EFFECTS OF HIIT, LISS, AND PHA ON BODY COMPOSITION: THE ROLE OF STANDARDIZED MEASUREMENTS AND SUBJECTIVE PERCEPTIONS IN HEALTH PROMOTION

Felice Di Domenico
Pegaso University
fldidomenico@gmail.com

Double Blind Peer Review

Citation
Di Domenico, F. (2026). Effects of hiit, liss, and pha on body composition: The role of standardized measurements and subjective perceptions in health promotion. *Italian Journal of Health Education, Sport and Inclusive Didactics*, *10*(2). https://doi.org/10.32043/gsd.v10i2.2005

Doi: https://doi.org/10.32043/gsd.v10i2.2005

Copyright notice:
© 2026 The Author(s). This is an open access, peer-reviewed article published by Cares S.r.l. – REN Press and distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

renpress.it/index.php/gsdj
ISSN: 3103-5744

ABSTRACT
High-Intensity Interval Training (HIIT), Peripheral Heart Action (PHA) training, and Low-Intensity Steady-State (LISS) exercise are among the most commonly adopted exercise models in health-oriented fitness and personal training settings. Although each modality has demonstrated beneficial effects on body composition and well-being, evidence integrating anthropometric and psychophysical adaptations across these approaches remains limited, particularly when standardized assessment procedures are employed. This study aimed to provide an integrated comparative analysis of anthropometric and psychophysical adaptations observed across three pilot interventions involving HIIT, PHA, and LISS conducted under comparable real-world personal training conditions. An integrated secondary analysis was performed on three quasi-experimental pilot studies involving physically active adults who completed supervised 12-week exercise interventions. All protocols were performed three times per week and monitored through heart rate control. Anthropometric outcomes were assessed using standardized International Society for the Advancement of Kinanthropometry (ISAK) procedures and included body mass, body mass index (BMI), circumferences, skinfold thicknesses, adipose mass, muscle mass, and somatotype components. Subjective perceptions of psychophysical well-being and perceived performance improvements were also examined. Findings from the three studies were comparatively integrated and interpreted. All exercise modalities produced significant improvements in body composition. Significant reductions in body mass, BMI, waist circumference, adipose mass, and endomorphy were observed within groups (all p < 0.05).

KEYWORDS
High-intensity interval training; peripheral heart action; lowintensity steady-state exercise; body composition; anthropometry.

Received 2026-05-22
Accepted 2026-06-22
Published 2026-07-31

1. Introduction

Regular physical activity is universally recognized as one of the most effective non-pharmacological strategies for health promotion, chronic disease prevention, and quality of life enhancement. Recent international guidelines emphasize that participation in structured exercise programs contributes to reducing cardiovascular risk, improving body weight management, enhancing body composition, and maintaining functional capacity throughout the lifespan (Bull et al., 2020; Pedersen & Saltin, 2015). At the same time, scientific evidence suggests that physical exercise should not be considered merely a physiological stimulus, but rather a multidimensional experience capable of influencing cognitive, emotional, and perceptual domains, thereby contributing to overall psychophysical well-being (Raiola et al., 2022; Ensrud-Skraastad & Haga, 2020; Ceruso et al., 2019). In recent years, there has been increasing interest in different exercise methodologies aimed at improving health and body composition. Among these, High-Intensity Interval Training (HIIT), Low-Intensity Steady-State (LISS) exercise, and Peripheral Heart Action (PHA) training represent three widely adopted approaches in fitness, personal training, and health-oriented exercise settings. Although all three methodologies share the common objective of promoting favorable metabolic and functional adaptations, they differ substantially in exercise intensity, training structure, neuromuscular involvement, and psychophysiological responses. High-Intensity Interval Training (HIIT) is characterized by alternating short periods of vigorous exercise with active or passive recovery intervals. Due to its high time efficiency, this methodology has received considerable attention from the scientific community. Numerous studies have demonstrated that HIIT can improve cardiorespiratory fitness, insulin sensitivity, energy metabolism, and body composition across different populations, including

physically active individuals, sedentary adults, and clinical populations (Gibala et al., 2012; Milanović et al., 2015; Weston et al., 2014). These adaptations appear to be associated with physiological mechanisms such as enhanced mitochondrial biogenesis, improved lipid oxidation, and increased excess post-exercise oxygen consumption (EPOC), which contributes to greater overall energy expenditure (Li et al., 2025; Little et al., 2010). Furthermore, the neuromuscular demands imposed by high-intensity exercise may facilitate the preservation of muscle mass during reductions in body fat (Longo et al., 2022). In contrast, Low-Intensity Steady-State (LISS) exercise consists of continuous aerobic activity performed at a stable moderate intensity, generally between 60% and 70% of maximal heart rate. This methodology remains one of the most commonly used approaches in programs focused on health promotion and body weight management. Although the training intensity is lower than that typically associated with HIIT, numerous studies have reported positive effects on cardiovascular health, energy metabolism, and body composition (Garber et al., 2011; Donnelly et al., 2009). An additional advantage of LISS concerns its greater perceived tolerability. Moderate-intensity continuous exercise is frequently associated with positive affective responses, lower perceived exertion, and a higher likelihood of long-term adherence to physical activity programs (Ekkekakis et al., 2011). Consequently, LISS is often regarded as a particularly suitable strategy for individuals seeking sustainability and continuity in exercise participation. Peripheral Heart Action (PHA) training represents an intermediate methodology that integrates cardiovascular and neuromuscular components within the same training session. The protocol is based on the systematic alternation of upper- and lower-body exercises, with the aim of maintaining elevated cardiovascular demand through continuous redistribution of blood flow across different body regions. Compared with traditional aerobic protocols, PHA combines metabolic and muscular stimuli

