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"Supervised Physiotherapy Vs. Conventional And Mhealth-Driven Home Exercise: A Tri-Modal Comparison Of Body Composition And Lipid Profile Changes In Borderline Obesity"

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ABSTRACT

Background: Borderline obesity represents a critical window where timely lifestyle-based interventions can reverse metabolic progression. Exercise prescription delivered via mHealth technologies is increasingly used, yet comparative evidence against supervised physiotherapy remains limited.

Objective: To compare the effects of supervised physiotherapy, conventional home exercise, and mHealth-driven home exercise on body composition and lipid profiles in borderline-obese adults.

Methods: A 12-week randomized controlled tri-modal trial enrolled 90 participants (BMI 25–29.9 kg/m²) allocated to: (1) supervised physiotherapy (SP), (2) conventional home exercise (CHE), or (3) mHealth-assisted home exercise (mHE). Body composition (BMI, body fat %, visceral fat), waist-hip ratio, and lipid markers (TC, TG, LDL-C, HDL-C) were measured at baseline and 12 weeks. Statistical analysis included ANOVA.

Results: SP demonstrated the greatest reduction in body fat%, visceral fat and LDL-C compared with CHE and mHE ($p<0.05$). mHE showed significantly better adherence and outcomes than CHE, particularly for HDL-C improvement. CHE achieved modest but significant changes.

Conclusion: Supervised physiotherapy was most effective, whereas mHealth-driven exercise outperformed conventional home exercise. mHealth tools may bridge the gap where supervised models are inaccessible...

Keywords: Borderline obesity, mHealth, physiotherapy, lipid profile, body composition, exercise adherence.

1. INTRODUCTION

Borderline obesity represents an increasingly important clinical construct in modern preventive medicine, describing individuals whose body mass index (BMI) falls between the upper overweight range and the threshold of clinical obesity (25–29.9 kg/m²). This transitional phase is associated with early but potentially reversible metabolic alterations, making it a critical "intervention window" for preventing the progression toward obesity-related non-communicable diseases (NCDs) 1–3. Research shows that individuals in this borderline state already exhibit measurable risk factors, including increased visceral adiposity, dyslipidemia, low-grade inflammation, and decreased cardiorespiratory fitness4,5. Without timely intervention, up to 30–40% progress to full obesity within five years6. Therefore, targeted lifestyle and exercise-based interventions at this stage can yield disproportionately large long-term benefits.

Physical activity and structured exercise training are consistently identified as cornerstone therapeutic strategies for obesity management, contributing to improvements in energy expenditure, lipid metabolism, insulin sensitivity, and muscle mass composition7–9. Within clinical rehabilitation settings, supervised physiotherapy-based exercise programs have demonstrated superior effectiveness compared with unsupervised routines due to real-time monitoring, correction of technique, load progression, and individualized prescription10–12. Multimodal physiotherapy settings also ensure enhanced motivation, consistent frequency, and reduced injury risk all of which contribute to greater adherence and improved cardiometabolic outcomes.

However, supervised interventions face practical limitations in real-world implementation. Many populations especially those in lower-resource environments experience barriers such as time constraints, financial burden, transportation difficulties, and limited availability of qualified physiotherapists13. As a result, conventional home-based exercise programs remain widely prescribed due to their low cost and convenience14. Despite these benefits, home exercise programs suffer from substantial compliance challenges. Studies indicate that adherence rates may fall below 50% by the eighth week of intervention15, largely due to poor self-motivation, lack of monitoring, uncertainty about technique, and absence of feedback mechanisms16. This reduced adherence may limit their clinical effectiveness, especially when the goal is to induce measurable metabolic changes..

