the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author.
- A piece of writing or other work reflecting such unauthorized use or imitation.
- The deliberate or reckless representation of another's words, thoughts or ideas as one's own without attribution in connection with submission of academic work, whether graded or otherwise.

I hereby declare that the thesis prepared by me is original-one and does not involve plagiarism anywhere. In case at a later stage, it is found that I have indulged in plagiarism, then I am solely responsible for the same and the Institution is at liberty to take any disciplinary action against me including cancellation of dissertation or any other penalties imposed by the University.

Date:
Place: Belagavi

Signature of the Research Scholar
PEEYOOSHA GURUDUT
Part time Ph. D. Research Scholar
Reg. No: DO1220031
KAHER, Belagavi-590010.

PLAGIARISM REPORT

Ref. No. KAHER/AA/24-25/D- 428

12th December 2024

Madam,

The soft copy of Ph.D. research thesis of **Dr. Peeyoosha Gurudut, Faculty of Physiotherapy, KAHER, Belagavi** has been submitted for anti-plagiarism check at the office of the undersigned through "Turn-it-in" package. The scan has been carried out and the scanned output reveals a match percentage of **9%** which is within the acceptable limit of 10%.

To obtain the comprehensive report of the plagiarism test, research scholar can send a mail to **diracademic@kledeemeduniversity.edu.in** along with the Registration Number, Name of the Scholar, Name of Guide/Co-guide and title of the thesis.

DIRECTOR * Deemed-to-be University * ACADEMIC AFFAIRS

Dr. Jyoti M. Nagamoti
Director, Academic Affairs

To,

Dr. Peeyoosha Gurudut
Part-Time Ph.D. Scholar,
2020-21 Batch, Faculty of Physiotherapy,
KLE Institute of Physiotherapy,
Belagavi.

Cc to :

1. The Principal, KLE Institute of Physiotherapy, Belagavi
2. Dr. Sanjeev Kumar, Professor of Neurology-Physiotherapy, KLE Institute of Physiotherapy, Belagavi-Guide
3. Dr. Ashwin Patil, Professor of Radiology, JNMC, Belagavi-Co-guide

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)



Copyright Declaration

We hereby declare that **KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH, BELAGAVI, KARNATAKA,** shall have the rights to preserve, use and disseminate this thesis in print or electronic format for academic/research purpose.

Signature:

PEEYOOSHA GURUDUT
Part-time Ph.D. Research Scholar
Reg. No: DO1220031
KAHER, Belagavi-590010.

Date:
Place: Belagavi

Signature of Guide:

Dr. SANJIV KUMAR MPT, Ph.D., FIAP
Principal & Professor
KLE Institute of Physiotherapy,
KAHER, Belagavi-590010.

Date:
Place: Belagavi

© KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH, BELAGAVI

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)



Declaration

I hereby declare that the thesis entitled **"HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL"** is bonafide and original research carried out by me under the guidance of **Dr. SANJIV KUMAR MPT, Ph.D., FIAP,** Principal & Professor, KLE Institute of Physiotherapy, Belagavi. The thesis or any part thereof has not formed the basis for the award of any degree/fellowship or similar title to any candidate of any University.

Date:
Place: Belagavi

Signature of the Research Scholar
PEEYOOSHA GURUDUT
Part-time Ph. D Research Scholar
Reg. No: DO1220031
KLE Institute of Physiotherapy,
Belagavi-590010.

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)

KLE
EMPOWERING PROFESSIONALS

Certificate

This is to certify that the thesis entitled "**HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL**" is bonafide and genuine research carried out by **PEEYOOSHA GURUDUT** under the guidance of **Dr. SANJIV KUMAR** MPT, Ph.D., FIAP, Principal & Professor, KLE Institute of Physiotherapy, Belagavi.

Date:
Place: Belagavi

Signature
PEEYOOSHA GURUDUT
HOD,
Dept of Orthopedic Physiotherapy,
KLE Institute of Physiotherapy,
KAHER, Belagavi.

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)



Certificate

This is to certify that the thesis entitled "**HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL**" is a bonafide and genuine research carried out by **PEEYOOSHA GURUDUT** under the guidance of **Dr. SANJIV KUMAR** MPT, Ph.D., FIAP, Principal & Professor, KLE Institute of Physiotherapy, Belagavi.

Date:
Place: Belagavi

Signature
Dr. VIJAY KAGE MPT, Ph.D.
Dean, Faculty of Physiotherapy
KLE Institute of Physiotherapy,
KAHER, Belagavi.

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)



Certificate of Guide

This is to certify that the thesis entitled **"HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL"** is a bonafide record of original research carried out by **PEEYOOSHA GURUDUT** for the award of the degree of DOCTOR OF PHILOSOPHY IN FACULTY OF PHYSIOTHERAPY under my supervision and guidance.

Date:

Place: Belagavi

Signature:

Dr. SANJIV KUMAR MPT, Ph.D., FIAP
Professor,
KLE Institute of Physiotherapy,
KAHER, Belagavi.

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)



Certificate of Co-guide

This is to certify that the thesis entitled **"HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL"** is a bonafide record of original research carried out by **PEEYOOSHA GURUDUT** for the award of the degree of DOCTOR OF PHILOSOPHY IN FACULTY OF PHYSIOTHERAPY under my supervision and co-guidance.

Date:

Place: Belagavi

Signature of Co-guide:

Dr. ASHWIN PATIL, MBBS, MD (Radiology)
Professor,
Dept. of Radiology,
J. N. Medical College,
KAHER, Belagavi

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed-to-be-University)
[Declared as Deemed-to-be-University u/s 3 12B of the UGC Act, 1956 vide Govt. of India Notification No.F.9-19/2000-U.3 (A)]
(Accredited 'A^{+}' Grade by NAAC (3rd Cycle)
Placed in Category 'A' by MoE (GoI)



Certificate

This is to certify that the thesis entitled **"HIGH-INTENSITY INTERVAL TRAINING VERSUS HATHA YOGA FOR POSTMENOPAUSAL WOMEN WITH CENTRAL OBESITY, SARCOPENIA AND DYNAPENIA ON MUSCLE AND FAT MASS, ABDOMINAL FAT AND LOWER LIMB ALIGNMENT: A RANDOMIZED CLINICAL TRIAL"** is a bonafide record of original research carried out by **PEEYOOSHA GURUDUT** under the guidance of **Dr. SANJIV KUMAR MPT, Ph.D., FIAP,** Principal & Professor, KLE Institute of Physiotherapy, Belagavi.

Date:

Place: Belagavi

Signature:

Dr. SANJIV KUMAR MPT, Ph.D., FIAP
Principal
KLE Institute of Physiotherapy,
KAHER, Belagavi.

ACKNOWLEDGMENT

I made it to the finish line! I am deeply grateful to the exceptional individuals who supported and guided me, helping me achieve my doctorate despite the unforeseen obstacles.

First and foremost, I extend my deepest gratitude to my supervisor and mentor, ***Dr. (Prof.) Sanjiv Kumar, Professor & Principal, KLE Institute of Physiotherapy*** *for his unwavering support and insightful critiques throughout my research journey. His commitment to academic excellence and meticulous attention to detail have significantly shaped this dissertation. His guidance and encouragement were invaluable from refining my research proposal to the final submission.*

*I would like to thank my PhD co-guide****, Dr. Ashwin Patil, Professor, Dept. of Radiology, J. N. Medical College, Belagavi,*** *for his constant support, help, guidance, and encouragement, which have been invaluable throughout the entire process.*

I want to extend my deepest gratitude to ***the Principal of KIPT*** *and the* ***Medical Director, of KLE Hospital and MRC****, for providing the essential resources and facilities that made this thesis possible.*

My heartfelt gratitude goes to ***Dr. Vijay Kage, Dean, Faculty of Physiotherapy****, for his constant optimism, help, and motivation which paved my path toward the successful completion of my PhD project and submission of my thesis.*

This dissertation would not have been possible without the financial support from ***Krsnaa Diagnostics Pvt. Ltd., KLES Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi,*** *India who sponsored for X-ray at 50% discounted charges for assessment of lower limb alignment.*

I would like to extend my deepest gratitude to ***Mrs. Sunanda Halki, Biostatistician, Belagavi Institute of Medical Sciences****, whose expertise and guidance in statistical analysis have been invaluable to this research.*

My sincere thanks to my research assistants ***Mr. Deepak T,*** *and* ***Mrs. Vidya Bhat****, as well as my postgraduates* ***Dr. Rutuja Phadke, Dr. Shamli Thali Dr. Soumya Hulamani, Dr. Keertana Vaidynathan, Dr. Sonal Pattanshetti,*** *and* ***Dr. Gauri Kotabagi*** *whose patience and readiness to assist at all times, have left a profound impact on the completion of my project. Additionally, I acknowledge the technical staff of the Dept. of Radiology,* ***Mr. Salim & Ms. Renuka*** *who provided the necessary support needed for the x-ray assessment of my study participants, which greatly impacted the timely completion of my project. My special thanks to the managers or caretakers,* ***Mr. Vijay More, Shantai Vruddhashram****, Old Age Home, Macche, Belagavi, and* ***Mr. Ramnath, Gharkul Old Age Home****, Ganeshpur, Belagavi for permitting me to conduct exercise sessions for the eligible inmates of old age homes that aided me in completing my data collection. I thank* ***Mr. Ashok Naik, Ex-President of Rotary Club of Belgaum – South*** *for helping me to conduct camp in the community.*

I would also like to acknowledge my peers, friends, and colleagues ***Dr. Renu Pattanshetty, Dr. Arati Mahishale, Late. Dr. Deepti Bagewadi, Dr. Aarti Welling, Dr. Varsha Huddar,*** *and* ***Dr. Ashwini Bulbuli*** *for their camaraderie, encouragement, appreciation, and stimulating discussions that created an environment conducive to academic success.*

I would like to express my deepest gratitude to my lifetime mentor, ***Dr. Subhash Khatri*** *for believing in me, and for unwavering guidance, wisdom, and support that have been the cornerstone of my academic journey.*

I owe an immense debt of gratitude to my endearing ***parents late. Shri. V. G. Nitsure (father),*** *and especially* ***my mom Smt. Usha Nitsure*** *who nurtured my curiosity and supported my educational endeavors from the very beginning. To my better half,* ***Dr. K. S. Gurudut,*** *your endless patience and understanding, especially during the most demanding phases of this research, have been my anchor. My deepest gratitude to my daughter,* ***Ms. Spruha*** *for her unwavering patience and understanding during the long hours of my work-related absence. My heartfelt thank you goes to my in-laws,* ***Shri. Siddabasavaiah, and Smt. Lalitha****, for their persistent motivation and encouragement. My immense gratitude to my beloved sister* ***Mrs. Utkala Kulkarni****, and my sister-in-law* ***Ms. Chinmayi*** *for their belief in my abilities which has been a source of strength to me.*

Lastly, I express my deepest gratitude to the Almighty for divine guidance, wisdom, and blessings, for illuminating my path, and for providing me with the perseverance and inspiration needed to complete this thesis.

I dedicate my thesis to my beloved ***late father Shri. Vishnu G. Nitsure****. I have missed him throughout my academic journey so far. I am sure he will be proud of me and is blessing me from wherever he is.*

Date: ***Peeyoosha Gurudut***

Place:Belagavi

LIST OF ABBREVIATIONS

Sl. No.	ABBREVIATIONS
1.	PMW: Postmenopausal Women
2.	HGS: Hand Grip Strength
3.	GS: Gait Speed
4.	AWGS: Asian Working Group for Sarcopenia
5.	DEXA: Dual Energy X-ray Absorptiometry
6.	BIA: Bio-electric Impedance Analysis
7.	WC: Waist Circumference
8.	BMI: Body Mass Index
9.	OA: Osteoarthritis
10.	HKA angle: Hip-Knee-Ankle Angle
11.	QoL: Quality of Life
12.	MICT: Moderate Intensity Continuous Training
13.	HIIT: High-intensity interval training
14.	YEP: Yoga Education Program
15.	EWGSOP: European Working Group on Sarcopenia in Older People
16.	HKAA: Hip-Knee-Ankle Angle
17.	WOMAC: Western Ontario and McMaster Universities Arthritis Index
18.	OR: Odd’s Ratio

19.	AWGS: Asian Working Group for Sarcopenia
20.	BMD: Bone Mineral Density
21.	ICC: Intraclass correlation coefficient
22.	PSS: Perceived Stress Scale
23.	SF-36: Short Form - 36
24.	MENQOL: Menopause-specific Quality of Life Questionnaire
25.	FFM: Fat-Free Mass
26.	ER: Energy Restriction
27.	CT: Combined Training
28.	RT: Resistance Training
29.	TY: Thai Yoga
30.	ASMI: Appendicular Skeletal Muscle Index
31.	SD: Standard Deviation
32.	ANOVA: Analysis of Variance
33.	kgs: kilograms
34.	cms: centimeters

ABSTRACT

Background: Menopause is a demanding phase in a woman's life, often accompanied by a rise in musculoskeletal concerns and obesity, requiring early and effective intervention. The influence of High-Intensity Interval Training (HIIT) and Hatha yoga on musculoskeletal health in postmenopausal women remains inadequately studied. While both exercise methods have distinct characteristics, they also share notable differences and similarities.

Aims: To assess and compare the effects of 12 weeks of HIIT and yoga interventions on postmenopausal women experiencing central obesity, sarcopenia, dynapenia, and knee misalignment. This article outlines a study protocol to evaluate the outcomes of HIIT and yoga programs for postmenopausal women.

Methodology: The present study was an open-label, randomized, parallel-armed, assessor-blinded clinical trial conducted on 160 postmenopausal women between 46 and 70 years randomly assigned to either HIIT or yoga group. The intervention was in the form of group therapy, which consisted of 5 sessions per week for 12 weeks. The outcomes included Appendicular skeletal Mass Index (ASMI) using a bioelectric impedance analyzer, a radiological measure of Hip-Knee-Ankle angle, perceived stress scale & short-form 36 questionnaires assessed twice (pre & post). The outcomes including gait speed (GS), hand grip strength (HGS), waist circumference, and body mass index were assessed pre-, post-4th week, post-8th week, and post-12th week.

Results: The within-group analysis of outcome variables for both study groups was statistically significant for all parameters at $P<0.05$. However, the between-group

analysis revealed mixed results. Yoga was significantly better than HIT for sarcopenic outcome parameters (GS, HGS & ASMI), dynapenia by HGS, and perceived stress levels at $P<0.05$ while for all other outcome parameters, both groups were equally effective at $P>0.05$.

Conclusion: Yoga training was slightly superior to HIT protocol for sarcopenia, dynapenia, and stress levels in post-menopausal women. However, in terms of body composition parameters, obesity, quality of life, and lower limb alignment changes, both were equally effective. The study outcomes provide confirmatory evidence on the effects of Hatha yoga and HIIT exercise training protocols in managing menopausal health issues.

Keywords: aging; exercise; high-intensity intermittent; menopause; clinical trials; yoga; obesity; sarcopenia; women; exercise prescription;

TABLE OF CONTENTS

Sl. No.	Particulars	Page No.
1.	INTRODUCTION	1-5
2.	BACKGROUND	6-8
3.	LITERATURE REVIEW	9-31
4.	JUSTIFICATION	32-34
5.	AIMS AND OBJECTIVES	35
6.	RESEARCH QUESTION AND HYPOTHESIS	36
7.	MATERIAL AND METHODS	37-49
8.	RESULTS	50-64
9.	DISCUSSION	65-91
10.	CONCLUSION	92-94
11.	SUMMARY	95-96
12.	BIBLIOGRAPHY	97-130
13.	ANNEXURES	131-
	ANNEXURE–I- CTRI FINAL REGISTRATION DOCUMENT PHD	131
	ANNEXURE – II - ETHICAL CLEARANCE CERTIFICATE PHD	132
	ANNEXURE - III - INFORMED CONSENT FORM	133-140
	ANNEXURE - IV – FIGURES	141-145
	ANNEXURE V - TABLES	146-172
	ANNEXURE - VI - LOG DIARY AND DIET CHART	173-179
	ANNEXURE VII - DATA COLLECTION SHEET	180-195
	ANNEXURE VIII- GRAPHS	196-217
	ANNEXURE IX- PRESENTATIONS AND PUBLICATIONS	218-242

LIST OF TABLES

Sl. No.	Particulars	Page No.
1	Table 1: High-Intensity Interval Training exercise protocol	**146**
2	Table 2: Hatha Yoga exercise protocol	**147**
3	Table 3: Schematic diagram of schedule of enrolment, interventions, and assessments (Participant Timeline)	**148**
4	Table 4: Normality Distribution Table – HIIT group	**149-151**
5	Table 5: Normality Distribution Table – Yoga group	**152-154**
6	Table 6 a-h: Demographic distribution and characteristics for the two study groups: categorical variables	**155-156**
7	Table 7 a-c: Demographic distribution and characteristics for the two study groups: continuous variables	**156**
8	Table 8 a-d: Pre-post comparison of obesity parameters across timelines for the HIIT group	**157-158**
9	Table 9 a-c: Pre-post comparison of sarcopenic and dynapenia parameters across timelines for the HIIT group	**159**
10	Table 10: Pre-post comparison of Body composition parameters across two timelines for the HIIT group	**160**
11	Table 11: Pre-post comparison of Hip-Knee-Ankle angle (degrees) across two timelines for the HIIT group	**160**
12	Table 12: Pre-post comparison of perceived stress scale score across two timelines for the HIIT group	**160**
13	Table 13: Pre-post comparison of domains of SF- 36 Quality of life questionnaire across two timelines for the HIIT group	**162**
14	Table 14 a-d: Pre-post comparison of obesity parameters across timelines for the Yoga group	**163-164**
15	Table 15 a-c: Pre-post comparison of Sarcopenic and dynapenia parameters across timelines for the Yoga group	**165-166**
16	Table 16: Pre-post comparison of Body composition parameters across two timelines for the Yoga group	**167**

17	Table 17: Pre-post comparison of Hip-Knee-Ankle angle (degrees) across two timelines for the Yoga group	**167**
18	Table 18: Pre-post comparison of perceived stress scale score across two timelines for the Yoga group	**167**
19	Table 19: Pre-post comparison of domains of SF- 36 Quality of life questionnaire across two timelines for the Yoga group	**168**
20	Table 20: Between-group comparison of obesity parameters	**169**
21	Table 21: Between-group comparison of Sarcopenic and dynapenia parameters	**169**
22	Table 22: Between-group comparison of body composition parameters	**169**
23	Table 23: Between-group analysis for Hip Knee Ankle Angle for both sides	**170**
24	Table 24: Between-group analysis of perceived stress score and domains of SF-36	**170**
25	Table 25: Comparisons of effect size and % difference between Yoga and HIIT groups for obesity variables	**171**
26	Table 26: Comparisons of effect size and % difference between Yoga and HIIT groups for Sarcopenia and dynapenia variables	**171**
27	Table 27: Comparisons of effect size and % difference between Yoga and HIIT groups for Body composition variables	**171**
28	Table 28: Comparisons of effect size and % difference between Yoga and HIIT groups for Hip-Knee-Ankle angle variable	**172**
29	Table 29: Comparisons of effect size and % difference between Yoga and HIIT groups for Perceived stress levels	**172**
30	Table 30: Comparisons of effect size and % difference between Yoga and HIIT groups for Health-related quality of life by SF-36	**172**

LIST OF FIGURES

Sl. No.	Particulars	Page No.
1	Figure 1: CONSORT flow diagram	**141**
2	Figure 2 a & b: High-Intensity Interval Training Intervention	**142**
3	Figure 3 a-d: Hatha Yoga Intervention	**142-143**
4	Figure 4: Body composition assessment by Bio-Impedance Analyzer	**144**
5	Figure 5: Gait Speed Assessment by 4m-Speed test	**145**
6	Figure 6: Hand Grip Strength Assessment by Jamar Dynamometer	**146**
7	Figure 7a &b: Patient position for HKA angle measurement by Xray	**147**
8	Figure 8 a: HKA angle markings with values at pre-intervention for a study subject in HIIT group	**148**
9	Figure 8 b: HKA angle markings with values at post-intervention for a study subject in HIIT group	**148**
10	Figure 9 a: HKA angle markings with values at pre-intervention for a study subject in Hatha Yoga group	**149**
11	Figure 9 b: HKA angle markings with values at post-intervention for a study subject in Hatha Yoga group	**149**

LIST OF GRAPHS

Sl. No.	Particulars	Page No.
1	Graphs 1 a-g: Demographic characteristics in the two study groups	**196-198**
2	Graphs 2 a-c: Basic characteristics of the two study groups	**198-199**
3	Graphs 3 a-f: Pre- and post-intervention comparisons of all outcome measures for the HIIT group	**199-201**
4	Graphs 4 a-f: Pre- and post-intervention comparisons of all outcome measures for the yoga group	**201-203**
5	Graph 5 a-d: Comparison of obesity parameters across timelines between the two study groups	**203-204**
6	Graphs 6 a-c: Comparison of sarcopenia and dynapenia parameters across timelines between the two study groups	**204-205**
7	Graphs 7 a-d: Comparison of body composition parameters across timelines between the two study groups	**205-206**
8	Graphs 8 a & b: Comparison of Hip-Knee-Ankle Angle across timelines between the two study groups	**207**
9	Graph 9: Comparison of perceived stress scale at pre- and post-intervention between the two study groups	**207**
10	Graph 10 a-h: Comparison of health-related quality of life domains by SF-36 across timelines between the two study groups	**208-210**
11	Graph 11a-d: Repeated measures ANOVA analysis for obesity parameters	**210-211**
12	Graphs 12 a-c: Repeated measures ANOVA analysis for sarcopenia and dynapenia parameters	**212**
13	Graphs 13 a-d: Repeated measures ANOVA analysis for body composition parameters	**213-214**
14	Graphs 14 a & b: Repeated measures ANOVA analysis for Hip- Knee-Ankle Angle parameter	**214**
15	Graph 15: Repeated measures ANOVA analysis for perceived stress levels parameter	**215**
16	Graphs 16a-h: Repeated measures ANOVA analysis for health-related quality of life domains by SF-36	**215-217**

INTRODUCTION

Women's health is a national issue, not just an individual concern. Menopause or post-reproductive life marks an important shift in an adult female's life, characterized by various physiological changes that can profoundly impact health. While menopause is a natural phase, its physiological changes can lead to significant health challenges. The cessation of ovarian function results in decreased levels of estrogen and progesterone hormone levels. This decline leads to various symptoms and health risks, including symptoms like hot flashes and night sweats [1,2]. An increase in androgens can lead to metabolic changes, such as overall weight gain and abdominal fat redistribution [3], which in turn heightens the risk of cardiovascular diseases and metabolic issues [4,5]. Estrogen deficiency increases the hazard of osteoporosis due to disrupted bone turnover [3]. Reduced physical activity during this period can worsen health outcomes [4]. Women may experience heightened anxiety and depression during menopause, exacerbated by physical symptoms [2].

Additionally, menopause is closely linked to a higher incidence of various non-communicable diseases and comorbidities, leading to significant health challenges for women compared to age-matched men and women of reproductive age. This substantially burdens individuals, healthcare systems, and financial resources [6,7]. These comorbidities include cardiovascular diseases, central adiposity, diabetes mellitus, hypertension, musculoskeletal ailments, cardiovascular disorders, metabolic syndrome, cancers, etc. which put women at risk of getting affected by various health risks [6].

Menopause induces significant physiological changes in the musculoskeletal system, primarily due to decreased estrogen levels. These changes can lead to various health issues, including osteoporosis, sarcopenia, and Osteoarthritis (OA), which

collectively impact women's quality of life (QoL) [6]. These further make a woman prone to fractures, falls, frailty, etc. compromising a woman's functional autonomy [7].

An editorial highlighted that osteoporosis, obesity, and sarcopenia may form an interconnected trio in post-menopausal women (PMWs) [8]. Consequently, central obesity, and sarcopenia, are key health issues that emerge in mid-adulthood and worsen with age. These conditions increase the risk of unfavorable health consequences when they occur individually. When they occur together, the combined risks potentially exacerbate each other. Sarcopenia is the loss of total body muscle mass, which fat mass replaces. At the same time, dynapenia is characterized by the loss of muscle strength, typically measured by palmar or Hand Grip Strength (HGS) or quadriceps strength [9]. Central adiposity, a shift in fat distribution to the abdomen, becomes more pronounced after menopause, whereas during the reproductive years, fat distribution is primarily around the hips and thighs [10-12].

The average age of menopause in India varies slightly across different studies, but a systematic review indicates it is approximately 46.6 years [13]. This figure reflects data collected from various regions and populations, highlighting the complexity of menopause timing influenced by socio-economic and health factors. In Indian women, the average climacteric age is 46.2 years, before women in Western countries, where it typically occurs at 51 years [14].

Studies show that the prevalence of sarcopenia varies globally and within India, influenced by factors such as age, lifestyle, and nutritional status. A systematic review reported that the global occurrence of sarcopenia in individuals aged 60 years and more ranges from 10% to 27%, with women experiencing higher rates than men. Severe sarcopenia affects 2% to 9% of this population [15]. In a study of perimenopausal and PMWs in India, 16% were found to have sarcopenia, primarily

among those with sedentary lifestyles [16]. Another study reported a prevalence of 28.8% in older women [17]. The occurrence of sarcopenia ranged from 17.5% (India) to 12.6% (Poland) in a multicontinental study comparing 7 cities indicating a higher occurrence in Indians than in their Western counterparts[18].

The prevalence of dynapenia, characterized by loss of muscle strength occurring with aging, varies significantly among older adults globally and in India, particularly among women. Studies indicate that dynapenia is a critical health concern, with varying prevalence rates influenced by diagnostic criteria and demographic factors. In a study of elderly women, the prevalence of dynapenia was 56.5% when defined by an HGS of less than 20 kg [19]. Another study reported a prevalence of 46.3% using the same HGS cutoff [20]. Research in India revealed that specific cut-points for diagnosing dynapenia were lower than international standards, with Indian women showing a higher prevalence of muscle weakness [21,22]. In a study conducted in Belagavi, India, the prevalence of dynapenia was 23.65% among women over 70, compared to 14.81% in younger cohorts [23].

Central obesity is significantly higher in menopausal women than in their reproductive-age counterparts, both in India and globally. A study indicates that 68% of rural and 74% of urban PMWs have a Waist Circumference (WC) exceeding 88 cm, indicating central obesity. In contrast, only 27% of rural and 31% of urban premenopausal women exhibit similar abdominal obesity [24].

The Asian Working Group for Sarcopenia (AWGS) has established criteria for the diagnosis of sarcopenia and cut-offs specifically for the Asian populace, which include the evaluation of fat mass and muscle mass using Dual Energy X-ray Absorptiometry (DEXA) and/or Bio-electric Impedance Analysis (BIA). Along with this, evaluation of muscle strength by palmar grip strength and physical functional

assessment by gait speed measurement is also needed [9]. Bioelectric Impedance analysis is a valid and cost-effective alternative to DEXA to measure total body fat and lean mass [25]. Dynapenia can be diagnosed using various methods, primarily focusing on isometric handgrip strength which is widely used, with cutoff points typically set at <18 kgs for women [20,26]. The diagnosis of central obesity in Asian or Indian women is primarily assessed through WC and Body Mass Index (BMI) cut-offs, which differ from Western standards due to ethnic variations in body fat distribution and associated health risks. For Asian Indian women, a WC cut-off of 72 cm is recommended to identify those with cardiovascular risk factors, while a higher risk is indicated at ≥80 cm**.** These cut-offs are more sensitive than the international standard of 88 cm, which may misclassify many individuals as non-obese [27].

Another concern for aging women is the alteration in lower limb angular orientation, particularly in the knee joint (varus or valgus), which can result from central obesity or muscle imbalances. This misalignment may contribute to arthritis that requires attention [28, 29]. Both knee malalignment and obesity are significant biomechanical risk factors for knee OA, primarily due to their role in increasing knee joint loading [29]. Lower extremity malalignment is a significant factor in the development of OA of the knee joint. Bow-leggedness (varus) increases strain on the medial tibiofemoral compartment, while knock-knees (valgus) reduce medial loading but increase lateral loading, which heightens OA risk in that compartment. Strong correlations exist between both varus and valgus deformities and the progression of existing knee OA, with the severity of deformity increasing the risk [30]. These malalignments can be precisely diagnosed through long-axis X-ray measurements of weight-bearing lower limbs, with the frontal plane Hip-Knee-Ankle (HKA) angles being marked and measured [30]. A typical HKA ranges from 180° (neutral alignment)

to +5 (185°) for slight varus and -5 (175°) for slight valgus [31]. The relationship between obesity, increased adduction moment, and loading in the knee joint, which intensifies with aging in elderly men and women, has been well-documented in the literature, particularly concerning coronal HKA angles [32].

A well-planned weight loss program or structured exercise program that aims to correct the muscle imbalance helps mitigate the loading on the knee joints. According to a recent study, knee, and hip frontal plane kinematics improved after a 12-week structured exercise program that strengthened the knee extensors and hip abductors and enhanced lower-limb alignment control during dynamic loading, though the effect sizes were not very large [33]. Additionally, both proprioceptive exercises over three months and a weight loss intervention through diet were shown to have beneficial effects on foot posture, loading, knee internal rotation moment, and alignment of the lower limbs in elderly individuals and knee OA patients [34,35].

Therefore, menopause represents a difficult stage in a female's life that requires the implementation of effective strategies to manage its impact. However, proactive management through lifestyle changes and medical interventions can help alleviate these impacts and betterment of QoL. The significance of identifying women with sarcopenia, obesity, and osteoporotic conditions, and addressing these issues through a personalized, calorie-deficit, high-protein diet combined with a resistance exercise program, has been highlighted [8]. Preventive measures for sarcopenia include physical activity and improving body composition by reducing body fat [18]. Physical workout is an essential non-medicinal strategy to enhance health in the aging population, helping to prevent the development of secondary health issues.

BACKGROUND

Exercise combined with an adequate amount of ideal nutrition aids in managing not only hormonal and cardiac issues but also musculoskeletal risks like being overweight, arthritis, osteoporosis, sarcopenia, and dynapenia [36]. Physical workout and balanced nutrition are the best recipes to manage the mentioned musculoskeletal issues [36]. A dose-dependent relation between the amount of exercise performed and the amount of fat loss has been reported in sedentary, obese adults of both genders between the age range of 45 and 60 years [37].

Various types of exercise have been explored for their effectiveness in preventing and managing musculoskeletal health risks in elderly women. The literature review reveals that several studies have focused on either resistance training or aerobic exercise protocols to improve musculoskeletal health and body composition [38]. A substantial body of research supports the positive role of both resistance and endurance training in addressing these conditions [38,39]. Moderate Intensity Continuous Training (MICT) is advised for increasing weight and fat mass, with 150–250 minutes per week recommended for maintenance and more than 250 minutes per week for weight loss, following the latest American College of Sports Medicine guidelines [40].

High-intensity interval training (HIIT) involves alternating between periods of intense exercise and lower-intensity recovery phases [41]. HIIT protocols have been shown to effectively reduce fat mass, including both abdominal and visceral fat. When compared to MICT, HIIT offers the advantage of requiring less time while yielding similar or even superior results in terms of fat mass reduction and improvements in cardiovascular health [42].

A comparison between running and cycling suggests that running may be more effective in reducing total and visceral fat [42]. The impact of HIIT on aging, whether at the aerobic or muscular levels, is receiving a lot of attention. Studies involving both human and animal models suggest that HIIT may help mitigate age-related changes across several areas, including body composition, physical functional capacity, and inflammatory markers [43]. In particular, it has been demonstrated that twelve weeks of HIIT improves body composition, functional ability, and indicators of glucose homeostasis and fasting serum lipids in both young and healthy individuals [43]. The 16-week HIIT program effectively improved the lipid profile and fasting glucose levels in females with dyslipidemia and hyperglycemia. Additionally, it enhanced blood pressure, endurance, and anthropometric measurements across all groups, while reducing medication dosages for women with type 2 diabetes. Notably, these advantages were attained with a weekly time commitment that was 25% to 56% less than what is now advised, indicating that HIIT may be a more time-effective strategy for controlling dyslipidemia and enhancing general health [44].

Yoga, an ancient practice originating in India, combines static postures (Hatha yoga) or dynamic postures in a flow (Vinyasa yoga) with controlled breathing techniques [45]. In recent years, yoga has gained worldwide popularity, supported by an expanding body of research in Western countries. Regular yoga practice has been linked to improvements in systolic and diastolic blood pressure, heart rate, body fat percentage, total cholesterol, triglycerides, and bad cholesterol in those with cardiovascular diseases and hypertension, according to studies [46]. A 12-week yoga program has also demonstrated positive outcomes on body measurements and self-reported outcomes in females with central obesity, highlighting yoga as a safe and effective approach for managing abdominal obesity in women [47]. For Chinese adults,

a 12-week Hatha yoga program improved their flexibility, muscular strength and endurance, and cardiovascular endurance. Yoga seems like a promising substitute for exercise, given the positive findings of this study and the high rates of adherence and attendance [48].

A study investigated a yoga education program (YEP) aimed at enhancing gait speed, muscle strength, and physical functioning in aging women with sarcopenia across Asia and Africa. The findings revealed that women from middle-class backgrounds in a few cities in Asia, who were conjugal, lived with family, rated their health positively, and regularly attended yoga sessions, experienced an increase in walking speed and strength of muscle. The most significant predictor of these positive outcomes was the instructors' self-practice. The authors concluded that YEP is an effective enduring strategy for preventing sarcopenia in aging women [49].

LITERATURE REVIEW

The search strategy for the review of the literature included:

- Keywords: ageing; woman; menopause; musculoskeletal health; body composition, obesity, muscle strength; muscle function; assessment; fat mass; lean mass; physical functions; adiposity; flexibility; sarcopenia; dynapenia; prevalence; balance; malalignments; lower limb; arthritis; knee valgus or varus; bio-electric impedance analysis; DEXA; radiography; reliability; validity; exercise; physical activity; aerobic training; resistance training; Tai chi; high-intensity training; yoga; gait; QoL; stress; sleep; physical fitness;
- The search of Resources: BOOLEAN operators 'and' 'or' and 'not' for the below databases:
- PubMed Central, Medline, Biomedcentral, Elsevier, EMBASE, Publons, ScienceDirect, PEDro, EBSCO, CINAHL and Google Scholar
- ProQuest Databases for Dissertations and Thesis
- KAHER Institute of Physiotherapy library databases for Ovid, Cochrane online

Age of menopause in India and global comparison:

• This study reviews 202 articles on menopause age in India, finding an average age of 46.6 years, lower than in developed countries, likely due to socio-economic and health factors. It identifies a positive correlation between menopause and menarche age, with minimal publication bias. The study calls for further research to understand the causes of these differences and the impact of methodological variations [13]. Menopause, occurring at a mean age of 46.2 years in India, is earlier than the global average of 51, raising the need for early prevention. This study surveys 21 chapters of the Indian Menopause Society and 23 medical practitioners,

highlighting the impact of socioeconomic factors, marital status, and reproductive history on menopause age and health outcomes for Indian women [14]. A study of 199 peri- and post-menopausal women in Uttar Pradesh found an average menopause onset age of 45.38 years. All participants had physical symptoms, and 94.5% faced psychosocial issues. Poor stress management worsened symptoms, while regular exercise reduced vasomotor issues. The study emphasizes the need for targeted interventions to improve QoL [50].

Menopause cause and outcomes:

- Evidence from other studies supports that surgical menopause, compared to natural menopause, is associated with more severe psychological and physical symptoms. Surgical menopause presents with more severe vasomotor symptoms (hot flashes & night sweats), higher rates of anxiety and depression, more severe, sexual dysfunctions, somatic symptoms like headaches, body aches, and lower quality of life scores than natural menopause except for the fact that the weight gain more in natural menopause [51-54].

Menopause and physiological adaptations in the musculoskeletal system:

- This study examined sarcopenia prevalence in premenopausal and PMWs with osteopenia and osteoporosis, finding higher prevalence in PMWs, especially with osteoporosis. Physical activity was linked to skeletal muscle index, but diet and hormone replacement therapy had no impact. The study emphasizes the importance of sarcopenia screening and exercise interventions for managing muscle loss and osteoporosis risk [55]. This review differentiates sarcopenia (muscle mass loss) and dynapenia (muscle strength decline), highlighting that strength declines faster than mass with aging and is a stronger predictor of disability and death. It suggests resistance training, proper nutrition, and potential hormonal therapies to preserve

muscle mass and strength, emphasizing the need for further research on effective treatments [56]. This literature review examines the link between dietary protein, metabolic syndrome, and sarcopenia in Asian Indians. It highlights how inadequate protein intake, common in traditional diets, contributes to muscle loss and metabolic disorders like insulin resistance, dyslipidemia, and obesity. The review emphasizes the need for sufficient protein to prevent sarcopenia and advocates for culturally appropriate nutritional interventions to improve health outcomes in this population [57].

- This review emphasizes a multifactorial approach to sarcopenia assessment, considering muscle mass, strength, and function. It discusses various evaluation methods, including imaging, strength testing, and performance measures, and highlights the impact of nutrition, physical activity, and chronic diseases. A holistic approach is recommended for better detection and treatment [58].
- PMWs are more prone to sarcopenia, influenced by factors like sedentary behavior, malnutrition, and health conditions, with estrogen decline accelerating its onset. The hormonal changes during menopause, particularly the decline in estrogen (E2), testosterone, dehydroepiandrosterone (DHEA), growth hormone (GH), and insulin-like growth factor 1 (IGF-1), contribute to muscle mass loss and sarcopenia in women. Estrogen (E2)'s reduction leads to increased inflammation and muscle dysfunction, while lower testosterone levels worsen muscle strength and mass. DHEA's decline also impacts muscle growth, fat distribution, and metabolism. The decrease in GH and IGF-1, which are important for body composition, accelerates muscle loss. Cortisol levels increase with age, potentially contributing to muscle catabolism. These hormonal changes, along with factors like obesity and ethnicity, play a critical role in the decline of muscle function and mass in postmenopausal

women. A healthy lifestyle, including proper diet, physical activity, and possibly hormone therapy, can reduce the risk of sarcopenia in PMWs [59].

- This study examines the link between body composition and knee OA (OA) in PMWs. It found that higher body fat and lower muscle mass were associated with more severe OA and increased functional impairment. The study emphasizes the importance of maintaining a healthy body composition through physical activity and weight management to prevent or manage knee OA in this population [60].
- This review explores how estrogen deficiency accelerates sarcopenia through mechanisms like mitochondrial dysfunction. A decline in estrogen levels during menopause is linked to the loss of muscle mass and function, contributing to sarcopenia. Estrogen is positively associated with lean body mass, and its reduction is related to decreased muscle strength. Estrogen replacement therapy has been shown to help mitigate age-related muscle loss in postmenopausal women. Muscle strength loss due to estrogen deficit is particularly notable in type II muscle fibers, which are more affected by aging and show a stronger expression of estrogen receptors. It also highlights the role of aerobic and resistance exercise in counteracting muscle loss after menopause and emphasizes the importance of physical activity in managing sarcopenia [61].

Obesity and its ill effects:

- Obesity impairs muscle strength, endurance, and functional performance, leading to increased fatigue and reduced physical fitness. While obese individuals have greater absolute muscle strength, they are weaker when normalized to body weight. This study highlights the need for interventions like resistance training and weight management to improve muscle strength and physical capacity in obese individuals [62]. A study found that WC is more strongly related to grip strength than BMI in

obesity. While higher BMI correlated with a stronger grip, WC was a better indicator of muscle strength decline, especially in individuals with normal BMI but high central fat. The findings stress the importance of assessing central obesity in muscle strength evaluation[63]. Research shows that obesity negatively impacts skeletal muscle function, with obese individuals having lower maximum strength in antigravity muscles relative to body mass. Obesity is linked to functional limitations and higher OA incidence, especially in older adults. High fat levels may also hinder muscle activation in younger individuals, worsening functional limitations [64]. The study finds that while obese individuals have higher absolute muscle strength, it is lower when adjusted for body weight. It shows no significant difference in muscle fatigue, suggesting obesity doesn't affect intrinsic muscle properties. The review highlights factors like excess fat and reduced coordination, calling for further research on obesity's impact on muscle function and rehabilitation [65].

Prevalence of Central obesity in PMWs:

- This study in Chennai, India, found that 45.9% of individuals had generalized obesity, with women (47.4%) more affected than men (43.2%). Abdominal obesity was present in 46.6%, more prevalent in women (56.2%) than men (35.1%). Women had higher isolated abdominal obesity (14%), while men had more isolated generalized obesity (12.7%). Combined obesity was found in 32.6% of men and 43.3% of women. WC was a stronger metabolic risk indicator in women, emphasizing its importance in assessing obesity-related health risks [66]. During menopause, women experience significant fat gain, particularly abdominal fat, due to decreased estrogen levels. On average, women gain 2-2.5 kg over three years, and up to 65% are overweight or obese, with the highest increase in obesity after age 40. This fat distribution change raises the risk of diseases like osteoporosis,

cardiovascular disease, and type 2 diabetes. Targeted interventions, including lifestyle, diet, and physical activity, are crucial to reducing health risks in PMWs [67]. A systematic review and meta-analysis of 13.2 million people reveals the rising global prevalence of central obesity, highlighting regional differences and time trends. Central obesity, a major risk for metabolic and cardiovascular diseases, shows significant variations across populations, emphasizing the need for tailored public health strategies to address this growing concern [68].

Prevalence of Sarcopenia:

- Sarcopenia, the loss of muscle mass and function, is a major concern for perimenopausal and PMWs, particularly in tropical regions. Estrogen decline increases the risk, leading to reduced strength and mobility. The study emphasizes early detection, lifestyle changes like exercise and nutrition, and addressing sarcopenia as a public health issue to prevent disability and improve health outcomes [16]. A study on sarcopenia in Indian males and females highlights the need for ethnicity-specific diagnostic criteria. Using data from 1009 young and 1755 older adults, it found that Indian cut-points for sarcopenia are lower than international standards. The revised European Working Group on Sarcopenia in Older People (EWGSOP2) cut points had the highest predictive ability. Additionally, sex differences in muscle-bone health showed a stronger relationship in women than men, emphasizing the need for tailored sarcopenia diagnostics in diverse populations [22]. A study of 106 PMWs found that 45.3% had sarcopenia, leading to reduced mobility and physical limitations. The longer women experience menopause, the lower their muscle mass, highlighting the need for early intervention. Targeted treatments like exercise and nutrition can improve QoL and mitigate sarcopenia's impact [69]. A study of Hungarian PMWs aged 50+ found a high prevalence of sarcopenia: 36% probable, 31% sarcopenia, and 8% severe

sarcopenia. Key predictors included height, weight, HGS, and gait speed. These findings highlight the need for effective screening and public health strategies to address sarcopenia and promote healthy aging in older women [70]. A study of 340 middle-aged PMWs found that 12% were pre-sarcopenic, with low muscle mass strongly linked to a BMI of ≤ 20 kg/m². The findings emphasize the importance of early diagnosis of pre-sarcopenia and maintaining a healthy BMI to reduce the risk of muscle deterioration in middle-aged and older women [71].

Prevalence of Dynapenia India and globally:

- A study of 205 older women (average age 72.7) found a 14.1% prevalence of dynapenia using a handgrip strength cutoff of <16 kg and 46.3% with a <20 kg cutoff. The results highlight a high prevalence of dynapenia, with a significantly higher rate when the lower threshold was used [20]. A study in Belagavi, India, assessed the prevalence of sarcopenia and dynapenia among 702 residents aged 40 and above. It found that sarcopenia (20.37%) and dynapenia (23.6%) were more prevalent in those over 70 years, with dynapenia being more common in women (40.03%) than men (34.19%). The study highlighted the strong correlation between muscle weakness, frailty, and functional decline, emphasizing the need for early screening and interventions to improve the QoL for older adults [23].

Prevalence of lower limb malalignments or OA in PMW:

- A community-based study in India found that knee OA affects 28.7% of the population, with a higher prevalence in women (31.6%). The condition is linked to risk factors such as aging, obesity, and sedentary work. The study emphasizes the need for public health initiatives focusing on physical activity, weight management, and early diagnosis to address the rising OA prevalence in India[72]. The Global Burden of Disease Study reveals a significant increase in OA prevalence and

disability in India from 1990 to 2019, rising from 23.46 million to 62.35 million affected individuals. The age-standardized prevalence grew from 4,895 to 5,313 per 100,000 people, with a higher impact on women. Knee joints were most commonly affected. The findings highlight the growing public health burden of OA, especially in older populations, and stress the need for preventive strategies and targeted public health policies to address risk factors like obesity, occupational stress, and injuries [73].

- An investigation of 146,494 PMWs aged 50 to 79 from the Women's Health Initiative found that 44% reported OA. The study identified a higher BMI, particularly ≥40, and older age (70-79 years) as strong risk factors for OA. Ethnic differences in OA prevalence were noted, with American Indian women having the highest rate (51%), followed by African American (57.9%), Hispanic white (41.9%), and non-Hispanic white women (32.9%). These findings emphasize the need for targeted prevention strategies addressing demographic and modifiable risk factors [74]. A study using data from the Longitudinal Ageing Study of India found that 9.36% of Indians aged 45 and older have arthritis, with a higher prevalence in women (11.03%) compared to men (7.49%). The odds ratio of 1.59 indicated women are more likely to develop arthritis than men, while an adjusted odds ratio of 1.41 highlighted age as a significant risk factor [75]. A study by Nayak et al. (2020) on 966 Indian participants with OA found that 65.8% had varus knee alignment, as measured by the HKA Angle (HKAA), with a mean of 174.5° ± 6.5°. The study correlated knee alignment with OA severity, emphasizing the role of radiological assessment in understanding knee deformities and their impact on OA progression [76].

- Shah et al. (2024) found a positive correlation between knee varus angle and knee pain in PMWs with knee OA, with a moderate Western Ontario and McMaster Universities Arthritis Index (WOMAC) score indicating pain. Physiotherapy improved knee function, and the standing varus angle was suggested as a useful screening tool for knee OA in the absence of imaging [77]. A study of 333 middle-aged women with BMI ≥27 kg/m² found that knee malalignment, particularly varus alignment, significantly increased the risk of developing radiographic knee OA over 2.5 years (Odd's Ratio (OR): 3.3). Valgus alignment also showed a slightly higher risk (OR: 2.8). However, neither malalignment type significantly affected joint space narrowing, indicating that while malalignment is a risk factor for radiographic OA, its impact on joint space narrowing or clinical OA may be less significant [78].

Diagnosis of Sarcopenia:

- The EWGSOP updated its 2018 diagnostic criteria for sarcopenia, defining stages from pre-sarcopenia to severe sarcopenia. Diagnosis requires evaluating both decreased muscle mass and poor muscle function (strength or performance). Low muscular strength indicates suspected sarcopenia, while low muscle mass and function confirm sarcopenia, with severe sarcopenia including all three features [79].
- The Asian Working Group for Sarcopenia (AWGS) updated its sarcopenia diagnostic criteria in 2019, focusing on early detection. The concept of "possible sarcopenia" was introduced, with diagnostic cutoffs validated across Asian cultures. The 2019 criteria retained the 2014 definition of sarcopenia as age-related muscle loss with reduced strength and/or performance. Key criteria include low muscle mass, handgrip strength (<28 kg for men, <18 kg for women), and low physical performance (6-meter walk <1.0 m/s, Short Physical Performance Battery ≤9, or 5-time chair stand ≥12 seconds) [9].

- The European Working Group on Sarcopenia in Older People (EWGSOP) and the Asian Working Group for Sarcopenia (AWGS) have recommended handgrip strength (HGS) as a key criterion for diagnosing sarcopenia. HGS is a simple and reliable measure of maximum voluntary muscle strength, making it an important tool for diagnosing sarcopenia. It is widely used as a single indicator to assess overall muscle strength [9,79].
- Boshnjaku and Krasniqi's research highlights challenges in diagnosing sarcopenia due to varying global criteria. The study emphasizes the need for population-specific criteria, as prevalence varies greatly (10% to 86.5%). It advocates using the SARC-F questionnaire for initial screening, followed by muscle strength tests and validation via DEXA or BIA [80].

Diagnosis of Dynapenia:

- Dynapenia was defined by handgrip strength <28 kg for men and <18 kg for women. The study assessed the five-times sit-to-stand test and anthropometric measurements for detecting dynapenia in 529 participants aged 60+. The prevalence was 35.42% in men and 25.61% in women. The study found that a sit-to-stand time ≥14.6 seconds and calf circumference ≤35.2 cm reliably indicated dynapenia in men, while a time ≥11.8 seconds was most accurate for women. The article also considers HGS as a standard, accurate and reliable method of measure of dynapenia against which other measurement methods like sit-to-stand and calf circumference were measured [26].

Diagnosis of Central obesity and body composition:

- A study of 2,050 adults in north India found that WC thresholds of 72 cm for women and 78 cm for men had higher sensitivity and specificity for identifying cardiovascular risk than internationally recommended WC cutoffs (102 cm for men,

88 cm for women) [27]. In a Chinese study of healthy adults, the accuracy of body composition estimates using MRI and DEXA was compared with two commercially available BIA devices (OMRON & Tanita). The researchers concluded that both instruments had a strong connection with DEXA for fat mass percentage [81].

Diagnosis of lower limb malalignment:

- This study on 202 PMWs with knee OA found that those with varus deformity had significantly lower bone mineral density (BMD) and higher rates of osteoporosis than those with normal alignment. The study also identified osteoporosis as an additional risk factor for varus deformity. Significant associations between alignment angles and BMD were observed, highlighting the importance of addressing both osteoporosis and varus deformity in PMWs with Knee OA [82]. The HKA angle, measured on full-length weight-bearing X-rays, is a more accurate and reliable measure of knee malalignment in pre-operative OA patients than the angle between the femur and tibial anatomic axis on anteroposterior weight-bearing X-rays [83]. Long-leg radiographs remain the recommended technique for evaluating lower limb malalignments over CT scans because of their accessibility and reduced radiation exposure [84]. Furthermore, the umbilical method for evaluating frontal plane knee alignment has been proven to be a valid non-radiographic measure with accuracy on par with radiographic methods, especially in obese patients with OA in their knees [85]. The study found a good correlation between the femur-tibia and HKA angles in knee OA patients, with good sensitivity and specificity, suggesting the femur-tibia angle should be considered in future studies [86].
- The study compared physical exams and two radiographic techniques to assess knee alignment in 57 patients with OA. It found that full-limb radiographs closely matched clinical evaluations, but suggested that clinical exams and knee

radiographs could provide valuable insights without the need for full-limb radiographs [87]. Coronal HKA angles are used in older adults to assess how obesity increases knee adduction moment and joint loading, which accelerates knee wear and the onset of OA (OA) [32]. Horsak et al. (2019) studied a 12-week exercise program that improved lower-limb alignment and strengthened hip abductors and knee extensors. While the program showed some improvement in knee and hip kinematics, the effects were less than expected, suggesting limited benefits in altering kinematic patterns[33]. Proprioceptive exercises and weight loss therapies improve lower-limb alignment, foot posture, and knee adduction moment in older adults and those with knee OA, reducing mechanical stress and alleviating OA development risks. These combined approaches help decrease obesity's impact on knee joint loading and lower-limb alignment, reducing OA risk in at-risk populations [34,35].

Stress and QoL assessments:

- A study assessing the Iranian version of the SF-36 in 100 seniors (60+) showed strong internal consistency (Cronbach's alpha > 0.7). It demonstrated good convergent validity with the General Health Questionnaire- 28 and identified gender differences in Health-Related QoL (HRQoL). While reliable, the SF-36's validity was only moderate, particularly in measuring emotional and physical role limits, suggesting the need for further research to improve its applicability for older adults [88]. A study found the sphygmomanometer is a reliable alternative to the Jamar dynamometer for measuring grip strength, with strong correlations (0.85 vs. 0.82). A conversion formula was developed to align sphygmomanometer values with Jamar units, supporting its use in clinical settings [89]. According to a study, the Jamar

dynamometer is a very valid [Intraclass correlation coefficient (ICC) [2, K] = 0.99)] and very trustworthy (ICC [3,1] = 0.98) tool for determining HGS [90].

- The study analyzed the 10-item PSS (PSS) using data from 1,236 individuals. It found a two-factor oblique model best fit the scale, with no gender bias in scores, despite gender differences in one subscale. The study confirms the PSS-10's multidimensionality and validity [91]. The study assessed the psychometric properties of two surveys measuring menopausal stress and coping in 221 Sarawakian women. It found high face validity (ICC = 0.979), good internal consistency (Cronbach's alpha >0.70), and validated the surveys as reliable tools for this demographic [92]. The study evaluated the PSS (PSS) in 509 early postmenopausal Chinese women. It found a two-factor structure, good internal consistency (Cronbach's $\alpha = 0.81$), and strong test-retest reliability (0.86). The PSS demonstrated construct validity and correlated with depression, anxiety, menopausal symptoms, and health behaviors, confirming its reliability for measuring perceived stress in this population [93].
- A study on menopause, perceived stress, and obesity compared premenopausal (18–44) and postmenopausal (45–60) women. It found that 88.8% of PMWs reported stress, while premenopausal stress levels were more evenly distributed. Menopause significantly increased stress ($\chi^2 = 6.67$, $p < 0.01$), but did not significantly affect obesity ($\chi^2 = 1.57$, $p < 0.05$). The study suggests promoting a healthy lifestyle to reduce postmenopausal stress and improve health outcomes[94]. A study of 219 PMWs in Puducherry found 26% reported moderate to high stress. Key stress predictors included fewer children, nuclear family structure, higher education, and alcohol/tobacco use. Age, occupation, and socioeconomic status also influence stress. The study emphasized the role of education, family dynamics, and substance use, recommending further research and stress-reduction strategies [95].

- A study of 300 PMWs found that 43.33% reported a good QoL, 40.67% had low stress, and 45.66% experienced high stress. Stress was negatively correlated with overall and menopause-specific QoL. The study concluded that stress management through diet, exercise, and stress reduction is crucial for improving the QoL in PMWs and recommended holistic therapies for physical and emotional well-being [96]. A study of 190 PMWs found a significant correlation between stress levels and insomnia severity, with those experiencing severe insomnia reporting the highest stress. The results highlight the importance of addressing both sleep and stress to improve the QoL and health of PMWs [97].

Short Form- 36 (SF-36) – QoL Questionnaire:

- A study of 827 adults, including 216 aged 65+, found the SF-36 to have high internal consistency (Cronbach's alpha > 0.8) and strong construct validity, making it suitable for use with elderly adults in interview-based settings [98]. This study of 338 women in rural Turkey found that PMWs reported worse QoL than premenopausal women, with symptoms like hot flushes being the most severe. QoL declined with age in PMWs, emphasizing the need for public healthcare in this group [99]. A study of 105,269 women found that weight loss of 15+ pounds improved physical health-related QoL (HRQoL), while weight gain of 15+ pounds worsened it. Weight changes had a greater effect on physical aspects of HRQoL than on mental well-being[100]. Menopause significantly affects a woman's QoL (QoL), with tools like SF-36 and the Menopause-specific QoL Questionnaire (MENQOL) assessing physical, psychological, and social health. Factors such as age, race, BMI, menopause duration, employment, and education impact QoL, with higher employment and education linked to better outcomes [101].

Managing menopause with exercises:

- Menopause can lead to weight gain and associated "diseases of affluence." Personalized care, including pharmacological, surgical, or nutritional approaches, is essential, with tailored dietary plans recommended for each [102]. Spanish experts developed guidelines highlighting the importance of physical activity in menopause for preventing sarcopenia, and improving muscle mass, strength, flexibility, and balance. Aerobic and strength training reduces metabolic syndrome risks, with HIIT, Pilates, and resistance training recommended for PMWs [103]. A study found that different exercise regimens did not significantly improve bone BMD in PMWs, except for whole-body vibration training, which effectively increased lumbar spine BMD [104].
- A study of 11 trials found that both diet and exercise led to significant weight loss in overweight and obese perimenopausal and PMWs. Combining diet and exercise resulted in greater reductions in fat, lean mass, and weight compared to diet alone [105]. A study of 439 inactive, overweight-to-obese PMWs found that combining a low-fat, calorie-reduced diet and moderate-intensity aerobic exercise (D+E) led to the greatest weight loss (10.8%) and improvements in BMI, WC, and body fat, compared to diet (8.5%) or exercise (2.4%) alone [106]. A review of 52 studies found that exercise alone had little effect on fat-free mass (FFM) or body weight in overweight/obese middle-aged and older adults. Energy restriction (ER) led to significant FFM loss in 81% of participants. Combining ER and exercise resulted in 39% of individuals losing similar amounts of FFM. The study emphasizes combining exercise and energy restriction to preserve muscle mass and prevent sarcopenic obesity in older adults, especially PMWs [107]. Dhillon RJS (2017) emphasizes the importance of combining exercise with ER for effective obesity management. While ER alone reduces weight, exercise helps preserve fat-free mass

and prevents sarcopenic obesity, especially in older adults, highlighting the need for consistent diet and exercise for better health outcomes [108]. Roth SM (2000) highlights that strength training helps counteract sarcopenia in adults over 50, preserving and even increasing muscle mass and strength. It also improves neuromuscular function and stimulates muscle protein synthesis [109]. Research by Yarasheski examines how resistance training boosts muscle protein synthesis, reducing age-related muscle loss and improving strength in the elderly. Despite a reduced anabolic response, regular strength training still leads to significant muscle growth and functional improvements [110]. The study finds that combining resistance training with protein supplements enhances muscle strength, growth, and function in older adults, with those using supplements showing greater improvements than those who did not [111].

Relevant Literature on HIIT:

- This review finds HIIT more effective than moderate-intensity training in improving muscle function and performance in older adults, but more research is needed on its impact on those with sarcopenia or aged 80+ [112]. This study found that CT was more effective than HIIT in improving muscle strength and walking speed in postmenopausal obese women. After 12 weeks, both groups showed reduced body fat, increased lean leg mass, and improved chair stand duration, but only the CT group had significant gains in walking speed (5%) and muscle strength (29%). This study highlights that strength training prevents age-related muscle loss and improves function [113]. A 12-week pilot study found no significant differences in body fat or anthropometric measures between walking and HIIT, though HIIT showed a greater increase in FFM. The study suggests HIIT may benefit FFM, but further research is needed to confirm its effectiveness over traditional exercise [114].

- This study found that high-intensity multimodal exercise (resistance, weight-bearing, balancing, and mobility) significantly improved lumbar spine bone density and muscle performance in PMWs aged 45-70, compared to low-to-moderate intensity exercise [115]. This study found that four weeks of HIIT in postmenopausal obese women led to anti-inflammatory effects, with increased levels of IL-6, IL-10, and IL-1ra, while oxidative stress markers showed minimal changes [116]. This study showed that six weeks of HIIT improved VO2 max and reduced anthropometric measurements in perimenopausal and PMWs. While menopause status influenced heart rate variability and lipid oxidation, age affected VO2 max before the intervention. HIIT helped counteract age and menopause-related health declines [117]. This study found that HIIT, especially combined with resistance training (HIIT+RT), was more effective than moderate-intensity continuous training (MICT) in reducing abdominal fat and increasing muscle mass in overweight or obese PMWs. All exercise groups reduced body weight and fat, but HIIT+RT showed additional benefits in muscle and fat-free mass [118].
- This review highlights HIIT's effectiveness in improving muscle strength, function, and combating sarcopenia in older adults. It enhances muscle hypertrophy, body composition, and cardiorespiratory health, especially when combining aerobic and strength training. However, the authors point out that the current body of research has drawbacks that limit generalizability [119]. This review underscores HIIT's effectiveness in improving muscle strength, function, and combating sarcopenia in older adults, particularly when combining aerobic and strength training. However, the research has limitations, including bias and a limited number of studies [120]. Age-related muscle decline contributes to sarcopenia, frailty, and disability. HIIT, combining intense activity with rest, along with progressive resistance exercise, is

key in preventing muscle degeneration and maintaining function, cardiovascular health, and reducing chronic health risks [121].

• HIIT positively influences stress levels in PMWs through various physiological mechanisms. Research indicates that HIIT can lead to reductions in inflammatory markers which are crucial for managing stress. HIIT has been associated with decreased levels of pro-inflammatory cytokines such as IL-6 after a training period, suggesting an anti-inflammatory effect that may alleviate stress responses [116]. The study provides important insights into the relationship between physical activity and perceived stress during menopause. The study found that participants' perceived stress remained low and stable over five years, with no significant impact from menopause status, which challenges earlier research linking higher stress to peri-menopause. Additionally, higher levels of vigorous physical activity were associated with lower stress, especially in the first two years, while light and moderate activities showed no significant effect on stress. [122]

Relevant Literature on Yoga:

• Machawe's (2017) study shows that five years of regular hatha yoga significantly improved bone density, muscle strength, muscle mass, and gait speed in PMWs, suggesting its potential as an effective long-term intervention for age-related health declines [123]. An 8-week study comparing hatha yoga and an energy-restricted diet showed that yoga, combined with moderate energy restriction, was more effective for weight management. It improved resting metabolic rate, body composition, and metabolic markers like adiponectin and leptin, suggesting yoga as a non-restrictive treatment for obesity and related metabolic issues [124]. A study comparing 15 days of supervised yoga and walking in overweight or obese individuals found both effective for weight management and metabolic health, with similar outcomes in body weight, WC, and lipid profiles. The study highlights yoga as a low-impact

alternative to walking for improving physical and metabolic health, despite slight differences in postural stability and grip strength [125].

- An 8-month Ashtanga yoga intervention improved muscle strength but did not affect vascular health in healthy premenopausal women. The yoga group showed increased leg press strength, but no changes in arterial compliance were observed [126]. A study on "cyclic yoga," which links positions in a continuous flow, showed that it improved muscle mass, strength, and fitness in PMWs. Compared to traditional yoga, cyclic yoga enhanced muscular endurance and flexibility, offering a promising low-impact exercise for combating sarcopenia and preserving muscle health in older women [127]. A study found that regular yoga practice positively affects whole-body protein utilization in older women, improving muscle protein metabolism and potentially preventing sarcopenia. Yoga was also linked to better muscle strength and functional performance, suggesting its benefits for active aging. Further research with larger samples is needed to confirm long-term effects [128]. This study aimed to examine the impact of 20 weeks of Cyclic Yoga exercises on core muscle hypertrophy in adult women. A total of 24 female participants, with at least 3 months of yoga experience, were divided into a yoga group (15 women) and a control group (9 women). Core muscle thickness, including muscles like the rectus, psoas, and obliques, was measured using ultrasound before and after the intervention. The yoga group practiced for 20 weeks, three times a week, while the control group did not exercise. Results showed significant increases in muscle thickness for the rectus, transversus, obliques, psoas, and erector spine muscles in the yoga group compared to the control group. The study concluded that Cyclic Yoga positively affects core muscle hypertrophy[129]. [Ahari SD, Ghazalian F, Gholami M. Effect of 20 weeks of selected Cyclic Yoga style training on core

muscles hypertrophy in adult women. The Quarterly Journal of School of Medicine. 2020; 43(4): 204-210.]

- Balaji PA (2012) reviews the benefits of yoga for health conditions such as obesity, cognition, cardiovascular issues, and diabetes. The study shows yoga improves weight management, cognitive function, and metabolic health. While these positive outcomes are well-documented, the article calls for more research to understand the physiological mechanisms behind these effects [130]. Scientific studies show that yoga improves dexterity, strength, and musculoskeletal coordination. Isometric movements in yoga enhance stability, strength, stamina, flexibility, and endurance. By using the body's weight as resistance, yoga helps prevent age-related bone loss and osteoporosis [131]. A randomized controlled trial found that six months of Hatha yoga significantly improved mood, QoL, fatigue, and cognitive function in seniors (65-85) compared to walking and control groups. Yoga also showed greater cognitive benefits and enhanced physical and mental well-being, making it a valuable intervention for older adults [132]. A nine-day yoga-based lifestyle program significantly reduced oxidative stress, as indicated by a decrease in Thiobarbituric acid reactive substances levels. The study also suggested that yoga may enhance immune resistance, making it a potentially effective short-term intervention for healthy aging, though long-term effects require further investigation [133].
- This review found moderate evidence that yoga relieves pain (especially in OA and neck pain), improves physical function (in OA and sarcopenia), and enhances QoL in restless leg syndrome. While its effects on pain and function are similar to other exercises, the short study durations limit conclusions on long-term quality-of-life benefits. Further research on yoga's qualitative benefits for older adults is recommended [134]. This meta-analysis of six trials with 307 older adults found that yoga moderately improved balance and mobility, though not significantly. It

suggests yoga can help prevent falls but calls for more research on its long-term effects [135]. This study compared the effects of yoga and Pilates on older adults' core strength, balance, and cognition. Yoga improved cognitive function, while Pilates enhanced balance and core strength. Both exercises were equally effective, with yoga promoting mental well-being and Pilates focusing on physical strength and stability [136].

- This study assessed the impact of an 8-week Thai Yoga (TY) program on muscle strength and mobility in overweight and obese older women. The TY group showed significant improvements in knee strength and physical mobility after 4 and 8 weeks, while the control group showed no changes. The TY program effectively enhanced muscle strength and physical function in this population [137]. This study assessed the impact of an 8-week TY program on muscle strength and mobility in overweight and obese older women. The TY group showed significant improvements in knee strength and physical mobility after 4 and 8 weeks, while the control group showed no changes. The TY program effectively enhanced muscle strength and physical function in this population [138]. This review of 22 studies found that yoga significantly improved balance, flexibility, lower limb strength, and health-related QoL in older adults, including reducing depression and enhancing energy, mental health, and sleep. It supports yoga as a beneficial activity for both physical and mental health in older adults [139].
- This randomized trial found that yoga significantly reduced menopausal symptoms, as measured by the Total Menopause Rating Scale, including urogenital, psychosocial, and somato-vegetative symptoms. The yoga group showed greater improvements than the control group, suggesting yoga as an effective alternative therapy for managing menopausal symptoms [140]. This study compared the effects of Hatha yoga and regular physical exercise on perimenopausal women's health. Hatha

yoga significantly reduced fasting blood sugar and glycated hemoglobin, improving glucose regulation, while exercise increased cortisol levels and oxidative stress markers. Both interventions managed perimenopausal symptoms, but yoga was more effective for stress relief and overall health, suggesting its potential for metabolic issue management in this population [141]. This study found that resistance training improved body image, while Hatha yoga reduced fatigue, boosted self-esteem, and improved QoL. Both exercises alleviated depressive symptoms. Combining both could offer comprehensive mental and physical health benefits [142].

- Reddy's study compared brisk walking and yoga in managing hypertension, cholesterol, and blood glucose in hypertensive patients. Both interventions reduced blood pressure and blood glucose, with yoga being more effective for blood pressure and brisk walking better for cholesterol. The study highlights the value of non-pharmacological strategies in hypertension management [143].

Literature on diet and menopause:

The paper "The Importance of Nutrition in Menopause and Perimenopause-A Review" highlights the key role of nutrition during menopause and perimenopause in reducing health risks. It stresses the importance of dietary changes and recommends nutrition counseling by dietitians to help women develop healthier eating habits. The authors suggest that lifestyle factors like diet can lower the risk of conditions such as cardiovascular disease, insulin resistance, type 2 diabetes, and certain cancers during this period. It is advised that saturated fat intake should stay below 10% of total energy, and salt consumption should be limited for better health outcomes [144].

A balanced diet during menopause is vital for preventing nutrient deficiencies, which can increase the risk of chronic diseases and impact overall health. Optimal nutrition, through diet or supplementation, enhances quality of life for postmenopausal women. Additionally, dietary interventions like hypocaloric and Mediterranean diets can help

reduce weight and visceral fat, countering common menopause-related body composition changes. These diets also promote better outcomes by improving body composition, bone health, and reducing cardiovascular risks, with benefits such as lower fat mass, improved cholesterol levels, and reduced blood pressure [145 - 147].

JUSTIFICATION

In HIIT, rest intervals with lower-intensity efforts alternate with times of intensive exercise[41]. Diabetes mellitus[42], obesity blood inflammatory biomarkers[43], dyslipidemia[44], fat loss [148], and cardiometabolic disease[41] can all be effectively managed with HIIT at any age or gender [149]. The authors of a scoping review that looked at HIIT as a possible exercise intervention pointed out that there isn't enough data on HIIT for older people with sarcopenia, emphasizing the necessity for more interventional research in this demographic [112].

Yoga is an effective moderate-intensity exercise strategy for addressing obesity[45], improving lipid markers[46], enhancing muscle strength[48], and managing metabolic syndrome[150]. A literature review revealed a multicity prospective trial on the impact of yoga programs for older Asian and African women with sarcopenia, demonstrating that yoga is an effective preventive approach for improving gait and overall fitness in the elderly [49]. Additionally, the research demonstrates the beneficial effects of yoga on women's health, weight management, falls, osteopenia, and stress. Nevertheless, little is known about how yoga affects other facets of PMW's musculoskeletal health.

In terms of time efficiency, workout intensity, and general structure, yoga and high-intensity interval training (HIIT) are similar. In contrast to HIIT, which consists of brief bursts of intensive exercise followed by recovery periods, yoga incorporates physical postures, focus, and deep breathing and is usually done at a slow to moderate pace [151]. Yoga keeps a steady, moderate tempo, whereas HIIT is vigorous and alternates with active rest. Because it saves time and often yields similar or better results, HIIT is a popular option in today's hectic world. While yoga incorporates both static and dynamic poses, HIIT is primarily a dynamic training style. Because of its

intensity, HIIT requires a lot of motivation, whereas yoga positions can be challenging for certain people. Running, jogging, or rapid walking are examples of HIIT activities, but yoga emphasizes maintaining different postures. While HIIT offers both aerobic and anaerobic adaptations[152], yoga has been demonstrated to primarily offer aerobic benefits with some anaerobic effects as well [153]. Additionally, yoga can be done at a lower to moderate level, whereas high-intensity workouts might not always be suitable for older folks.

For obesity and other patient populations, the effects of HIIT have been compared to other exercise modalities including standard MICT, with both strategies demonstrating comparable efficacy [114]. Similarly, research comparing the effects of yoga and conventional aerobic workouts on mental and physical health outcomes has shown that yoga is either less or more effective than conventional forms of exercise [154,155]. According to a study conducted on male schoolchildren, HIIT outperformed power yoga, Pilates, and HIIT in terms of muscle endurance [156]. Another study found that HIIT and Bikram yoga, or intensive yoga, were equally effective for women with chronic pain in the 20–50 age range [157]. Obesity's impact on lower limb alignment, particularly in older persons, is well-documented [158], with changes in angular alignment potentially leading to arthritis in the future. Instead of depending solely on dynamic frontal plane angles, it would be beneficial to examine the impact of 12 weeks of generalized exercise on knee alignment using gold standard metrics such as the HKA angle on X-rays. This would assist in determining if the remedial effects are restricted to muscle alterations or are substantial enough to prevent OA.

Menopause and aging frequently lead to mental disorders, stress management issues, and problems with QoL. Many people agree that yoga is a good way to reduce stress and elevate mood [159]. HIIT may also improve mental health and QoL because exercise can promote the production of feel-good hormones. As a result, the

experiment will also look at how exercise affects perceived stress and QoL concerning health. The effects of HIIT on musculoskeletal health metrics and physical function in PMWs are yet unknown, even though its advantages in different patient populations are widely established. Less is known about yoga's effects on other facets of PMWs musculoskeletal health, despite its well-established advantages for aging-related health issues like falls, osteopenia, weight management, and stress. Trials comparing the effects of HIIT and Hatha yoga programs on musculoskeletal health and health-related outcomes in this cohort are also lacking. Accordingly, the study postulates that PMWs with central obesity, sarcopenia, dynapenia, and knee alignment may respond differently to HIIT and yoga.

The trial's findings will shed important light on the ideal type and intensity of exercise required to increase physical functional capacity, muscle mass, strength, and obesity-related metrics. The findings will also help determine whether weight loss or exercise prescriptions influence knee malalignment, examining the role of exercise and weight reduction in this context. Any changes in angular alignment will be confirmed using the HKA angle, which remains the gold standard in assessment.

This study's main goal is to compare how 12 weeks of HIIT and Hatha yoga training, along with a standardized diet, affect PMWs with central adiposity, sarcopenia, and dynapenia in terms of body composition, abdominal adiposity, knee joint alignment, muscle strength, functional capacity, perceived stress levels, and health-related QoL.

AIMS AND OBJECTIVES

Aim of the study:

To determine and compare the effects of High-Intensity Interval Training and Hatha Yoga for postmenopausal women with central obesity, sarcopenia, and dynapenia

Objectives of the study:

- ***Primary objective:***

To determine and compare the effects of 12 weeks of HIIT and Hatha yoga training protocols on body composition, abdominal adiposity, knee joint mal-alignment, muscle strength, and functional capacity in postmenopausal women with central adiposity, sarcopenia, and dynapenia.

- ***Secondary objective:***

To determine and compare the effects of HIIT and yoga on the perceived level of stress, and health-related quality of life in postmenopausal women.

RESEARCH QUESTION AND HYPOTHESIS

Research Question:

How do 12 weeks of High-Intensity Interval Training (HIIT) and Hatha Yoga differ in their effects on body composition, abdominal adiposity, knee joint mal-alignment, muscle strength, functional capacity, perceived stress, and health-related quality of life in postmenopausal women with central adiposity, sarcopenia, and dynapenia?

Study Hypothesis:

Null Hypothesis/H0: There will be no difference between the effects of HIIT and Hatha Yoga in postmenopausal women with central adiposity, sarcopenia, and dynapenia.

Alternative Hypothesis/ Ha: Either HIIT or Hatha Yoga will be superior in their effects on postmenopausal women with central adiposity, sarcopenia, and dynapenia.

MATERIAL AND METHODS

CONSORT- 2010 Statement: guidelines have been referred to for better trial reporting.

Trial Registry: The trial was prospectively registered in the clinical trial registry of India with registration number CTRI/2021/12/038878 [Registered on: 23/12/2021] - Trial Registered Prospectively. **(ANNEXURE- I)**

Study Setting & Design: Participants in an open-label, randomized, parallel-group clinical trial were split into two research groups at random. The trial was conducted at Belagavi city's senior care facilities and communal areas. The study was double-blind, meaning that neither the statistical analyst nor the independent assessor knew the group identities, designated as A and B. Code group B was assigned to the yoga group, and group A was the HIIT group.

Ethical Considerations:

Ethical Approval: Under Ph.D. research reference number KAHER/EC/21-22/018 the KAHER Ethical Committee for Human Subjects provided ethical permission for the study. **(ANNEXURE-II)**

Informed Consent: Before taking part in the trial, each subject gave written informed consent. Consent forms and information sheets were provided in both the native language and English. Illiterate participants had the material read to them in their mother tongue, and they were asked to sign a witness signature and provide their thumbprint. **(ANNEXURE-III)**

Confidentiality: The confidentiality of participant information collected during the study was strictly maintained. Group data was anonymized and presented in coded form in scientific publications and presentations. All data was stored electronically with password protection. Efforts were made to ensure participant identities were not

disclosed, including taking measures to conceal their identities in published photographs.

Participant Selection Criteria:

Inclusion Criteria:

Participants were eligible if they met the following criteria:

- Post-menopausal women aged between 46 and 70 years;
- WC of at least 80 cm [27];
- Palmar grip strength of the dominant hand: ≤ 18 kg for women aged 60-70 years and ≤ 23 kg for women aged 46-60 years [160];
- 4-meter gait speed of less than 0.8 m/s [9];
- Not currently engaged in regular physical exercise (defined as at least 3 days per week) such as yoga, aerobic exercise, or gym activities in the past 3 months;
- Willingness to adhere to the prescribed diet and exercise regimen for 3 months.

Exclusion criteria:

Participants were excluded if they had/were:

- Uncontrolled diabetes mellitus & hypertension according to their blood report or physician's report in the last 3 months;
- K/C/O or with a history of cardiovascular/pulmonary/neurological diseases or surgeries;
- Diagnosed cases of severe osteoporosis, arthritis or spondyloarthropathies, physical disabilities, or any condition that may affect joint mobility and performing exercises;
- Cancer survivors or known cases of cancer;
- Currently undergoing any weight loss programs or taking medications that impact body fat (e.g., steroids, hormonal therapy);

- Have experienced any fractures, dislocations, or surgeries involving the abdomen, lower limbs, or spine within the past 2 years;
- Have any medical, surgical, or neurological conditions that would prevent participation in exercise.
- Any contraindications to BIA like hearing aids, pacemakers, metal implants, kidney disorders, dialysis, diarrhea, etc.;
- Inability to comprehend commands.

Sample recruitment and randomization methods: Flyers, leaflets, ads in local newspapers, and community-level screening camps were used to entice participants to take part in the study. Eligibility screening and comprehensive study details were given to those who showed interest. Consenting eligible participants were randomized to either the yoga or HIIT group. Because the intervention was conducted as group therapy, participants were divided into several groups of ten to twelve people according to where they lived in the city. Using a computer-generated random number table and block randomization with a 1:1 ratio, each group was assigned at random to either the HIIT or Yoga group.

Sample Size Calculation: Based on information from a prior study that used WC as an outcome metric, the necessary sample size was established [37,42]. S1 = 9.8 for yoga and S2 = 4.6 for HIIT were the standard deviations, and the expected mean difference (x1 - x2) was taken to be 3.6 = d. The sample size was determined using the following formula with these values:

$n = 2S^2 (Z\ 1\text{-}\alpha + Z\ 1\text{-}\beta)^2 / (x1\text{-}x2)^2$, where S= S1+S2/2=7.1, Z 1-α= 1.96 at 5% α error, Z 1-β = 1.037 at 85% power, d = x1-x2=3.65. Based on this calculation, the sample size was determined to be 68 participants per group. To account for a 20% dropout

rate (using the formula n/1-d, where d is the dropout percentage), the adjusted total sample size for each group was 80 participants [161].

Participants: Of the 393 PMWs who were screened for eligibility, 232 were excluded due to various reasons cited in the exclusion criteria. Finally, 161 women who met the criteria of inclusion in the study were allocated to either the HIIT group or the Yoga group by 1:1 block randomization by computer-generated random number table, with 81 women in the HIIT group and 80 women in the yoga group. At T1 follow-up (post 4th week), 9 were lost to follow-up from the HIIT group while 6 were lost from the yoga group. At the T2 follow-up timeline (post 8th week), 3 dropped out from HIIT and 9 from yoga groups. At the T3 timeline (post-12th week), there were no losses to follow up with 69 women completing the 12-week protocol from the HIIT group, and 65 women completing the Yoga group **(ANNEXURE IV- Figure 1)**.

Dropout Criteria:

- If participants missed more than 12 sessions (20%) of the total 60 exercise sessions.
- If participants missed two or more of the three scheduled follow-up evaluations/assessments.
- If, during the research period, a participant had a medical emergency or their pre-existing comorbid conditions deteriorated;
- If, for personal or medical reasons, participants decided not to continue the exercise program.

Criteria for protocol modifications/discontinuation: Only in the event of a negative outcome or if there were practical difficulties during the trial was the study protocol changed or stopped. Any changes were immediately submitted to the Research Ethics Committee, and their approval was requested.

Procedure for Study Interventions: The study used the Consensus on Exercise Reporting Template (CERT) and the Template for Intervention Description and Replication (TIDieR) guidelines/checklists to guarantee high-quality reporting of the interventions [162,163].

After being randomly assigned to one of the two study groups, participants were asked to attend a two-hour counseling and orientation workshop where they received information on how to prepare for the exercise sessions and what they would need, such as clothing, shoes, and mats.