simultaneously, promoting adaptations that may influence both body composition and overall functional efficiency (Paoli et al., 2013; Staley, 1996). Despite its increasing popularity in personal training and health-oriented fitness settings, scientific evidence regarding PHA remains considerably more limited than that available for HIIT and continuous aerobic exercise. Alongside physiological and anthropometric adaptations, contemporary research has increasingly recognized the importance of psychological and perceptual dimensions associated with physical exercise. Variables such as motivation, self-efficacy, perceived well-being, satisfaction, enjoyment, and perceived performance improvements are now considered fundamental determinants of exercise adherence and long-term behavioral maintenance (Bandura, 1997; Ryan & Deci, 2000). According to Self-Determination Theory (McAnally & Hagger, 2024), perceptions of competence, autonomy, and enjoyment are among the primary factors supporting sustained participation in physical activity. Similarly, Social Cognitive Theory (Luszczynska & Schwarzer, 2005) highlights the role of perceived self-efficacy in determining an individual's ability to maintain healthy behaviors over time. From this perspective, the effectiveness of an exercise program should not be evaluated solely through physiological indicators, but also through the psychophysical and subjective responses generated by the exercise experience. Another important methodological consideration concerns body composition assessment. Many studies comparing different training methodologies rely on indirect indicators such as Body Mass Index (BMI), body weight, or bioelectrical impedance analysis. Although these methods are practical and easy to implement, they present significant limitations in terms of accuracy and sensitivity for detecting qualitative changes in body composition. In contrast, standardized anthropometric protocols proposed by the International Society for the Advancement of Kinanthropometry (ISAK) allow a more precise assessment of

skinfold thicknesses, body circumferences, somatotype components, and adipose and muscular tissues, thereby improving the validity and comparability of findings across studies (Ackland et al., 2012). Despite the growing body of literature in health-oriented exercise science, important knowledge gaps remain. First, most studies compare only two training modalities, typically HIIT and continuous aerobic exercise, whereas hybrid methodologies such as PHA have received considerably less attention. Second, available investigations predominantly focus on physiological and anthropometric outcomes, often neglecting psychological and perceptual dimensions. Third, substantial heterogeneity in training protocols, monitoring procedures, and body composition assessment methods limits the comparability of findings across studies. Finally, evidence attempting to integrate and jointly interpret the anthropometric and psychophysical adaptations associated with HIIT, PHA, and LISS within comparable applied settings remains scarce. A better understanding of the specific adaptive characteristics associated with these three methodologies could provide valuable guidance for exercise professionals, kinesiologists, and personal trainers involved in designing individualized exercise programs. In particular, understanding how different training models simultaneously influence body composition, perceived well-being, and exercise responses may contribute to optimizing exercise prescription according to individual goals, psychological characteristics, and exercise tolerance. Therefore, the aim of the present study was to provide an integrated comparative analysis of the anthropometric and psychophysical adaptations observed across three pilot studies investigating the effects of High-Intensity Interval Training, Peripheral Heart Action Training, and Low-Intensity Steady-State Exercise in physically active adults participating in supervised real-world personal training programs. Specifically, the study sought to integrate evidence regarding changes in body composition, somatotype characteristics, and

subjective perceptions of psychophysical well-being in order to identify both common and modality-specific adaptation patterns. It was hypothesized that all three exercise modalities would produce favourable anthropometric adaptations, although differences would emerge in the magnitude of metabolic responses, neuromuscular characteristics, and psychological perceptions associated with the training experience.

2. Materials and Methods

2.1. Study Design

The present study was conceived as an integrated comparative analysis of three previously conducted quasi-experimental pilot studies performed within a real-world supervised personal training setting. The original studies compared the effects of High-Intensity Interval Training (HIIT) and Low-Intensity Steady-State Exercise (LISS), HIIT and Peripheral Heart Action Training (PHA), and LISS and PHA, respectively. All interventions were conducted within the same operational environment, using comparable methodological procedures and standardized assessment protocols, thereby enabling an integrated analysis of the observed adaptations. Each intervention lasted 12 weeks and consisted of three supervised training sessions per week. Anthropometric assessments were performed at baseline (T0) and at the end of the intervention (T1). Subjective perceptions related to psychophysical well-being and perceived performance improvements were collected at the conclusion of the training period. The integrated analysis was designed to identify both common and modality-specific adaptation patterns associated with HIIT, PHA, and LISS while maintaining the high ecological validity derived from the implementation of the interventions in a real-world supervised exercise setting.

