

Discussion on the Application of Comprehensive Pre-Training Assessment System for Fat Loss and Muscle Gain Among Fitness Populations

Minghao Pan¹

¹ Hangzhou Ruiao Fitness Management Co., Ltd., Hangzhou 311121, China

Correspondence: Minghao Pan, Hangzhou Ruiao Fitness Management Co., Ltd., Hangzhou 311121, China.

doi:10.63593/JRSSH.2026.09.04

Abstract

Driven by strong demand for fat-loss and muscle-gain services in commercial fitness, the industry suffers from inadequate pre-training assessment, single-dimensional indicators and subjective goal-setting, which easily lead to sports injuries, high training dropout rates and unsatisfactory intervention outcomes. This study constructs a five-dimensional comprehensive pre-training assessment system covering physical condition-metabolism-behavior-psychology-goal rationality, and verifies its practical value among Asian-adult fitness populations. A cross-sectional design combined with a 24-week prospective real-world cohort was adopted. Based on three premium fitness studios, 581 Asian subjects with fitness intentions were surveyed, and 216 participants were finally enrolled: 112 in the assessment group receiving interventions guided by the five-dimensional assessment, and 104 in the control group receiving conventional assessment. Multiple statistical models were applied for outcome analysis. The results showed that 41.48 % of the 581 subjects held unreasonable training goals, and 27.19 % had latent musculoskeletal risks. After 24-week intervention, the assessment group achieved significantly better improvements in body fat and lean body mass ($P < 0.001$), with higher goal-achievement rates, fewer adverse events and lower dropout rates. The mediating effect of improved goal cognition accounted for 31.4 %. This system can optimize intervention outcomes, enhance training safety and compliance, and is suitable for promotion in commercial fitness scenarios.

Keywords: commercial fitness, fat loss and muscle gain, pre-training assessment, five-dimensional system, real-world cohort, body composition

1. Introduction

1.1 Research Background

The global commercial fitness market keeps expanding, and refined personal training for fat loss and muscle gain has become mainstream. According to IHRSA data of 2022, the annual

output value of global fitness industry exceeds 105 billion US dollars, and Asian-adult clients pursuing fat-loss and muscle-gain training account for 42.7 %. The domestic fitness industry is also transforming from mass-mode services toward specialized and refined personal-training interventions.

Most domestic fitness institutions prioritize training schemes while neglecting assessment. They only perform basic body-composition tests and ignore comprehensive screening of physiological risks, metabolic characteristics, exercise behaviors, psychological status and training-goal rationality. Such one-sided assessment leads to high subjectivity and blindness in fat-loss and muscle-gain interventions.

The absence of standardized pre-training assessment triggers numerous industrial problems. Populations without standardized assessment report a 23.6 % sports-injury rate and a training-dropout rate above 30 % (International Society of Sports Nutrition, 2020). Meanwhile, unreasonable training goals disconnected from individual physiological baselines easily result in excessive fat loss, inefficient muscle gain and postural imbalance, which severely impair service quality and actual training benefits for the public.

1.2 Literature Review and Research Gaps

Existing domestic and international fitness-assessment studies have obvious deficiencies. Foreign studies feature single dimensions and fragmented systems, and are mostly developed for Caucasian populations, hence poorly adapted to physical characteristics of Asians. Domestic studies are largely theoretical, lacking quantitative criteria, ignoring psychological and behavioral factors, and lacking support from large-sample real-world cohort data from commercial fitness settings.

Four critical research gaps are identified:

- 1) **Dimension gap:** No closed-loop five-dimensional assessment system integrating physiology, metabolism, behavior, psychology and training goals has been established.
- 2) **Population gap:** Large-sample real-world intervention data of Asian adults in commercial fitness are insufficient.
- 3) **Method gap:** Most researches are cross-sectional status surveys; prospective controlled studies are scarce, making it impossible to verify causal relationships between assessment systems and training outcomes.
- 4) **Application gap:** Theoretical recommendations from authoritative guidelines have not been converted into

quantifiable and implementable standardized business workflows.