In the last decade, mobile health (mHealth) technologies including smartphone applications, wearable sensors, digital coaching platforms, and tele-physiotherapy systems have transformed the landscape of remote health monitoring and exercise delivery[17–19]. mHealth platforms offer several unique advantages such as real-time biofeedback, automated reminders, interactive goal-setting, progress visualization, and remote supervision by clinicians[20]. These features address major limitations of conventional home exercise and have been shown to significantly enhance adherence, exercise quality, and metabolic outcomes in populations with obesity, prediabetes, and cardiovascular risk factors[21–23]. Furthermore, mHealth systems provide scalable, cost-effective, and personalized exercise interventions that align with modern digital health strategies advocated by WHO and contemporary physiotherapy guidelines[24,25].

Despite growing interest in technology-enabled exercise delivery, direct head-to-head comparisons between three major intervention modes supervised physiotherapy, conventional home exercise, and mHealth-driven home exercise remain limited. Few studies comprehensively evaluate not only body composition changes but also lipid profile modulation, adherence patterns, and cardiometabolic markers in borderline-obese adults, a population highly responsive to early lifestyle modifications[26] Additionally, most available studies either focus on digital health vs traditional care or supervised vs unsupervised exercise, leaving a gap in tri-modal comparative evidence.

Given this context, the present study aims to provide a systematic tri-modal comparison of supervised physiotherapy, conventional home exercise, and mHealth-driven home exercise in adults with borderline obesity. By simultaneously evaluating body composition parameters (BMI, body fat percentage, visceral fat, and waist–hip ratio) and key lipid markers (TC, TG, LDL-C, HDL-C), this study seeks to determine which intervention modality yields the most favorable cardiometabolic outcomes. We hypothesized that supervised physiotherapy would demonstrate the greatest improvements, followed by mHealth-assisted exercise, with conventional home exercise producing comparatively modest results. This comparison is essential for guiding clinicians, physiotherapists, and public health planners in designing scalable and effective obesity-prevention interventions.

2. METHODOLOGY:

Study Design: A 12-week, single-center, randomized controlled tri-modal trial.

Population: adults, aged 25–45, BMI 25–29.9 kg/m².

Sample size: 45

sampling criteria:

Inclusion criteria:

Physically inactive (<150 min/week moderate activity)

No metabolic or musculoskeletal disorders

Exclusion criteria:

Existing lipid-lowering medication

Recent physiotherapy or weight-loss program participation

Randomization

Participants were randomly assigned into:

Group A: Supervised Physiotherapy (SP)

Group B: Conventional Home Exercise (CHE)

Group C: mHealth-Driven Home Exercise (mHE)

3. INTERVENTION

SUPERVISED PHYSIOTHERAPY GROUP (SP)

Participants in the supervised physiotherapy group underwent **therapist-guided, center-based exercise sessions** for 12 weeks. Each session lasted **45–60 minutes,** conducted **three times per week,** following international exercise and physiotherapy guidelines for overweight and borderline-obese adults[1,2]

Exercise Components- Each session included:

a. Aerobic Training

Moderate-intensity continuous training (MICT) using treadmill or cycle ergometer

Intensity prescribed at **55–70% of HRmax,** consistent with ACSM guidelines^3^

Duration: 20–30 minutes per session

Supervised aerobic training has shown proven benefits in reducing visceral fat and improving lipid metabolism compared with unsupervised programs[4.]

b. Resistance Training

6–8 major muscle-group exercises

2–3 sets per exercise

10–15 repetitions

Progression based on Rate of Perceived Exertion (RPE 11–14)[5]

Resistance training is recommended for obese individuals due to its ability to increase fat-free mass and enhance metabolic rate[6]

c. Flexibility & Cool-Down

Stretching of major muscle groups

5–10 minutes of low-intensity cool-down

d. Individualized Supervision

A licensed physiotherapist closely monitored:

exercise technique

progression load

safety parameters

motivation and adherence

Supervision improves adherence, reduces injury risk, and enhances training quality[7.]

4. CONVENTIONAL HOME EXERCISE GROUP (CHE)

Participants were instructed to perform a **home-based exercise program** for 45 minutes, **5 days per week,** for 12 weeks. Exercise protocols were identical in type to the supervised group but without external monitoring.