HIIT Group: The HIIT sessions were led by a qualified physiotherapist. Over 12 weeks, participants attended 3 supervised HIIT sessions per week. The program consisted of spot jogging or running for 30 seconds at 70-90% intensity, followed by 120 seconds of low-intensity active recovery (walking). The exercise intensity was personalized, based on the individual's maximum heart rate (calculated as 208 minus age multiplied by a percentage) [42,44].

Progression: The protocol was uniform for all the participants. All participants started with 70% MHR in the first four weeks and progressed to 80% MHR in the second 4-8 weeks followed by 90 % MHR in the subsequent 8 to 12 weeks respectively. The progression was done every 4 weeks in terms of an increase in active and recovery exercise time and the number of exercise bouts.

The specific protocol and progression details are outlined in **Table 1 (ANNEXURE V)**. **(ANNEXURE IV - Figure 2: a &b)**

Yoga Group: The yoga sessions were led by a licensed yoga trainer. Warm-up exercises, two to three yoga positions (repeated two to three times, increasing from simple to difficult postures), Sun Salutation (6 to 20 repetitions), pranayama (breathing exercises), and a cool-down (Savasana) were all part of the one-hour

session [49]. Over 12 weeks, three supervised yoga sessions were held each week. **Table 2 (ANNEXURE V)** provides the yoga group with a detailed exercise regimen and progression. The progression in the yoga group was done every 4 weeks in terms of the complexity of asanas and the number of suryanamaskaras performed during the session. **(ANNEXURE IV - Figure 3:a-d)**

Diet: A certified nutritionist developed the diet program, which was provided to participants in both English and regional languages. The diet plan was high in protein, low in fat and carbohydrates, and included portion sizes and a meal schedule. Each participant's pre-intervention diet was recorded, and their total calorie intake was calculated. A deficit of 600 calories per day was prescribed, tailored to the individual. Participants also received a list of permitted and prohibited foods. **(ANNEXURE-VI)**

Concomitant Care: Both interventions began with a warm-up and ended with a cool-down period. On non-intervention days, participants were instructed to engage in brisk walking (30-40 minutes) as per their capacity. The interventions were conducted in a large exercise hall, with a detailed schedule for HIIT and yoga sessions provided in **Tables 1 & 2 (ANNEXURE – V)**. Participants were instructed not to start any new medications, exercise regimens, or weight loss diets during the study period.

Adherence to Interventions: A comprehensive log diary was given to each participant to track daily adherence to the exercise and diet protocols. This diary was reviewed every two weeks, and feedback was provided if any adjustments were necessary. To further support adherence, the investigator sent reminder messages **(ANNEXURE-VI).**

Safety Monitoring: Prior to taking part in the study, each participant had to get their family doctor's approval. Joint inflammation, edema, injuries, dizziness, and chest pain during workouts were among the expected side effects. The subject would be

taken out of the study and sent for additional medical care if any such incidents were reported to the Ethical Review Committee.

Data Collection Procedures: Outcome assessments were conducted by a qualified physiotherapist who was blinded to the group assignments. The same assessor performed all measurements and assessments at each time point. Demographic information, including age, diet, comorbidities, and age of menopause, was also recorded. **(ANNEXURE-VII)**

Primary Outcomes:

Central Obesity (WC): WC was measured in centimeters using a non-stretchable fiber tape with participants standing. The measurement was taken at 1 cm above the umbilicus during full exhalation to ensure consistency. The measurement was rounded to the nearest centimeter [59,164]. WC was measured at the following time points: pre-intervention (T0), and at the end of 4 weeks (T1), 8 weeks (T2), and 12 weeks (T3) post-intervention.

Secondary Outcomes:

Assessment of body composition parameters [Bioelectric Impedance Analyzer (BIA)]: Body composition parameters were measured using a Bioelectric Impedance Analyzer machine [Actofit Body Analyzer -Promax (Actofit Wearables, China)]. The participants were instructed to maintain at least 10 hours of fasting on the previous night of assessment [25]. The potential contraindications for using BIA, which could affect the accuracy of the readings, were assessed (refer to exclusion criteria). The BIA machine is connected to the mobile of the assessor through Bluetooth with a software application downloaded from the Google Play Store (https://play.google.com/store/apps/details?id=com.actofitSmartScale&hl=en_IN&gl=US). After entering basic demographic details like name, age, and height, the

participants were made to stand barefoot on the machine. **(ANNEXURE – IV; Figure 4)**

Body composition parameters: The machine analyzes several body composition parameters, including fat mass, lean body mass, skeletal muscle mass in the arms and legs, and body fat percentage. The results were generated in a PDF format, saved on the assessor's mobile device, and uploaded to the electronic database. These outcome measures were assessed at baseline (T0) and after 12 weeks (T3) of the intervention.

Body Weight: The body weight of the female measured by the BIA machine which was noted by the assessor in the units of kgs. The participant was instructed to maintain at least 10 hours of fasting on the previous night of assessment. This too was measured at preintervention (T0), end of 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention. The same machine was used for all timeline measurements so as not to compromise reliability.

Body Mass Index (BMI): The BMI was calculated by the BIA machine based on the height of the participant entered into the machine which was noted by the assessor. This too was measured at preintervention (T0), end of 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention and noted in units of kg/m^2.

Height/Stature measurement: The height of the participant was measured with shoes off using a stadiometer fixed to the wall following all the standard requirements of height measurements and noted in the units of meters. The height was noted to calculate BMI and to enter into the BIA machine to measure body composition parameters. This measure was taken only once at the beginning of the study. The same value was entered for all subsequent measures of body composition and BMI.

Hip Circumference: This was measured with the participant standing straight with feet together. The tape was wrapped around the widest part of the hips and buttocks

ensuring the tape was level all the way around and not too tight or too loose. The value was recorded in units of cms [164].

Criteria for diagnosing Sarcopenia: Sarcopenia was diagnosed using the AWGS criteria, which include: a low Appendicular Skeletal Muscle Index (ASMI) (≤ 5.7 kg/m² for females) measured by BIA; reduced muscle mass combined with decreased muscle strength (≤ 18 kg for females); or impaired physical performance, indicated by a 6-meter or 4-meter walk test with speeds < 1.0 m/s and < 0.8 m/s, respectively.

The ASMI was calculated using the formula [9]:

ASMI (kgs/m2) = (lean body mass of arms +lean body mass of legs (kgs)) / (height^2 (m^2)) The values of lean body mass of arms and legs were taken from the BIA analyzer for calculation.

Gait Speed: Gait Speed was assessed using the 4-meter walk test, as recommended by AWGS 2019, to measure physical performance[9]. To make sure there were no obstacles in the way, a 4-meter walking path was designated with black adhesive tape or red cones and a carpenter's measuring tape. From the beginning to the conclusion, participants were instructed to walk at their normal pace. A stopwatch was used to monitor how long it took them to cover the 4 meters. By dividing the distance (4 meters) by the time (in seconds), the speed was determined. Performance impairment was defined as a gait speed of less than 0.8 m/s [165]. For analysis, the better outcome from the two trials was utilized. Pre-intervention (T0) and the end of the fourth (T1), eighth (T2), and twelfth (T3) weeks after the intervention were measured. **(ANNEXURE – IV; Figure 5)**

HGS (HGS) to measure sarcopenia and dynapenia: A measure of HGS (HGS) was employed to evaluate dynapenia and sarcopenia. The measurement was performed using a Jamar hand dynamometer (Model no. 0205010), manufactured by Sammons

Preston Rolyan, UK; reliability [3,1] = 0.98 and validity [ICC (2, K) = 0.99]. HGS was assessed on the dominant hand only. Participants were seated on a chair with an upright back (no armrests) and their feet flat on the floor. The dominant side was positioned with the wrist in 25–30° dorsiflexion, the forearm in mid-prone, the elbow bent at a 90-degree angle, and the shoulder adducted. Participants were instructed to exert maximum isometric force by pressing the dynamometer's handle. The better of two readings, with a one-minute rest period between trials to minimize fatigue, was used for analysis [9]. Measurements were taken at baseline (T0) and again at the end of the 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention. **(ANNEXURE – IV; Figure 6)**

Lower limb alignment by HKA angle: The angle created between the femur and tibia's mechanical axes, as determined by a full-length radiograph of the lower limb, is known as the HKA angle. It is thought to be the most precise way to evaluate mechanical alignment. The X-ray measurements were taken by a certified radiology technician. Participants had their lower limbs radiographed while wearing no shoes and with their patella and tibial tubercles pointing forward. A 51×14-inch graduated grid cassette was used to take a single anteroposterior radiograph. Using specialized application software, two separate images were combined into one continuous film from the pelvis to both feet. The HKA angle was marked by the principal assessor, trained in angle marking by a certified radiologist, to ensure consistency and reliability [30]. The HKA angle was recorded for both legs at baseline (T0) and at 12 weeks (T3) post-intervention. **(ANNEXURE – IV; Figure 7 a & b)**

The methods described in the reference article were used to calculate the HKA angle. From the center of the femoral head to the center of the femoral intercondylar point, the femoral mechanical axis (FM) was calculated. From the tibial interspinous point

to the midpoint of the tibial plafond, the tibial mechanical axis (TM) was measured. The HKA angle is the angle formed by the junction of the extended FM and TM lines [30]. This angle was measured using software analysis. In cases of neutral knee alignment, the HKA angle typically measures around 180°, with a possible variation of ±1–1.5° for valgus or varus. In healthy individuals, the HKA angle can range from 1° valgus to 3.2° varus [166].

Patient-reported functional outcomes: These outcomes were evaluated both at preintervention (T0) and 12 weeks after the intervention (T3). Written questionnaires were given to the participants in their native tongue. Illiterate participants had their surveys read to them and filled out appropriately. The two surveys below were translated and back-translated into regional languages for participants who were not fluent in English.

Short Form 36 Health Survey (SF-36): A popular, valid, and trustworthy instrument for evaluating Health-Related QoL (HRQOL) in both adult and senior populations is the SF-36. Scores on this 36-item survey, which ranges from 0 to 100, assess eight facets of health. A mean score of 50 is regarded as the normative value, and higher scores indicate greater health [98]. **(ANNEXURE-VII)**

Perceived Stress Scale (PSS): An accepted method for determining a person's degree of stress is the PSS. Participants answer a self-administered questionnaire on their emotions during the previous month. The PSS has a score range of 0 to 40, where larger numbers correspond to higher levels of perceived stress [49]. **(ANNEXURE-VII)**

DATA ANALYSIS:

Data entry and management: The data was fed and tabulated manually on an Excel spreadsheet, ensuring anonymization. The fed data was verified twice for any errors in entry or duplicate data. The errors found were rectified and given for analysis by the

blinded statistician. To maintain blinding for the statistician, the intervention groups were labelled as Group A and Group B. Group A was assigned to the HIIT group, while Group B represented the yoga group. Participant data was kept confidential and was only shared in a deidentified or coded form.

Statistical methods: Version 28.0 of the Statistical Package for Social Sciences (SPSS) software (SPSS, Inc., Chicago, IL, USA) was used to analyze the data. The gathered data was analyzed using both descriptive and inferential statistical methods.

Descriptive statistics: Descriptive data including categorical and discrete variables were analyzed for distribution in terms of frequency and percentage based on ranks/categories of division. The demographic data of continuous variables at baseline were compared between study groups by the Mann-Whitney U test. The quantitative variables were presented in mean and standard deviation.

Inferential statistics: Skewness and Kurtosis Z values, as well as the Shapiro-Wilk test, were used to assess the normality of the distribution and showed that, with 95% confidence, the data did not follow a normal distribution. Either parametric (t or Z test and/or ANOVA) or non-parametric (Mann-Whitney U test or the Wilcoxon signed-rank test) tests were used, depending on the normality distribution results. Non-parametric tests were performed to evaluate the data because the majority of the data did not follow a normal distribution. The data from two distinct timelines were compared using pairwise comparisons.

Additionally, the mean and standard deviation (SD) variations with the parameters' effect sizes were examined. According to the reference, the effect sizes were classified as minor, medium, and large [167]. Furthermore, a two-way mixed approach was used to analyze the interaction between group and time on all outcome variables to compare the impact of the intervention on the experimental and control

groups. Split-plot ANOVA and Repeated Measures Analysis of Variance (ANOVA) [168].

The primary effect analysis was by the intention-to-treat principle. However, considering the criteria of dropout or loss to follow-up mentioned in the methodology, this was not applied to the data since there were no dropouts who did not meet the criteria of loss to follow-up.

A p-value below 0.05 was regarded as statistically significant.

Summary table of statistical tests:

Variable	**Statistical tests applied**
Data entry & Management	Manually on Excel spreadsheet
Data Analysis	SPSS version 28.0
Normality Distribution	Shapiro Wilk test
Descriptive statistics	Distribution and Frequencies
Inferential Statistics	Non-parametric tests
Within-group differences	Wilcox signed-rank test
Between-group differences	Mann Whitney U test
Between the two timelines	Pairwise- comparisons
Additional analyses: Between-group difference	Mean % differences and Effect sizes
Time * Group interactions	Repeated measures ANOVA

RESULTS

The study intended to compare the 12-week protocol of HIIT exercise with Hatha Yoga for post-menopausal women on various musculoskeletal issues, perceived stress, and QoL. At the end of 12 weeks, 69 women and 65 women completed the protocol in HIIT and Yoga groups respectively whose data were considered for further statistical analysis and drawing of inferences and conclusions. There were no adverse events like falls, injuries, or traumas that occurred during the study course. However, one female participant who was morbidly obese in the HIIT group complained of pain in her bilateral knees at week 3 of the protocol after which she discontinued. The lady dropped out from the study following which standard physiotherapy care was given to her along with rest after which she recovered from pain. She was further advised to avoid weight-bearing exercises. However, there was no such event in the yoga group. **ANNEXURE V** provides the tabular representation and **ANNEXURE VIII** provides the graphical representations and details of the data and its analyses respectively.

Descriptive statistical analysis for demographic characteristics of the participants:

Table 6 (a-h) & Graphs 1 (a-g) present the data distribution and analysis for categorical and discrete variables such as occupation, marital status, diet, education level, and hand dominance.

Occupation: Based on occupation, of 69 participants in the HIIT group, 14 (20.2%) were working women as opposed to the yoga group which had 43 (66.2%) among 65 participating individuals. There were 55 (79.8%) homemakers in HIIT group and 22 (33.8 %) in yoga group **(Table 6a).**

Inference: There were more working women in the yoga group while there were more homemakers in the HIIT group.

Marital Status: Both groups had a similar distribution of married women with 65 (94.2) of 69 total participants in the HIIT group and 62 (95.4) of 65 total women in the yoga group. Further, there were 3 widows in each group and 1 divorcee/single woman in the HIIT group against 0 in the yoga group **(Table 6b)**.

Inference: Similar distribution of females based on marital status in both study groups.

Level of education: In the HIIT group, among 69 (100%) women who participated, the distribution of education was 3 (4.3) at the primary level, 32 (46.3) at the secondary level, and 34 (49.4) at the graduate level with none being illiterate. With regards to the Yoga group, there were none (n=0) with education at the primary level, 17 (26.2) educated at the secondary level, 47 (72.3) educated at the graduate level, and 1 (1.5) who were illiterate **(Table 6c)**.

Inference: More than 90% of women were educated to secondary and graduate levels in both study groups.

Diet type: There were 16 (23.2%) and 27 (41.5%) women who followed mixed diet type and 53 (76.8%) and 38 (58.5%) women were pure vegetarians respectively in the HIIT group and Yoga group **(Table 6d)**.

Inference: Predominantly there were vegetarians in the HIIT group while the yoga group had more mixed veg diet female participants.

Hand Dominance: Based on hand dominance, 66 (95.7) of 69 were right-dominant in the HIIT group while 64 (98.5) of 65 total were right-hand dominant in the Yoga group with the remaining being left-hand dominant **(Table 6e)**.

Inference: More than 95% of women were right-hand dominant in both study groups.

Cause of Menopause: Of the 69 total women in the HIIT group, 51 (73.9%) attained menopause by natural cause while 18 (26.5%) attained it surgically by hysterectomy. In the Yoga group, of the 65 women who participated, 51 (78.5) attained menopause naturally and 14 (21.5) surgically **(Table 6f)**.

Inference: In both study groups, the natural cause of menopause was three times more predominant than a surgical cause.

Presence of Comorbidities: In the HIIT group, 27 (39.1) women had some form of comorbid medical condition while the remaining 42 (60.9) had none. In the yoga group, of the total 65 women participants, 25 (38.5) had comorbid conditions present while the remaining 40 (61.5%) had no comorbid conditions cooccurring **(Table 6g)**.

Of all the individuals who presented with comorbidities, hypertension, and diabetes mellitus were predominant ones in both groups followed by thyroid condition and asthma **(Table 6h)**.

Inference: There was a nearly equal distribution of participants with coexisting comorbidities in both study groups. Around 40% of females in both groups had some comorbidity. All were on medications and the levels were under control.

Analysis of baseline characteristics for continuous variables:

Table 7 (a-c) & Graphs 2 (a-c) depict the data and analysis for continuous variables such as age (years) of participants, age (years) of attaining menopause, and height (meters), along with their baseline weight (kilograms), and BMI (kilograms per meter square) describing the baseline characteristics of the study subjects in the study groups.

The mean and standard deviation (SD) for age was 57.21±5.35 in the HIIT group and 56.32±4.98 in the yoga group with $P < 0.554$ indicating no statistical significance **(Table 7a)**.

In terms of age of menopause attained by the women participants, the mean and SD were 48.76±3.49 and 48.38±2.24 for HIIT and yoga groups respectively with a statistically insignificant p-value of 0.224 **(Table 7b)**.

The height of the participants in the HIIT group was 1.56±0.06 and 1.55±0.05 in the yoga group with a P value of 0.633 which was statistically insignificant **(Table 7c)**.

Inference: With regards to, the age of participants, age of menopause, height as well as baseline values of body weight and BMI of the participants matched between both study groups.

Inferential Statistical Analysis of Data:

Intragroup analysis for HIIT group (Graphs 3a-d):

The median values were compared using the non-parametric Friedman test because the data was not normally distributed. The non-parametric Wilcoxon signed-rank test was used to compare the two medians in pairwise comparisons between two-time points.

Pre-post comparison of obesity parameters (Graph 3a):

Body Weight (kilograms): As the data was not normally distributed, the nonparametric test Friedman test was applied to compare all 4 median values. The means and SD values for body weight were 68.57±10.81, 68.12±10.72, 67.64±10.69 and 67.23±10.67 at pre-, post-4, post 8, and post-12-week timelines respectively. The chi-square value for the median body weights and IQR for 4 timelines was 203.19 with the P value being statistically significant at <0.001 **(Table 8a)**.

The medians of all four timelines showed a statistically significant difference (p-value <0.001) for pairwise comparisons between two-time points. **[Table 8a(i)]**.

Inference: The median value at pre-intervention was 68 which reduced to 66.4 at post-12 weeks with a median difference of 1.6kgs. For the HIIT group, body weight significantly decreased at every assessment timeline. This indicates HIIT helped women participants to reduce body weight.

BMI (kilograms per meter square): This parameter was assessed at pre and post-12 weeks. The pre-BMI value was 28.21±3.99 at pre-intervention which significantly reduced to 27.65±3.87 at post-intervention 12 weeks with a p-value of less than 0.001 **(Table 8b)**.

Inference: The BMI significantly decreased with HIIT intervention at 12 weeks indicating with HIIT intervention the BMI significantly reduced in females.

WC (centimeters): The parameter did not meet normality distribution; hence Friedman test was applied to compare all 4 median values. The mean and SD values were 96.01±6.89, 93.46±6.29, 91.25±6.26, and 89.16±6.11 from pre-, post-4, post-8, and post-12 weeks respectively with a p-value of <0.001 being statistically significant **(Table 8c)**. The pair-wise comparison between every two timelines also was significant statistically with a p-value of less than 0.001 **[Table 8c (i)]**.

Inference: The median value at pre-intervention was 95 which reduced to 89 at post-12 weeks with a median difference of 6 cms. For the HIIT group, WC significantly decreased indicating HIIT helped women participants to reduce abdominal obesity.

Hip Circumference (centimeters): The pre-hip circumference value was 107.35±8.14 at pre-intervention which significantly reduced to 102.49±7.64 at post-intervention 12 weeks with a p-value of less than 0.001 **(Table 8d)**.

Inference: The hip circumference significantly decreased by the median value of 5 centimeters with HIIT intervention at 12 weeks.

Pre-post comparison of sarcopenic and dynapenia parameters (Graph 3b):

HGS (kgs): The HGS was assessed across 4 timelines. The mean and SD values increased from pre-, post-4 weeks, post 8weeks to 12 weeks from 15.79±2.55, 17.41±2.73, 18.77±2.76, and 20.65±2.79 respectively with p-value <0.001 **(Table 9a)**. The pairwise comparison between every two timelines for HGS also was significant with a p-value of less than 0.001 **[Table 9a(i)]**.

Inference: The median value at pre-intervention was 16 which increased to 21 at post-12 weeks with a median difference of 5kgs of HGS. For the HIIT group, HGS significantly increased indicating HIIT helped women participants to improve muscle strength.

Gait Speed (meters per second): The mean and SD values for the gait speed parameter increased significantly at 12 weeks with a p-value of less than 0.001. The mean and SD values were 0.82±0.082, 0.89±0.08, 0.95±0.094, and 1.02±0.13 for pre-, post4weeks, post 8weeks and post-12 weeks respectively **(Table 9b).** The comparison between every two timelines also showed a significant increase in the gait speed statistically with a p-value of less than 0.001. The median value for gait speed was 0.81m/s at pre which increased to 1.0m/s at post-12 weeks **[Table 9b(i)]**.

Inference: The gait speed increased with HIIT intervention indicating better physical function capacity of participating post-menopausal women.

Appendicular Skeletal Muscle Index (kilograms per meter square): The ASMI was assessed twice at pre- and post-12 weeks of intervention with the mean and SD values of 5.3±0.36 and 5.35±0.47 respectively. The difference was not significant statistically with a p-value of 0.212 **(Table 9c)**.

Inference: The ASMI did not increase significantly with HIIT intervention given for 12 weeks.

Pre-post comparison of Body composition parameters (Graph 3c):

Body fat % and Body fat mass (kgs): The mean and SD value for body fat % at pre-intervention was 39.59±5.69 and at post-intervention, 12 weeks was 38.54±5.39. Similarly, the mean and SD values for body fat mass were 27.56±8.26 and 26.42±7.88 at pre- and post-12 weeks intervention timelines respectively. The decrease in the % and fat mass were significant with a p-value of <0.001 **(Table 10).**

S***keletal Muscle mass and lean body mass (kgs):*** The mean and SD values for SMM were 28.81±6.45 and 30.35±6.99 at pre-intervention and post-intervention 12 weeks respectively with a statistically significant increase at p-value less than 0.001. The pre-and post-12 weeks mean and SD values for LBM were 38.64±3.71, and 39.01±4.04 respectively. There was a statistically significant increase in LBM with a p-value of 0.035 **(Table 10)**.

Inference: The HIIT intervention had a positive impact on body composition, showing a reduction in body fat percentage and an increase in skeletal muscle mass.

Pre-post comparison of HKA angle (degrees): The HKA angle measured on the X-ray showed a significant increase in the angle on both the right and left sides statistically with p-values of less than 0.001. The mean and SD values on the right side were 176.58±1.5 and 177.39±1.45 at pre- and post-12 weeks respectively. Similarly, for the left side, the HKA angle mean and SD values were 176.59±1.62 pre- and 177.33±1.62 post-intervention **(Table 11); (Graph 3d); (Figures 8 a & b)**.

Inference: The HKA angle increased bilaterally indicating better alignments in both lower limbs.

Pre-post comparison of PSS score: The perceived stress score was 20.5±4.81 at pre-intervention and 16.04±4.29 at 12 weeks post-intervention with a p-value of less than 0.001 indicating a significant difference statistically **(Table 12 & (Graph 3e).**

Inference: The stress levels were significantly reduced over 12 weeks with HIIT intervention in PMWs.

Pre-post comparison of domains of Health-related QoL SF-36 questionnaire: All 8 domains of QoL by short-form 36 improved significantly from pre- to post-12 weeks with p-value <0.001 with HIIT **(Table 13) & (Graph 3f)**.

Intragroup analysis for the Yoga group (Graphs 4a-d):

Pre-post comparison of obesity parameters: The median values were compared using the non-parametric Friedman test because the data was not normally distributed. The medians were compared using the Wilcoxon signed-rank test for pairwise comparisons between two time points **(Graph 4a)**.

Body Weight (kilograms): The means and SD values for body weight were 70.38±10.09, 69.79±9.98, 69.24±9.86, and 68.93±9.84at pre-, post-4, post-8, and post-12-week timelines respectively with the P-value being statistically significant at <0.001 **(Table 14a)**.

For pair-wise comparisons for values between two timelines, there was a significant difference between the two medians of all 4 timelines with a p-value of less than 0.001 **[Table 14a(i)]**.

Inference: For the Yoga group, body weight significantly decreased at every assessment timeline. This indicates Yoga helped women participants to reduce body weight.

BMI (kilograms per meter square): This parameter was assessed at pre and post-12 weeks. The pre-BMI value was 29.09±4.32 at pre-intervention which significantly reduced to 28.49±4.19 at post-intervention 12 weeks with a p-value of less than 0.001 **(Table14b)**.

Inference: The BMI significantly decreased with Yoga intervention at 12 weeks indicating with Yoga the BMI significantly reduced in post-menopausal females.

Waist Circumference (centimeters): The mean and SD values were 96.32±6.96, 93.75±6.91, 91.78±6.92, and 89.72±7.08 from pre-, post-4, post-8, and post-12 weeks respectively with a p-value of <0.001 being statistically significant **(Table 14c)**. The pair-wise comparison between every two timelines also was statistically significant with a p-value <0.001 **[Table 14c (i)]**.

Inference: The median value at pre-intervention was 95 which reduced to 89 at post-12 weeks with a median difference of 6 cms. For the Yoga group, WC significantly decreased indicating Yoga helped women participants to reduce abdominal obesity.

Hip Circumference (centimeters): The pre-hip circumference value was 108.88±7.71 at pre-intervention which significantly reduced to 104.68±7.55 at post-intervention 12 weeks with a p-value of less than 0.001 **(Table 14d)**.

Inference: The hip circumference significantly decreased by the median value of 3 centimeters with Yoga intervention at 12 weeks.

Pre-post comparison of sarcopenic and dynapenia parameters (Graph 4b):

HGS (kgs): The HGS was assessed across 4 timelines. The mean and SD values increased from pre-, post-4 weeks, post 8weeks to 12 weeks from 16.8±1.52, 18.85±1.98, 20.43±2.19, and 21.85±2.22 respectively with p-value <0.001 **(Table 15a)**. The pairwise comparison between every two timelines for HGS also was significant with a p-value of less than 0.001 **[Table 15a(i)]**.

Inference: For the Yoga group, HGS significantly increased indicating Yoga helped women participants to improve muscle strength.

Gait Speed (meters per second): The mean and SD values for the gait speed parameter increased significantly over 12 weeks with a p-value of less than 0.001.

The mean and SD values were 0.81±0.084, 0.89±0.081, 0.96±0.083, and 1.06±0.099 for pre-, post4weeks, post 8weeks and post-12 weeks respectively **(Table 15b).** The comparison between every two timelines also showed a statistically significant improvement in the gait speed with a p-value of less than 0.001. The median value for gait speed was 0.81m/s at pre which increased to 1.05m/s at post-12 weeks **[Table 15b(i)]**.

Inference: The gait speed increased with Yoga intervention indicating better physical function capacity of participating post-menopausal women.

Appendicular Skeletal Muscle Index (kilograms per meter square): The ASMI was assessed twice at pre and post-12 weeks with the mean and SD values of 5.38±0.42 and 5.45±0.46 respectively. The difference was significant statistically with a p-value equal to 0.003 **(Table 15c)**.

Inference: The ASMI increased significantly with the Yoga intervention given for 12 weeks.

Pre-post comparison of Body composition parameters (Graph 4c):

Body fat % and Body fat mass (kgs): The mean and SD value for body fat % at pre-intervention was 40.31±6.02and at post-intervention, 12 weeks was 39.07±5.95. Similarly, the mean and SD values for body fat mass were 28.76±8.08 and 27.53±7.72 at pre and post-12 weeks intervention timelines respectively. The decrease in the % and fat mass were significant with a p-value of less than 0.001 **(Table 16).**

S***keletal Muscle mass and lean body mass (kgs):*** The mean and SD values for SMM were 28.22±5.93 and 29.85±5.77 at pre-intervention and post-intervention 12 weeks respectively with a significant increase in p-value of less than 0.001. The pre and post-12 weeks mean and SD values for LBM were 39.14±3.67 and 39.57±3.82

respectively. There was a statistically significant increase in LBM with a p-value of <0.001**(Table 16)**.

Inference: There was a positive outcome of Yoga intervention on body composition parameters indicating the fat % reduced and skeletal mass increased.

Pre-post comparison of HKA angle (degrees) (Graph 4d): The HKA angle measured on the X-ray showed a significant increase in the angle statistically bilaterally with p-values <0.001. The mean and SD values on the right side were 176.74±1.65 and 177.62±1.34 at pre and post-12 weeks respectively. Similarly, for the left side, the HKA angle mean and SD values were 176.62±1.72 and 177.49±1.38 post-intervention **(Table 17) (Figures 9 a & b)**.

Inference: The HKA angle increased bilaterally indicating better alignments with Yoga in both lower limbs.

Pre-post comparison of PSS score (Graph 4e): The perceived stress score was 19.46±4.82 at pre-intervention and 13.58±4.86 at 12 weeks post-intervention with a p-value of less than 0.001 indicating a significant difference statistically **(Table 18).**

Inference: The stress levels were significantly reduced over 12 weeks with Yoga intervention in PMWs.

Pre-post comparison of domains of Health-related QoL SF-36 questionnaire: All 8 domains of QoL by short-form 36 improved significantly from pre- to post-12 weeks with p-value <0.001 with Yoga **(Table 19) & (Graph 4f)**.

Inference: All the domains of SF-36 significantly improved over 12 weeks with Yoga intervention in PMWs.

Intergroup analysis between HIIT and Yoga groups:

Obesity Parameters: All four parameters for obesity including body weight, BMI, WC, and hip circumference were statistically not significant at all timelines assessed

with p > 0.05 **(Table 20) [Graph 5 (a-d)]**. The p-values for body weight at pre-, post-4, post-8, and post-12 were 0.185, 0.229, 0.261, and 0.249 respectively. The p values for BMI were 0.125 at pre- and 0.124 at post-12 weeks. The WC variable had a p-value of 0.75 at pre-, 0.901 at post-4, 0.655 at post-8, and 0.659 at post-12 weeks. The p-value for hip circumference was 0.136 at pre- and 0.059 at post-12 weeks.

Inference: Both HIIT and yoga interventions were equally effective in reducing obesity parameters in post-menopausal women.

Sarcopenic and Dynapenia Parameters: There was a statistically noteworthy difference between HIIT and Yoga groups for HGS outcomes at all 4 timelines with a p-value ≤0.05 indicating the Yoga group was better than the HIIT group in increasing the strength. Gait speed showed a statistically significant increase at post 12 weeks assessment between two study groups with a P value of 0.017. It can be inferred that Yoga was better than the HIIT group in increasing the gait speed. In terms of ASMI parameters, there was no statistically significant difference at post-12 weeks with a p-value of 0.132. However, the Yoga group gave statistically significant change at pre-to-post comparison while the HIIT group showed insignificant p values for pre-to-post comparison for ASMI **(Table 21) [Graph 6 (a-c)]**.

Inference: Thus, it can be inferred that Yoga is superior to HIIT for all the parameters for sarcopenia and dynapenia.

Body Composition parameters: All four parameters for body composition including body fat %, body fat mass, skeletal muscle mass, and lean body mass were statistically not significant at all timelines assessed with p > 0.05 **(Table 22) [Graph 7 (a-d)]**. The p-values for body fat %, at pre-and post-12 were 0.291 and 0.413 respectively. The p values for body fat mass were 0.189 at pre- and 0.243 at post-12 weeks. The skeletal muscle mass variable had a p-value of 0.56 at pre- and 0.654 at

post-12 weeks. The p-value for lean body mass was 0.698 at pre- and 0.569 at post-12 weeks.

Inference: Both HIIT and yoga interventions were equally effective in reducing fat mass and % and increased muscle mass in post-menopausal women at 12 weeks.

HKA Angles for both lower limbs: The p-value for HKA on the right side at pre was 0.296 and 0.379 at post-12 weeks and the p-value for the angle on the left side was 0.949 at pre and 0.666 at post-12 weeks. The angles were statistically not significant (p-value > 0.05) at pre- and post-12 weeks on both sides indicating equal effectiveness of HIIT and Yoga interventions in increasing the angles **(Table 23) [Graph 8 (a & b)]**.

Perceived Stress Score: The perceived stress scores were not significant at pre with a p-value of 0.222 while at post-12-week intervention the scores were significantly lower in the Yoga group than the HIIT group with a p-value of 0.003. Hence, Yoga was more beneficial in reducing the levels of perceived stress in participating women **(Table 24) (Graph 9)**.

Health-related Quality-of-life domains by SF-36: All the eight QOL domains were not statistically insignificant between the two study groups at pre and post-12-week intervention indicating both groups were equally effective in improving the QOL of post-menopausal women **(Table 24) [Graph 10 (a-h)]**.

Mean and % mean Differences and effect size

Tables 25 to 30 provide a detailed analysis of mean and percentage mean differences and Cohen's d-effect size for every outcome parameter for the HIIT and Yoga study groups.

Inferences of the tables are as follows:

- Very large effect sizes (d=>1.3): HGS and gait speed for both study groups

- Large effect sizes (d = 0.8-1.3): BMI, WC, Perceived stress, physical functioning, energy/fatigue, pain, and general health domains of SF-36 for both study groups
- Moderate effect sizes (d = 0.5-0.8): Hip circumference, HKA angle on both sides for both study groups
- Small effect sizes (d = 0.2 – 0.5): Skeletal Muscle Mass and body fat % for both study groups
- Mixed picture for other domains of SF-36 with moderate to large effect sizes. For the domain of role limitations due to emotional problems, yoga had a large effect size while HIIT had a moderate effect size. For the emotional well-being domain, Yoga had a moderate effect size while HIIT had a large effect size. In terms of, the social functioning domain, Yoga had a moderate effect size while HIIT had a small effect size.

Repeated measures ANOVA analysis of data and its inference: The time-by-group interaction analysis is presented in graphs for each outcome variable. The graphs show no significant interaction between the study groups over time indicating equal effect of both study groups for all parameters except for perceived stress levels, gait speed, and HGS which is in line with the results of the between-group analysis. The stress levels significantly were lesser in the yoga group over 12 weeks duration than in the HIIT group. Similarly, gait speed and HGS increased faster in the yoga group at 12 weeks than HIIT group **(Graphs 11-16).**

Summary of the results: By pre-post intervention comparison, the statistical analysis revealed both exercise training protocols to be effective for all studied outcome parameters. However, when the two study groups were compared, the present study findings provided mixed study outcomes. HIIT and Yoga were equally effective for

obesity parameters, lower limb alignment, and health-related QoL domains. Hence, the null hypothesis was accepted for the above-stated outcomes. However, for sarcopenic parameters, dynapenia, and stress levels, Yoga was superior to the HIIT protocol. Hence, an alternative hypothesis was accepted for the outcome mentioned earlier.

The results of the study offer important new information about how two types of exercise—HIIT and hatha yoga—affect the health of older women. In addition to enhancing the QoL and lowering stress levels in PMWs, high-intensity training, and moderate-intensity yoga are useful in treating musculoskeletal conditions such as sarcopenia, dynapenia, and lower limb malalignment. Notably, yoga was more effective than HIIT at improving sarcopenic markers, reducing stress, and easing dynapenia.

DISCUSSION

The current study sought to ascertain and compare the effects of 12 weeks of two types of exercise training, HIIT and Hatha Yoga, on PMWs stress levels, health-related QOL outcomes, and musculoskeletal health outcomes, including sarcopenia, dynapenia, and lower limb alignment, in addition to obesity and body composition parameters.

The pre-post intervention analysis demonstrated that both HIIT and Yoga were effective in improving all the outcome parameters evaluated in this study. However, when the two exercise protocols were compared directly, the results revealed some differences. Both HIIT and Yoga showed similar effectiveness in addressing obesity-related factors, lower limb alignment, and health-related QoL. On the other hand, Yoga outperformed HIIT in improving sarcopenic parameters, reducing dynapenia, and lowering stress levels.

Menopause is a difficult phase in a woman's life, often accompanied by a range of health challenges that need proper management. An editorial emphasizes that obesity, sarcopenia, and osteoporosis may be interrelated in PMWs. It emphasizes the need to identify women affected by this combination and treat them with a customized approach, including a calorie-controlled, high-protein diet and a resistance exercise regimen [8]. Combining physical exercise with a tailored diet is an essential non-drug strategy to enhance health in the aging population, helping to prevent secondary health issues.

Demographic Characteristics:

Menopause is associated with various health risks. The age at which a woman experiences menopause can act as a biomarker for predicting future diseases and mortality [1]. An earlier onset of menopause is linked to a higher risk of cardiovascular

disease, frailty, cancer, and osteoporosis. Hence relating menopause demographics with lifestyle factors becomes crucial. In the present study, the mean age of menopause was around 48.5 years with 24% of total women who participated attained menopause surgically which means the ratio of natural to surgical menopause was 1:3. The education level among the women participants was secondary and above in 130 of 134 total participants. Around 43 (32%) of 134 of the participants were vegetarians while the remaining followed a mixed type of diet.

All the above are considered as associating factors that are correlated with menopause. Ahuja Mahinder's 2016 pan-India study looked at the average age of menopause and the variables that affect it. In line with the current study, which claims an average age of 48.5 years [14], the study indicated that the average age of menopause for Indian women is 46.2 years. The study found a relationship between the age of menopause and variables like parity, marital status, and social and economic standing. Unmarried women were found to experience menopause earlier than married or widowed women, and the present study included only married or widowed participants. Additionally, the study indicated that women with higher education tend to have a significantly later onset of menopause [14]. However, the present study did not analyze the age of menopause based on education levels since this was an interventional study with a different study objective. In addition, lower BMI, nulliparity and smoking, alcohol consumption, and contraceptive pills are associated with early onset menopause. However, these factors were not analyzed for relations due to the smaller sample size that cannot derive valid correlations between variables.

The women participants in the current study were of higher body weight and BMI which is known to correlate with the menopausal symptoms. The connection between body mass index (BMI) and menopausal symptoms in women is notable,

with evidence suggesting that a higher BMI is linked to more intense menopausal experiences. This relationship is largely due to changes in hormones and the accumulation of visceral fat that often occurs during menopause, which can worsen symptoms like hot flashes, sleep issues, and joint discomfort.[169,170]

The relationship between aging women and musculoskeletal issues is multifaceted, and influenced by physiological, hormonal, and lifestyle factors. As women age, they face an increased risk of conditions such as osteoarthritis, osteoporosis, sarcopenia, and aging which are all linked to decreased physical functional capacity[6]. Reproductive factors such as age at menarche and parity influence musculoskeletal health. Later menarche and higher parity are associated with better grip strength in later life [171].

In the present study, all participants were married while by occupation 57 (42%) of 134 were homemakers and the remaining were working women. This factor could have influenced the outcomes of the results since there are differences in fitness levels between working women and homemakers that are influenced by various factors, including cardiopulmonary endurance, body composition, and physical activity levels. While working women often show better cardiorespiratory endurance, homemakers participate in different physical activities that also contribute to their overall fitness. Working women, especially those in physically demanding jobs, tend to have higher cardiopulmonary endurance compared to homemakers. However, both groups report similar levels of life satisfaction and fatigue, indicating that endurance does not necessarily correlate with overall well-being [172]. When it comes to body composition, studies reveal that working women generally have a higher BMI and more visceral fat than homemakers. This suggests that the physical demands of work may influence body fat distribution in a way that differs from the activities typically

performed at home [173]. However, in the present study, all women included were with higher central obesity. Further, the differences in the outcomes of working and homemaker women were not compared in the present study since it was not the object of the study.

Menopause is closely associated with a higher prevalence of non-communicable diseases and comorbidities, creating substantial health challenges for women when compared to both age-matched men and women of reproductive age. This increases the burden on individuals, healthcare systems, and financial resources. Conditions such as cardiovascular diseases, central obesity, diabetes, hypertension, musculoskeletal issues, metabolic syndrome, and certain cancers elevate the risk of various health complications in postmenopausal women [6,7]. In the HIIT group, 27 (39.1%) women had some form of comorbid medical condition while in the yoga group, of the total 65 women participants, 25 (38.5%) had comorbid conditions present. The presence of comorbidities in women has a negative impact on the outcomes in the present study as compared to those of women without comorbidities. However, the percentage of the presence of comorbidities was nearly equal in both groups. Hence, there may have been no differences in the outcomes between the study groups due to the presence of comorbidities. However, the ill effects of these conditions cannot be ruled out.

Sarcopenia & Dynapenia:

Sarcopenia, marked by muscle mass and strength decline, affects the QoL and increases mortality risk [58]. Menopause triggers hormonal changes that can accelerate the onset of sarcopenia, a condition that primarily leads to functional impairments and physical disabilities. Dynapenia, a condition marked by a decline in muscle strength, is closely linked to sarcopenia, as HGS is a critical factor in diagnosing sarcopenia.

Additionally, HGS is also regarded as the standard diagnostic measure for dynapenia [26]. Meager studies exist in literature where dynapenia is directly addressed through exercise interventions. Hence, studies that have targeted muscle strength components with HIIT or Yoga have been discussed. To mitigate these adverse health effects, it is essential to prevent and manage sarcopenia by adopting a healthy lifestyle, which includes a balanced diet and regular physical activity [59]. In line with the recommendations, the present study addressed both issues by combining physical exercise (HIIT or Yoga) and a commonly prescribed diet chart.

HIIT & Sarcopenia and dynapenia:

The outcomes of the present study demonstrated significant improvements in variables assessing sarcopenia and dynapenia on comparing the scores between pre and all post-timelines. High-intensity interval Training (HIIT) has emerged as a promising intervention for addressing sarcopenia in older adults, showing significant benefits. High-intensity interval Training (HIIT) positively influences muscle fibre composition and HGS / strength, which are critical in addressing sarcopenia and dynapenia in PMWs. HIIT not only enhances muscle strength and mass but also improves overall physical performance and health. These changes in muscle mass and strength with HIIT can be explained through various physiological adaptations. HIIT promotes muscle hypertrophy, enhances muscle quality [119], and reduces apoptosis in muscle cells, with muscle preservation [174]. HIIT also promotes the activation of fast-twitch muscle fibers, which are crucial for developing strength and power. This leads to morphological changes, including increased mitochondrial content and function in skeletal muscle, thereby improving oxidative capacity [175, 176]. Hence, previous basic science-based research provides evidence that HIIT can improve muscle mass, strength, and functional performance, thereby mitigating the effects of age-related

muscle loss and weakness. HIIT can lead to increases in muscle cross-sectional area, indicating hypertrophy, particularly in the rectus femoris and vastus lateralis [177].

The current study's findings are supported by prior research in systematic reviews. A scoping study examined the impact of HIIT on sarcopenia, including 32 studies with participants mostly in their 60s (27 studies), 70s (2 studies), and 80s (3 studies). Twelve studies assessed physical performance, twenty focused on muscle function, and twenty-two on muscle mass. Compared to pre-HIIT, moderate-intensity training, or no exercise, HIIT was shown to significantly improve muscle function and physical performance [112]. High-intensity training proved more advantageous than low-to-moderate-intensity exercise for boosting strength without raising risk, according to a different evaluation that looked at HIIT as a treatment for sarcopenia. Interval training produces greater acute physiological responses than continuous training, but it also allows for rest periods, which makes it simpler for the body to adjust. Furthermore, it was discovered that low-volume HIIT produced strength increases comparable to those of moderate- or high-volume training, but with a smaller time investment [120].

A study comparing the effects of HIIT alone versus HIIT plus L-citrulline (CIT) supplementation on muscle function and functional ability in obese older individuals was found through a review of the literature. The study found that supplementing HIIT with CIT increased walking speed and upper limb strength in this population [178]. The findings correspond with the current study in terms of improved HGS and walking speed with HIIT. However, the present study did not include CIT supplementation. Instead, a high protein and low carbohydrate and fat diet chart was prescribed to the participants.

Yoga & Sarcopenia and dynapenia:

Yoga showed statistically significant improvements in parameters measuring sarcopenia by increased values of gait speed, HGS, and appendicular skeletal muscle index. It also showed improved scores of dynapenia measured by HGS.

Yoga can enhance muscle strength, functional performance, and lean muscle mass which are diagnostic features of sarcopenia. Yoga is also critical in combating the age-related decline in strength known as dynapenia. These positive effects can be explained by the nature of performing yoga combined with breathing which brings about physiologic changes in the muscles. Yoga involves attaining and maintaining static yogic postures that require the muscles to contract isometrically and isotonically. These contractions and co-contractions of the muscles lead to toning up and further increase the bulk of muscle. Additionally, prolonged muscle engagements in yogic postures lead to neuromuscular adaptations and muscular hypertrophy.

The above explanations have been supported in the literature. Yoga enhances muscle strength through increased muscle engagement during poses, promoting hypertrophy and improved neuromuscular coordination, leading to better overall function and strength adaptations [179]. Routine yoga practice was shown to positively influence whole-body protein utilization, with lower protein breakdown and higher lean body mass in women aged 50-65 compared to non-active counterparts [128]. This suggests that yoga may help maintain muscle mass, a critical factor in combating sarcopenia.

The literature review resulted in recent research that studied the impact of yoga on sarcopenia in older women. A 10-year follow-up study conducted in multiple cities on yoga education showed significant improvements in gait speed, muscle strength, and functions in aged women diagnosed with sarcopenia [49]. Participants

engaged in structured yoga sessions, which contributed to enhanced mobility and reduced risk of falls. The study's results are consistent with those of the current investigation. Another study examined the effects of five years of hatha yoga on PMWs bone density, muscle mass, muscle strength, and gait speed. The researchers discovered that regular hatha yoga practice resulted in long-term gains in each of these domains [123].

It has been demonstrated that a new method of Hatha yoga called 'cyclic yoga,' which links poses in a fluid sequence to increase the benefits of each asana, improves muscular strength and flexibility. A recent study set out to assess how long-term cyclic yoga practice affected PMWs' body composition and muscle strength. The findings indicate that regular, long-term practice of cyclic yoga positively influenced muscle mass, strength, and overall body fitness in these women. Based on these results, cyclic yoga may be recommended as a preventive measure against age-related sarcopenia in PMWs [127]. Further, studies in the literature have explored the effect of yoga on outcomes of strength, balance, gait speed, and physical functions in geriatric adults [180] and premenopausal women [126]. The results of all the above studies are concurrent with the findings of the current study where the outcomes showed significant improvements with yoga.

HIIT versus Yoga for Sarcopenia and Dynapenia:

When compared between the effects of HIIT and Yoga for sarcopenia and dynapenia, Yoga proved to be superior to HIIT in improving HGS, gait speed, and ASMI, though the effects were with smaller but statistically significant differences.

Based on several variables, the two types of interventions differed, which explains these group discrepancies. HIIT consists of brief bursts of high-intensity activity with a relative burden of ≥90% VO2 max, whereas yoga combines physical

positions, focus, and deep breathing, usually at a slow to moderate pace and intensity [151]. Unlike yoga, which is moderate in intensity and involves a consistent pace, HIIT alternates between vigorous exercise and active rest periods. HIIT is primarily a dynamic form of exercise, whereas yoga combines both static and dynamic postures. Because of its high levels of effort, HIIT demands a lot of motivation, although yoga poses may seem difficult or complicated to learn. HIIT typically includes simpler exercises like brisk walking, running, or jogging, while yoga focuses on achieving and holding specific postures. HIIT offers both aerobic and anaerobic adaptations [152] whereas Yoga provides predominantly aerobic benefits and some anaerobic effects [153]. High-intensity exercises may not be comfortable for the older population while yoga has the advantage of being performed with moderate to lower intensity.

In the present study, participants were made to perform dynamic exercises in HIIT such as running and jogging interspersed with brisk walking at the spot. These are dynamic forms of aerobic exercises with no isometric contractions or static posture hold. But yoga involves a combination of static as well as dynamic postures that cause isometric and co-contractions of the working muscles to hold the end yogic posture. Such forms of muscular contractions and holds cause the muscles to strengthen better than exercises like running and walking which are more dynamic.

Another reason for such a difference may be that yoga includes lifestyle change and a holistic approach. The practitioner attains a yoga posture while being mindful of breathing with every yoga session ending with meditation and relaxation postures. These integrated practices lead to stress reductions directly linked to serum cortisol levels associated with higher leptin and visceral adiposity [181]. The reduced stress is also linked to better sleep quality. These adaptations further lead to better physical performance on gait speed.

A limited body of literature compares High-Intensity Interval Training (HIIT) and Yoga across various patient populations, especially on outcomes of sarcopenia and dynapenia. As a result, providing a detailed evidence-based discussion on this comparison posed a significant challenge. However, these forms of exercise have been compared with different exercise protocols based on intensity. HIIT improves muscle function and physical functional capacity in older adults, with studies indicating similar or superior effects compared to persistent aerobic exercise (PAE) [112,120,182]. In populations with obesity and other health issues, HIIT has been compared with MICT and other conventional types of exercise, showing similar outcomes [114]. Similarly, yoga was either as effective as or more effective than traditional exercise modalities when compared to aerobic workouts for mental and physical health outcomes [154,155]. A literature review also identified a study that compared Pilates, power yoga, and HIIT in male school students, specifically focusing on muscle endurance. The results suggested that HIIT outperformed the other two exercise forms [156]. Additionally, a study examining Bikram Yoga (a form of intense yoga) versus HIIT in women aged 20-50 years with persistent pain concluded that both interventions were equally effective [157]. The studies reviewed present mixed outcomes in comparing these exercise modalities. Some research suggests that HIIT is either as effective or better than moderate-intensity exercises, while other studies indicate that Yoga is either as effective or more beneficial than both moderate- and high-intensity exercise forms.

HIIT & Obesity and Body Composition Parameters:

HIIT significantly impacts body composition and obesity in PMWs, primarily by reducing total and abdominal fat mass. While HIIT is effective for weight loss, its benefits appear to vary based on menopausal status and training modalities. With

statistically significant but moderate effect sizes on body weight and BMI reduction, the current study's findings show that HIIT significantly improves key obesity characteristics including WC and HC. When it came to body composition measures, HIIT showed statistically significant but modest to moderate impact sizes in terms of increasing skeletal muscle mass and decreasing body fat percentage.

The contributing factors for changes in obesity are explained in the literature by basic science research that indicates improved metabolic health & neuromuscular adaptations. The metabolic health is improved by greater glycolysis, fat oxidation, and improved insulin sensitivity [183], as well as increased energy production capabilities in skeletal muscle with mitochondrial adaptations [184]. The better neuromuscular adaptations with HIIT are explained by improved hormonal regulations that facilitate muscle growth and recovery [185], with higher Serum irisin levels, a myokine that regulates energy metabolism, which can aid in fat loss and metabolic health [186].

Several studies conducted in the recent past agree with the findings of the present study where HIIT was effective in fat reduction and obesity reduction. An editorial concluded that HIIT not only aids in body composition changes but also improves functional abilities and metabolic health in PMWs, making it a valuable exercise strategy for this population [187]. A meta-analysis of 38 trials with 959 participants examined the effects of HIIT on weight, total fat mass (FM), and abdominal FM before and after menopause in normal-weight and overweight/obese women. HIIT significantly reduced weight and total FM in both groups, with abdominal FM decreasing only in overweight/obese women. Pre-menopausal women showed notable reductions in weight and FM, while PMWs had fewer clear results [188]. Cycling HIIT was more effective than running for PMWs, and longer interventions (over 8 weeks, three sessions per week) were more efficient. Further research is

needed to better understand HIIT's effects on PMWs [188]. Another study investigated if, as compared to combined training, high-intensity interval training (HIIT) is a more time-efficient method of lowering visceral fat and improving inflammatory markers in postmenopausal obese women. According to the findings, HIIT successfully decreased inflammatory markers and visceral fat. Additionally, changes in serum cytokines were partially linked to reductions in visceral adiposity. A study indicated that HIIT resulted in a 0.5% reduction in body fat percentage and increased leg lean mass, although it did not significantly enhance muscle strength compared to combined training [189].

In conclusion, the body of literature on the effects of HIIT in older adults, particularly PMWs, continues to expand. However, it is clear that HIIT, regardless of its specific format, remains a safe and effective training method. It can enhance the health and QoL in obese PMWs, fostering a level of adherence comparable to other forms of physical activity, such as resistance and continuous training.

Yoga and Obesity and Body Composition Parameters:

During the menopausal phase, there is an increase in androgens that can lead to metabolic changes, such as overall weight gain and abdominal fat redistribution [3]. Obesity is directly associated with an increase in body fat percentage and mass with a decrease in skeletal muscle mass. This change is termed sarcopenia which becomes dominant with aging and menopause. Hence, the parameters that are directly linked to sarcopenia like body composition and central obesity were also addressed in the present study.

According to the current study, yoga was a successful strategy for treating post-menopausal women's body composition and abdominal obesity. A slight but significant decrease in BMI was accompanied by a significant decrease in WC.

Additionally, skeletal muscle mass increased and body fat decreased little but significantly. These positive effects can be attributed to factors like yoga leads to increased metabolism, and sympathetic activity which in turn increases calory burn. Further practicing yoga is a mind-body behavioural approach to lifestyle. The lifestyle change yoga brings in a person, leads to decreased stress levels which are linked to appetite and satiety with cortisol levels. Previous research on the physiological effects of yoga on obesity supports several key findings: yoga enhances metabolism [190], increases the basal metabolic rate [191], and promotes a behavioral shift toward a yogic lifestyle [192]. Additionally, yoga improves awareness of satiety and the discomfort of overeating, boosts sympathetic activity, which may be linked to higher energy expenditure, and reduces circulating cortisol levels. Elevated cortisol has been associated with increased leptin and visceral fat [181]. A narrative review of clinical trials on yoga interventions and weight-related outcomes examined 17 studies and found that 13 reported significant improvements in body composition, despite minimal changes in weight or BMI. Three studies showed no significant changes, and one did not provide significant data. The findings highlight that consistent and sustained yoga practice can lead to positive changes in body composition, similar to the effects seen with other lifestyle modifications like diet and exercise [192].

The new study's findings are consistent with those of a prior postmenopausal randomized controlled experiment. Participants in that study who participated in a 16-week yoga program had decreases in their body weight (3.9 kg), body fat percentage (3.1%), BMI (1.7 units), and WC (1.7 cm) as compared to a group that did not exercise. The degree of decline in the results varied, nevertheless, in the current investigation. In the present study, the decrease in WC (6cms) was much greater, while the decrease in BMI (0.5 units), and body weight (1.6kg) were lesser, and %

body fat reduction was equal (3.1%) in the above study. This could be due to 16 weeks of intervention which was a longer duration of treatment than 4 weeks in the present study [150]. A 12-week yoga intervention study on women with abdominal obesity (mean age 46-48 years) showed similar positive effects on obesity and body composition measures as the current study. The authors concluded that yoga is a safe practice for this population and can be recommended as an effective approach to managing abdominal obesity in women [47]. A study on patients with coronary artery diseases with 6 months of yogic practices demonstrated similar results on body composition parameters and lipid profiles [46]. Continuous yoga practice has been linked to significant reductions in BMI and body fat mass among obese adolescents, indicating its effectiveness as an alternative therapy for obesity management [193]. A further study sought to examine the anthropometric characteristics and body composition of yoga practitioners and non-practitioners. The findings indicated that, in comparison to non-practitioners, yoga practitioners had normal body weight, WC, decreased body fat, and BMI [194].

HIIT versus Yoga on obesity and body composition:

The outcomes of the present study showed equal effects of HIIT and yoga on parameters of obesity and body composition after 12 weeks of intervention in PMWs. These two forms of exercise have not been compared in post-menopausal women in the past published pieces of evidence. However, they have been compared to other modalities of exercises on obesity and body composition variables.

The similar effects of both exercise modalities in the present study can be attributed to the combination of diet chart that was high protein with low carbohydrate and fat, prescribed to the participants of both groups to follow during the 12 weeks of study duration. To date for body weight reduction, the gold standard combination

remains diet plus exercises which can bring about calorie deficit and lead to weight loss or fat loss. Physical exercise, combined with proper nutrition, is considered the most effective approach for addressing menopausal issues [36]. Additionally, a dose-dependent relationship between exercise intensity and fat loss has been observed in sedentary, obese individuals aged 45 to 60 years [37].

A study comparing HIIT when given with resistance and without resistance with moderate-intensity training concluded HIIT was more effective than MICT in reducing abdominal fat, while MICT showed better results in improving muscle strength. HIIT combined with RT also led to significant changes in body composition, particularly in fat mass and muscle mass, although the addition of RT did not enhance fat loss further [118]. This study can be comparable with the present study since yoga is considered moderate-intensity training. However, results showed contradicted, that when HIIT was combined with RT it showed significant changes in fat and muscle mass than MICT.

This study examined the effects of combined training (CT) and HIIT on postmenopausal obese women's muscle strength, body composition, and physical functioning. While the HIIT group engaged in bodyweight squats and intensive stair climbing with light walking recovery, the CT group engaged in RT and moderate walking. The findings showed that while CT was superior at increasing muscle strength and walking speed, HIIT was more successful in improving chair stand performance and body composition. These results suggest that while HIIT is good for body composition and functional performance, CT should be given priority for increasing walking speed and muscle strength [113]. The study included strength training combined with HIIT in the form of body-weight squats. However, when walking was combined with strength training, muscle strength and walking speed increased.

Yoga practitioners have been found to have a lower BMI and reduced fat mass compared to non-practitioners, suggesting that regular yoga practice can contribute to a healthier body composition and improved body image [194]. In another study comparing body composition between yoga and Zumba practitioners, yoga participants had a higher BMI, but a lower body fat percentage and greater fat-free mass. The findings indicate that, despite having a higher BMI, yoga practitioners exhibited a more promising body composition overall, suggesting that yoga positively influences body components and shape, and enhances psychophysical well-being in women [195]. Zumba can be considered as a high-intensity training but the outcomes of the study contradict the findings of the present study where both groups were equally effective on body composition and BMI.

Effects of HIIT & Yoga on lower limb alignment on HKA angle:

The effect of obesity on altering lower limb alignment, particularly in the aging population, is well-documented [158]. These changes in angular alignment can eventually contribute to the development of arthritis.

The results of the present study indicate statistically significant increases but with smaller effect sizes in the angular measurements of the mechanical axis of the lower limbs measured radiographically by marking HKA angles bilaterally by intervention with both HIIT and Yoga. The link between obesity, increased knee adduction moment, and joint loading with aging in elderly men and women, as measured by coronal HKA angles, is well-documented in the literature [32]. The present study targeted an increase of HKA angles by reducing the body weight and increasing the strengths of the working muscles by performing generalized body exercises either Yoga or HIIT.

Skeletal muscle function is adversely affected by obesity; compared to non-obese people, obese people have reduced maximum strength in anti-gravity muscles proportional to body mass. Particularly in older persons, this increases the risk of OA and results in functional limits [64]. Another important concern for aging women is the change in lower limb angular alignment, particularly in the knee joint (varus or valgus), which may result from central obesity or muscle imbalances that contribute to arthritis [28,29]. Therefore, the studies suggest that the combination of lower limb muscle imbalances and obesity contributes to angular malalignments, which are significant biomechanical risk factors for the development of knee OA, primarily by increasing the load on the knee joint [28,29,32,64].

Although the effect sizes were small, a recent study demonstrated that a 12-week structured exercise program aimed at strengthening the knee extensors and hip abductors as well as enhancing control of lower-limb alignment during dynamic loading improved the ability to control knee and hip frontal plane kinematics [33]. Furthermore, after three months of proprioceptive exercises and a diet-based weight loss intervention, both senior people and patients with OA showed improvements in lower limb alignment, loading, foot posture, and knee adduction moment [34,35]. One significant conclusion from the aforementioned trials is that, albeit with smaller effect sizes, a planned program of hip and knee strengthening exercises and proprioceptive exercises in conjunction with a weight loss intervention improved the frontal plane kinematics of the knee and hip [33-35]. However, these studies included dynamic angular assessments of the knee joint in the frontal plane using markers or single-leg squat tests which are in contrast to the present study which measured the malalignments with a static angular measure of the mechanical axis of lower limbs on X-ray which is considered a gold standard method. The previous studies cited above have targeted

specific lower limb joints like the hip and knee with structured strengthening or proprioceptive exercise protocol combined with diet for weight loss, unlike the present study that included more generalized forms of exercises combined with diet for weight loss.

Both exercise interventions in this study showed comparable effects from pre to post, indicating similar outcomes. This similarity can be attributed to the fact that both interventions led to the same amount of weight loss and changes in body composition, as previously discussed. Since both exercise programs were general and combined with a common diet plan, their impact on lower limb alignment likely resulted in similar effects.

To the best of the literature search conducted by the authors, there are no studies where generalized forms of exercises were explored for their effects on static angular assessments of lower limb angular alignment in weight bearing. Hence, the study results on alignment have provided insights into whether weight loss affects knee malalignment and helps prevent arthritic changes, highlighting the role of exercise and weight reduction. Any observable changes in knee angle due to the intervention would serve as confirmation, as the HKA angle remains the gold standard for measurement.

Perceived Stress Levels:

Menopause and aging are often linked to a decline in QoL, mood disturbances, and challenges in coping with stress, among other issues. Results of a study comparing stress levels in pre-and post-menopausal women showed that 88.8% of PMWs experienced stress, significantly higher than premenopausal women, where stress levels were more evenly distributed [94]. In a study, 45.66% of participants exhibited high perceived stress, highlighting the widespread nature of this issue.

Stress negatively impacts both general and menopause-specific QoL, indicating a need for effective stress management strategies [96].

Effects of HIIT on Stress Levels:

Positive effects on reduction in perceived stress levels among PMWs were demonstrated in the present study with both 12 weeks of HIIT exercise intervention. Physical exercise is widely recognized for reducing stress through various physiological mechanisms, including neuro-endocrine, psychological, cardiovascular, and metabolic changes. It stimulates the release of endorphins, which improve mood and help counteract stress hormones like cortisol [196]. Regular activity enhances the body's stress management by adapting the hypothalamic-pituitary-adrenal axis reactivity for a more balanced hormonal response [197]. Exercise also boosts energy metabolism, reducing the physiological strain of stress [198]. A study found that vigorous activity was associated with reduced perceived stress, highlighting the importance of exercise in managing stress during menopause [199].

HIIT positively influences stress levels in PMWs through various physiological mechanisms. Research indicates that HIIT can lead to reductions in inflammatory markers [116] and improvements in cardiovascular responses [199], which are crucial for managing stress. HIIT has been associated with decreased levels of pro-inflammatory cytokines such as IL-6 after a training period, suggesting an anti-inflammatory effect that may alleviate stress responses [116]. The chronic effects of HIIT on blood pressure and heart rate variability suggest improved autonomic function, which is beneficial for stress resilience [199].

Effects of Yoga on Stress Levels:

The current study results indicate yoga to be effective in reducing stress levels at post-intervention of 12 weeks. Regular yoga practice has been linked to reductions

in physiological arousal, such as lower blood pressure and heart rate, which are often elevated during stress. Specific techniques like Bhramari pranayama have shown significant improvements in anxiety levels and cognitive functions, indicating a holistic benefit of yoga on mental health [200].

Yoga practices enhance emotional regulation and mindfulness, contributing to lower stress and anxiety levels. Studies indicate that yoga can significantly lower anxiety scores in PMWs, with interventions leading to a shift from mild anxiety to normal levels [201,202]. The combination of physical movement and breath control in yoga fosters a sense of calm and emotional stability, which is crucial during the menopausal transition [203]. Research indicated that yoga exercises positively influenced cortisol levels and psychosocial well-being in menopausal women, suggesting a reduction in daily stress and improvement in metabolic health [204]. Yoga practice may reduce stress levels in PMWs by promoting hormonal balance, preventing cortisol increases, and enhancing psychological well-being. It facilitates relaxation and mindfulness, contributing to decreased stress symptoms and improved overall QoL during menopause [205].

A study was conducted to explore the effects of yoga on the psychological health of PMWs using the depression anxiety stress scale-21 questionnaire. The study results indicated a significant reduction in anxiety, stress, and depression levels among PMWs following a yoga intervention, with a p-value of less than 0.001 [206]. The findings of the study are concurrent with the outcomes of the present study on stress levels. A detailed literature search on the effect of yoga on stress resulted in a scanty number of studies on postmenopausal or aging women. Studies are conducted on adult women, healthy adults, workplace stress, student population, post-traumatic stress disorders, and anxiety in premenopausal women. A recent meta-analysis

examining the effects of yoga on stress in stressed adults found that the evidence for the short-term benefits of yoga on perceived stress is of low quality when compared to passive control groups. However, it concluded that yoga can still be considered a viable non-pharmacological option for stress reduction in this population [207]. Hence, more quality studies are needed to be conducted and published about yoga on stress in PMWs.

HIIT versus Yoga on Perceived Stress Levels:

The statistical analysis between HIIT and Yoga for perceived levels of stress at 12 weeks resulted in a significant reduction in the stress levels in the yoga group over the HIIT group. Yoga has emerged as a highly effective method for stress reduction, distinguishing itself from other forms of exercise through its unique combination of physical postures, breath control, and meditation. This multifaceted approach not only addresses physical tension but also promotes mental relaxation and emotional well-being, making it particularly beneficial for managing stress. Yoga significantly is said to create a mind-body connection bringing about behavioral changes in the practitioner, fostering a holistic approach to stress management [208]. Practices such as pranayama (breath control) have been shown to induce feelings of calm and reduce anxiety, enhancing overall mental health [209]. Yoga is effective on stress due to its focus on physical and mental relaxation, relieving muscular tension, and easing pain, which collectively help reduce stress and anxiety more effectively than many other forms of exercise [210].

A literature search indicated no studies are comparing high-intensity workouts with yoga in either PMWs or any other patient population. Further, meager comparative studies compare yoga with other modern forms of exercise on stress levels. A study compared yoga including Surya Namaskar with aerobic exercise in the

form of treadmill walking on cardiovascular markers and stress levels, with results showing both interventions improved physiological markers such as heart rate and blood pressure, but yoga was more effective in lowering perceived stress in medical professionals [211]. Additionally, yoga has been shown to alleviate burnout symptoms among nurses, particularly in emotional exhaustion, compared to aerobic exercises [212]. These findings are similar to the current study where yoga was superior to HIIT which was an aerobic form of exercise. Hence, both HIIT and yoga interventions are safe and beneficial, but yoga often yields more significant psychological benefits.

HIIT and Yoga on health-related QoL:

After 12 weeks, PMWs' health-related QoL was evaluated using the Short-Form 36 on its eight areas, incorporating yoga and HIIT. The outcomes demonstrated the effectiveness of both pre- and post-comparison exercise regimens. Both groups were equally effective, as evidenced by the lack of substantial differences between them.

Menopause significantly impacts the QoL for women, influenced by various psychological and physiological factors. Research indicates that natural menopause is an independent predictor of a decline in QoL, particularly in physical functioning. Budakoglu et al. (2007) demonstrated that PMWs experience worse QoL compared to premenopausal women, emphasizing the need for public health interventions, especially in rural populations [99]. Furthermore, Pan et al. (2014) found that weight growth was negatively correlated with several physical health characteristics, including energy, pain, role restrictions brought on by physical and general health, and physical functionality [100]. A review by Schneider et al. (2014) compared the SF-36 sum score with the somatic and psychological dimensions of the Menopause Rating Scale (MRS), concluding that the severity of menopausal symptoms

significantly impacts both physical and psychological well-being, highlighting the importance of targeted interventions during this phase [213]. A cross-sectional community-based study in rural Indian perimenopausal women concluded that physical and psychosocial problems significantly impacted the QoL, suggesting that appropriate preventive measures could improve outcomes for this population [50].

Physical activity enhances the QoL by improving mental health, reducing body aches, reducing menopausal symptoms, managing body weight, and improving body composition parameters. A study found a strong correlation ($r = 0.649$, $p < 0.05$) between physical activity levels and QOL in menopausal women, suggesting that increased activity leads to better overall well-being [214]. Women who engaged in regular exercise reported improvements across multiple QOL domains, including physical functioning and mental health [215,216].

The effects of HIIT on the QoL in PMWs have not been explored yet in the literature. However, the effects of submaximal exercises and moderate-intensity exercises are studied in the above-mentioned population. The results of these studies demonstrated significant improvements in the QoL in menopausal women by enhancing physical and mental health, independent of hormone therapy [217,218]. HIIT has shown positive effects on sarcopenia, body composition, obesity parameters, and perceived stress levels in the present study. All these are independently correlated with QoL. Hence, these changes could be attributed to improved QOL.

Yoga has been shown to significantly improve the QOL in menopausal women through various physiological mechanisms. These mechanisms include hormonal regulation, symptom management, and psychological well-being, which collectively enhance overall health during this transitional phase. Studies indicate that yoga effectively alleviates physical symptoms like joint pain and sleep disturbances,

which are common during menopause [218,219]. A clinical yoga package has been shown to significantly improve menopause-specific QoL, addressing both physical and psychological symptoms [220]. Yoga promotes emotional stability and resilience, helping women cope with mood changes and anxiety during menopause. The practice encourages self-awareness and empowerment, allowing women to navigate this life stage with greater confidence and health awareness [220,221].

Extensive literature exists on the effects of yoga on QOL in peri or pre-menopausal women with all of them showing positive outcomes on all domains and parameters of QOL. According to a comprehensive analysis of ten randomized controlled trials (RCTs), yoga is a safe and successful strategy for reducing menopausal symptoms and enhancing QoL. The authors concluded that yoga is a risk-free alternative therapy that can effectively reduce menopausal symptoms and enhance QoL. This recommendation is supported by evidence that regular practice of yoga can positively affect many of the common symptoms associated with menopause [222]. Another community-based study in India found that lifestyle-related interventions, including yoga, significantly improved QoL among PMWs, evidenced by reduced scores in vasomotor, psychosocial, physical, and sexual domains of the MENQOL questionnaire post-intervention [223]. Thus, more research is needed on the effect of HIIT and Yoga on QoL outcomes in the post-menopause stage of women.

Summary of the discussion:

To conclude the discussion, while there is substantial evidence supporting the effects of HIIT and yoga on obesity and body composition, research specifically focused on post-menopausal women is limited. Similarly, there is a scarcity of studies examining the impact of HIIT and yoga on sarcopenia and dynapenia in this population. On a similar line, the effects of generalized fitness exercises on static

weight-bearing angular corrections in lower limbs are lacking. Although existing literature does address the effects of yoga on anxiety and depression, there is a clear gap in research regarding its influence on stress levels in post-menopausal women. Furthermore, the effects of HIIT on stress are not well-documented, highlighting the need for further investigation in this area. Finally, no studies have directly compared these two exercise modalities for the parameters assessed in the present study, indicating a significant gap in the existing literature.

Limitations:

- While DEXA is a more reliable tool for assessing body composition, the study opted for BIA due to the cost associated with DEXA. It is worth noting that both BIA and DEXA are recognized by the AWGS for diagnosing sarcopenia.
- Maintaining a consistent and fixed daytime schedule for follow-up assessments of body composition measurements presented a practical challenge during the data collection phase of the study.
- 12 weeks' duration may be shorter to bring about larger effect sizes in alignment angular corrections as well as body composition parameters.
- The exercise groups were not matched by either their age or BMI levels in both study groups. However, the participants were instructed to perform to their capacity levels.
- Participant compliance remains a concern despite efforts to encourage adherence through the use of logbooks and regular reminders.
- The participants with comorbidities were not excluded, as doing so would have impacted the ability to achieve the required sample size.

Future recommendations:

- Future research should consider conducting long-term trials lasting 6 months to 1 year, accompanied by follow-up studies to assess sustained effects.
- Controlled studies involving age and BMI-matched participants would enhance the validity of findings.
- Additionally, it would be beneficial to analyze participants with and without comorbidities separately to better understand the impact of exercise interventions.
- Comparative studies of various exercise modalities on sarcopenia would also provide valuable insights.
- Furthermore, more interventional studies are needed to explore effective management strategies for dynapenia.

Strength of the study:

- The study investigated the effects of generalized exercise forms on static angular corrections in the lower extremities by targeting weight loss and toning up the muscles, thereby contributing valuable insights into the prevention of arthritis and other joint issues.
- The study addresses musculoskeletal issues in post-menopausal women that are often overlooked by both researchers and clinicians.
- Furthermore, the study explored the impacts of 2 forms of exercises viz. HIIT and yoga on sarcopenia and dynapenia in this population, are areas that have received limited attention in the existing literature.
- The study also developed and validated specific HIIT protocols tailored for aging post-menopausal women to address health challenges effectively.

- Additionally, a multilingual log diary and diet chart was created (with a registered copyright for the same), providing a useful tool for researchers and clinicians working with individuals facing obesity-related issues.

CONCLUSIONS

- The study findings reveal substantial information on the role of two forms of exercises viz. HIIT and yoga on aging women's musculoskeletal health outcomes.
- When compared pre- to post-intervention, the following conclusions were drawn for the two study groups:

✓ HIIT and Hatha yoga were effective exercise intervention protocols at 12 weeks for managing musculoskeletal issues like sarcopenia, dynapenia, and lower limb malalignment,

✓ HIIT and Hatha Yoga were also effective for central obesity outcomes by reducing WC and body weight with large effect sizes.

✓ At 12 weeks post-intervention, improved body composition parameters were noted with both HIIT and Hatha Yoga in terms of decreased body fat percentage and increased skeletal muscle mass although with smaller effect sizes.

✓ The lower limb alignments assessed radiologically by measuring HKA Angles on both lower limbs, demonstrated both HIIT and Hatha Yoga protocols were effective in increasing the angles at 12 weeks intervention period

✓ There were considerable improvements observed in patient-reported QOL domains and reduction in stress levels in post-menopausal women at 12 weeks with both HIIT and Hatha Yoga.

- Further, on comparing the HIIT and yoga exercise interventions for studied outcomes in post-menopausal women in the present study, the following conclusions can be drawn:

- ✓ At 12 weeks post-intervention, in terms of obesity parameters including WC, hip circumference, body weight, and BMI, both HIIT and yoga proved equally effective.
- ✓ In the case of parameters related to sarcopenia and dynapenia such as HGS, gait speed, and appendicular skeletal muscle index, yoga was more effective than HIIT at 12 weeks post-intervention.
- ✓ Further, in terms of levels of perceived stress, yoga was more effective in reducing stress levels in PMWs than the HIIT protocol.
- ✓ In terms of correction of lower limb alignment by radiological HKA angles measured bilaterally, both HIIT and Yoga were equally effective in reducing the angles at 12 weeks post-intervention.
- ✓ Lastly, the HIIT protocol was as effective as the hatha yoga approach in terms of improving the health-related QoL domains taken by patient-reported short-form 36 questionnaire.

- To summarize, the study highlights the benefits of both HIIT and hatha yoga for aging women, showing effectiveness in improving musculoskeletal health, QoL, and stress reduction. However, yoga proved more effective than HIIT in addressing sarcopenia, dynapenia, and stress levels.

Clinical implications of the study:

- Healthcare providers can improve health outcomes and QoL for aging women through targeted exercise interventions.
- The study's findings will be highly relevant to clinicians, exercise specialists, physiotherapists, yoga instructors, and rehabilitation professionals who work with the aging population and PMWs to address musculoskeletal concerns.
- Clinicians can incorporate either HIIT or hatha yoga into exercise prescriptions for post-menopausal women, as HIIT improves overall fitness and metabolic health while yoga is particularly effective for enhancing musculoskeletal health and reducing stress.
- The validated HIIT protocol developed and the diet chart along with the compliance logbook created by the study can be applied safely and effectively to aging women or obese women.
- Regular assessments of musculoskeletal health and stress levels can help tailor exercise programs effectively.
- Continued research is needed to explore the long-term benefits of these exercises, and clinical guidelines should be updated to reflect their importance in managing health issues specific to aging women.

SUMMARY

Menopause is a challenging period in a woman's life, often accompanied by increased musculoskeletal issues and obesity, which require timely and effective intervention. However, the effects of High-Intensity Interval Training (HIIT) and Hatha yoga on musculoskeletal health in PMWs have not been sufficiently studied. Both exercise methods are distinct but also share certain similarities, and this study aims to assess and compare their effects on PMWs, particularly those suffering from central obesity, sarcopenia (muscle loss), dynapenia (loss of strength), and knee misalignment.

The study was a randomized, open-label clinical trial involving 160 PMWs between the ages of 46 and 70. These women were randomly assigned to one of two intervention groups: HIIT or yoga. Both groups participated in 12 weeks of group therapy, with five sessions each week. The study aimed to evaluate a range of health outcomes, including body composition, musculoskeletal strength, and stress levels. Specifically, the researchers measured the Appendicular Skeletal Mass Index (ASMI), which indicates muscle mass, using a bioelectric impedance analyzer. They also assessed the radiological measure of the HKA angle, as well as perceived stress levels and overall QoL through questionnaires. Various physical performance outcomes were tracked, including gait speed, HGS, WC, and BMI (BMI), with assessments at the start, the fourth week, the eighth week, and the end of the 12-week intervention period.

The results of the study showed that both HIIT and yoga led to significant improvements within each group across all measured parameters, with statistical significance at $P<0.05$. However, when comparing the two groups, the outcomes were mixed. Yoga was found to be more effective than HIIT in improving sarcopenic

parameters, such as gait speed, HGS, and ASMI, as well as reducing dynapenia and stress levels. On the other hand, for most other parameters, such as body composition, obesity, QoL, and lower limb alignment, both HIIT and yoga were equally effective.

In conclusion, the study suggests that yoga is slightly superior to HIIT in addressing sarcopenia, dynapenia, and stress levels in PMWs. However, both exercise methods showed similar benefits in terms of improving body composition, managing obesity, enhancing QoL, and correcting lower limb misalignment. These findings provide valuable evidence supporting the use of both HIIT and yoga as effective interventions for managing menopausal health issues.

.