1.3 Research Questions and Research Hypotheses

1.3.1 Core Research Questions

- **RQ1:** What are the actual detection rates and population distribution characteristics of latent musculoskeletal physiological risks and unreasonable training goals among Asian adults intending to receive commercial fat-loss and muscle-gain fitness training?
- **RQ2:** Can a quantifiable and implementable five-dimensional pre-training comprehensive assessment system be constructed for Asian-adult populations?
- **RQ3:** Compared with conventional single-dimensional assessment workflows in the industry, can full-cycle application of the five-dimensional comprehensive-assessment system significantly optimize 24-week body-composition outcomes and reduce sports-related adverse events and training dropout rates?

1.3.2 Research Hypotheses

- **H1:** A considerable proportion of Asian commercial-fitness participants have latent musculoskeletal exercise risks and unreasonable fat-loss and muscle-gain goals, representing common industrial problems.
- **H2:** Compared with conventional single-dimensional assessment workflows, interventions guided by five-dimensional comprehensive pre-training assessment can significantly optimize core body-composition indicators such as body-fat percentage and lean-body-mass, and raise training-goal achievement rates after 24 weeks.
- **H3:** The five-dimensional comprehensive assessment can effectively avoid latent exercise risks, correct clients' cognitive biases, and significantly lower the incidence of training-related adverse events and course dropout rates.

1.4 Research Innovation and Significance

- 1) **Theoretical innovation:** This study introduces quantitative evaluation of goal

rationality into fitness pre-training assessment for the first time, constructs an integrated closed-loop five-dimensional assessment model, fills theoretical gaps in comprehensive assessment for Asian fat-loss and muscle-gain populations, and expands theories for personalized exercise-science interventions.

- 2) **Methodological innovation:** A mixed design combining large-sample cross-sectional investigation and a 24-week real-world prospective cohort is adopted. Data are collected under real commercial-fitness conditions, breaking limitations of small-sample laboratory-based research and improving external validity and practical applicability of results.
- 3) **Practical innovation:** Authoritative exercise guidelines from ISSN and ACSM are transformed into quantifiable, scoring-based and replicable standardized workflows. This solves the problem of formalized assessment lacking practical standards in the fitness industry and bridges academic research and commercial-fitness practice.

This research provides data evidence and practical references for standardized personal-training services, public fat-loss-muscle-gain practice and sports-injury prevention, and promotes refined and standardized development of China's commercial fitness industry.

2. Materials and Methods

2.1 Study Design

This study adopts a mixed-method design consisting of cross-sectional baseline investigation plus a 24-week prospective real-world controlled cohort. It includes two phases. Phase 1 is cross-sectional research targeting 581 Asian adults intending fat-loss-muscle-gain training, to systematically investigate baseline characteristics and detection rates of unreasonable training goals and latent exercise risks and identify core industrial problems. Phase 2 is prospective-cohort research: 216 eligible participants were screened and divided into assessment group and control group for 24-week standardized personal-training follow-up. Multidimensional statistical methods were used to compare outcome differences between groups and verify application effects of the five-dimensional assessment system.

Mediation analysis, subgroup analysis and sensitivity analysis were performed to clarify action mechanisms and result robustness.

2.2 Study Setting and Time Window

Three large-scale premium commercial fitness studios in China were selected as research sites. All studios possessed standardized personal-training systems, professional body-composition testing equipment and unified course-management rules. Small non-standard fitness venues and community fitness spots were excluded to guarantee data uniformity and standardization. The study period spanned March 2021 to December 2022. The cross-sectional baseline survey ran from March 2021 to August 2021; prospective-cohort intervention and follow-up ran from September 2021 to December 2022. All participants received standardized 24-week personal-training fat-loss-muscle-gain intervention with unified training frequency of 3 sessions per week and 60 minutes per session (American College of Sports Medicine, 2022).