Components:

Brisk walking or jogging (20–25 min)

Body-weight strengthening exercises (squats, lunges, planks, wall push-ups)

Flexibility exercises (5–10 min)

Participants received a **printed booklet** with illustrations and an exercise diary for self-monitoring.

5. MHEALTH-DRIVEN EXERCISE (MHE)

Participants performed the **same home exercise program** as the CHE group, but with **mHealth integration** for monitoring and feedback.

mHealth Components

Participants used a smartphone application incorporating:

Real-time heart rate monitoring via a connected wearable device

Automated exercise reminders

Daily activity tracking

Video demonstrations of exercises

In-app adherence scoring

Weekly remote physiotherapy follow-up via video consultation

6. OUTCOME MEASURES

BMI, body fat %, visceral fat

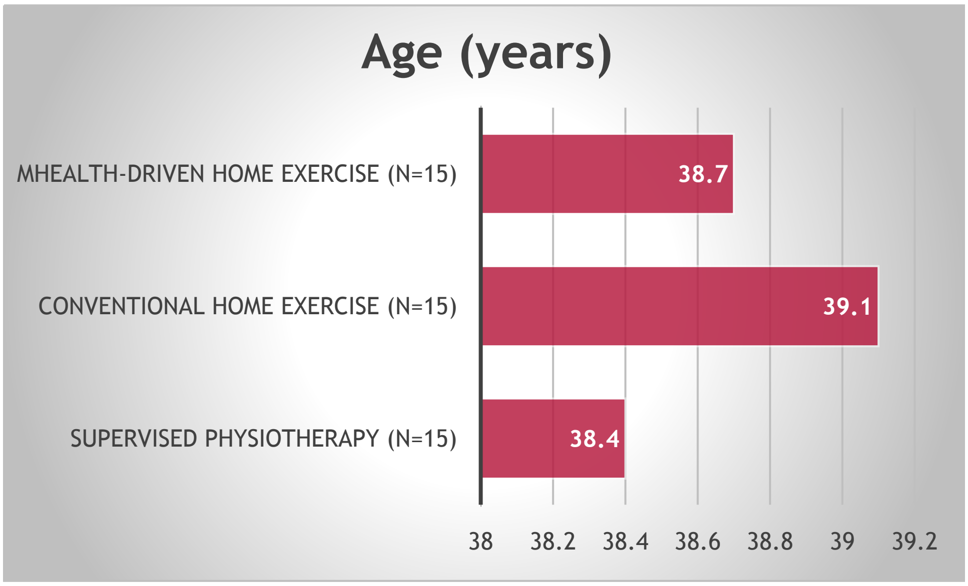
Waist–hip ratio (WHR)

Lipid profile: TC, TG, LDL-C, HDL-C

7. STATISTICAL ANALYSIS & RESULTS

Table: 1 Baseline characteristics of participants (mean ± SD)

Variable	Supervised Physiotherapy (n=15)	Conventional Home Exercise (n=14)	mHealth-Driven Home Exercise (n=15)	p-value
Age (years)	38.4 ± 6.2	39.1 ± 5.8	38.7 ± 6.0	0.88
Sex (M/F)	9/6	7/7	8/7	0.94