2.2. Participants

A total of 36 physically active adults (18 men and 18 women) participated in the studies. Participants were recruited through convenience sampling among regular clients of a personal training studio located in the province of Salerno, Italy. The overall sample (n = 36) was divided into three training groups: High-Intensity Interval Training (HIIT; n = 12), Peripheral Heart Action Training (PHA; n = 12), and Low-Intensity Steady-State Exercise (LISS; n = 12). Within the integrated study, three pairwise comparisons were subsequently conducted (HIIT vs. LISS, HIIT vs. PHA, and LISS vs. PHA), using the same experimental groups and identical assessment procedures. Consequently, the present work represents an integrated comparative analysis derived from cross-comparisons performed on the same overall sample.

2.3. Inclusion criteria

Participants were eligible if they:

- were between 18 and 40 years of age;
- had regularly participated in structured physical activity for at least 12 months;
- had no medical contraindications to moderate or vigorous exercise;
- were willing to participate in a supervised 12-week training program.

2.4. Exclusion criteria

Participants were excluded if they:

- had experienced musculoskeletal injuries within the previous six months;
- presented cardiovascular, metabolic, or neurological conditions incompatible with exercise participation;
- were taking medications that could significantly influence cardiovascular responses or body composition;
- participated in other structured training programs during the study period.

Group allocation in the original studies was non-randomized and based on participant availability and previous training background, in order to reflect typical operational conditions encountered in applied personal training settings. The three pairwise comparisons were derived from the same overall sample and should therefore be interpreted as complementary analyses rather than independent experimental studies. All participants provided written informed consent prior to participation. The procedures were conducted in accordance with the principles of the Declaration of Helsinki and were included within the research project *"Psychophysical perception and body awareness in educational and sports settings through observational and non-invasive tools"*, approved by the Ethics Committee of the University of Pegaso (Protocol No. Prot./E 004726, July 15, 2025).

2.5. Procedures and Instruments

All interventions were carried out in a personal training studio and supervised by qualified exercise and sport science professionals.

2.6. Training Protocols

Participants completed three training sessions per week for 12 consecutive weeks. The HIIT protocol consisted of alternating periods of high-intensity exercise and active or passive recovery intervals. Exercise intensity was maintained between 80% and 95% of maximal heart rate (HRmax). The PHA protocol was organized as a circuit-training model alternating upper- and lower-body exercises. Exercise intensity was maintained between 70% and 80% of HRmax, providing simultaneous cardiovascular and neuromuscular stimulation. The LISS protocol consisted of continuous aerobic exercise performed at a stable intensity between 60% and 70% of HRmax using treadmills, stationary bicycles, elliptical trainers, or climbers. Exercise intensity was monitored throughout all training sessions using Polar H9® heart rate monitors (Polar Electro Oy, Kempele, Finland) synchronized with the Polar Flow® platform.

2.7. Anthropometric Assessment

Anthropometric measurements were performed by an ISAK-certified assessor according to the guidelines of the International Society for the Advancement of Kinanthropometry (ISAK). The following variables were assessed:

- body mass (kg);
- stature (cm);
- body mass index (BMI);
- body circumferences (waist, hip, arm, thigh, and calf);
- skinfold thicknesses (triceps, subscapular, biceps, suprailiac, supraspinale, abdominal, thigh, and calf).

Measurements were collected at both assessment points (T0 and T1) under standardized conditions. Based on the anthropometric data, the following variables were also calculated:

- adipose mass using Kerr's anthropometric model (1991);
- muscle mass using the prediction equation proposed by Lee et al. (2000);
- somatotype components (endomorphy, mesomorphy, and ectomorphy) according to the Heath–Carter method.

2.8. Perceived Psychophysical Well-Being Assessment

At the end of the intervention, participants completed a structured questionnaire designed to explore subjective perceptions regarding:

- psychological well-being;
- physical and functional well-being;
- perceived performance improvement.

Responses were collected using a five-point Likert scale, with higher scores indicating more positive perceptions of the training experience. The questionnaire was used for exploratory purposes to complement objective measurements with subjective indicators related to the exercise experience.

2.9. Statistical Analysis

Descriptive statistics were expressed as mean ± standard deviation. In the original studies, data distribution was assessed using the Shapiro–Wilk test. Depending on the fulfillment of normality assumptions, either parametric or non-parametric statistical procedures were applied. The primary variables

considered in the integrated analysis included body mass, BMI, waist circumference, adipose mass, muscle mass, abdominal skinfold thickness, and somatotype components. Secondary outcomes included perceptions of psychological well-being, physical well-being, and perceived performance improvements. For the integrated comparative analysis, findings from the three studies were synthesized and interpreted according to the direction and magnitude of the observed adaptations, with the aim of identifying common patterns and modality-specific differences among HIIT, PHA, and LISS. The level of statistical significance adopted in the original studies was set at $p < 0.05$.

3. Results

3.1. Participant Flow and Study Integration

The integrated comparative analysis included three quasi-experimental pilot studies conducted within a real-world supervised personal training setting. The first study compared the effects of High-Intensity Interval Training (HIIT) and Low-Intensity Steady-State Exercise (LISS) in 24 participants (12 HIIT; 12 LISS). The second study compared HIIT and Peripheral Heart Action Training (PHA) in 24 participants (12 HIIT; 12 PHA), whereas the third study compared LISS and PHA in 24 participants (12 LISS; 12 PHA). All studies employed comparable assessment procedures, allowing the integration of findings related to body composition, somatotype characteristics, and psychophysical perceptions. Figure 1 presents the flow diagram of the included studies and the integrated data analysis process.