2.3 Study Participants

2.3.1 Sample Grouping

Total cross-sectional sample size $n = 581$: Asian adults aged 18-45 years with clear intention to receive fat-loss-muscle-gain personal training, who voluntarily participated in baseline survey and signed informed consent forms. Valid prospective-cohort sample $n = 216$, split into two groups according to pre-intervention assessment procedures: assessment group (full five-dimensional pre-training assessment plus personalized targeted intervention) $n = 112$; control group (conventional industrial workflow with only basic body-composition measurement and no systematic multi-dimensional assessment) $n = 104$.

2.3.2 Inclusion Criteria

Aged 18-45 years; Asian ethnicity with no foreign ancestry; no long-term regular resistance-training history (resistance training < 1 session per week in the past 12 months); voluntary participation in full-cycle personal-training fat-loss-muscle-gain intervention; intact cognitive function enabling independent completion of scale assessment and data collection; signed informed consent for research participation.

2.3.3 Exclusion Criteria

Uncontrolled severe endocrine-metabolic

diseases including thyroid disorders and diabetes; untreated osteoarticular injuries or chronic motor-system lesions; major underlying cardiovascular-cerebrovascular diseases; pregnant or lactating women; training interruption longer than 2 weeks during intervention; samples with more than 10 % missing scale or testing data.

2.4 Operational Definition of Variables and Testing Standards

Core variables include independent variable, primary outcome variables, secondary outcome variables and confounding variables. All variables were operationally defined and quantitatively measured in accordance with international exercise-science standards.

2.4.1 Independent Variable: Five-Dimensional Comprehensive Pre-Training Assessment System

The self-constructed five-dimensional assessment system covers physiological function, metabolic level, exercise behavior, psychological

status and goal rationality. Quantitative testing criteria and scoring rules were formulated for each dimension to form a complete implementable assessment framework.

- 1) **Physiological-function dimension:** Focuses on musculoskeletal-risk screening and joint-function evaluation. A simplified standardized FMS risk-screening scale was used to quantitatively score range of motion of shoulder, elbow, knee and hip joints, core stability and postural symmetry. Total score ranges 0-21 points; score ≤ 14 points indicates latent musculoskeletal exercise risk.
- 2) **Metabolic dimension:** DXA dual-energy X-ray absorptiometry body-composition measurement verified by bioelectrical impedance was adopted to precisely determine body-fat percentage, lean-body-mass, muscle mass and basal-metabolism indicators. Resting metabolic rate (RMR) was estimated via professional metabolic formulas:

$$\text{RMR(Male)} = 10 \times \text{Weight(kg)} + 6.25 \times \text{Height(cm)} - 5 \times \text{Age} + 5$$

$$\text{RMR(Female)} = 10 \times \text{Weight(kg)} + 6.25 \times \text{Height(cm)} - 5 \times \text{Age} - 161$$

Individual metabolic baseline databases were built based on test results to judge metabolic adaptability and fat-loss-muscle-gain potential.

- 3) **Behavioral dimension:** The Pittsburgh Sleep Quality Index (PSQI, score 0-21) evaluated sleep quality over the previous month; PSQI > 7 points indicates abnormal sleep. A simplified dietary-behavior record form recorded daily calorie intake and macronutrient ratios. Non-exercise activity thermogenesis (NEAT) was quantified by counting daily consumption from walking, housework, standing and other non-training activities; daily NEAT consumption < 300 kcal indicates insufficient behavioral-activity level.
- 4) **Psychological dimension:** The Sport Motivation Scale (SMS) assessed intrinsic and extrinsic training motivation, total score 12-84; higher scores represent stronger exercise motivation. A body-image scale was combined to evaluate physical-appearance cognitive bias and quantify rationality of psychological demands for fat loss and muscle gain.
- 5) **Goal-rationality dimension:** Based on Asian-population physical characteristics, exclusive reasonable training thresholds

were established from individual baseline body-fat percentage, lean-body-mass and RMR. Quantitative scoring ranged from 0-10 points: 8-10 = reasonable goal; 4-7 = basically reasonable goal; 0-3 = unreasonable goal.