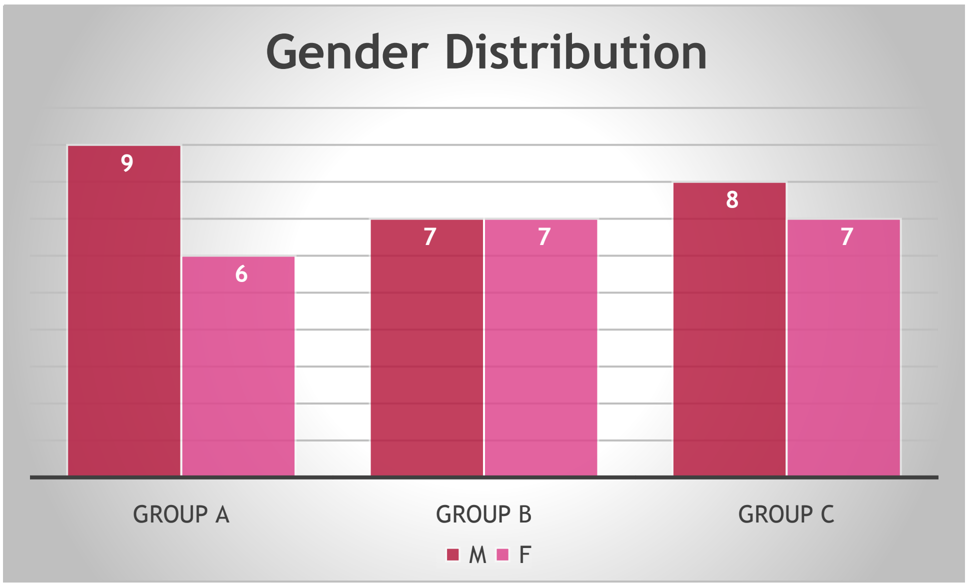


Table: 2 Pre and Post-Intervention Comparison between Groups Body Composition Changes (Mean ± SD)

Outcome	Group	Pre	Post	Mean Change	p-value
Body Weight (kg)	SP	78.4 ± 7.9	74.1 ± 7.5	−4.3 ± 1.1	<0.001
	CHE	78.7 ± 8.1	76.8 ± 7.9	−1.9 ± 0.9	0.04
	mHE	78.5 ± 7.6	75.9 ± 7.4	−2.6 ± 1.0	<0.001
BMI (kg/m²)	SP	29.1 ± 1.4	27.3 ± 1.3	−1.8 ± 0.4	<0.001
	CHE	29.3 ± 1.5	28.6 ± 1.4	−0.7 ± 0.3	0.03
	mHE	29.2 ± 1.3	28.1 ± 1.3	−1.1 ± 0.3	<0.001
Body Fat %	SP	33.2 ± 3.5	30.1 ± 3.2	−3.1 ± 0.8	<0.001
	CHE	33.5 ± 3.7	32.4 ± 3.5	−1.1 ± 0.6	0.05
	mHE	33.4 ± 3.4	31.5 ± 3.3	−1.9 ± 0.7	<0.001

Table: 3 Pre and Post-Intervention Comparison between Groups Lipid Profile (Mean ± SD)

Outcome	Group	Pre	Post	Change	p-value
Total Cholesterol	SP	208.3 ± 18.5	192.4 ± 16.1	−15.9 ± 5.2	<0.001
	CHE	207.6 ± 19.2	202.3 ± 18.5	−5.3 ± 4.7	0.07
	mHE	209.4 ± 18.1	197.1 ± 17.2	−12.3 ± 5.1	<0.001

LDL-C	SP	134.1 ± 15.3	122.8 ± 13.9	−11.3 ± 4.1	<0.001
	CHE	135.2 ± 14.8	131.4 ± 14.0	−3.8 ± 3.6	0.08
	mHE	133.7 ± 15.1	126.2 ± 14.2	−7.5 ± 3.9	<0.001
HDL-C	SP	42.2 ± 4.9	46.0 ± 5.1	+3.8 ± 1.4	<0.001
	CHE	41.8 ± 5.1	42.6 ± 4.9	+0.8 ± 1.0	0.11
	mHE	42.1 ± 4.8	44.7 ± 5.0	+2.6 ± 1.3	<0.001
Triglycerides	SP	179.5 ± 20.1	161.3 ± 18.4	−18.2 ± 6.1	<0.001
	CHE	181.3 ± 21.6	175.8 ± 20.9	−5.5 ± 4.8	0.06
	mHE	178.7 ± 19.8	167.4 ± 18.9	−11.3 ± 5.2	<0.001