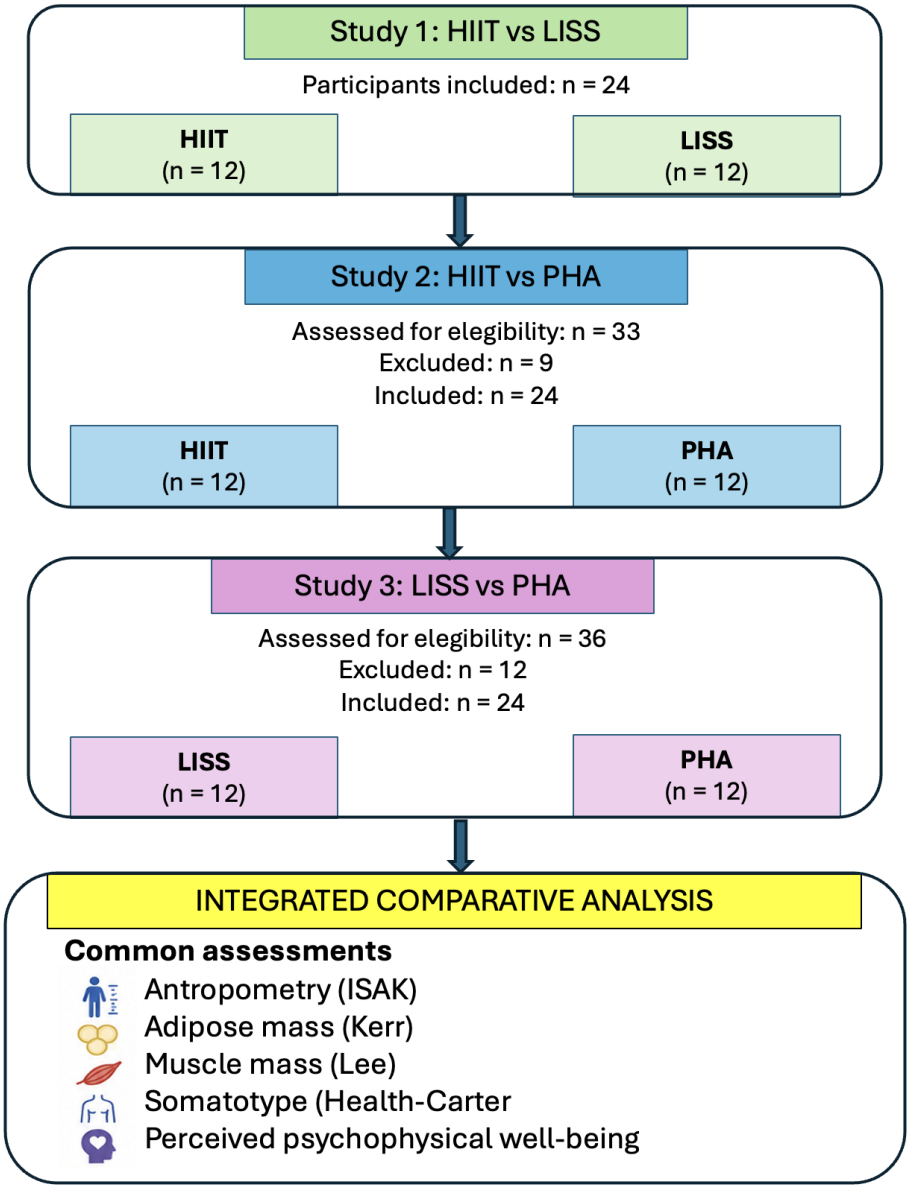


Figure 1. Flow diagram of the included studies and the integrated data analysis process.

3.2. Characteristics of the Training Protocols

The three exercise methodologies differed in terms of training structure and exercise intensity while maintaining the same intervention duration (12 weeks) and weekly frequency (three sessions per week).

HIIT was characterized by high-intensity intervals performed between 80% and 95% of maximal heart rate (HRmax), PHA consisted of circuit-based training performed at 70–80% of HRmax, whereas LISS involved continuous aerobic exercise performed between 60% and 70% of HRmax.

The main characteristics of the training protocols are presented in Table 1.

Table 1. Main Characteristics of the Training Protocols

Variable	HIIT	PHA	LISS
Training modality	High-Intensity Interval Training	Peripheral Heart Action Training	Low-Intensity Steady-State Exercise
Duration	12 weeks	12 weeks	12 weeks
Frequency	3 sessions·week^{-1}	3 sessions·week^{-1}	3 sessions·week^{-1}
Target intensity	80–95% HRmax	70–80% HRmax	60–70% HRmax
Exercise structure	Intermittent intervals	Circuit training	Continuous aerobic exercise
Predominant stimulus	Metabolic and cardiovascular	Cardiovascular and neuromuscular	Aerobic and cardiovascular
Main training objective	Body recomposition and performance enhancement	Integrated cardiovascular and muscular conditioning	Cardiovascular fitness and sustainable fat reduction