BIBLIOGRAPHY

1. da Silva AM, Dilson NK, Batista TC, Cavalcante MÁ, de Oliveira Melo GJ, de Sousa KO, Barcelos JO, Alves PC, de Lima LG, César TC. The Impacts of Menopause on Women's Health: A Multidisciplinary Approach. Revista CPAQV-Centro de Pesquisas Avançadas em Qualidade de Vida. 2024 Mar 20;16(1):6. DOI: https://doi.org/10.36692/V16N1-139R
2. Su Y, Zhang D. Management of menopausal physiological symptoms. Highlights in Science, Engineering and Technology. 2022 Sep 29;14:163-70. doi: 10.54097/hset.v14i.1606
3. Motlani V, Motlani G, Pamnani S, Sahu A, Acharya N. Endocrine changes in PMWs: a Comprehensive View. Cureus. 2023 Dec;15(12). doi: 10.7759/cureus.51287
4. Hulteen RM, Marlatt KL, Allerton TD, Lovre D. Detrimental changes in health during menopause: the role of physical activity. International journal of sports medicine. 2023 Jun;44(06):389-96. doi: 10.1055/a-2003-9406
5. Fenton A, Smart C, Goldschmidt L, Price V, Scott J. Fat mass, weight, and body shape changes at menopause–causes and consequences: A narrative review. Climacteric. 2023 Jul 4;26(4):381-7.doi: 10.1080/13697137.2023.2178892
6. Khadilkar SS. Post-reproductive health: window of opportunity for preventing comorbidities. The Journal of Obstetrics and Gynecology of India. 2019 Feb 6;69:1-5. doi: 10.1007/s13224-019-01202-w
7. Batsis JA, Villareal DT. Sarcopenic obesity in older adults: aetiology, epidemiology and treatment strategies. Nature Reviews Endocrinology. 2018 Sep;14(9):513-37. https://doi.org/10.1038/s41574-018-0062-9

8. Vaidya R. Obesity, sarcopenia, and postmenopausal osteoporosis: An interlinked triad. J Midlife Health. 2014 Jan 1;5:1-2. doi: 10.4103/0976-7800.127778
9. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, Jang HC, Kang L, Kim M, Kim S, Kojima T. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. Journal of the American Medical Directors Association. 2020 Mar 1;21(3):300-7. doi: 10.1016/j.jamda.2019.12.012.
10. Drenowatz C, Hand GA, Sagner M, Shook RP, Burgess S, Blair SN. The prospective association between different types of exercise and body composition. Medicine and science in sports and exercise. 2015 Dec;47(12):2535–2541. doi: 10.1249/MSS.0000000000000701
11. Baumgartner RN, Wayne SJ, Waters DL, Janssen I, Gallagher D, Morley JE. Sarcopenic obesity predicts instrumental activities of daily living disability in the elderly. Obesity research. 2004 Dec;12(12):1995-2004. https://doi.org/10.1038/oby.2004.250
12. Koliaki C, Liatis S, Dalamaga M, Kokkinos A. Sarcopenic obesity: epidemiologic evidence, pathophysiology, and therapeutic perspectives. Current obesity reports. 2019 Dec;8:458-71. https://doi.org/10.1007/s13679-019- 00359-9
13. Prasad JB, Tyagi NK, Verma P. Age at menopause in India: A systematic review. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2021 Jan 1;15(1):373-7. doi: 10.1016/J.DSX.2021.01.013
14. Ahuja M. Age of menopause and determinants of menopause age: A PAN India survey by IMS. Journal of mid-life health. 2016 Jul 1;7(3):126-31. doi: 10.4103/0976-7800.191012

15. Petermann-Rocha F, Balntzi V, Gray SR, Lara J, Ho FK, Pell JP, Celis-Morales C. Global prevalence of sarcopenia and severe sarcopenia: a systematic review and meta-analysis. Journal of cachexia, sarcopenia and muscle. 2022 Feb;13(1):86-99. doi: 10.1002/JCSM.12783
16. Agarwal A, Asnani M, Singh R, Sridhar A. Sarcopenia in Perimenopausal and PMWs in a Tropical Country [ID: 1377057]. Obstetrics & Gynecology. 2023 May 1;141(5S):14S. doi: 10.1097/01.AOG.0000929872.03937.b6
17. Bogucka A, Kopiczko A, Charzewska J. Sarcopenia: prevalence and its main risk factors in older women. Anthropological Review. 2023; 86(1):51-66. doi: 10.18778/1898-6773.86.1.05
18. Tyrovolas S, Koyanagi A, Olaya B, Ayuso-Mateos JL, Miret M, Chatterji S, Tobiasz-Adamczyk B, Koskinen S, Leonardi M, Haro JM. Factors associated with skeletal muscle mass, sarcopenia, and sarcopenic obesity in older adults: a multi-continent study. Journal of cachexia, sarcopenia and muscle. 2016 Jun;7(3):312-21. doi: 10.1002/jcsm.12076.
19. Leite MM, de Carvalho JM, Abdelmur SB, Stival MM, de Lima LR, da Silva IC, Funghetto SS. Prevalence and factors associated with dynapenia in elderly women in primary health care: Prevalência e fatores associados a dinapenia em idosas na atenção primária em saúde. Concilium. 2024 May 14;24(10):36-54. doi: 10.53660/clm-3426-24i39
20. Pereira AV, Santos LD, Pedreira RB, Miranda CG, Fernandes MH, Carneiro JA. Prevalence and factors associated with dynapenia in older women using different diagnostic criteria. Motriz: Revista de Educação Física. 2022 Oct 14;28:e10220005822. doi: 10.1590/s1980-657420220005822

21. Santos LD, Miranda CG, Souza TC, Brito TA, Fernandes MH, Carneiro JA. Body composition of women with and without dynapenia defined by different cut-off points. Revista de Nutrição. 2021 Dec 6;34:e200084. https://doi.org/10.1590/1678-9865202134e200084
22. Zengin A, Kulkarni B, Khadilkar AV, Kajale N, Ekbote V, Tandon N, Bhargava SK, Sachdev HS, Sinha S, Scott D, Kinra S. Prevalence of sarcopenia and relationships between muscle and bone in Indian men and women. Calcified Tissue International. 2021 Oct;109:423-33. doi: 10.1007/S00223-021-00860-1
23. Gurudut P, Kumar S, Patil A, Mhetri S, Misquita D, Mulgaonkar S. A City-based Demographic Research on Community-dwelling Residents of Belagavi, India, about Dynapenia, Frailty, and Sarcopenia. Indian Journal of Physical Therapy and Research. 2023 Jan 1;5(1):51-9. doi: 10.4103/ijptr.ijptr_6_23
24. Chhabra N, Sodhi KS. Central obesity and prevalence of metabolic syndrome in post-menopausal women. [Internet] 2014 Jan 21. [Cited 2021 June 19] Available from: https://webmedcentral.com/wmcpdf/Article_WMC004532.pdf
25. Hofsteenge GH, Chinapaw MJ, Weijs PJ. Fat-free mass prediction equations for bioelectric impedance analysis compared to dual energy X-ray absorptiometry in obese adolescents: a validation study. BMC Pediatrics. 2015 Dec;15(1):1-9. doi: 10.1186/s12887-015-0476-7
26. Wang X, Chen L, Lyu M, Wei N. The optimal cut-off values of screening tools for dynapenia: a cross-sectional study. Disability and Rehabilitation. 2024 Sep 10;46(19):4540-5. doi: 10.1080/09638288.2023.2274884
27. Misra A, Vikram NK, Gupta R, Pandey RM, Wasir JS, Gupta VP. Waist Circumference cutoff points and action levels for Asian Indians for identification

of abdominal obesity. International journal of obesity. 2006 Jan;30(1):106-11. doi: 10.1038/SJ.IJO.0803111

28. Al-Safi ZA, Polotsky AJ. Obesity and menopause. Best Practice & Research Clinical Obstetrics & Gynaecology. 2015 May 1;29(4):548-53. http://dx.doi.org/10.1016/j.bpobgyn.2014.12.002
29. Messier SP, Pater M, Beavers DP, Legault C, Loeser RF, Hunter DJ, DeVita P. Influences of alignment and obesity on knee joint loading in osteoarthritic gait. OA and Cartilage. 2014 Jul 1;22(7):912-7. http://dx.doi.org/10.1016/j.joca.2014.05.013
30. Sheehy L, Felson D, Zhang Y, Niu J, Lam YM, Segal N, Lynch J, Cooke TD. Does measurement of the anatomic axis consistently predict HKA angle (HKA) for knee alignment studies in OA? Analysis of long limb radiographs from the multicenter OA (MOST) study. OA and cartilage. 2011 Jan 1;19(1):58-64. doi:10.1016/j.joca.2010.09.011.
31. Bagaria V, Kulkarni RV, Sadigale OS, Sahu D, Parvizi J, Thienpont E. Varus knee deformity classification based on degree and extra-or intra-articular location of coronal deformity and OA grade. JBJS reviews. 2021 Oct 1;9(10):e20. doi: 10.2106/JBJS.RVW.20.00296
32. Katsumi R, Mochizuki T, Sato T, Kobayashi K, Watanabe S, Tanifuji O, Endo N. Contribution of sex and body constitution to three-dimensional lower extremity alignment for healthy, elderly, non-obese humans in a Japanese population. Journal of Experimental Orthopaedics. 2018 Dec;5:1-8. https://doi.org/10.1186/s40634-018-0147-3
33. Horsak B, Schwab C, Baca A, Greber-Platzer S, Kreissl A, Nehrer S, Keilani M, Crevenna R, Kranzl A, Wondrasch B. Effects of a lower extremity exercise

program on gait biomechanics and clinical outcomes in children and adolescents with obesity: A randomized controlled trial. Gait & posture. 2019 May 1;70:122-9. https://doi.org/10.1016/j.gaitpost.2019.02.032

34. Cho Y, Kim M, Lee W. Effect of proprioceptive training on foot posture, lower limb alignment, and knee adduction moment in patients with degenerative knee OA: a randomized controlled trial. Journal of Physical Therapy Science. 2015;27(2):371-4. https://doi.org/10.1589/jpts.272.371
35. Song J, Kane R, Tango DN, Vander Veur SS, Furmato J, Komaroff E, Foster GD. Effects of weight loss on foot structure and function in obese adults: a pilot randomized controlled trial. Gait & posture. 2015 Jan 1;41(1):86-92. https://doi.org/10.1016/j.gaitpost.2014.08.013
36. Sampaio RA, Sampaio PY, Uchida MC, Arai H. Management of dynapenia, sarcopenia, and frailty: the role of physical exercise. Journal of Aging Research. 2020;2020: 8186769. doi: 10.1155/2020/8186769
37. Slentz CA, Duscha BD, Johnson JL, Ketchum K, Aiken LB, Samsa GP, Houmard JA, Bales CW, Kraus WE. Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE—a randomized controlled study. Archives of internal medicine. 2004 Jan 12;164(1):31-9. doi:10.1001/archinte.164.1.31
38. de Mello RG, Dalla Corte RR, Gioscia J, Moriguchi EH. Effects of physical exercise programs on sarcopenia management, dynapenia, and physical performance in the elderly: a systematic review of randomized clinical trials. Journal of aging research. 2019;2019(1):1959486. https://doi.org/10.1155/2019/1959486

39. Barajas-Galindo DE, Arnáiz EG, Vicente PF, Ballesteros-Pomar MD. Effects of physical exercise in sarcopenia. A systematic review. Endocrinología, Diabetes y Nutrición (English ed.). 2021 Mar 1;68(3):159-69. https://doi.org/10.1016/j.endien.2020.02.007

40. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Medicine & Science in Sports & Exercise. 2009 Feb 1;41(2):459-71. doi:: 10.1249/MSS.0b013e3181949333. Erratum in: Med Sci Sports Exerc. 2009 Jul;41(7):1532.

41. Weston KS, Wisløff U, Coombes JS. High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis. British journal of sports medicine. 2014 Aug 1;48(16):1227-34. https://doi.org/10.1136/bjsports-2013-092576

42. Maillard F, Rousset S, Pereira B, Traore A, Del Amaze PD, Boirie Y, Duclos M, Boisseau N. High-intensity interval training reduces abdominal fat mass in PMWs with type 2 diabetes. Diabetes & metabolism. 2016 Dec 1;42(6):433-41. https://doi.org/10.1016/j.diabet.2016.07.031

43. Marzuca-Nassr GN, Artigas-Arias M, Olea MA, SanMartín-Calísto Y, Huard N, Durán-Vejar F, Beltrán-Fuentes F, Muñoz-Fernández A, Alegría-Molina A, Sapunar J, Salazar LA. High-intensity interval training on body composition, functional capacity and biochemical markers in healthy young versus older people. Experimental Gerontology. 2020 Nov 1;141:111096. https://doi.org/10.1016/j.exger.2020.111096

44. Alvarez C, Ramirez-Campillo R, Martinez-Salazar C, Castillo A, Gallardo F, Ciolac EG. High-intensity interval training as a tool for counteracting

dyslipidemia in women. International journal of sports medicine. 2018 May;39(05):397-406. doi:10.1055/s-0044-100387

45. Horovitz EG & Elgelid S. *Yoga therapy: Theory and practice.* 1st ed. New York, NY: Routledge/Taylor & Francis Group; 2015.
46. Pal A, Srivastava N, Tiwari S, Verma NS, Narain VS, Agrawal GG, Natu SM, Kumar K. Effect of yogic practices on lipid profile and body fat composition in patients of coronary artery disease. Complementary Therapies in Medicine. 2011 Jun 1;19(3):122-7. https://doi.org/10.1016/j.ctim.2011.05.001
47. Cramer H, Thoms MS, Anheyer D, Lauche R, Dobos G. Yoga in women with abdominal obesity—a randomized controlled trial. Deutsches Ärzteblatt International. 2016 Sep;113(39):645. doi: 10.3238/arztebl.2016.0645
48. Lau C, Yu R, Woo J. Effects of a 12-Week Hatha Yoga Intervention on Cardiorespiratory Endurance, Muscular Strength and Endurance, and Flexibility in Hong Kong Chinese Adults: A Controlled Clinical Trial. Evidence-Based Complementary and Alternative Medicine. 2015;2015(1):958727. https://doi.org/10.1155/2015/958727
49. Pandya SP. Yoga education program for older women diagnosed with sarcopenia: A multicity 10-year follow-up experiment. Journal of women & aging. 2019 Sep 3;31(5):446-69. https://doi.org/10.1080/08952841.2018.1510245
50. Mathew DJ, Kumar S, Jain PK, Shukla SK, Ali N, Singh DR. A cross-sectional study to assess the QoL of perimenopausal and post menopausal women in rural Etawah, Uttar Pradesh, India. Journal of Mid-life Health. 2020 Jul 1;11(3):161-7. DOI: 10.4103/jmh.JMH_88_19
51. Bhattacharya SM, Jha A. A comparison of health-related quality of life (HRQOL) after natural and surgical menopause. Maturitas. 2010 Aug 1;66(4):431-4.

52. Mahajan N, Kumar D, Fareed P. Comparison of menopausal symptoms and quality of life after natural and surgical menopause. International Journal of Scientific Study. 2015;2(11):74-7.

53. Page CE, Soreth B, Metcalf CA, Johnson RL, Duffy KA, Sammel MD, Loughead J, Epperson CN. Natural vs. surgical postmenopause and psychological symptoms confound the effect of menopause on executive functioning domains of cognitive experience. Focus. 2024 Jan;22(1):97-108.

54. Kavga F, Bothou A, Nanou C, Kyrkou G, Vivilaki V, Deltsidou A. Quality of Life Among Natural Menopausal Women and Early Surgical Menopausal Women: A Study from Greece. Nursing Reports. 2024; 14(4):3445-3453. https://doi.org/10.3390/nursrep14040250

55. Walsh MC, Hunter GR, Livingstone MB. Sarcopenia in premenopausal and postmenopausal women with osteopenia, osteoporosis and normal bone mineral density. Osteoporosis International. 2006 Jan;17:61-7. https://doi.org/10.1007/s00198-005-1900-x

56. Mitchell WK, Williams J, Atherton P, Larvin M, Lund J, Narici M. Sarcopenia, dynapenia, and the impact of advancing age on human skeletal muscle size and strength; a quantitative review. Frontiers in physiology. 2012 Jul 11;3:260. https://doi.org/10.3389/fphys.2012.00260

57. Gulati S, Misra A. Dietary proteins, metabolic syndrome, and sarcopenia: focus on Asian Indians. Diabetes & metabolic syndrome. 2019;13(6):3091-2. doi: 10.1016/j.dsx.2019.11.009

58. Supriya R, Singh KP, Gao Y, Li F, Dutheil F, Baker JS. A multifactorial approach for sarcopenia assessment: a literature review. Biology. 2021 Dec 20;10(12):1354. https://doi.org/10.3390/biology10121354

59. Buckinx F, Aubertin-Leheudre M. Sarcopenia in menopausal women: current perspectives. International Journal of Women's Health. 2022 Jun 23:805-19. https://doi.org/10.2147/IJWH.S340537

60. Nur H, Tuncer T. The relationship between body composition and knee OA in PMWs. Turkish journal of physical medicine and rehabilitation. 2018 Jun;64(2):121-125. doi: 10.5606/tftrd.2018.1496

61. Cho EJ, Choi Y, Jung SJ, Kwak HB. Role of exercise in estrogen deficiency-induced sarcopenia. Journal of exercise rehabilitation. 2022 Feb;18(1):2-9. doi: 10.12965/jer.2244004.002

62. Maffiuletti NA, Jubeau M, Munzinger U, Bizzini M, Agosti F, De Col A, Lafortuna CL, Sartorio A. Differences in quadriceps muscle strength and fatigue between lean and obese subjects. European journal of applied physiology. 2007 Sep;101:51-9. DOI 10.1007/s00421-007-0471-2

63. Keevil VL, Luben R, Dalzell N, Hayat S, Sayer AA, Wareham NJ, Khaw KT. Cross-sectional associations between different measures of obesity and muscle strength in men and women in a British cohort study. The journal of nutrition, health & aging. 2015 Jan;19:3-11. doi: 10.1007/s12603-014-0492-6.

64. Beechy L, Galpern J, Petrone A, Das SK. Assessment tools in obesity—Psychological measures, diet, activity, and body composition. Physiology & behavior. 2012 Aug 20;107(1):154-71. https://doi.org/10.1016/j.physbeh.2012.04.013

65. Maffiuletti NA, Ratel S, Sartorio A, Martin V. The impact of obesity on in vivo human skeletal muscle function. Current Obesity Reports. 2013 Sep;2:251-60. https://doi.org/10.1007/s13679-013-0066-7

66. Deepa M, Farooq S, Deepa R, Manjula D, Mohan V. Prevalence and significance of generalized and central body obesity in an urban Asian Indian population in Chennai, India (CURES: 47). European journal of clinical nutrition. 2009 Feb;63(2):259-67. https://doi.org/10.1038/sj.ejcn.1602920

67. Atapattu PM. Obesity at menopause: an expanding problem. Journal of Patient Care. 2015;1(1):2-7. doi: 10.4172/2573-4598.1000103

68. Wong MC, Huang J, Wang J, Chan PS, Lok V, Chen X, Leung C, Wang HH, Lao XQ, Zheng ZJ. Global, regional and time-trend prevalence of central obesity: a systematic review and meta-analysis of 13.2 million subjects. European journal of epidemiology. 2020 Jul;35:673-83. https://doi.org/10.1007/s10654-020-00650-3

69. Sriramaneni N, Selvan C, Kalra P, Naushad AA, Sourabh S. Quality of Life in postmenopausal women and its association with sarcopenia. Menopause. 2024 May 28; 31(8):679-695. DOI: 10.1097/GME.0000000000002378

70. Pap Z, Kalabiska I, Balogh Á, Bhattoa HP. Prevalence of sarcopenia in community-dwelling outpatient postmenopausal Hungarian women. BMC Musculoskeletal Disorders. 2022 Mar 4;23(1):207. https://doi.org/10.1186/s12891-022-05167-2

71. Orprayoon N, Wainipitapong P, Champaiboon J, Wattanachanya L, Jaisamrarn U, Chaikittisilpa S. Prevalence of pre-sarcopenia among postmenopausal women younger than 65 years. Menopause. 2021 Dec 1;28(12):1351-7. doi: 10.1097/GME.0000000000001866

72. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. Epidemiology of knee OA in India and related factors. Indian Journal of Orthopaedics. 2016 Oct;50(5):518-22. https://doi.org/10.4103/0019-5413.189608

73. Singh A, Das SK, Chopra A, Danda D, Paul BJ, March L, Mathew AJ, Shenoy P, Gotay C, Palmer AJ, Antony B. Pos1425 the burden of osteoarthritis across the states of India, 1990–2019: findings from the global burden of disease study 2019. Annals of the Rheumatic Diseases. 2022;81(Suppl 1):1055.2-1056. doi: 10.1136/annrheumdis-2022-eular.2361

74. Wright NC, Riggs GK, Lisse JR, Chen Z. Self-reported OA, ethnicity, BMI, and other associated risk factors in postmenopausal women —results from the Women's Health Initiative. Journal of the American Geriatrics Society. 2008 Sep;56(9):1736-43. https://doi.org/10.1111/j.1532-5415.2008.01812.x

75. Sabat SK, Panda S, Merli PK, Bhuyan SK. Prevalence and Correlates of Arthritis in Indian Older Adults: Findings from the Longitudinal Aging Study of India. International journal of health sciences.;6(S5):10062-72. doi: 10.53730/ijhs.v6nS5.11119

76. Nayak M, Kumar V, Kanojiya G, Mellon S, Srivastava DN, Pandit H, Malhotra R. A radiographic analysis of alignment in 966 lower extremities with knee pain and its association with osteoarthritis in Indian population. Journal of Orthopaedics. 2020 Jul 1;20:207-12. https://doi.org/10.1016/j.jor.2019.12.003

77. Shah Y, Pratinidhi SA, Chakor R., Ingale M, Dongarde Z, Pawar S, Solanki A. Varus angle correlation with knee pain in Indian post-menopausal women. International Journal of Scientific Research. 2024 July;13(7):27-29. doi: 10.36106/ijsr/6713072

78. Runhaar J, van Middelkoop M, Reijman M, Vroegindeweij D, Oei EH, Bierma-Zeinstra SM. Malalignment: a possible target for prevention of incident knee OA in overweight and obese women. Rheumatology. 2014 Sep 1;53(9):1618-24. https://doi.org/10.1093/rheumatology/keu141

79. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, Cooper C, Landi F, Rolland Y, Sayer AA, Schneider SM, Sieber CC, Topinkova E, Vandewoude M, Visser M, Zamboni M; Writing Group for the European Working Group on Sarcopenia in Older People 2 (EWGSOP2), and the Extended Group for EWGSOP2. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing. 2019 Jan 1;48(1):16-31. doi: 10.1093/ageing/afy169. Erratum in: Age Ageing. 2019 Jul 1;48(4):601. doi: 10.1093/ageing/afz046. PMID: 30312372; PMCID: PMC6322506.

80. Boshnjaku A, Krasniqi E. Diagnosing sarcopenia in clinical practice: International guidelines vs. population-specific cutoff criteria. Frontiers in Medicine. 2024 Jul 26;11:1405438. https://doi.org/10.3389/fmed.2024.1405438

81. Xu L, Cheng X, Wang J, Cao Q, Sato T, Wang M, Zhao X, Liang W. Comparisons of body-composition prediction accuracy: a study of 2 bioelectric impedance consumer devices in healthy Chinese persons using DXA and MRI as criteria methods. Journal of Clinical Densitometry. 2011 Oct 1;14(4):458-64. https://doi.org/10.1016/j.jocd.2011.04.001

82. Zhang C, Zhuang Z, Chen X, Li K, Lin T, Pang F, Zhang Y, He W, Wei Q. Osteoporosis is associated with varus deformity in postmenopausal women with knee Osteoarthritis: a cross-sectional study. BMC Musculoskeletal Disorders. 2021 Dec;22:1-0. https://doi.org/10.1186/s12891-021-04580-3

83. Zampogna B, Vasta S, Amendola A, Marbach BU, Gao Y, Papalia R, Denaro V. Assessing lower limb alignment: comparison of standard knee Xray vs long leg view. The Iowa Orthopaedic Journal. 2015;35:49-54. PMID: 26361444; PMCID: PMC4492139.

84. Babazadeh S, Dowsey MM, Bingham RJ, Ek ET, Stoney JD, Choong PF. The long leg radiograph is a reliable method of assessing alignment when compared to computer-assisted navigation and computer tomography. The Knee. 2013 Aug 1;20(4):242-9. https://doi.org/10.1016/j.knee.2012.07.009

85. Gibson K, Sayers SP, Minor MA. Measurement of varus/valgus alignment in obese individuals with knee osteoarthritis. Arthritis care & research. 2010 May;62(5):690-6. https://doi.org/10.1002/acr.20084

86. Issa SN, Dunlop D, Chang A, Song J, Prasad PV, Guermazi A, Peterfy C, Cahue S, Marshall M, Kapoor D, Hayes K. Full-limb and knee radiography assessments of varus-valgus alignment and their relationship to osteoarthritis disease features by magnetic resonance imaging. Arthritis Care & Research. 2007 Apr 15;57(3):398-406. https://doi.org/10.1002/art.22618

87. Kraus VB, Vail TP, Worrell T, McDaniel G. A comparative assessment of alignment angle of the knee by radiographic and physical examination methods. Arthritis & Rheumatism. 2005 Jun;52(6):1730-5. https://doi.org/10.1002/art.21100

88. Eshaghi SR, Ramezani MA, Shahsanaee A, Pooya A. Validity and reliability of the Short Form-36 Items questionnaire as a measure of quality of life in elderly Iranian population. Am J Appl Sci. 2006 Mar;3(3):1763-6.

89. Hamilton GF, McDonald C, Chenier TC. Measurement of grip strength: validity and reliability of the sphygmomanometer and Jamar grip dynamometer. Journal of Orthopaedic & Sports Physical Therapy. 1992 Nov;16(5):215-9.

90. Bellace JV, Healy D, Besser MP, Byron T, Hohman L. Validity of the Dexter Evaluation System's Jamar Dynamometer Attachment for Assessment of hand grip strength in a Normal Population. J Hand Ther. 2000;13:46-51.

91. Taylor JM. Psychometric analysis of the Ten-Item Perceived Stress Scale. Psychol Assess. 2015 Mar;27(1):90-101. doi: 10.1037/a0038100.

92. Masani NA. Psychometric analysis of Perceived Stress Scale and brief-cope inventory scale in menopausal women. The Indonesian Journal of Public Health. 2024;19(1):57. https://doi.org/10.20473/Ijph.v19i1.2023.57-68

93. Yu R, Ho SC. Psychometric evaluation of the Perceived stress scale in early postmenopausal Chinese women. Psychology. 2010 Apr 1;1(1):1-8. doi:10.4236/psych.2010.11001

94. Somanath A, Bhat RM, Nayanatara AK, Pai SR. Prevalence of perceived stress and obesity among women before and after menopause. Journal of Medical Science and Clinical Research. 2015;3(7):6534-7.

95. Sarveswaran G, Jayaseelan V, Krishnamoorthy Y, Sakthivel M, Arivarasan Y, Vijayakumar K, Marimuthu Y. Perceived stress and its determinants among PMWs in Urban Puducherry. Journal of Mid-life Health. 2021 Jan 1;12(1):33-8. doi: 10.4103/JMH.JMH_127_20

96. Shaji A, Reeja R. Stress and Quality of life among postmenopausal women. International Journal of Health Sciences and Research. 2024 Aug;14(8):153-157. DOI: https://doi.org/10.52403/ijhsr.20240821

97. Masoudi M, Ahmadian H, Akbari M, Jalilian N. The correlation of perceived stress and insomnia severity in postmenopausal women. Journal of Kermanshah University of Medical Sciences. 2020;24(2):e103493. https://doi.org/10.5812/jkums.103493.

98. Lyons RA, Perry IM, Littlepage BN. Evidence for the validity of the Short-form 36 Questionnaire (SF-36) in an elderly population. Age Ageing. 1994 May 1;23(3):182-4.

99. Budakoğlu İİ, Özcan C, Eroğlu D, Yanik F. QoL and postmenopausal symptoms among women in a rural district of the capital city of Turkey. Gynecological endocrinology. 2007 Jan 1;23(7):404-9. https://doi.org/10.1080/09513590701444748

100. Pan A, Kawachi I, Luo N, Manson JE, Willett WC, Hu FB, Okereke OI. Changes in body weight and health-related quality of life: 2 cohorts of US women. American journal of epidemiology. 2014 Aug 1;180(3):254-62. https://doi.org/10.1093/aje/kwu136

101. Jenabi E, Shobeiri F, Hazavehei SM, Roshanaei G. Assessment of questionnaire measuring QoL in menopausal women: a systematic review. Oman Medical Journal. 2015 May;30(3):151. https://search.informit.org/doi/10.3316/informit.212662231385568

102. Brończyk-Puzoń A, Piecha D, Nowak J, Koszowska A, Kulik-Kupka K, Dittfeld A, Zubelewicz-Szkodzińska B. Guidelines for dietary management of menopausal women with simple obesity. Menopause Review/Przegląd Menopauzalny. 2015 Mar 25;14(1):48-52. doi: 10.5114/pm.2015.48678.

103. Mendoza N, De Teresa C, Cano A, Godoy D, Hita-Contreras F, Lapotka M, Llaneza P, Manonelles P, Martínez-Amat A, Ocón O, Rodríguez-Alcalá L. Benefits of physical exercise in postmenopausal women. Maturitas. 2016 Nov 1;93:83-8.http://dx.doi.org/10.1016/j.maturitas.2016.04.017.

104. Mohammad Rahimi GR, Smart NA, Liang MT, Bijeh N, Albanaqi AL, Fathi M, Niyazi A, Mohammad Rahimi N. The impact of different modes of exercise training on bone mineral density in older postmenopausal women: A systematic review and meta-analysis research. Calcified Tissue International. 2020 Jun;106:577-90. https://doi.org/10.1007/s00223-020-00671-w

105. Cheng CC, Hsu CY, Liu JF. Effects of dietary and exercise intervention on weight loss and body composition in obese postmenopausal women: a systematic review and meta-analysis. Menopause. 2018 Jul 1;25(7):772-82. doi: 10.1097/GME.0000000000001085

106. Foster-Schubert KE, Alfano CM, Duggan CR, Xiao L, Campbell KL, Kong A, Bain CE, Wang CY, Blackburn GL, McTiernan A. Effect of diet and exercise, alone or combined, on weight and body composition in overweight-to-obese postmenopausal women. Obesity. 2012 Aug;20(8):1628-38. doi: 10.1038/OBY.2011.76

107. Eileen M Weinheimer, Laura P Sands, and Wayne W Campbell. A systematic review of the separate and combined effects of energy restriction and exercise on fat-free mass in middle-aged and older adults: implications for sarcopenic obesity. Nutrition Reviews. 2022. Vol. 68(7):375–388. doi:10.1111/j.1753-4887.2010.00298.x

108. Dhillon RJ, Hasni S. Pathogenesis and management of sarcopenia. Clinics in geriatric medicine. 2017 Feb 1;33(1):17-26. DOI: 10.1016/j.cger.2016.08.002

109. Roth SM, Ferrell RF, Hurley BF. Strength training for the prevention and treatment of sarcopenia. The journal of nutrition, health & aging. 2000 Jan 1;4(3):143-55. PMID: 10936901.

110. Yarasheski KE. Exercise, aging, and muscle protein metabolism. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2003 Oct 1;58(10):M918-22. doi: 10.1093/gerona/58.10.m918. PMID: 14570859.

111. Wakabayashi H, Sakuma K. Comprehensive approach to sarcopenia treatment. Current clinical pharmacology. 2014 May 1;9(2):171-80. doi: 10.2174/15748847086661311111928 45. PMID: 24219006.

112. Hayes LD, Elliott BT, Yasar Z, Bampouras TM, Sculthorpe NF, Sanal-Hayes NE, Hurst C. High-Intensity Interval Training (HIIT) as a potential countermeasure for phenotypic characteristics of sarcopenia: A scoping review. Frontiers in physiology. 2021 Aug 24;12:715044. https://doi.org/10.3389/fphys.2021.715044

113. Nunes PR, Martins FM, Souza AP, Carneiro MA, Nomelini RS, Michelin MA, Murta EF, de Oliveira EP, Orsatti FL. Comparative effects of high-intensity interval training with combined training on physical function markers in obese postmenopausal women: a randomized controlled trial. Menopause. 2019 Nov 1;26(11):1242-9. doi:10.1097/GME.0000000000001399

114. Grossman JA, Payne EK. A randomized comparison study regarding the impact of short-duration, high-intensity exercise and traditional exercise on anthropometric and body composition measurement changes in postmenopausal women–A pilot study. Post reproductive health. 2016 Mar;22(1):14-9. https://doi.org/10.1177/2053369115623899

115. Riaz H, Babur MN, Farooq A. Effects of high-intensity multi-modal exercise training (HIT-MMEX) on bone mineral density and muscle performance in postmenopausal women. A Pilot randomized controlled trial. J Pak Med Assoc. 2022 Oct;72(10):1904-1908. doi: 10.47391/JPMA.5394. PMID: 36660974.

116. Henke E, Oliveira VS, Silva IM, Schipper L, Dorneles G, Elsner VR, de Oliveira MR, Romão PR, Peres A. Acute and chronic effects of HIIT on inflammatory and oxidative stress markers of postmenopausal obese women. Translational sports medicine. 2018 Nov;1(6):257-64. https://doi.org/10.1002/tsm2.43

117. Jabbour G, Iancu HD. Comparison of performance and health indicators between perimenopausal and postmenopausal obese women: the effect of high-intensity

interval training (HIIT). Menopause. 2021 Jan 1;28(1):50-7. doi: 10.1097/GME.0000000000001654

118. Dupuit M, Rance M, Morel C, Bouillon P, Pereira B, Bonnet A, Maillard F, Duclos M, Boisseau N. Moderate-Intensity Continuous Training or High-Intensity Interval Training with or without Resistance Training for Altering Body Composition in postmenopausal women. Medicine and science in sports and exercise. 2020 Mar 1; 52 (3):736-45. doi:10.1249/MSS.0000000000002162
119. Morcillo-Losa JA, Díaz-Martínez MD, Ceylan Hİ, Moreno-Vecino B, Bragazzi NL, Párraga Montilla J. Effects of High-Intensity Interval Training on Muscle Strength for the Prevention and Treatment of Sarcopenia in Older Adults: A Systematic Review of the Literature. Journal of Clinical Medicine. 2024 Feb 25;13(5):1299. https://doi.org/10.3390/jcm13051299
120. Liu QQ, Xie WQ, Luo YX, Li YD, Huang WH, Wu YX, Li YS. High-intensity interval training: A potential method for treating sarcopenia. Clinical Interventions in Aging. 2023 Dec 31:857-72. https://doi.org/10.2147/CIA.S366245
121. Peterson MD, Serra JA. 2nd edn; Book Editor(s):Alfonso J. Cruz-Jentoft, . Exercise interventions to prevent and improve sarcopenia. Sarcopenia. 2021 Apr 27:305-33. Wiley Online Library. John Wiley & Sons Ltd. https://doi.org/10.1002/9781119597896.ch22
122. Guérin E, Biagé A, Goldfield G, Prud'homme D. Physical activity and perceptions of stress during the menopause transition: a longitudinal study. Journal of Health Psychology. 2019 May;24(6):799-811. doi: 10.1177/1359105316683787
123. Machawe M, Ahmadi S, Maghbooli Z, Eshaghi SM, Shirazi S, Hossein-Nezhad A, Larijani B. Stand Strong: Cyclic Yoga for Musculoskeletal Health. In

Osteoporosis International 2017 Jul 1 (Vol. 28, pp. S256-S257). 236 Grays Inn Rd, 6th Floor, London Wc1x 8hl, England: Springer London Ltd.

124. Yazdanparast F, Jafarirad S, Borazjani F, Haghighizadeh MH, Jahanshahi A. Comparing between the effect of energy-restricted diet and yoga on the resting metabolic rate, anthropometric indices, and serum adipokine levels in overweight and obese staff women. Journal of Research in Medical Sciences. 2020 Jan 1;25(1):37. doi:10.4103/jrms.JRMS_787_19
125. Telles S, Sharma SK, Yadav A, Singh N, Balkrishna A. A comparative controlled trial comparing the effects of yoga and walking for overweight and obese adults. Med Sci Monit. 2014 May 31;20:894-904. doi: 10.12659/MSM.889805. PMID: 24878827; PMCID: PMC4051462.
126. Kim S, Bemben MG, Bemben DA. Effects of an 8-month yoga intervention on arterial compliance and muscle strength in premenopausal women. Journal of sports science & medicine. 2012 Jun;11(2):322-330. PMID: 24149206; PMCID: PMC3737865.
127. Hossein-Nezhad A, Yarjoo B, Niketeghad G, Bakhshizadeh A, Machawe M, Eshaghi SM, Shirazi S, Maghbooli Z, Azarbayjani MA. Cyclic yoga for the prevention of age-related sarcopenia. In Osteoporosis International 2016 Apr 1; 27:S283-S283. DOI 10.1007/s00198-016-3530-x.
128. Colletto M, Rodriguez N. Routine yoga practice impacts whole body protein utilization in healthy women. Journal of Aging and Physical Activity. 2018 Jan 1;26(1):68-74. doi: https://doi.org/10.1123/japa.2016-0085.
129. Ahari SD, Ghazalian F, Gholami M. Effect of 20 weeks of selected Cyclic Yoga style training on core muscles hypertrophy in adult women. The Quarterly Journal of School of Medicine. 2020; 43(4): 204-210.

130. Balaji PA, Varne SR, Ali SS. Physiological Effects of Yogic Practices and Transcendental Meditation in Health and Disease. North American Journal of Medical Sciences. 2012. 4(10): 442-8. doi: 10.4103/1947-2714.101980.

131. Madanmohan M. Effect of yogic practices on different systems of human body. [Internet]. 2011 [cited 2023 Jan 5];1-14. Available from: http://www.icyer.com/documents/yogresearchMMT.pdf

132. Oken BS, Zajdel D, Kishiyama S, Flegal K, Dehen C, Haas M, Kraemer DF, Lawrence J, Leyva J. Randomized, controlled, six-month trial of yoga in healthy seniors: effects on cognition and QoL. Alternative Therapies in Health and Medicine. 2006 Jan-Feb;12(1):40-7. PMID: 16454146; PMCID: PMC1457100.

133. Yadav RK, Ray RB, Vempati R, Bijlani RL. Effect of a comprehensive yoga-based lifestyle modification program on lipid peroxidation. Indian J Physiol Pharmacol. 2005 Jul-Sep;49(3):358-62. PMID: 16440857. https://pubmed.ncbi.nlm.nih.gov/16440857/

134. Denham-Jones L, Gaskell L, Spence N, Pigott T. A systematic review of the effectiveness of yoga on pain, physical function, and quality of life in older adults with chronic musculoskeletal conditions. Musculoskeletal Care. 2022 Mar;20(1):47-73. https://doi.org/10.1002/msc.1576

135. Youkhana S, Dean CM, Wolff M, Sherrington C, Tiedemann A. Yoga-based exercise improves balance and mobility in people aged 60 and over: a systematic review and meta-analysis. Age and Ageing. 2016 Jan 1;45(1):21-9. https://doi.org/10.1093/ageing/afv175

136. Thakkar V, Palekar SK, Desai RR, Basu S. Effect of Pilates vs. yoga on balance, cognition and core strength in elderly. Indian J. Physiother. Occup. Ther.-Int. J. 2021 Jan;15:155-62..

137. Widjaja W, Wongwattanapong T, Laskin JJ, Ajjimaporn A. Benefits of Thai Yoga on physical mobility and lower limb muscle strength in overweight/obese older women: A randomized controlled pilot trial. Complementary Therapies in Clinical Practice. 2021 May 1;43:101345. https://doi.org/10.1016/j.ctcp.2021.101345

138. Gronek J, Domaszewska K. Effects of yoga training in post-menopausal women. Trends in Sport Sciences. 2022 Jul 1;29(3):85-89. doi: 10.23829/TSS.2022.29.3-1

139. Sivaramakrishnan D, Fitzsimons C, Kelly P, Ludwig K, Mutrie N, Saunders DH, Baker G. The effects of yoga compared to active and inactive controls on physical function and health-related QoL in older adults-systematic review and meta-analysis of randomized controlled trials. International Journal of Behavioral Nutrition and Physical Activity. 2019 Dec;16(1):1-22. https://doi.org/10.1186/s12966-019-0789-2

140. Joshi S, Khandwe R, Bapat D, Deshmukh U. Effect of yoga on menopausal symptoms. Menopause international. 2011 Sep;17(3):78-81. https://doi.org/10.1258/mi.2011.011020

141. Chaturvedi A, Nayak G, Nayak AG, Rao A. Comparative assessment of the effects of hatha yoga and physical exercise on biochemical functions in perimenopausal women. Journal of clinical and diagnostic research: JCDR. 2016 Aug;10(8):KC01. doi: 10.7860/JCDR/2016/18891.8389

142. Taspinar B, Aslan UB, Agbuga B, Taspinar F. A comparison of the effects of hatha yoga and resistance exercise on mental health and well-being in sedentary adults: A pilot study. Complementary therapies in medicine. 2014 Jun 1;22(3):433-40. https://doi.org/10.1016/j.ctim.2014.03.007

143. Reddy P. A Comparative Study to Assess the Effectiveness of Brisk Walking and Yoga Interventions on the Level of Hypertension, Cholesterol, and Blood Glucose

among Hypertensive Patients in Selected Areas of The City. Current Journal of Applied Science and Technology. 2024 Jun 19;43(7):47-60. https://doi.org/10.9734/cjast/2024/v43i74405.

144. Erdélyi A, Pálfi E, Tűű L, Nas K, Szűcs Z, Török M, Jakab A, Várbíró S. The Importance of Nutrition in Menopause and Perimenopause-A Review. Nutrients. 2023 Dec 21;16(1):27. doi: 10.3390/nu16010027
145. Wylenzek F, Bühling KJ, Laakmann E. A systematic review on the impact of nutrition and possible supplementation on the deficiency of vitamin complexes, iron, omega-3 fatty acids, and lycopene in relation to increased morbidity in women after menopause. Archives of Gynecology and Obstetrics. 2024 Oct;310(4):2235-45.
146. McClain K, Bodensteiner A. Nutrition Interventions for Weight Gain and Body Composition Changes in Menopausal Women: A Review. Current Developments in Nutrition. 2022 Jun 1;6:1074. https://doi.org/10.1093/cdn/nzac070.033
147. Silva TR, Oppermann K, Reis FM, Spritzer PM. Nutrition in menopausal women: a narrative review. Nutrients. 2021 Jun 23;13(7):2149. https://doi.org/10.3390/NU13072149]
148. Boutcher SH. High-intensity intermittent exercise and fat loss. Journal of obesity. 2011;2011(1):868305.https://doi.org/10.1155/2011/868305
149. Sijie T, Hainai Y, Fengying Y, Jianxiong W. High-intensity interval exercise training in overweight young women. The Journal of sports medicine and physical fitness. 2012 Jun 1;52(3):255-62. PMID: 22648463. https://europepmc.org/article/med/22648463

150. Lee JA, Kim JW, Kim DY. Effects of yoga exercise on serum adiponectin and metabolic syndrome factors in obese postmenopausal women. Menopause. 2012 Mar 1;19(3):296-301. *DOI:* 10.1097/gme.0b013e31822d59a2

151. Buchheit M, Laursen PB. High-intensity interval training, solutions to the programming puzzle: Part I: cardiopulmonary emphasis. Sports medicine. 2013 May;43(5):313-38. https://doi.org/10.1007/s40279-013-0029-x

152. Foster C, Farland CV, Guidotti F, Harbin M, Roberts B, Schuette J, Tuuri A, Doberstein ST, Porcari JP. The effects of HIIT vs steady state training on aerobic and anaerobic capacity. J Sports Sci Med. 2015 Dec;14(4):747-755. https://pmc.ncbi.nlm.nih.gov/articles/PMC4657417/

153. Rajan AI, Dixit RK, Joshi AR. Effect of yoga on aerobic power, anaerobic power and audio-visual reaction time in healthy individuals. International Journal of Physiology. 2014;2(1):9-13.

154. Abhilash SS, Joseph G. Effects of Pilates exercise, power yoga, and high-intensity interval training on muscular endurance among male school students. International Journal of Physical Education, Sports and Health 2019; 6(1): 41-43. https://www.kheljournal.com/archives/2019/vol6issue1/PartA/9-3-69-788.pdf

155. Govindaraj R, Karmani S, Varambally S, Gangadhar BN. Yoga and physical exercise–a review and comparison. International Review of Psychiatry. 2016 May 3;28(3):242-53. https://doi.org/10.3109/09540261.2016.1160878

156. Ross A, Thomas S. The health benefits of yoga and exercise: a review of comparison studies. The journal of alternative and complementary medicine. 2010 Jan 1;16(1):3-12. https://doi.org/10.1089/acm.2009.0044

157. Flehr A, Barton C, Coles J, Gibson SJ, Lambert GW, Lambert EA, Dhar AK, Dixon JB. # MindinBody-feasibility of vigorous exercise (Bikram yoga versus

HIIT) to improve persistent pain in women with a history of trauma: a pilot randomized control trial. BMC complementary and alternative medicine. 2019 Dec;19:1-6. https://doi.org/10.1186/s12906-019-2642-1

158. Felson DT, Anderson JJ, Naimark A, Walker AM, Meenan RF. Obesity and knee osteoarthritis: the Framingham Study. *Ann Intern Med*. 1988 Jul 1;109(1):18-24.
159. Sharifi N, Afshari F, Bahri N. The effects of yoga on quality of life among postmenopausal women: A systematic review study. Post Reproductive Health. 2021 Dec;27(4):215-21. https://doi.org/10.1177/20533691211046152
160. Walankar P, Verma C, Mehta A. Study of Hand Grip Strength in Indian Population. International Journal of Health Sciences and Research. 2016;6 (11):162-166.
161. KK Gupta, Attri JP, A Singh, H Kaur, G Kaur. Basic Concepts for sample size calculation: Critical step for any clinical trials! Saudi Journal of Anaesthesia. 2016; 10(3): 328-331. doi:10.4103/1658-354X.174918
162. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, Altman DG, Barbour V, Macdonald H, Johnston M, Lamb SE. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. Bmj. 2014 Mar 7;348:g1687. doi: https://doi.org/10.1136/bmj.g1687
163. Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. Journal of Pharmacology and Pharmacotherapeutics. 2010 Dec;1(2):100-7. https://doi.org/10.4103/0976-500X.72352

164. WC and Waist–Hip Ratio: Report of a WHO Expert Consultation. Geneva, Switzerland [Internet]. 8–11 December 2008. [cited October 17 2021]. Available from: https://www.who.int/publications/i/item/9789241501491

165. Pal R, Aggarwal A, Singh T, Sharma S, Khandelwal N, Garg A, Bhansali A, Kumar A, Yadav U, Singh P, Dhiman V. Diagnostic cut-offs, prevalence, and biochemical predictors of sarcopenia in healthy Indian adults: the Sarcopenia-Chandigarh Urban Bone Epidemiological Study (Sarco-CUBES). European Geriatric Medicine. 2020 Oct;11:725-36. doi: 10.1007/s41999-020-00332-z

166. Weng N, Knipe H, Rock P. HKA angle. [Internet] Reference article, Radiopaedia.org. 2021 Jan 29. [cited 2022 March 2] Available at: https://radiopaedia.org/articles/HKA-angle. https://doi.org/10.53347/rID-88254

167. Leppink J, O'Sullivan P, Winston K. Effect size–large, medium, and small. Perspectives on medical education. 2016 Dec;5:347-9. https://doi.org/10.1007/s40037-016-0308-y

168. Leppink J, O'Sullivan P, Winston K. Are differences between groups different at different occasions?. Perspectives on Medical Education. 2017 Dec;6:413-7. https://doi.org/10.1007/s40037-017-0380-y

169. Palacios S, Chedraui P, Sánchez-Borrego R, Coronado P, Nappi RE. Obesity and menopause. Gynecological Endocrinology. 2024 Dec 31;40(1):2312885.

170. Zulfi OE, Dwiningsih SR, Krisnana I. The body mass index (BMI) related to menopause symptoms. Indonesian Midwifery and Health Sciences Journal. 2021 Jan 28;5(1):73-87.

171. Nagaraj N. The role of reproductive health in musculoskeletal aging: A life-course approach. 2017. (Doctoral dissertation, University of Pittsburgh).

172. Chavda JA, Chokshi TR, Patel MH. A comparison of cardiopulmonary endurance, fatigue level, and life satisfaction among paramedical married working women and housewives. Physiotherapy-The Journal of Indian Association of Physiotherapists. 2024 Jan 1;18(1):34-7.

173. Nutan, N., & Ghildyal, S. (2024). Body composition distribution in middle-aged working women and homemakers- a comparison. Indian Journal of Applied Research. 2024: 14 (5): 70-71.

174. Su H, Wen T, Liu D, Shao J, Zhao L, Gao Q. Effect of 32-week high-intensity interval training and resistance training on delaying sarcopenia: Focus on endogenous apoptosis. Frontiers in Physiology. 2022 Apr 28;13:811369. doi: 10.3389/fphys.2022.811369. PMID: 35574455; PMCID: PMC9095960.

175. Hoshino D, Kitaoka Y, Hatta H. High-intensity interval training enhances oxidative capacity and substrate availability in skeletal muscle. The Journal of Physical Fitness and Sports Medicine. 2016 Mar 25;5(1):13-23. doi: 10.7600/JPFSM.5.13

176. Torma F, Gombos Z, Jokai M, Takeda M, Mimura T, Radak Z. HIIT and molecular adaptive response of skeletal muscle. Sports Medicine and Health Science. 2019 Dec 1;1(1):24-32. doi: 10.1016/J.SMHS.2019.08.003

177. Moghaddam M, Estrada CA, Baghurst T, Jacobson BH. Muscular morphological adaptations of two whole-body HIIT configurations. The Journal of Sports Medicine and Physical Fitness. 2020 Apr 27;60(7):985-91. doi: 10.23736/S0022-4707.20.10526-7. Epub 2020 Apr 27. PMID: 32343081.

178. Buckinx F, Gouspillou G, Carvalho LP, Marcangeli V, El Hajj Boutros G, Dulac M, Noirez P, Morais JA, Gaudreau P, Aubertin-Leheudre M. Effect of High-Intensity Interval Training Combined with L-Citrulline Supplementation on

Functional Capacities and Muscle Function in Dynapenic-Obese Older Adults. J Clin Med. 2018 Dec 17;7(12):561. doi: 10.3390/jcm7120561. PMID: 30562948; PMCID: PMC6306942.

179. Tripathi M. The Impact of Yoga on Physiological Wellness of Human Being. [Internet]. March 2, 2013 [cited 2024 August 24] Available at SSRN: https://ssrn.com/abstract=2227376 or http://dx.doi.org/10.2139/ssrn.2227376
180. Loewenthal J, Innes KE, Mitzner M, Mita C, Orkaby AR. Effect of yoga on frailty in older adults: a systematic review. Annals of internal medicine. 2023 Apr;176(4):524-35. https://doi.org/10.7326/M22-2553
181. Bernstein AM, Bar J, Ehrman JP, Golubic M, Roizen MF. Yoga in the Management of Overweight and Obesity. American Journal of Lifestyle Medicine. 2014;8(1):33-41. doi:10.1177/1559827613492097
182. Lichtenberg T, von Stengel S, Sieber C, Kemmler W. The favorable effects of a high-intensity resistance training on sarcopenia in older community-dwelling men with osteosarcopenia: the randomized controlled FrOST study. Clinical interventions in aging. 2019 Dec 16:2173-86. doi: 10.2147/CIA.S225618
183. Plizga J, Jaworski A, Grajnert F, Głuszczyk A, Surma A, Cecot J, Parfianowicz A, Zarzecki K, Mandryk M, Holdun N. High-Intensity Interval Training - health benefits and risks - literature review. Qual Sport [Internet]. 2024 Jul. 27 [cited 2024 Dec. 3];18:53359. https://doi.org/10.12775/QS.2024.18.53359 Available at: https://apcz.umk.pl/QS/article/view/53359
184. Hostrup M, Lemminger AK, Stocks B, Gonzalez-Franquesa A, Larsen JK, Quesada JP, Thomassen M, Weinert BT, Bangsbo J, Deshmukh AS. High-intensity interval training remodels the proteome and acetylome of human skeletal

muscle. Elife. 2022 May 31;11:e69802. doi: 10.7554/eLife.69802. PMID: 35638262; PMCID: PMC9154743.

185. Wahl P, Bloch W, Proschinger S. The molecular signature of high-intensity training in the human body. International journal of sports medicine. 2022 Mar;43(03):195-205. DOI: 10.1055/a-1551-9294

186. Murawska-Cialowicz E, Wolanski P, Zuwala-Jagiello J, Feito Y, Petr M, Kokstejn J, Stastny P, Goliński D. Effect of HIIT with Tabata protocol on serum irisin, physical performance, and body composition in men. International journal of environmental research and public health. 2020 May;17(10):3589. https://doi.org/10.3390/ijerph17103589

187. Buckinx F, Aubertin-Leheudre M. Menopause and high-intensity interval training: effects on body composition and physical performance. Menopause. 2019 Nov 1;26(11):1232-3. *DOI:* 10.1097/GME.0000000000001433

188. Dupuit M, Maillard F, Pereira B, Marquezi ML, Lancha Jr AH, Boisseau N. Effect of HIIT on body composition in women before and after menopause: a meta-analysis. Experimental physiology. 2020 Sep;105(9):1470-90. https://doi.org/10.1113/EP088654

189. Nunes PR, Martins FM, Souza AP, Carneiro MA, Orsatti CL, Michelin MA, Murta EF, de Oliveira EP, Orsatti FL. Effect of high-intensity interval training on body composition and inflammatory markers in obese postmenopausal women: a randomized controlled trial. Menopause. 2019 Mar 1;26(3):256-64. doi: 10.1097/GME.0000000000001207. PMID: 30277921.

190. Kamakhya K, Seema P. Influence of Yoga and Diet control in managing the state of Obesity. J Yoga & Physio. 2016; 1(1): 555553. doi: 10.19080/JYP.2016.03.555553

191. Petrofsky JS, Laymon MS, Khowailed IA, Lee H, Petrofsky A. The effect of an 8-minute yoga breathing program on fitness, weight loss, and breathing capacity. Journal of Applied Medical Sciences. 2016;5(4), 57-80.

192. Rioux JG, Ritenbaugh C. Narrative review of yoga intervention clinical trials including weight-related outcomes. Altern Ther Health Med. 2013 May 1;19(3):32-46.

193. Na Nongkhai MP, Yamprasert R, Punsawad C. Effects of continuous yoga on body composition in obese adolescents. Evidence-Based Complementary and Alternative Medicine. 2021;2021(1):6702767. https://doi.org/10.1155/2021/6702767

194. Gawrys W, Ślęzak A. Yoga practitioners body composition and health-related indicators. Physical Activity Review. 2020 Jan 22;1(8):9-15. doi: 10.16926/par.2020.08.02

195. Omelan A, Wiśniewska J, Podstawski R. Body composition and psychophysical well-being of women practicing yoga. Baltic Journal of Health and Physical Activity. 2022; 14(3):4. https://doi.org/10.29359/BJHPA.14.3.0.

196. Arabadzhy A, Arabadzhy A, Fedoryna T. Analysis of the impact of physical exercises on reducing stress among students under martial law. Bulletin of the National Technical University KhPI Series: Actual problems of Ukrainian society development. 2024 July. doi: 10.20998/2227-6890.2024.1.19

197. Arvidson E, Dahlman AS, Börjesson M, Gullstrand L, Jonsdottir IH. The effects of exercise training on hypothalamic-pituitary-adrenal axis reactivity and autonomic response to acute stress—a randomized controlled study. Trials. 2020 Dec;21:1-4. doi: 10.1186/S13063-020-04803-3

198. Rodnick KJ, Planas JV. The stress and stress mitigation effects of exercise: cardiovascular, metabolic, and skeletal muscle adjustments. In Fish Physiology. Editor(s): Schreck CB, Tort L, Farrell AP, Brauner AJ, Academic Press. 2016 Jan 1; 35: 251-294. doi: 10.1016/B978-0-12-802728-8.00007-2
199. de Freitas VH, Mariano IM, Amaral AL, Rodrigues ML, Carrijo VH, Nakamura FY, Puga GM. Blood pressure and heart rate variability responses to high-intensity interval training in untrained PMWs. Research quarterly for exercise and sport. 2022 Oct 2;93(4):749-57. doi: 10.1080/02701367.2021.1917756
200. Maharana S, Jayaprakash M. Effect of Bhramari Pranayama on Menopausal Women. SBV Journal of Basic, Clinical and Applied Health Science. 2023 Sep 28;6(4):73-8. doi: 10.5005/jp-journals-10082-03202
201. Hayati S, Sansuwito TB, Irawan E. The Effect of Yoga Exercise on Depression In Menopausal Women In Babakan Sari Sub-District, Bandung City. International Journal of Health Sciences. 2023 Oct 20;1(4):449-57. doi: 10.52523/jika.v1i2.51
202. Kothari A. Managing Anxiety among postmenopausal women through Yoga. International Journal of Indian Psychology. 2021;9(2). doi: 10.25215/0902.004
203. Apriyani T, Rahmadayanti AM., Purwani R. The effect of yoga on reducing anxiety levels in premenopausal women at PMB Sumiyati. Journal of Midwifery Sciences. 2023;12(2):193-199. DOI:10.35328/92f9xb46
204. Koh SH, Son S, Ha SM, Kim TK., Kim D. The Effect of Yoga Exercise on PWI-SF, Cortisol, and hs-CRP in Menopause Women. Korean Journal of Neuromuscular Rehabilitation. 2022;12(4):72-79. doi: 10.37851/kjnr.2022.12.4.8
205. Jorge MP, Santaella DF, Pontes IM, Shiramizu VK, Nascimento EB, Cabral A, Lemos TM, Silva RH, Ribeiro AM. Hatha Yoga practice decreases menopause

symptoms and improves QoL: A randomized controlled trial. Complementary therapies in medicine. 2016 Jun 1;26:128-35. doi: 10.1016/J.CTIM.2016.03.014

206. Joice SPP, Sudhir PK. Impact of yoga on psychological status of PMWs. International Journal of Medical Science and Public Health 2019;8(11):959-961. doi: 10.5455/ijmsph.2019.0824410092019
207. Schleinzer A, Moosburner A, Anheyer D, Burgahn L, Cramer H. Effects of yoga on stress in stressed adults: a systematic review and meta-analysis. Frontiers in Psychiatry. 2024 Nov 1;15:1437902. doi: 10.3389/fpsyt.2024.1437902
208. Garana M. Yoga for stress reduction: a psychologist's perspective. Divyayatan-A Journal of Lakulish Yoga University. 2024 Jun 29;1(2):7-12. doi: 10.69919/tdbgqm22
209. Kumari D. A comprehensive review on effect of yogic practices (Pranayama) on stress and anxiety. International Journal of yogic, human movement and sports sciences. 2024: 9(1): 03-09 doi: https://doi.org/10.22271/yogic.2024.v9.i1a.1512
210. Khan MU, Raza Y, Garg AK, Mishra VD. A study to assess the effectiveness of yoga exercise to control the stress among adults at selected rural areas of Jaipur city. International journal of advance research in medical surgical nursing. 2024; 6(1): 106-109. doi: 10.33545/surgicalnursing.2024.v6.i1b.176
211. Joshi SJ, Khan SN, Kantharia JS, Mhase S, Pashine AA, Umate R. A pragmatic comparison between aerobic exercise and Suryanamaskar in stress management in medical professionals: a quasi-experimental study. Cureus. 2022 Sep;14(9):e29414. doi: 10.7759/cureus.29414
212. Faramarzi S, Dehghani A, Hojat M. Comparison of the Effect of Yoga and Aerobic Exercise on Nurses' Burnout: A Randomized Controlled Trial. Journal of

Nursing and Midwifery Sciences. 2024;11(1): e142568. doi: 10.5812/jnms-142568

213. Schneider HP. The Quality of Life in the post-menopausal woman. Best practice & research. Clin Obstet Gynecol 2002. Jun;16(3):395-409.
214. Guna IW, Andayani NL, Ayu IG, Putra IP. The Relationship between Physical Activity Levels and Quality of Life in Menopausal Women. FISIO MU: Physiotherapy Evidences. 2024 Jun 1;5(2):162-8. doi: 10.23917/fisiomu.v5i2.4862
215. Putri DI, Wati DM, Ariyanto Y. Quality of life among menopausal women. Health Library. Jan 10, 2014; 2(1):167-74.
216. Woods NF. Exercise, fitness, and Quality of Life: implications for health promotion for midlife and older women. Menopause. 2008 Jul 1;15(4):579-80. doi: 10.1097/GME.0B013E3181784192
217. Nikpour S, Haghani H. The effect of exercise on quality of life in postmenopausal women referred to the bone densitometry centers of Iran University of Medical Sciences. Journal of mid-life health. 2014 Oct 1;5(4):176-9. doi: 10.4103/0976-7800.145156
218. Nayak G, Kamath A, Kumar PN, Rao A. Effect of yoga therapy on physical and psychological quality of life of perimenopausal women in selected coastal areas of Karnataka, India. Journal of mid-life health. 2014 Oct 1;5(4):180-5. doi: 10.4103/0976-7800.145161
219. Crowe BM, Van Puymbroeck M, Linder SM, Mcguire FA, Watt PJ. The effects of yoga participation on women's quality of life and symptom management during the menopausal transition: A pilot study. Health care for women international. 2015 Oct 3;36(10):1124-42. doi: 10.1080/07399332.2015.1066789

220. Sijna VP, Shobhana MC. Effect of clinical yoga package on quality of life of perimenopausal women: a randomized controlled trial. International Journal of Research in Ayurveda and Pharmacy. 2021;12(2):25-28. doi: 10.7897/2277-4343.120240

221. Madhumita P, Mahesh V, Prasad MK. Influence of yoga asana, pranayama on quality of life and menopausal syndrome. International Journal of Ayurveda and Pharma Research. 2016 Jul; 4(6):80-83.

222. Gangadharan S, Arulappan J, Matua GA, Bhagavathy MG, Alrahbi H. Effectiveness of yoga on menopausal symptoms and quality of life among menopausal women: a systematic review. International Journal of Nutrition, Pharmacology, Neurological Diseases. 2024 Jul 1;14(3):300-16. doi: 10.4103/ijnpnd.ijnpnd_23_24

223. Beura S, Patnaik L, Sahu M. Effectiveness of lifestyle-related interventions to improve quality of life among postmenopausal women in selected slums of Bhubaneswar: A community based quasi experimental study. J Educ Health Promot. 2023 Nov 27;12:388. doi: 10.4103/jehp.jehp_599_23. PMID: 38333177; PMCID: PMC10852166.

ANNEXURE –I- CTRI FINAL REGISTRATION DOCUMENT PHD

CLINICAL TRIALS REGISTRY - INDIA
ICMR - National Institute of Medical Statistics



PDF of Trial
CTRI Website URL - http://ctri.nic.in

Clinical Trial Details (PDF Generation Date :- Thu, 27 Jan 2022 13:35:21 GMT)

CTRI Number	CTRI/2021/12/038878 [Registered on: 23/12/2021] - **Trial Registered Prospectively**
Last Modified On	02/12/2021
Post Graduate Thesis	Yes
Type of Trial	Interventional
Type of Study	Yoga & Naturopathy Physiotherapy (Not Including YOGA)
Study Design	Randomized, Parallel Group Trial
Public Title of Study	Comparing 2 types of exercise protocols including high intensity training and Yoga for Postmenopausal Women with abdominal Obesity, muscle mass loss and weakness and alignment corrections of the Lower Limb Angulations
Scientific Title of Study	High Intensity Interval Training versus Hatha Yoga for Postmenopausal Women with Central Obesity, Sarcopenia and Dynapenia on Muscle and Fat mass, Abdominal Fat and Lowe Limb Alignment: A Randomized Clinical Trial

Secondary IDs if Any

Secondary ID	Identifier
NIL	NIL

Details of Principal Investigator or overall Trial Coordinator (multi-center study)

Details of Principal Investigator	
Name	Peeyoosha Gurudut
Designation	Associate Professor
Affiliation	KLE Institute of Physiotherapy
Address	Dept. of Orthopedic Physiotherapy, KLE Institute of Physiotherapy, Nehru Nagar, Belagavi Dept. of Orthopedic Physiotherapy, KLE Institute of Physiotherapy, Nehru Nagar, Belagavi Belgaum KARNATAKA 590010 India
Phone	9844821355
Fax	
Email	peeoo123@yahoo.com

Details Contact Person (Scientific Query)

Details Contact Person (Scientific Query)	
Name	Peeyoosha Gurudut
Designation	Associate Professor
Affiliation	KLE Institute of Physiotherapy
Address	Dept. of Orthopedic Physiotherapy, KLE Institute of Physiotherapy, Nehru Nagar, Belagavi Dept. of Orthopedic Physiotherapy, KLE Institute of Physiotherapy, Nehru Nagar, Belagavi Belgaum KARNATAKA 590010 India
Phone	9844821355
Fax	
Email	peeoo123@yahoo.com

Details Contact Person (Public Query)

Details Contact Person (Public Query)	
Name	Dr Sanjiv Kumar
Designation	Professor & Principal
Affiliation	KLE Institute of Physiotherapy,
Address	KLE Institute of Physiotherapy, Nehru Nagar, Belagavi KLE Institute of Physiotherapy, Nehru Nagar, Belagavi

ANNEXURE – II - EHICAL CLEARANCE CERTIFICATE PHD

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Formerly known as KLE University)
(Deemed-to-be-University established u/s 3 of the UGC Act, 1956)
Accredited **'A' Grade** by NAAC (2nd Cycle) Placed in **Category 'A'** by MHRD (GoI)
JNMC Campus, Nehru Nagar, Belagavi-590 010, Karnataka State, India
☎: 0831-2444444 FAX: 0831-2493777 Web: http://www.kledeemeduniversity.edu.in E-mail: info@kledeemeduniversity.edu.in

Ref.No.KAHER/EC/21-22/ 018 29th July 2021

To,
Dr. Peeyoosha Gurudut
Part-Time Ph.D. Research Scholar,
2020-21Batch, Faculty of Physiotherapy,
KAHER, Belagavi.

Dear Research Scholar,

The KAHER Ethics Committee on Human Subjects for Ph.D. Research Project met on **the 7th and 8th June, 2021** to consider your application for approval of the research project **"High intensity interval training versus hatha yoga for postmenopausal women with central obesity, sarcopenia and dynapenia on muscle and fat mass, abdominal fat and Lowe Limb alignment: a randomised clinical trial."**

As there are no ethical issues involved in your proposed research project, the committee has provided approval for this research project.

You are requested to report to Ethical Committee of the following:

1. Any deviation from or change of the protocol.
2. Any changes in study documents.

(Dr. Sheetal U. Harakuni)
Member-Secretary
Ethical Committee (Human) for Ph. D. Research
KAHER, Belagavi.

(Dr. B.C. Kotintot)
Chairman
Ethical Committee (Human) for Ph. D. Research
KAHER, Belagavi.

CC to:

- Special Officer to Hon. Vice Chancellor, KAHER, Belagavi
- The Registrar, KAHER, Belagavi.
- The Director Research Foundation, KAHER, Belagavi.
- The Director Academic Affairs, KAHER, Belagavi.

ANNEXURE - III - INFORMED CONSENT FORM

INFORMED CONSENT FORM & PATIENT INFORMATION SHEET

Study Title: High-Intensity Interval Training Versus Hatha Yoga for PMWs with Central Obesity, Sarcopenia and Dynapenia on Muscle and Fat Mass, Abdominal Fat and Knee Alignment: A Randomized Clinical Trial

PRINCIPAL INVESTIGATOR: Peeyoosha Gurudut, Professor, Department of Orthopedic Physiotherapy, KAHER Institute of Physiotherapy, Belagavi

SUPERVISOR: Dr. (Prof) Sanjiv Kumar, Principal & Professor, KAHER Institute of Physiotherapy, Belagavi

Introduction: I am Peeyoosha Gurudut, working in KAHER Institute of Physiotherapy, Belagavi. We are doing research on obesity in PMWs, which is very common in this country. I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them to me.

Purpose of the research: Menopause is strongly associated with diseases like obesity, heart diseases, weight gain around abdomen and hips, Diabetes, High blood pressure, cancers posing numerous challenging health issues in a woman's life. [1] The bone and muscle system are also prone to several risks including osteoporosis, joint degenerations, fractures, falls, muscle mass loss, slower walking speed, strength loss, etc. Exercise training programs like walking, jogging and yoga are very effective in prevention and management of health risks in elderly women. Hence, we are doing research to know if exercise training is better than yoga or vice versa.

Type of Research Intervention/therapy/protocol: Around 160 PMWs from Belagavi city will be invited to participate in this study. This is a study where you will be required to perform exercises of 1hour duration in each session. The protocol includes intervention in form of either exercise (combination of jogging and walking) or Yoga which will be for 5 sessions per week for 12 weeks. You will also be provided education about the diet you need to follow during the study period.

Participant selection: We are inviting all PMWs between age group of 46 to 70 years with increased WC to participate in the research.

Voluntary Participation: Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate in this research project, you will be offered the standard education and counselling that is routinely offered in this clinic/hospital for the problem, and we will tell you more about it later. You may change your mind later and stop participating even if you agreed earlier.

Information on the study protocol/exercise:

Justification of the study: Weight loss or fat mass loss with gain in muscle mass is recommended for PMWs to prevent many health risks. HIIT and Yoga are two such exercise forms which are prescribed safely in PMWs. HIIT is gaining popularity due to its time efficient characteristic while being effective in weight loss. The impact of yoga on aging health of women, fall, osteopenia, weight management, stress have been well established in the literature. In addition to this, weight gain is also related to changes in the knee angles which may lead to degenerative changes in long run. Hence, preventive role of these exercises by reduced fat mass or weight on avoiding arthritis in knee can be studied. Thus, it was thought to study the effects of 12 weeks of HIIT and yoga training protocols in PMWs with abdominal adiposity, muscle mass, physical function quality and knee alignment.

Information about the exercise technique and the therapeutic/modality:

HIIT: The protocol includes intervention that includes combination of jogging and walking at your 90% capacity. You will be given warm up and cool down before and after exercising respectively.

Hatha Yoga: You will be made to do warm up followed by yoga asanas, sun salutation poses along with pranayama. The session will end with Shavasana.

You will also be provided education about the diet you need to follow during the study period.

Procedures, process of randomization and study Protocol: There are 2 groups in the study. One group will be given HIIT and other group will be give Yoga. You will have equal chance to be in either of the two study groups. You will be asked to pick a chit to decide which group you will be allocated.
Before beginning the exercise intervention, you will undergo a detailed evaluation for exercise capacity, health related issues, fat mass, muscle mass, grip strength, BMI, WC, stress levels as perceived by you and your functional capacity including walking speed and HGS. The same measurements will be again repeated at end of 3rd month to document the improvement.
An x-ray of your lower limbs will be taken to measure angles of your lower limbs and ultrasonography of abdomen for measuring central fat will be performed by radiologist twice i.e., once at the beginning of the study and once at the end of the third month.
Description of the study Process: During the research you make many visits to the clinic.

- In the first visit, you will be screened for the criteria to participate in the study.
- If you are eligible, you will be made to attend an orientation session of 30mins during which you will be explained about the study protocol in detail. A group of like need participants will be formed and basic details will be noted down.
- At the next visit, you will undergo a detailed assessment as per the study requirement which includes your x ray, body composition assessment, walking speed, HGS, and BMI.
- A week later, your exercise protocol will begin for next three months with 3 supervised sessions and 2 home exercise per week.
- After 3months (about 12 weeks) your assessment will be repeated again to study the changes or improvement.

Duration of the study (Days/weeks/months): Exercises will be prescribed for 1hour duration per session with 5 sessions per week for 12 weeks. Out of 5 sessions, you will be required to come to the exercise venue for 3 sessions to perform exercise under supervision while 2 sessions will be performed at your own place. We would like to meet with you within a week's time after your last clinic visit for a final check-up and evaluation. In total, you will be asked to come 40 times to the clinic in 3 -4 months duration. At the end of 3 to 4 months, the research will be finished. **Do you have any further questions?**
Side Effects/ Risks: None of the assessment procedures will cause you any pain or discomfort. All the assessment processes are non-invasive and standard operating procedures will be followed. There are no risks involved in the assessment process.
There are no apparent risks of participating in the study. However, you may have risk of developing delayed onset muscle soreness due to the exercise intervention for which necessary precautions will be taken like intensity of exercises will be increased progressively from lower intensity to higher intensity. To prevent these effects, warm up and cool down exercises will also be prescribed.
In case of an unexpected side effect or risk, you will be given the standard treatment for the same and your study participation may be discontinued. However, you will be given the usual education or counselling for your problem. **Do you have any other questions?**
Benefits: You may be benefited by reduction of the abdominal fat, total body fat percentage, increase in muscle mass, and better physical function performance like faster walking, stronger muscles.
You also will experience reduced stress levels and better QoL.
The lower limb alignments may get corrected following weight reduction and exercise intervention.
Reimbursements: There will be no financial incentives provided to the participants for participating in the study. **Do you have any other question?**
Confidentiality: The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one but the researchers will be able to see it. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone except physician/ researcher /investigator/concerned staff. **Do you have any question?**
Sharing the Results: The knowledge that we get from doing this research will be shared with you if you are interested to know. Before it is published/widely available to public at conferences or publications, however confidential information will not be shared.

Right to Refuse or Withdraw: You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will still be respected.

Who to Contact: If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact any of the following:

Peeyoosha Gurudut, Ph: 9844821355 E mail: peeyooshagurudut@klekipt.edu.in

Dr. Sanjiv Kumar, Ph: 9448745648

Dr. Ashwin Patil, Ph: 9900104299

This proposal has been reviewed and approved by [name of the local IRB], which is a committee whose task it is to make sure that research participants are protected from harm. If you wish to find about more about the IRB, contact [name, address, and telephone number.]).

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

INFORMED CONSENT FORM

Declaration by the participant: I have read the foregoing information, or it has been read to me in my vernacular language. I understand the possible risks, benefits and volunteer to be a part of this study. I may withdraw at any time. I am not giving up any of my legal rights by signing this form. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research by signing below.

In case participant is illiterate: I have witnessed the accurate reading of the consent form to the potential participant in my vernacular language, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Statement by the researcher/person taking consent: I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands about the study related details. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Participant's name:	
Signature / Left Thumb impression of the participant:	
Date & Place:	
Witness' Name:	
Signature / Left Thumb impression:	
Date & Place:	
Investigator's name and signature:	
Date & Place:	

ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆ

ಅಧ್ಯಯನದ ಶೀರ್ಷಿಕೆ: ಕೊಬ್ಬು, ಕೇಂದ್ರೀಯ ಸ್ಥೂಲಕಾಯತೆ, ಮತ್ತು ಮೊಣಕಾಲು ಅಸಮರ್ಪಕ ಜೋಡಣೆ ಹೊಂದಿರುವ ಮುಟ್ಯಾಗುವಿಕೆ ನಿಂತ ನಂತರ ಮಹಿಳೆಯರಿಗೆ ಹೆಚ್ಚಿನ ತೀವ್ರತೆಯ ಮಧ್ಯಂತರ ತರಬೇತಿ ಮತ್ತು ಹಠ ಯೋಗ ಪರಿಣಾಮ ಹೋಲಿಕೆ.

ಮುಖ್ಯ ಸಂಶೋಧಕ: ಡಾ.ವಿಯೂಶಾ ಗುರುದುತ್, ಮೂಳೆ ಭೌತಚಿಕಿತ್ಸೆಯ ವಿಭಾಗದ ಸಹ ಪ್ರಾಧ್ಯಾಪಕ, ಕಹೇರ್ ಇನ್ಸ್ಟಿಟ್ಯೂಟ್ ಆಫ್ ಫಿಸಿಯೋಥೆರಪಿ, ಬೆಳಗಾವಿ

ಸೂಪರ್‌ವೈಸರ್: ಡಾ. (ಪ್ರೊ.) ಸಂಜೀವ್ ಕುಮಾರ್, ಪ್ರಾಂಶುಪಾಲರು ಮತ್ತು ಪ್ರಾಧ್ಯಾಪಕರು, ಕಹೇರ್ ಇನ್‌ಸ್ಟಿಟ್ಯೂಟ್ ಆಫ್ ಫಿಸಿಯೋಥೆರಪಿ, ಬೆಳಗಾವಿ

ಪರಿಚಯ: ನಾನು ಪೆಯೂ ಶಾಗುರುದುತ್, ಬೆಳಗಾವಿಯ ಕಹೇರ ಇನ್ಸ್ಟಿಟ್ಯೂಟ್ ಆಫ ಪಿಸಿಯೋಥೆರಪಿ, ಬೆಳಗಾವಿಯಲ್ಲಿ ಕೆಲಸ ಮಾಡುತ್ತಿದ್ದೇನೆ. ಮುಟ್ಟು ನಿಂತ ಮಹಿಳೆಯರಲ್ಲಿ ಸ್ಥೂಲಕಾಯತೆಯ ಬಗ್ಗೆ ನಾವು ಸಂಶೋಧನೆ ನಡೆಸುತ್ತಿದ್ದೇವೆ, ಇದು ಈ ದೇಶದಲ್ಲಿ ಬಹಳ ಸಾಮಾನ್ಯವಾಗಿದೆ. ನಾನು ನಿಮಗೆ ಮಾಹಿತಿಯನ್ನು ನೀಡಲಿದ್ದೇನೆ ಮತ್ತು ಈ ಸಂಶೋಧನೆಯ ಭಾಗವಾಗಲು ನಿಮ್ಮನ್ನು ಆಹ್ವಾನಿಸುತ್ತೇನೆ. ನೀವು ಸಂಶೋಧನೆಯಲ್ಲಿ ಭಾಗವಹಿಸುತ್ತೀರೋ ಇಲ್ಲವೋ ಎಂಬುದನ್ನು ನೀವು ಇಂದು ನಿರ್ಧರಿಸಬೇಕಾಗಿಲ್ಲ. ನೀವು ನಿರ್ಧರಿಸುವ ಮೊದಲು, ಸಂಶೋಧನೆಯ ಬಗ್ಗೆ ನಿಮಗೆ ಹಿತಕರವಾಗಿರುವ ಯಾರೊಂದಿಗೂ ನೀವು ಮಾತನಾಡಬಹುದು.

ನಿಮಗೆ ಅರ್ಥವಾಗದ ಕೆಲವು ಪದಗಳು ಇರಬಹುದು. ಅವುಗಳನ್ನು ನೀವು ಕೇಳಿದರೇ ನಾನು ವಿವರಿಸುತ್ತೇನೆ.

ಸಂಶೋಧನೆಯ ಉದ್ದೇಶ: ಮೂಟ್ಟು ನಿಲ್ಲುವುದು ಬೊಜ್ಜು, ಹೃದ್ರೋಗಗಳು, ಹೊಟ್ಟೆ ಮತ್ತು ಸೊಂಟದ ಸುತ್ತಲಿನ ತೂಕ, ಮಧುಮೇಹ, ಅಧಿಕ ರಕ್ತದೊತ್ತಡ, ಮಹಿಳೆಯ ಜೀವನದಲ್ಲಿ ಹಲವಾರು ಸವಾಲಿನ ಆರೋಗ್ಯ ಸಮಸ್ಯೆಗಳನ್ನು ಉಂಟು ಮಾಡುವ ಕ್ಯಾನ್ಸರ ಮುಂತಾದ ಕಾಯಿಲೆಗಳೊಂದಿಗೆ ಬಲವಾಗಿ ಸಂಬಂಧಿಸಿದೆ.ಮೂಳೆ ಮತ್ತು ಸ್ನಾಯು ವ್ಯವಸ್ಥೆಯು ಆಸ್ಟಿಯೊಪೊರೋಸಿಸ್, ಜಂಟಿ ಕ್ಷೀಣತೆ, ಮುರಿತಗಳು, ಬೀಳುವಿಕೆ, ಸ್ನಾಯುವಿನದ್ರವ್ಯರಾಶಿನಷ್ಟ, ನಿಧಾನವಾಗಿ ನಡೆಯುವ ವೇಗ, ಶಕ್ತಿನಷ್ಟ ಇತ್ಯಾದಿ ಸೇರಿದಂತೆ ಹಲವಾರು ಅಪಾಯಗಳಿಗೆ ಗುರಿಯಾಗುತ್ತದೆ. ವ್ಯಾಯಾಮ ತರಬೇತಿ ಕಾರ್ಯಕ್ರಮಗಳು ವಾಕಿಂಗ್, ಜಾಗಿಂಗ್ ಮತ್ತು ಯೋಗ ಬಹಳ ಪರಿಣಾಮಕಾರಿಯಾಗಿ ವಯಸ್ಸಾದ ಮಹಿಳೆಯರಲ್ಲಿ ಆರೋಗ್ಯದ ಅಪಾಯಗಳ ತಡೆಗಟ್ಟುವಿಕೆ ಮತ್ತು ನಿರ್ವಹಣೆಗೆ ಸಹಾಯ ಮಾಡುತ್ತದೆ. ಆದ್ದರಿಂದ, ವ್ಯಾಯಾಮ ತರಬೇತಿ ಯೋಗಕ್ಕಿಂತ ಉತ್ತಮವಾ ಅಥವಾ ಇಲ್ಲವೇ ಎಂದು ತಿಳಿಯಲು ನಾವು ಸಂಶೋಧನೆ ನಡೆಸುತ್ತಿದ್ದೇವೆ.