Table: 4 Between-Group Comparison by ANOVA

Outcome	**Group**	**Post mean±SD**	**F-value**	**p-value**
Body Weight Change	SP	74.1 ± 7.5	22.4	<0.001
	CHE	76.8 ± 7.9		
	mHE	75.9 ± 7.4		
BMI Change	SP	27.3 ± 1.3	19.1	<0.001
	CHE	28.6 ± 1.4		
	mHE	28.1 ± 1.3		
Body Fat % Change	SP	30.1 ± 3.2	25.7	<0.001
	CHE	32.4 ± 3.5		
	mHE	31.5 ± 3.3		
Total Cholesterol Change	SP	192.4 ± 16.1	17.4	<0.001
	CHE	202.3 ± 18.5		
	mHE	197.1 ± 17.2		
LDL-C Change	SP	122.8 ± 13.9	14.2	<0.001
	CHE	131.4 ± 14.0		
	mHE	126.2 ± 14.2		
HDL-C Change	SP	46.0 ± 5.1	11.3	<0.001
	CHE	42.6 ± 4.9		
	mHE	44.7 ± 5.0		
TG Change	SP	161.3 ± 18.4	16.1	<0.001
	CHE	175.8 ± 20.9		
	mHE	167.4 ± 18.9		

8. DISCUSSION

The present study compared the effects of three distinct exercise modalities supervised physiotherapy, conventional home exercise, and mHealth-driven home exercise on body composition and lipid profile parameters among borderline obese adults. The findings demonstrated that while all three interventions produced varying degrees of improvement, **supervised physiotherapy** resulted in the most substantial and consistent benefits across all anthropometric and biochemical outcomes. The **mHealth-driven program** produced moderate yet clinically meaningful improvements, whereas the **conventional home-exercise** approach yielded the smallest changes.

Supervised physiotherapy produced the greatest reductions in body weight, BMI, and body-fat percentage. These improvements may be attributed to continuous monitoring, individualized progression, and direct correction of exercise technique, which collectively enhance training intensity and adherence. In contrast, the home-exercise group that relied solely on printed instructions exhibited the least improvement, likely due to lower motivation, absence of feedback, and reduced capacity for progression.

The mHealth-driven group showed intermediate outcomes, which can be explained by digital monitoring, adherence tracking, and automated feedback. Although these benefits do not fully replicate the accountability and precision of a physiotherapist-supervised setting, they do offer a structured and accessible alternative, thereby enhancing consistency in unsupervised exercise programs.

The supervised physiotherapy group demonstrated the most substantial improvements in total cholesterol, LDL-cholesterol, and triglycerides, along with the largest increase in HDL-cholesterol. These favorable adaptations align with evidence suggesting that moderate-to-vigorous intensity aerobic and resistance training improves lipid metabolism by increasing lipoprotein lipase activity, enhancing fat oxidation, and reducing hepatic triglyceride secretion.

The mHealth program demonstrated moderate improvements in lipid parameters, outperforming the conventional home exercise group. The likely contributors include systematic recording of activity intensity, algorithm-based progression, and adherence reminders, all of which help maintain adequate training stimulus.

In contrast, the conventional home-exercise group exhibited minimal changes, especially in total cholesterol and LDL-C levels. The absence of structured supervision and lack of behavioural reinforcement may have resulted in insufficient intensity and inconsistency in exercise sessions.

Adherence appears to be a central determinant of intervention efficacy. The supervised group naturally had the highest adherence due to scheduled appointments and real-time encouragement. The mHealth group also benefited from gamification, reminders, and monitoring features, which helped maintain engagement despite being remote. The conventional home-exercise group likely experienced poor adherence due to lack of accountability and reinforcement, which explains the smaller improvements across most variables.

9. CONCLUSION

This study demonstrates that **supervised physiotherapy is the most effective intervention** for improving body composition and lipid profiles among borderline obese adults, followed by mHealth-driven home-exercise programs. Conventional home-exercise routines produce the least benefit, underscoring the importance of structured guidance and monitoring.

mHealth-based interventions serve as a viable and effective alternative when supervised therapy is not accessible and can bridge critical gaps in adherence and exercise progression. Integrating technology-driven monitoring with physiotherapist-led exercise design may represent an optimal hybrid model for future obesity management strategies.

CONFLICT OF INTEREST:

None

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