3.3. Anthropometric and Body Composition Adaptations

The main changes in body composition and somatotype are reported in Table 2. All exercise modalities produced significant improvements in body composition. Body mass decreased by 4.0% in the HIIT group, 4.45% in the LISS group, and 1.52% in the PHA group. The reduction was significantly greater in the HIIT versus PHA comparison ($p = 0.039$), whereas no significant differences were observed between HIIT and LISS ($p = 0.894$) or between LISS and PHA ($p = 0.064$). Similarly, BMI decreased by 4.5% in the HIIT group, 4.28% in the LISS group, and 1.72% in the PHA group. The HIIT versus PHA comparison revealed a significant between-group difference ($p = 0.007$). Adipose mass estimated according to Kerr's anthropometric model decreased in all groups (HIIT: −2.69 kg; PHA: −1.79 kg; LISS: −1.69 kg), with no significant differences observed between training modalities. Regarding muscle mass estimated using the Lee equation, HIIT demonstrated a mean increase of 0.47 kg, whereas PHA and LISS showed slight reductions (−0.10 kg and −0.16 kg, respectively). Although these differences did not reach statistical significance, favorable trends toward HIIT were observed when compared with both PHA ($p = 0.051$) and LISS ($p = 0.060$). Endomorphy decreased significantly in all groups, with reductions of 17.9% in HIIT, 11.06% in LISS, and 8.91% in PHA. The HIIT versus PHA comparison revealed a significantly greater reduction in the HIIT group ($p = 0.019$). Mesomorphy increased in the HIIT group (+11.4%; $p = 0.0022$) and, to a lesser extent, in the PHA group (+0.7%; $p = 0.034$), whereas no significant changes were observed in the LISS group (+4.88%; $p = 0.487$). Ectomorphy increased significantly in both PHA (+7.01%; $p = 0.0006$) and LISS (+29.32%; $p = 0.017$), while it decreased in HIIT (−8.5%; $p = 0.0029$). A significant difference was observed between HIIT and PHA ($p = 0.007$).

Table 2. Main Changes in Body Composition and Somatotype Following HIIT, PHA and LISS Interventions

Variable	HIIT (%)	p	PHA (%)	p	LISS (%)	p	Between-group findings
Body Mass	−4.0	<0.01	−1.52	<0.001	−4.45	0.009	HIIT vs LISS: p = 0.894; HIIT vs PHA: p = 0.039; LISS vs PHA: p = 0.064
BMI	−4.5	0.0003	−1.72	<0.001	−4.28	0.010	HIIT vs LISS: p = 0.720; HIIT vs PHA: p = 0.007; LISS vs PHA: p = 0.088
Fat Mass (Kerr, kg)	−2.69	<0.001	−1.79	0.001	−1.69	<0.05	HIIT vs LISS: p = 0.173; HIIT vs PHA: p = 0.167; LISS vs PHA: p = 0.858
Muscle Mass (Lee, kg)	+0.47	0.067	−0.10	0.510	−0.16	0.480	HIIT vs LISS: p = 0.060; HIIT vs PHA: p = 0.051; LISS vs PHA: p = 0.807
Endomorphy	−17.9	0.0037	−8.91	0.001	−11.06	0.015	HIIT vs PHA: p = 0.019; HIIT vs LISS: p = 0.223; LISS vs PHA: p = 0.499

Mesomorphy	+11.4	0.0022	+0.7	0.034	+4.88	0.487	HIIT vs PHA: p = 0.492; HIIT vs LISS: p = 0.534; LISS vs PHA: p = 0.479
Ectomorphy	−8.5	0.0029	+7.01	0.0006	+29.32	0.017	HIIT vs LISS: p = 0.971; HIIT vs PHA: p = 0.007; LISS vs PHA: p = 0.075

Note. Values are expressed as percentage changes from baseline, except for fat mass (kg) and muscle mass (kg). HIIT = High-Intensity Interval Training; PHA = Peripheral Heart Action Training; LISS = Low-Intensity Steady-State Exercise.

3.4. Perceived Psychophysical Well-Being and Performance Improvements

The analysis of subjective perceptions revealed interesting differences among the training methodologies. Participants who followed the HIIT protocol reported the highest scores for perceived improvements in physical performance and functional capacity, suggesting a stronger perception of training effectiveness in terms of performance enhancement. Conversely, participants assigned to the LISS protocol reported the highest levels of perceived psychological well-being. In particular, direct comparisons with both HIIT ($p = 0.002$) and PHA ($p < 0.001$) revealed significantly more favorable ratings in the LISS group. The LISS protocol also received positive evaluations across all assessed dimensions and was characterized by high levels of perceived tolerability and sustainability, supporting its suitability as an exercise strategy aimed at long-term adherence and continuity of physical activity participation. The outcomes related to perceived psychophysical well-being

and subjective benefits are presented in Table 3. A conceptual summary of the predominant adaptation patterns observed across the three exercise modalities is presented in Figure 2.