ಸಂಶೋಧನಾ ಹಸ್ತಕ್ಷೇಪ / ಚಿಕಿತ್ಸೆ / ಪ್ರೋಟೋಕಾಲ್ಕಾರ: ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ಬೆಳಗಾವಿ ನಗರದ ಸುಮಾರು 160 ಮುಟ್ಟು ನಿಂತ ಮಹಿಳೆಯರನ್ನು ಆಹ್ವಾನಿಸಲಾಗುತ್ತದೆ. ಇದು ಪ್ರತಿ ಅಧಿವೇಶನದಲ್ಲಿ 1 ಗಂಟೆಯಅವಧಿಯ ವ್ಯಾಯಾಮಗಳನ್ನು ನೀವು ಮಾಡಬೇಕಾದ ಅಧ್ಯಯನವಾಗಿದೆ. ಪ್ರೋಟೋಕಾಲ್ ವ್ಯಾಯಾಮ (ಜಾಗಿಂಗ್ ಮತ್ತು ವಾಕಿಂಗ್ ಸಂಯೋಜನೆ) ಅಥವಾ ಯೋಗದ ರೂಪದಲ್ಲಿ ಹಸ್ತಕ್ಷೇಪವನ್ನು ಒಳಗೊಂಡಿರುತ್ತದೆ, ಇದು ವಾರಕ್ಕೆ 5 ಸೆಷನ್‌ಗಳಿಗೆ 12 ವಾರಗಳವರೆಗೆ ಇರುತ್ತದೆ. ಅಧ್ಯಯನದ ಅವಧಿಯಲ್ಲಿ ನೀವು ಅನುಸರಿಸಬೇಕಾದ ಆಹಾರದ ಬಗ್ಗೆ ನಿಮಗೆ ಶಿಕ್ಷಣವನ್ನು ಸಹನೀಡಲಾಗುವುದು.

ಭಾಗವಹಿಸುವವರ ಆಯ್ಕೆ: 46ರಿಂದ 70ವರ್ಷದೊಳಗಿನ ಮುತ್ತು ನಿಂತ ಎಲ್ಲ ಮಹಿಳೆಯರನ್ನು ಸೊಂಟದ ಸುತ್ತಳತೆಯೊಂದಿಗೆ ಸಂಶೋಧನೆಯಲ್ಲಿ ಭಾಗವಹಿಸಲು ನಾವು ಆಹ್ವಾನಿಸುತ್ತಿದ್ದೇವೆ.

ಸ್ವಯಂಪ್ರೇರಿತ ಭಾಗವಹಿಸುವಿಕೆ: ಈಸಂಶೋಧನೆಯಲ್ಲಿ ನಿಮ್ಮ ಭಾಗವಹಿಸುವಿಕೆ ಸಂಪೂರ್ಣವಾಗಿ ಸ್ವಯಂ ಪ್ರೇರಿತವಾಗಿದೆ. ಭಾಗವಹಿಸಬೇಕೆ ಅಥವಾ ಬೇಡವೇ ಎಂಬುದು ನಿಮ್ಮ ಆಯ್ಕೆಯಾಗಿದೆ. ಈ ಸಂಶೋಧನಾ ಯೋಜನೆಯಲ್ಲಿ ಭಾಗವಹಿಸದಿರಲು ನೀವು ಆರಿಸಿದರೆ, ಸಮಸ್ಯೆಗೆ ಈ ಕ್ಲಿನಿಕ್ / ಆಸ್ಪತ್ರೆಯಲ್ಲಿ ವಾಡಿಕೆಯಂತೆ ನೀಡಲಾಗುವ ಗುಣಮಟ್ಟದ ಶಿಕ್ಷಣ ಮತ್ತು ಸಮಾಲೋಚನೆಯನ್ನುನಿಮಗೆ ನೀಡಲಾಗುವುದು, ಮತ್ತು ಅದರ ಬಗ್ಗೆ ನಾವು ನಂತರ ನಿಮಗೆ ತಿಳಿಸುತ್ತೇವೆ. ನೀವು ನಂತರ ನಿಮ್ಮ ಮನಸ್ಸನ್ನು ಬದಲಾಯಿಸಬಹುದು ಮತ್ತು ನೀವು ಮೊದಲೇ ಒಪ್ಪಿಕೊಂಡರೂ ಭಾಗವಹಿಸುವುದನ್ನು ನಿಲ್ಲಿಸಬಹುದು.

ಅಧ್ಯಯನದ ಪ್ರೋಟೋಕಾಲ್ / ವ್ಯಾಯಾಮದ ಮಾಹಿತಿ:

ಅಧ್ಯಯನದ ಸಮರ್ಥನೆ: ಮುಟ್ಟು ನಿಂತ ಮಹಿಳೆಯರಿಗೆ ಅನೇಕ ಆರೋಗ್ಯದ ಅಪಾಯಗಳನ್ನು ತಡೆಗಟ್ಟಲು ತೂಕ ನಷ್ಟ ಅಥವಾ ಸ್ನಾಯುವಿನ ದ್ರವ್ಯರಾಶಿಯ ಹೆಚ್ಚಳದೊಂದಿಗೆ ಶಿಫಾರಸು ಮಾಡಲಾಗಿದೆ. ಅಧಿಕ ತೀವ್ರತೆಯ ಮಧ್ಯಂತರ ತರಬೇತಿ ಮತ್ತು ಯೋಗ ಅಂತಹ ಎರಡು ವ್ಯಾಯಾಮ ರೂಪಗಳಾಗಿವೆ, ಇವು ಮುಟ್ಟು ನಿಂತ ಮಹಿಳೆಯರಲ್ಲಿ ಸುರಕ್ಷಿತವಾಗಿ ಸೂಚಿಸಲ್ಪಡುತ್ತವೆ. ಹೆಚ್ಚಿನ ತೀವ್ರತೆಯ ಮಧ್ಯಂತರ ತರಬೇತಿಯು ತೂಕನಷ್ಟದಲ್ಲಿ ಪರಿಣಾಮಕಾರಿಯಾಗಿರುವಾಗ ಅದರ ಸಮಯದ ಪರಿಣಾಮಕಾರಿ ಗುಣಲಕ್ಷಣದಿಂದಾಗಿ ಜನಪ್ರಿಯತೆಯನ್ನು ಗಳಿಸುತ್ತಿದೆ. ಮಹಿಳೆಯರ ವಯಸ್ಸಾದ ಆರೋಗ್ಯ, ಪತನ, ಆಸ್ಟಿಯೋಪೆನಿಯಾ, ತೂಕನಿರ್ವಹಣೆ, ಒತ್ತಡದ ಮೇಲೆ ಯೋಗದ ಪ್ರಭಾವವು ಸಾಹಿತ್ಯದಲ್ಲಿ ಉತ್ತಮವಾಗಿ ಸ್ಥಾಪಿತವಾಗಿದೆ. ಇದರ ಜೊತೆಗೆ, ತೂಕ ಹೆಚ್ಚಾಗುವುದು ಮೊಣಕಾಲು ಕೋನಗಳಲ್ಲಿನ ಬದಲಾವಣೆಗಳಿಗೆ ಸಂಬಂಧಿಸಿದೆ, ಇದು ದೀರ್ಘಾವಧಿಯಲ್ಲಿ ಕ್ಷೀಣಗೊಳ್ಳುವ ಬದಲಾವಣೆಗಳಿಗೆ ಕಾರಣವಾಗಬಹುದು. ಆದ್ದರಿಂದ, ಮೊಣಕಾಲಿನಲ್ಲಿ ಸಂಧಿವಾತವನ್ನು ತಪ್ಪಿಸುವ ಕೊಬ್ಬಿನದ್ರವ್ಯರಾಶಿ ಅಥವಾ ತೂಕವನ್ನು ಕಡಿಮೆ ಮಾಡುವ ಮೂಲಕ ಈ ವ್ಯಾಯಾಮಗಳ ತಡೆಗಟ್ಟುವ ಪಾತ್ರವನ್ನು ಅಧ್ಯಯನ ಮಾಡಬಹುದು. ಹೀಗಾಗಿ, ಹೊಟ್ಟೆಯ ಅಡಿಪೋಸಿಟಿ, ಸ್ನಾಯುವಿನ ದ್ರವ್ಯರಾಶಿ, ದೈಹಿಕ ಕ್ರಿಯೆಯ ಗುಣಮಟ್ಟ ಮತ್ತು ಮೊಣಕಾಲು ಜೋಡಣೆಯೊಂದಿಗೆ ಮುಟ್ಟು ನಿಂತ ಮಹಿಳೆಯರಲ್ಲಿ 12 ವಾರಗಳ ಎಚ್‌ಐಐಟಿ ಮತ್ತು ಯೋಗ ತರಬೇತಿ ಪ್ರೋಟೋಕಾಲ್‌ಗಳ ಪರಿಣಾಮಗಳನ್ನು ಅಧ್ಯಯನ ಮಾಡಲು ಯೋಚಿಸಲಾಗಿದೆ.

ವ್ಯಾಯಾಮ ತಂತ್ರ ಮತ್ತು ಚಿಕಿತ್ಸಕ / ವಿಧಾನದ ಬಗ್ಗೆ ಮಾಹಿತಿ:

ಹೆಚ್ಚಿನ ತೀವ್ರತೆಯ ಮಧ್ಯಂತರ ತರಬೇತಿ: ಪ್ರೋಟೋಕಾಲ್ ನಿಮ್ಮ 90% ಸಾಮರ್ಥ್ಯದಲ್ಲಿ ಜಾಗಿಂಗ್ ಮತ್ತು ವಾಕಿಂಗ್ ಸಂಯೋಜನೆಯನ್ನು ಒಳಗೊಂಡಿರುವ ಹಸ್ತಕ್ಷೇಪವನ್ನು ಒಳಗೊಂಡಿದೆ. ಕ್ರಮವಾಗಿ ವ್ಯಾಯಾಮ ಮಾಡುವ ಮೊದಲು ಮತ್ತು ನಂತರ ನಿಮಗೆ ಪೂರ್ವಬ್ಯಾಸ ನೀಡಲಾಗುವುದು. ಹಠಯೋಗ:ಯೋಗ ಆಸನಗಳನ್ನು ಅನುಸರಿಸಿ ನಿಮಗೆ ಪೂರ್ವಬ್ಯಾಸ ಮಾಡಲಾಗುವುದು, ಪ್ರಾಣಾಯಾಮದ ಜೊತೆಗೆ ಸೂರ್ಯನಮಸ್ಕಾರ. ಅಧಿವೇಶನವು ಶವಾಸನದೊಂದಿಗೆ ಕೊನೆಗೊಳ್ಳುತ್ತದೆ.

ಅಧ್ಯಯನದ ಅವಧಿಯಲ್ಲಿ ನೀವು ಅನುಸರಿಸಬೇಕಾದ ಆಹಾರದ ಬಗ್ಗೆ ನಿಮಗೆ ಶಿಕ್ಷಣವನ್ನು ಸಹ ನೀಡಲಾಗುವುದು.

ಕಾರ್ಯ ವಿಧಾನಗಳು, ಮತ್ತು ಅಧ್ಯಯನದ ಪ್ರಕ್ರಿಯೆ ಪ್ರೋಟೋಕಾಲ್: ಅಧ್ಯಯನದಲ್ಲಿ 2 ಗುಂಪುಗಳಿವೆ. ಒಂದು ಗುಂಪಿಗೆ ಹೆಚ್ಚಿನ ತೀವ್ರತೆಯ ಮಧ್ಯಂತರ ತರಬೇತಿ ನೀಡಲಾಗುವುದು ಮತ್ತು ಇತರ ಗುಂಪಿಗೆ ಯೋಗ ನೀಡಲಾಗುವುದು. ಎರಡು ಅಧ್ಯಯನ ಗುಂಪುಗಳಲ್ಲಿ ಒಂದಾಗಲು ನಿಮಗೆ ಸಮಾನ ಅವಕಾಶವಿದೆ. ನಿಮಗೆ ಯಾವ ಗುಂಪನ್ನು ಹಂಚಲಾಗುತ್ತದೆ ಎಂಬುದನ್ನು ನಿರ್ಧರಿಸಲು ಚಿಟ್ ಆಯ್ಕೆ ಮಾಡಲು ನಿಮ್ಮನ್ನು ಕೇಳಲಾಗುತ್ತದೆ. ವ್ಯಾಯಾಮದ ಹಸ್ತಕ್ಷೇಪವನ್ನು ಪ್ರಾರಂಭಿಸುವ ಮೊದಲು, ವ್ಯಾಯಾಮ ಸಾಮರ್ಥ್ಯ, ಆರೋಗ್ಯ ಸಂಬಂಧಿತ ಸಮಸ್ಯೆಗಳು, ಕೊಬ್ಬಿನ ದ್ರವ್ಯರಾಶಿ, ಸ್ನಾಯುವಿನ ದ್ರವ್ಯರಾಶಿ, ಹಿಡಿತದ ಶಕ್ತಿ, ದೇಹದ ದ್ರವ್ಯರಾಶಿ ಸೂಚ್ಯಂಕ, ಸೊಂಟದ ಸುತ್ತಳತೆ, ಒತ್ತಡದ ಮಟ್ಟಗಳು ಮತ್ತು ನೀವು ಗ್ರಹಿಸಿದ ಒತ್ತಡದ ಮಟ್ಟಗಳು ಮತ್ತು ವಾಕಿಂಗ್ವೇಗ ಮತ್ತು ನಿಮ್ಮಕ್ರಿಯಾತ್ಮಕ ಸಾಮರ್ಥ್ಯದ ಬಗ್ಗೆ ವಿವರವಾದ ಮೌಲ್ಯ ಮಾಪನಕ್ಕೆ ನೀವು ಒಳಗಾಗುತ್ತೀರಿ. ಕೈ ಹಿಡಿತದ ಶಕ್ತಿ. ಸುಧಾರಣೆಯನ್ನು ದಾಖಲಿಸಲು ಅದೇ ಅಳತೆಗಳನ್ನು 3ನೇ ತಿಂಗಳ ಕೊನೆಯಲ್ಲಿ ಪುನರಾವರ್ತಿಸಲಾಗುತ್ತದೆ. ನಿಮ್ಮ ಕಾಲುಗಳ ಕ್ಷ-ಕಿರಣವನ್ನು ನಿಮ್ಮ ಕಾಲುಗಳ ಕೋನಗಳನ್ನು ಅಳೆಯಲು ಮತ್ತು ಕೇಂದ್ರ ಕೊಬ್ಬನ್ನು ಅಳೆಯಲು ಹೊಟ್ಟೆಯ ಅಲ್ಟ್ರಾಸೊನೋಗ್ರಫಿಯನ್ನು ವಿಕಿರಣ ಶಾಸ್ತ್ರಜ್ಞರು ನಿರ್ವಹಿಸುತ್ತಾರೆ ಎರಡು ಬಾರಿ ಅಳೆಯಲು ತೆಗೆದುಕೊಳ್ಳಲಾಗುತ್ತದೆ, ಅಂದರೆ, ಅಧ್ಯಯನದ ಪ್ರಾರಂಭದಲ್ಲಿ ಒಮ್ಮೆ ಮತ್ತು ಮೂರನೇ ತಿಂಗಳ ಕೊನೆಯಲ್ಲಿ.

ಅಧ್ಯಯನದ ವಿವರಣೆ ಪ್ರಕ್ರಿಯೆ: ಸಂಶೋಧನೆಯ ಸಮಯದಲ್ಲಿ ನೀವು ಚಿಕಿತ್ಸಾಲಯಕ್ಕೆ ಅನೇಕ ಭೇಟಿಗಳನ್ನು ನೀಡುತ್ತೀರಿ.

ಮೊದಲ ಭೇಟಿಯಲ್ಲಿ, ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವ ಮಾನದಂಡಗಳಿಗಾಗಿ ನಿಮ್ಮನ್ನು ಪರೀಕ್ಷಿಸಲಾಗುತ್ತದೆ. ನೀವು ಅರ್ಹರಾಗಿದ್ದರೆ, ನಿಮ್ಮನ್ನು 30 ನಿಮಿಷಗಳ ದೃಷ್ಟಿಕೋನ ಅಧಿವೇಶನಕ್ಕೆ ಹಾಜರಾಗುವಂತೆ ಮಾಡಲಾಗುವುದು, ಈ ಸಮಯದಲ್ಲಿ ನಿಮಗೆ ಅಧ್ಯಯನ ಪ್ರೋಟೋಕಾಲ್ ಬಗ್ಗೆ ವಿವರವಾಗಿ ವಿವರಿಸಲಾಗುವುದು. ಭಾಗವಹಿಸುವವರ ಗುಂಪನ್ನು ರಚಿಸಲಾಗುತ್ತದೆ ಮತ್ತು ಮೂಲ ವಿವರಗಳನ್ನು ಗಮನಿಸಲಾಗುವುದು. ಮುಂದಿನ ಭೇಟಿಯಲ್ಲಿ. ನಿಮ್ಮ ಎಕ್ಸರೆ, ದೇಹದ ಸಂಯೋಜನೆ ಮೌಲ್ಯಮಾಪನ, ವಾಕಿಂಗ್ ವೇಗ, ಕೈಹಿಡಿತದ ಶಕ್ತಿ ಮತ್ತು ಬಾಡಿಮಾಸ್ ಇಂಡೆಕ್ಸ್ ಅನ್ನು ಒಳಗೊಂಡಿರುವ ಅಧ್ಯಯನದ ಅವಶ್ಯಕತೆಗೆ ಅನುಗುಣವಾಗಿ ನೀವು ವಿವರವಾದ ಮೌಲ್ಯಮಾಪನಕ್ಕೆ ಒಳಗಾಗುತ್ತೀರಿ. ಒಂದು ವಾರದ ನಂತರ, ನಿಮ್ಮ ವ್ಯಾಯಾಮ ಪ್ರೋಟೋಕಾಲ್ ಮುಂದಿನ ಮೂರು ತಿಂಗಳವರೆಗೆ 3 ಮೇಲ್ವಿಚಾರಣೆಯ ಅವಧಿಗಳು ಮತ್ತು ವಾರಕ್ಕೆ 2 ಮನೆವ್ಯಾಯಾಮದೊಂದಿಗೆ ಪ್ರಾರಂಭವಾಗುತ್ತದೆ. 3 ತಿಂಗಳ ನಂತರ (ಸುಮಾರು 12 ವಾರಗಳು) ಬದಲಾವಣೆಗಳು ಅಥವಾ ಸುಧಾರಣೆಯನ್ನು ಅಧ್ಯಯನ ಮಾಡಲು ನಿಮ್ಮ ಮೌಲ್ಯ ಮಾಪನವನ್ನು ಮತ್ತೆ ಪುನರಾವರ್ತಿಸಲಾಗುತ್ತದೆ.

ಅಧ್ಯಯನದ ಅವಧಿ (ದಿನಗಳು / ವಾರಗಳು / ತಿಂಗಳುಗಳು): ಪ್ರತಿ ಸೆಷನ್‌ಗೆ 1 ಗಂಟೆಯ ಅವಧಿಗೆ ವ್ಯಾಯಾಮವನ್ನು 12 ವಾರಗಳವರೆಗೆ ವಾರಕ್ಕೆ 5 ಸೆಷನ್‌ಗಳೊಂದಿಗೆ ಸೂಚಿಸಲಾಗುತ್ತದೆ. 5 ಸೆಷನ್‌ಗಳಲ್ಲಿ, ಮೇಲ್ವಿಚಾರಣೆಯಡಿಯಲ್ಲಿ ವ್ಯಾಯಾಮ ಮಾಡಲು ನೀವು 3 ಸೆಷನ್‌ಗಳಿಗೆ ವ್ಯಾಯಾಮ ಸ್ಥಳಕ್ಕೆ ಬರಬೇಕಾಗುತ್ತದೆ ಮತ್ತು 2 ಸೆಷನ್‌ಗಳನ್ನು ನಿಮ್ಮ ಸ್ವಂತ ಸ್ಥಳದಲ್ಲಿ ನಡೆಸಲಾಗುತ್ತದೆ. ಅಂತಿಮ ತಪಾಸಣೆ ಮತ್ತು ಮೌಲ್ಯಮಾಪನಕ್ಕಾಗಿ ನಿಮ್ಮ ಕೊನೆಯ ಕ್ಲಿನಿಕ್ ಭೇಟಿಯ ನಂತರ ಒಂದುವಾರದೊಳಗೆ ನಿಮ್ಮೊಂದಿಗೆ ಭೇಟಿಯಾಗಲು ನಾವು ಬಯಸುತ್ತೇವೆ. ಒಟ್ಟಾರೆಯಾಗಿ, 3 -4 ತಿಂಗಳ ಅವಧಿಯಲ್ಲಿ ಕ್ಲಿನಿಕ್ಗೆ 40 ಬಾರಿ ಬರಲು ನಿಮ್ಮನ್ನು ಕೇಳಲಾಗುತ್ತದೆ. 3 ರಿಂದ 4 ತಿಂಗಳ ಕೊನೆಯಲ್ಲಿ, ಸಂಶೋಧನೆ ಪೂರ್ಣಗೊಳ್ಳುತ್ತದೆ. ನೀವು ಇನ್ನೂ ಹೆಚ್ಚಿನ ಪ್ರಶ್ನೆಗಳನ್ನು ಹೊಂದಿದ್ದೀರಾ?

ಅಡ್ಡಪರಿಣಾಮಗಳು / ಅಪಾಯಗಳು: ಯಾವುದೇ ಮೌಲ್ಯಮಾಪನ ಕಾರ್ಯವಿಧಾನಗಳು ನಿಮಗೆ ಯಾವುದೇ ನೋವು ಅಥವಾ ಅಸ್ವಸ್ಥತೆಯನ್ನು ಉಂಟು ಮಾಡುವುದಿಲ್ಲ. ಎಲ್ಲಾ ಮೌಲ್ಯಮಾಪನ ಪ್ರಕ್ರಿಯೆಗಳು ಆಕ್ರಮಣಶೀಲವಲ್ಲದವು ಮತ್ತು ಪ್ರಮಾಣಿತ ಕಾರ್ಯಾಚರಣಾ ವಿಧಾನಗಳನ್ನುಅನುಸರಿಸಲಾಗುತ್ತದೆ. ಮೌಲ್ಯಮಾಪನಪ್ರಕ್ರಿಯೆಯಲ್ಲಿಯಾವುದೇಅಪಾಯಗಳಿಲ್ಲ.

ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವದಕ್ಕೆ ಯಾವುದೇ ಸ್ಪಷ್ಟ ಅಪಾಯಗಳಿಲ್ಲ. ಆದಾಗ್ಯೂ, ವ್ಯಾಯಾಮದ ಹಸ್ತಕ್ಷೇಪದಿಂದಾಗಿ ವಿಳಂಬವಾದ ಪ್ರಾರಂಭದ ಸ್ನಾಯು ನೋವನ್ನು ನೀವು ಹೊಂದಿರಬಹುದು, ಇದಕ್ಕಾಗಿ ವ್ಯಾಯಾಮದ ತೀವ್ರತೆಯಂತೆ ಅಗತ್ಯ ಮುನ್ನೆಚ್ಚರಿಕೆಗಳನ್ನು ತೆಗೆದುಕೊಳ್ಳಲಾಗುತ್ತದೆ ಕಡಿಮೆ ತೀವ್ರತೆಯಿಂದ ಹೆಚ್ಚಿನ ತೀವ್ರತೆಗೆ ಕ್ರಮೇಣ ಹೆಚ್ಚಾಗುತ್ತದೆ. ಈ ಪರಿಣಾಮಗಳನ್ನು ತಡೆಗಟ್ಟಲು, ಪೂರ್ವಾಭ್ಯಾಸ ಮತ್ತು ವಿಶ್ರಾಂತಿ ವ್ಯಾಯಾಮಗಳನ್ನು ಸಹ ಸೂಚಿಸಲಾಗುತ್ತದೆ.

ಪ್ರಯೋಜನಗಳು: ಕಿಬ್ಬೊಟ್ಟೆಯ ಕೊಬ್ಬನ್ನು ಕಡಿಮೆಮಾಡುವುದು, ದೇಹದ ಒಟ್ಟು ಕೊಬ್ಬಿನ ಶೇಕಡಾವಾರು, ಸ್ನಾಯುವಿನ ದ್ರವ್ಯರಾಶಿಯ ಹೆಚ್ಚಳ ಮತ್ತು ವೇಗವಾಗಿ ನಡೆಯುವುದು, ಬಲವಾದ ಸ್ನಾಯುಗಳಂತಹ ಉತ್ತಮ ದೈಹಿಕ ಕ್ರಿಯೆಯ ಕಾರ್ಯಕ್ಷಮತೆಯಿಂದ ನಿಮಗೆ ಲಾಭವಾಗುತ್ತದೆ.

ಕಡಿಮೆ ಒತ್ತಡದ ಮಟ್ಟಗಳು ಮತ್ತು ಉತ್ತಮ ಜೀವನದ ಗುಣಮಟ್ಟವನ್ನು ಸಹ ನೀವು ಅನುಭವಿಸುವಿರಿ.

ತೂಕ ಇಳಿಸುವಿಕೆಯಿಂದಾಗಿ, ತೂಕ ಕಡಿತ ಮತ್ತು ವ್ಯಾಯಾಮದ ಹಸ್ತಕ್ಷೇಪದ ನಂತರ ಕಡಿಮೆ ಅಂಗಜೋಡಣೆಗಳನ್ನು ಸರಿಪಡಿಸಬಹುದು.

ಮರುಪಾವತಿ: ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ಭಾಗವಹಿಸುವವರಿಗೆ ಯಾವುದೇ ಆರ್ಥಿಕ ಪ್ರೋತ್ಸಾಹ ನೀಡಲಾಗುವುದಿಲ್ಲ. ನೀವು ಬೇರೆ ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನುಹೊಂದಿದ್ದೀರಾ?

ಗೌಪ್ಯತೆ: ಈ ಸಂಶೋಧನಾ ಯೋಜನೆಯಿಂದ ನಾವು ಸಂಗ್ರಹಿಸುವ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿಡಲಾಗುತ್ತದೆ. ಸಂಶೋಧನೆಯ ಸಮಯದಲ್ಲಿ ಸಂಗ್ರಹಿಸಲಾಗುವ ನಿಮ್ಮ ಬಗ್ಗೆ ಮಾಹಿತಿಯನ್ನು ಸಂಶೋಧಕರು ಮಾತ್ರ ಅದನ್ನು ನೋಡಲು ಸಾಧ್ಯವಾಗುತ್ತದೆ. ನಿಮ್ಮ ಬಗ್ಗೆ ಯಾವುದೇ ಮಾಹಿತಿಯು ನಿಮ್ಮ ಹೆಸರಿನ ಬದಲು ಅದರ ಮೇಲೆ ಸಂಖ್ಯೆಯನ್ನು ಹೊಂದಿರುತ್ತದೆ. ನಿಮ್ಮ ಸಂಖ್ಯೆ ಏನೆಂದು ಸಂಶೋಧಕರಿಗೆ ಮಾತ್ರ ತಿಳಿಯುತ್ತದೆ ಮತ್ತು ನಾವು ಆ ಮಾಹಿತಿಯನ್ನು ಲಾಕ್ ಮತ್ತು ಕೀಲಿಯೊಂದಿಗೆ ಲಾಕ್ಮಾಡುತ್ತೇವೆ. ಇದನ್ನು ವೈದ್ಯ / ಸಂಶೋಧಕ / ತನಿಖಾಧಿಕಾರಿ / ಸಂಬಂಧಪಟ್ಟ ಸಿಬ್ಬಂದಿಯನ್ನು ಹೊರತುಪಡಿಸಿ ಯಾರೊಂದಿಗೂ ಹಂಚಿಕೊಳ್ಳಲಾಗುವುದಿಲ್ಲ ಅಥವಾ ನೀಡಲಾಗುವುದಿಲ್ಲ. ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ಹೊಂದಿದ್ದೀರಾ?

ಫಲಿತಾಂಶಗಳನ್ನುಹಂಚಿಕೊಳ್ಳುವುದು: ನೀವು ತಿಳಿಯಲು ಆಸಕ್ತಿ ಹೊಂದಿದ್ದರೆ ಈ ಸಂಶೋಧನೆ ಮಾಡುವುದರಿಂದ ನಾವು ಪಡೆಯುವ ಜ್ಞಾನವನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ಹಂಚಿಕೊಳ್ಳಲಾಗುತ್ತದೆ. ಸಮ್ಮೇಳನಗಳು ಅಥವಾ ಪ್ರಕಟಣೆಗಳಲ್ಲಿ ಇದನ್ನು ಪ್ರಕಟಿಸುವ / ವ್ಯಾಪಕವಾಗಿ ಸಾರ್ವಜನಿಕರಿಗೆ ಲಭ್ಯವಾಗುವ ಮೊದಲು, ಆದರೆ ಗೌಪ್ಯಮಾಹಿತಿಯನ್ನು ಹಂಚಿಕೊಳ್ಳಲಾಗುವುದಿಲ್ಲ.

ನಿರಾಕರಿಸುವ ಅಥವಾ ಹಿಂತೆಗೆದುಕೊಳ್ಳುವ ಹಕ್ಕು: ನೀವು ಭಾಗವಹಿಸಲು ಬಯಸದಿದ್ದರೆ ನೀವು ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಭಾಗವಹಿಸಬೇಕಾಗಿಲ್ಲ. ನೀವು ಆಯ್ಕೆ ಮಾಡಿದ ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ನೀವು ಸಂಶೋಧನೆಯಲ್ಲಿ ಭಾಗವಹಿಸುವುದನ್ನು ನಿಲ್ಲಿಸಬಹುದು. ಇದು ನಿಮ್ಮ ಆಯ್ಕೆಯಾಗಿದೆ ಮತ್ತು ನಿಮ್ಮ ಎಲ್ಲಾ ಹಕ್ಕುಗಳನ್ನು ಇನ್ನೂ ಗೌರವಿಸಲಾಗುತ್ತದೆ.

ಯಾರನ್ನು ಸಂಪರ್ಕಿಸಬೇಕು: ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಗಳನ್ನು ಹೊಂದಿದ್ದರೆ, ಅಧ್ಯಯನ ಪ್ರಾರಂಭವಾದ ನಂತರವೂ ನೀವು ಈಗ ಅಥವಾ ನಂತರ ಇವರನ್ನು ಕೇಳಬಹುದು. ನೀವು ನಂತರ ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳಲು ಬಯಸಿದರೆ, ನೀವು ಈ ಕೆಳಗಿನ ಯಾವುದನ್ನಾದರೂ ಸಂಪರ್ಕಿಸಬಹುದು:

ಪಿಯೂಶಾ ಗುರುದುತ್,

ಪಿಎಚ್: 9844821355 ಇಮೇಲ್: peeyooshagurudut@klekipt.edu.in

ಡಾ.ಸಂಜೀವ್ ಕುಮಾರ್, ಪಿಎಚ್: 9448745648

ಡಾ.ಅಶ್ವಿನ್ ಪಾಟೀಲ್, ಪಿಎಚ್: 9900104299

ಈ ಪ್ರಸ್ತಾಪವನ್ನು [ಸ್ಥಳೀಯ ಐಆರ್‌ಬಿಯ ಹೆಸರಿನಿಂದ] ಪರಿಶೀಲಿಸಲಾಗಿದೆ ಮತ್ತು ಅಂಗೀಕರಿಸಲಾಗಿದೆ, ಇದು ಸಂಶೋಧನಾ ಭಾಗವಹಿಸುವವರನ್ನು ಹಾನಿಯಿಂದ ರಕ್ಷಿಸಲಾಗಿದೆಯೆ ಎಂದು ಖಚಿತಪಡಿಸಿಕೊಳ್ಳುವುದು ಅವರ ಕಾರ್ಯವಾಗಿದೆ. ಐಆರ್‌ಬಿ ಬಗ್ಗೆ ಹೆಚ್ಚಿನದನ್ನು ಕಂಡುಹಿಡಿಯಲು ನೀವು ಬಯಸಿದರೆ, ಸಂಪರ್ಕಿಸಿ [ಹೆಸರು, ವಿಳಾಸ ಮತ್ತು ದೂರವಾಣಿ ಸಂಖ್ಯೆ.]).

ನೀವು ಬಯಸಿದರೆ ಸಂಶೋಧನಾ ಅಧ್ಯಯನದ ಯಾವುದೇ ಭಾಗದ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಪ್ರಶ್ನೆಗಳನ್ನು ನೀವು ನನ್ನನ್ನು ಕೇಳಬಹುದು. ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಗಳನ್ನು ಹೊಂದಿದ್ದೀರಾ?

ಮಾಹಿತಿ ಒಪ್ಪಿಗೆ ನಮೂನೆ:

ಭಾಗವಹಿಸುವವರ ಘೋಷಣೆ: ನಾನು ಮೇಲಿನ ಮಾಹಿತಿಯನ್ನು ಓದಿದ್ದೇನೆ, ಅಥವಾ ಅದನ್ನು ನನ್ನ ಸ್ಥಳೀಯ ಭಾಷೆಯಲ್ಲಿ ಓದಲಾಗಿದೆ. ಈ ಅಧ್ಯಯನದ ಸಂಭವನೀಯ ಅಪಾಯಗಳು, ಪ್ರಯೋಜನಗಳು ನಾನು ಅರ್ಥಮಾಡಿಕೊಂಡಿದ್ದೇನೆ ಮತ್ತು ನಾನು ಸ್ವಯಂ ಭಾಗವಹಿಸಲು ಒಪ್ಪಿದ್ದೇನೆ. ನಾನು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ಹಿಂತೆಗೆದುಕೊಳ್ಳಬಹುದು. ಈ ಫಾರ್ಮ್ಗೆ ಸಹಿ ಮಾಡುವ ಮೂಲಕ ನಾನು ನನ್ನ ಯಾವುದೇ ಕಾನೂನು ಹಕ್ಕುಗಳನ್ನು ಬಿಟ್ಟುಕೊಡುತ್ತಿಲ್ಲ. ಅದರ ಬಗ್ಗೆ ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳುವ ಅವಕಾಶ ನನಗೆ ಸಿಕ್ಕಿದೆ ಮತ್ತು ನಾನು ಕೇಳಿದ ಯಾವುದೇ ಪ್ರಶ್ನೆಗಳಿಗೆ ನನ್ನ ತೃಪ್ತಿಗೆ ಉತ್ತರಿಸಲಾಗಿದೆ. ಕೆಳಗೆ ಸಹಿ ಮಾಡುವ ಮೂಲಕ ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವವರಾಗಿ ಭಾಗವಹಿಸಲು ನಾನು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಒಪ್ಪುತ್ತೇನೆ.

ಒಂದು ವೇಳೆ ಭಾಗವಹಿಸುವವರು ಅನಕ್ಷರಸ್ಥರಾಗಿದ್ದರೆ: ನನ್ನ ಸ್ಥಳೀಯ ಭಾಷೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವವರಿಗೆ ಒಪ್ಪಿಗೆಯ ರೂಪವನ್ನು ನಿಖರವಾಗಿ ಓದುವುದಕ್ಕೆ ನಾನು ಸಾಕ್ಷಿಯಾಗಿದ್ದೇನೆ ಮತ್ತು ವ್ಯಕ್ತಿಯು ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳುವ ಸಾಕಷ್ಟು ಅವಕಾಶವನ್ನು ಹೊಂದಿದ್ದಾನೆ. ವ್ಯಕ್ತಿಯು ಮುಕ್ತವಾಗಿ ಒಪ್ಪಿಗೆ ನೀಡಿದ್ದಾರೆ ಎಂದು ನಾನು ಖಚಿತಪಡಿಸುತ್ತೇನೆ.

ಸಂಶೋಧಕ ಅಥವಾ ಒಪ್ಪಿಗೆಯನ್ನು ತೆಗೆದುಕೊಳ್ಳುವ ವ್ಯಕ್ತಿಯಿಂದ ಹೇಳಿಕೆ: ಪಾಲ್ಗೊಳ್ಳುವವರಿಗೆ ನಾನು ಮಾಹಿತಿ ಹಾಳೆಯನ್ನು ನಿಖರವಾಗಿ ಓದಿದ್ದೇನೆ ಮತ್ತು ನನ್ನ ಸಾಮರ್ಥ್ಯದ ಪ್ರಕಾರ ಭಾಗವಹಿಸುವವರು ಅಧ್ಯಯನಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ವಿವರಗಳ ಬಗ್ಗೆ ಅರ್ಥಮಾಡಿಕೊಳ್ಳುತ್ತಾರೆ ಎಂದು ಖಚಿತಪಡಿಸಿಕೊಂಡಿದ್ದಾರೆ. ಭಾಗವಹಿಸುವವರಿಗೆ ಅಧ್ಯಯನದ ಬಗ್ಗೆ ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳಲು ಅವಕಾಶ ನೀಡಲಾಗಿದೆ ಎಂದು ನಾನು ಖಚಿತಪಡಿಸುತ್ತೇನೆ, ಮತ್ತು ನನ್ನ ಸಾಮರ್ಥ್ಯಕ್ಕೆ ತಕ್ಕಂತೆ ಭಾಗವಹಿಸುವವರು ಕೇಳಿದ ಎಲ್ಲಾ ಪ್ರಶ್ನೆಗಳಿಗೆ ಸರಿಯಾಗಿ ಉತ್ತರಿಸಲಾಗಿದೆ. ಒಪ್ಪಿಗೆ ನೀಡುವಂತೆ ವ್ಯಕ್ತಿಯನ್ನು ಒತ್ತಾಯಿಸಲಾಗಿಲ್ಲ ಮತ್ತು ಒಪ್ಪಿಗೆಯನ್ನು ಮುಕ್ತವಾಗಿ ಮತ್ತು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ನೀಡಲಾಗಿದೆ ಎಂದು ನಾನು ಖಚಿತಪಡಿಸುತ್ತೇನೆ.

ಭಾಗವಹಿಸುವವರಿಗೆ ಈ ಮಾಹಿತಿ ಒಪ್ಪಿಗೆ ನಮೂನೆ ನಕಲನ್ನು ಒದಗಿಸಲಾಗಿದೆ.

ಭಾಗವಹಿಸುವವರ ಹೆಸರು	
ಭಾಗವಹಿಸುವವರ ಸಹಿ / ಎಡ ಹೆಬ್ಬೆರಳು ಮುದ್ರಣ	
ದಿನಾಂಕ ಮತ್ತು ಸ್ಥಳ	
ಸಾಕ್ಷಿ 'ಹೆಸರು	
ಸಹಿ / ಎಡ ಹೆಬ್ಬೆರಳು ಅನಿಸಿಕೆ	
ದಿನಾಂಕ ಮತ್ತು ಸ್ಥಳ	
ತನಿಖಾಧಿಕಾರಿ ಹೆಸರು ಮತ್ತು ಸಹಿ:	
ದಿನಾಂಕ ಮತ್ತು ಸ್ಥಳ	

रुग्णांची माहिती पत्रक

अभ्यासाचे शीर्षकः लठ्ठपणा, स्नायू आणि चरबीयुक्त मास, पोटात चरबी आणि गुडघा संरेखन असलेल्या रजोनिवृत्ती (पोस्टमेनोपॉझल)महिलांसाठी तीव्रता कसरत प्रशिक्षण आणि हठ योग परिणाम तुलना

प्रधान संशोधक:पीयूषा गुरुदूत, असोसिएट प्रोफेसर, ऑर्थोपेडिक फिजिओथेरपी विभाग, के.एच.आर. इंस्टीट्यूट ऑफ फिजिओथेरपी, बेलगावी

पर्यवेक्षक:डॉ. (प्रा.) संजीव कुमार, प्राचार्य व प्राध्यापक, के.एच.ई.आर. इन्स्टिट्यूट ऑफ फिजिओथेरपी, बेलगावी

परिचय: मी पीयूषा गुरुदूत, बेलगावीतील के.एल.ई. इंस्टीट्यूट ऑफ फिजिओथेरपीमध्ये कार्यरत आहे. आम्ही पोस्टमेनोपॉसल महिलांमध्ये लठ्ठपणाबद्दल संशोधन करीत आहोत, जे या देशात सामान्य आहे. मी आपल्याला माहिती देणार आहे आणि आपल्याला या संशोधनात सहभागी होण्यासाठी आमंत्रित करणार आहे. आपण संशोधनात सहभागी व्हाल की नाही याचा निर्णय आपण आज घेण्याची गरज नाही. आपण निर्णय घेण्यापूर्वी, आपण संशोधनाबद्दल आपल्यास अनुकूल असलेल्या कोणाशीही बोलू शकता.

असे काही शब्द असू शकतात जे आपणास समजत नाहीत. कृपया आम्ही माहिती घेताना मला थांबायला सांगा आणि मी स्पष्ट करण्यास वेळ देईन. आपल्याकडे नंतर प्रश्न असल्यास आपण त्यांना माझ्याकडे विचारू शकता.

संशोधनाचा उद्देशः रजोनिवृत्ती हा लठ्ठपणा, हृदयरोग, पोट आणि कंबरभोवती वजन वाढणे, मधुमेह, उच्च रक्तदाब, कर्करोग अशा स्त्रींशी संबंधित असंख्य आव्हानात्मक आरोग्याचा प्रश्न उद्भवणाऱ्या आजारांशी संबंधित आहे. अस्थिसुषिरता , संधिवात,फ्रॅक्चर, वारंवार पडणे,स्नायूंचा प्रमाण कमी होणे, चालण्याची गती कमी करणे, शक्ती कमी होणे इत्यादींसह अनेक धोके रजोनिवृत्ती कारण घडतात. त्याच्या उपचारासाठी चालणे, जॉगिंग आणि योगा सारख्या व्यायामाचे प्रशिक्षण कार्यक्रम खूप प्रभावी आहेत. म्हणूनच, व्यायामाचे प्रशिक्षण योगापेक्षा किंवा त्याउलट चांगले आहे की नाही हे जाणून घेण्यासाठी आम्ही संशोधन करीत आहोत.

संशोधन प्रकार / थेरपी / प्रोटोकॉलचा प्रकार: बेलागावी शहरातील सुमारे 160 पोस्टमेनोपॉसल महिलांना या अभ्यासात सहभागी होण्यासाठी आमंत्रित केले जाईल. हा एक अभ्यास आहे जिथे आपल्याला प्रत्येक सत्रात 1 तासाच्या कालावधीचे व्यायाम करणे आवश्यक असेल. या प्रोटोकॉलमध्ये व्यायाम (जॉगिंग आणि चालण्याचे संयोजन) किंवा योगाच्या स्वरूपात समाविष्ट आहे जे दर आठवड्यात 5 सत्रांसाठी 12 आठवड्यांसाठी असतील. अभ्यासाच्या कालावधीत आपल्याला आवश्यक असलेल्या आहाराबद्दल देखील आपल्याला शिक्षण दिले जाईल.

सहभागींची निवडः आम्ही संशोधनात सहभागी होण्यासाठी कंबरच्या परिघासह 46 ते 70 वर्षे वयोगटातील सर्व पोस्टमेनोपॉसल महिलांना आमंत्रित करीत आहोत.

ऐच्छिक सहभाग: या संशोधनात तुमचा सहभाग पूर्णपणे ऐच्छिक आहे. सहभागी व्हावे की नाही हे आपली निवड आहे. आपण या संशोधन प्रकल्पात भाग न घेणे निवडल्यास, आपल्यास क्लिनिक / रुग्णालयात या समस्येसाठी नियमितपणे दिले जाणारे प्रमाणित शिक्षण आणि समुपदेशन दिले जाईल आणि आम्ही त्याबद्दल नंतर आपल्याला अधिक सांगू. आपण नंतर कदाचित आपला विचार बदलू शकता आणि आपण आधी सहमती दर्शविली तरीही त्यात भाग घेणे थांबवू शकता.

संशोधनाचे प्रोटोकॉल / व्यायामाची माहिती:

अभ्यासाचे औचित्य: अनेक आरोग्याच्या जोखमी रोखण्यासाठी रजोनिवृत्ती महिलांना स्नायूंच्या वजन कमी होणे किंवा चरबीचि वाढ होणे याची शिफारस केली जाते. तीव्रता कसरत प्रशिक्षण आणि योग असे दोन व्यायाम प्रकार आहेत जे रजोनिवृत्ती (पोस्टमेनोपॉसल) महिलांमध्ये सुरक्षित आहेत आणि विहित आहेत. वजन कमी होण्यास प्रभावी ठरत असताना, वेळेच्या कार्यक्षम वैशिष्ट्यामुळे **तीव्रता कसरत प्रशिक्षण** लोकप्रिय होत आहे. स्त्रियांच्या वृद्धापकाळातील आरोग्यावर योगाचा प्रभाव, गडी बाद होण्याचा क्रम, ऑस्टिओपेनिया, वजन व्यवस्थापन, तणाव या साहित्यात चांगलेच सिद्ध झाले आहेत. या व्यतिरिक्त, वजन वाढणे गुडघ्याच्या कोनात बदल होण्याशी देखील संबंधित आहे ज्यामुळे दीर्घकाळापर्यंत झीज होऊ शकतात. म्हणूनच, चरबीयुक्त वस्तुमान कमी करून किंवा गुडघ्यात संधिवात टाळण्यावरील वजन या व्यायामाच्या प्रतिबंधात्मक भूमिकेचा अभ्यास केला जाऊ शकतो. अशाप्रकारे, पोटाच्या चरबी, स्नायूंचा समूह, शारीरिक कार्यक्षमता आणि गुडघा संरेखन असलेल्या पोस्टमेनोपॉसल महिलांमध्ये एचआयआयटीच्या 12 आठवड्यांच्या आणि योग प्रशिक्षण प्रोटोकॉलच्या प्रभावांचा अभ्यास करण्याचा विचार केला गेला.

व्यायामाचे तंत्र आणि उपचारात्मक / कार्यक्षमता याबद्दल माहिती:

तीव्रता कसरत प्रशिक्षण: या प्रोटोकॉलमध्ये व्यायामाचे या प्रकारांचा समावेश आहे ज्यात जॉगिंग आणि चालणे आपल्या 90% क्षमतेनुसार संयोजन आहे. वॉर्म अप करणं अनिवार्य आहे

हठ योग: वॉर्म अप नंतर योग आसन, प्राणायामाबरोबर सूर्य नमस्कार केला जाईल. शवासनने सत्र संपेल.

अभ्यासाच्या कालावधीत आपल्याला आवश्यक असलेल्या आहाराबद्दल देखील आपल्याला शिक्षण दिले जाईल.

प्रक्रिया, यादृच्छिकरण प्रक्रिया आणि अभ्यासाचे प्रोटोकॉल: अभ्यासात 2 गट आहेत. एका गटाला तीव्रता कसरत प्रशिक्षण दिले जाईल आणि दुसऱ्या गटाला योग दिले जाईल. आपणास दोन अभ्यास गटांपैकी एक असण्याची समान संधी आहे. आपणास कोणत्या गटाचे वाटप होईल हे ठरवण्यासाठी आपल्याला एक चिठ्ठी निवडायला सांगितले जाईल. व्यायामाची सुरूवात करण्यापूर्वी, आपण व्यायामाची क्षमता, आरोग्याशी संबंधित समस्या, चरबी द्रव्यमान, स्नायूंचा समूह, हाताची पकड सामर्थ्य, बॉडी मास इंडेक्स, कमरचा घेर, आपण आणि आपल्या चालण्याच्या गतीसह आपल्या कार्यक्षम क्षमतेनुसार तणाव पातळीचे तपशीलवार मूल्यांकन केले जाईल. दस्तऐवजीकरण करण्यासाठी त्याच मापाची 3 महिन्यांच्या शेवटी पुनरावृत्ती होईल. आपल्या पाय संबंधित कोण (कोन) मोजण्यासाठी एक्स-रे घेतला जाईल. केंद्रीय चरबी मोजण्यासाठी उदराचे अल्ट्रासोनोग्राफी रेडिओलॉजिस्ट द्वारे दोनदा म्हणजेच एकदा अभ्यासाच्या सुरूवातीला आणि तिसऱ्या महिन्याच्या शेवटी केले जाईल.

संशोधन पद्धतीविषयी वर्णन: संशोधनाच्या वेळी आपण क्लिनिकमध्ये बऱ्याच वेळा भेट दिली जाईल. पहिल्या भेटीत, अभ्यासामध्ये भाग घेण्यासाठी आपल्या निकषांची तपासणी केली जाईल. पण पात्र असल्यास, आपल्याला 30 मिनिटांच्या अभिमुखतेच्या सत्रात भाग घ्यावा लागेल ज्या दरम्यान आपल्याला अभ्यास प्रोटोकॉलबद्दल तपशीलवार वर्णन केले जाईल. यासारख्या समान तक्रारी असलेले लोक यांचा एक गट तयार केला जाईल आणि मूलभूत तपशील नमूद केला जाईल. पुढच्या भेटीत, अभ्यासाच्या आवश्यकतेनुसार आपल्याकडे विस्तृत मूल्यांकन केले जाईल ज्यात आपला क्ष- किरण, शरीर रचना मूल्यांकन, चालण्याची गती, हाताची पकड सामर्थ्य आणि बॉडी मास इंडेक्सचा समावेश आहे. एका आठवड्यानंतर, आपल्या व्यायामाचा प्रोटोकॉल पुढील तीन महिन्यासाठी 3 पर्यवेक्षी सत्र आणि आठवड्यात 2 गृह व्यायामासह सुरू होईल.

3 महिन्यांनंतर (सुमारे 12 आठवडे) बदल किंवा सुधारणांचा अभ्यास करण्यासाठी आपल्या मूल्यांकनाची पुनरावृत्ती होईल.

अभ्यासाचा कालावधी (दिवस / आठवडे / महिने): प्रत्येक सत्रात 1 तासाच्या कालावधीसाठी व्यायामासाठी आठवड्यात 5 सत्रे आठवड्यातून 12 आठवड्यांसाठी निर्धारित केली जातील. देखरेखीखाली व्यायाम करण्यासाठी 5 सत्रांपैकी 3 सत्रांसाठी तुम्हाला व्यायामाच्या ठिकाणी येण्याची आवश्यकता असेल तर २ सत्रे तुमच्या स्वतःच्या जागी होतील. अंतिम तपासणी आणि मूल्यांकन करण्यासाठी आपल्या अंतिम क्लिनिक भेटीनंतर आम्ही एका आठवड्याच्या आत आपल्याशी भेटू इच्छितो. एकूणच, आपल्याला 3 -4 महिन्यांच्या कालावधीत 40 वेळा क्लिनिकमध्ये येण्यास सांगितले जाईल. 3 ते 4 महिन्यांच्या शेवटी, संशोधन समाप्त होईल. आपल्याकडे आणखी काही प्रश्न आहेत?

दुष्परिणाम / जोखीम: कोणत्याही मूल्यांकन प्रक्रियेमुळे आपल्याला त्रास किंवा अस्वस्थता उद्भवणार नाही. सर्व मूल्यांकन प्रक्रिया आक्रमक नसलेल्या आहेत आणि मानक कार्यप्रणाली चे पालन केले जाईल. मूल्यांकन प्रक्रियेमध्ये कोणताही धोका नाही. अभ्यासामध्ये सहभागी होण्याचे

कोणतेही स्पष्ट जोखीम नाहीत. तथापि, व्यायामाच्या प्रकारामुळे आपणास स्नायूंच्या वेदना होण्याचा धोका असू शकतो ज्यासाठी आवश्यक सावधगिरी बाळगली जाईल. व्यायामाची तीव्रता कमी तीव्रतेपासून उच्च तीव्रतेपर्यंत क्रमाने वाढविली जाईल. या भावापासून बचाव करण्यासाठी, वॉर्म अप व्यायाम देखील सुचविला जाईल.

अनपेक्षित दुष्परिणाम किंवा जोखीम असल्यास, आपल्याला त्यासाठी मानक उपचार दिले जातील आणि आपला अभ्यासाचा सहभाग बंद केला जाऊ शकतो. तथापि, आपल्या समस्येसाठी आपल्याला नेहमीचे शिक्षण किंवा समुपदेशन दिले जाईल. आपल्याकडे इतर काही प्रश्न आहेत?

फायदेः पोटाभोवती चरबी कमी करणे, शरीराच्या एकूण चरबीची टक्केवारी, स्नायूंच्या वस्तुमानात वाढ आणि वेगवान चालणे, मजबूत स्नायू यासारखे तुम्हाला फायदा होईल. आपण कमी तणाव पातळी आणि जीवनाची गुणवत्ता देखील अनुभवाल. वजन कमी केल्याने आणि व्यायामाच्या प्रकारामुळे पायचे संरेखन सुधारले जाऊ शकतात.

आर्थिक लाभ: अभ्यासात भाग घेण्यासाठी सहभागींना कोणतीही आर्थिक प्रोत्साहन दिले जाणार नाही. आपल्याकडे आणखी काही प्रश्न आहे का?

गोपनीयता: आम्ही या संशोधन प्रकल्पातून गोळा केलेली माहिती गोपनीय ठेवली जाईल. आपल्या संशोधनाच्या वेळी गोळा केली जाणारी माहिती काढून टाकली जाईल आणि फक्त संशोधक ते पाहण्यास सक्षम असतील. आपल्याबद्दल कोणतीही माहिती आपल्या नावाऐवजी त्यावर एक नंबर असेल. केवळ संशोधकांना आपला नंबर काय आहे हे समजेल आणि आम्ही त्या माहितीला लॉक करु. हे फिजीशियन / संशोधक / अन्वेषक / संबंधित कर्मचारी वगळता कोणाशीही सामायिक केले जाणार नाही वा दिले जाणार नाही. आपल्याकडे आणखी काही प्रश्न आहे का?

परिणाम सामायिक करणे: आपल्याला हे जाणून घेण्यास स्वारस्य असल्यास आपल्याला हे संशोधन केल्याने प्राप्त झालेले ज्ञान आपल्यासह सामायिक केले जाईल. कॉन्फरन्स किंवा प्रकाशनात सार्वजनिकपणे हे प्रकाशित / व्यापकपणे उपलब्ध होण्यापूर्वी, तथापि गोपनीय माहिती सामायिक केली जाणार नाही.

सहभाग नाकारण्याचा किंवा मागे घेण्याचा अधिकारः आपण इच्छित नसल्यास आपल्याला या संशोधनात भाग घेण्याची गरज नाही. आपण निवडता त्या वेळी आपण संशोधनात भाग घेणे देखील थांबवू शकता. ही आपली निवड आहे आणि आपल्या सर्व अधिकारांचा अजूनही आदर केला जाईल.

कोणाशी संपर्क साधावा: आपणास काही प्रश्न असल्यास आपण आता किंवा अभ्यासाला सुरुवात झाल्यानंतरही विचारू शकता. आपण नंतर प्रश्न विचारू इच्छित असल्यास आपण खालीलपैकी कोणत्याहीशी संपर्क साधू शकता:

डॉ पीयूषा गुरुदूत, दूरध्वनी: 9844821355 ई मेल: peeyooshagurudut@klekipt.edu.in

डॉ संजीव कुमार, फोनः 9448745648

डॉ अश्विन पाटील, फोनः 9900104299

या प्रस्तावाचे [स्थानिक आयआरबीच्या नावाने] पुनरावलोकन केले गेले आणि त्याला मान्यता देण्यात आली. ही एक समिती आहे ज्याचे कार्य संशोधनात सामील लोक हानीपासून संरक्षित असल्याचे सुनिश्चित करणे आहे. आपण आयआरबीबद्दल अधिक जाणून घेऊ इच्छित असल्यास, [नाव, पत्ता आणि दूरध्वनी क्रमांक.] वर संपर्क साधा.

आपण इच्छित असल्यास संशोधन अभ्यासाच्या कोणत्याही भागाबद्दल मला आणखी प्रश्न विचारू शकता. आपल्याकडे आणखी काही प्रश्न आहे का?

माहिती संमती पत्र

भागीदार द्वारे जाहीर केलेली माहिती: मी वरील माहिती वाचली आहे किंवा ती मला माझ्या स्थानिक भाषेत वाचली गेली आहे. मला या अभ्यासाचा एक भाग होण्यासाठी संभाव्य जोखीम, फायदे समजले आणि मी सहभागी होण्यास संमत आहे. मी कधीही माघार घेऊ शकतो. या फॉर्मवर सही करून मी माझा कोणताही कायदेशीर हक्क सोडत नाही. मला त्याबद्दल प्रश्न विचारण्याची संधी मिळाली आहे आणि मी विचारलेल्या कोणत्याही प्रश्नांची उत्तरे माझ्या समाधानाला दिली आहेत. मी खाली स्वाक्षरी करून या संशोधनात सहभागी होण्यासाठी स्वेच्छेने सहमती देतो.

सहभागी अशिक्षित असल्यास: मी माहिती संमती पत्र च्या अचूक वाचन स्थानिक भाषेत संभाव्य सहभागीला पाहीले आहे. आणि त्या व्यक्तीस प्रश्न विचारण्याची संधी मिळाली आहे. मी पुष्टी करतो की स्वतंत्रपणे संमती दिली आहे.

संमती घेणाऱ्या संशोधक / व्यक्तीचे विधान: मी संभाव्य सहभागीला माहिती पत्र अचूकपणे वाचले आहे आणि माझ्या उत्तमतेने ही खात्री करुन दिली आहे की अभ्यासाशी संबंधित तपशीलांबद्दल सहभागीला समजले आहे. मी पुष्टी करतो की सहभागीला अभ्यासाबद्दल प्रश्न विचारण्याची संधी दिली गेली होती, आणि सहभागीने विचारलेल्या सर्व प्रश्नांची उत्तरे योग्यरित्या आणि माझ्या उत्तमतेनुसार दिली गेली आहेत. मी पुष्टी करतो की त्या व्यक्तीस संमती देण्यास भाग पाडले गेले नाही आणि संमती स्वतंत्रपणे आणि स्वेच्छेने दिली गेली आहे.

या माहिती संमती पत्र सहभागीला पुरविली गेली आहे:

सहभागीचे नाव:	
सहभागीची सही / डावा अंगठा	
तारीख आणि ठिकाण:	
साक्षीदाराचे नाव:	
साक्षीदाराचे सही / डावा अंगठा प्रभाव:	
तारीख आणि ठिकाण:	
अन्वेषकांचे नाव आणि स्वाक्षरीः	
तारीख आणि ठिकाण:	

ANNEXURE - IV – FIGURES

Figure 1: CONSORT FLOW DIAGRAM

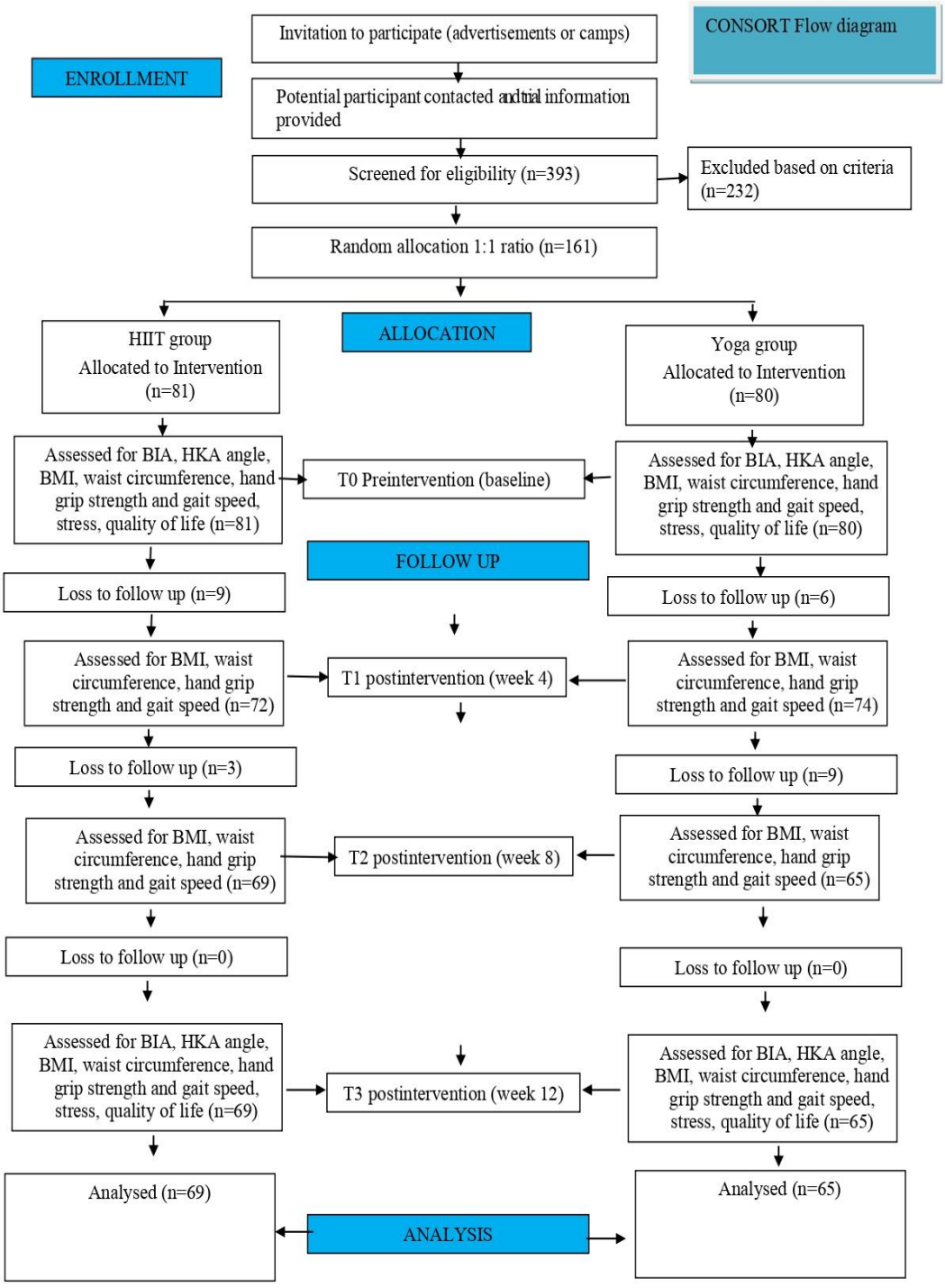




Figure 2a: HIIT intervention



Figure 2b: HIIT intervention



Figure 3a: Yoga Intervention



Figure 3b: Yoga Intervention



Figure 3c: Yoga Intervention



Figure 3d: Yoga Intervention



Figure 4: Bio-Impedance Analyser



Figure 5: Gait Speed Assessment



Figure 6: Hand grip assessment by Jamar Dynamometer



Figure 7a & b: Patient position for HKA angle Xray assessment



Figure 8a: HKA pre-HIIT

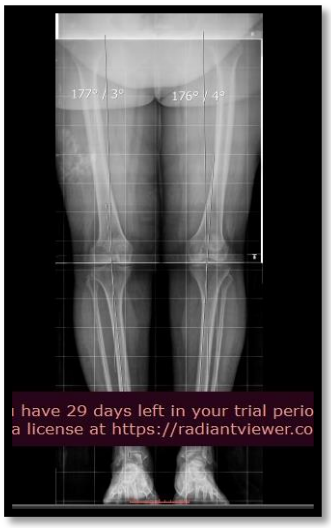


Figure 8b: HKA post-HIIT

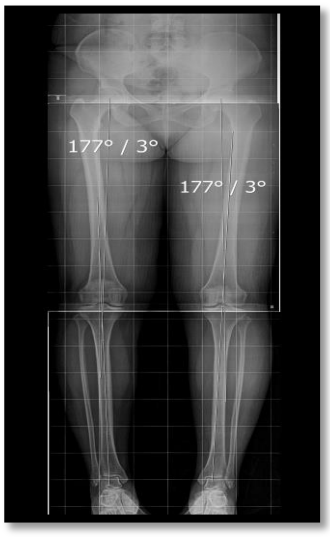


Figure 9a: HKA pre-yoga

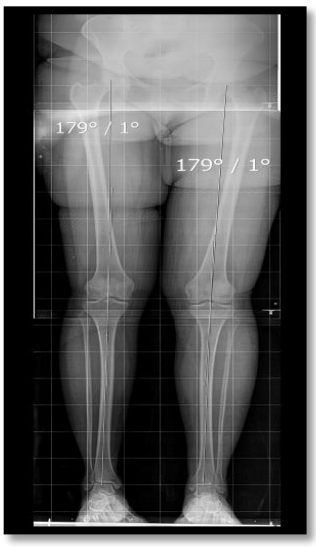


Figure 9b: HKA post-yoga

ANNEXURE V - TABLES

Table 1: High-Intensity Interval Training exercise protocol

Variables	Week 1 to 4	Week 5 to 8	Week 8 to 12
Intensity	70% MHR	80% MHR	90% MHR
Level	Beginner	Beginner - Intermediate	Intermediate
Warm-up (type & time)	General mobility/stretches for all major joints (10 minutes)	General mobility exercises/stretches for all major joints (10 minutes)	General mobility exercises/stretches for all major joints (10 minutes)
Type of exercise	Spot Jogging/running (repeated alternately)	Spot Jogging/running (repeated alternately)	Spot Jogging/running (repeated alternately)
Single Exercise bout Time	30 seconds	30 seconds	30 seconds
Exercise bouts (Number)	6	8	10
Total Exercise time	3 minutes	4 minutes	5 minutes
Recovery exercise type	Brisk walking (repeated alternately)	Brisk walking (repeated alternately)	Brisk walking (repeated alternately)
Single Active Recovery exercise time	120 seconds	120 seconds	120 seconds
Recovery bouts (Number)	7	9	11
Total active recovery exercise time	14 minutes	18 minutes	22 minutes
Total exercise time	30 -35mins	35-40 minutes	40 - 45minutes
Cool down (type & time)	Stretching of major muscle and breathing exercises (10mins)	Stretching of major muscle and breathing exercises (10mins)	Stretching of major muscle and breathing exercises (10mins)
Supervised sessions/week	3	3	3
Home exercise sessions/week (Brisk walking)	2	2	2
Frequency	5 sessions per week	5 sessions per week	5 sessions per week

- MHR: Maximum Heart Rate

Table 2: Hatha Yoga exercise protocol

Variables	Week 1 to 4	Week 5 to 8	Week 8 to 12
Intensity	Beginners	Beginner - Intermediate	Intermediate
Warm-up (type & time)	General mobility/stretches exercises for all major joints (10 minutes)	General mobility exercises/stretches for all major joints (10 minutes)	General mobility exercises/stretches for all major joints (10 minutes)
Type of exercise	Basic asanas with suryanamaskaras	Basic asanas with suryanamaskaras	Basic asanas with suryanamaskaras
Repetitions	Asanas (any 2): 2 to 3 reps Suryanamaskara (3-6)	Asanas (any 2): 2 to 3 reps Suryanamaskara (7-12)	Asanas (any 2): 2 to 3 reps Suryanamaskara (13-20)
Cool down (type & time)	Savasana & pranayama (10mins)	Savasana & pranayama (10mins)	Savasana & pranayama (10mins)
Total exercise time	50-60 minutes	50 -60 minutes	50 – 60 minutes
Supervised sessions/week	3	3	3
Home exercise sessions/week (Brisk walking)	2	2	2
Frequency	5 sessions per week	5 sessions per week	5 sessions per week

Table 3: Schematic diagram of schedule of enrolment, interventions, and assessments (Participant Timeline)

	Enrolment	**Allocation**	**Post Allocation**			**Closeout**
TIMEPOINT	***-t_1***	**0**	***T_0/ Baseline***	***T_1/ Week 4***	***T_2/ Week 8***	***T_3/ Week 12***
ENROLMENT:						
Eligibility screen	X					
Informed consent	X					
Allocation		X				
INTERVENTIONS:			←	—	—	→
[HIIT]			X	X	X	X
[Yoga]			X	X	X	X
ASSESSMENTS:						
[WC]	X		X	X	X	X
[HGS]	X		X	X	X	X
[Gait speed]	X		X	X	X	X
[Body Impedance analysis]			X			X
[BMI]			X	X	X	X
[HKA angle]			X			X
[Short–form 36]			X			X
[Perceived Stress Score]			X			X

Table 4: Normality Distribution Table – HIIT group

HIIT group	Kolmogorov-Smirnov[a]			Shapiro-Wilk[#]		
	Statistic	df	Sig.	Statistic	df	Sig.
Demographic variables						
Age	.144	68	.001	.936	68	.002*
Age of Menopause	.122	68	.014	.963	68	.042*
Height	.110	68	.040	.959	68	.026*
Anthropometric parameters						
Weight X 4 timelines						
Weight Pre	.117	68	.022	.937	68	.002*
Weight Post 4	.117	68	.022	.937	68	.002*
Weight Post 8	.114	68	.028	.937	68	.002*
Weight Post 12	.117	68	.023	.938	68	.002*
BMI X 2 timelines						
BMI Pre	.101	68	.080	.934	68	.001*
BMI Post 12	.102	68	.077	.939	68	.002*
WC X 4 timelines						
WC Pre	.124	68	.011	.880	68	.000*
WC Post 4	.136	68	.003	.905	68	.000*
WC Post 8	.139	68	.002	.915	68	.000*
WC Post 12	.137	68	.003	.928	68	.001*
Hip circumference X 2 timelines						
Hip circumference Pre	.125	68	.010	.889	68	.000*
Hip circumference Post 12	.160	68	.000	.912	68	.000*
Sarcopenia and Dynapenia						
HGS X 4 timelines						
HGS Pre	.225	68	.000	.814	68	.000*

HGS Post 4	.223	68	.000	.887	68	<0.001*
HGS Post 8	.225	68	.000	.877	68	.000*
HGS Post 12	.228	68	.000	.866	68	.000*
Gait speed X 4 timelines						
Gait speed Pre	.115	68	.027	.961	68	.031*
Gait speed Post 4 weeks	.061	68	.200*	.989	68	.805
Gait speed Post 8 weeks	.098	68	.178	.957	68	.020*
Gait speed Post 12 weeks	.123	68	.012	.945	68	.005*
Appendicular Skeletal Mass Index						
ASMI (LBMHt2) Pre	.103	68	.070	.955	68	.016*
ASMI (LBMHt2) Post12	.118	68	.019	.966	68	.057
ASMIAT3Pre	.097	68	.189	.957	68	.019*
ASMIAT3Post12	.109	68	.043	.964	68	.046*
Body composition parameters						
Body fat %						
Body Fat % Pre	.102	68	.078	.933	68	.001*
Body Fat % Post12	.102	68	.076	.926	68	.001*
Body fat mass						
Body Fat Mass Pre	.131	68	.005	.828	68	.000*
Body Fat Mass Post12	.114	68	.029	.851	68	.000*
Skeletal muscle mass						
Skeletal Muscle Mass Pre	.083	68	.200*	.984	68	.535
Skeletal Muscle Mass Post 12	.094	68	.200*	.982	68	.429
Lean body mass						
Lean Body Mass Pre	.084	68	.200*	.985	68	.603
Lean Body Mass Post12	.071	68	.200*	.987	68	.717
HKA angle						
HKA Angle Rt Pre	.096	68	.193	.967	68	.069

HKA Angle Rt Post 12	.095	68	.200*	.953	68	.011*
HKA Angle Lt Pre	.109	68	.043	.951	68	.010*
HKA Angle Lt Post 12	.100	68	.088	.951	68	.009*
Perceived Stress						
Perceived Stress Score Pre	.066	68	.200*	.984	68	.556
Perceived Stress Score Post12	.069	68	.200*	.979	68	.305
QoL SF-36						
Physical Function Pre	.091	68	.200*	.972	68	.131
Physical Function Post12	.118	68	.020	.949	68	.007*
Role Limitation due to Physical Health Pre	.200	68	.000	.841	68	.000*
Role Limitation due to Physical Health Post12	.241	68	.000	.843	68	.000*
Role Limitation due to Emotional Problems Pre	.237	68	.000	.811	68	.000*
Role Limitation due to Emotional Problems Post12	.362	68	.000	.728	68	.000*
Energy/ Fatigue Pre	.117	68	.023	.973	68	.141
Energy/Fatigue Post12	.084	68	.200*	.969	68	.085
Emotional Well-being Pre	.108	68	.049	.975	68	.196
Emotional Well-being Post 12	.102	68	.078	.964	68	.044*
Social Functions Pre	.144	68	.001	.949	68	.008*
Social Functions Post 12	.164	68	.000	.888	68	.000*
Pain Pre	.085	68	.200*	.977	68	.249
Pain Post 12	.145	68	.001	.936	68	.002*
General Health Pre	.135	68	.004	.976	68	.219
General Health Post 12	.117	68	.022	.943	68	.004*
*. This is a lower bound of the true significance.						
#. Considered Shapiro -Wilk test for selection of test of significance						

Table 5: Normality Distribution Table – Yoga group

Yoga group	Kolmogorov-Smirnov[a]			Shapiro-Wilk[#]		
	Statistic	df	Sig.	Statistic	df	Sig.
Demographic variables						
Age	.069	65	.200*	.978	65	.300
Age of Menopause	.147	65	.001	.963	65	.049
Height	.119	65	.023	.973	65	.167
Anthropometric parameters						
Weight X 4 timelines						
Weight Pre	.066	65	.200*	.974	65	.192
Weight Post 4weeks	.083	65	.200*	.973	65	.164
Weight Post 8weeks	.079	65	.200*	.974	65	.187
Weight Post 12weeks	.076	65	.200*	.975	65	.209
BMI X 2 timelines						
BMI Pre	.083	65	.200*	.960	65	.033*
BMI Post 12 weeks	.070	65	.200*	.964	65	.057
WC X 4 timelines						
WC Pre	.112	65	.041	.917	65	.000*
WC Post 4	.124	65	.015	.929	65	.001*
WC Post 8	.114	65	.034	.954	65	.017*
WC Post 12	.088	65	.200*	.965	65	.066
Hip circumference X 2 timelines						
Hip circumference Pre	.134	65	.005	.957	65	.025*
Hip circumference Post 12 weeks	.099	65	.189	.956	65	.022*
Sarcopenia and Dynapenia						
HGS X 4 timelines						
HGS Pre	.246	65	.000	.770	65	.000*
HGS Post 4 weeks	.150	65	.001	.962	65	.043*

HGS Post 8 weeks	.133	65	.006	.959	65	.032*
HGS Post 12 weeks	.189	65	.000	.948	65	.008*
Gait speed X 4 timelines						
Gait speed Pre	.063	65	.200*	.989	65	.837
Gait speed Post 4 weeks	.103	65	.085	.960	65	.033*
Gait speed Post 8 weeks	.055	65	.200*	.988	65	.761
Gait speed Post 12 weeks	.074	65	.200*	.977	65	.277
Appendicular Skeletal Mass Index						
ASMI (LBMHt2) Pre	.083	65	.200*	.975	65	.206
ASMI (LBMHt2) Post12	.086	65	.200*	.968	65	.089
ASMIAT3Pre	.111	65	.046	.971	65	.125
ASMIAT3Post12	.096	65	.200*	.966	65	.069
Body composition parameters						
Body fat %						
Body Fat % Pre	.072	65	.200*	.973	65	.166
Body Fat % Post12	.073	65	.200*	.973	65	.173
Body fat mass						
Body Fat Mass Pre	.078	65	.200*	.916	65	.000*
Body Fat Mass Post12	.076	65	.200*	.934	65	.002
Skeletal muscle mass						
Skeletal Muscle Mass Pre	.106	65	.066	.952	65	.013*
Skeletal Muscle Mass Post 12	.108	65	.057	.971	65	.133
Lean body mass						
Lean Body Mass Pre	.112	65	.042	.938	65	.003*
Lean Body Mass Post12	.126	65	.012	.963	65	.050*
HKA angle						
HKA Angle Rt Pre	.154	65	.001	.882	65	.000*
HKA Angle Rt Post 12	.095	65	.200*	.905	65	.000*
HKA Angle Lt Pre	.158	65	.000	.907	65	.000*

HKA Angle Lt Post 12	.117	65	.027	.890	65	.000*
Perceived Stress						
Perceived Stress Score Pre	.085	65	.200*	.981	65	.437
Perceived Stress Score Post12	.097	65	.200*	.980	65	.374
QoL SF-36						
Physical Function Pre	.088	65	.200*	.972	65	.148
Physical Function Post12	.150	65	.001	.922	65	.001*
Role Limitation due to Physical Health Pre	.213	65	.000	.823	65	.000*
Role Limitation due to Physical Health Post12	.284	65	.000	.823	65	.000*
Role Limitation due to Emotional Problems Pre	.215	65	.000	.827	65	.000*
Role Limitation due to Emotional Problems Post12	.372	65	.000	.715	65	.000*
Energy/ Fatigue Pre	.098	65	.198	.966	65	.068
Energy Fatigue Post12	.097	65	.200*	.977	65	.271
Emotional Well-being Pre	.113	65	.039	.972	65	.141
Emotional Well-being Post 12	.090	65	.200*	.948	65	.008*
Social Functions Pre	.142	65	.002	.948	65	.008*
Social Functions Post 12	.458	65	.000	.219	65	.000*
Pain Pre	.077	65	.200*	.976	65	.235
Pain Post 12	.162	65	.000	.901	65	.000*
General Health Pre	.081	65	.200*	.974	65	.197
General Health Post 12	.145	65	.002	.938	65	.003*
*. This is a lower bound of the true significance.						
#. Considered Shapiro -Wilk test for selection of test of significance						

Table 6: Demographic distribution and characteristics for the two study groups: categorical variables

6a. Occupation:

Occupation	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Working	14 (20.2)	43 (66.2)
Home-makers	55 (79.8)	22 (33.8)

6b. Marital status:

Marital status	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Divorcee	1 (1.4)	0
Married	65 (94.2)	62 (95.4)
Widow	3 (4.4)	3 (4.6)

6c. Level of Education:

Education	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Primary	3 (4.3)	0
Secondary	32 (46.3)	17 (26.2)
Graduate	34 (49.4)	47 (72.3)
Illiterate	0	1 (1.5)

6d. Diet:

Diet	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Mixed	16 (23.2)	27 (41.5)
Veg	53 (76.8)	38 (58.5)

6e. Hand Dominance:

Hand Dominance	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Left	3 (4.3)	1 (1.5)
Right	66 (95.7)	64 (98.5)

6f. Cause of menopause:

Cause of Menopause	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Natural	**51 (73.9)**	**51 (78.5)**
Surgical	**18 (26.5)**	**14 (21.5)**

6g. Presence of comorbidities:

Comorbidities	HIIT [n=69] (100%)	Yoga [n=65] (100%)
Absent	42 (60.9)	40 (61.5)
Present	27 (39.1)	25 (38.5)
Grand Total	69	65

6h. Medical Condition:

Medical conditions	HIIT [n=27] (100%)]	Yoga [n=25] (100%)
Asthma	1 (3.7)	0
Diabetes Mellitus	7 (25.9)	4 (16)
Hypertension	10 (37)	7 (28)
Hypertension & Diabetes	2 (7.5)	8 (32)
Hypertension & Thyroid	3 (11.1)	4 (16)
Thyroid & Diabetes	1 (3.7)	0
Thyroid	3 (11.1)	2 (8)

Table 7: Demographic distribution and characteristics for the two study groups: continuous variables

7a. Age

AGE (years)	Mean ± SD	Median	IQR	95% CI for Mean	Test Statistic	P value
HIIT	57.21±5.35	56	6.50	(55.93, 58.50)	Z=0.591	< 0.554 NOT Significant
Yoga	56.32±4.98	56.25	8.00	(55.08, 57.55)		

7b. Age of Menopause (years)

Age menopause	Mean ± SD	Median	IQR	95% CI for Mean	Test Statistic	P value
HIIT	48.76±3.49	49	4	(47.92, 49.60)	Z=1.215	=0.224 Not Significant
Yoga	48.38±2.24	49	3	(47.82, 48.93)		

7c. Height (meters)

Height (meters)	Mean ± SD	Median	IQR	95% CI for Mean	Test Statistic	P value
HIIT	1.56±0.06	1.57	0.08	(1.54, 1.57)	Z=0.478	=.633 Not Significant
Yoga	1.55±0.05	1.55	0.08	(1.54, 1.56)		

Intra-group Analysis for HIIT group

Table 8: Pre-post comparison of obesity parameters across timelines for the HIIT group

Table 8a: Pre-post comparison of body weight (kgs) across 4 timelines for the HIIT group

Body Weight	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	68.57±10.81	68	11.5	(65.97, 71.17)	Chi-square = 203.19	< 0.001 *
Post4	68.12±10.72	68	11.4	(65.43, 70.69)		
Post 8	67.64±10.69	67.1	11.35	(65.08, 70.21)		
Post 12	67.23±10.67	66.4	10.95	(64.66, 69.79)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; HIIT: HIIT; kgs: kilograms

Table 8a(i): Pair-wise comparison of body weight (kgs) between two timelines for the HIIT group

Body weight	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	68.57±10.81	68	11.5	(65.97, 71.17)	Z=6.804	< 0.001 *
Post4	68.12±10.72	68	11.4	(65.43, 70.69)		
Pre	68.57±10.81	68	11.5	(65.97, 71.17)	Z=7.226	< 0.001 *
Post 8	67.64±10.69	67.1	11.35	(65.08, 70.21)		
Pre	68.57±10.81	68	11.5	(65.97, 71.17)	Z=7.223	< 0.001 *
Post 12	67.23±10.67	66.4	10.95	(64.66, 69.79)		
Post4	68.12±10.72	68	11.4	(65.43, 70.69)	Z=7.188	< 0.001 *
Post 8	67.64±10.69	67.1	11.35	(65.08, 70.21)		
Post4	68.12±10.72	68	11.4	(65.43, 70.69)	Z=7.225	< 0.001 *
Post 12	67.23±10.67	66.4	10.95	(64.66, 69.79)		
Post8	67.64±10.69	67.1	11.35	(65.08, 70.21)	Z=7.088	< 0.001 *
Post 12	67.23±10.67	66.4	10.95	(64.66, 69.79)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; HIIT: HIIT; kgs: kilograms

Table 8b: Pre-post comparison of BMI (kg/m^2) between pre and 12 weeks post for HIIT group

BMI	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	28.21±3.99	27.5	4.9	(27.25, 29.17)	Z=7.186	< 0.001 *
Post 12	27.65±3.87	27.1	4.35	(26.72, 28.58)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; HIIT: HIIT; kgs: kilograms; m^2: meter square

Table 8c: Pre-post comparison of WC (cms) between 4 timelines for the HIIT group

WC	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	96.01±6.89	95	9.5	(94.36, 97.67)	Chi-square = 205.241	< 0.001 *
Post4	93.46±6.29	92	8.25	(91.94, 94.97)		
Post8	91.25±6.26	91	8	(89.74, 92.75)		
Post12	89.16±6.11	89	7.5	(87.69, 90.63)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; HIIT: HIIT; cms: centimeters

Table 8c(i): Pair-wise comparison of WC (cms) between two timelines for the HIIT group

WC	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	96.01±6.89	95	9.5	(94.36, 97.67)	Z=7.265	< 0.001 *
Post4	93.46±6.29	92	8.25	(91.94, 94.97)		
Pre	96.01±6.89	95	9.5	(94.36, 97.67)	Z=7.254	< 0.001 *
Post 8	91.25±6.26	91	8	(89.74, 92.75)		
Pre	96.01±6.89	95	9.5	(94.36, 97.67)	Z=7.245	< 0.001 *
Post 12	89.16±6.11	89	7.5	(87.69, 90.63)		
Post 4	93.46±6.29	92	8.25	(91.94, 94.97)	Z=7.257	< 0.001 *
Post 8	91.25±6.26	91	8	(89.74, 92.75)		
Post 4	93.46±6.29	92	8.25	(91.94, 94.97)	Z=7.258	< 0.001 *
Post 12	89.16±6.11	89	7.5	(87.69, 90.63)		
Post 8	91.25±6.26	91	8	(89.74, 92.75)	Z=7.101	< 0.001 *
Post 12	89.16±6.11	89	7.5	(87.69, 90.63)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; HIIT: HIIT; cms: centimeters

Table 8d: Pre-post comparison of the Hip circumference (cms) between pre and 12 weeks post for the HIIT group

Hip circumference	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	107.35±8.14	106	9	(105.39, 109.3)	Z=7.254	< 0.001 *
Post12	102.49±7.64	101	8	(100.66, 104.33)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; HIIT: HIIT; cms: centimeters

Table 9: Pre-post comparison of sarcopenic and dynapenia parameters across timelines for the HIIT group

Table 9a: Pre-post comparison of hand-grip strength (kgs) [dynapenia] across 4 timelines for the HIIT group

Hand-Grip Strength	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	15.79±2.55	16	4	(15.19, 16.41)	Chi-square = 199.824	< 0.001 *
Post4	17.41±2.73	18	3	(16.75, 18.06)		
Post8	18.77±2.76	20	4	(18.11, 19.43)		
Post12	20.65±2.79	21	3	(19.98, 21.32)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs: kilograms

Table 9a(i): Pair-wise comparison of hand-grip strength (kgs) [dynapenia] between two timelines for the HIIT group

Hand-Grip Strength	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	15.79±2.55	16	4	(15.19, 16.41)	Z=7.069	< 0.001 *
Post4	17.41±2.73	18	3	(16.75, 18.06)		
Pre	15.79±2.55	16	4	(15.19, 16.41)	Z=7.283	< 0.001 *
Post8	18.77±2.76	20	4	(18.11, 19.43)		
Pre	15.79±2.55	16	4	(15.19, 16.41)	Z=7.261	< 0.001 *
Post 12	20.65±2.79	21	3	(19.98, 21.32)		
Post 4	17.41±2.73	18	3	(16.75, 18.06)	Z=6.979	< 0.001 *
Post 8	18.77±2.76	20	4	(18.11, 19.43)		
Post 4	17.41±2.73	18	3	(16.75, 18.06)	Z=7.245	< 0.001 *
Post 12	20.65±2.79	21	3	(19.98, 21.32)		
Post 8	18.77±2.76	20	4	(18.11, 19.43)	Z=6.92	< 0.001 *
Post 12	20.65±2.79	21	3	(19.98, 21.32)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs: kilograms

Table 9b: Pre-post comparison of Gait Speed (m/s) across 4 timelines for the HIIT group

Gait Speed	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Pre	0.82±0.082	0.81	0.14	(0.803, 0.84)	Chi-square =205.537	< 0.001 *
Post4	0.89±0.08	0.88	0.11	(0.87, 0.91)		
Post8	0.95±0.094	0.94	0.1	(0.93, 0.97)		
Post12	1.02±0.13	1.0	0.16	(0.99, 1.05)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; m/s: meter per seconds

Table 9b(i): Pairwise comparison of Gait Speed (m/s) between two timelines for HIIT group

Gait Speed	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	0.82±0.082	0.81	0.14	(0.803, 0.84)	Z=7.169	< 0.001 *
Post4	0.89±0.08	0.88	0.11	(0.87, 0.91)		
Pre	0.82±0.082	0.81	0.14	(0.803, 0.84)	Z=7.223	< 0.001 *
Post 8	0.95±0.094	0.94	0.1	(0.93, 0.97)		
Pre	0.82±0.082	0.81	0.14	(0.803, 0.84)	Z=7.222	< 0.001 *
Post 12	1.02±0.13	1.0	0.16	(0.99, 1.05)		
Post 4	0.89±0.08	0.88	0.11	(0.87, 0.91)	Z=7.235	< 0.001 *
Post 8	0.95±0.094	0.94	0.1	(0.93, 0.97)		
Post 4	0.89±0.08	0.88	0.11	(0.87, 0.91)	Z=7.222	< 0.001 *
Post 12	1.02±0.13	1.0	0.16	(0.99, 1.05)		
Post 8	0.95±0.094	0.94	0.1	(0.93, 0.97)	Z=7.228	< 0.001 *
Post 12	1.02±0.13	1.0	0.16	(0.99, 1.05)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; m/s: meter per seconds

Table 9c: Pre-post comparison of Appendicular Skeletal Muscle Index across 2 timelines for the HIIT group

ASMI	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	5.3±0.36	5.38	0.42	(5.21, 5.39)	Z=1.247	0.212 Not sign
Post 12	5.35±0.47	5.33	0.46	(5.23, 5.46)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kg/m^2: kilograms per meter square

Table 10: Pre-post comparison of Body composition parameters across two timelines for the HIIT group

Timeline	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Body fat %						
Pre	39.59±5.69	38.7	6.25	(38.23, 40.97)	Z=7.12	< 0.001 *
Post 12	38.54±5.39	38.1	5.9	(37.24, 39.84)		
Body fat mass (kgs)						
Pre	27.56±8.26	26.2	9.15	(25.58, 29.54)	Z=6.47	< 0.001 *
Post 12	26.42±7.88	25.2	8.7	(24.53, 28.31)		
Skeletal Muscle Mass (kgs)						
Pre	28.81±6.45			(27.26, 30.36)	t=4.452	< 0.001 *
Post 12	30.35±6.99			(28.67, 32.03)		
7d.Lean Body Mass (kgs)						
Pre	38.64±3.71			(37.75, 39.53)	t=2.152	=0.035 *
Post 12	39.01±4.04			(38.04, 39.98)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Table 11: Pre-post comparison of HKA angle (degrees) across two timelines for HIIT group

Timeline	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
HKA (Right)						
Pre	176.58±1.5	176.75	2.13	(176.21, 176.94)	Z=7.078	< 0.001 *
Post 12	177.39±1.45	177.6	1.97	(177.04, 177.74)		
HKA (Left)						
Pre	176.59±1.62	176.85	2.15	(176.2, 176.99)	Z=7.07	<0.001 *
Post 12	177.33±1.62	177.6	2.17	(176.94, 177.72)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Table 12: Pre-post comparison of PSS score across two timelines for the HIIT group

Stress	Mean ± SD	95% CI for Mean	Test statistic	P value
Pre	20.5±4.81	(19.34, 21.66)	t=14.76	<0.001 *
Post 12	16.04±4.29	(15.004, 17.08)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Table 13: Pre-post comparison of domains of SF- 36 QoL questionnaire across two timelines for HIIT group

SF-36	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Physical Function domain						
Pre	45.01±25.92	50	39.38	(38.74, 51.28)	Z=6.857	<0.001 *
Post 12	66.98±22.27	70	32.5	(61.59, 72.37)		
Role limitations due to physical health						
Pre	50.71±39.19	50	75	(41.22, 60.19)	Z=5.58	<0.001 *
Post 12	73.53±26.23	75	50	(67.18, 79.88)		
Role limitations due to emotional problems						
Pre	53.72±41.24	66	100	(43.73, 63.69)	Z=5.1	<0.001 *
Post 12	76.64±31.09	100	58.5	(69.12, 84.17)		
Energy/Fatigue						
Pre	57.88±15.79			(54.06, 61.7)	t=9.228	<0.001 *
Post 12	74.31±14.48			(70.8, 77.81)		
Emotional Well-being						
Pre	64.95±16.13	64	27	(61.05, 68.85)	Z=6.639	<0.001 *
Post 12	78.13±14.18	78.25	23.5	(74.7, 81.56)		
Social Functioning						
Pre	62.80±22.26	62.5	25	(57.41, 68.19)	Z=5.536	<0.001 *
Post 12	76.29±19.82	75	38	(71.49, 81.09)		
Pain						
Pre	59.79±22.25	57.5	32.5	(54.5, 65.18)	Z=6.371	<0.001 *
Post 12	78.09±16.28	77.5	23	(74.16, 82.04)		
General Health						
Pre	62.8±18.87	65	30	(58.24, 67.37)	Z=6.748	<0.001 *
Post 12	77.31±15.91	77.25	23.75	(73.46, 81.16)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Intra-group Analysis for Yoga

Table 14: Pre-post comparison of obesity parameters across timelines for the Yoga group

Table 14a: Pre-post comparison of body weight (kgs) across 4 timelines for the Yoga group

Weight	Mean ± SD	95% CI for Mean	Test statistic	P value
Pre	70.38±10.09	(67.88, 72.88)	Chi-square = 77.704	< 0.001 *
Post4	69.79±9.98	(67.33, 72.27)		
Post 8	69.24±9.86	(66.79, 71.68)		
Post 12	68.93±9.84	(66.49, 71.37)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs: kilograms

Table 14a(i): Pair-wise comparison of body weight (kgs) between two timelines for the Yoga group

Body Weight	Mean ± SD	95% CI for Mean	Test statistic	P value
Pre	70.38±10.09	(67.88, 72.88)	t=9.796	< 0.001 *
Post4	69.79±9.98	(67.33, 72.27)		
Pre	70.38±10.09	(67.88, 72.88)	t=12.942	< 0.001 *
Post 8	69.24±9.86	(66.79, 71.68)		
Pre	70.38±10.09	(67.88, 72.88)	t=13.411	< 0.001 *
Post 12	68.93±9.84	(66.49, 71.37)		
Post4	69.79±9.98	(67.33, 72.27)	t=9.34	< 0.001 *
Post 8	69.24±9.86	(66.79, 71.68)		
Post4	69.79±9.98	(67.33, 72.27)	t=11.092	< 0.001 *
Post 12	68.93±9.84	(66.49, 71.37)		
Post8	69.24±9.86	(66.79, 71.68)	t=6.261	< 0.001 *
Post 12	68.93±9.84	(66.49, 71.37)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs: kilograms

Table 14b: Pre-post comparison of BMI (kg/m^2) between pre and 12 weeks post for the Yoga group

BMI	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	29.09±4.32	29.4	5.5	(28.02, 30.16)	Z=6.84	< 0.001 *
Post 12	28.49±4.19	28.4	5.5	(27.45, 29.53)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs/m^2: kilograms per square meter

Table 14c: Pre-post comparison of WC (cms) between 4 timelines for the Yoga group

WC	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	96.32±6.96	95	10.5	(94.59, 98.05)	Chi-square =184.215	< 0.001 *
Post4	93.75±6.91	93	10	(92.04, 95.47)		
Post8	91.78±6.92	91	10	(90.07, 93.49)		
Post12	89.72±7.08	89	10	(87.97, 91.48)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; cms: centimeters

Table 14c(i): Pair-wise comparison of WC (cms) between two timelines for the Yoga group

WC	Mean ± SD	Median	Test statistic	P value
Pre	96.32±6.96	95	Z=6.965	< 0.001 *
Post4	93.75±6.91	93		
Pre	96.32±6.96	95	Z=7.033	< 0.001 *
Post 8	91.78±6.92	91		
Pre	96.32±6.96	95	Z=7.023	< 0.001 *
Post 12	89.72±7.08	89		
Post 4	93.75±6.91	93	Z=6.544	< 0.001 *
Post 8	91.78±6.92	91		
Post 4	93.75±6.91	93	Z=6.933	< 0.001 *
Post 12	89.72±7.08	89		
Post 8	91.78±6.92	91	Z=6.501	< 0.001 *
Post 12	89.72±7.08	89		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; cms: centimeters

Table 14d: Pre-post comparison of Hip circumference (cms) between pre and 12 weeks post for the Yoga group

Hip circumference	Mean ± SD	Median	IQR	95% CI for Mean	Test Statistic	P value
Pre	108.88±7.71	108	10	(106.97, 110.79)	Z=7.038	< 0.001 *
Post12	104.68±7.55	105	9.5	(102.81, 106.55)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; cms: centimeters

Table 15: Pre-post comparison of Sarcopenic and dynapenia parameters across timelines for the Yoga group

Table 15a: Pre-post comparison of hand-grip strength (kgs) across 4 timelines for the Yoga group

Hand- Grip Strength	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	16.8±1.52	17	2	(16.42, 17.18)	Chi-square = 185.338	< 0.001 *
Post4	18.85±1.98	19	2	(18.36, 19.34)		
Post8	20.43±2.19	21	3	(19.89, 20.97)		
Post12	21.85±2.22	22	2.5	(21.29, 22.39)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs: kilograms

Table 15a(i): Pair-wise comparison of hand-grip strength (kgs) between two timelines for the Yoga group

Hand-grip strength	Mean ± SD	Median	Test statistic	P value
Pre	16.8±1.52	17	Z=6.584	< 0.001 *
Post4	18.85±1.98	19		
Pre	16.8±1.52	17	Z=7.054	< 0.001 *
Post8	20.43±2.19	21		
Pre	16.8±1.52	17	Z=7.059	< 0.001 *
Post 12	21.85±2.22	22		
Post 4	18.85±1.98	19	Z=6.678	< 0.001 *
Post 8	20.43±2.19	21		
Post 4	18.85±1.98	19	Z=7.065	< 0.001 *
Post 12	21.85±2.22	22		
Post 8	20.43±2.19	21	Z=6.135	< 0.001 *
Post 12	21.85±2.22	22		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kgs: kilograms

Table 15b: Pre-post comparison of Gait Speed (m/s) across 4 timelines for the Yoga group

Gait Speed	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
Pre	0.81±0.084	0.81	0.12	(0.79, 0.83)	Chi-square =186.069	< 0.001 *
Post4	0.89±0.081	0.9	0.1	(0.88, 0.92)		
Post8	0.96±0.083	0.96	0.12	(0.94, 0.98)		
Post12	1.06±0.099	1.05	0.13	(1.03, 1.08)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; m/s: meter/second

Table 15b(i): Pairwise comparison of Gait Speed (m/s) between two timelines for the Yoga group

Gait Speed	Mean ± SD	Median	Test statistic	P value
Pre	0.81±0.084	0.81	Z=7.015	< 0.001 *
Post4	0.89±0.081	0.9		
Pre	0.81±0.084	0.81	Z=6.958	< 0.001 *
Post 8	0.96±0.083	0.96		
Pre	0.81±0.084	0.81	Z=7.01	< 0.001 *
Post 12	1.06±0.099	1.05		
Post 4	0.89±0.081	0.9	Z=6.566	< 0.001 *
Post 8	0.96±0.083	0.96		
Post 4	0.89±0.081	0.9	Z=7.012	< 0.001 *
Post 12	1.06±0.099	1.05		
Post 8	0.96±0.083	0.96	Z=6.875	< 0.001 *
Post 12	1.06±0.099	1.05		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; m/s: meter/second

Table 15c: Pre-post comparison of Appendicular Skeletal Mass Index across 2 timelines for the Yoga group

	Mean ± SD	IQR	95% CI for Mean	Test statistic
Pre	5.38±0.42	(5.28, 5.48)	t=3.091	=0.003 *
Post 12	5.45±0.46	(5.33, 5.56)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT; kg/m^2: kilograms/square meters

Table 16: Pre-post comparison of Body composition parameters across two timelines for the Yoga group

Timeline	Mean ± SD	Median	IQR	95% Confidence Interval for Mean	Test statistic	P value
Body fat %						
Pre	40.31±6.02	39.8	7.85	(38.82, 41.80)	Z=6.592	< 0.001 *
Post 12	39.07±5.95	38.6	7.4	(37.59, 40.55)		
Body fat mass (kgs)						
Pre	28.76±8.08	28.3	10.3	(26.76, 30.76)	Z=6.658	< 0.001 *
Post 12	27.53±7.72	26.3	9.73	(25.62, 29.44)		
Skeletal Muscle Mass (kgs)						
Pre	28.22±5.93	28.8	9.73	(26.75, 29.69)	t=6.514	< 0.001 *
Post 12	29.85±5.77	30.6	8.84	(28.42, 31.28)		
Lean Body Mass (kgs)						
Pre	39.14±3.67	38.8	3.55	(38.23, 40.05)	t=3.223	=0.001 *
Post 12	39.57±3.82	39.6	3.7	(38.62, 40.51)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Table 17: Pre-post comparison of HKA angle (degrees) across two timelines for the Yoga group

Timeline	Mean ± SD	Median	IQR	95% CI for Mean	Test statistic	P value
HKA (Right)						
Pre	176.74±1.65	177.1	1.65	(176.33, 177.15)	Z=6.516	< 0.001 *
Post 12	177.62±1.34	177.8	1.75	(177.28, 177.95)		
HKA (Left)						
Pre	176.62±1.72	176.8	1.5	(176.19, 177.04)	Z=6.339	<0.001 *
Post 12	177.49±1.38	177.7	1.65	(177.15, 177.84)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Table 18: Pre-post comparison of PSS score across two timelines for the Yoga group

Stress	Mean ± SD	95% CI for Mean	Test statistic	P value
Pre	19.46±4.82	(18.27, 20.66)	t=12.053	<0.001 *
Post 12	13.58±4.86	(12.38, 14.79)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Table 19: Pre-post comparison of domains of SF- 36 QoL questionnaire across two timelines for the Yoga group

SF-36	Mean±SD	Median	IQR	95% CI for Mean	Test statistic	P value
19a. Physical Function domain						
Pre	49.08±25.32	50	40	(42.80, 55.35)	Z=6.521	<0.001 *
Post 12	69.69±21.77	75	35	(64.29, 75.09)		
19b. Role of limitations due to physical health						
Pre	44.97±40.32	25	100	(34.98, 54.96)	Z=5.029	<0.001 *
Post 12	72.17±30.07	75	50	(64.72, 79.62)		
19c. Role limitations due to emotional problems						
Pre	53.66±40.08	66.6	85	(43.73, 63.59)	Z=5.235	<0.001 *
Post 12	82.72±24.86	100	33.3	(76.56, 88.88)		
19d. Energy/Fatigue						
Pre	54.02±17.1			(49.78, 58.26)	t=8.212	<0.001 *
Post 12	68.85±17.8			(64.43, 73.26)		
19e. Emotional Well-being						
Pre	63.89±18.33	64	26.05	(59.35, 68.44)	Z=6.135	<0.001 *
Post 12	76.003±16.19	76	24	(71.99, 80.02)		
19f. Social Functioning						
Pre	66.35±21.004	62.5	37.25	(61.14, 71.55)	Z=5.55	<0.001 *
Post 12	93.21±99.88	85	37.5	(68.46, 117.96)		
19g. Pain						
Pre	62.36±20.22	65	31.25	(57.35, 67.37)	Z=6.35	<0.001 *
Post 12	78.99±17.08	80	17.5	(74.76, 83.22)		
19h. General Health						
Pre	58.87±17.68	60	30	(54.49, 63.25)	Z=6.58	<0.001*
Post 12	76.58±14.86	80	20	(72.89, 80.26)		

*P≤0.05 indicates statistically significant difference; IQR: Inter-Quartile Range; SD: Standard deviation; CI: Confidence Interval; HIIT: HIIT;

Inter-group Analyses between HIIT and Yoga

Table 20: Between-group comparison of obesity parameters

Outcome parameters	Timeline	t-value/Z-value	P - value
Body weight	**Pre**	Z=1.324	0.185
	Post 4	Z=1.202	0.229
	Post 8	Z=1.124	0.261
	Post 12	Z=1.153	0.249
BMI	**Pre**	Z=1.534	0.125
	Post 12	Z=1.538	0.124
WC	**Pre**	Z=0.319	0.75
	Post 4	Z=0.125	0.901
	Post 8	Z=0.446	0.655
	Post 12	Z=0.442	0.659
Hip Circumference	**Pre**	Z=1.492	0.136
	Post 12	Z=1.886	0.059

*P≤0.05 indicates statistically significant difference;

Table 21: Between-group comparison of Sarcopenic and dynapenia parameters

Outcome parameters	Timeline	t-value/Z-value	P – value
ASMI	**Pre**	't' = 1.21	0.229
	Post 12	Z=1.508	0.132
HGS	**Pre**	Z=2.171	0.03 *
	Post 4	Z=2.969	0.003 *
	Post 8	Z=3.439	0.001 *
	Post 12	Z=2.472	0.013 *
Gait Speed	**Pre**	Z=0.642	0.521
	Post 4	Z=0.987	0.324
	Post 8	Z=1.21	0.226
	Post 12	Z=2.338	0.017 *

*P≤0.05 indicates a statistically significant difference

Table 22: Between-group comparison of body composition parameters

Outcome parameters	Timeline	t-value/Z-value	P – value
Body fat %	**Pre**	Z=1.055	0.291
	Post 12	Z=0.819	0.413
Body fat mass	**Pre**	Z=1.313	0.189
	Post 12	Z=1.166	0.243
Skeletal Muscle Mass	**Pre**	Z=0.583	0.56
	Post 12	't' = 0.449	0.654
Lean Body Mass	**Pre**	Z =0.387	0.698
	Post 12	Z=0.57	0.569

*P≤0.05 indicates a statistically significant difference

Table 23: Between-group analysis for Hip Knee Ankle Angle for both sides

Outcome parameters	Timeline	t-value/Z-value	P – value
HKA (Right)	**Pre**	Z=1.045	0.296
	Post 12	Z=0.88	0.379
HKA (Left)	**Pre**	Z = 0.065	0.949
	Post 12	Z=0.432	0.666

*P≤0.05 indicates a statistically significant difference

Table 24: Between-group analysis of perceived stress score and domains of SF-36

Outcome parameters	Timeline	t-value/Z-value	P - value
Perceived Stress Score	**Pre**	't' = 1.226	0.222
	Post 12	Z = 2.986	0.003 *
Physical Function	**Pre**	't' = 0.836	0.405
	Post 12	Z= 0.701	0.483
Role limitation due to physical health	**Pre**	Z=0.862	0.388
	Post 12	Z = 0.03	0.976
Role limitation due to Mental health	**Pre**	Z = 0.002	0.998
	Post 12	Z=1.165	0.224
Energy/Fatigue	**Pre**	't' = 1.506	0.135
	Post 12	Z =1.699	0.089
Emotional Well-being	**Pre**	't' = 0.483	0.63
	Post 12	Z=0.64	0.522
Social function	**Pre**	Z=1.145	0.252
	Post 12	Z=1.42	0.156
Pain	**Pre**	't' = 0.759	0.449
	Post 12	Z=0.482	0.63
General Health	**Pre**	't' = 1.259	0.21
	Post 12	Z = 0.308	0.758

*P≤0.05 indicates a statistically significant difference

Mean and % mean Differences and effect size

Table 25: Comparisons of effect size and % difference between Yoga and HIIT groups for obesity variables

Outcome variables	Study groups	Mean Difference (Pre to post 12)	% difference (Pre to post 12)	Effect size (Cohen's d)
Weight	**Yoga**	1.45	2.06	0.14
	HIIT	1.33	1.94	0.12
BMI	**Yoga**	0.60	2.05	0.94
	HIIT	0.56	1.99	0.86
WC	**Yoga**	6.60	6.85	0.94
	HIIT	6.86	7.14	1.05
Hip Circumference	**Yoga**	4.20	3.86	0.55
	HIIT	4.86	4.52	0.61

*indicates high effect size

Table 26: Comparisons of effect size and % difference between Yoga and HIIT groups for Sarcopenia and dynapenia variables

Outcome variables	Study groups	Mean Difference (Pre to post 12)	% difference (Pre to post 12)	Effect size (Cohen's d)
HGS	**Yoga**	-5.05	-30.04	-2.65*
	HIIT	-4.86	-30.73	-1.82
Gait Speed	**Yoga**	-0.24	-29.92	-2.64*
	HIIT	-0.20	-23.95	-1.84
Appendicular Skeletal Mass Index	**Yoga**	-0.18	-1.12	-0.14
	HIIT	-0.14	-0.88	-0.11

*indicates high effect size

Table 27: Comparisons of effect size and % difference between Yoga and HIIT groups for Body composition variables

Outcome variables	Study groups	Mean Difference (Pre to post 12)	% difference (Pre to post 12)	Effect size (Cohen's d)
Body fat percentage	**Yoga**	1.24	3.07	0.21
	HIIT	1.06	2.67	0.19
Body fat mass	**Yoga**	1.23	4.27	0.16
	HIIT	1.14	4.13	0.14
Skeletal Muscle mass	**Yoga**	-1.63	-5.77	-0.28
	HIIT	-1.54	-5.35	-0.23
Lean body mass	**Yoga**	-0.43	-1.09	-0.11
	HIIT	-0.32	-0.82	-0.08

*indicates high effect size

Table 28: Comparisons of effect size and % difference between Yoga and HIIT groups for HKA angle variable

Outcome variable	Study groups	Mean Difference (Pre to post 12)	% difference (Pre to post 12)	Effect size (Cohen's d)
HKA Angle (on right and left)				
HKA right	**Yoga**	-0.88	-0.50	-0.59
	HIIT	-0.83	-0.47	-0.56
HKA left	**Yoga**	-0.87	-0.49	-0.56
	HIIT	-0.74	-0.42	-0.46

*indicates high effect size

Table 29: Comparisons of effect size and % difference between Yoga and HIIT groups for Perceived stress levels

Outcome variable	Study groups	Mean Difference (Pre to post 12)	% difference (Pre to post 12)	Effect size (Cohen's d)
PSS				
Perceived stress score	**Yoga**	5.88	30.20	1.21*
	HIIT	4.42	21.59	0.98

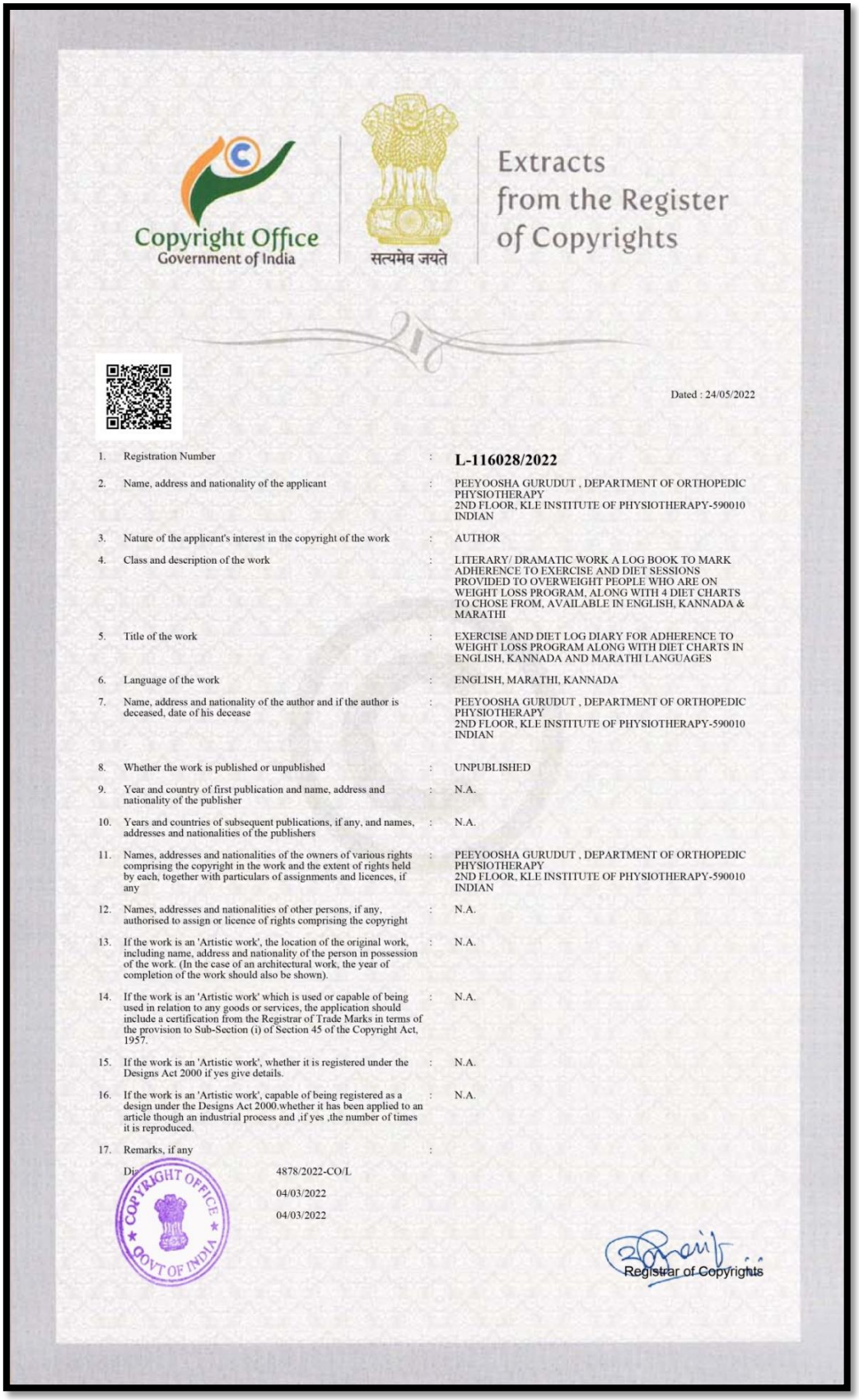
*indicates high effect size

Table 30: Comparisons of effect size and % difference between Yoga and HIIT groups for Health-related QoL by SF-36

Outcome variables	Study groups	Mean Difference (Pre to post 12)	% difference (Pre to post 12)	Effect size (Cohen's d)
SF-36 for QoL				
Physical Functioning	**Yoga**	-20.62	-42.01	-0.87
	HIIT	-21.87	-48.19	-0.91
Role Limitation due to Physical Health	**Yoga**	-27.20	-60.48	-0.76
	HIIT	-23.22	-46.46	-0.69
Role Limitation due to Emotional Problems	**Yoga**	-29.06	-54.15	-0.87
	HIIT	-22.59	-41.91	-0.62
Energy/ Fatigue	**Yoga**	-14.82	-27.44	-0.85
	HIIT	-16.19	-27.74	-1.06
Emotional Well-being	**Yoga**	-12.11	-18.95	-0.70
	HIIT	-12.99	-19.88	-0.85
Social Functioning	**Yoga**	-26.86	-40.49	-0.37
	HIIT	-13.29	-20.99	-0.63
Pain	**Yoga**	-16.63	-26.66	-0.89
	HIIT	-18.51	-31.07	-0.95
General Health	**Yoga**	-17.71	-30.09	-1.08
	HIIT	-14.48	-23.04	-0.83

*indicates high effect size

ANNEXURE VI - LOG DIARY AND DIET CHART



Copyright Office
Government of India

सत्यमेव जयते

Extracts
from the Register
of Copyrights

Dated : 24/05/2022

1.	Registration Number	:	**L-116028/2022**
2.	Name, address and nationality of the applicant	:	PEEYOOSHA GURUDUT , DEPARTMENT OF ORTHOPEDIC PHYSIOTHERAPY 2ND FLOOR, KLE INSTITUTE OF PHYSIOTHERAPY-590010 INDIAN
3.	Nature of the applicant's interest in the copyright of the work	:	AUTHOR
4.	Class and description of the work	:	LITERARY/ DRAMATIC WORK A LOG BOOK TO MARK ADHERENCE TO EXERCISE AND DIET SESSIONS PROVIDED TO OVERWEIGHT PEOPLE WHO ARE ON WEIGHT LOSS PROGRAM, ALONG WITH 4 DIET CHARTS TO CHOSE FROM, AVAILABLE IN ENGLISH, KANNADA & MARATHI
5.	Title of the work	:	EXERCISE AND DIET LOG DIARY FOR ADHERENCE TO WEIGHT LOSS PROGRAM ALONG WITH DIET CHARTS IN ENGLISH, KANNADA AND MARATHI LANGUAGES
6.	Language of the work	:	ENGLISH, MARATHI, KANNADA
7.	Name, address and nationality of the author and if the author is deceased, date of his decease	:	PEEYOOSHA GURUDUT , DEPARTMENT OF ORTHOPEDIC PHYSIOTHERAPY 2ND FLOOR, KLE INSTITUTE OF PHYSIOTHERAPY-590010 INDIAN
8.	Whether the work is published or unpublished	:	UNPUBLISHED
9.	Year and country of first publication and name, address and nationality of the publisher	:	N.A.
10.	Years and countries of subsequent publications, if any, and names, addresses and nationalities of the publishers	:	N.A.
11.	Names, addresses and nationalities of the owners of various rights comprising the copyright in the work and the extent of rights held by each, together with particulars of assignments and licences, if any	:	PEEYOOSHA GURUDUT , DEPARTMENT OF ORTHOPEDIC PHYSIOTHERAPY 2ND FLOOR, KLE INSTITUTE OF PHYSIOTHERAPY-590010 INDIAN
12.	Names, addresses and nationalities of other persons, if any, authorised to assign or licence of rights comprising the copyright	:	N.A.
13.	If the work is an 'Artistic work', the location of the original work, including name, address and nationality of the person in possession of the work. (In the case of an architectural work, the year of completion of the work should also be shown).	:	N.A.
14.	If the work is an 'Artistic work' which is used or capable of being used in relation to any goods or services, the application should include a certification from the Registrar of Trade Marks in terms of the provision to Sub-Section (i) of Section 45 of the Copyright Act, 1957.	:	N.A.
15.	If the work is an 'Artistic work', whether it is registered under the Designs Act 2000 if yes give details.	:	N.A.
16.	If the work is an 'Artistic work', capable of being registered as a design under the Designs Act 2000.whether it has been applied to an article though an industrial process and ,if yes ,the number of times it is reproduced.	:	N.A.
17.	Remarks, if any	:	
	Di		4878/2022-CO/L
			04/03/2022
			04/03/2022

COPYRIGHT OFFICE * GOVT OF INDIA *

Registrar of Copyrights



EXERCISE LOG AND DIET CHART

Compiled by:
Dr. Peeyoosha Gurudut
Ph.no: 9844821355

Waist circumference:	Weight:	Height:	BMI:	Start date:	End date:
Tick the boxes when you have performed the exercises				✘	
Cross mark the session box when you have missed the exercise sessions				✘	

Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		Week 8		Week 9		Week 10		Week 11		Week 12	
1		6		11		16		21		26		31		36		41		46		51		56	
2		7		12		17		22		27		32		37		42		47		52		57	
3		8		13		18		23		28		33		38		43		48		53		58	
4		9		14		19		24		29		34		39		44		49		54		59	
5		10		15		20		25		30		35		40		45		50		55		60	
Wt						Wt								Wt								Wt	
WC						WC								WC								WC	

NAME:		Age:	Sex:	
Waist circumference:	Weight:	Height:	BMI:	
Calorie plan:	Calorie deficit:	Start Date:	End date:	
PRE-INTERVENTION DIET/ ಚಿಕಿತ್ಸೆಯ ಮೊದಲ ಆಹಾರಕ್ರಮ ದಿನಚರಿ / उपचार करण्यापूर्वी आहार दैनिक डायरी				
Routine diet/ದಿನನಿತ್ಯದ ಆಹಾರ/ **नियमित आहार**	Menu/ ಆಹಾರ ಪದಾರ್ಥಗಳು/ खाद्यपदार्थ	Portion/ ಪ್ರಮಾಣ/ प्रमाण	Time/ಸಮಯ/ **वेळ**	Calories
Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता				
Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता				
Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण				
Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता				
Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण				
Total calories				

INSTRUCTIONS:
- Have balanced diet
- Have small and frequent meals
- Do not skip meals
- Drink adequate water in your daily routine
- Use flax seed (2–3 tsp /day), garlic, curry leaves, ground nut in your diet
- Control stress and do regular walking and exercise

ಸೂಚನೆಗಳು:
- ಸಮತೋಲಿತ ಆಹಾರವನ್ನು ತೆಗೆದುಕೊಳ್ಳಿ
- ಕಡಿಮೆ ಪ್ರಮಾಣದಲ್ಲಿ ಮತ್ತು ಆಗಾಗ್ಗೆ ಊಟ ತೆಗೆದುಕೊಳ್ಳಿ
- ಊಟವನ್ನು ಬಿಡಬೇಡಿ
- ನಿಮ್ಮ ದಿನಚರಿಯಲ್ಲಿ ಸಾಕಷ್ಟು ನೀರು ಕುಡಿಯಿರಿ
- ನಿಮ್ಮ ಆಹಾರದಲ್ಲಿ ಅಗಸೆಬೀಜ (2-3 ಟೀಸ್ಪೂನ್ / ದಿನ), ಬೆಳ್ಳುಳ್ಳಿ, ಕರಿಬೇವಿನ ಎಲೆಗಳು, ಕಡಲೆಕಾಯಿ ಬಳಸಿ.
- ಒತ್ತಡವನ್ನು ನಿಯಂತ್ರಿಸಿ ಮತ್ತು ನಿಯಮಿತ ನಡಿಗೆ ಮತ್ತು ವ್ಯಾಯಾಮ ಮಾಡಿ

सूचना:
- संतुलित आहार घ्या
- वारंवार आणि कमी प्रमाणात जेवण घ्या
- जेवण वगळू नका
- आपल्या दैनंदिन दिनचर्येत पुरेसे पाणी घ्या
- तुमच्या आहारात अंबाडीचे बियाणे (2-3 चमचे/दिवस), लसूण, कढीपत्ता, शेंगदाणे वापरा.
- तणावावर नियंत्रण ठेवा आणि नियमित चालणे आणि व्यायाम करा

Foods that are allowed:
- Use all types of whole pulses and daal/lentils
- Use all colourful vegetables in your diet.
- Use all cereals like wheat, jowar, rice, maize, millets like foxtail millet, and little millet.
- Use all types of vegetable oils like groundnut oil, sunflower oil, soyabean oil, corn oil, mustard oil, etc. (change cooking oil monthly4 tsp oil /Day).
- Use skimmed milk and its products.
- Have egg white only as well as clean and white meat.

ಅನುಮತಿಸಲಾದ ಆಹಾರ ಪದಾರ್ಥಗಳು:
- ಎಲ್ಲಾ ರೀತಿಯ ಸಂಪೂರ್ಣ ಬೇಳೆಕಾಳುಗಳನ್ನು ಬಳಸಿ
- ನಿಮ್ಮ ಆಹಾರದಲ್ಲಿ ವಿವಿಧ ಬಣ್ಣಗಳ ತರಕಾರಿಗಳನ್ನು ಬಳಸಿ.
- ಗೋಧಿ, ಜೋಳ, ಅಕ್ಕಿ, ರಾಗಿ ಮತ್ತು ಸಜ್ಜೆ ಮುಂತಾದ ಧಾನ್ಯಗಳನ್ನು ಬಳಸಿ
- ಕಡಲೆಕಾಯಿ ಎಣ್ಣೆ, ಸೂರ್ಯಕಾಂತಿ ಎಣ್ಣೆ, ಸೋಯಾಬೀನ್ ಎಣ್ಣೆ, ಸಾಸಿವೆ ಎಣ್ಣೆ, ಇತ್ಯಾದಿ ಎಲ್ಲಾ ರೀತಿಯ ಸಸ್ಯಜನ್ಯ ಎಣ್ಣೆಗಳನ್ನು ಬಳಸಿ. (4 ಟೀಸ್ಪೂನ್ ಎಣ್ಣೆ / ದಿನಕ್ಕೆ ಮತ್ತು ಮಾಸಿಕ ಅಡುಗೆ ಎಣ್ಣೆಯನ್ನು ಬದಲಾಯಿಸಿ).
- ಕೆನೆ ತೆಗೆದ ಹಾಲು ಮತ್ತು ಅದರ ಉತ್ಪನ್ನಗಳನ್ನು ಬಳಸಿ.
- ಮೊಟ್ಟೆಯ ಬಿಳಿಭಾಗವನ್ನು ಮಾತ್ರ ತಿನ್ನಿರಿ. ಶುದ್ಧ ಮತ್ತು ಬಿಳಿ ಮಾಂಸವನ್ನು ತಿನ್ನಿರಿ.

परवानगी असलेल्या खाद्यपदार्थ:
- सर्व प्रकारची अख्खी डाळी वापरा
- तुमच्या आहारात विविध रंगांचे भाज्या वापरा.
- गहू, ज्वारी, तांदूळ, मका, नाचणी आणि बाजरी यासारखी सर्व तृणधान्ये वापरा
- शेंगदाणा तेल, सूर्यफूल तेल, सोयाबीन तेल, मोहरीचे तेल इत्यादी सर्व प्रकारच्या वनस्पती तेलांचा वापर करा. (स्वयंपाकाचे तेल मासिक बदला आणि 4 चमचे तेल/दिवस).
- मलईशिवाय दुधाच्या आणि त्याच्या उत्पादनांचा वापर करा.
- तुम्ही सर्वजण अंड्याचा पांढरा भागच खा आणि स्वच्छ आणि पांढरे मांस घ्या.

Foods to be avoided:
- Sugar, jaggery, fruit juices and sweets of all kinds.
- Extra ghee, butter, cream etc.
- All bakery products like cakes, pastries etc.
- All fried foods.
- Alcoholic and aerated drinks.
- Egg yolk & organ red meat.

ನಾವು ತಿನ್ನಬಾರದ ಆಹಾರ ಪದಾರ್ಥಗಳು:
- ಸಕ್ಕರೆ, ಬೆಲ್ಲ, ಹಣ್ಣಿನ ರಸಗಳು ಮತ್ತು ಎಲ್ಲಾ ರೀತಿಯ ಸಿಹಿ ಪದಾರ್ಥಗಳು.
- ಹೆಚ್ಚುವರಿ ತುಪ್ಪ, ಬೆಣ್ಣೆ, ಕೆನೆ ಇತ್ಯಾದಿ.
- ಎಲ್ಲಾ ಬೇಕರಿ ಉತ್ಪನ್ನಗಳು ಕೇಕ್, ಪೇಸ್ಟ್ರಿಗಳು ಇತ್ಯಾದಿ
- ಎಲ್ಲಾ ಕರಿದ ಆಹಾರಗಳು.
- ಮದ್ಯ ಮತ್ತು ಗಾಳಿಯಾಡಿಸಿದ ಪಾನೀಯಗಳು.
- ಮೊಟ್ಟೆಯ ಹಳದಿ ಮತ್ತು ಅಂಗ ಕೆಂಪು ಮಾಂಸ.

अन्न पदार्थ जे आपण टाळले पाहिजेत:
- साखर, गूळ, फळांचे रस आणि सर्व प्रकारचे गोड पदार्थ.
- खूप जास्त तूप, लोणी, मलई इत्यादी
- सर्व बेकरी उत्पादने जसे केक पेस्ट्री इत्यादी
- सर्व तळलेले पदार्थ.
- दारू युक्त आणि वातित पेय.
- अंड्यातील पिवळ बलक आणि अवयव लाल मांस.

- **Follow the diet chart which is marked for you**
- **ನಿಮಗಾಗಿ ಗುರುತಿಸಲಾದ ಆಹಾರ ಕ್ರಮವನ್ನು ಅನುಸರಿಸಿ**
- **तुमच्यासाठी चिन्हांकित केलेल्या आहार चार्टचे अनुसरण करा**

TIME	Calorie-1050kcal/day		ಕ್ಯಾಲೋರಿ - 1050kcal / ದಿನ		ಕೆಲರಿ – 1050kcal/ದಿವಸ	
	Menu	Quantity	ಆಹಾರ ಪದಾರ್ಥಗಳು	ಪ್ರಮಾಣ	ಖಾದ್ಯಪದಾರ್ಥ	ಪ್ರಮಾಣ
6 am ಸಕಾಲಿ ಬೆಳಗ್ಗೆ	Water+honey + almonds	1 glass+1tsp 4no	ನೀರು+ಜೇನು+ ಬಾದಾಮಿ	1 ಗ್ಲಾಸ್ + 1 ಟೀಸ್ಪೂನ್ 4 ಬಾದಾಮಿ	ಪಾಣಿ + ಮಧ +ಬದಾಮ	1 ಗ್ಲಾಸ + 1 ಟೀಸ್ಪೂನ ೪ ಬದಾಮ
9am Breakfast/ ನಾಶ್ತಾ/ ಉಪಹಾರ	Salad/fruit+ cereal: Upma/Poha/oats idli/bread chapati/roti +milk/curd	100gm 1 katori 2/2 slice 1No(30gm) 1cup(100ml)	ಸಲಾಡ್/ಹಣ್ಣು+ ಉಪ್ಮಾ/ಪೋಹಾ/ ಓಟ್ಸ್ ಇಡ್ಲಿ/ಚಪಾತಿ/ ರೊಟ್ಟಿ +ಹಾಲು/ಮೊಸರು	100 ಗ್ರಾಂ 1 ಕಟೋರಿ 2/2 ಸ್ಲೈಸ್ 1ಸಂಖ್ಯೆ (30ಗ್ರಾಂ) 1ಕಪ್ (100 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ/ಫಲ + ತೃಣಧಾನ್ಯೆ: ಉಪಮಾ/ಪೋಹೆ/ಓಟ್ಸ ಇಡಲಿ/ಬ್ರೆಡ ಚಪಾತಿ/ರೋಟಿ +ದೂಧ/ದಹಿ	100 ಗ್ರೆಮ 1 ಕಾಟೋರಿ 2/2 ಸ್ಲಾಇಸ 1 ನಾಹಿ (30 ಗ್ರೆಮ) 1 ಕಪ (100 ಮಿಲಿ)
11 am Mid-morning snacks/ ಬೆಳಗಿನ ತಿಂಡಿ / ಸಕಾಳಚೆ ನಾಶ್ತಾ	Fruit/ salad or buttermilk/ veg soup/ coconut water	1No/100gm 1glass (150 ml)	ಹಣ್ಣು / ಸಲಾಡ್ ಅಥವಾ ಮಜ್ಜಿಗೆ / ಸಸ್ಯಾಹಾರಿ ಸೂಪ್ / ತೆಂಗಿನ ನೀರು	1ಸಂ/100ಗ್ರಾಂ 1 ಗ್ಲಾಸ್ (150 ಮಿಲಿ)	ಫಲ/ ಕೋಶಿಂಬೀರ ಕಿವಾ ತಾಕ/ ವ್ಹೆಜ ಸೂಪ/ ನಾರಳ ಪಾಣಿ	1 ನಾಹಿ/100 ಗ್ರೆಮ 1 ಗ್ಲಾಸ (150 ಮಿಲಿ)
1:30 pm Lunch/ **ಮಧ್ಯಾಹ್ನ** ಊಟ/ ದುಪಾರಚೆ ಜೆವಣ	Salad Chapati/roti Rice (brown/millets) Dal/egg white Vegetable curd	100gm 1no ½ katori 1 katori ½ cup (50ml)	ಸಲಾಡ್ ಚಪಾತಿ/ರೊಟ್ಟಿ ರೈಸ್(ಕಂದು/ಗಿರಣಿ ಇಟ್ಸ್) ದಾಲ್/ಮೊಟ್ಟೆಯ ಬಿಳಿ ತರಕಾರಿ ಮೊಸರು	100 ಗ್ರಾಂ 1ಸಂ ½ ಕಟೋರಿ ½ ಕಟೋರಿ 1 ಕಟೋರಿ ½ ಕಪ್ (50 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ ಚಪಾತಿ/ರೋಟಿ ಭಾತ (ತಪಕಿರಿ/ಚಕ್ಕಿ ಇಟ್ಸ) ಡಾಲ/ಅಂಡಿ ಪಾಂಢರಿ ಭಾಜಿ ದಹಿ	100 ಗ್ರೆಮ ೧ ಕ್ರ ½ ಕಟೋರಿ ½ ಕಟೋರಿ ೧ ಕಟೋರಿ ½ ಕಪ (50 ಮಿಲಿ)
5:30 pm Evening snack/ ಸಂಜೆ ತಿಂಡಿ/ ಸಂಧ್ಯಾಕಾಳಚಾ ನಾಶ್ತಾ	Tea/coffee/milk +fruit	1cup(50ml) 1no(100gm)	ಚಹಾ / ಕಾಫಿ / ಹಾಲು + ಹಣ್ಣು	1 ಕಪ್ (50 ಮಿಲಿ) 1 ಇಲ್ಲ (100 ಗ್ರಾಂ)	ಚಹಾ/ಕಾಫಿ/ದೂಧ +ಫಲೆ	1 ಕಪ (50 ಮಿಲಿ) 1 ನಾಹಿ (100 ಗ್ರೆಮ)
8:30 pm Dinner/ **ರಾತ್ರಿ** ಊಟ / ರಾತ್ರೀಚೆ ಜೆವಣ	Same as lunch		**ಮಧ್ಯಾಹ್ನ** ಊಟದಂತೆಯೇ		ದುಪಾರಚ್ಯಾ ಜೆವಣಾಸಾರಖೆಚ	
10:30 pm Bed time/ ಮಲಗುವ ಸಮಯ/ ಝೋಪಯಾಚೀ ವೆಳ	Milk	1 cup (100 ml)	ಹಾಲು	1 ಕಪ್ (100 ಮಿಲಿ)	ದೂಧ	1 ಕಪ (100 ಮಿಲಿ)

TIME	Calorie-1300kcal/day		ಕ್ಯಾಲೋರಿ - 1300kcal / ದಿನ		ಕೆಲರಿ - 1300kcal/ದಿವಸ	
	Menu	Quantity	ಆಹಾರ ಪದಾರ್ಥಗಳು	ಪ್ರಮಾಣ	ಖಾದ್ಯಪದಾರ್ಥ	ಪ್ರಮಾಣ
6 am ಸಕಾಲಿ ಬೆಳಗ್ಗೆ	Water+honey + almonds	1 glass+1tsp 4no	ನೀರು+ಜೇನು+ ಬಾದಾಮಿ	1 ಗ್ಲಾಸ್ + 1 ಟೀಸ್ಪೂನ್ 4 ಬಾದಾಮಿ	ಪಾಣಿ + ಮಧ +ಬದಾಮ	1 ಗ್ಲಾಸ + 1 ಟೀಸ್ಪೂನ ೪ ಬದಾಮ
9am Breakfast/ ನಾಶ್ತಾ/ ಉಪಹಾರ	Salad/fruit+ cereal: Upma/Poha/oat s idli/bread chapati/roti +milk/curd	100gm 1 katori 2/2 slice 1No(30gm) 1cup(100ml)	ಸಲಾಡ್/ಹಣ್ಣು+ ಏಕದಳ: ಉಪ್ಮಾ/ಪೋಹಾ/ ಓಟ್ಸ ಇಡ್ಲಿ/ಬ್ರೆಡ ಚಪಾತಿ/ರೊಟ್ಟಿ +ಹಾಲು/ಮೊಸರು	100 ಗ್ರಾಂ 1 ಕಟೋರಿ 2/2 ಸ್ಲೈಸ್ 1ಸಂಖ್ಯೆ (30ಗ್ರಾಂ) 1ಕಪ್ (100 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ/ಫಲ + ತೃಣಧಾನ್ಯೆ: ಉಪಮಾ/ಪೋಹೆ/ಓಟ್ಸ ಇಡಲಿ/ಬ್ರೆಡ ಚಪಾತಿ/ರೋಟಿ +ದೂಧ/ದಹಿ	100 ಗ್ರೆಮ 1 ಕಾಟೋರಿ 2/2 ಸ್ಲಾಇಸ 1 ನಾಹಿ (30 ಗ್ರೆಮ) 1 ಕಪ (100 ಮಿಲಿ)
11 am Mid-morning snacks/ ಬೆಳಗಿನ ತಿಂಡಿ / ಸಕಾಳಚೆ ನಾಶ್ತಾ	Fruit/ salad or buttermilk/ veg soup/ coconut water	1No/100gm 1glass (150 ml)	ಹಣ್ಣು / ಸಲಾಡ್ ಅಥವಾ ಮಜ್ಜಿಗೆ / ಸಸ್ಯಾಹಾರಿ ಸೂಪ್ / ತೆಂಗಿನ ನೀರು	1ಸಂ/100ಗ್ರಾಂ 1 ಗ್ಲಾಸ್ (150 ಮಿಲಿ)	ಫಲ/ ಕೋಶಿಂಬೀರ ಕಿವಾ ತಾಕ/ ವ್ಹೆಜ ಸೂಪ/ ನಾರಳ ಪಾಣಿ	1 ನಾಹಿ/100 ಗ್ರೆಮ 1 ಗ್ಲಾಸ (150 ಮಿಲಿ)
1:30 pm Lunch/ **ಮಧ್ಯಾಹ್ನ** ಊಟ/ ದುಪಾರಚೆ ಜೆವಣ	Salad Chapati/roti Rice (brown/ millets) Dal/egg white Vegetable curd	100gm 1no ½ katori 1 katori ½ cup (50ml)	ಸಲಾಡ್ ಚಪಾತಿ/ರೊಟ್ಟಿ ರೈಸ್(ಕಂದು/ಗಿರಣಿ ಇಟ್ಸ್) ದಾಲ್/ಮೊಟ್ಟೆಯ ಬಿಳಿ ತರಕಾರಿ ಮೊಸರು	100 ಗ್ರಾಂ 1ಸಂ 1 ಕಟೋರಿ ½ ಕಟೋರಿ 1 ಕಟೋರಿ ½ ಕಪ್ (50 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ ಚಪಾತಿ/ರೋಟಿ ಭಾತ (ತಪಕಿರಿ/ಚಕ್ಕಿ ಇಟ್ಸ) ಡಾಲ/ಅಂಡಿ ಪಾಂಢರಿ ಭಾಜಿ ದಹಿ	100 ಗ್ರೆಮ ೧ ಕ 1 ಕಾಟೋರಿ ½ ಕಾಟೋರಿ ೧ ಕಾಟೋರಿ ½ ಕಪ (50 ಮಿಲಿ)
5:30 pm Evening snack/ ಸಂಜೆ ತಿಂಡಿ/ ಸಂಧ್ಯಾಕಾಳಚಾ ನಾಶ್ತಾ	Tea/coffee/ milk +fruit	1cup(50ml) 1no(100gm)	ಚಹಾ / ಕಾಫಿ / ಹಾಲು + ಹಣ್ಣು	1 ಕಪ್ (50 ಮಿಲಿ) 1 ಇಲ್ಲ (100 ಗ್ರಾಂ)	ಚಹಾ/ಕಾಫಿ/ದೂಧ +ಫಲೆ	1 ಕಪ (50 ಮಿಲಿ) 1 ನಾಹಿ (100 ಗ್ರೆಮ)
8:30 pm Dinner/ **ರಾತ್ರಿ** ಊಟ / ರಾತ್ರೀಚೆ ಜೆವಣ	Same as lunch		**ಮಧ್ಯಾಹ್ನ** ಊಟದಂತೆಯೇ		ದುಪಾರಚ್ಯಾ ಜೆವಣಾಸಾರಖೆಚ	
10:30 pm Bed time/ ಮಲಗುವ ಸಮಯ/ ಝೋಪಯಾಚೀ ವೆಳ	Milk	1 cup(100 ml)	ಹಾಲು	1 ಕಪ್ (100 ಮಿಲಿ)	ದೂಧ	1 ಕಪ (100 ಮಿಲಿ)

TIME	Calorie-1500kcal/day		ಕ್ಯಾಲೋರಿ - 1500kcal / ದಿನ		ಕೆಲರಿ - 1500kcal/ದಿವಸ	
	Menu	**Quantity**	**ಆಹಾರ ಪದಾರ್ಥಗಳು**	**ಪ್ರಮಾಣ**	**ಖಾದ್ಯಪದಾರ್ಥ**	**ಪ್ರಮಾಣ**
6 am ಸಕಾಲಿ ಬೆಳಗ್ಗೆ	Water+honey +almonds	1 glass+1tsp 4no	ನೀರು+ಜೇನು+ ಬಾದಾಮಿ	1 ಗ್ಲಾಸ್ + 1 ಟೀಸ್ಪೂನ್ 4 ಬಾದಾಮಿ	ಪಾಣಿ + ಮಧ +ಬದಾಮ	1 ಗ್ಲಾಸ + 1 ಟೀಸ್ಪೂನ ೪ ಬದಾಮ
9am Breakfast/ ನಾಶ್ತಾ/ ಉಪಹಾರ	Salad/fruit+ cereal: Upma/Poha/oat s idli/bread chapati/roti +milk/curd	100gm 1 katori 2/2 slice 1No(30gm) 1cup(100ml)	ಸಲಾಡ್/ಹಣ್ಣು+ ಏಕದಳ: ಉಪ್ಮಾ/ಪೋಹಾ/ ಓಟ್ಸ್ ಇಡ್ಲಿ/ಬ್ರೆಡ್ ಚಪಾತಿ/ರೊಟ್ಟಿ +ಹಾಲು/ಮೊಸರು	100 ಗ್ರಾಂ 1 ಕಟೋರಿ 2/2 ಸ್ಲೈಸ್ 1ಸಂಖ್ಯೆ (30ಗ್ರಾಂ) 1ಕಪ್ (100 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ/ಫಲ + ತೃಣಧಾನ್ಯೆ: ಉಪಮಾ/ಪೋಹೆ/ಓಟ್ಸ ಇಡಲಿ/ಬ್ರೆಡ ಚಪಾತಿ/ರೋಟಿ +ದೂಧ/ದಹಿ	100 ಗ್ರೆಮ 1 ಕಾಟೋರಿ 2/2 ಸ್ಲಾಇಸ 1 ನಾಹಿ (30 ಗ್ರೆಮ) 1 ಕಪ (100 ಮಿಲಿ)
11 am Mid-morning snacks/ ಬೆಳಿಗಿನ ತಿಂಡಿ / ಸಕಾಲಚೆ ನಾಶ್ತಾ	Fruit/ salad or buttermilk/ veg soup/ coconut water	1No/100gm 1glass (150 ml)	ಹಣ್ಣು / ಸಲಾಡ್ ಅಥವಾ ಮಜ್ಜಿಗೆ / ಸಸ್ಯಹಾರಿ ಸೂಪ್ / ತೆಂಗಿನ ನೀರು	1ಸಂ/100ಗ್ರಾಂ 1 ಗ್ಲಾಸ್ (150 ಮಿಲಿ)	ಫಲ/ ಕೋಶಿಂಬೀರ ಕಿಂವಾ ತಾಕ/ ವ್ಹೆಜ ಸೂಪ/ ನಾರಲ ಪಾಣಿ	1 ನಾಹಿ/100 ಗ್ರೆಮ 1 ಗ್ಲಾಸ (150 ಮಿಲಿ)
1:30 pm Lunch/ **ಮಧ್ಯಾಹ್ನ** ಊಟ/ ದುಪಾರಚೆ ಜೆವಣ	Salad Chapati/roti Rice (brown/millets) Dal/egg white Vegetable curd	100gm 1no ½ katori 1 katori ½ cup (50ml)	ಸಲಾಡ್ ಚಪಾತಿ/ರೊಟ್ಟಿ ರೈಸ್(ಕಂದು/ಗಿ ರಣಿ ಇಟ್ಸ್) ದಾಲ್/ಮೊಟ್ಟೆ ಯ ಬಿಳಿ ತರಕಾರಿ ಮೊಸರು	100 ಗ್ರಾಂ 1ಸಂ 1 ಕಟೋರಿ ½ ಕಟೋರಿ 1 ಕಟೋರಿ ½ ಕಪ್ (50 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ ಚಪಾತಿ/ರೋಟಿ ಭಾತ (ತಪಕಿರಿ/ಚಕ್ಕಿ ಇದ್ಸ) ಡಾಲ/ಅಂಡಿ ಪಾಂಢರಿ ಭಾಜಿ ದಹಿ	100 ಗ್ರೆಮ ೧ ಕ್ರ 1 ಕಾಟೋರಿ ½ ಕಾಟೋರಿ ೧ ಕಾಟೋರಿ ½ ಕಪ (50 ಮಿಲಿ)
5:30 pm Evening snack/ ಸಂಜೆ ತಿಂಡಿ/ ಸಂಧ್ಯಾಕಾಳಚಾ ನಾಶ್ತಾ	Tea/coffee/milk Churmura+putan a Biscuits/bread	1cup(50ml) 2+½ katori 3/2 no	ಟೀ/ಕಾಫಿ/ಹಾ ಲು ಚುರ್ಮುರ+ಪು ಟಾನ ಬಿಸ್ಕತ್ತು/ಬ್ರೆಡ್	1 ಕಪ್ (50 ಮಿಲಿ) 2 + ½ ಕಟೋರಿ 3/2 ಸಂ	ಚಹಾ/ಕಾಫಿ/ದೂಧ ಚುರ್ಮುರಾ+ಪುತಾನಾ ಬಿಸ್ಕಿಟೆ/ಬ್ರೆಡ	1 ಕಪ (50 ಮಿಲಿ) 2 + ½ ಕಾಟೋರಿ 3/2 ಕ್ರ
8:30 pm Dinner/ **ರಾತ್ರಿ** ಊಟ / ರಾತ್ರೀಚೆ ಜೆವಣ	Same as lunch		**ಮಧ್ಯಾಹ್ನ** ಊಟದಂತೆಯೇ		ದುಪಾರಚ್ಯಾ ಜೆವಣಾಸಾರಖೆಚ	
10:30 pm Bed time/ ಮಲಗುವ ಸಮಯ/ ಝೋಪಯಾಚೀ ವೆಳ	Milk	1 cup (100 ml)	ಹಾಲು	1 ಕಪ್ (100 ಮಿಲಿ)	ದೂಧ	1 ಕಪ (100 ಮಿಲಿ)

TIME	Calorie-1885kcal/day		ಕ್ಯಾಲೋರಿ - 1885kcal / ದಿನ		ಕೆಲರಿ - 1885kcal/ದಿವಸ	
	Menu	**Quantity**	**ಆಹಾರ ಪದಾರ್ಥಗಳು**	**ಪ್ರಮಾಣ**	**ಖಾದ್ಯಪದಾರ್ಥ**	**ಪ್ರಮಾಣ**
6 am ಸಕಾಲಿ ಬೆಳಗ್ಗೆ	Water+honey + almonds	1 glass+1tsp 4no	ನೀರು+ಜೇನು+ ಬಾದಾಮಿ	1 ಗ್ಲಾಸ್ + 1 ಟೀಸ್ಪೂನ್ 4 ಬಾದಾಮಿ	ಪಾಣಿ + ಮಧ +ಬದಾಮ	1 ಗ್ಲಾಸ + 1 ಟೀಸ್ಪೂನ ೪ ಬದಾಮ
9am Breakfast/ ನಾಶ್ತಾ/ ಉಪಹಾರ	Salad/fruit+ cereal: Upma/Poha/oat s idli/bread chapati/roti +milk/curd +sprouts/egg white	100gm 1 katori 2/2 slice 1No(30gm) 1cup(100ml) ½ katori/ 1 no	ಸಲಾಡ್/ಹಣ್ಣು+ ಏಕದಳ: ಉಪ್ಮಾ/ಪೋಹಾ/ಓ ಟ್ಸ್ ಇಡ್ಲಿ/ಬ್ರೆಡ್ ಚಪಾತಿ/ರೊಟ್ಟಿ +ಹಾಲು/ಮೊಸರು+ ಮೊಗ್ಗುಗಳು/ಮೊಟ್ಟೆ ಯ ಬಿಳಿಭಾಗ	100 ಗ್ರಾಂ 1 ಕಟೋರಿ 2/2 ಸ್ಲೈಸ್ 1ಸಂಖ್ಯೆ (30ಗ್ರಾಂ) 1ಕಪ್ (100 ಮಿಲಿ) ½ ಕಟೋರಿ / 1 ಸಂ	ಕೋಶಿಂಬೀರ/ಫಲ + ತೃಣಧಾನ್ಯೆ: ಉಪಮಾ/ಪೋಹೆ/ಓ ದ್ಸ ಇಡಲಿ/ಬ್ರೆಡ ಚಪಾತಿ/ರೋಟಿ +ದೂಧ/ದಹಿ +ಸ್ಪಾಉದ್ಸ/ಅಂಡಿ ಪಾಂಢರಾ	100 ಗ್ರೆಮ 1 ಕಾಟೋರಿ 2/2 ಸ್ಲಾಇಸ 1 ನಾಹಿ (30 ಗ್ರೆಮ) 1 ಕಪ (100 ಮಿಲಿ) ½ ಕಾಟೋರಿ / 1 ಕ್ರ
11 am Mid-morning snacks/ ಬೆಳಿಗಿನ ತಿಂಡಿ / ಸಕಾಲಚೆ ನಾಶ್ತಾ	Fruit/ salad or buttermilk/ veg soup/ coconut water	1No/100gm 1glass (150 ml)	ಹಣ್ಣು / ಸಲಾಡ್ ಅಥವಾ ಮಜ್ಜಿಗೆ / ಸಸ್ಯಹಾರಿ ಸೂಪ್ / ತೆಂಗಿನ ನೀರು	1ಸಂ/100 ಗ್ರಾಂ 1 ಗ್ಲಾಸ್ (150 ಮಿಲಿ)	ಫಲ/ ಕೋಶಿಂಬೀರ ಕಿಂವಾ ತಾಕ/ ವ್ಹೆಜ ಸೂಪ/ ನಾರಲ ಪಾಣಿ	1 ನಾಹಿ/100 ಗ್ರೆಮ 1 ಗ್ಲಾಸ (150 ಮಿಲಿ)
1:30 pm Lunch/ **ಮಧ್ಯಾಹ್ನ** ಊಟ/ ದುಪಾರಚೆ ಜೆವಣ	Salad Chapati/roti Rice (brown/millets) Dal/egg white Vegetable curd	100gm 1no ½ katori 1 katori ½ cup (50ml)	ಸಲಾಡ್ ಚಪಾತಿ/ರೊಟ್ಟಿ ರೈಸ್(ಕಂದು/ಗಿ ರಣಿ ಇಟ್ಸ್) ದಾಲ್/ಮೊಟ್ಟೆ ಯ ಬಿಳಿ ತರಕಾರಿ ಮೊಸರು	100 ಗ್ರಾಂ 1ಸಂ ½ ಕಟೋರಿ ½ ಕಟೋರಿ 1 ಕಟೋರಿ ½ ಕಪ್ (50 ಮಿಲಿ)	ಕೋಶಿಂಬೀರ ಚಪಾತಿ/ರೋಟಿ ಭಾತ (ತಪಕಿರಿ/ಚಕ್ಕಿ ಇದ್ಸ) ಡಾಲ/ಅಂಡಿ ಪಾಂಢರಿ ಭಾಜಿ ದಹಿ	100 ಗ್ರೆಮ ೧ ಕ್ರ ½ ಕಾಟೋರಿ ½ ಕಾಟೋರಿ ೧ ಕಾಟೋರಿ ½ ಕಪ (50 ಮಿಲಿ)
5:30 pm Evening snack/ ಸಂಜೆ ತಿಂಡಿ/ ಸಂಧ್ಯಾಕಾಳಚಾ ನಾಶ್ತಾ	Tea/coffee/milk Churmura+ putana Biscuits/bread	1cup(50ml) 2+½ katori 3/2 no	ಟೀ/ಕಾಫಿ/ ಹಾಲು ಚುರ್ಮುರ+ ಪುಟಾನ ಬಿಸ್ಕತ್ತು/ಬ್ರೆಡ್	1 ಕಪ್ (50 ಮಿಲಿ) 2 + ½ ಕಟೋರಿ 3/2 ಸಂ		
8:30 pm Dinner/ **ರಾತ್ರಿ** ಊಟ / ರಾತ್ರೀಚೆ ಜೆವಣ	Same as lunch		**ಮಧ್ಯಾಹ್ನ** ಊಟದಂತೆಯೇ		ದುಪಾರಚ್ಯಾ ಜೆವಣಾಸಾರಖೆಚ	
10:30 pm Bed time/ ಮಲಗುವ ಸಮಯ/ ಝೋಪಯಾಚೀ ವೆಳ	Milk	1 cup (100 ml)	ಹಾಲು	1 ಕಪ್ (100 ಮಿಲಿ)	ದೂಧ	1 ಕಪ (100 ಮಿಲಿ)

INSTRUCTIONS/ ಸೂಚನೆಗಳು/सूचना

1. **Please mark as 'YES' (√) if you followed the diet and mark as 'NO'(X) if you did not.**
2. **Kindly add the timing at which you had your food in 'TIME' column**

1. **ನೀವು ಆಹಾರವನ್ನು ಅನುಸರಿಸಿದರೆ ದಯವಿಟ್ಟು 'ಹೌದು'(√) ಎಂದು ಗುರುತಿಸಿ ಮತ್ತು ನೀವು ಅನುಸರಿಸದಿದ್ದರೆ 'ಇಲ್ಲ'(X) ಎಂದು ಗುರುತಿಸಿ**
2. **ದಯವಿಟ್ಟು ನೀವು 'ಸಮಯ' ಅಂಕಣದಲ್ಲಿ ನಿಮ್ಮ ಆಹಾರವನ್ನು ಸೇವಿಸಿದ ಸಮಯವನ್ನು ಸೇರಿಸಿ**

1. **जर तुम्ही आहाराचे पालन केले असेल तर कृपया 'होय'(√) म्हणून खूण करा आणि तसे न केल्यास 'नाही' (X) म्हणून चिन्हांकित करा**
2. **कृपया 'वेळ' स्तंभात तुम्ही तुमचे जेवण कोणत्या वेळेत घेतले ते लिहा**

Post intervention diet log/ ಚಿಕಿತ್ಸೆಯ ನಂತರದ ಆಹಾರಕ್ರಮ ದಿನಚರಿ / उपचारानंतर आहार दैनिक डायरी				
Month/ತಿಂಗಳು/महिना:	Week/ ವಾರ/ आठवडा:	Yes √	No X	Time /ಸಮಯ/वेळ
Day/ ದಿನ/ दिवस 1	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			
Day/ ದಿನ/ दिवस 2	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			
Day/ ದಿನ/ दिवस 3	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			
Day/ ದಿನ/ दिवस 4	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			
Day/ ದಿನ/ दिवस 5	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			
Day/ ದಿನ/ दिवस 6	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks / ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			
Day/ ದಿನ/ दिवस 7	Breakfast/ ಬೆಳಗಿನ ಉಪಹಾರ / सकाळचा नाश्ता			
	Mid-morning snacks/ ನಡುಹಗಲ ತಿಂಡಿ/ मध्य सकाळचा नाश्ता			
	Lunch/ ಮಧ್ಯಾಹ್ನ ಊಟ /दुपारचे जेवण			
	Evening Snacks/ ಸಂಜೆಯ ತಿಂಡಿ / संध्याकाळचे नाश्ता			
	Dinner/ ರಾತ್ರಿ ಊಟ /रात्रीचे जेवण			

ANNEXURE VII - DATA COLLECTION SHEET

Data Collection Instrument

Subject No: Date:

Name: _____

Age: _____years Occupation: _____ Marital status: _____

Educational Status: _____ Diet: _____

Address: _____

Contact No: _____ Hand dominance: _____

Age of Menopause: _____ Reason: Natural Surgical Any coexisting comorbid condition:

Diabetes mellitus (HbA1C: _____) Since_____months/years

Hypertension Since _____months/years

Heart disease Since _____months/years

Chronic Inflammatory Disease Since _____months/years

Arthritis Since _____months/years

Active infections Since _____months/years

Tumour/space occupying lesions Since _____months/years

Hormonal conditions Since _____months/years

Physical Disabilities_____

Cancer _____

Any other systemic conditions _____

Medications/Drugs: _____

History of Surgery: _____

Currently on any weight loss program: _____

Are you involved in physical exercise: Yes No

If Yes, Regular (> 5 days/wk) _____ Irregular (<5days/wk) _____

Mode of exercise:

Physical activity in a day: Mild Moderate Intense/Heavy

Time you spend sitting or reclining in a place in a typical day: _____hours

Comprehension to speech: Present: Absent:

WC: _____ cms

Palmar grip strength (dominant hand) (kgs): Reading 1:_____; Reading 2: _____

Willingness to participate in the study protocol: Yes: _____ No: _____

Group Allocation: Group HIIT: _____Group YG: _____

Variable	T0 / pre-intervention	12th Week /post intervention (T3)
Fat mass		
Body fat %		
Visceral fat		
Subcutaneous fat		
Skeletal Muscle Mass		
Lean body mass		
Appendicular Skeletal Muscle Index		
Skeletal mass		
Variable	**T0 /pre- intervention**	**12th Week /post intervention (T1)**
Hip-Knee- Ankle Angle (degrees)		
PSS		
SF-36		

Variable	T0 / pre-intervention	T1/ 4th week	T2/8th week	12th Week / post intervention (T1)
BMI (kg/m^2)				
WC (cm)				
Palmar grip strength (kgs)				
Gait Speed (m/s)				

_____
Name & Signature of Investigator

_____

Name & Signature of Assessor/Radiologist
Date:
Place:

PERCIVED STRESS SCALE

The questions in this scale ask about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, don't try to count up the number of times you felt a particular way; rather indicate the alternative that seems like a reasonable estimate.

For each question choose from the following alternatives:

0 - never **1 - almost never** **2 - sometimes** **3 - fairly often** **4 - very often**

_____2. In the last month, how often have you felt that you were unable to control the important things in your life?

_____3. In the last month, how often have you felt nervous and stressed?

_____4. In the last month, how often have you felt confident about your ability to handle your personal problems?

_____5. In the last month, how often have you felt that things were going your way?

_____6. In the last month, how often have you felt that you could not cope up with all the things that you had to do?

_____7. In the last month, how often have you been able to control irritations in your life?

_____8. In the last month, how often have you felt that you were on top of things?

_____ 9. In the last month, how often have you been angered because of things that happened that were outside of your control?

_____10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Figuring Your PSS Score

You can determine your PSS score by following these directions:

- First, reverse your scores for questions 4, 5, 7, and 8. On these 4 questions, change the scores like this: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0
- Now add up your scores for each item to get a total. **My total score is_____.**
- Individual scores on the PSS can range from 0 to 40 with higher scores indicating higher perceived stress.
    - ► Scores ranging from 0-13 would be considered low stress.
    - ► Scores ranging from 14-26 would be considered moderate stress.
    - ► Scores ranging from 27-40 would be considered high perceived stress.