Table 3. Psychophysical Outcomes and Perceived Benefits Across Training Modalities

Domain	Item	HIIT vs LISS	HIIT vs PHA	LISS vs PHA
Psychological well-being	Feeling psychologically better	LISS > HIIT (p=0.002)	n.s. (p=0.225)	LISS > PHA (p<0.001)
Motivation	Increased motivation	n.s.	n.s.	n.s.
Physical well-being	General physical well-being	n.s.	n.s.	n.s.
Functional capacity	Daily activities	n.s.	n.s.	n.s.
Performance	Overall performance	HIIT > LISS (p=0.002)	HIIT > PHA (p<0.001)	n.s.
Performance	Strength/speed/endurance	HIIT > LISS (p<0.001)	n.d.	n.s.

Note. n.s. = not significant; n.d. = not directly assessed.

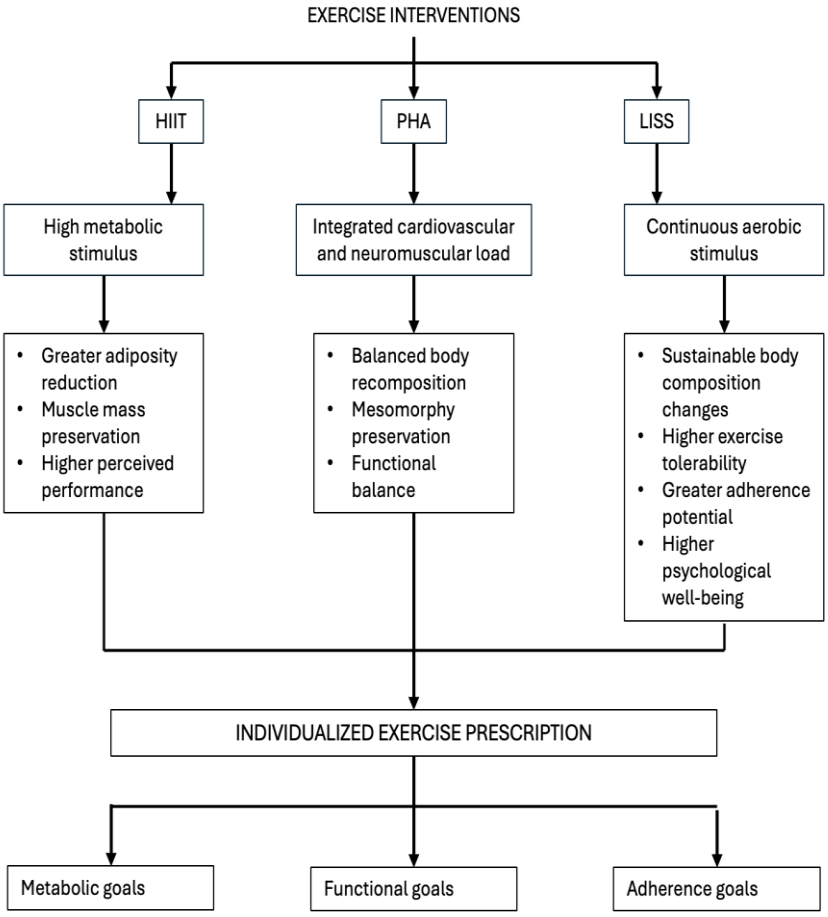


Figure 2. Conceptual model summarizing the predominant adaptation patterns associated with High-Intensity Interval Training (HIIT), Peripheral Heart Action Training (PHA), and Low-Intensity Steady-State Exercise (LISS). Although all methodologies produced favorable anthropometric adaptations, HIIT appeared primarily associated with metabolic efficiency and muscle mass preservation, PHA with balanced cardio-neuromuscular adaptations, and LISS with psychological well-being, exercise sustainability and long-term adherence.

4. Discussion

4.1. Body Composition Adaptations

The main finding of the present integrated comparative analysis is that all three training methodologies produced favorable improvements in body composition, confirming the effectiveness of structured exercise programs in promoting positive anthropometric adaptations in physically active adults. Specifically, HIIT, PHA, and LISS resulted in significant reductions in body mass, BMI, adipose mass, waist circumference, and endomorphy, suggesting that training modalities characterized by different levels of intensity and organizational structures can all contribute to improvements in body composition when performed consistently over a 12-week period. Despite these common benefits, the magnitude of the observed adaptations was not uniform across protocols. HIIT demonstrated the largest reductions in BMI and adiposity, as well as a tendency toward the preservation of muscle mass, whereas LISS produced an overall weight loss comparable to that observed following HIIT. In contrast, PHA generated more moderate improvements in the principal anthropometric variables. These findings are consistent with previous literature attributing particular effectiveness to HIIT for body recomposition through the combined effects of elevated energy expenditure, increased excess post-exercise oxygen consumption (EPOC), and greater neuromuscular involvement (Gibala et al., 2012; Boutcher, 2011; Milanović et al., 2015). A particularly interesting observation concerns muscle mass estimated using the equation proposed by Lee et al. (2000). Although the differences did not reach statistical significance, HIIT was the only protocol to demonstrate a positive change (+0.47 kg), whereas both PHA and LISS showed slight reductions. This finding suggests a potentially greater capacity of high-intensity interval training to preserve skeletal muscle during fat-loss interventions, an aspect that may be

particularly relevant in exercise programs aimed at body recomposition. Overall, the findings indicate that reductions in body weight alone should not be considered the sole indicator of training effectiveness. Although LISS and HIIT produced similar decreases in total body mass, HIIT appeared to promote qualitatively more favorable adaptations by combining reductions in adiposity with preservation of muscle mass.

4.2. Somatotype Adaptations

The analysis of somatotype components revealed changes consistent with the body composition adaptations observed across the interventions. All three protocols produced significant reductions in endomorphy, confirming a relative decrease in body fatness. However, the greatest reduction was observed in the HIIT group, which demonstrated significantly larger improvements than the PHA group. The increase in mesomorphy observed in the HIIT group and, to a lesser extent, in the PHA group suggests a tendency toward a greater relative expression of the musculoskeletal component. Although the LISS group also demonstrated a positive change in mesomorphy, this variation did not reach statistical significance. These findings are consistent with the characteristics of the exercise protocols, as both HIIT and PHA involve greater neuromuscular engagement than continuous aerobic exercise and therefore provide a stronger stimulus to the muscular system. Particularly noteworthy is the behavior of ectomorphy. While HIIT showed a slight reduction in this component, both PHA and LISS demonstrated significant increases. This pattern may reflect a greater contribution of body mass reduction relative to muscle mass modifications in protocols with a predominantly aerobic component. In this regard, somatotype analysis provides complementary information beyond traditional anthropometric indicators, allowing a more comprehensive understanding of

the adaptation patterns induced by different exercise methodologies. Taken together, the findings suggest that HIIT may be associated with a more pronounced shift toward a body profile characterized by lower adiposity and greater relative muscularity, whereas PHA appears to promote more balanced adaptations and LISS changes predominantly associated with reductions in body mass and fatness.

4.3. Psychophysical Responses and Subjective Perceptions

Beyond anthropometric adaptations, the present study identified meaningful differences in subjective perceptions associated with the different training modalities. The findings demonstrate that psychological and perceptual responses do not necessarily follow the same patterns observed for body composition, highlighting the multidimensional nature of the exercise response. Participants who followed the LISS protocol reported the highest levels of perceived psychological well-being, with significantly more favorable ratings than those observed following either HIIT or PHA. This finding is consistent with the affective model of exercise proposed by Ekkekakis et al. (2011), according to which moderate-intensity activities tend to generate more pleasant and sustainable experiences than exercise performed at high perceived intensities. Lower perceived exertion and greater tolerability may have contributed to a more positive overall evaluation of the training experience. Conversely, participants assigned to HIIT reported the highest scores for perceived improvements in overall performance, strength, speed, and endurance. This observation suggests that perceptions of competence and physical improvement may be particularly enhanced during high-intensity training programs, possibly due to the challenging nature of the exercise and the more evident perception of performance gains. PHA generally produced

intermediate scores across most of the assessed dimensions without demonstrating clear advantages over the other protocols. Nevertheless, the combination of favorable anthropometric outcomes and positive psychophysical perceptions suggests that this methodology may represent a balanced alternative for individuals seeking to integrate cardiovascular and neuromuscular stimuli within the same training program. These findings emphasize that the selection of an exercise methodology should not rely exclusively on expected physiological adaptations but should also consider subjective perceptions and psychological responses, which are widely recognized as key determinants of long-term exercise adherence.

4.4. Practical Implications, Limitations, and Future Directions

From an applied perspective, the findings suggest that the selection of a training methodology should be guided by the specific objectives of the participant. HIIT appears particularly suitable when the primary goals are body recomposition and perceived improvements in physical performance. In contrast, LISS seems more appropriate for promoting psychological well-being, exercise sustainability, and long-term adherence. PHA may represent a valuable alternative for individuals seeking an integrated approach that combines cardiovascular and neuromuscular stimuli within the same training session. Several limitations should be considered when interpreting the findings. First, the sample size was relatively small, limiting the generalizability of the results. Second, the original studies employed quasi-experimental designs with non-randomized group allocation. Third, the three pairwise comparisons were derived from the same overall sample and should therefore be interpreted as complementary analyses rather than independent experimental investigations. Finally, psychophysical perceptions were assessed

using an exploratory questionnaire rather than validated psychometric instruments. Future research should involve larger samples, randomized controlled designs, and medium- to long-term follow-up assessments to determine the stability of the observed adaptations. Further investigations should also examine the role of psychological, motivational, and behavioral factors in influencing adherence to different exercise models and their effectiveness within health-promotion contexts.

5. Conclusions

The present integrated analysis demonstrated that HIIT, PHA, and LISS are all effective exercise strategies for improving body composition and selected aspects of psychophysical well-being in physically active adults. However, each methodology appeared to exhibit distinct adaptation patterns. HIIT showed the strongest tendency toward adiposity reduction and muscle mass preservation and was associated with greater perceived improvements in physical performance. PHA produced more balanced cardiovascular and neuromuscular adaptations, whereas LISS was characterized by higher levels of perceived psychological well-being and greater exercise sustainability. Overall, these findings support the importance of individualized exercise programming based not only on anthropometric and functional goals but also on the psychological characteristics and preferences of participants.

References

Ackland, T. R., Lohman, T. G., Sundgot-Borgen, J., Maughan, R. J., Meyer, N. L., Stewart, A. D., & Müller, W. (2012). Current status of body composition assessment in sport: review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I.O.C. Medical Commission. *Sports medicine (Auckland, N.Z.)*, *42*(3), 227–249. https://doi.org/10.2165/11597140-000000000-00000

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman and Company.