ಒತ್ತಡದ ಪ್ರಮಾಣವನ್ನು ಗ್ರಹಿಸವ ಮಾಪನ

ಈ ಪ್ರಮಾಣದ ಪ್ರಶ್ನೆಗಳು ಕಳೆದ ತಿಂಗಳಲ್ಲಿ ನಿಮ್ಮ ಭಾವನೆಗಳು ಮತ್ತು ಆಲೋಚನೆಗಳ ಬಗ್ಗೆ ಕೇಳುತ್ತವೆ. ಪ್ರತಿಯೊಂದು ಸಂದರ್ಭದಲ್ಲೂ, ನೀವು ಎಷ್ಟು ಬಾರಿ ಭಾವಿಸಿದ್ದೀರಿ ಅಥವಾ ನಿರ್ದಿಷ್ಟ ರೀತಿಯಲ್ಲಿ ಯೋಚಿಸಿದ್ದೀರಿ ಎಂಬುದನ್ನು ಸೂಚಿಸಲು ನಿಮ್ಮನ್ನು ಕೇಳಲಾಗುತ್ತದೆ. ಕೆಲವು ಪ್ರಶ್ನೆಗಳು ಒಂದೇ ರೀತಿಯದ್ದಾಗಿದ್ದರೂ, ಅವುಗಳ ನಡುವೆ ವ್ಯತ್ಯಾಸಗಳಿವೆ ಮತ್ತು ನೀವು ಪ್ರತಿಯೊಂದನ್ನು ಪ್ರತ್ಯೇಕ ಪ್ರಶ್ನೆಯಂತೆ ಪರಿಗಣಿಸಬೇಕು. ಉತ್ತಮ ವಿಧಾನವೆಂದರೆ ತಕ್ಕಮಟ್ಟಿಗೆ ತ್ವರಿತವಾಗಿ ಉತ್ತರಿಸುವುದು. ಅಂದರೆ, ನೀವು ನಿರ್ದಿಷ್ಟ ಬಾರಿ ಎಷ್ಟು ಬಾರಿ ಭಾವಿಸಿದ್ದೀರಿ ಎಂದು ಎಣಿಸಲು ಪ್ರಯತ್ನಿಸಬೇಡಿ; ಬದಲಿಗೆ ಸಮಂಜಸವಾದ ಅಂದಾಜಿನಂತೆ ತೋರುವ ಪರ್ಯಾಯವನ್ನು ಸೂಚಿಸಿ.

ಪ್ರತಿ ಪ್ರಶ್ನೆಗೆ ಈ ಕೆಳಗಿನ ಪರ್ಯಾಯಗಳಿಂದ ಆರಿಸಿಕೊಳ್ಳಿ:

0 - ಎಂದಿಗೂ; 1 - ಬಹುತೇಕ ಎಂದಿಗೂ; 2 - ಕೆಲವೊಮ್ಮೆ; 3 - ತಕ್ಕಮಟ್ಟಿಗೆ; 4 - ಆಗಾಗ್ಗೆ

1. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ಅನಿರೀಕ್ಷಿತವಾಗಿ ಏನಾದರೂ ಸಂಭವಿಸಿದ ಕಾರಣ ನೀವು ಎಷ್ಟು ಬಾರಿ ಅಸಮಾಧಾನಗೊಂಡಿದ್ದೀರಿ?

_____ 2. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನಿಮ್ಮ ಜೀವನದ ಪ್ರಮುಖ ವಿಷಯಗಳನ್ನು ನಿಯಂತ್ರಿಸಲು ನಿಮಗೆ ಸಾಧ್ಯವಾಗುತ್ತಿಲ್ಲ ಎಂದು ನೀವು ಎಷ್ಟು ಬಾರಿ ಭಾವಿಸಿದ್ದೀರಿ?

_____ 3. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನೀವು ಎಷ್ಟುಬಾರಿ ಗಾಬರಿ ಮತ್ತು ಒತ್ತಡವನ್ನು ಅನುಭವಿಸಿದ್ದೀರಿ?

_____ 4. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನಿಮ್ಮ ವೈಯಕ್ತಿಕ ಸಮಸ್ಯೆಗಳನ್ನು ನಿಭಾಯಿಸುವ ನಿಮ್ಮ ಸಾಮರ್ಥ್ಯದ ಬಗ್ಗೆ ನೀವು ಎಷ್ಟು ಬಾರಿ ವಿಶ್ವಾಸ ಹೊಂದಿದ್ದೀರಿ?

_____ 5. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ವಿಷಯಗಳು ನಿಮ್ಮ ಹಾದಿಯಲ್ಲಿ ಸಾಗುತ್ತಿವೆ ಎಂದು ನೀವು ಎಷ್ಟು ಬಾರಿ ಭಾವಿಸಿದ್ದೀರಿ?

_____ 6. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನೀವು ಮಾಡಬೇಕಾಗಿರುವ ಎಲ್ಲ ಕೆಲಸಗಳನ್ನು ನಿಭಾಯಿಸಲು ಸಾಧ್ಯವಿಲ್ಲ ಎಂದು ನೀವು ಎಷ್ಟು ಬಾರಿ ಕಂಡುಕೊಂಡಿದ್ದೀರಿ?

_____ 7. ಕಳೆದತಿಂಗಳಲ್ಲಿ, ನಿಮ್ಮಜೀವನದಲ್ಲಿಕಿರಿಕಿರಿಯನ್ನುನಿಯಂತ್ರಿಸಲುಎಷ್ಟುಬಾರಿಸಾಧ್ಯವಾಯಿತು?

_____ 8. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನೀವು ವಸ್ತುಗಳಮೇಲಿದ್ದೀರಿ ಎಂದು ಎಷ್ಟು ಬಾರಿ ಭಾವಿಸಿದ್ದೀರಿ?

_____ 9. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನಿಮ್ಮ ಆಗುಹೋಗುಗಳ ಮೇಲೆ ನಿಮಗೆ ಸಂಪೂರ್ಣ ಹಿಡಿತ ಇದೆ ಎಂದು ಅನ್ನಿಸಿದೆಯೇ?

_____ 10. ಕಳೆದ ತಿಂಗಳಲ್ಲಿ, ನೀವು ಎಷ್ಟು ಬಾರಿ ತೊಂದರೆಗಳನ್ನು ಅನುಭವಿಸುತ್ತಿದ್ದೀರಿ ಎಂದು ನೀವುಭಾವಿಸಿದ್ದೀರಿ?

ನಿಮ್ಮ ಪಿಎಸ್ಎಸ ಸ್ಕೋರನ್ನು ಕಡುಹಿಡಿಯುವುದು ಈ ನಿರ್ದೇಶನಗಳನ್ನು ಅನುಸರಿಸುವ ಮೂಲಕ ನಿಮ್ಮ ಪಿಎಸ್ಎಸ ಸ್ಕೋರನ್ನು ನೀವು ನಿರ್ಧರಿಸಬಹುದು:

ಮೊದಲಿಗೆ, 4, 5, 7 ಮತ್ತು 8 ಪ್ರಶ್ನೆಗಳಿಗೆ ನಿಮ್ಮ ಸ್ಕೋರ್‌ಗಳನ್ನು ರಿವರ್ಸ್ ಮಾಡಿ. ಈ 4 ಪ್ರಶ್ನೆಗಳಲ್ಲಿ,

ಈ ರೀತಿಯ ಸ್ಕೋರ್‌ಗಳನ್ನು ಬದಲಾಯಿಸಿ: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0.

ಒಟ್ಟು ಪಡೆಯಲು ಈಗ ಪ್ರತಿ ಐಟಂಗೆ ನಿಮ್ಮ ಸ್ಕೋರ್‌ಗಳನ್ನು ಸೇರಿಸಿ. Total ನನ್ನ ಒಟ್ಟು ಸ್ಕೋರ್ _____.

ಪಿಎಸ್ಎಸ್ನಲ್ಲಿನ ವೈಯಕ್ತಿಕ ಸ್ಕೋರ್ಗಳು 0 ರಿಂದ 40 ರವರೆಗೆ ಇರಬಹುದು, ಹೆಚ್ಚಿನ ಸ್ಕೋರ್ಗಳು ಹೆಚ್ಚಿನ ಗ್ರಹಿಸಿದ

• ಒತ್ತಡವನ್ನು ಸೂಚಿಸುತ್ತವೆ. 0-13 ರವರೆಗಿನ ಅಂಕಗಳನ್ನು ಕಡಿಮೆ ಒತ್ತಡ ಎಂದು ಪರಿಗಣಿಸಲಾಗುತ್ತದೆ. 14-26 ರವರೆಗಿನ ಅಂಕಗಳನ್ನು ಮಧ್ಯಮ ಒತ್ತಡವೆಂದುಪರಿಗಣಿಸಲಾಗುತ್ತದೆ. 27-40 ರವರೆಗಿನ ಅಂಕಗಳನ್ನು ಹೆಚ್ಚಿನ ಗ್ರಹಿಸಿದಒತ್ತಡವೆಂದು ಪರಿಗಣಿಸಲಾಗುತ್ತದೆ.

ताण मापन scale

भिन्न परिस्थितींनी आपल्या भावनांवर आणि आपल्या मनावर असलेल्या तणावावर कसा परिणाम होतो हे समजून घेण्यात मदत करण्यासाठी हे एक लोकप्रिय पर्याय आहे. या स्तरामधील प्रश्न गेल्या महिन्यात आपल्या भावना आणि विचारांबद्दल विचारतात. प्रत्येक प्रकरणात, आपल्याला किती वेळा एखाद्या विशिष्ट मार्गाने वाटले किंवा विचार केले ते दर्शविण्यास सांगितले जाईल. जरी काही प्रश्न समान असले तरीही त्यांच्यात भिन्नता आहेत आणि आपण प्रत्येकास स्वतंत्र प्रश्न समजला पाहिजे. उत्तम दृष्टीकोन म्हणजे बऱ्यापैकी द्रुतपणे उत्तर देणे. म्हणजेच, आपल्याला एखाद्या विशिष्ट प्रकारे किती वेळा वाटले याची संख्या मोजण्याचा प्रयत्न करू नका; त्याऐवजी वाजवी अंदाजाप्रमाणे वाटणारा विकल्प दर्शवा.

प्रत्येक प्रश्नासाठी खालील पर्यायांमधून निवडाः
0 - कधीही 1 नाही - जवळजवळ कधीच नाही 2 कधी कधी 3 - बऱ्याचदा 4 - बऱ्याचदा

_____ 1. गेल्या महिन्यात, अनपेक्षितपणे घडलेल्या गोष्टीमुळे आपण किती वेळा अस्वस्थ झाला आहात?
_____ 2. गेल्या महिन्यात, आपल्या जीवनातल्या महत्वाच्या गोष्टींवर तुम्ही नियंत्रण ठेवू शकत नाही असं किती वेळा तुम्हाला वाटले असेल?
_____ 3. गेल्या महिन्यात, आपण कितीवेळा चिंताग्रस्त आणि तणावग्रस्त आहात?
_____4. गेल्या महिन्यात, आपल्या वैयक्तिक समस्या हाताळण्याच्या आपल्या क्षमतेबद्दल आपण किती वेळा आत्मविश्वास वाटला आहे?
_____ 5. गेल्या महिन्यात, आपल्या गोष्टींकडे कधीकधी जात आहे असे आपल्याला किती वेळा वाटले आहे?
_____ 6. मागील महिन्यात, आपण करत असलेल्या सर्व गोष्टींचा आपण सामना करू शकत नाही असे किती वेळा आढळले आहे?
_____ 7. गेल्या महिन्यात, आपण आपल्या जीवनात किती वेळा चिडचिड नियंत्रित करण्यास सक्षम आहात?
_____ 8. गेल्या महिन्यात, आपण बऱ्याचदा गोष्टी वरच्या स्थानावर असल्याचे आपल्यास किती वेळा वाटले आहे?
_____ 9. गेल्या महिन्यात, तुमच्या नियंत्रणाबाहेरच्या गोष्टींमुळे तुम्ही किती वेळा रागावले?
_____ १०. गेल्या महिन्यात तुम्हाला कितीवेळा अडचणी आल्या आहेत की तुम्ही त्यांच्यावर विजय मिळवू शकला नाही?

आपल्या पीएसएस स्कोअरची आकडेवारी काढणे आपण या दिशानिर्देशांचे अनुसरण करून आपली पीएसएस स्कोअर निश्चित करू शकता:

प्रथम, प्रश्न 4, 5, 7 आणि 8 साठी आपले स्कोअर उलट करा. या 4 प्रश्नांवर, यासारखे गुण मिळवा: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0.

एकूण मिळविण्यासाठी आता प्रत्येक वस्तूसाठी आपले स्कोअर जोडा. • माझी एकूण धावसंख्या _____ आहे.

पीएसएसवरील वैयक्तिक स्कोअर 0 ते 40 पर्यंत असू शकतात कारण उच्च स्कोअर उच्च-ज्ञात-तणाव दर्शवितात. 0 ०-१-13 पर्यंतचे गुण कमी ताण मानले जातील. 14 14-26 पर्यंतच्या स्कोअर मध्यम ताण मानले जातील. 27 27-40 पर्यंतचे स्कोअर उच्च मानले जाणारे ताण मानले जातील.

SF-36 HRQOL

SF-36 QUESTIONNAIRE

Name:_____ **Ref. Dr:**_____ **Date:** _____

ID#: _____ **Age:** _____ **Gender: M / F**

Please answer the 36 questions of the **Health Survey** completely, honestly, and without interruptions.

GENERAL HEALTH:
In general, would you say your health is:
○ Excellent ○ Very Good ○ Good ○ Fair ○ Poor

Compared to one year ago, how would you rate your health in general now?
○ Much better now than one year ago
○ Somewhat better now than one year ago
○ About the same
○ Somewhat worse now than one year ago
○ Much worse than one year ago

LIMITATIONS OF ACTIVITIES:
The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.
○ Yes, Limited a lot ○ Yes, Limited a Little ○ No, Not Limited at all

Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Lifting or carrying groceries
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Climbing several flights of stairs
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Climbing one flight of stairs
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Bending, kneeling, or stooping
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Walking more than a mile
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Walking several blocks
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Walking one block
○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

Bathing or dressing yourself

○Yes, Limited a Lot ○Yes, Limited a Little ○No, Not Limited at all

PHYSICAL HEALTH PROBLEMS:

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

Cut down the amount of time you spent on work or other activities

○Yes ○No

Accomplished less than you would like

○Yes ○No

Were limited in the kind of work or other activities

○Yes ○No

Had difficulty performing the work or other activities (for example, it took extra effort)

○Yes ○No

EMOTIONAL HEALTH PROBLEMS:

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

Cut down the amount of time you spent on work or other activities

○Yes ○No

Accomplished less than you would like

○Yes ○No

Didn't do work or other activities as carefully as usual

○Yes ○No

SOCIAL ACTIVITIES:

Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

○Not at all ○Slightly ○Moderately ○Severe ○Very Severe

PAIN:

How much bodily pain have you had during the past 4 weeks?

○None ○Very Mild ○Mild ○Moderate ○Severe ○Very Severe

During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

○Not at all ○A little bit ○Moderately ○Quite a bit ○Extremely

ENERGY AND EMOTIONS:

These questions are about how you feel and how things have been with you during the last 4 weeks. For each question, please give the answer that comes closest to the way you have been feeling.

Did you feel full of pep?

- ○ All of the time
- ○ Most of the time
- ○ A good Bit of the Time
- ○ Some of the time
- ○ A little bit of the time
- ○ None of the Time

Have you been a very nervous person?

- ○ All of the time
- ○ Most of the time
- ○ A good Bit of the Time
- ○ Some of the time
- ○ A little bit of the time
- ○ None of the Time

Have you felt so down in the dumps that nothing could cheer you up?

- ○ All of the time
- ○ Most of the time
- ○ A good Bit of the Time
- ○ Some of the time
- ○ A little bit of the time
- ○ None of the Time

Have you felt calm and peaceful?

- ○ All of the time
- ○ Most of the time
- ○ A good Bit of the Time
- ○ Some of the time
- ○ A little bit of the time
- ○ None of the Time

Did you have a lot of energy?

- ○ All of the time
- ○ Most of the time
- ○ A good Bit of the Time
- ○ Some of the time
- ○ A little bit of the time
- ○ None of the Time

Have you felt downhearted and blue?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

Did you feel worn out?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

Have you been a happy person?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

Did you feel tired?

- All of the time
- Most of the time
- A good Bit of the Time
- Some of the time
- A little bit of the time
- None of the Time

SOCIAL ACTIVITIES:
During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

- All of the time
- Most of the time
- Some of the time
- A little bit of the time
- None of the Time

GENERAL HEALTH:
How true or false is each of the following statements for you?

I seem to get sick a little easier than other people

Definitely true | Mostly true | Don't know | Mostly false | Definitely false

I am as healthy as anybody I know

Definitely true | Mostly true | Don't know | Mostly false | Definitely false

I expect my health to get worse

Definitely true | Mostly true | Don't know | Mostly false | Definitely false

My health is excellent

Definitely true | Mostly true | Don't know | Mostly false | Definitely false

SF – 36 ಪ್ರಶ್ನಾವಳಿ

ಹೆಸರು: _____ ರೆಫ್. ಡಾ: _____ ದಿನಾಂಕ: _____

ID #: _____ ವಯಸ್ಸು: _____ ಲಿಂಗ: M / F

ಆರೋಗ್ಯ ಸಮೀಕ್ಷೆಯ 36 ಪ್ರಶ್ನೆಗಳಿಗೆ ದಯವಿಟ್ಟುಸಂಪೂರ್ಣವಾಗಿ, ಪ್ರಾಮಾಣಿಕವಾಗಿ ಮತ್ತು ಅಡತಡೆಗಳಿಲ್ಲದೆ ಉತ್ತರಿಸಿ.

1. ಸಾಮಾನ್ಯಆರೋಗ್ಯ: ಸಾಮಾನ್ಯವಾಗಿ, ನಿಮ್ಮಆರೋಗ್ಯ ಹೀಗಿದೆಎಂದುನೀವು ಹೇಳುತ್ತೀರಾ:

- ಅತ್ಯುತ್ತಮವಾದ
- ತುಂಬಾ ಒಳ್ಳೆಯ
- ಒಳ್ಳೆಯ
- ಸಾಮಾನ್ಯ
- ಸಾರವಿಲ್ಲದ

2. ಒಂದು ವರ್ಷದ ಹಿಂದೆ ಹೋಲಿಸಿದರೆ, ಈಗ ನಿಮ್ಮ ಆರೋಗ್ಯವನ್ನು ಸಾಮಾನ್ಯವಾಗಿ ಹೇಗೆ ರೇಟ್ ಮಾಡುತ್ತೀರಿ?

- ಒಂದು ವರ್ಷದ ಹಿಂದಿನದಕ್ಕಿಂತ ಈಗ ತುಂಬಾ ಉತ್ತಮವಾಗಿದೆ
- ಒಂದು ವರ್ಷದ ಹಿಂದಿನದಕ್ಕಿಂತ ಈಗ ಸ್ವಲ್ಪ ಉತ್ತಮವಾಗಿದೆ
- ಅದೇ ರೀತಿ ಇದೆ.
- ಒಂದುವರ್ಷದಹಿಂದಿನದಕ್ಕಿಂತಈಗಸ್ವಲ್ಪಕೆಟ್ಟದಾಗಿದೆ
- ಒಂದು ವರ್ಷದ ಹಿಂದಿನದಕ್ಕಿಂತ ತುಂಬಾ ಕೆಟ್ಟದಾಗಿದೆ

ಚಟುವಟಿಕೆಗಳಮಿತಿಗಳು: ಈಕೆಳಗಿನ ವಸ್ತುಗಳು ಒಂದುವಿಶಿಷ್ಟದಿನದಲ್ಲಿ ನೀವು ಮಾಡಬಹುದಾದ ಚಟುವಟಿಕೆಗಳ ಬಗ್ಗೆ. ನಿಮ್ಮ ಆರೋಗ್ಯವು ಈಗ ಈ ಚಟುವಟಿಕೆಗಳಲ್ಲಿ ನಿಮ್ಮನ್ನು ಮಿತಿಗೊಳಿಸುತ್ತದೆಯೇ? ಹಾಗಿದ್ದರೆ, ಎಷ್ಟು?

3. ಓಡುವುದು, ಭಾರವಾದ ವಸ್ತುಗಳನ್ನುಎತ್ತುವುದು, ಶ್ರಮದಾಯಕ ಕ್ರೀಡೆಗಳಲ್ಲಿ ಭಾಗವಹಿಸುವುದು ಮುಂತಾದ ಹುರುಪಿನ ಚಟುವಟಿಕೆಗಳು.

- ಹೌದು, ಬಹಳಷ್ಟು ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

4. ಟೇಬಲ್ ಚಲಿಸುವುದು, ವ್ಯಾಕ್ಯೂಮ್ ಕ್ಲೀನರ ಅನ್ನುತಳ್ಳುವುದು, ಬೌಲಿಂಗ್ ಮಾಡುವುದು ಅಥವಾ ಗಾಲ್ಫ್ ಆಡುವಂತಹ ಮಧ್ಯಮ ಚಟುವಟಿಕೆಗಳು

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

5. ದಿನಸಿ ವಸ್ತುಗಳನ್ನು ಎತ್ತುವುದು ಅಥವಾ ಸಾಗಿಸುವುದು

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

6. ಹಲವು ಮೆಟ್ಟಿಲುಗಳನ್ನು ಒಟ್ಟಿಗೆ ಹತ್ತುವುದು

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

7. ಒಂದೊಂದೇ ಮೆಟ್ಟಿಲು ಹತ್ತುವುದು

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

8. ಬಾಗುವುದು, ಮಂಡಿಯೂರುವುದು ಅಥವಾ ಕುಣಿಯುವುದು

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

9. ಒಂದು ಮೈಲಿಗಿಂತ ಹೆಚ್ಚು ನಡೆಯುವುದು

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪಇಲ್ಲ,
- ಎಲ್ಲೂ ಸೀಮಿತವಾಗಿಲ್ಲ

10. ಹಲವಾರು ಬ್ಲಾಕ್ಗಳ ವಾಕಿಂಗ್

- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ

- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

11. ಒಂದು ಬ್ಲಾಕ್ ವಾಕಿಂಗ್
- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

12. ನೀವೇ ಸ್ನಾನ ಮಾಡುವುದು ಅಥವಾ ಧರಿಸುವುದು
- ಹೌದು, ಸೀಮಿತವಾಗಿದೆ
- ಹೌದು, ಸ್ವಲ್ಪ ಸೀಮಿತವಾಗಿದೆ
- ಇಲ್ಲ, ಸೀಮಿತವಲ್ಲ

ದೈಹಿಕ ಆರೋಗ್ಯ ಸಮಸ್ಯೆಗಳು: ಕಳೆದ 4 ವಾರಗಳಲ್ಲಿ, ನಿಮ್ಮ ದೈಹಿಕ ಆರೋಗ್ಯದ ಪರಿಣಾಮವಾಗಿ ನಿಮ್ಮ ಕೆಲಸ ಅಥವಾ ಇತರ ನಿಯಮಿತ ದೈನಂದಿನ ಚಟುವಟಿಕೆಗಳಲ್ಲಿ ಈ ಕೆಳಗಿನ ಯಾವುದೇ ಸಮಸ್ಯೆಗಳನ್ನುನೀವು ಹೊಂದಿದ್ದೀರಾ?

13. ನೀವು ಕೆಲಸ ಅಥವಾ ಇತರ ಚಟುವಟಿಕೆಗಳಿಗಾಗಿ ಕಳೆದ ಸಮಯವನ್ನು ಕಡಿತಗೊಳಿಸಿ
- ಹೌದು
- ಇಲ್ಲ

14. ನೀವು ಬಯಸಿದಕ್ಕಿಂತ ಕಡಿಮೆ ಸಾಧಿಸಿದೆ
- ಹೌದು
- ಇಲ್ಲ

15. ಕೆಲಸ ಅಥವಾ ಇತರ ಚಟುವಟಿಕೆಗಳಲ್ಲಿ ಸೀಮಿತವಾಗಿತ್ತು
- ಹೌದು
- ಇಲ್ಲ

16. ಕೆಲಸ ಅಥವಾ ಇತರ ಚಟುವಟಿಕೆಗಳನ್ನು ನಿರ್ವಹಿಸಲು ಕಷ್ಟವಾಯಿತು (ಉದಾಹರಣೆಗೆ, ಇದು ಹೆಚ್ಚುವರಿ ಪ್ರಯತ್ನವನ್ನು ತೆಗೆದುಕೊಂಡಿತು)
- ಹೌದು
- ಇಲ್ಲ

ಭಾವನಾತ್ಮಕ ಆರೋಗ್ಯ ಸಮಸ್ಯೆಗಳು: ಕಳೆದ 4 ವಾರಗಳಲ್ಲಿ, ಯಾವುದೇ ಭಾವನಾತ್ಮಕ ಸಮಸ್ಯೆಗಳ (ಖಿನ್ನತೆ ಅಥವಾ ಆತಂಕದಂತಹ) ಪರಿಣಾಮವಾಗಿ ನಿಮ್ಮ ಕೆಲಸ ಅಥವಾ ಇತರ ನಿಯಮಿತ ದೈನಂದಿನ ಚಟುವಟಿಕೆಗಳಲ್ಲಿ ನೀವು ಈ ಕೆಳಗಿನ ಯಾವುದೇ ಸಮಸ್ಯೆಗಳನ್ನು ಹೊಂದಿದ್ದೀರಾ?

17. ನೀವು ಕೆಲಸ ಅಥವಾ ಇತರ ಚಟುವಟಿಕೆಗಳಿಗಾಗಿ ಕಳೆದ ಸಮಯವನ್ನು ಕಡಿತಗೊಳಿಸಿ
- ಹೌದು
- ಇಲ್ಲ

18. ನೀವು ಬಯಸಿದಕ್ಕಿಂತ ಕಡಿಮೆ ಸಾಧಿಸಿದೆ
- ಹೌದು
- ಇಲ್ಲ

19. ಎಂದಿನಂತೆ ಎಚ್ಚರಿಕೆಯಿಂದ ಕೆಲಸ ಅಥವಾ ಇತರ ಚಟುವಟಿಕೆಗಳನ್ನು ಮಾಡಲಿಲ್ಲ
- ಹೌದು
- ಇಲ್ಲ

20. ಸಾಮಾಜಿಕ ಚಟುವಟಿಕೆಗಳು: ಕುಟುಂಬ, ಸ್ನೇಹಿತರು, ನೆರೆಹೊರೆಯವರು ಅಥವಾ ಗುಂಪುಗಳೊಂದಿಗೆನಿಮ್ಮಸಾಮಾನ್ಯ ಸಾಮಾಜಿಕ ಚಟುವಟಿಕೆಗಳಲ್ಲಿ ಭಾವನಾತ್ಮಕ ಸಮಸ್ಯೆಗಳು ಹಸ್ತಕ್ಷೇಪ ಮಾಡುತ್ತವೆ?
- ಇಲ್ಲವೇ ಇಲ್ಲ
- ಸ್ವಲ್ಪ
- ಮಧ್ಯಮವಾಗಿ
- ತೀವ್ರ
- ತುಂಬಾ ತೀವ್ರ

21. ನೋವು: ಕಳೆದ 4 ವಾರಗಳಲ್ಲಿ ನೀವು ಎಷ್ಟು ದೈಹಿಕ ನೋವನ್ನು ಅನುಭವಿಸಿದ್ದೀರಿ?
- ಯಾವುದೂ ಇಲ್ಲ
- ತುಂಬಾ ಸೌಮ್ಯ
- ಸೌಮ್ಯ
- ಮಧ್ಯಮ
- ತೀವ್ರ
- ತುಂಬಾ ತೀವ್ರ

22. ಕಳೆದ 4 ವಾರಗಳಲ್ಲಿ, ನಿಮ್ಮಸಾಮಾನ್ಯ ಕೆಲಸಕ್ಕೆ (ಮನೆಯ ಹೊರಗಿನ ಕೆಲಸ ಮತ್ತು ಮನೆ ಕೆಲಸ ಎರಡನ್ನೂ ಒಳಗೊಂಡಂತೆ) ನೋವು ಎಷ್ಟು ಹಸ್ತಕ್ಷೇಪ ಮಾಡಿದೆ?

- ಇಲ್ಲವೇ ಇಲ್ಲ
- ಸ್ವಲ್ಪ
- ಮಧ್ಯಮವಾಗಿ
- ಸ್ವಲ್ಪ ಜಾಸ್ತಿ
- ಅತ್ಯಂತ

23. ಶಕ್ತಿ ಮತ್ತು ಭಾವನೆಗಳು: ಈ ಪ್ರಶ್ನೆಗಳು ಕಳೆದ 4 ವಾರಗಳಲ್ಲಿ ನೀವು ಹೇಗೆ ಭಾವಿಸುತ್ತೀರಿ ಮತ್ತು ನಿಮ್ಮೊಂದಿಗೆ ಹೇಗೆ ಇದ್ದೀರಿ ಎಂಬುದರ ಕುರಿತು. ಪ್ರತಿಪ್ರಶ್ನೆಗೆ, ದಯವಿಟ್ಟು ನೀವು ಅನುಭವಿಸುತ್ತಿರುವ ರೀತಿಗೆ ಹತ್ತಿರವಿರುವ ಉತ್ತರವನ್ನು ನೀಡಿ.

- ನಿಮಗೆ ಜೀವನೋತ್ಸಾಹ ತುಂಬಿತ್ತು?
- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

24. ನೀವು ತುಂಬಾ ಆತಂಕಕೋಳಗಾಗಿದ್ದಿರ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

25. ಏನೂ ನಿಮ್ಮನ್ನು ಹುರಿದುಂಬಿಸಲು ಸಾಧ್ಯವಾಗದಷ್ಟು ಕೆಳಗೆ ಇಳಿದಿದ್ದೀರಾ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

26. ನೀವು ಶಾಂತ ಮತ್ತು ಶಾಂತಿಯುತ ಭಾವನೆ ಹೊಂದಿದ್ದೀರಾ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

27. ನೀವು ಸಾಕಷ್ಟು ಶಕ್ತಿಯನ್ನು ಹೊಂದಿದ್ದೀರಾ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

28. ನೀವು ನಿರಾಶೆ ಅನುಭವಿಸಿದ್ದೀರಾ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ

- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

29. ನೀವು ಬಳಲಿದ ಭಾವನೆ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

30. ನೀವು ಸಂತೋಷದ ವ್ಯಕ್ತಿಯಾಗಿದ್ದೀರಾ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

31. ನಿಮಗೆ ದಣಿದಿದೆಯೆ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಸಮಯದ ಉತ್ತಮ ಬಿಟ್
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

32. ಸಾಮಾಜಿಕ ಚಟುವಟಿಕೆಗಳು: ಕಳೆದ 4 ವಾರಗಳಲ್ಲಿ, ನಿಮ್ಮ ದೈಹಿಕ ಚಟುವಟಿಕೆಗಳಲ್ಲಿ (ಸ್ನೇಹಿತರು, ಸಂಬಂಧಿಕರೊಂದಿಗೆ ಭೇಟಿ ನೀಡುವುದು ಇತ್ಯಾದಿ) ನಿಮ್ಮ ದೈಹಿಕ ಆರೋಗ್ಯ ಅಥವಾ ಭಾವನಾತ್ಮಕ ಸಮಸ್ಯೆಗಳು ಎಷ್ಟು ಸಮಯವನ್ನು ಹಸ್ತಕ್ಷೇಪ ಮಾಡಿವೆ?

- ಎಲ್ಲಾ ಸಮಯ
- ಹೆಚ್ಚಿನ ಸಮಯ
- ಕೆಲವು ಸಮಯ
- ಸ್ವಲ್ಪ ಸಮಯ
- ಸಮಯ ಯಾವುದೂ ಇಲ್ಲ

ಸಾಮಾನ್ಯ ಆರೋಗ್ಯ: ಈ ಕೆಳಗಿನ ಪ್ರತಿಯೊಂದು ಹೇಳಿಕೆಗಳು ನಿಮಗಾಗಿ ಎಷ್ಟು ನಿಜ ಅಥವಾ ಸುಳ್ಳು?

33. ನಾನು ಇತರ ಜನರಿಗಿಂತ ಸ್ವಲ್ಪ ಸುಲಭವಾಗಿ ಅನಾರೋಗ್ಯಕ್ಕೆ ಒಳಗಾಗುತ್ತಿದ್ದೇನೆ

- ಖಂಡಿತವಾಗಿಯೂ ನಿಜ
- ಹೆಚ್ಚಾಗಿ ನಿಜ
- ಗೊತ್ತಿಲ್ಲ
- ಹೆಚ್ಚಾಗಿ ಸುಳ್ಳು
- ಖಂಡಿತವಾಗಿಯೂ ಸುಳ್ಳು

34. ನನಗೆ ತಿಳಿದಿರುವ ಯಾರೊಬ್ಬರಂತೆ ನಾನು ಆರೋಗ್ಯವಾಗಿದ್ದೇನೆ

- ಖಂಡಿತವಾಗಿಯೂ ನಿಜ
- ಹೆಚ್ಚಾಗಿ ನಿಜ
- ಗೊತ್ತಿಲ್ಲ
- ಹೆಚ್ಚಾಗಿ ಸುಳ್ಳು
- ಖಂಡಿತವಾಗಿಯೂ ಸುಳ್ಳು

35. ನನ್ನ ಆರೋಗ್ಯವು ಹದಗೆಡುತ್ತದೆ ಎಂದು ನಾನು ನಿರೀಕ್ಷಿಸುತ್ತೇನೆ

- ಖಂಡಿತವಾಗಿಯೂ ನಿಜ
- ಹೆಚ್ಚಾಗಿ ನಿಜ
- ಗೊತ್ತಿಲ್ಲ
- ಹೆಚ್ಚಾಗಿ ಸುಳ್ಳು
- ಖಂಡಿತವಾಗಿಯೂ ಸುಳ್ಳು

36. ನನ್ನ ಆರೋಗ್ಯ ಅತ್ಯುತ್ತಮವಾಗಿದೆ
- ಖಂಡಿತವಾಗಿಯೂ ನಿಜ
- ಹೆಚ್ಚಾಗಿ ನಿಜ
- ಗೊತ್ತಿಲ್ಲ
- ಹೆಚ್ಚಾಗಿ ಸುಳ್ಳು
- ಖಂಡಿತವಾಗಿಯೂ ಸುಳ್ಳು

SF 36 प्रश्नावली

नाव: _____ संदर्भ डॉ: _____ तारीख: _____
आयडी #: _____ वय: _____ लिंग: एम / एफ

कृपया आरोग्य सर्वेक्षणातील 36 प्रश्नांची पूर्ण उत्तरे द्या, प्रामाणिकपणे आणि कोणत्याही व्यत्ययाशिवाय.

1. सर्वसाधारण आरोग्य: सर्वसाधारणपणे, आपण म्हणाल की तुमचे आरोग्य आहे:
- उत्कृष्ट
- खूप चांगले चां
- गले
- फेअर
- गरीब

2. एक वर्षा पूर्वीच्या तुलनेत, आपण आपल्या आरोग्यास सर्वसाधारणपणे कसे रेटिंग द्याल?
- एका वर्षा पूर्वीपेक्षा बरेच चांगले
- आता एक वर्षापूर्वीचे काहीसे
- काही बदल नाही
- आता एक वर्षापूर्वीचे काहीसे वाईट
- आता एका वर्षा पूर्वीपेक्षा बरेच वाईट

उपक्रमांच्या मर्यादा:
खालील गोष्टी आपण ठराविक दिवसा दरम्यान करू शकणाऱ्या क्रियांविषयी असतात:

3. आपले आरोग्य आता या क्रियाकलापांमध्ये मर्यादित आहे का? असल्यास, किती?
    - धावणे, अवजड वस्तू उचलणे, कठोर खेळात भाग घेणे यासारख्या जोरदार क्रियाकलाप.
    - होय, बरेच मर्यादित
    - होय, मर्यादित
    - नाही, मर्यादित नाही
4. मध्यम क्रियाकलाप, जसे की टेबल हलविणे, व्हॅक्यूम क्लिनर ढकलणे, गोलंदाजी करणे किंवा गोल्फ खेळणे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

5. किराणा सामान उचलणे किंवा नेणे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

6. पाय st्यांची अनेक उड्डाणे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

7. पायर्यांपैकी एक उड्डाण चढत आहे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

8. वाकणे, गुडघे टेकणे किंवा खाली वाकणे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

9. मैलापेक्षा जास्त चालणे
- होय, मर्यादित
- होय, मर्यादित नाही,
- अजिबात मर्यादित नाही

10. अनेक ब्लॉक्स चालणे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

11. एक ब्लॉक चालणे
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

12. आंघोळ किंवा स्वत: ला ड्रेसिंग
- होय, मर्यादित
- होय, मर्यादित
- नाही, मर्यादित नाही

शारीरिक आरोग्याच्या समस्या:

मागील आठवड्यांत, आपल्या शारीरिक आरोग्याच्या परिणामी आपल्यास आपल्या कामात किंवा इतर नियमित दैनंदिन कामांमध्ये खालीलपैकी काही समस्या आहेत?

13. आपण कामावर किंवा इतर कामांवर किती वेळ घालवला आहे ते कमी करा
- होय
- नाही

14. आपल्या इच्छेपेक्षा कमी केले
- होय
- नाही

15. कामाच्या प्रकारात किंवा इतर कामांमध्ये मर्यादित होते
- होय
- नाही

16. काम किंवा इतर क्रियाकलाप करण्यात अडचण आली (उदाहरणार्थ, त्यासाठी अतिरिक्त प्रयत्न केले)
- होय
- नाही

भावनात्मक आरोग्य समस्या:

गेल्या 4 आठवड्यांत, भावनाप्रधान समस्यांमुळे (जसे की औदासिन्य किंवा चिंताग्रस्त होणे) आपल्या कामाबद्दल किंवा इतर नियमित दैनंदिन कार्यात तुम्हाला खालीलपैकी काही समस्या आहेत?

17. आपण कामावर किंवा इतर कामांवर किती वेळ घालवला आहे ते कमी करा
- होय
- नाही

18. आपल्या इच्छेपेक्षा कमी केले
- होय
- नाही

19. नेहमीप्रमाणे काळजीपूर्वक काम किंवा इतर कामे केली नाहीत
- होय
- नाही

सामाजिक क्रियाकलाप:

20. कुटुंब, मित्र, शेजारी किंवा गट यांच्यासह आपल्या सामान्य सामाजिक कार्यात व्यत्यय आणणारी भावनात्मक समस्या?
- अजिबात नाही
- किंचित
- माफक प्रमाणात
- गंभीर
- खूप गंभीर

वेदना:

21. गेल्या 4 आठवड्यांत तुम्हाला किती शारीरिक वेदना होत आहे?
- काहीही नाही
- खूप सौम्य
- सौम्य
- मध्यम
- गंभीर
- खूप गंभीर

22. मागील 4 आठवड्यांत, वेदना आपल्या सामान्य कामात (घराबाहेरचे काम आणि घरकाम यासह) किती व्यत्यय आणते?
- अजिबात नाही
- जरासे
- माफक प्रमाणात
- थोडा
- अत्यंत

ऊर्जा आणि भावना:

हे प्रश्न आपल्याला कसे वाटते आणि गेल्या 4 आठवड्यांमध्ये आपल्याबरोबर गोष्टी कशा आहेत याबद्दल आहेत. प्रत्येक प्रश्नासाठी, कृपया असे उत्तर द्या जे आपणास वाटत असलेल्या मार्गाने सर्वात जवळ येते.

23. तुला पेप भरलेले वाटले का?
- सर्व वेळ
- बहुतांश वेळा
- वेळ एक चांगला बिट
- काही वेळ
- थोडा वेळ
- वेळ नाही

24. आपण खूप चिंताग्रस्त व्यक्ती आहात?
- सर्व वेळ
- बहुतांश वेळा
- वेळ एक चांगला बिट

- काही वेळ
- थोडा वेळ
- वेळ नाही

25. आपणास कचर्यामध्ये इतके निराशा झाली आहे की कोणतीही गोष्ट तुम्हाला उत्तेजन देऊ शकणार नाही?
- सर्व वेळ
- बहुतांश वेळा
- वेळ एक चांगला बिट
- काही वेळ
- थोडा वेळ
- वेळ नाही

26. आपण शांत आणि शांतता अनुभवली आहे?
- सर्व वेळ
- बहुतांश वेळा
- वेळ एक चांगला बिट
- काही वेळ
- थोडा वेळ
- वेळ नाही

27. आपल्याकडे खूप ऊर्जा आहे?
- सर्व वेळ
- बहुतांश वेळा
- वेळ एक चांगला बिट
- काही वेळ
- थोडा वेळ
- वेळ नाही

28. आपण निराश आणि निळा वाटला आहे?
- सर्व वेळ
- बहुतांश वेळा
- वेळ एक चांगला बिट
- काही वेळ
- थोडा वेळ
- वेळ नाही

29. आपण थकल्यासारखे वाटले का?
- सर्व वेळ; बहुतांश वेळा; वेळ एक चांगला बिट; काही वेळ; थोडा वेळ; वेळ नाही

30. आपण आनंदी व्यक्ती आहात?
- सर्व वेळ; बहुतांश वेळा; वेळ एक चांगला बिट; काही वेळ; थोडा वेळ; वेळ नाही

31. तुम्हाला थकवा जाणवला आहे का?
- सर्व वेळ; बहुतांश वेळा; वेळ एक चांगला बिट; काही वेळ; थोडा वेळ; वेळ नाही

सामाजिक क्रियाकलाप:

32. मागील 4 आठवड्यांत, आपल्या शारीरिक आरोग्यास किंवा भावनिक समस्यांमुळे आपल्या सामाजिक क्रियाकलापांमध्ये किती वेळ व्यत्यय आला आहे (जसे की मित्र, नातेवाईक इत्यादींना भेट दिली आहे?)
- सर्व वेळ
- बहुतांश वेळा
- काही वेळ
- थोडा वेळ
- वेळ नाही

सर्वसाधारण आरोग्यः

आपल्यासाठी खालील प्रत्येक विधान किती खरे किंवा खोटे आहे?

33. इतर लोकांपेक्षा मी आजारी पडलो आहे असे मला वाटते
- निश्चितच सत्य आहे
- मुख्यतः सत्य
- माहित नाही
- मुख्यतः खोटे
- नक्कीच खोटे

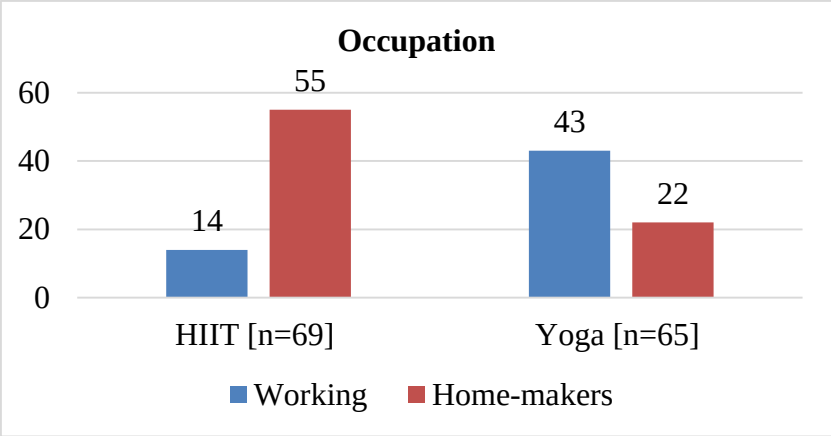
34. मी ज्यांना ओळखतो त्याच्याइतकेच मी निरोगी आहे
- निश्चितच सत्य आहे
- मुख्यतः सत्य
- माहित नाही
- मुख्यतः खोटे
- नक्कीच खोटे

35. माझी तब्येत आणखी खराब होईल अशी मी अपेक्षा करतो
- निश्चितच सत्य आहे
- मुख्यतः सत्य
- माहित नाही
- मुख्यतः खोटे
- निश्चितच खोटे

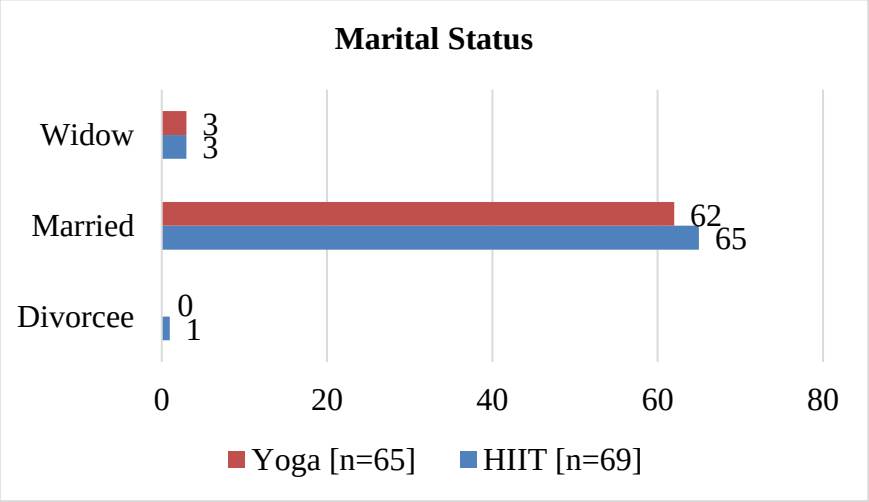
36. माझे आरोग्य उत्कृष्ट आहे
- निश्चितच सत्य आहे
- मुख्यतः सत्य
- माहित नाही
- मुख्यतः खोटे
- नक्कीच खोटे

ANNEXURE VIII- GRAPHS

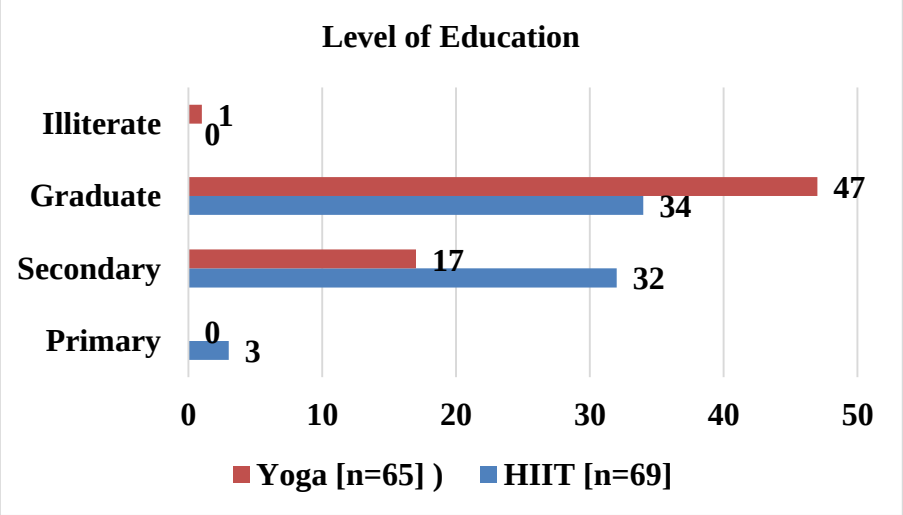
Graph 1a: Distribution of participants based on occupation



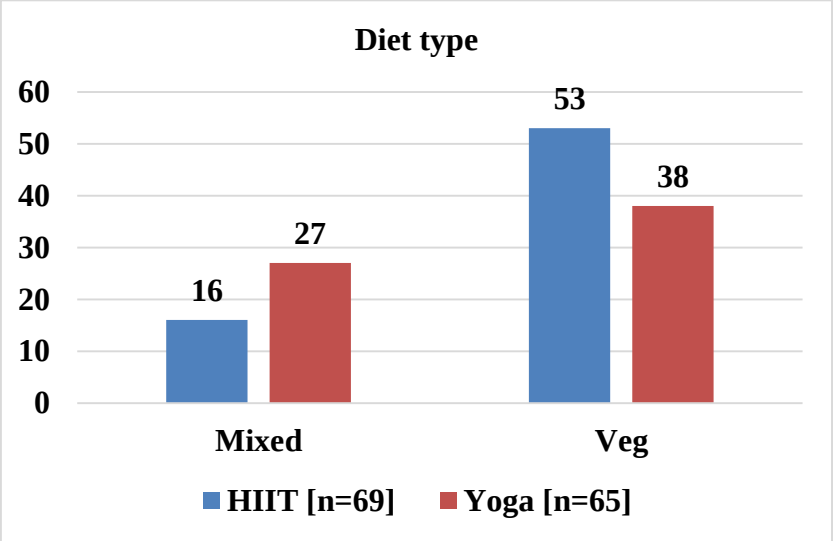
Graph 1b: Distribution of participants based on Marital Status



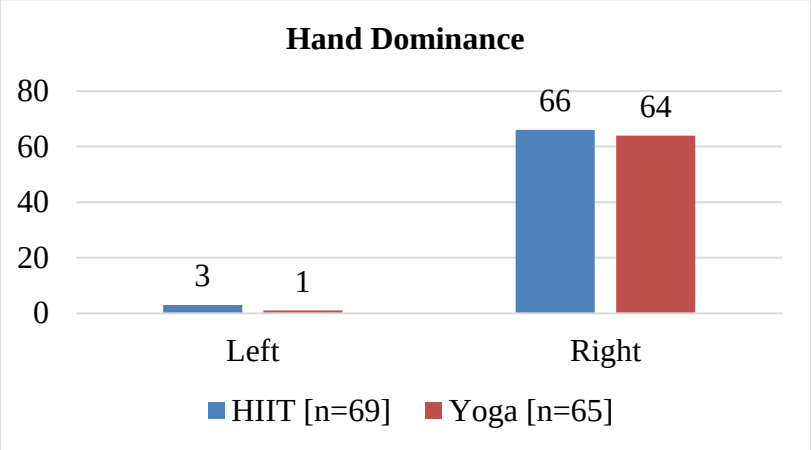
Graph 1c: Distribution of participants based on the Level of Education



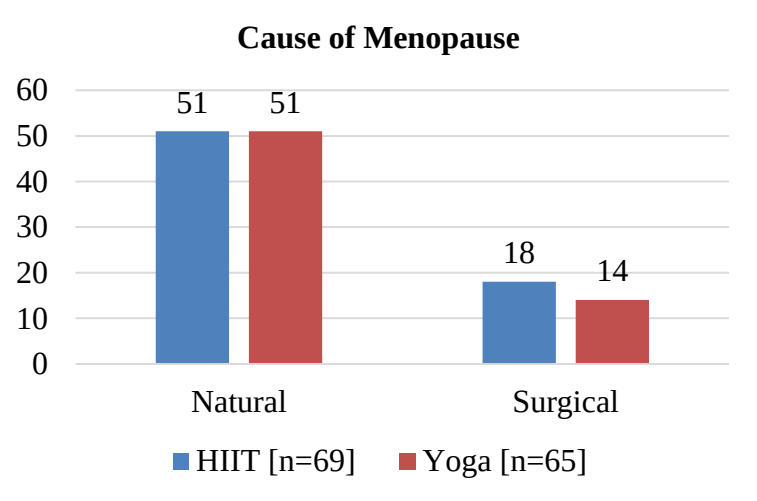
Graph 1d: Distribution of participants based on Diet type



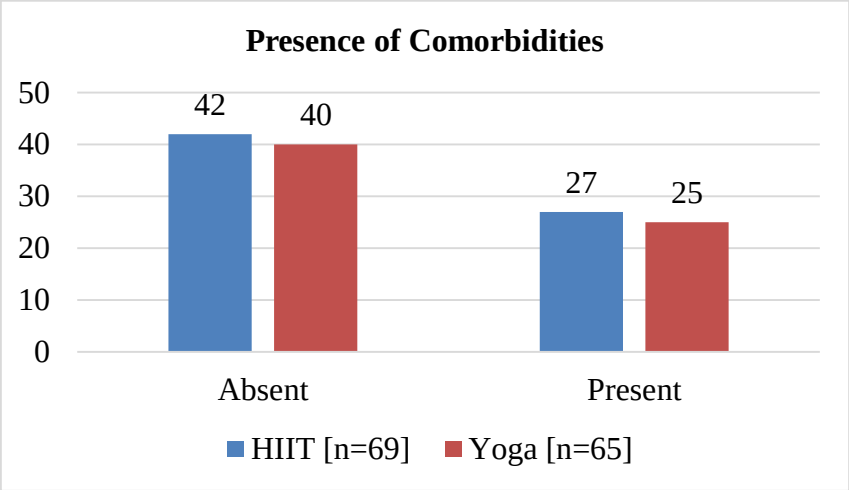
Graph 1e: Distribution of participants based on Hand dominance



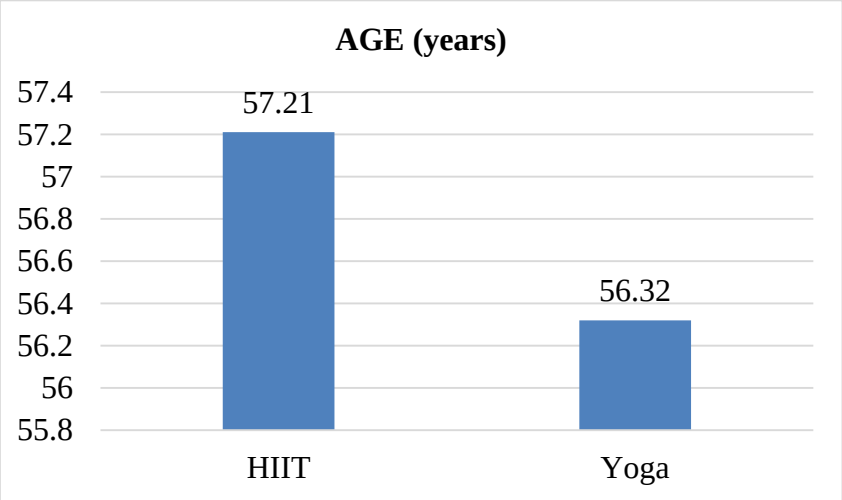
Graph 1f: Distribution of participants based on the cause of menopause



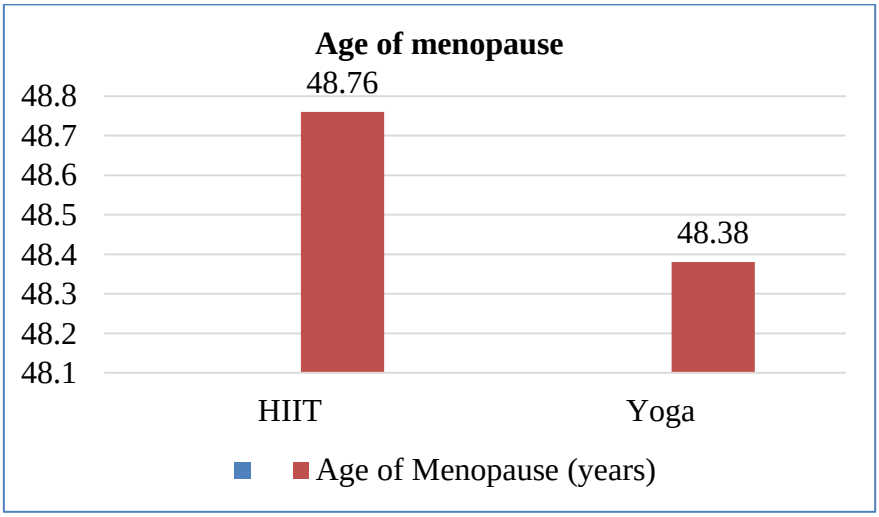
Graph 1g: Distribution of participants based on the presence of comorbidities



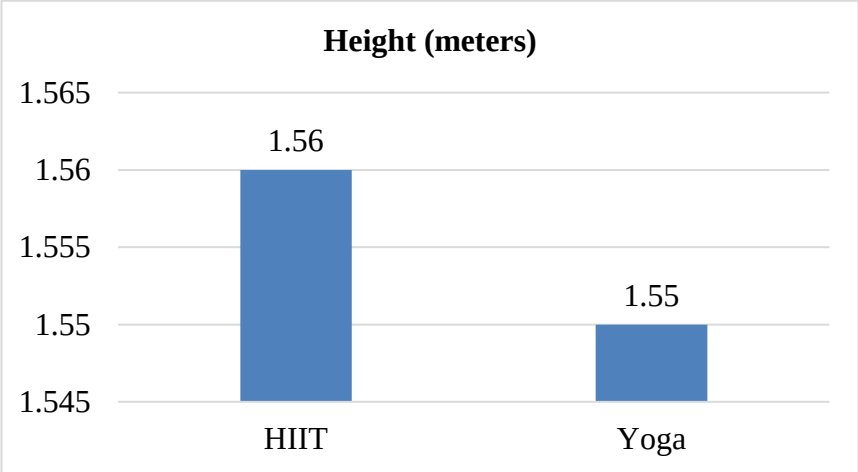
Graph 2a: Age of participants (years) in the two study groups



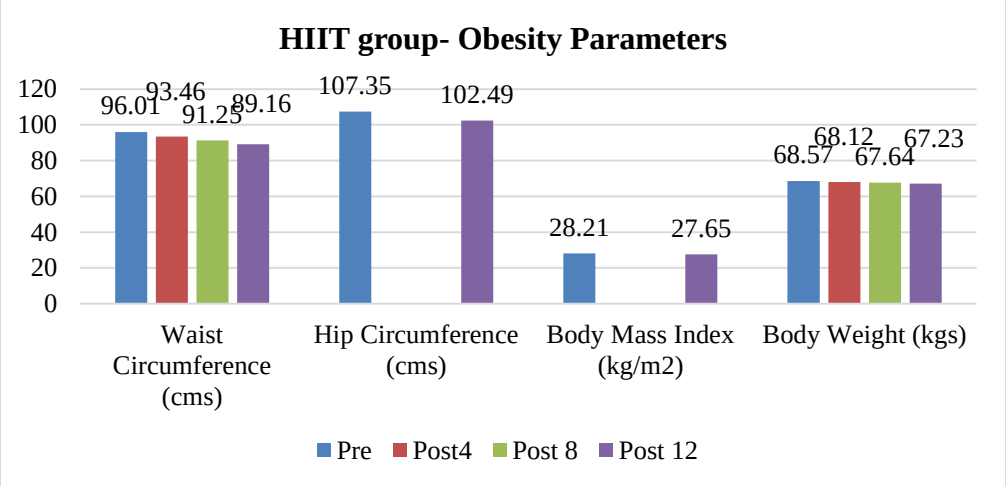
Graph 2b: Age of menopause (years) in the two study groups



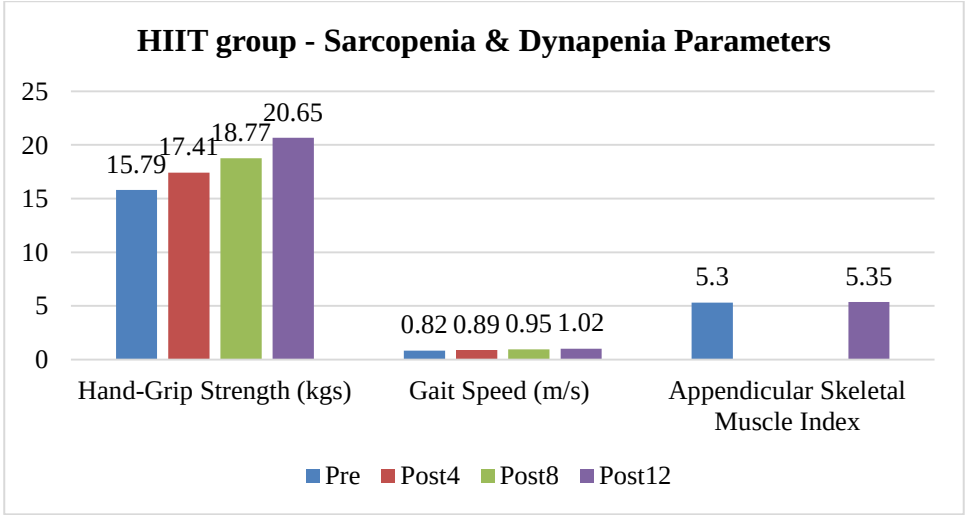
Graph 2c: Height of the participants (meters) in the two study groups



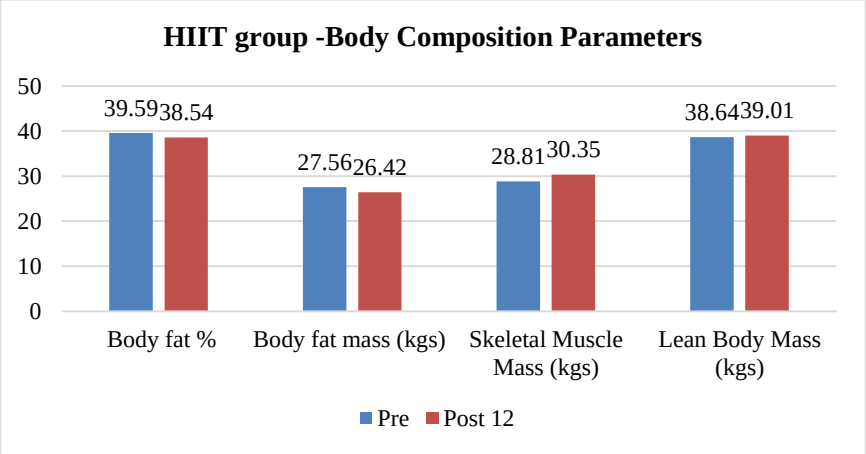
Graph 3a: Comparisons of Obesity parameters across timelines for the HIIT group



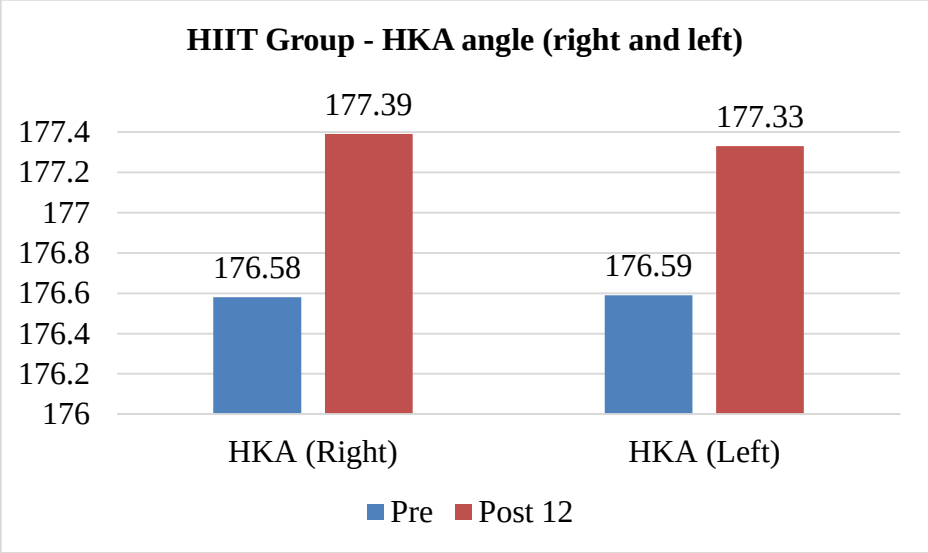
Graph 3b: Comparisons of Sarcopenia and Dynapenia parameters across timelines for the HIIT group



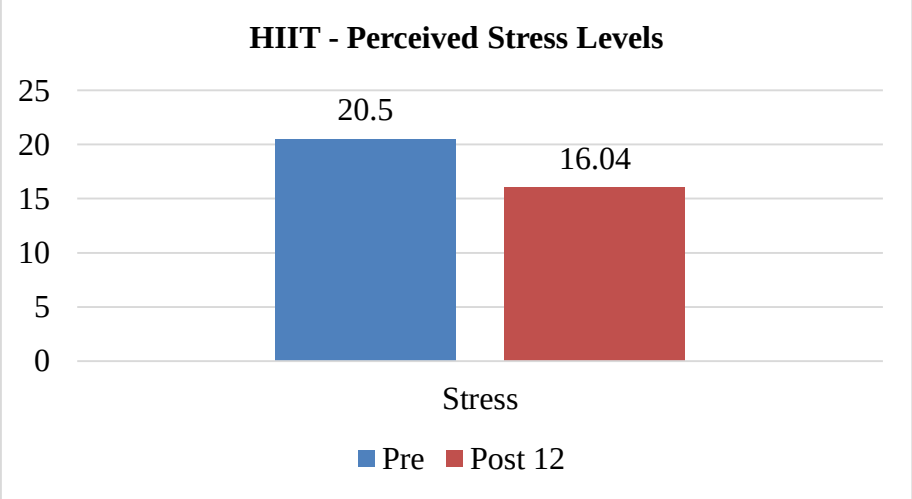
Graph 3c: Comparisons of Body Composition parameters across timelines for the HIIT group



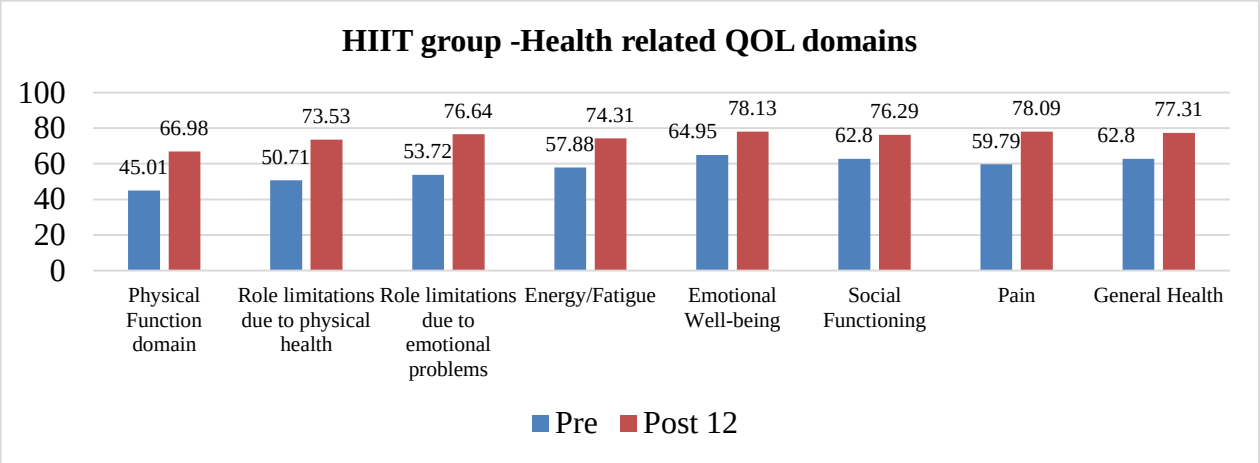
Graph 3d: Comparisons of HKA Angle across timelines for the HIIT group



Graph 3e: Comparisons of Perceived Stress Levels across timelines for the HIIT group

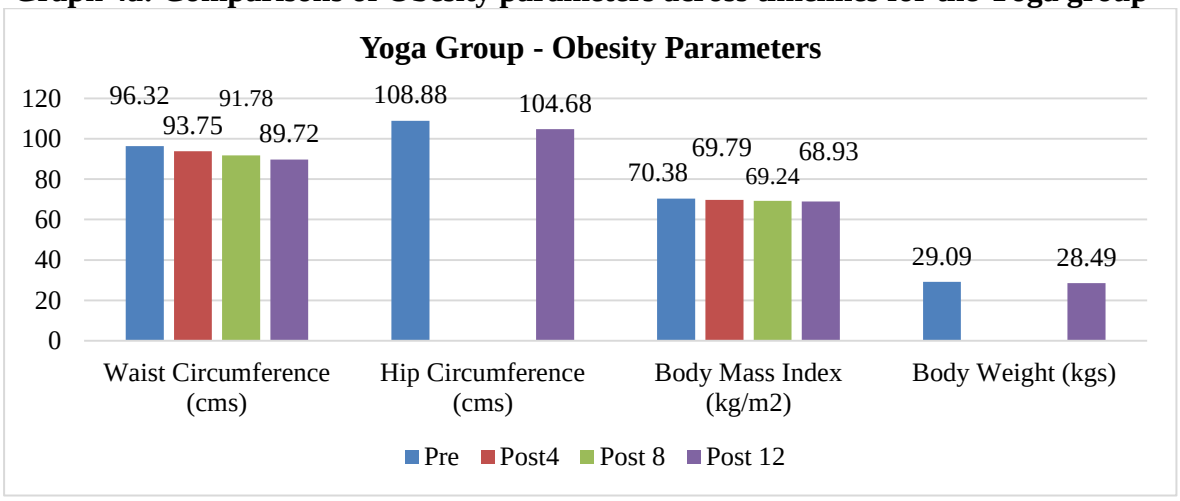


Graph 3f: Comparisons of Health-Related QoL domains by Short-form 36 across timelines for the HIIT group

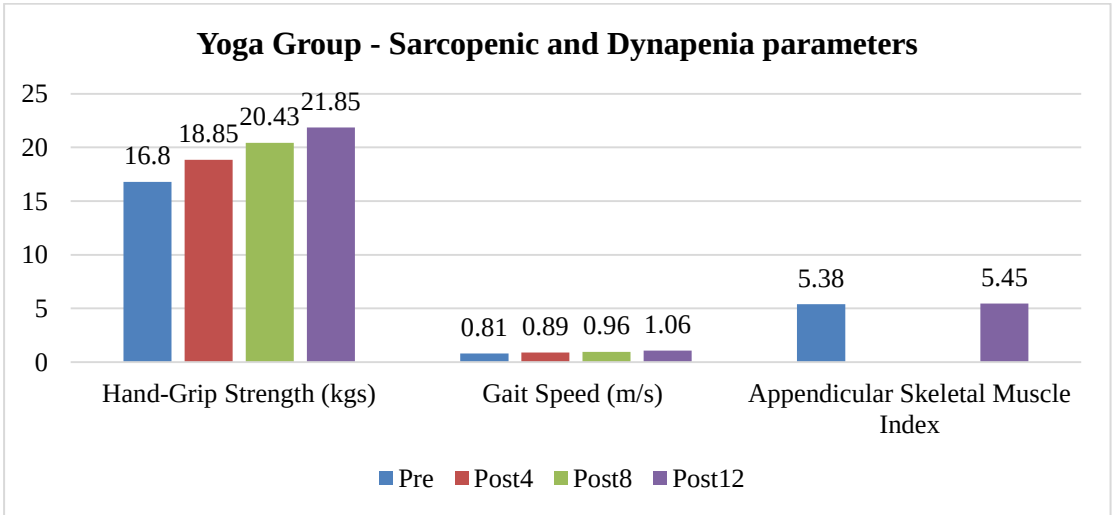


Graph 4: Graphical representations of all outcome measures for yoga group at pre and post-intervention comparisons

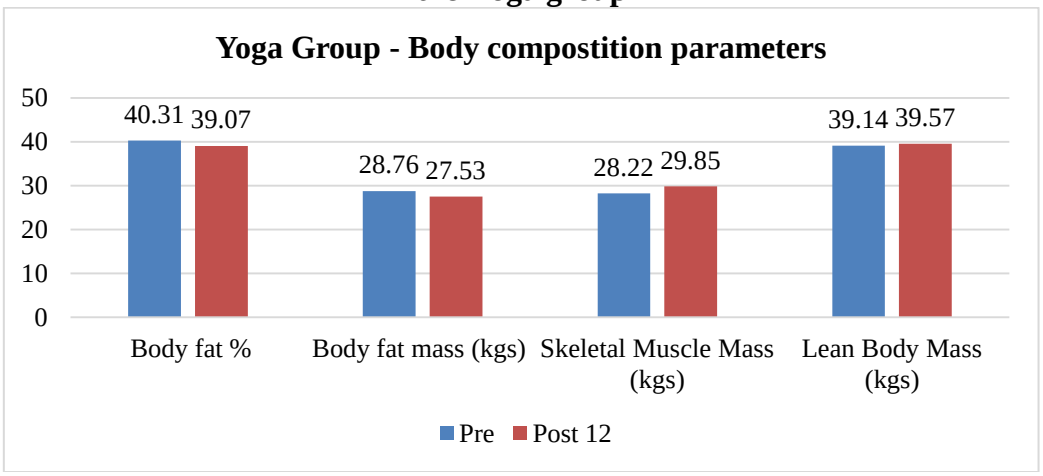
Graph 4a: Comparisons of Obesity parameters across timelines for the Yoga group



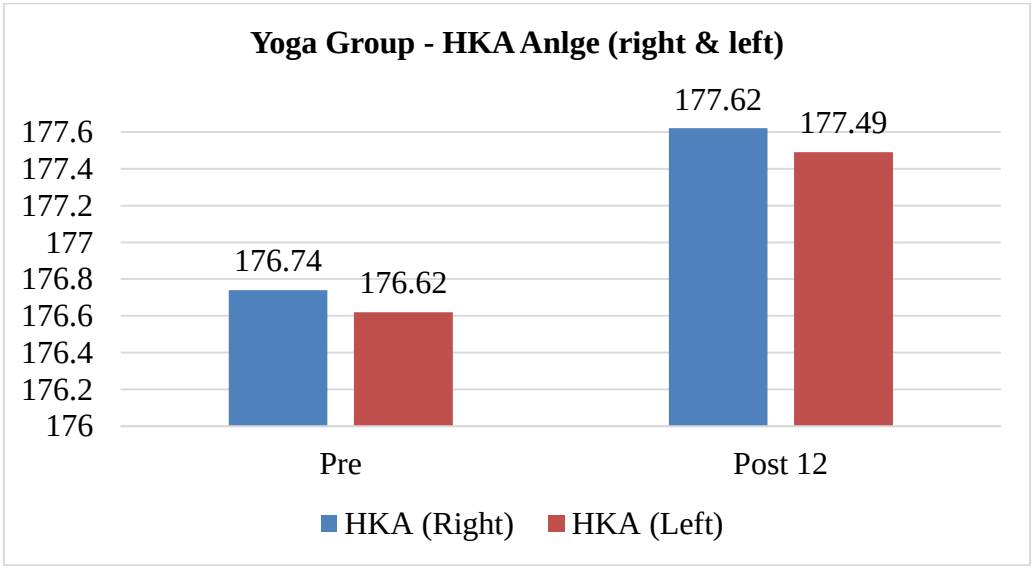
Graph 4b: Comparisons of Sarcopenia and Dynapenia parameters across timelines for the Yoga group



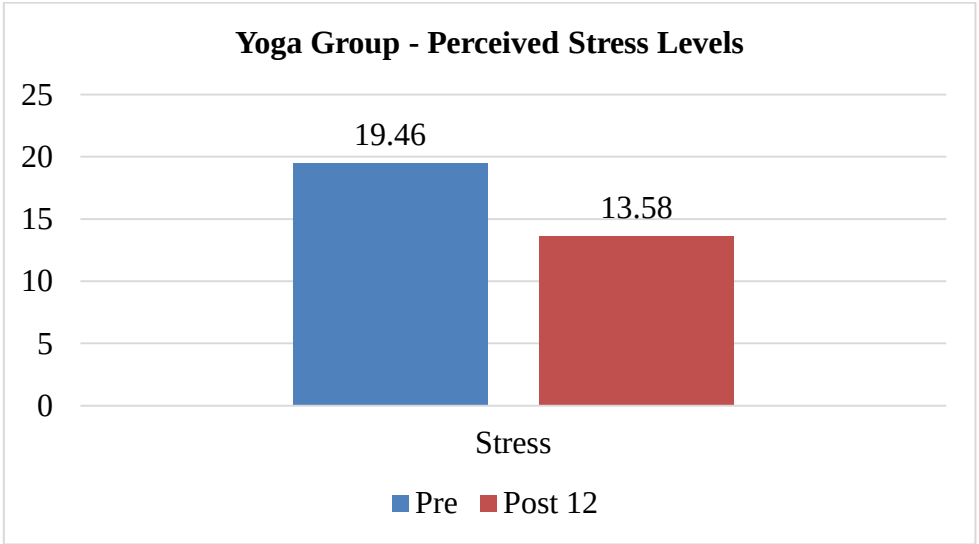
Graph 4c: Comparisons of Body Composition parameters across timelines for the Yoga group



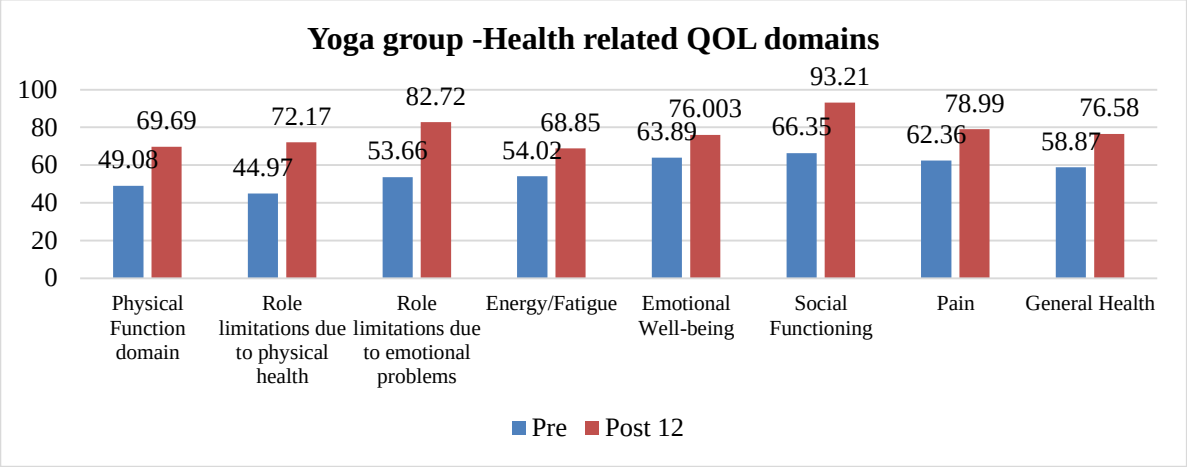
Graph 4d: Comparisons of HKA Angle across timelines for the Yoga group



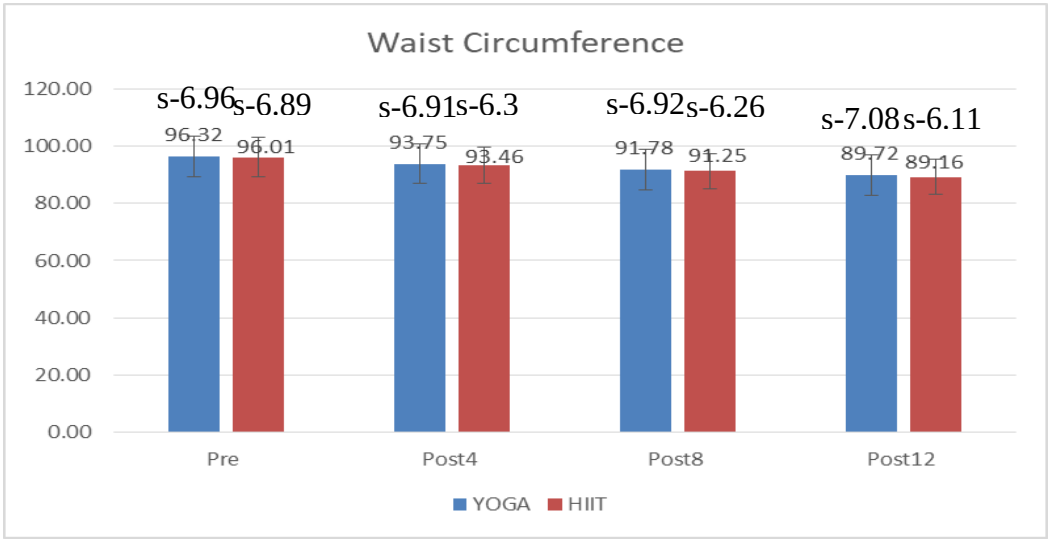
Graph 4e: Comparisons of Perceived Stress Levels across timelines for the Yoga group



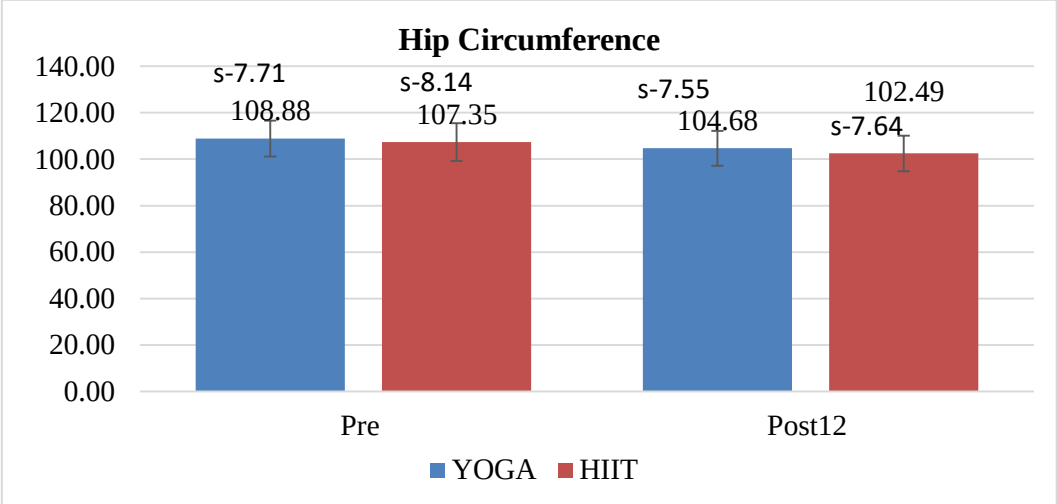
Graph 4f: Comparisons of Health-Related QoL domains by Short-form 36 across timelines for the Yoga group



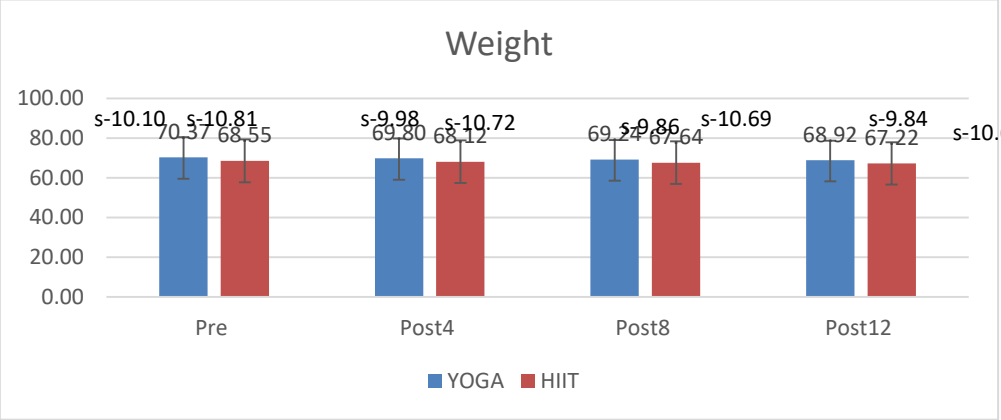
Graph 5a: Comparison of WC at 4 timelines between the two study groups



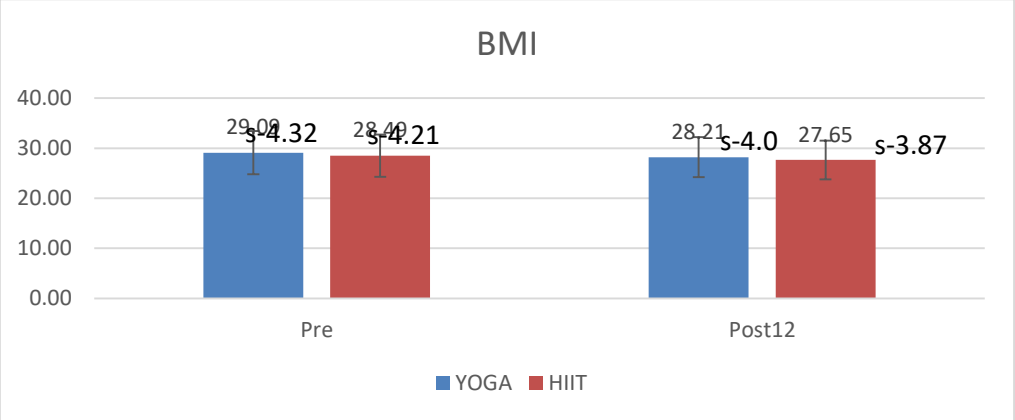
Graph 5b: Comparison of Hip Circumference across timelines between the two study groups



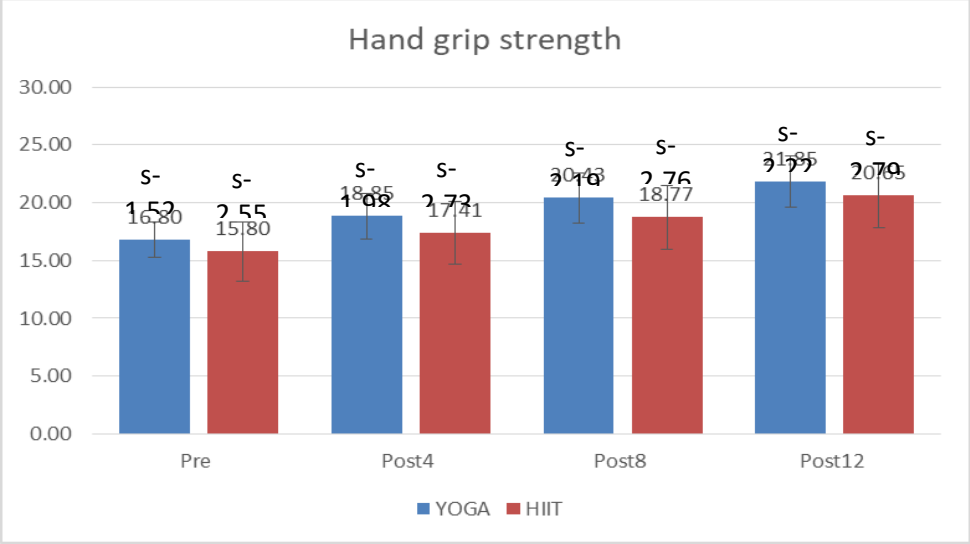
Graph 5c: Comparison of Body weight at 4 timelines between the two study groups



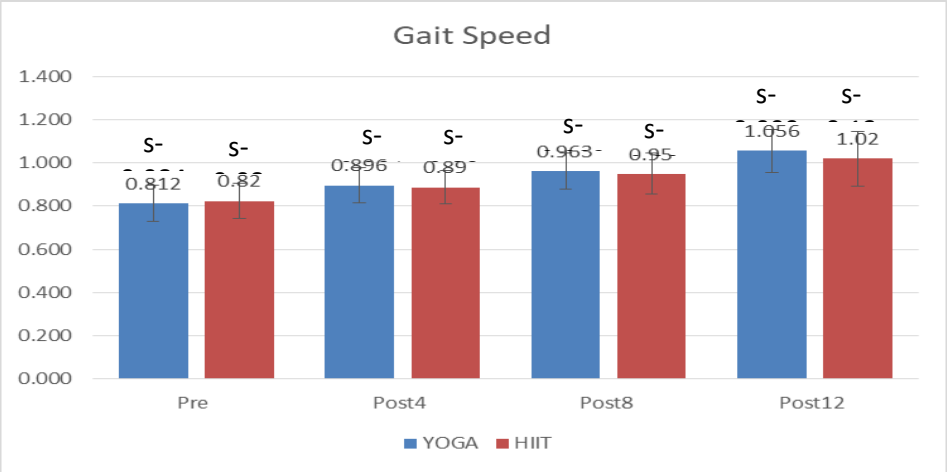
Graph 5d: Comparison of BMI across timelines between the two study groups



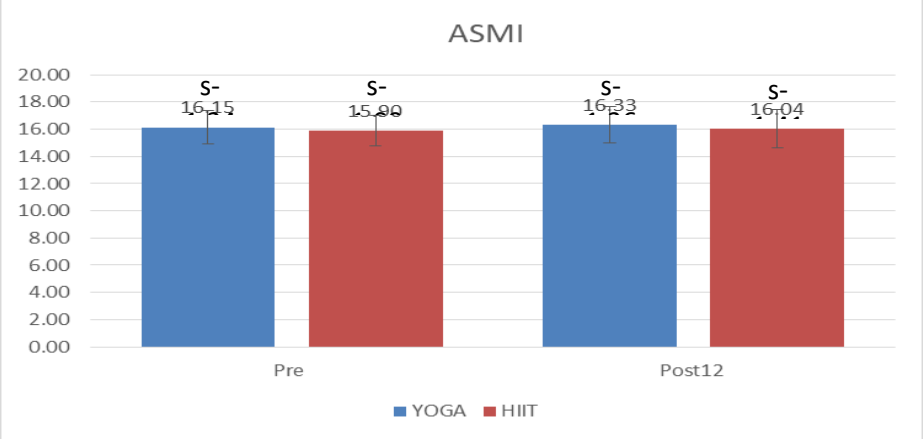
Graph 6a: Comparison of HGS at 4 timelines between the two study groups



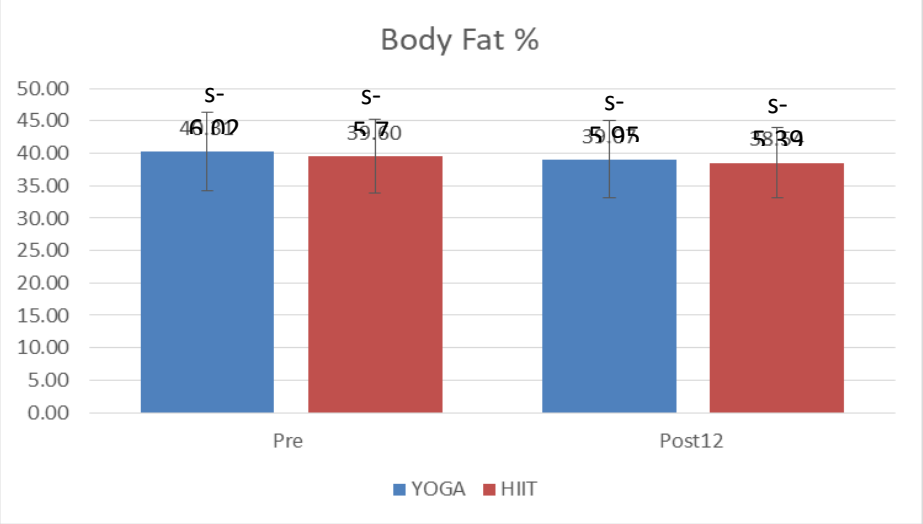
Graph 6b: Comparison of Gait Speed at 4 timelines between the two study groups



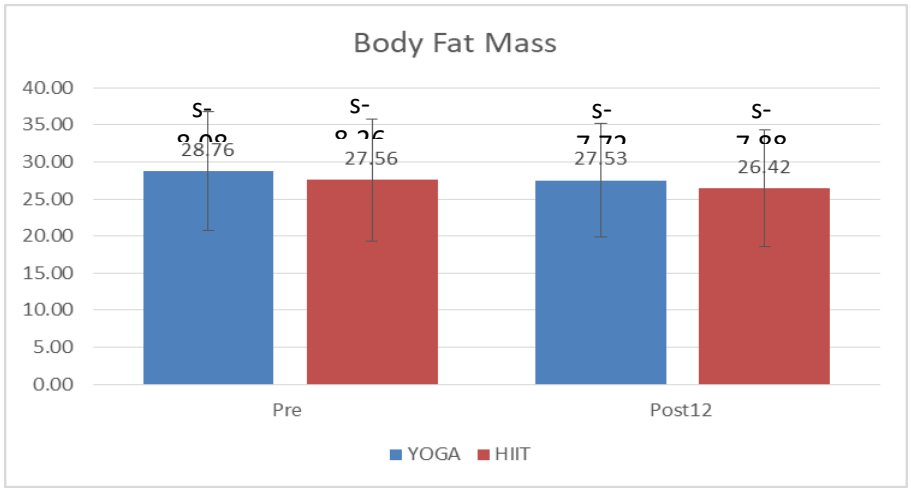
Graph 6c: Comparison of Appendicular Skeletal Muscle Index at pre and post-intervention between the two study groups



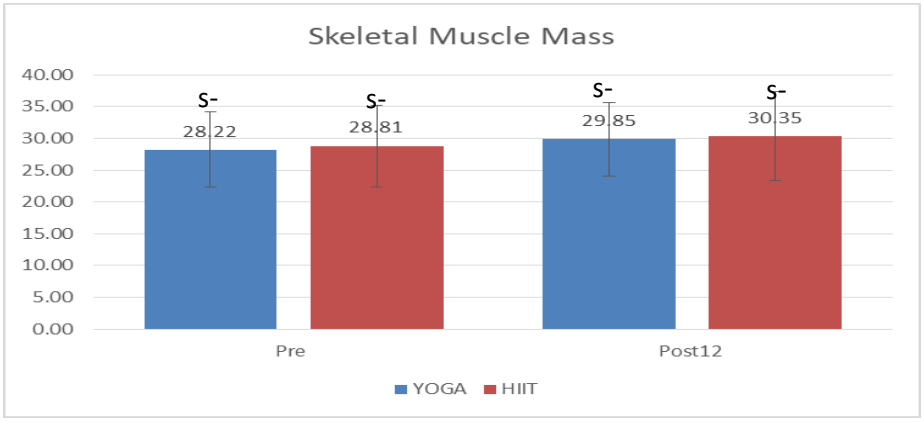
Graph 7a: Comparison of Body Fat % at pre and post-intervention between the two study groups



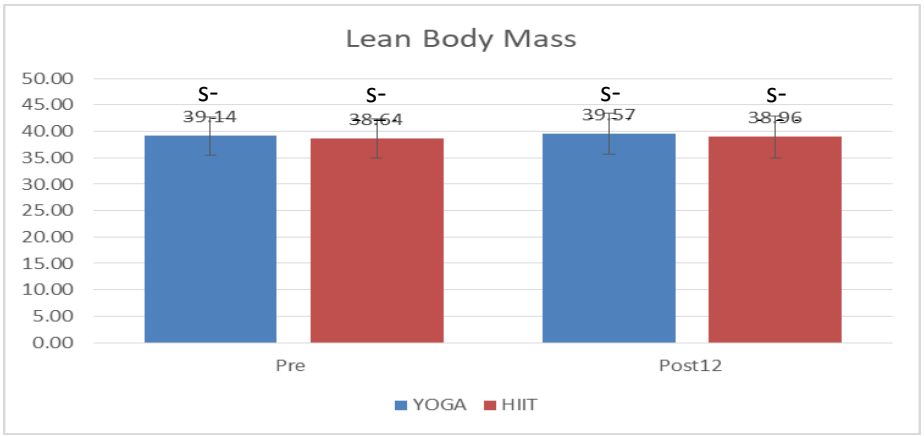
Graph 7b: Comparison of Body Fat Mass at pre and post-intervention between the two study groups



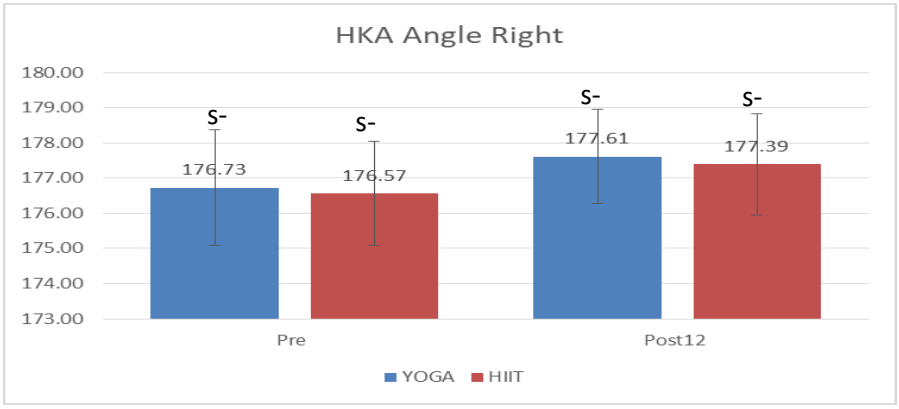
Graph 7c: Comparison of Skeletal Muscle Mass at pre and post-intervention between the two study groups



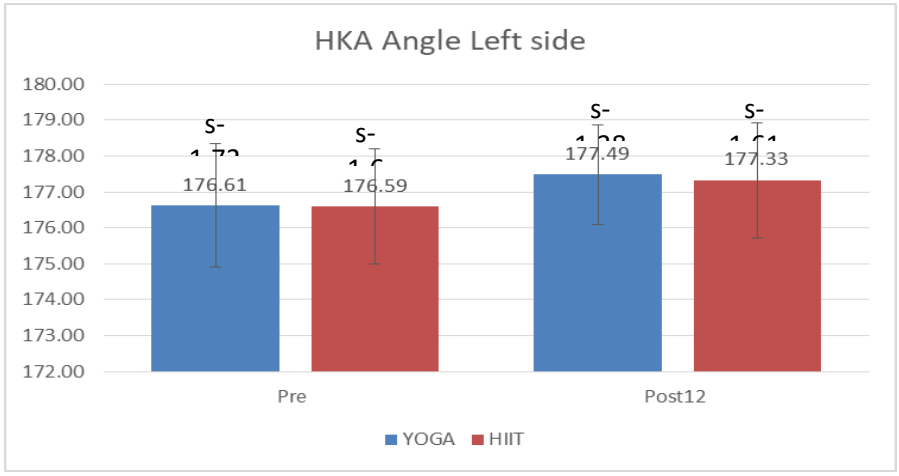
Graph 7d: Comparison of Lean Body Mass at pre and post-intervention between the two study groups



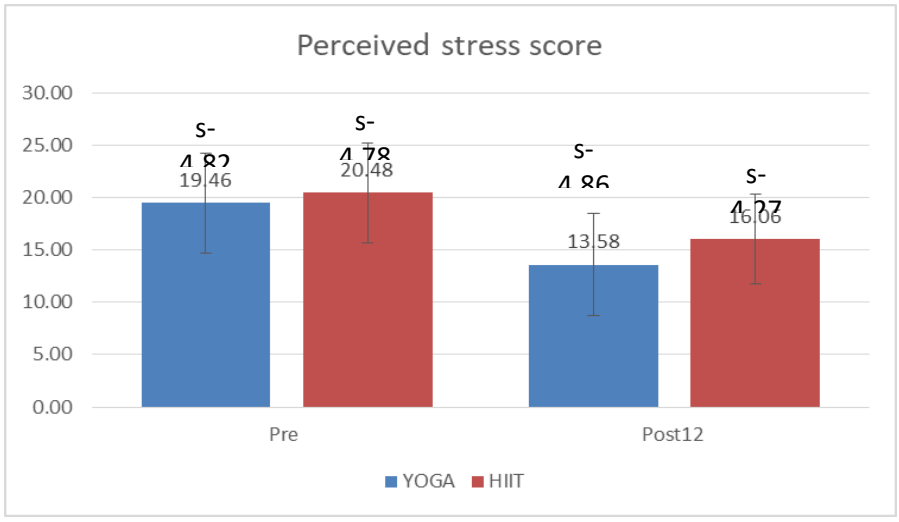
Graph 8a: Comparison of Hip-Knee- Ankle Angle (Right Side)at pre and post-intervention between the two study groups



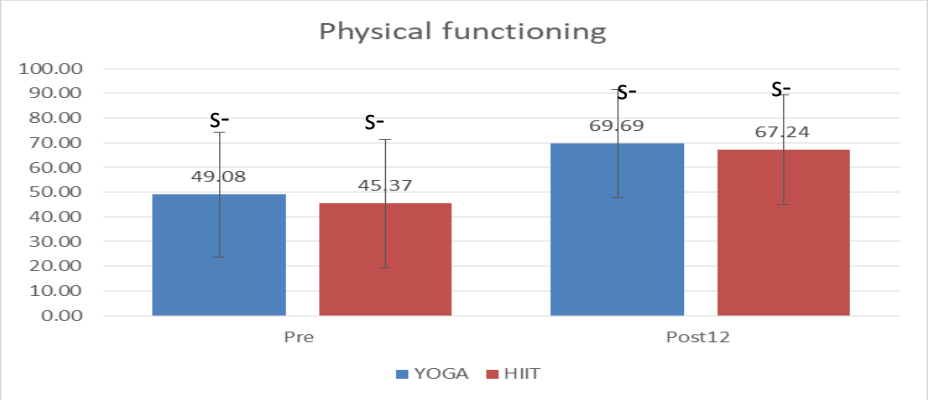
Graph 8b: Comparison of Hip-Knee- Ankle Angle (Left Side)at pre and post-intervention between the two study groups



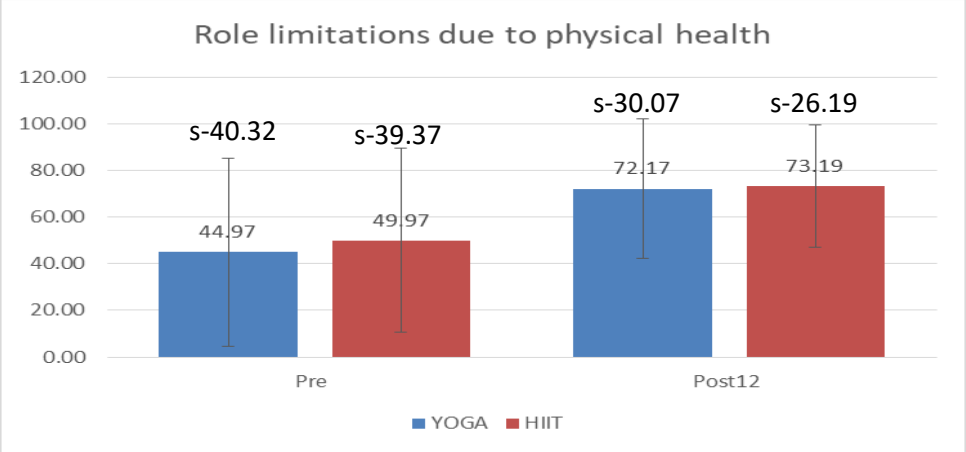
Graph 9: Comparison of PSS at pre and post-intervention between the two study groups



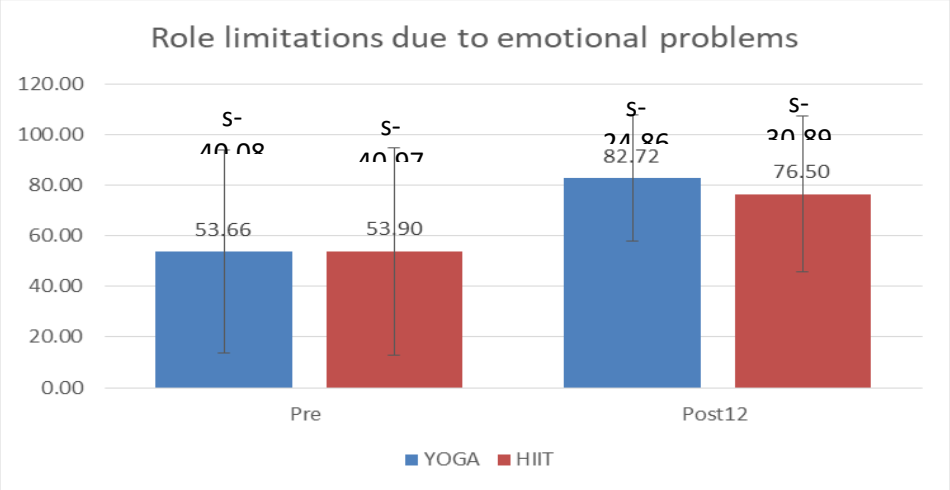
Graph 10a: Comparison of Physical Functioning domain of Short Form -36 at pre and post-intervention between the two study groups



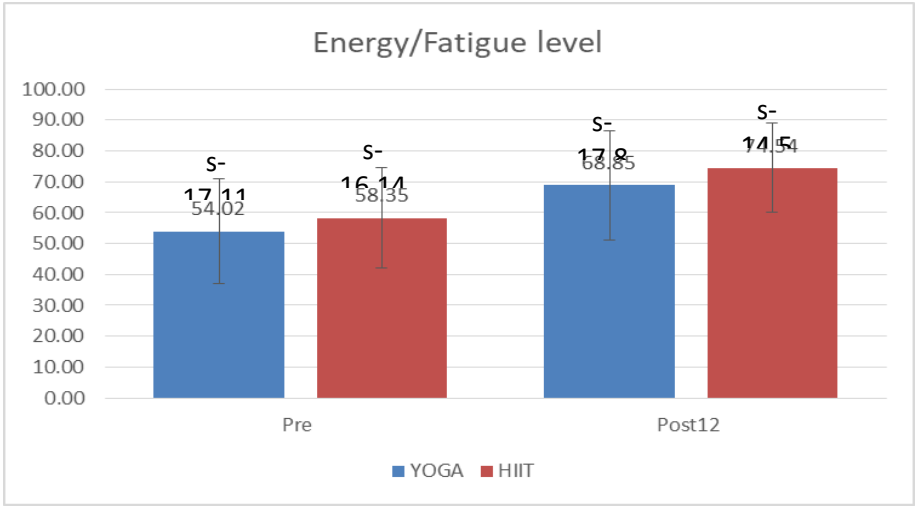
Graph 10b: Comparison of Role Limitations due to Physical Health domain of Short Form -36 at pre and post-intervention between the two study groups



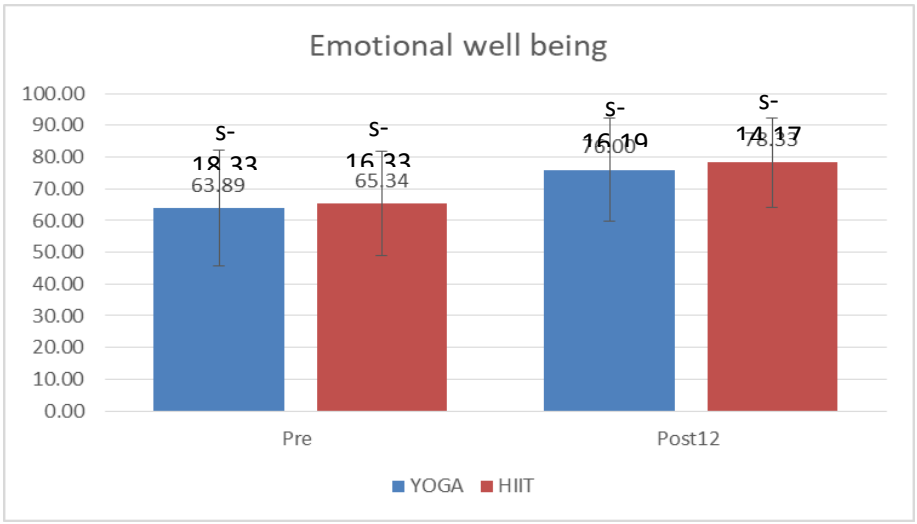
Graph 10c: Comparison of Role Limitations due to Emotional Problems domain of Short Form -36 at pre and post-intervention between the two study groups



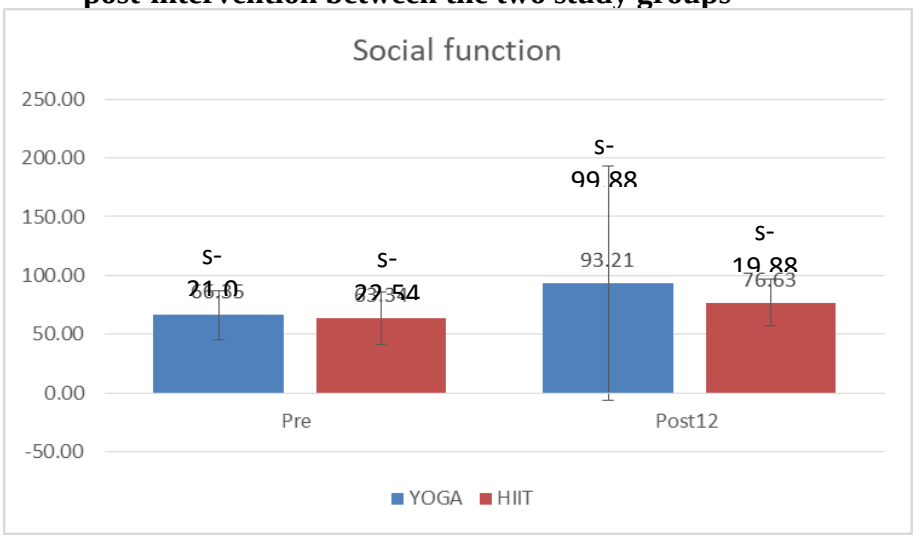
Graph 10d: Comparison of Energy/Fatigue level domain of Short Form -36 at pre and post-intervention between the two study groups



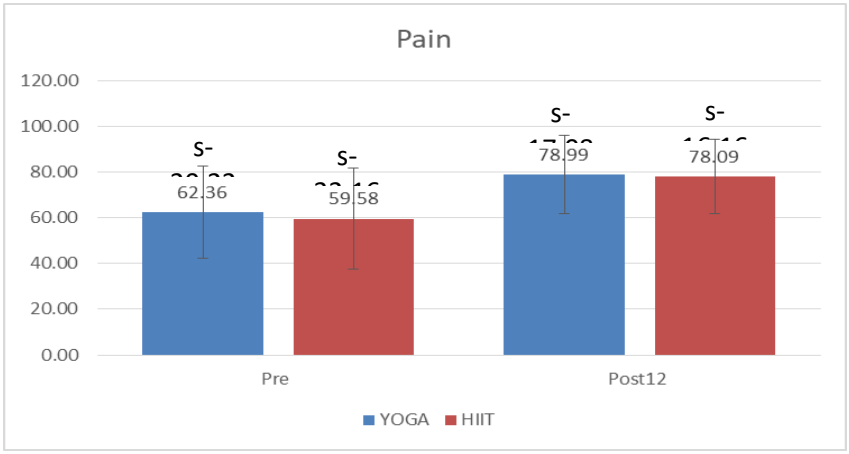
Graph 10e: Comparison of Emotional Well-being domain of Short Form -36 at pre and post-intervention between the two study groups



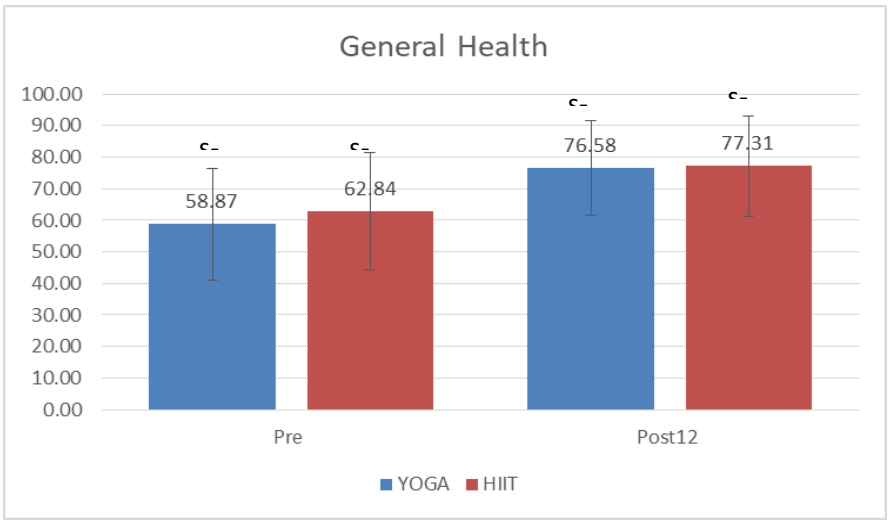
Graph 10f: Comparison of Social Function domain of Short Form -36 at pre and post-intervention between the two study groups



Graph 10g: Comparison of Pain domain of Short Form -36 at pre and post-intervention between the two study groups

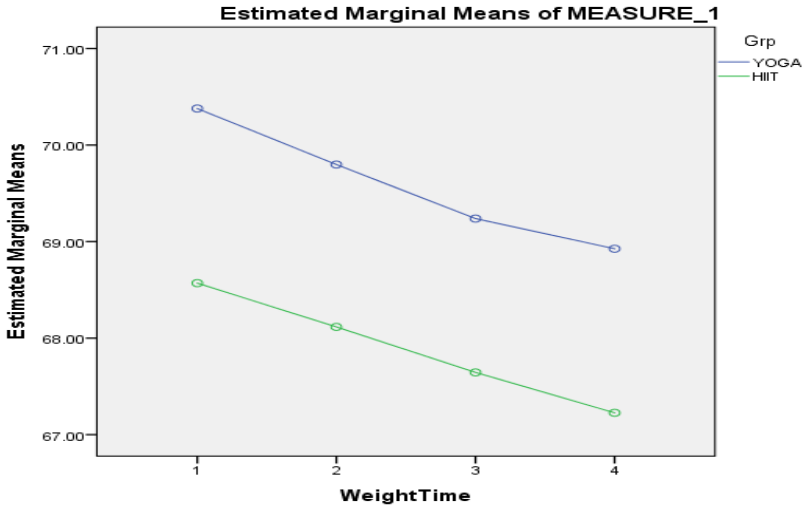


Graph 10h: Comparison of General health domain of Short Form -36 at pre and post-intervention between the two study groups

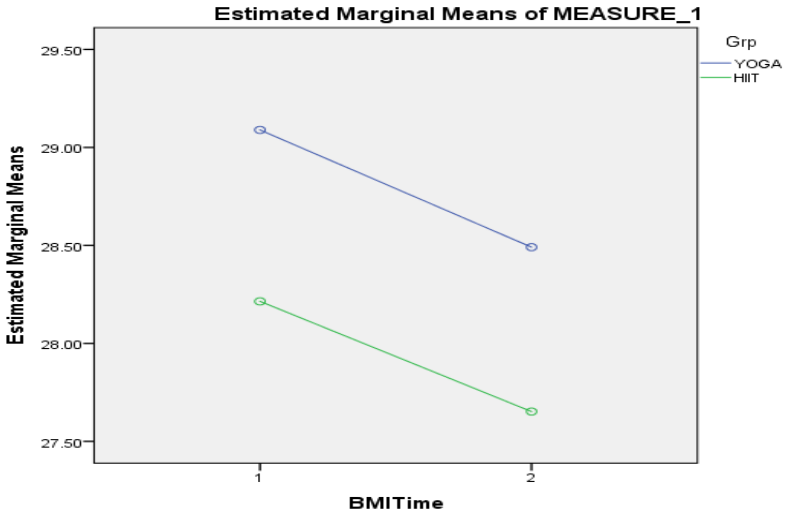


Graph 11: Graphical representation of Two-way mixed model or Repeated measures ANOVA analysis for obesity parameters

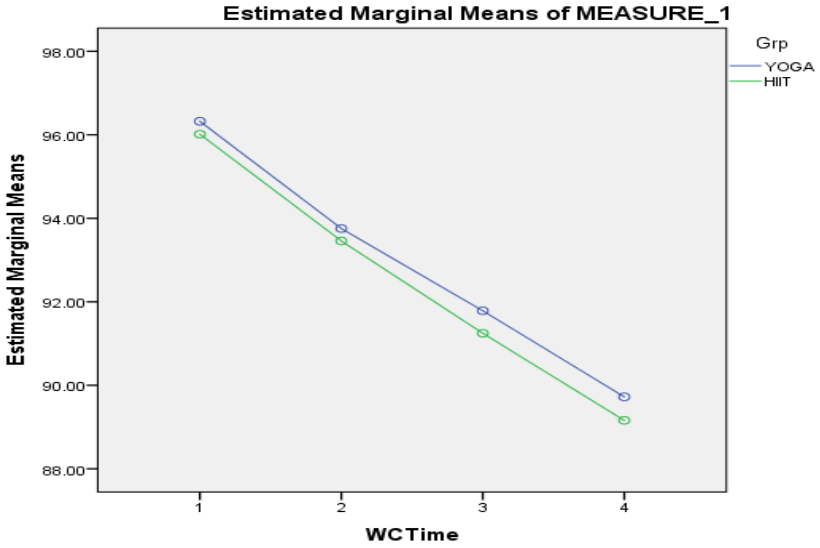
Graph 11a: Group versus time interaction for body weight parameter



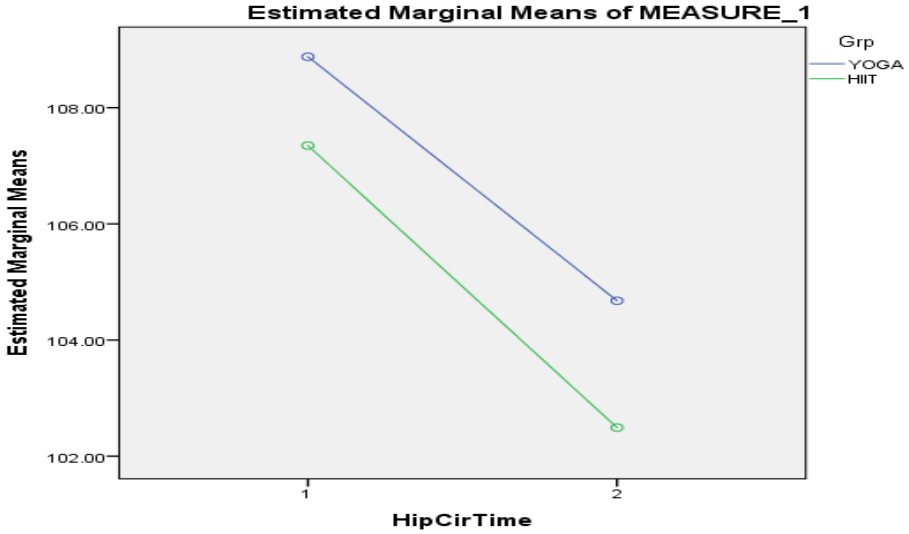
Graph 11b: Group versus time interaction for BMI parameter



Graph 11c: Group versus time interaction for WC parameter

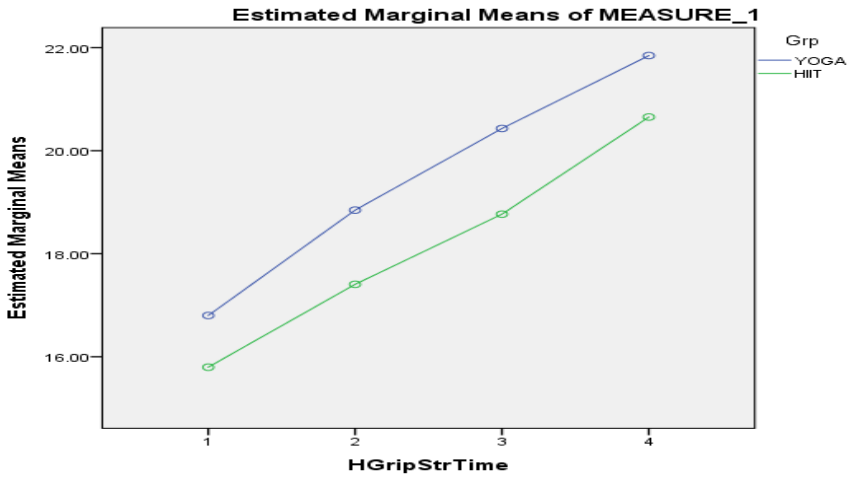


Graph 11d: Group versus time interaction for Hip Circumference parameter

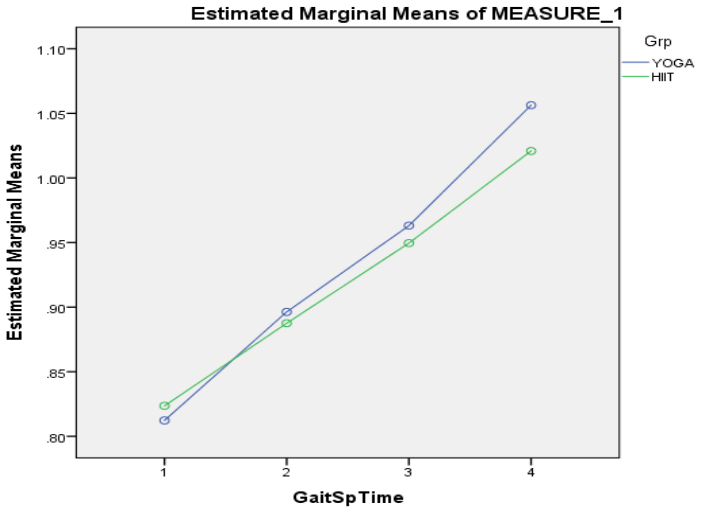


Graph 12: Graphical representation of Two-way mixed model or Repeated measures ANOVA analysis for sarcopenia and dynapenia parameters

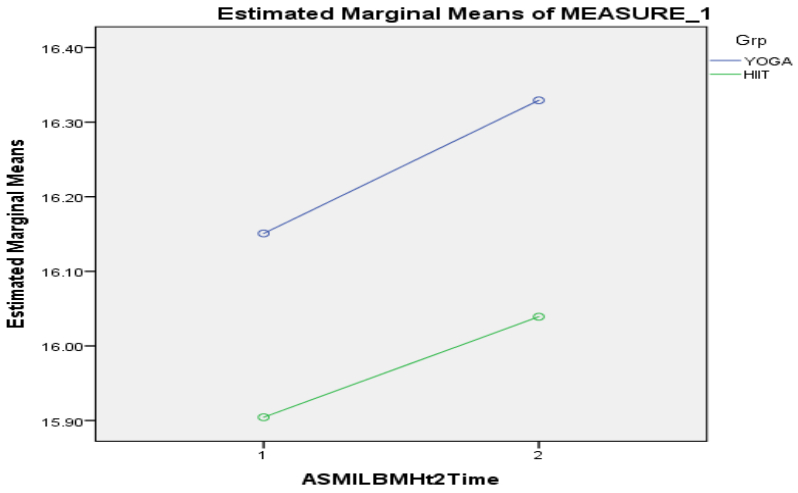
Graph 12a: Group versus time interaction for HGS parameter



Graph 12b: Group versus time interaction for Gait Speed parameter

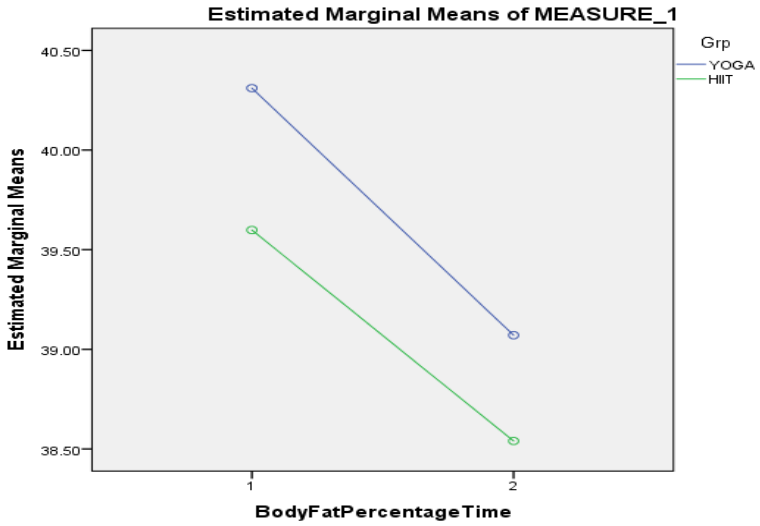


Graph 12c: Group versus time interaction for Appendicular Skeletal Mass Index parameter

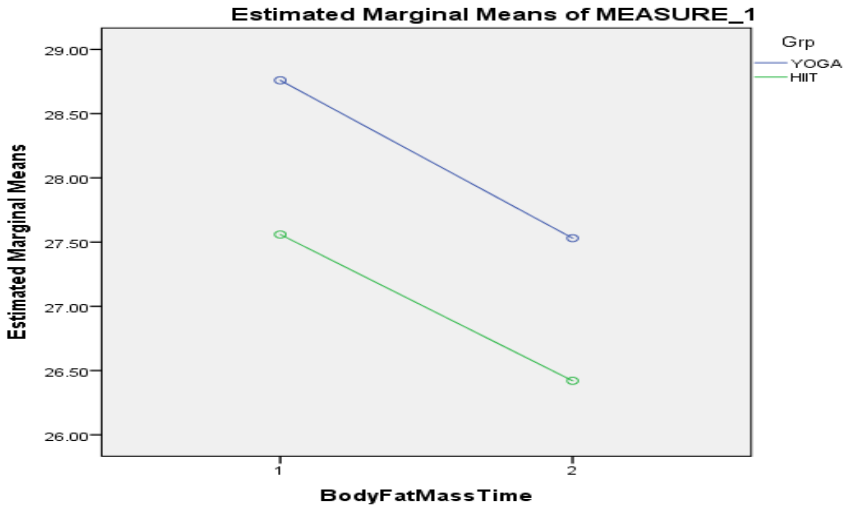


Graph 13: Graphical representation of Two-way mixed model or Repeated measures ANOVA analysis for body composition parameters

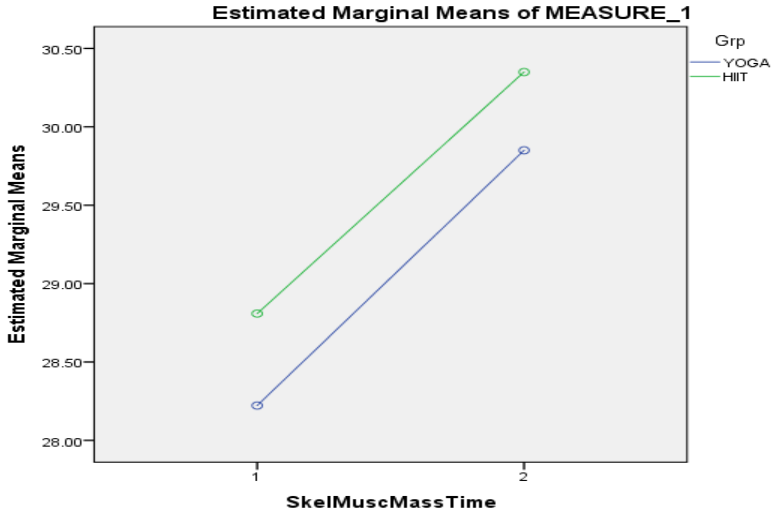
Graph 13a: Group versus time interaction for Body fat % parameter



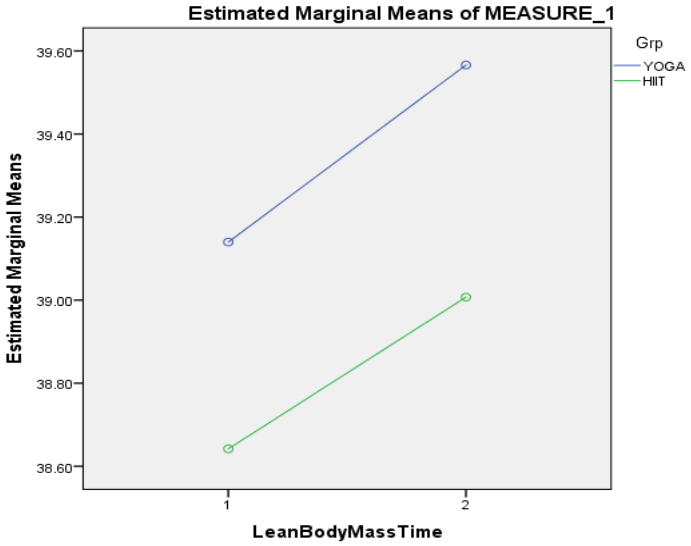
Graph 13b: Group versus time interaction for Body fat mass parameter



Graph 13c: Group versus time interaction for Skeletal Muscle Mass parameter

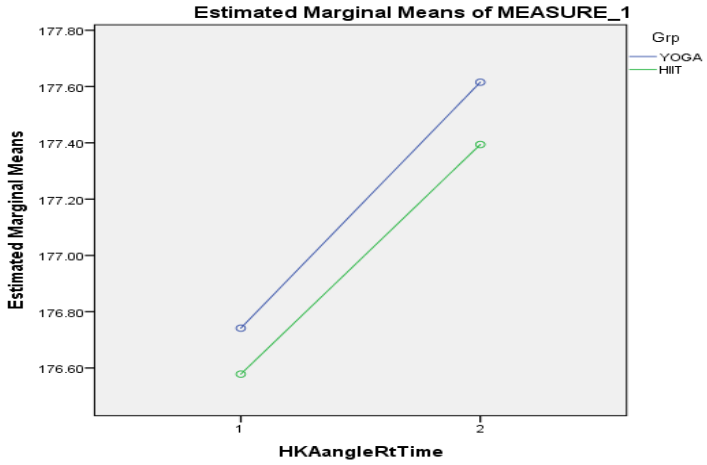


Graph 13d: Group versus time interaction for Lean Body Mass parameter

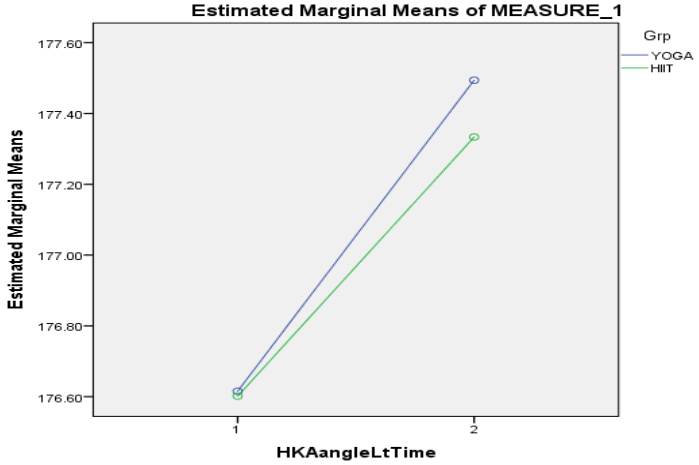


Graph 14: Graphical representation of Repeated measures ANOVA analysis for Group versus time interaction for Hip- Knee- Ankle Angle parameter

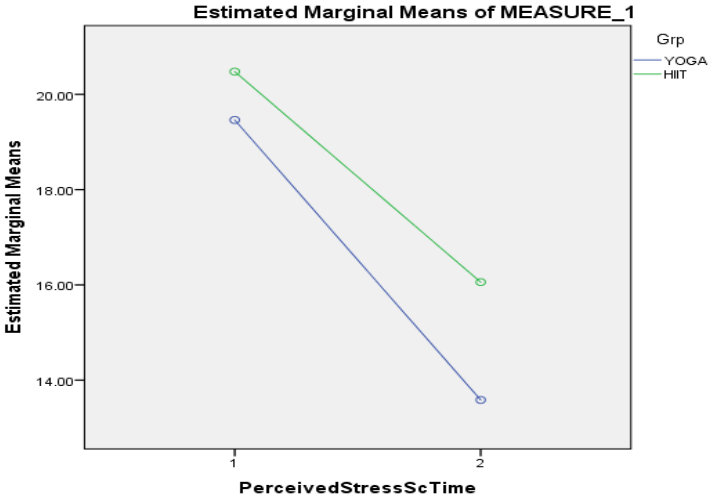
Graph 14a: Group versus time interaction for Hip- Knee- Ankle Angle parameter on Right side



Graph 14b: Group versus time interaction for Hip-knee- Ankle Angle parameter on Right side

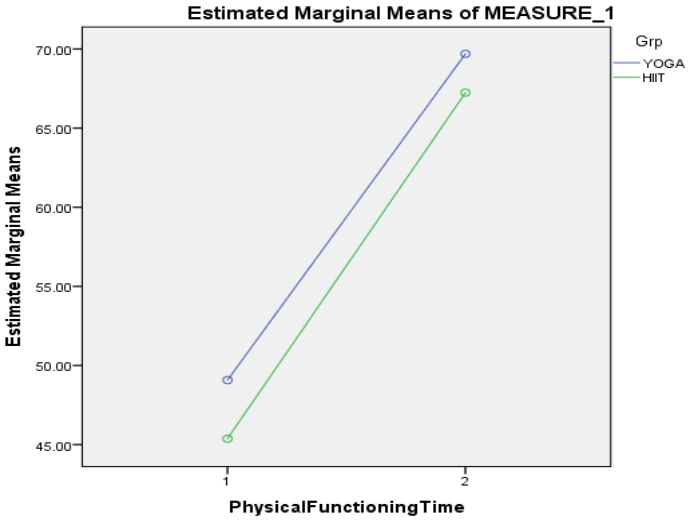


Graph 15: Graphical representation of Repeated measures ANOVA analysis for Group versus time interaction for perceived stress levels parameter

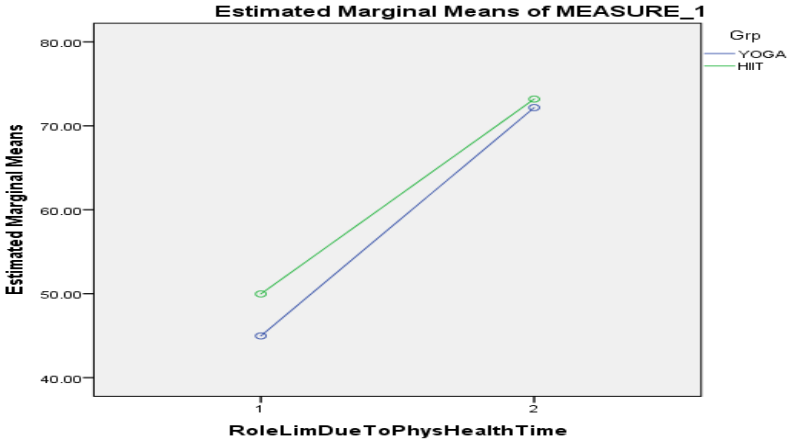


Graph 16: Graphical representation of Repeated measures ANOVA analysis for Group versus time interaction for Health-related QoL domains by SF-36

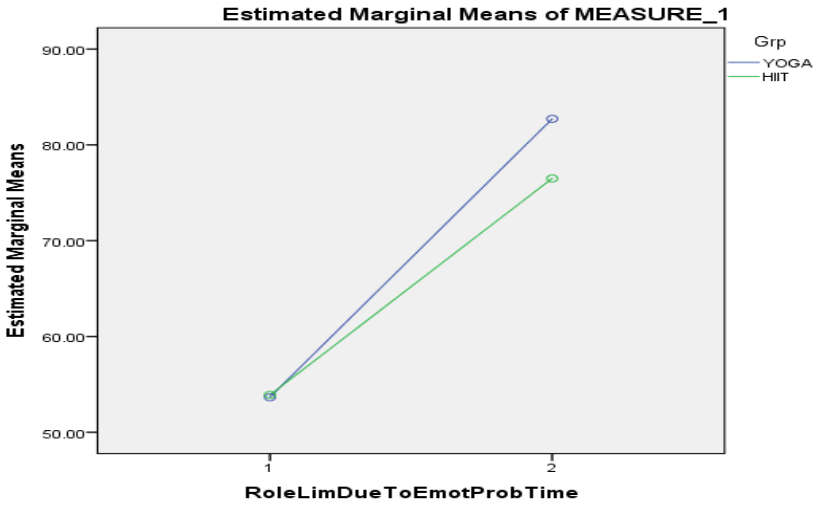
Graph 16a: Group versus time interaction for physical functioning domain of SF-36



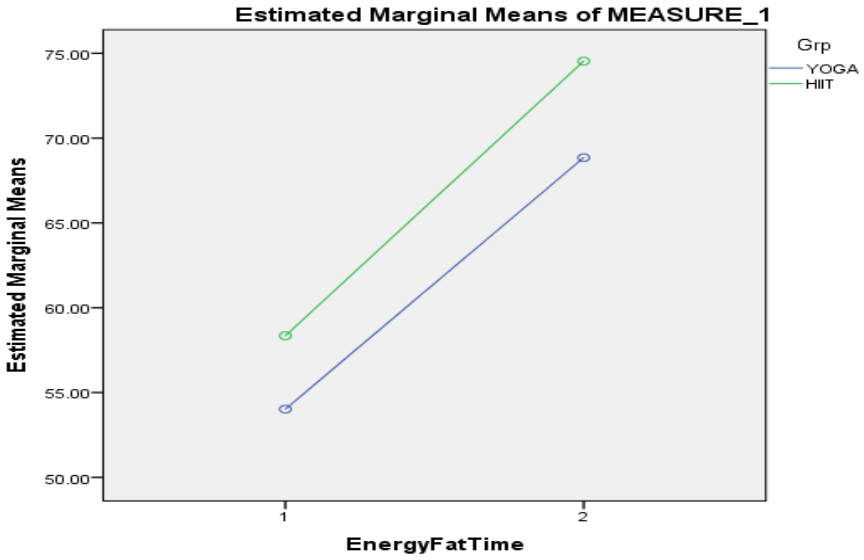
Graph 16b: Group versus time interaction for Role limitation due to physical health domain of SF-36



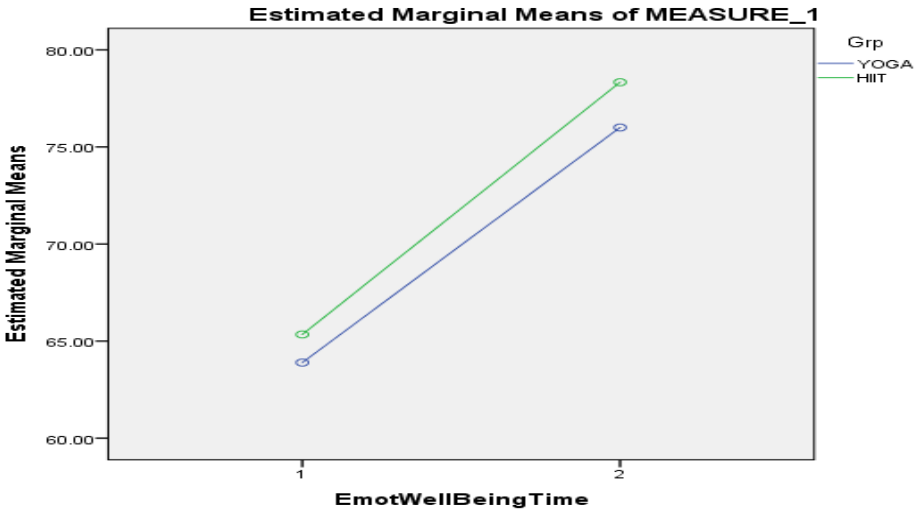
Graph 16c: Group versus time interaction for Role limitation due to emotional problem domain of SF-36



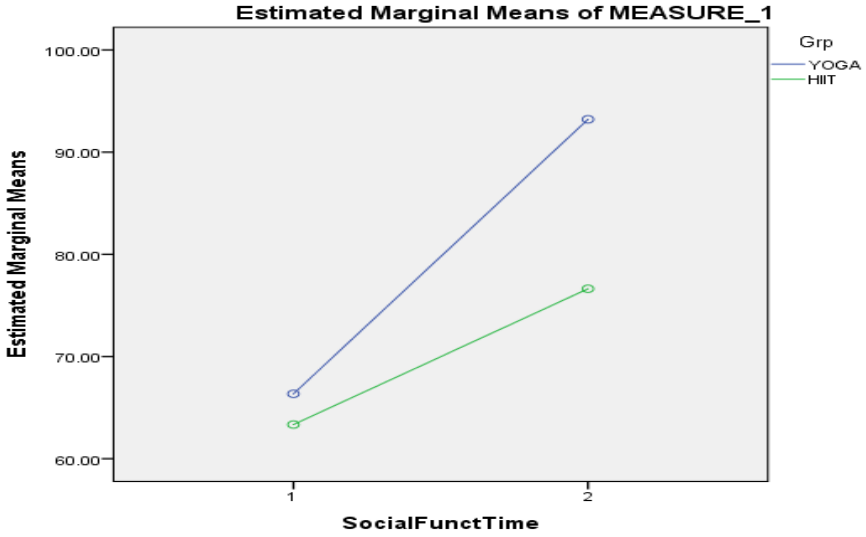
Graph 16d: Group versus time interaction for energy or fatigue domain of SF-36



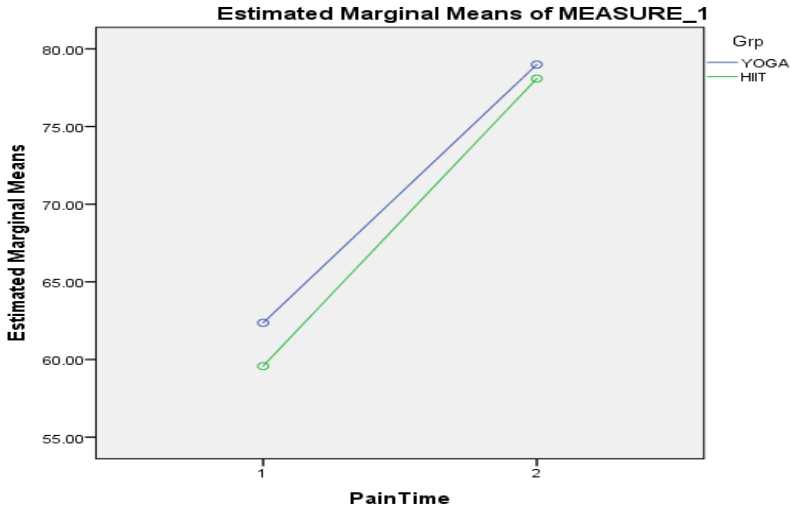
Graph 16e: Group versus time interaction for emotional well-being domain of SF-36



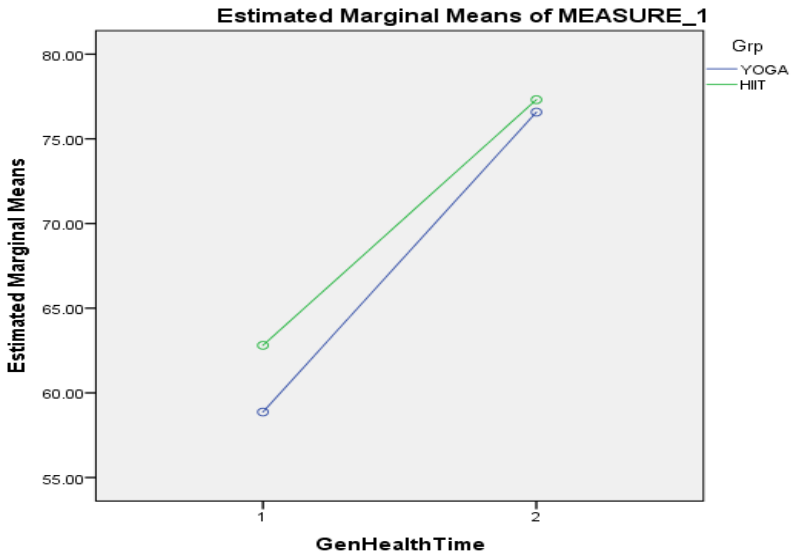
Graph 16f: Group versus time interaction for social functioning domain of SF-36



Graph 16g: Group versus time interaction for Pain domain of SF-36



Graph 16h: Group versus time interaction for general health domain of SF-36



ANNEXURE IX- PRESENTATIONS AND PUBLICATIONS

PHYSIO CONCLAVE
PGI - CHANDIGARH

CERTIFICATE OF SCIENTIFIC PAPER PRESENTATION

THIS CERTIFICATE IS PRESENTED TO

DR. PEEYOOSHA GURUDUT

FOR PRESENTING THE SCIENTIFIC PAPER TITLED *"A CITY-BASED DEMOGRAPHIC RESEARCH ON COMMUNITY DWELLING RESIDENTS OF BELAGAVI, INDIA ABOUT DYNAPENIA, FRAILTY, AND SARCOPENIA"*

IN TWO DAYS NATIONAL LEVEL CONFERENCE "PHYSIO CONCLAVE PGI- CHANDIGARH" HELD ON 1ST & 2ND APRIL 2023,

ORGANIZESD JOINTLY BY PGIMER PHYSIOTHERAPISTS ASSOCIATION & MAHARISHI MARKANDESHWAR (DEEMED TO BE UNIVERSITY), MULLANA, AMBALA.

Dr. Pradip Sarkar
PERESIDENT PPA

Dr. Ajit Kumar
GENERAL SECRETARY PPA

Dr. Upendra Goswamil
CHAIRPERSON PPA



SHRI B. M. KANKANAWADI AYURVED MAHAVIDYALAYA
POST GRADUATE STUDIES, RESEARCH CENTRE & AYURVEDA HOSPITAL
SHAHAPUR, BELAGAVI - 590003, KARNATAKA, INDIA.
www.kleayurworld.edu.in | 0831-2486286 | E-mail: swasthayu2k22@gmail.com
INDIA'S 1ST AYUSH INSTITUTION WITH NAAC & NABH ACCREDITATION
A constituent unit of
KLE Academy of Higher Education and Research
Deemed-to-be University
[Re-Accredited 'A+' Grade by NAAC (3rd Cycle) & Placed in Category 'A' by MHRD GoI]
Swasthāyu 2K22
TOWARDS HEALTHY LIVING
Certificate
INTERNATIONAL CONFERENCE ON SWASTHAVRITTA & YOGA
17th - 19th November 2022
Organised by :
Department of PG Studies in Swasthavritta & Yoga
This is to certify that Dr. / ~~Mr./~~ ~~Miss~~ PEEYOOSHA GURUDUT has participated as a **Paper Presenter / ~~Poster Presenter~~** at **Swasthāyu 2K22, International Conference on Swasthavritta & Yoga** organized by Shri B. M. Kankanawadi Ayurved Mahavidyalaya, Belagavi held from 17th - 19th November 2022.
Dr. Ashok Patil
Organizing Secretary
Dr. Sanjeev Tonni
Co-Organizing Secretary
Dr. Prashant Jadar
Co-Chairman
Dean/Vice-Principal
Dr. Suhas Kumar Shetty
Chairman
Principal /Medical Director

Original Article

A City-based Demographic Research on Community-dwelling Residents of Belagavi, India, about Dynapenia, Frailty, and Sarcopenia

Peeyoosha Gurudut, Sanjiv Kumar, Ashwin Patil[1], Sanjana Mhetri, Delia Misquita, Saiksha Mulgaonkar

KLE Institute of Physiotherapy, KLE Academy of Higher Education and Research, [1]Department of Radiology, J. N. Medical College, KLE Academy of Higher Education and Research, Belagavi, Karnataka, India

Abstract

Context: Age-related loss in skeletal muscle mass (sarcopenia), decreased muscle strength (dynapenia), and frailty can impede functional skills and cause mobility problems, leading to falls and fractures. There are scanty epidemiological data on the prevalence of these conditions in areas in the Indian subcontinental areas.

Aims: The aim of the study is to create epidemiological statistics on sarcopenia, dynapenia, and frailty in a cross section of community-dwelling individuals in Belagavi city.

Study Design and Settings: This is an epidemiological study on community-dwelling individuals from Belagavi city, India.

Subjects and Methods: Seven hundred and two residents over the age of 40 years were evaluated and diagnosed for sarcopenia as per the guidelines given by the Asian Working Group for sarcopenia which included gait speed, dominant hand grip strength (HGS), and appendicular skeletal mass index (ASMI). They were assessed for frailty with a Clinical Frailty Scale and dynapenia with HGS.

Statistical Analysis: The prevalence was calculated as the frequency and distribution.

Results: A total of 309 men and 393 women were enrolled in the study. The results depicted higher prevalence after the age of 70 years for sarcopenia (20.37%), dynapenia (23.65%), and frailty (5.98%) when compared to those of 40–50 years (11.82%, 14.81%, and 0.14%, respectively). Sarcopenia was equally prevalent among females (30.77%) and males (30.48%). Females (40.03%) had a higher prevalence of dynapenia than males (34.19%) and females (4.56%) were frailer than males (2.42%).

Conclusions: With advancing age, the prevalence of sarcopenia, dynapenia, and frailty increased. The changes become more prevalent after 70 years of age in both genders. Although sarcopenia was equally prevalent in both genders, dynapenia and frailty were more prevalent in women than men.

Keywords: Aging, Epidemiology, Frailty, India, Muscle strength, Sarcopenia

Address for correspondence: Dr. Peeyoosha Gurudut, Department of Orthopedic Physiotherapy, KLE Institute of Physiotherapy, KLE Academy of Higher Education and Research, Nehru Nagar, Belagavi - 590 010, Karnataka, India.
E-mail: peeyooshagurudut@klekipt.edu.in

Access this article online	
Quick Response Code:	Website: www.ijptr.org
	DOI: 10.4103/ijptr.ijptr_6_23

Received: 13-01-2022, **Revised:** 25-11-2022,
Accepted: 01-07-2023, **Web Published:** 11-08-2023

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Gurudut P, Kumar S, Patil A, Mhetri S, Misquita D, Mulgaonkar S. A city-based demographic research on community-dwelling residents of Belagavi, India, about dynapenia, frailty, and sarcopenia. Indian J Phys Ther Res 2023;5:51-9.

INTRODUCTION

Aging is defined as the progressive deterioration of the physiological functions required for survival over time.[1] Sarcopenia, a term coined by Rosemburg in 1989, was defined as an "age-related reduction in muscle mass with little or no dependence on muscle strength and function nor frailty."[2] Sarcopenia and dynapenia mostly influence the elderly, inactive people, and along with those with associated comorbidities.[3] Sarcopenia has been seen as an inevitable part of aging with severity depending on certain risk factors. Dynapenia, a little less known condition than sarcopenia, is defined as loss of muscle strength as assessed by handgrip strength <30 kg (men) and <20 kg (women) caused by neither neurological nor muscular diseases and not always accompanied by decreased muscle mass.[4] Frailty is theoretically defined as a "clinically recognizable state of increased vulnerability caused by age-related decline in reserve and function across multiple physiological systems, compromising the ability to cope with everyday stressors."[5] Although sarcopenia, dynapenia, and frailty by definition differ, the diagnostic criteria for sarcopenia also include the assessment of dynapenia and frailty factors.[6] Hence, all three conditions are associated and correlated with each other and most commonly co-occur with advanced aging.

A consensus was reached by the International Working Group on Sarcopenia in 2009 that sarcopenia is an "age-associated decrease of skeletal muscle mass and function." An updated version of diagnostic criteria was given by the European Working Group on Sarcopenia in Older People (EWGSOP2), which now includes assessment in addition to the cutoff values for appendicular lean mass or appendicular skeletal mass index (ASMI), muscle strength measured by hand grip strength (HGS), and physical performance measured by gait speed assessment.[6]

Since the anthropometric and physical measurements differ between European and Asian people, the Asian Working Group for Sarcopenia (AWGS) proposed a consensus regarding diagnostic cutoff and protocol based on South-east Asian data. Thus, it can be observed that although the criteria for the diagnosis were the same, the cutoff values were different for Asian people. They suggested considering these cutoffs rather than the values of EWGS to diagnose people with sarcopenia in Asian geographical regions.[7]

A meta-analysis of the prevalence studies on sarcopenia suggested that a larger section of elderly people, including apparently healthy individuals, has sarcopenia. Hence, the early diagnosis was stressed to prevent associated adverse morbidities and mortalities.[8] To better understand the trends for estimating parameters and diagnosing the conditions globally for different regions of the world, a larger database on the prevalence is necessitated. At present, a fair number of the prevalence studies on sarcopenia and frailty exists in the Western[6] and Southeast Asian[9] populations. However, in the scenario of the Indian Union, very meager data exist with prevalence studies conducted in the cities of Chandigarh,[10] Dakshin Kannada,[11] and Thanjavur.[12] Further, vast cultural and demographic differences exist within the Indian union which may have an influence on the characteristics of aging that demands more studies to be published on the population of various Indian states.

Hence, the present study was conducted with the aim to create the epidemiological data on sarcopenia, dynapenia, and frailty in a cross-section of community-dwelling individuals in Belagavi, a South Indian-based urban city.

SUBJECTS AND METHODS

Study design and setting

The current cross-sectional epidemiological investigation used community settings for data collection. The participants were enrolled by conducting two screening camps in the north and south sectors of Belagavi city in addition to collecting the data from the three old-age homes in the city. Consent to collect the data from inmates of old-age homes was procured from the individuals as well as the manager/caretaker. Publicity about the camp was ensured through newspaper advertisements. Written consent was also obtained from all the participants of the study in their vernacular language before taking the data. The individuals who attended the camp were included if they were above 40 years of age with or without comorbidities, residing in Belagavi city, Karnataka, India, and who could comprehend commands. Individuals were excluded if they had any of the following criteria: upper limb or hand problems which may affect their dominant hand grip; clinically known/diagnosed cases of cervical problems with radiculopathies/myelopathies; history of orthopedic or cardiopulmonary surgeries in the past 6 months; any neurological conditions such as stroke, Parkinson's, ataxia; any lower-limb musculoskeletal condition or any form of physical disabilities due to which their walking is affected; one who is dependent on walking aids for locomotion; who are severely frail/bedridden/terminally ill; and contraindications to

bioimpedance analyzer (hearing aids, pacemakers; and any metal implants that cause interference).

Ethical approval

Ethical approval was obtained from the Institutional Ethical Committee before the commencement of the study (Reference No: KLE/REC/21-22/692). The conduct of the study procedure complied with the guidelines and regulations of the Helsinki Declaration. The guidelines of the *Indian Council of Medical Research* were followed throughout the interview and all the safety precautions were taken in the light of current pandemic. In accordance with the study's inclusion and exclusion criteria, every individual was screened. Before the evaluation, all of the participants were given a written explanation of the study's purpose.

Data collection

Demographic characteristics such as age, gender, diet, occupation, marital educational status, hand dominance, comorbidities, physical activity, age of menopause (females), and physical exercise were noted.

Basic anthropometric measurements

This included measurement of height using a stadiometer, and waist and hip circumferences using a measuring tape both measured with the participant in a standing position barefoot. The formula waist circumference divided by hip circumference was used to determine the waist–hip ratio considering 0.95 in men and 0.80 in women as the upper limit for normative values.

Body composition (using a bio-impedance analyzer)

Actofit Body Analyzer-Pro Max (Actofit Wearables, China) is connected to mobile through bluetooth with a software application downloaded from the playstore (https://play.google.com/store/apps/details?id=com.actofitSmartScale&hl=en_IN&gl=US). The height and age (date of birth) were entered in the application. The contraindications for the use of these analyzers were confirmed by the participants such as hearing aid, pacemakers, any metal implants, history of kidney disorders, dialysis, and diarrhea that may cause fibrillations/interference with the readings, etc., Individuals were then made to stand erect on the machine to give an estimated body composition parameter. The machine then was analyzed various body composition parameters including skeletal/lean muscle mass, lean body mass of arms and legs, and body fat percentage to calculate the appendicular skeletal muscle index (ASMI). The report was generated by the software application in the pdf format and was stored in the assessor's mobile [Figure 1]. The appendicular skeletal muscle index (ASMI) was calculated using the following formula:[10]



Figure 1: Assessment of body composition using Actofit Body Fat Analyzer

$$\text{ASMI (kg/m}^2\text{)} = \frac{\text{lean body mass of arms + lean body mass of legs (kgs)}}{\text{height}^2\ (\text{m}^2)}$$

Physical performance (gait speed by 4-m walk test)

Physical performance was measured by the assessment of gait speed using a 4-m walk test calculated by time taken per unit time (meter/seconds). For this, a 4-m walking path was marked with no obstructions/obstacles using a carpenter measuring tape and two tapes to mark the start and end points. The participants were given instructions to walk at their normal/usual speed from the start point to the endpoint and the time taken to complete the 4-m course was timed with a stopwatch. The speed was calculated by 4 m divided by the time taken to walk (seconds). <0.8 m/s were considered as "slow performance." A 4-m walk test was marked using carpenter tape and two tapes to mark the start and the end. The participants were asked to walk at their normal speed and the time taken to complete the 4-m course was timed with a stopwatch and <0.8 m/s will be considered as a "slow performance"[10] [Figure 2].

Dynapenia/muscle strength (using hand dynamometer)

A Jamar Hand Dynamometer (reliability is $r = 0.98$ and validity [ICC (2, K) =0.99]) (Manufacturer: Sammons Preston Rolyan, UK. Model no. 0205010) was used to assess muscle strength. Participants were made to sit on a chair with an erect back (without an armrest) with feet well supported on the floor. For the measurement,



Figure 2: Assessment of gait speed across 4-m distance



Figure 3: Hand grip strength assessment

the participant was positioned with the dominant side shoulder adducted, elbow flexed at a right angle, forearm in neutral/mid-prone, and wrist in 25°–30° dorsiflexion/extension. The researcher demonstrated the working of the dynamometer before giving it to the participant. Dominant hand measurement was taken with the individual who was commanded to press the handle of the dynamometer as hard as possible. The better of the two readings was considered for analysis. A 1-min break was given before taking the next reading to rule out fatigue [Figure 3].

Frailty (by Clinical Frailty Scale)

Frailty assessment was done using the Clinical Frailty Scale (reliability ICC score of about 0.800) by asking the participant questions on their medical conditions, activity limitation, comorbidities, and balance issues as noted on observation. This is a nine-grade scale created by the Canadian Study of Health and Aging, which states the level of the frailty of an elderly individual. Frailty provides information on the risk of falls in such individuals since the greater the frailty, the greater the risk of falls. It provides an outline to assess frailty and fitness on categories that can be observed without any training. Grade 1–3 describes a person as being very fit to manage well, 4 describes as vulnerable while Grades 5–8 describe the severity of frailty from mild to very severe while Grade 9 indicates terminally ill.[13] This included grading by the assessor by observing the individual and asking questions pertaining to their levels of functions or activities of daily living and matching the descriptor of each grade.

Diagnosing sarcopenia

Sarcopenia was determined by the cutoffs given by AWGS criteria as follows: low ASMI either by DEXA or BIA; diminished muscle mass along with reduced muscle strength (males <28 kg, females <18 kg) or physical performance by 6 m or 4-m walk test with <1.0 m/s or <0.8 m/s, respectively.[7]

Statistical analysis

To analyze the outcomes of the study, statistical analysis was carried out using (Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp). The participants' baseline characteristics and demographic variables were presented as the number of respondents and percentage. The prevalence of sarcopenia, dynapenia, and frailty among participants was determined using various statistical techniques, including mean, standard deviation, and test of significance to compare between genders and age categories. A $P \leq 0.05$ was considered as statistically significant.

RESULTS

Basic demographic details

The study included 309 males and 393 females in total above the age of 40 years from the urban Belagavi region. Table 1 presents in detail the demographic profile and characteristics with its distribution among respondents.

Age-wise comparison of basic body anthropometric parameters showed the peak of waist circumference in their sixth decade of life which declines by the seventh decade ($P = 0.00$). The hip circumference, on the other hand, showed a peak in their fourth decade which gradually showed a decline with increasing age ($P = 0.01$). The waist–hip ratio showed an increasing trend up to the sixth decade after which it showed a slight decrease ($P = 0.00$). A similar trend was noted with the body mass index (BMI) which was higher in earlier age

class intervals, i.e., up to the sixth decade after which showed a significant decline ($P = 0.00$), [Table 2].

Gender-wise comparison of anthropometric characteristics resulted in waist circumference ($P = 0.00$) and waist-to-hip ratio ($P = 0.00$) being significantly higher in males than females. However, BMI and hip circumferences were not statistically significantly different between the genders [Table 3].

Sarcopenia

The age-wise occurrence of sarcopenia according to the cutoffs given by the Asian Working Group of Sarcopenia demonstrated a gradual increase in the number of individuals with sarcopenia from the fourth (11.82%) up to the seventh decade (20.37%) [Table 4]. The overall gender-wise prevalence of sarcopenia (irrespective of age) demonstrated an equal distribution between the genders of approximately 30% [Table 5]. Table 6 illustrates the prevalence of sarcopenia (as per AWGS cutoffs) across different age categories and genders. There is an equal prevalence of sarcopenia in both genders in the fourth, fifth, and sixth decades of life. At the age of 70 years and above, a significant difference between genders was noted with females at 9.12% and males at 11.25%.