Biddle, S. J., & Batterham, A. M. (2015). High-intensity interval exercise training for public health: a big HIT or shall we HIT it on the head?. *The international journal of behavioral nutrition and physical activity*, *12*, 95. https://doi.org/10.1186/s12966-015-0254-9

Boutcher S. H. (2011). High-intensity intermittent exercise and fat loss. *Journal of obesity*, *2011*, 868305. https://doi.org/10.1155/2011/868305

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J. P., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., Lambert, E., … Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British journal of sports medicine*, *54*(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

Ceruso, R., Esposito, G., & D'Elia, F. (2019). Analysis and evaluation of the qualitative aspects of the young players. *Journal of Physical Education and Sport*, *19*, 1814-1819. DOI:10.7752/jpes.2019.s5266

De Mello, M. T., Lemos, V.deA., Antunes, H. K., Bittencourt, L., Santos-Silva, R., & Tufik, S. (2013). Relationship between physical activity and depression and anxiety

symptoms: a population study. *Journal of affective disorders*, *149*(1-3), 241–246. https://doi.org/10.1016/j.jad.2013.01.035

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports medicine (Auckland, N.Z.)*, *41*(8), 641–671. https://doi.org/10.2165/11590680-000000000-00000

Ensrud-Skraastad, O. K., & Haga, M. (2020). Associations between Motor Competence, Physical Self-Perception and Autonomous Motivation for Physical Activity in Children. *Sports (Basel, Switzerland)*, *8*(9), 120. https://doi.org/10.3390/sports8090120

Gibala, M. J., Little, J. P., Macdonald, M. J., & Hawley, J. A. (2012). Physiological adaptations to low-volume, high-intensity interval training in health and disease. *The Journal of physiology*, *590*(5), 1077–1084. https://doi.org/10.1113/jphysiol.2011.224725

Kandola, A., & Stubbs, B. (2020). Exercise and Anxiety. *Advances in experimental medicine and biology*, *1228*, 345–352. https://doi.org/10.1007/978-981-15-1792-1_23

Lee, R. C., Wang, Z., Heo, M., Ross, R., Janssen, I., & Heymsfield, S. B. (2000). Total-body skeletal muscle mass: development and cross-validation of anthropometric prediction models. *The American journal of clinical nutrition*, *72*(3), 796–803. https://doi.org/10.1093/ajcn/72.3.796

Li, Y., Zhao, W., & Yang, Q. (2025). Effects of high-intensity interval training and moderate-intensity continuous training on mitochondrial dynamics in human skeletal muscle. *Frontiers in physiology*, *16*, 1554222. https://doi.org/10.3389/fphys.2025.1554222

Little, J. P., Safdar, A., Wilkin, G. P., Tarnopolsky, M. A., & Gibala, M. J. (2010). A practical model of low-volume high-intensity interval training induces mitochondrial biogenesis in human skeletal muscle: potential mechanisms. *The Journal of physiology*, *588*(Pt 6), 1011–1022. https://doi.org/10.1113/jphysiol.2009.181743

Longo, A. R., Silva-Batista, C., Pedroso, K., de Salles Painelli, V., Lasevicius, T., Schoenfeld, B. J., Aihara, A. Y., de Almeida Peres, B., Tricoli, V., & Teixeira, E. L. (2022). Volume Load Rather Than Resting Interval Influences Muscle Hypertrophy During High-Intensity Resistance Training. *Journal of strength and conditioning research*, *36*(6), 1554–1559. https://doi.org/10.1519/JSC.0000000000003668

Luszczynska, A., & Schwarzer, R. (2005). Social cognitive theory. In M. Conner & P. Norman (Eds.), *Predicting health behaviour* (2nd ed., pp. 127–169). Open University Press.

McAnally, K., & Hagger, M. S. (2024). Self-Determination Theory and Workplace Outcomes: A Conceptual Review and Future Research Directions. Behavioral Sciences, 14(6), 428 https://doi.org/10.3390/bs14060428

Milanović, Z., Sporiš, G., & Weston, M. (2015). Effectiveness of High-Intensity Interval Training (HIT) and Continuous Endurance Training for VO2max Improvements: A Systematic Review and Meta-Analysis of Controlled Trials. *Sports medicine (Auckland, N.Z.)*, *45*(10), 1469–1481. https://doi.org/10.1007/s40279-015-0365-0

Raiola, G., D'Isanto, T., Di Domenico, F., & D'Elia, F. (2022). Effect of Teaching Methods on Motor Efficiency, Perceptions and Awareness in Children. *International journal of environmental research and public health*, *19*(16), 10287. https://doi.org/10.3390/ijerph191610287

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation. *American Psychologist, 55*(1), 68–78.

Staley, T. (1996). *Muscle logic: Escalating density training*. IronMind.

Weston, M., Taylor, K. L., Batterham, A. M., & Hopkins, W. G. (2014). Effects of low-volume high-intensity interval training (HIT) on fitness in adults: a meta-analysis of controlled and non-controlled trials. *Sports medicine (Auckland, N.Z.)*, *44*(7), 1005–1017. https://doi.org/10.1007/s40279-014-0180-z