Table 1: Demographic profile with its distribution among respondents

Variable (*n*=702)	Variable categories	Number of respondents (percentage of respondents-100%)
Age groups (years)	40–49	170 (34.00)
	50–59	178 (34.00)
	60–69	173 (20.20)
	70+	181 (11.80)
Gender	Male	309 (44.02)
	Female	393 (55.98)
Marital status	Married	631 (89.89)
	Single	16 (2.28)
	Widow/widower	55 (7.83)
Education	Illiterate/uneducated	152 (21.65)
	Primary/secondary	240 (34.19)
	Graduation	273 (38.89)
	Postgraduation	37 (5.27)
Diet	Vegetarian	314 (44.73)
	Mixed	388 (55.27)
Hand dominance	Left hand	6 (0.85)
	Right hand	696 (99.15)
Comorbidities	Present	206 (29.34)
	Absent	496 (70.66)
Physical exercise	No	367 (52.28)
	Yes	335 (47.72)
Physical activity	Intense	154 (21.94)
	Moderate	258 (36.75)
	Mild	195 (27.78)
	Sedentary	95 (13.53)
Menopause (*n*=393)	Attained (natural/surgical)	296 (75.32)
	Not attained	97 (24.68)
Menopausal age (years) (*n*=296)	40–49 (*n*=112)	34 (11.49)
	50–59 (*n*=102)	88 (29.73)
	60–69 (*n*=47)	85 (28.72)
	70+ (*n*=25)	89 (30.06)

Dynapenia

The analysis of the age-wise overall prevalence of dynapenia as assessed by the dominant HGS defined by the cutoffs of <28 kg for men and <18 kg was 72.21% out of 702 people. The prevalence increased with age from 14.81% in the fourth decade to 23.65% in the seventh decade and above. Two hundred and eighty-one (40.03%) females and 240 (34.19%) males were having dynapenia (irrespective of age) for women. The age and gender-wise prevalence of dynapenia depicts a consistent percentage (9%–11%) of females being affected with dynapenia across the age ranges. However, among males, the prevalence increased with increasing age [Tables 4-6].

Frailty

The severity of frailty as per the Clinical Frailty Scale showed that with increasing age, a greater number of respondents became frailer indicating an increased risk of falls. The overall gender-wise prevalence (irrespective of age) for frailty indicated that women (4.56%) have more frailty as compared to men (2.42%). Age-wise analysis of frailty prevalence showed a significant rise during the seventh decade and above of life with 5.98% while the prevalence in the remaining age groups ranged from 0.14% to 0.57%. The gender-wise comparison during different age categories showed equal frailty grades in the fourth to sixth decade. During the life of 70 years and above, frailty occurrence increased significantly in both genders [Tables 4-6].

Table 2: Age-wise comparison of basic anthropometric parameters# (*n*=702)

Age (years)	Mean±SD				*F*	*P*
	40–50	50–60	60–70	70+		
Height (m)	1.55±0.09	1.57±0.09	1.55±0.10	1.49±0.20	0.44	0.72
Weight (kg)	60.93±12.63	63.83±13.65	62.99±11.61	57.51±13.34	5.88	0.00*
BMI (kg/m^2)	25.301±4.29	26.34±4.87	26.25±4.73	24.35±5.85	9.37	0.00*
Waist circumference (cm)	89.5±12.01	92.72±15.04	94.5±14.19	90.2±12.31	5.52	0.00*
Hip circumference (cm)	105.76±8.06	100.35±10.73	99.0±9.56	97.1±12.03	1.70	0.01*
WHR	0.89±0.09	0.92±0.10	0.95±0.10	0.92±0.14	13.39	0.00*

*$P<0.05$, #ANOVA. WHR: Waist–hip ratio, BMI: Body mass index, SD: Standard deviation

To summarize, the results showed an overall prevalence of sarcopenia of 61.25%, 74.23% of dynapenia, and 6.97% of frailty considering 702 respondents in total. Irrespective of age, males, and females were equally sarcopenic. Across all age groups, women had higher dynapenic levels than men. Only in the seventh decade did fragility problems emerge, with females being more fragile than males. Sarcopenia and dynapenia are much more common throughout the seventh decade of life than in the earlier age groups.

Table 3: Gender-wise comparison of basic body anthropometric parameters# (*n*=702)

Age (years)	Mean±SD		*F*	*P*
	Female	Male		
Height (m)	1.49±0.09	1.62±0.08	288.25	0.00*
Weight (kg)	56.84±12.21	66.23±12.36	75.39	0.00*
BMI (kg/m^2)	25.66±5.56	25.26±4.55	0.73	0.39
Waist circumference (cm)	88.61±14.57	95.00±11.47	29.99	0.00*
Hip circumference (cm)	102.51±15.25	100.20±9.60	1.66	0.19
WHR	0.89±0.10	0.97±0.07	113.20	0.00*

*P<0.05, #ANOVA. WHR: Waist–hip ratio, BMI: Body mass index, SD: Standard deviation

Table 4: Age-wise prevalence of sarcopenia (as per Asian Working Group for Sarcopenia cutoffs), dynapenia (hand grip strength), and frailty (Clinical Frailty Scale)

Age (years)	Frequency (prevalence percentage)		
	Sarcopenia	Dynapenia	Frailty
40–50	83 (11.82)	104 (14.81)	1 (0.14)
50–60	100 (14.25)	121 (17.23)	2 (0.28)
60–70	104 (14.81)	130 (18.52)	4 (0.57)
Above 70	143 (20.37)	166 (23.65)	42 (5.98)
Total	430 (61.25)	521 (74.21)	49 (6.97)

Table 5: Gender-wise prevalence of sarcopenia (as per Asian Working Group for Sarcopenia cutoffs), dynapenia (hand grip strength), and frailty (Clinical Frailty Scale)

Gender	Frequency (prevalence percentage)		
	Sarcopenia	Dynapenia	Frailty
Female	216 (30.77)	281 (40.03)	32 (4.56)
Male	214 (30.48)	240 (34.19)	17 (2.42)
Total	430 (61.25)	521 (74.21)	49 (6.97)

DISCUSSION

The present cross-sectional study was conducted to estimate epidemiological details of sarcopenia, dynapenia, and frailty with aging on anthropometric parameters, lean body mass, appendicular skeletal muscle index, muscle strength, and physical functional capacity in men and women of Belagavi urban city, India, and to compare the data between the genders.

Sarcopenia is an age-related reduction in muscle mass that is strongly associated with muscle strength and function or frailty. This condition has a well-established association with falls, frailty, fractures, functional disabilities, dependency on activities of daily living, and eventually early mortality.[14,15] The European working group on sarcopenia in older people (EWGSOP) provided criteria for the clinical diagnosis of sarcopenia along with its subclasses in 2018.[6] EWGSOP updated and revised the cutoffs which aim to help health-care professionals to identify sarcopenia and its risks as well as initiate primary preventive measures or early intervention. However, considering the differences in body structure, diet type, physical culture, and level of physical activity among Asians and Caucasians, the criteria/cutoffs of diagnosing sarcopenia as given by EWGSOP may not be applicable to the demographic features of Asian people. Hence, the AWGS provided consensus with new cutoffs for the diagnosis of sarcopenia in the Asian population. Further, the Indian Union is the second most populous country in the world with the size of the elderly population increasing over time having 10.1% in 2021 with approximately 138 million elderly persons with an estimated increase to 13.1% in 2031.[16] Since India is a vast country, the demographic characteristics of individuals vary from north to south and east to west. Belagavi is one such urban city located in south India in the province of Karnataka, with around 7-lakh population of which the elderly population comprises about 7% of the total population.[17] Hence, data need to be created among different sects/geographical regions about the prevalence or occurrence of sarcopenia, frailty, and dynapenia.

Table 6: Age and gender-wise prevalence of sarcopenia (as per Asian Working Group for Sarcopenia cutoffs), dynapenia, and frailty

Prevalence	Sarcopenia (as per AWGS cutoffs) (%)			Dynapenia (%)			Frailty (%)		
Age (years)	Gender		Total	Gender		Total	Gender		Total
	Female	Male		Female	Male		Female	Male	
40–50	6.41	5.41	11.82	9.68	5.13	14.81	0.14	0.00	0.14
50–60	7.69	6.56	14.25	9.77	7.46	17.23	0.14	0.14	0.28
60–70	7.55	7.26	14.81	9.70	8.82	18.52	0.29	0.28	0.57
Above 70	9.12	11.25	20.37	10.98	12.67	23.65	3.99	1.99	5.98
Total	30.77	30.48	61.25	40.13	34.1	74.23	4.56	2.41	6.97

AWGS: Asian Working Group for Sarcopenia

A study was conducted in Singapore to define the sarcopenia normative values among community-dwelling persons for individuals above 21 years, by applying AWGS-2019 criteria and compared with EWGSOP criteria.[9] The authors concluded that younger adults have a chance of developing sarcopenia as well as created cutoffs for diagnosing the same. Another study was conducted comparing the diagnostic cutoffs as per EWGSOP and AWGS in an urban city in North India.[10] The authors concluded that Indians have lower muscle mass and muscle strength and hence do not use western cutoffs to diagnose sarcopenia in Indians. Hence, in the present study, diagnostic cutoffs of ASWG were employed to study the prevalence of sarcopenia.

In this present study, the results depicted the overall prevalence of sarcopenia as 61.25%. Based on diagnostic cutoffs developed by the authors, an epidemiological investigation in the Indian city of Chandigarh with 804 participants over the age of 21 revealed that the prevalence of "probable sarcopenia," "sarcopenia," and "severe sarcopenia" was 14.6%, 3.2%, and 2.3%, respectively. The authors went on to compare the prevalence of sarcopenia and its subtypes as per AWGS-2019 against the cutoffs created by the authors, showing a higher prevalence of sarcopenia (6.7%) but a similar prevalence for probable sarcopenia (14.9%). The higher prevalence of sarcopenia in the present study could be due to the fact that the age group included was above 40 years as against 21 years in the Chandigarh study and due to the reason that the present study did not classify sarcopenia in different subcategories. Further, diagnostic cutoffs used in the present study were as per the Asian working group of Sarcopenia cutoffs. Another factor for the higher prevalence noted in the present study could be due to the exhaustive nature of the exclusion criteria of participants included in the Chandigarh-based study.[10] Another hospital-based study reported that the prevalence of sarcopenia is to be 15.3% in senior males and 20.5% in elderly females, based only on low total skeletal muscle index, in comparison to very few younger participants as reference.[18] However, another study that used Caucasian diagnostic and study-based cutoffs to find the prevalence of sarcopenia had 32.6% and 15% of prevalence only in women categorized as premenopausal (<50 years) and postmenopausal (>50 years) age group.[19]

The results of the present study showed that with advancing age, there is an increase in the prevalence of sarcopenia with a decline in the parameters by the seventh decade. Similar findings were noted in a study among South India's rural elderly, where 14.2% had sarcopenia[11] and also in a study conducted in an urban-based north Indian city (3.2%).[10] In a study in Thanjavur, India, one in five relatively healthy women had a loss of muscle mass, and 7.6% of women had a loss of muscle mass and strength.[12] A study by Lee and Park to evaluate the prevalence of sarcopenia, pre-sarcopenia, and severe sarcopenia in healthy Korean elderly women over the age of 65 years reported that aging also accelerated the onset of sarcopenia.[20] In a study in Singapore by Pang *et al*., to define the sarcopenia normative values among community-dwelling persons for individuals above 21 years, it was found that using AWGS-2019 criteria, sarcopenia was more prevalent in the 60+ age group (32.2%). These results were in line with the findings of the present study.[9]

The gender-wise comparison for the prevalence of sarcopenia showed that males are more affected by sarcopenia when compared to females at the age of 70 years and above. The results are in consensus with a previous study conducted in Chandigarh where 4.7% of men and 2.1% of females were found to be sarcopenic.[10] Although when compared to other studies in Dakshina Kannada (11.8% men and 88.2% women)[11] and Bhubaneswar, Odisha (15.3%, 20.5%),[18] it was seen that females were more affected than males. However, in the present study, the overall prevalence comparison between the genders showed equal distribution.

Frailty develops with age and is linked to a higher chance of health diseases, as well as a person's risk of falling, having balance problems, and having physical limitations.[21] In the present study, frailty was seen to reach its peak in the seventh decade (6.97%) and was seen as more severe in women (2.41%) than men (4.56%). The prevalence of frailty in the present study was 0.14% in the fourth decade with an ascending pattern seen with advancing age. A research project for adults aged 50+ years by Biritwum *et al*. aimed to find the prevalence of frailty and impairment in older adults, as well as the variables that contribute to it. In China, Ghana, India, Mexico, Russia, and South Africa as part of the study on global aging and adult health Wave 1, a frailty index was created based on the percentage of deficits in 40 variables, and disability was evaluated using the World Health Organization Disability Assessment Schedule 2.0. The finding showed that India had the highest percentage (55.5%). Among all nations, frailty and disability rose with age and were more prevalent in women.[22] In the present study too, a similar finding was noted, but frailty was graded using the Clinical Frailty Scale instead of a frailty index. Another comprehensive assessment of the current research on the relationship between dietary status and frailty syndrome in older persons was conducted.

Malnutrition and/or the risk of malnutrition and frailty have been linked, according to a study that examined the relationship between the mini-nutritional assessment and frailty.[23] However, in the present study, malnutrition factor was not considered.

Dynapenia is a condition of age-related muscle strength loss that increases the risk for mortality and everyday daily activities limitations.[24] The prevalence of dynapenia was higher at 74.23% in the present study. The findings are in consensus with the results of a study done in the urban areas of Brazil, including 387 hospitalized elderly people with the aim to determine the prevalence of sarcopenia and dynapenia, as well as to find which risk factors are linked to the senior population based on HGS that was used to test muscle strength. It was also seen that the prevalence of dynapenia in men and women was 52.4% and 38.2%.[4] However, in the present study, there were no significant gender differences noted. A cross-sectional study by Gracia Alfaro was done in postmenopausal women aged 50–84 years to find how common dynapenia is in them, as well as the factors that contribute to poor dominant handgrip strength. The results showed that dynapenia was found in 31.3% of women, while women over 65 years had significantly decreased hand grip ($P = 0.001$).[25] Similarly, in the present study, we noted that with advancing age, HGS reduced (seventh decade 91.53%). A study by Nebuloni *et al.* showed an association between diabetes and low muscular strength and found that diabetes increased the chance of dynapenia in both sexes[26] while in the present study, a comparison with specific comorbidities and dynapenia was not done since this association has been already well established in the literature.

The present study had a few limitations. First, for the assessment and calculation of ASMI, BIA was used against the dual-energy X-ray absorptiometry which was due to pricier rates and the big budget involved, and the study was self-funded. Second, the sarcopenia diagnosis was not categorized as probable, sarcopenia, or severe sarcopenia. In future, comparative data for the prevalence of sarcopenia in rural and urban populations to find if a geographical area can influence body composition parameters can be considered. More studies need to be conducted in other parts/sects of the Indian geographical regions to better understand the condition. It can be also used as a baseline for any future interventions to reduce sarcopenia.

CONCLUSION

The results showed an overall prevalence of sarcopenia of 61.25%, 74.23% of dynapenia, and 6.97% of frailty considering 702 respondents in total. Irrespective of age, males, and females were equally sarcopenic. In all age categories, women were more dynapenic than men. Frailty issues arise only during the sevent decade of life and women are more fragile than men counterparts. The seventh decade of life saw a considerable rise in the prevalence of sarcopenia and dynapenia.

Clinical implications

As age advances, individuals are more susceptible to sarcopenia, dynapenia, and frailty which have been linked to the loss of physical function and dependence on activities of daily living. By creating the baseline data, we can know the seriousness of the condition and work to prevent associated complications such as mortality, falls, and fractures from occurring by initiating early intervention.

Acknowledgment

We are grateful to the old-age homes for consenting and participating in the study. We would like to thank Rotary Club of South Belagavi for conducting the camp and helping us to collect data. We wish to thank the statistician, Mrs. Manjiri Desai, and her team from D. Y. Patil Vidyapeeth, Kolhapur, for helping us with the statistical analysis of the study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Gilbert SF. Aging: The biology of senescence. In: Developmental Biology. 6th ed. Sunderland (MA): Sinauer Associates; 2000. https://www.ncbi.nlm.nih.gov/books/NBK10041/. [Last accessed on 2022 Apr 06].
2. Rosenberg IH. Sarcopenia: Origins and clinical relevance. J Nutr 1997;127:990S-1S.
3. Ardeljan AD, Hurezeanu R. Sarcopenia. In: StatPearls. Treasure Island (FL): Stat Pearls Publishing; 2022. https://www.ncbi.nlm.nih.gov/books/NBK560813/. [Last acessed on 2022 Apr 06, Last updated on 2021 Jul 10].
4. Neves T, Ferriolli E, Lopes MB, Souza MG, Fett CA, Fett WC. Prevalence and factors associated with sarcopenia and dynapenia in elderly people. J Frailty Sarcopenia Falls 2018;3:194-202.
5. Xue QL. The frailty syndrome: Definition and natural history. Clin Geriatr Med 2011;27:1-15.
6. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, *et al.* Sarcopenia: European consensus on definition and diagnosis: Report of the European working group on sarcopenia in older people. Age Ageing 2010;39:412-23.
7. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, *et al.* Asian working group for sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc 2020;21:300-7.e2.
8. Shafiee G, Keshtkar A, Soltani A, Ahadi Z, Larijani B, Heshmat R. Prevalence of sarcopenia in the world: A systematic review and meta- analysis of general population studies. J Diabetes Metab Disord 2017;16:21.

9. Pang BW, Wee SL, Lau LK, Jabbar KA, Seah WT, Ng DH, *et al.* Prevalence and associated factors of sarcopenia in Singaporean adults-the Yishun study. J Am Med Dir Assoc 2021;22:885.e10.
10. Pal R, Aggarwal A, Singh T, Sharma S, Khandelwal N, Garg A, *et al.* Diagnostic cut-offs, prevalence, and biochemical predictors of sarcopenia in healthy Indian adults: The sarcopenia-Chandigarh urban bone epidemiological study (Sarco-CUBES). Eur Geriatr Med 2020;11:725-36.
11. Shaikh N, Harshitha R, Bhargava M. Prevalence of sarcopenia in an elderly population in rural South India: A cross-sectional study. F1000Res 2020;9:175.
12. Kendhapedi KK, Devasenapathy N. Prevalence and factors associated with frailty among community-dwelling older people in rural Thanjavur district of South India: A cross-sectional study. BMJ Open 2019;9:e032904.
13. Church S, Rogers E, Rockwood K, Theou O. A scoping review of the clinical frailty scale. BMC Geriatr 2020;20:393.
14. Beaudart C, Zaaria M, Pasleau F, Reginster JY, Bruyère O. Health outcomes of sarcopenia: A systematic review and meta-analysis. PLoS One 2017;12:e0169548.
15. Cruz-Jentoft AJ, Sayer AA. Sarcopenia. Lancet 2019;393:2636-46.
16. Vikaspedia Domains; 2022. Available from: https://as.vikaspedia.in/social-welfare/senior-citizens-welfare. [Last accessed on 2022 Apr 06].
17. Belgaum Population 2022 (Demographics, Maps, Graphs); 2022. Available from: https://worldpopulationreview.com/world-cities/belgaum-population. [Last accessed on 2022 Apr 06].
18. Mohanty L, Sahoo D. Prevalence and risk factors of sarcopenia: A study in a tertiary care center. Int J Adv Med 2016;3:364-7.
19. Marwaha RK, Garg MK, Bhadra K, Mithal A, Tandon N. Assessment of lean (muscle) mass and its distribution by dual energy X-ray absorptiometry in healthy Indian females. Arch Osteoporos 2014;9:186.
20. Lee ES, Park HM. Prevalence of sarcopenia in healthy Korean elderly women. J Bone Metab 2015;22:191-5.
21. UpToDate; 2022. Available from: https://www.uptodate.com/contents/frailty#:~:text=Frailty%20is%20most%20often%20defined,vulnerability%20to%20adverse%20health%20outcomes. [Last accessed on 2022 Apr 06].
22. Biritwum RB, Minicuci N, Yawson AE, Theou O, Mensah GP, Naidoo N, *et al.* Prevalence of and factors associated with frailty and disability in older adults from China, Ghana, India, Mexico, Russia and South Africa. Maturitas 2016;91:8-18.
23. Lorenzo-López L, Maseda A, de Labra C, Regueiro-Folgueira L, Rodríguez-Villamil JL, Millán-Calenti JC. Nutritional determinants of frailty in older adults: A systematic review. BMC Geriatr 2017;17:108.
24. Clark BC, Manini TM. Sarcopenia =/= dynapenia. J Gerontol A Biol Sci Med Sci 2008;63:829-34.
25. García-Alfaro P, García S, Rodríguez I, Pérez-López FR. Handgrip strength, dynapenia, and related factors in postmenopausal women. Menopause 2021;29:16-22.
26. Nebuloni CC, Máximo RO, de Oliveira C, Alexandre TD. Uncontrolled diabetes as an associated factor with dynapenia in adults aged 50 years or older: Sex differences. J Gerontol A Biol Sci Med Sci 2020;75:1191-7.

PROTOCOL PAPER

Physiotherapy Quarterly (ISSN 2544-4395)
2023, 31(4), 93–106
© Wroclaw University of Health and Sport Sciences

High-intensity interval training versus hatha yoga for postmenopausal females on obesity, sarcopenia, dynapenia, lower limb alignment: study protocol for RCT

DOI: https://doi.org/10.5114/pq.2023.133458

Peeyoosha Gurudut[1], Sanjiv Kumar[1], Ashwin Patil[2]
[1] KLE Institute of Physiotherapy, KLE Academy of Higher Education & Research, Nehru Nagar, Belagavi, Karnataka, India
[2] Department of Radiology, J.N. Medical College, KLE Academy of Higher Education & Research, Nehru Nagar, Belagavi, Karnataka, India

Abstract

Introduction. Menopause is a challenging stage of a woman's life, with increased occurrences of musculoskeletal issues and obesity that need to be tackled early and effectively. Less is known about the effect of HIIT & hatha yoga on musculoskeletal parameters in post-menopausal females. Both exercise approaches differ and are comparable in many ways. Thus, the objective of the study is to determine and compare the effects of 12 weeks of HIIT and yoga training protocols in postmenopausal females with central adiposity, sarcopenia, dynapenia, and knee alignment. The present research article presents a study protocol comparing yoga and HIIT protocols prescribed for postmenopausal females.

Methods. This is an open-label, randomised, parallel-armed, assessor-blinded clinical trial that will be conducted on 160 postmenopausal females between 46 and 70 years randomly assigned to either the HIIT or yoga group. The intervention will be in the form of group therapy for 5 sessions per week for 12 weeks. The outcomes include sarcopenia by lean muscle mass using a bioelectric impedance analyser, a radiological measure of the Hip-Knee-Ankle angle, and the perceived stress scale and 36-item short form questionnaires assessed twice (pre & post). The outcomes, including gait speed, hand grip strength, waist circumference, and body mass index, will be assessed at pre, post-4th week, post-8th week, and post-12th week.

Discussion. The study outcomes will provide confirmatory evidence on the effects of Hatha yoga and HIIT exercise training protocols in managing menopausal weight gain, musculoskeletal issues (sarcopenia and knee malalignment), physical and functional capacity, as well as mental health in postmenopausal females.

Key words: ageing, exercise, high-intensity intermittent, menopause, alternative therapy

Introduction

Menopause is strongly associated with the increased occurrence of several non-communicable diseases or comorbidities posing numerous health issues in a woman's life compared to peer-aged males and reproductive-age females, thereby imposing a great burden on individual, financial, and healthcare delivery [1, 2]. The average age of menopause in Indian females is 46.2 years, which is earlier than their Western counterparts (51 years) [3].

Sarcopenia, dynapenia, and central adiposity are the three health-related factors that become evident from middle age and more severe as age advances [4]. Sarcopenia is defined as the loss of total body muscle mass while being replaced with fat mass. Dynapenia is a loss of muscle strength, as assessed by the palmar grip strength [5]. The prevalence of sarcopenia and dynapenia is higher in Indians than in their Western counterparts [6]. Central adiposity type of fat redistribution occurs after menopause, while in the reproductive age group, a female's fat is predominantly distributed at the hips and thighs [7]. All these factors pose increased risks of adverse health outcomes when occurring independently or together [8, 9]. The Asian Working Group for Sarcopenia (AWGS) has given diagnostic criteria cut-offs for the Asian population for the diagnosis of sarcopenia [5].

Another issue that affects this ageing female population is the change in angular alignment in the lower limbs, predominantly in the knee joints (varus or valgus) either due to central obesity or imbalances in muscles, which may further lead to arthritis-like inflammatory processes that need to be addressed [10, 11]. This can be accurately diagnosed by long-axis frontal plane radiography of the weight-bearing lower limbs by marking and measuring the coronal hip-knee-ankle angles (HKA) [12]. The correlation between obesity and increased adduction moment and joint loading in the knees that occur with ageing in elderly males and females due to coronal HKA angles has been well established in the literature [13]. Existing literature suggests an effective correction of the kinematics of the knee and hip as well as adduction moment in the frontal plane during dynamic loading conditions with 12 weeks of a structured exercise program, including strengthening or proprioceptive exercises [14–16]. However, there is a paucity of literature, where a gold standard assessment of alignment such as the HKA angle measured on X-ray is considered, to understand the efficacy of weight loss on correction of the lower limb alignment.

Physical exercise and proper nutrition are the best combinations of treatments to deal with these musculoskeletal issues [17, 18]. Several forms of exercise have been studied for their effectiveness in the prevention and management

Correspondence address: Peeyoosha Gurudut, Department of Orthopedic Physiotherapy, KLE Institute of Physiotherapy, KLE Academy of Higher Education & Research, Nehru Nagar, Belagavi - 590010, Karnataka, India, e-mail: peeyooshagurudut@klekipt.edu.in; https://orcid.org/0000-0001-8055-4289

Received: 28.06.2023
Accepted: 04.09.2023

Citation: Gurudut P, Kumar S, Patil A. High-intensity interval training versus hatha yoga for postmenopausal females on obesity, sarcopenia, dynapenia, lower limb alignment: study protocol for RCT. Physiother Quart. 2023;31(4):93–106; doi: https://doi.org/10.5114/pq.2023.133458.

of musculoskeletal health risks in elderly females, with the majority of studies having intervened with either resistance or aerobic exercise protocols [19, 20]. Extensive literature exists on the role of aerobic and resistance training protocols in the above-stated conditions [21, 22]. The recent recommendations by the American College of Sports Medicine prescribe Moderate Intensity Continuous Training (MICT) for weight and fat mass with 150–250 minutes per week for prevention or >250 minutes of workout for weight reduction [20].

High-intensity interval training (HIIT) is a repeated set of high-intensity exercise efforts followed by rest intervals comprising lower-intensity efforts [23]. HIIT is an efficient exercise training method for managing diabetes mellitus [24], obesity blood inflammatory biomarkers [25], dyslipidemia [26], fat loss [27], and cardiometabolic disease [23] in all ages and sexes [28]. Compared to MICT, HIIT has the advantage of lesser time requirement while having similar or better improvements in terms of a decrease in fat mass and improved cardiovascular health [24]. In a scoping review on HIIT as a potential exercise intervention, the authors suggested that there are not enough studies looking into HIIT in elderly people with sarcopenia, and therefore additional interventional trials in this population are required [29].

Yoga is an ancient form of physical exercise and behavioural discipline of Indian origin. It involves being in static physical postures (Hatha yoga) or dynamic transitions (Vinyasa yoga) along with breathing control [30]. Recently, yoga has gained popularity globally, with a growing body of evidence stating effectiveness of yoga for treating various health and lifestyle conditions in Western countries as well. Yoga is a very effective strategy of moderate-intensity exercises for obesity [31], lipid markers [32], muscle strength [33], and metabolic syndrome [34]. One review reveals a single multicity prospective trial for the effect of yoga programs on Asian and African older females with sarcopenia, revealing yoga an effective preventive strategy on gait and fitness in the elderly [35].

Yoga and HIIT are comparable in many ways, based on various characteristics. While yoga involves physical poses, concentration, and deep breathing that is performed at a slow-to-moderate pace and intensity, HIIT involves relatively short bursts of vigorous activity performed at a high relative workload corresponding to ≥ 90% of $VO_{2\,max}$ [36]. Yoga provides aerobic effects [37] while HIIT provides both aerobic and anaerobic changes [38]. Further, HIIT has been compared with moderate-intensity training and other traditional exercise forms (Pilates, power yoga) for obesity and other patient populations [39, 40]. Yoga too has been compared to traditional aerobic exercises on mental and physical health outcomes [41–43].

Although evidence exists for the effects of HIIT in different patient populations, its potential effects on parameters that determine musculoskeletal health and physical function capacity are not known. The impact of yoga on issues related to ageing, such as falls, osteopenia, weight management, women's health, and stress, has been well-established in the literature. However, there is limited literature on the effect of yoga on other parameters of musculoskeletal health, such as sarcopenia, dynapenia, physical performance, and lower limb alignment in post-menopausal females. In addition, it would be interesting to explore more on the effects of 12 weeks of generalised forms of exercises on changes in the knee alignments employing a gold standard assessment method such as the HKA angle on X-ray rather than assessing the dynamic frontal plane angle to understand if the corrective effects are of any preventive importance for osteoarthritis (OA) of the knee or are only relevant at the muscular level. Further, there is a paucity of trials in postmenopausal women's health issues as well as health-related conditions of the elderly or the ageing population where HIIT and hatha yoga are compared.

Considering all this, the objective of the study will be to determine and compare the effects of 12 weeks of HIIT and Hatha yoga training on top of a prescribed standard diet chart on body composition, abdominal adiposity, knee joint alignment, muscle strength, functional capacity, perceived level of stress, and health-related quality of life in postmenopausal females with central adiposity, sarcopenia, and dynapenia.

Subjects and methods

The study protocol is reported using the SPIRIT reporting guidelines for protocol studies [44] (Appendix 1). For better reporting of the trial, CONSORT-2010 Statement: extension to pilot studies and feasibility trials guidelines have been referred to (Figure 1).

Trial design

This is an open-label, randomised, parallel-armed, assessor-blinded clinical trial with random allocation of study participants to two study groups. The trial will be undertaken in the community setting and in retirement homes of Belagavi city.

Participants

Participants will be post-menopausal females fulfilling the following criteria: Aged 46 to 70 years; waist circumference ≥ 80 cm [45]; palmar grip strength of the dominant hand: ≤ 18 kgs in 60–70 years and ≤ 23kgs in 46–60 years [46]; 4-metre gait speed of < 0.8m/s; not involved in any form of regular (regularity defined by at least 3 days per week) physical exercises (yoga/aerobic exercises/gym, etc.) in the most recent three months; and willing to comply with the prescribed diet and exercises for 3 months. Participants will be excluded if they have/are: associated comorbid conditions such as uncontrolled diabetes mellitus (DM) and/or hypertension according to their blood report or a physician's report in the most recent three months; known cases of cardiovascular surgeries/Ischemic heart disease; history of neurological or cerebrovascular disease; diagnosed case of polyarthritis, physical disability or severe joint degenerative condition such as osteoarthritis, spondyloarthropathies; cancer survivor or known case of cancer; diagnosed case of thyroid disease; currently on any weight loss program or medication; any fracture/dislocation or bone/joint surgery within the past year; any major surgical history including surgery on the abdomen/lower limb(s)/spine in the most recent year; known case of severe osteoporosis; history of total joint replacement; medications that affect body fat mass (e.g.: steroids, hormonal therapy); any other medical/surgical/neurological condition that prevents them from participating in the exercise; affected joint mobility due to any cause that affects performing the exercise; any contraindication to the application of a Bioelectrical Impedance Analyzer (BIA) such as a hearing aid, pacemaker, metal implant, kidney disorder, dialysis, diarrhoea, etc.; inability to comprehend commands.

Recruitment

Participants will be invited and informed about the study interventions through flyers/pamphlets, advertisements in regional newspapers, and screening camps conducted at the community level. Interested participants will be screened for eligibility and the study will be explained in detail.

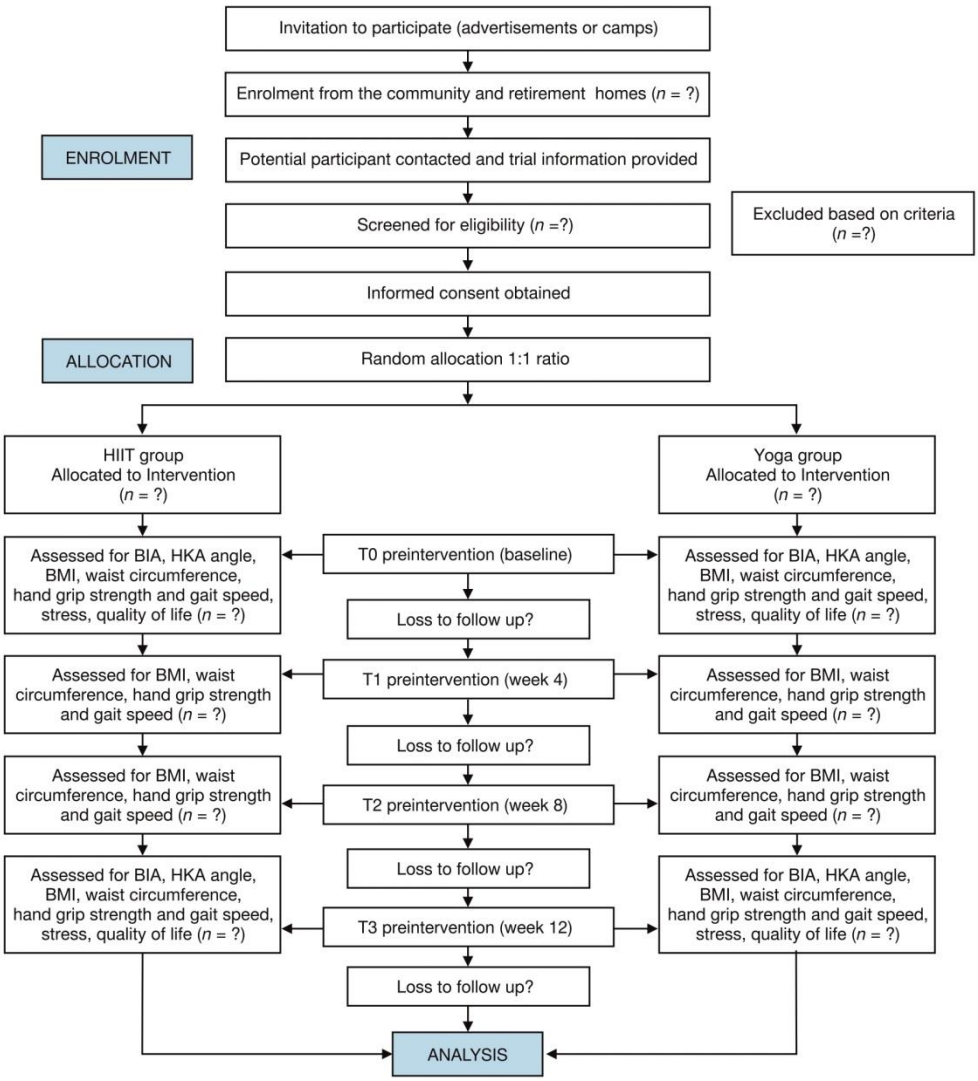


Figure 1. CONSORT flow diagram (SPIRIT guidelines)

Randomisation

Eligible consenting participants will be randomly assigned to either HIIT or Yoga groups. As the study intervention will be in the form of group therapy, multiple groups of 10–12 participants will be created as per the geographical area of the city. The entire group will be randomly allocated to HIIT or Yoga groups by block randomisation with a 1:1 ratio.

Blinding

It will be a double-blinded study. An independent assessor and statistical data analyst will be blinded from the names of the groups by coding the study groups as A or B.

Study interventions

To maintain the quality of reporting of interventions: Template for Intervention Description and Replication (TIDieR) and Consensus on Exercise Reporting Template (CERT) guidelines/checklists are referred to (Appendix 2, 3) [47, 48].

After random allocation to two groups, participants will be invited group-wise on a specific date and time for a 2-hour orientation workshop and counselling. They will be informed about the preparation for the exercise sessions, including mats, footwear, clothing, etc.

HIIT group

The sessions will be conducted by a qualified physiotherapist. Participants will perform three supervised sessions of HIIT per week over 12 weeks. This program will consist of spot jogging/running for 30 seconds, maintaining pace at 70–90% of MHR, and interspersed with low-intensity active recovery, which includes walking for 120 seconds. The exercise intensity will be kept at 70–90% of the maximum heart rate (heart rate max = 208 – 0.7 × age) such that it will be an individualised approach [24, 26]. The detailed exercise protocol and progression are presented in Table 1.

Table 1. High-Intensity Interval Training exercise protocol

Variables	Week 1 to 4	Week 5 to 8	Week 8 to 12
Intensity	70% MHR	80% MHR	90% MHR
Level	Beginner	Beginner–Intermediate	Intermediate
Warm-up (type & time)	General mobility / stretches for all major joints (10 min)	General mobility exercises / stretches for all major joints (10 min)	General mobility exercises / stretches for all major joints (10 min)
Type of exercise	Spot jogging/running (repeated alternately)	Spot jogging/running (repeated alternately)	Spot jogging/running (repeated alternately)
Single exercise bout time	30 s	30 s	30 s
Exercise bouts (*n*)	6	8	10
Total exercise time	3 min	4 minutes	5 minutes
Recovery exercise type	Brisk walking (repeated alternately)	Brisk walking (repeated alternately)	Brisk walking (repeated alternately)
Single active recovery exercise time	120 s	120 s	120 s
Recovery bouts (*n*)	7	9	11
Total active recovery exercise time	14 min	18 min	22 min
Total exercise time	30–35 min	35–40 min	40–45 min
Cool down (type & time)	Stretching of major muscles and breathing exercises (10 min)	Stretching of major muscles and breathing exercises (10 min)	Stretching of major muscles and breathing exercises (10 min)
Supervised sessions/week	3	3	3
Home exercise sessions / week (Brisk walking)	2	2	2
Frequency	5 sessions per week	5 sessions per week	5 sessions per week

MHR – maximum heart rate

Table 2. Hatha Yoga exercise protocol

Variables	Week 1 to 4	Week 5 to 8	Week 8 to 12
Intensity	Beginner	Beginner–Intermediate	Intermediate
Warm-up (type & time)	General mobility / stretches exercises for all major joints (10 min)	General mobility exercises / stretches for all major joints (10 min)	General mobility exercises / stretches for all major joints (10 min)
Type of exercise	Basic asanas with suryanamaskaras	Basic asanas with suryanamaskaras	Basic asanas with suryanamaskaras
Repetitions	Asanas (any 2): 2 to 3 reps Suryanamaskara (3–6)	Asanas (any 2): 2 to 3 reps Suryanamaskara (7–12)	Asanas (any 2): 2 to 3 reps Suryanamaskara (13–20)
Cool down (type & time)	Savasana & pranayama (10 mins)	Savasana & pranayama (10 min)	Savasana & pranayama (10 min)
Total exercise time	50–60 min	50–60 min	50–60 min
Supervised sessions / week	3	3	3
Home exercise sessions / week (Brisk walking)	2	2	2
Frequency	5 sessions per week	5 sessions per week	5 sessions per week

Yoga group

A certified yoga trainer will conduct the yoga sessions. Participants will practise yoga for 1 hour including warm-up, Yoga poses (any 2 repeated 2–3 times progressing from simple to complex poses), Sun salutation (repetitions 6–20) incrementally, Pranayama, and cool down (Savasana) [31, 35]. Three supervised yoga sessions per week will be conducted for 12 weeks. Table 2 presents with comprehensive exercise prescription for the yoga group.

Diet

A certified nutritionist will prepare the diet program. A printed diet program booklet in regional and English languages will be provided to study the participants to follow for 12 weeks.

The diet chart comprises a high-protein, low-fat, fat-carbohydrate diet along with a timely menu with portion sizes. The preintervention diet that the participant followed will be noted, total calories calculated and a deficit of 600 calories will be prescribed with an individualised approach.

Relevant concomitant care

Both interventions will begin with a warm-up and end with a cool-down. Home exercise for both groups will include brisk walking as per the individual's own capacity for 30–40 minutes to be performed on the two alternative days each week on which study intervention is not scheduled. Intervention for HIIT and Yoga will be conducted in a large exercise hall (Tables 1, 2). Participants will be told to refrain from any medications, other forms of exercise, or diets for weight loss until the study is completed. They will also receive a list of permitted/prohibited eateries.

Adherence to interventions

The participants will be provided a comprehensive log diary to mark their daily compliance with the exercise and diet during the study period, which will be reviewed every two weeks and feedback given. Also, the investigator will ensure adherence to reminder messages.

Criteria for dropout

– Participant misses more than 12 (20%) of the total 60 exercise sessions
– Participant misses any two of the three follow-up evaluations/assessments
– Participant is unwilling or unable to continue the exercise for any personal or medical reasons
– During the study period, the participant has any medical emergency or their existing comorbid conditions worsen

Criteria for protocol modifications/discontinuation

The protocol will be amended or modified only in the case of any adverse event noted or practical difficulty faced during the conduct of the trial. Should there be any modifications, information will be provided to the Research Ethical Committee for the amendments and permission sought.

Data collection procedures

The outcome assessments will be carried out by a qualified physiotherapist who will be blinded from the group allocation. Demographic characteristics such as age, diet, comorbidities, age of menopause, etc., will be noted (Figure 2).

Primary outcomes

Waist circumference: Waist circumference will be measured in centimetres using a non-stretch fibre tape with participants in a standing position. The measurement will be taken at 1 cm above the umbilicus in complete expiration to ensure reliable measures. Decimals will be rounded off to the nearest 1 cm [49]. The waist circumference will be measured at preintervention (T0), and at the end of the 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention.

Secondary outcomes

Criteria for diagnosing sarcopenia: Sarcopenia will be determined by the cutoffs given by AWGS criteria as follows: low Appendicular Skeletal Muscle Index by BIA with ≤ 5.7 kg/m^2 for females; diminished muscle mass along with reduced mus-

	Enrolment	Allocation	Post allocation			Closeout
TIMEPOINT	**-t_1**	**0**	**T_0/Baseline**	**T_1/Week 4**	**T_2/Week 8**	**T_3/Week 12**
ENROLMENT:						
Eligibility screen	X					
Informed consent	X					
Allocation		X				
INTERVENTIONS:						
HIIT			X	X	X	X
Yoga			X	X	X	X
ASSESSMENTS:						
Waist circumference	X		X	X	X	X
Hand grip strength	X		X	X	X	X
Gait speed	X		X	X	X	X
Body impedance analysis			X			X
Body mass index			X	X	X	X
Hip-knee-ankle angle			X			X
SF-36			X			X
Perceived stress score			X			X

HIIT – high-intensity interval training, SF-36 – 36-Item Short Form Survey

Figure 2. Schematic diagram of schedule of enrolment, interventions, and assessments (participant timeline)

cle strength [Females ≤ 18 kgs] or physical performance by 6 m or 4 m walk test with < 1.0 m/s or < 0.8 m/s, respectively. The appendicular skeletal muscle index (ASMI) is calculated using the formula [5]:

$$\text{ASMI (kg/m}^2\text{)} = \frac{\text{lean body mass of arms + lean body mass of legs (kg)}}{\text{height (m}^2\text{)}}$$

Total Fat and muscle mass using a Bioelectrical Impedance analyser (BIA)

BIA measurement will be performed after overnight fasting of 8 hours [50]. The contraindications for the use of BIA that may cause interference with the readings will be checked for. An Actofit Body Analyzer Pro Max (Actofit Wearables, China) will be used, connected to a smartphone via Bluetooth with the ActoFit Health software application installed (https://play.google.com/store/apps/details?id=com.actofitSmartScale). After entering basic details, the participants are made to stand barefoot on the machine. The machine then analyses various body composition parameters, including fat mass, lean muscle mass, skeletal mass arms and legs, and body fat %. The report is generated in pdf format, initially stored in the connected smartphone and transferred to the electronic database (Figure 1). The BIA outcome will be assessed at pre-intervention (T0), and 12 weeks (T3) post-intervention.

The body mass index (BMI) will be calculated by the BIA based on the height entered into the machine, which will be measured at pre-intervention (T0) and at the end of the 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention, and noted in the unit of kg/m^2.

Hand grip strength (HGS) to measure dynapenia: A Jamar hand dynamometer (reliability is [3,1] = 0.98 and validity [ICC (2, K) = 0.99]) (Manufacturer: Sammons Preston Rolyan, UK. Model no.0205010) will be used to assess HGS. Participants will be made to sit on a chair with an erect back (without an armrest) with the feet well supported on the floor. They will be positioned with the dominant side shoulder adducted, elbow flexed at a right angle, forearm in the mid-prone position, and wrist in 25–30° dorsiflexion. The individual will be told to press the handle of the dynamometer with a maximum-effort isometric contraction. The better of two readings will be considered for analysis with a 1-minute break between the trials to rule out fatigue [5]. This outcome will be measured at pre-intervention (T0) and at the end of the 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention.

Gait Speed by 4-metre Walk test: AWGS 2019 recommends measuring the gait speed by the time taken to walk 4 metres (m) at a normal pace as a measure of physical performance [5]. Using a carpenter's measuring tape, a 4 m walking path with no obstacles will be marked with adhesive black tape. The participants will be instructed to walk at their usual speed from the start to the endpoint and the time taken to complete the 4 m course will be noted. The speed will then be calculated by dividing the distance as a constant (4 m) by the time taken (seconds). A gait speed of ≤ 0.8m/s is considered affected [51]. The average of two trials will be considered for analysis. The outcome will be measured at pre-intervention (T0) and at the end the of 4th (T1), 8th (T2), and 12th (T3) weeks post-intervention.

Lower limb alignment by Hip-knee-ankle angle (HKA angle)

The HKA angle is defined as the angle between the mechanical axes of the femur and tibia, measured by a full-length lower limb radiograph. This is the best estimate of mechanical alignment. The X-ray measurements will be taken by a qualified radiology technician. Participants will undergo full-length lower limb radiographs in a weight-bearing position without footwear, with the tibial tubercles/patella facing forwards. A single exposure anteroposterior radiograph will be obtained using a 51 × 14 inch graduated grid cassette. The two images of the X-ray will be stitched together into a single film image from the pelvis to the bilateral feet with the help of software. The angle marking will be done by the principal investigator to maintain reliability, who will be trained to mark the angle by a radiologist [12]. The HKA will be noted for both sides in units of degrees at pre-intervention (T0), and 12 weeks (T3) post-intervention.

The HKA angle will be marked as per the reference article. The mechanical axis of the femur (FM) will be drawn from the centre of the head of the femur to the centre of the femoral intercondylar point. The mechanical axis of the tibia (TM) will be drawn from the tibial interspinous point to the tibial midplafond. By extending both the FM and TM lines, the angle formed at the point of their intersection is the HKA angle [12]. The angle will be measured by software. For the knee in neutral alignment, the HKA angle is approximately 1–1.5° varus. However, in healthy individuals, the HKA can vary between 1° valgus and 3.2°varus [52].

Secondary/patient-reported functional outcomes: These outcomes will be assessed at pre-intervention (T0), and 12 weeks (T3) post-intervention, where the participants will be provided with printed questionnaires in their regional language. If the participant is illiterate, it will be read out and filled in. The below-mentioned two questionnaires will be translated and back-translated into the required regional languages for the participants who are not conversant in the English language.

36-Item short form health survey: The 36-item short form survey (SF-36) is a standard, reliable, and valid instrument for evaluating Health-Related Quality of Life (HRQOL) in the elderly and adult population. It is a 36-item questionnaire that measures eight parameters of health status with scores from 0 to 100. Higher scores indicate better health status and a mean score of 50 is considered a normative value [53].

Perceived Stress Scale: This is a classic stress assessment instrument that helps to measure individual stress levels. This is a self-administered questionnaire where the questions are asked about one's feelings in the last month. Individual scores on the PSS can range from 0 to 40, with higher scores indicating higher perceived stress [35].

Sample size

The required sample size was calculated based on a previous study considering the waist circumference outcome parameter [18, 24]. The expected mean difference ($x_1 - x_2$) was assumed as 3.6 = *d*. The *SD* values were S1 = 9.8 (Yoga) and S2 = 4.6 (HIIT). With these available values and assumptions, the following formula was applied: $n = 2S^2(Z_{1-\alpha} + Z_{1-\beta})^2 / (x_1 - x_2)^2$, where S = S1 + S2/2 = 7.1, $Z_{1-\alpha}$= 1.96 at 5% α error, $Z_{1-\beta}$ = 1.037 at 85% power, $d = x_1 - x_2 = 3.65$. Hence, the sample size was calculated as 68 in each group. Considering a 20% dropout rate (with the formula n / 1-*d*, where d is the percent dropout) the net total sample resulted in 80 participants in each study group [54].

Safety monitoring

All participants will provide physical fitness approval to participate in the protocol from their family physician. The ex-

pected adverse events will be any joint inflammatory signs or swellings, injuries, light-headedness, chest discomfort, etc. during the exercise session. Should any such adverse event occur, the Ethical Review Committee will be informed, and the participant will be dropped and referred for further investigations and management.

Data management

The data will be fed into MS Excel and tabulated in an Excel spreadsheet, ensuring anonymity. These records will be stored securely with access only to the principal investigator. The intervention groups will be named A & B to keep the statistician blinded. The data will not be shared with anyone without coding or de-identification of participants.

Statistical methods

Statistical analysis will be performed with the SPSS software version 28.0 (SPSS, Inc. Chicago, IL, USA) Descriptive and inferential statistical analysis will be carried out for the collected data. Quantitative variables will be presented as means and standard deviations. Test for normality of distribution will be conducted, based on which, parametric (*Z* test and/or ANCOVA) or non-parametric (Mann–Whitney *U* test or the Wilcoxon signed-rank test) tests will be performed. The primary effect analysis will be by the intention-to-treat principle. A probability value of less than 0.05 will be considered statistically significant.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the KLE Academy of Higher Education and Research ethical committee for human subjects for Ph.D. research ref. no. KAHER/EC/21-22/018.

Informed consent

Each participant will be required to sign a written consent form for the study. The patient information sheets and informed consent forms will be given in English and regional languages. If a participant is illiterate, the form will be read out to the participant in their regional language, and a thumb impression will be taken with the witness' signature.

Confidentiality

All information collected from this research project about participants will be kept confidential. A coded form of the group data will be made available in scientific publications/presentations. The data will be stored electronically and password protected. The authors will ensure that the names of the participants will not be published, and due efforts will be made to conceal their identities should their photographs be published.

Discussion

Women's health is a national priority rather than a personal priority. Menopause is a difficult phase in a female's life, associated with numerous challenging health issues that need to be tackled with effective strategies. An editorial suggests obesity, sarcopenia, and osteoporosis may be an interlinked triad in postmenopausal females and stresses the importance of identifying those with the triad and managing them with a well-tailored energy-restricted, high-protein diet and a resistance exercise program [4].

Physical exercise is a crucial non-pharmacological approach to promote health in the context of the ageing population, thereby preventing secondary health complications. The literature review suggests a prescription of resistance training, aerobic training, or a combination of both for the prevention or treatment of sarcopenia [15].

Considering the different nature of exercises of HIIT and Yoga, their effect may vary. HIIT is intense and alternated with active rest periods, while yoga is moderately intense with a uniform, continuous pace. The time-saving nature of HIIT, while being as effective as traditional methods, makes this training more preferred in today's era. HIIT is predominantly a dynamic exercise form, while yoga involves static and dynamic postures. However, HIIT requires strong motivation due to the high level of exertion it poses, whereas yogic postures may be felt as complex or difficult to attain. HIIT involves performing simple exercises such as brisk walking, running, jogging, or similar dynamic exercises, while yoga involves attaining and maintaining yogic postures.

Further, HIIT has been compared with MICT and other traditional exercise forms for obesity and other patient populations, indicating equal effects for both [39]. Yoga has also been compared to traditional aerobic exercises on mental and physical health outcomes, with results suggesting yoga is either equally effective or superior to traditional exercise forms [40, 41]. A literature search resulted in a study conducted on male school students comparing Pilates, power yoga, and HIIT on muscle endurance, with results suggesting HIIT to be better than the other two [42]. Another study compared the feasibility of Bikram yoga (intense yoga) with HIIT in females (20–50 years) with persistent pain, with conclusions stating both to be equally effective [43]. The outcomes of the current trial will provide insight as to what intensity and form of exercise will be effective in bringing about changes in muscle mass, muscle strength, physical functional capacity, and other obesity-related parameters.

The impact of obesity on altering the lower limb alignment, especially in the ageing population, is a known fact [54]. The change in angular alignments may lead to arthritic changes at a later stage. A recent study demonstrated that a 12-week structured exercise program that aims at strengthening knee extensors and hip abductors and fostering control of the lower-limb alignment during dynamic loading conditions improved the ability to control the knee and hip frontal plane kinematics, although with smaller effect sizes [14]. There also have been positive effects of three months of proprioceptive exercise and weight loss intervention by diet on foot posture and loading as well as knee adduction moment and lower limb alignments in elderly and OA knee patients [15, 16].

The trial outcomes will help us determine whether weight reduction will have an impact on knee malalignment and prevention of arthritic changes, thereby exploring the role of exercise and weight loss. Any angular changes that are visible due to the intervention will be confirmatory as the HKA angle is currently accepted as the gold standard measure.

Menopause and ageing are also associated with affected quality of life, mood issues, difficulties in managing stress, etc. Yoga is considered best for managing stress and improving mood [55]. As there is evidence that shows the release of good hormones by exercising, HIIT may also show improvements in mental health parameters and quality of life [56]. Hence, the trial results will also help us determine the positive effects of exercising on reducing perceived stress levels and improving health-related quality of life.

To the best of the authors' knowledge, this will be the first study to explore the impact of weight loss on angular corrections in the lower extremities and to explore the impact of HIIT on Sarcopenia and dynapenia in post-menopausal females.

Limitations

This study poses a few limitations. The body composition parameters, such as fat and muscle mass, will be measured by BIA even though DEXA would be more valid. Due to its cost of assessment, BIA is considered. However, AWGS approves both BIA and DEXA for diagnosing sarcopenia. Maintaining a fixed and consistent timing of the day for follow-up assessments for body composition measures would pose a practical difficulty during the course of the study data collection. The questionnaires used for assessing perceived stress and quality of life were translated and back-translated into regional languages. However, verification of the translated versions through separate studies was not possible before their applications to study participants.

Expected outcomes

The outcomes of the trial will determine whether high-intensity exercise or the hatha yoga approach, which is a moderate-intensity exercise, is beneficial for musculoskeletal issues of ageing females, such as sarcopenia, dynapenia, and lower limb malalignment.

The literature confirms the role of exercise in preventing and treating sarcopenia and dynapenia. The ageing population in general, and postmenopausal females, approach healthcare providers to manage musculoskeletal issues. Thus, the study findings have the potential to reveal substantial information on the role of exercise and its beneficial effects on ageing women's health, which will be of interest to clinicians, exercise trainers, physiotherapists, yoga trainers, and rehabilitation professionals.

Trial status

Presently, trial status is open to recruitment, with 45% of recruitment completed. The enrolment is estimated to be completed in November 2023.

Acknowledgements

We thank the KLE Dr. Prabhakar Kore Hospital & MRC and the KLE Institute of Physiotherapy for providing me with the required infrastructure. Our special thanks to the managers of the retirement homes of Belagavi city, Mr. Vijay More and Mr. Ramnath for permitting us to conduct exercise sessions for the eligible residents. We also thank the statistician Dr (Prof) Jawali for helping with the calculation of the sample size.

Disclosure statement

The Radiology Department, Krsnaa Diagnostics Pvt. Ltd., KLES Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi, India provided sponsoring for X-ray with 50% discounted charges for radiological films for assessment of lower limb alignment. The sponsor has and will have no input into the study conceptualisation, design, protocol writing, or manuscript writing. They also bear no interest in the results or outcomes of the study. They play no role in the decision of the authors to submit the report for publication. The authors acknowledge their support.

Conflict of interest

The radiology dept, Krsnaa Diagnostics Pvt. Ltd., KLES Dr. PK Hospital & MRC, Belagavi sponsored X-rays at a 50% discounted price. However, the funding body will have no input into the study conceptualisation, design, protocol writing, or the manuscript's writing. They also bear no interest in the results or outcomes of the study.

Dissemination policy

The study outcomes will be published in a peer-reviewed scientific journal. Authorship for publication will be based on contribution to the study completion from the phase of study idea, concept, and design until the phase of manuscript drafting and write-up.

Availability of data and materials

The trial data will be available on request to the study's Principal Investigator. At the end of the study data collection phase, the dataset will be shared on Mendeley Data, access to which will be given only to those who send requests.

Study sponsor and role

The Radiology Department, Krsnaa Diagnostics Pvt. Ltd., KLES Dr. Prabhakar Kore Hospital & Medical Research Centre, Belagavi, India provided sponsoring for X-ray with 50% discounted charges for radiological films for assessment of lower limb alignment. The sponsor has and will have no input into the study conceptualisation, design, protocol writing, or manuscript writing. They also bear no interest in the results or outcomes of the study. They play no role in the decision of the authors to submit the report for publication. The authors acknowledge their support.

References

1. Khadilkar SS. Post-reproductive health: window of opportunity for preventing comorbidities. J Obstet Gynaecol India. 2019;69(1):1–5; doi: 10.1007/s13224-019-01202-w.
2. Batsis JA, Villareal DT. Sarcopenic obesity in older adults: aetiology, epidemiology and treatment strategies. Nat Rev Endocrinol. 2018;14(9):513–537; doi: 10.1038/s41574-018-0062-9.
3. Ahuja M. Age of menopause and determinants of menopause age: a PAN India survey by IMS. J Midlife Health. 2016;7(3):126–131; doi: 10.4103/0976-7800.191012.
4. Vaidya R. Obesity, sarcopenia and postmenopausal osteoporosis: an interlinked triad. J Midlife Health. 2014;5:1–2; doi: 10.4103/0976-7800.127778.
5. Chen LK, Woo J, Assantachai P, Auyeung T-W, Chou M-Y, Iijima K, et al. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc. 2020;21(3):300–307.e2; doi: 10.1016/j.jamda.2019.12.012.
6. Tyrovolas S, Koyanagi A, Olaya B, Ayuso-Mateos JL, Miret M, Chatterji S, et al. Factors associated with skeletal muscle mass, sarcopenia, and sarcopenic obesity in older adults: a multi-continent study. J Cachexia Sarcopenia Muscle. 2016;7(3):312–321; doi: 10.1002/jcsm.12076.
7. Drenowatz C, Hand GA, Sagner M, Shook RP, Burgess S, Blair SN. The prospective association between different types of exercise and body composition. Med Sci Sports Exerc. 2015;47(12):2535–2541; doi: 10.1249/MSS.0000000000000701.
8. Baumgartner RN, Wayne SJ, Waters DL, Janssen I, Gallagher D, Morley JE. Sarcopenic obesity predicts instrumental activities of daily living disability in the elderly. Obes Res. 2004;12(12):1995–2004; doi: 10.1038/oby.2004.250.
9. Koliaki C, Liatis S, Dalamaga M, Kokkinos A. Sarcopenic obesity: epidemiologic evidence, pathophysiology, and therapeutic perspectives. Curr Obes Rep. 2019;8(4):458–471; doi: 10.1007/s13679-019-00359-9.

10. Al-Safi ZA, Polotsky AJ. Obesity and menopause. Best Pract Res Clin Obstet Gynaecol. 2015;29(4):548–553; doi: 10.1016/j.bpobgyn.2014.12.002.
11. Messier SP, Pater M, Beavers DP, Legault C, Loeser RF, Hunter DJ, et al. Influences of alignment and obesity on knee joint loading in osteoarthritic gait. Osteoarthritis Cartilage. 2014;22(7):912–917; doi: 10.1016/j.joca.2014.05.013.
12. Sheehy L, Felson D, Zhang Y, Niu J, Lam Y-M, Segal N, et al. Does measurement of the anatomic axis consistently predict hip-knee-ankle angle (HKA) for knee alignment studies in osteoarthritis? Analysis of long limb radiographs from the multicenter osteoarthritis (MOST) study. Osteoarthr Cartilage. 2011;19(1):58–64; doi: 10.1016/j.joca.2010.09.011.
13. Katsumi R, Mochizuki T, Sato T, Kobayashi K, Watanabe S, Tanifuji O, et al. Contribution of sex and body constitution to three-dimensional lower extremity alignment for healthy, elderly, non-obese humans in a Japanese population. J Exp Orthop. 2018;5(1):1–8; doi: 10.1186/s40634-018-0147-3.
14. Horsak B, Schwab C, Baca A, Greber-Platzer S, Kreissl A, Nehrer S, et al. Effects of a lower extremity exercise program on gait biomechanics and clinical outcomes in children and adolescents with obesity: a randomized controlled trial. Gait Posture. 2019;70:122–129; doi: 10.1016/j.gaitpost.2019.02.032.
15. Cho Y, Kim M, Lee W. Effect of proprioceptive training on foot posture, lower limb alignment, and knee adduction moment in patients with degenerative knee osteoarthritis: a randomized controlled trial. J Phys Ther Sci. 27(2):371–374. doi: 10.1589/jpts.272.371
16. Song J, Kane R, Tango DN, Vander Veur SS, Furmato J, Komaroff E, Foster GD. Effects of weight loss on foot structure and function in obese adults: a pilot randomized controlled trial. Gait Posture. 2015;41(1):86–92; doi: 10.1016/j.gaitpost.2014.08.013.
17. Sampaio RAC, Sewo Sampaio PY, Uchida MC, Arai H. Management of dynapenia, sarcopenia, and frailty: The role of physical exercise. J Aging Res. 2020;2020:8186769; doi: 10.1155/2020/8186769.
18. Slentz CA, Duscha BD, Johnson JL, Ketchum K, Aiken LB, Samsa GP, et al. Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE – a randomized controlled study. Arch Intern Med. 2004;164(1):31–39; doi: 10.1001/archinte.164.1.31.
19. de Mello RG, Dalla Corte RR, Gioscia J, Moriguchi EH. Effects of physical exercise programs on sarcopenia management, dynapenia, and physical performance in the elderly: a systematic review of randomized clinical trials. J Aging Res. 2019;2019:1959486; doi: 10.1155/2019/1959486.
20. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK, et al. American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc. 2009;41(2):459–471; doi: 10.1249/MSS.0b013e3181949333. Erratum in: Med Sci Sports Exerc. 2009;41(7):1532.
21. de Mello RG, Dalla Corte RR, Gioscia J, Moriguchi EH. Effects of physical exercise programs on sarcopenia management, dynapenia, and physical performance in the elderly: a systematic review of randomized clinical trials. J Aging Res. 2019;2019:1959486; doi: 10.1155/2019/1959486.
22. Barajas-Galindo DE, Arnáiz EG, Vicente PF, Ballesteros-Pomar MD. Effects of physical exercise in sarcopenia. A systematic review. Endocrinol Diabetes Nutr. 2021;68(3):159–169; doi: 10.1016/j.endinu.2020.02.010.
23. Weston KS, Wisløff U, Coombes JS. High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis. Br J Sports Med. 2014;48(16):1227–1234; doi: 10.1136/bjsports-2013-092576.
24. Maillard F, Rousset S, Pereira B, Traore A, Amaze P, Boirie Y, et al. High-intensity interval training reduces abdominal fat mass in postmenopausal women with type 2 diabetes. Diabetes Metab. 2016;42(6):433–441; doi: 10.1016/j.diabet.2016.07.031.
25. Marzuca-Nassr GN, Artigas-Arias M, Olea MA, SanMartín-Calísto Y, Huard N, Durán-Vejar F, et al. High-intensity interval training on body composition, functional capacity and biochemical markers in healthy young versus older people. Exp Gerontol. 2020;141:111096; doi: 10.1016/j.exger.2020.111096.
26. Alvarez C, Ramirez-Campillo R, Martinez-Salazar C, Castillo A, Gallardo F, Ciolac EG. High-intensity interval training as a tool for counteracting dyslipidemia in women. Int J Sports Med. 2018;39(5):397–406; doi: 10.1055/s-0044-100387.
27. Boutcher SH. High-intensity intermittent exercise and fat loss. J Obes. 2011;2011:868305; doi: 10.1155/2011/868305.
28. Sijie T, Hainai Y, Fengying Y, Jianxiong W. High intensity interval exercise training in overweight young women. J Sports Med Phys Fitness. 2012;52(3):255–262.
29. Hayes LD, Elliott BT, Yasar Z, Bampouras TM, Sculthorpe NF, Sanal-Hayes NE, et al. High intensity interval training (HIIT) as a potential countermeasure for phenotypic characteristics of sarcopenia: a scoping review. Front Physiol. 2021:12:715044; doi: 10.3389/fphys.2021.715044. eCollection 2021.
30. Horovitz EG, Elgelid S. Yoga Therapy. Theory and Practice. 1st ed. New York: Routledge/Taylor & Francis Group; 2015.
31. Cramer H, Thoms MS, Anheyer D, Lauche R, Dobos G. Yoga in women with abdominal obesity – a randomized controlled trial. Dtsch Arztebl Int. 2016;113(39):645–652; doi: 10.3238/arztebl.2016.0645.
32. Pal A, Srivastava N, Tiwari S, Verma NS, Narain VS, Agrawal GG, et al. Effect of yogic practices on lipid profile and body fat composition in patients of coronary artery disease. Complement Ther Med. 2011;19(3):122–127; doi: 10.1016/j.ctim.2011.05.001.
33. Lau C, Yu R, Woo J. Effects of a 12-Week Hatha Yoga intervention on cardiorespiratory endurance, muscular strength and endurance, and flexibility in Hong Kong Chinese adults: a controlled clinical trial. Evid Based Complement Alternat Med. 2015;2015:958727; doi: 10.1155/2015/958727.
34. Lee JA, Kim JW, Kim DY. Effects of yoga exercise on serum adiponectin and metabolic syndrome factors in obese postmenopausal women. Menopause. 2012;19(3):296–301; doi: 10.1097/gme.0b013e31822d59a2.
35. Pandya SP. Yoga education program for older women diagnosed with sarcopenia: a multicity 10-year follow-up experiment. J Women Aging. 2019;31(5):446–469; do: 10.1080/08952841.2018.1510245.
36. Buchheit M., Laursen P.B. High-intensity interval training, solutions to the programming puzzle: Part I: Cardiopulmonary emphasis. Sports Med. 2013;43(5):313–338; doi: 10.1007/s40279-013-0029-x.

37. Rajan AI, Dixit RK, Joshi AR. Effect of yoga on aerobic power, anaerobic power and audio-visual reaction time in healthy individuals. Int J Physiol. 2014;2(1):9–13; doi: 10.5958/j.2320-608X.2.1.003.
38. Foster C, Farland CV, Guidotti F, Harbin M, Roberts B, Schuette J, et. al. The effects of high intensity interval training vs steady state training on aerobic and anaerobic capacity. J Sports Sci Med. 2015;14(4):747–755.
39. Grossman JAC, Payne EK. A randomized comparison study regarding the impact of short-duration, high-intensity exercise and traditional exercise on anthropometric and body composition measurement changes in post-menopausal women – a pilot study. Post Reprod Health. 2016;22(1):14–19; doi: 10.1177/2053369115623899.
40. Abhilash SS, Joseph G. Effects of Pilates exercise, power yoga, and high-intensity interval training on muscular endurance among male school students. Int J Phys Educ Sports Health. 2019;6(1):41–43.
41. Govindaraj R, Karmani S, Varambally S, Gangadhar BN. Yoga and physical exercise – a review and comparison. Int Rev Psychiatry. 2016;28(3):242–253; doi: 10.3109/09540261.2016.1160878.
42. Ross A, Thomas S. The health benefits of yoga and exercise: a review of comparison studies. J Altern Complement Med. 2010;16(1):3–12; doi: 10.1089/acm.2009.0044.
43. Flehr A, Barton C, Coles J, Gibson SJ, Lambert GW, Lambert EA, et al. MindinBody-feasibility of vigorous exercise (Bikram yoga versus high-intensity interval training) to improve persistent pain in women with a history of trauma: a pilot randomized control trial. BMC Complement Altern Med. 2019;19:234; doi: 10.1186/s12906-019-2642-1.
44. Chan A-W, Tetzlaff JM, Gøtzsche PC, Altman DG, Mann H, Berlin JA, et al. SPIRIT 2013 explanation and elaboration: guidance for protocols of clinical trials. BMJ. 2013;346:e7586. doi: 10.1136/bmj.e7586.
45. Misra A, Vikram NK, Gupta R, Pandey RM, Wasir JS, Gupta VP. Waist circumference cutoff points and action levels for Asian Indians for identification of abdominal obesity. Int J Obes. 2006;30(1):106–111; doi: 10.1038/sj.ijo.0803111.
46. Walankar P, Verma C, Mehta A. Study of hand grip strength in Indian population. Int J Health Sci Res. 2016;6(11):162–166.
47. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ. 2014;348:g1687; doi: 10.1136/bmj.g1687.
48. Schulz KF, Altman DG, Moher D; CONSORT Group. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMJ. 2010;340:c332; doi: 10.1136/bmj.c332.
49. Keevil VL, Luben R, Dalzell N, Hayat S, Sayer AA, Wareham NJ, et al. Cross-sectional associations between different measures of obesity and muscle strength in men and women in a British cohort study. J Nutr Health Aging. 2015;19(1):3–11; doi: 10.1007/s12603-014-0492-6.
50. Hofsteenge GH, Chinapaw MJ, Weijs PJ. Fat-free mass prediction equations for bioelectric impedance analysis compared to dual-energy X-ray absorptiometry in obese adolescents: a validation study. BMC Pediatrics. 2015;15(1):158; doi 10.1186/s12887-015-0476-7.
51. Pal R, Aggarwal A, Singh T, Sharma S, Khandelwal N, Garg A, et al. Diagnostic cut-offs, prevalence, and biochemical predictors of sarcopenia in healthy Indian adults: the Sarcopenia-Chandigarh Urban Bone Epidemiological Study (Sarco-CUBES). Eur Geriatr Med. 2020;11(5):725–736; doi: 10.1007/s41999-020-00332-z.
52. Weng N, Knipe H, Rock P. 2021. Hip-knee-ankle angle. Reference article. Radiopaedia.org. Available 29.01.2021 from: https://radiopaedia.org/articles/hip-knee-ankle-angle; doi: 10.53347/rID-88254.
53. Lyons RA, Perry IM, Littlepage BN. Evidence for the validity of the Short-form 36 Questionnaire (SF-36) in an elderly population. Age Ageing. 1994;23(3):182–184; doi: 10.1093/ageing/23.3.182.
54. Gupta KK, Attri JP, Singh A, Kaur H, Kaur G. Basic concepts for sample size calculation: critical step for any clinical trials! Saudi J Anaesth. 2016;10(3):328–331; doi: 10.4103/1658-354X.174918.
55. Felson DT, Anderson JJ, Naimark A, Walker AM, Meenan RF. Obesity and knee osteoarthritis: the Framingham Sudy. Ann Intern Med. 1988;109(1):18–24; doi: 10.7326/0003-4819-109-1-18.
56. Sharifi N, Afshari F, Bahri N. The effects of yoga on quality of life among postmenopausal women: A systematic review study. Post Reprod Health. 2021;27(4):215–221; doi: 10.1177/20533691211046152.

Appendix 1. SPIRIT 2013 checklist: recommended items to address in a clinical trial protocol and related documents*

Section / Item	Item No.	Description	Checklist
ADMINISTRATIVE INFORMATION			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	√
Trial registration	2a	Trial identifier and registry name. If not yet registered, the name of intended registry	√
	2b	All items from the World Health Organization Trial Registration Data Set	√
Protocol version	3	Date and version identifier	
Funding	4	Sources and types of financial, material, and other support	√
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	√
	5b	Name and contact information for the trial sponsor	√
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	√
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	N/A
INTRODUCTION			
Background and rationale	6a	Description of research question and justification for undertaking the trial, including a summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	√
	6b	Explanation for choice of comparators	√
Objectives	7	Specific objectives or hypotheses	√
Trial design	8	Description of trial design including type of trial (e.g., parallel-group, crossover, factorial, single group), allocation ratio, and framework (e.g., superiority, equivalence, noninferiority, exploratory)	√
METHODS: PARTICIPANTS, INTERVENTIONS, AND OUTCOMES			
Study setting	9	Description of study settings (e.g., community clinic, academic hospital) and list of countries where data will be collected. Reference to where the list of study sites can be obtained	√
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	√
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	√
	11b	Criteria for discontinuing or modifying allocated replication, including how and when they will be administered	√
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (e.g., drug tablet return, laboratory tests)	√
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	√
Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (e.g., systolic blood pressure),analysis metric (e.g., change from baseline, final value, time to event), method of aggregation (e.g., median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	√
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure 2)	√
Sample size	14	Estimated number of participants needed to achieve the study Objectives and how it was determined, including clinical and Statistical assumptions supporting any sample size calculations	√
Recruitment	15	Strategies for achieving adequate participant enrolment to reach the target sample size	√
METHODS: ASSIGNMENT OF INTERVENTIONS (FOR CONTROLLED TRIALS)			
Allocation			
Sequence generation	16a	Method of generating the allocation sequence (e.g., computer-generated random numbers), and list of any factors for stratification. To reduce the predictability of a random sequence, details of any planned restriction (e.g., blocking) should be provided in a separate document that is unavailable to those who enroll participants or assign interventions	√
Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (e.g., central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	√
Implementation	16c	Who will generate the allocation sequence, who will enroll participants, and who will assign participants to interventions	√

Blinding (masking)	17a	Who will be blinded after assignment to interventions (e.g., trial participants, care providers, outcome assessors, data analysts), and how	√
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	√
METHODS: DATA COLLECTION, MANAGEMENT, AND ANALYSIS			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	√
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	√
Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (e.g., double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	√
Statistic al method s	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	√
	20b	Methods for any additional analyses (e.g., subgroup and adjusted analyses)	√
	20c	Definition of analysis population relating to protocol non-adherence (e.g., as randomised analysis), and any statistical methods to handle missing data (e.g., multiple imputation)	√
METHODS: MONITORING			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	N/A
	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	√
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	N/A
ETHICS AND DISSEMINATION			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board(REC/IRB) approval	√
Protocol amendments	25	Plans for communicating important protocol modifications (e.g., changes to eligibility criteria, outcomes, analyses) to relevant parties (e.g., investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	√
Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	√
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	N/A
Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	√
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	√
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	√
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	N/A
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (e.g., via publication, reporting in results databases, or other data-sharing arrangements), including any publication restrictions	√
	31b	Authorship eligibility guidelines and any intended use of professional writers	√
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	√
APPENDICES			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	√
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	N/A

* It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license. [Informed consent Model: will be produced on request]

Appendix 2. The TIDieR (Template for Intervention Description and Replication) checklist*: information to include when describing an intervention and the location of the information

Item number	Item	Where located**	
		Primary paper (page or appendix number)	Other† (details)
BRIEF NAME			
1.	Provide the name or a phrase that describes the intervention.	Title page	
WHY			
2.	Describe any rationale, theory, or goal of the elements essential to the intervention.	Pg 4	
WHAT			
3.	Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in the training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	Pg 7–9	
4.	Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	Pg 6–9	
WHO PROVIDED			
5.	For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	Pg 6, 7, 9	
HOW			
6.	Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	Pg 5, 6	
WHERE			
7.	Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	Pg 5, 6	
WHEN and HOW MUCH			
8.	Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.	Pg 6; Table 1, 2	
TAILORING			
9.	If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.	Pg 6; Table 1, 2	
MODIFICATIONS			
10.‡	If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).	N/A	
HOW WELL			
11.	Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.	Pg 7	
12.‡	Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.	N/A	

** Authors – use N/A if an item is not applicable for the intervention being described. Reviewers – use '?' if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

‡ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

* We strongly recommend using this checklist in conjunction with the TIDieR guide (see BMJ 2014;348:g1687) which contains an explanation and elaboration for each item.

* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a randomised trial is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see www.consort-statement.org) as an extension of Item 5 of the CONSORT 2010 Statement. When a clinical trial protocol is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of Item 11 of the SPIRIT 2013 Statement (see www.spirit-statement.org). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see www.equator-network.org).

Appendix 3. CERT: Consensus on Exercise Reporting Template. A checklist for what to include when reporting exercise programs

Section / Topic	Item #	Checklist item	Location**	
			Primary paper (page, table, appendix)	Other† (paper or protocol, website (URL)
WHAT: materials	1	Detailed description of the type of exercise equipment (e.g. weights, exercise equipment such as machines, treadmill, bicycle ergometer etc.)	Pg 7–9	
WHO: provider	2	Detailed description of the qualifications, teaching/supervising expertise, and/or training undertaken by the exercise instructor	Pg 6–9	
HOW: delivery	3	Describe whether exercises are performed individually or in a group	Pg 5, 6	
	4	Describe whether exercises are supervised or unsupervised and how they are delivered	Pg 5, 6	
	5	Detailed description of how adherence to exercise is measured and reported	Pg 7	
	6	Detailed description of motivation strategies	Pg 7	
	7a	Detailed description of the decision rule(s) for determining exercise progression	Pg 7	
	7b	Detailed description of how the exercise program was progressed	Pg 6	
	8	Detailed description of each exercise to enable replication (e.g. photographs, illustrations, video etc.)	N/A	
	9	Detailed description of any home program component (e.g. other exercises, stretching etc.)	Pg 6; Tables 1, 2	
	10	Describe whether there are any non-exercise components (e.g. education, cognitive	Pg 6	
	11	Describe the type and number of adverse events that occurred during exercise	N/A (Pg 7 / protocol paper)	
WHERE: location	12	Describe the setting in which the exercises are performed	Pg 4, 5	
WHEN, HOW MUCH: dosage	13	Detailed description of the exercise intervention including, but not limited to, number of exercise repetitions / sets / sessions, session duration, intervention/program duration etc.	Pg 4, 5; Tables 1, 2	
TAILORING: what, how	14a	Describe whether the exercises are generic (one size fits all) or tailored whether tailored to the individual	Pg 6	
	14b	Detailed description of how exercises are tailored to the individual	Pg 5, 6; Tables 1, 2	
	15	Describe the decision rule for determining the starting level at which people commence an exercise program (such as beginner, intermediate, advanced etc.)	Tables 1, 2	
HOW WELL: planned, actual	16a	Describe how adherence or fidelity to the exercise intervention is assessed/measured	Pg 7	
	16b	Describe the extent to which the intervention was delivered as planned	N/A (protocol paper)	

The CERT Checklist is designed for reporting details of an exercise intervention. The CERT Checklist should be used in conjunction with a reporting checklist appropriate for the study type e.g. the CONSORT Statement (www.consort-statement.org) for randomised controlled trials, the SPIRIT Statement (www.spirit-statement.org) for a clinical trial protocol. For further guidance regarding reporting guidelines please consult the EQUATOR network (www.equator-network.org)

** Authors – please use N/A if an item is not applicable. Reviewers – please use "?" if information is not provided or not/insufficiently reported

† If the information is not provided in the primary paper that is under consideration, please provide details of where this information is available e.g. in a published protocol, published papers (provide citation details) or on a website (provide the URL).