2.4.2 Primary Outcome Indicators

Changes in body-fat percentage ($\Delta\text{BF} \%$) and changes in lean-body-mass (ΔFFM , kg) before and after 24-week intervention, serving as core effectiveness indicators for fat-loss-muscle-gain interventions; larger absolute values represent more remarkable intervention effects.

2.4.3 Secondary Outcome Indicators

Training-goal achievement rate (number of participants reaching preset reasonable body-composition goals / total participants); incidence of training-related adverse events (number of participants suffering joint pain, muscle strain or sports injury / total participants); 24-week training dropout rate (number of participants terminating courses halfway / total participants).

2.4.4 Confounding Variables

Seven core confounding variables were included: age, gender, baseline body-fat percentage, baseline lean-body-mass, weekly training frequency, dietary compliance and sleep quality.

They were adjusted uniformly in subsequent statistical models to avoid confounding bias.

2.5 Statistical Analysis

SPSS 26.0 and R 4.2.0 software were used for statistical analysis with significance level set at $\alpha = 0.05$. Analytical approaches are described below:

- 1) **Cross-sectional-data analysis:** Descriptive statistics calculated population basic characteristics, detection rates of unreasonable training goals and latent musculoskeletal risks; indicator distribution differences across gender and age subgroups were analysed.
- 2) **Baseline-balance testing:** Standardized mean difference (SMD) tested baseline comparability between assessment group and control group; $SMD < 0.11$ was taken as baseline-balance criterion. Variables with imbalance were adjusted in subsequent models.
- 3) **Primary-outcome analysis:** Linear mixed-effects models (LMM) were constructed, with group-by-time interaction term as core effect indicator. Confounders including age, gender and baseline body-composition were adjusted. P-values and partial η^2 (effect size) evaluated intervention effects: partial $\eta^2 \geq 0.01$ = small effect; ≥ 0.06 = moderate effect; ≥ 0.14 = large effect.

- 4) **Binary-outcome analysis:** Multivariate logistic regression adjusted for baseline confounders to calculate OR values and 95 % confidence intervals (95 %CI) for adverse events and training dropout, identifying protective effects of assessment-guided interventions.
- 5) **Mediating-effect analysis:** Bootstrap resampling (5 000 samples) tested the mediating role of improved goal cognition between assessment intervention and body-composition outcomes, and calculated the proportion of mediating effect.
- 6) **Subgroup and sensitivity analysis:** Subgroup analysis stratified by gender and age; multiple imputation handled missing data and samples with extreme baseline values were excluded for sensitivity analysis to verify result robustness.

3. Results

3.1 Cross-Sectional Baseline Characteristics and Risk-Detection Outcomes

The cross-sectional study enrolled 581 Asian adults aged 18-45 years intending fat-loss-muscle-gain training: 302 males (51.98 %), 279 females (48.02 %); 216 aged 18-25 years, 248 aged 26-35 years, 117 aged 36-45 years; mean age (29.63 ± 7.25) years. Mean baseline body-fat percentage (24.86 ± 5.32 %), mean lean-body-mass (48.72 ± 6.85) kg, mean resting metabolic rate (1586.35 ± 212.46) kcal/d.

Table 1. Detection rates of abnormal indicators in cross-sectional population

Indicator	Positive cases	Total cases	Detection rate (%)
Unreasonable training goal	241	581	41.48
Latent musculoskeletal risk	158	581	27.19
Abnormal sleep-behavior status	207	581	35.63
Low exercise motivation	124	581	21.34
Insufficient NEAT level	189	581	32.53

Stratified analysis showed that the detection rate of unreasonable goals among females (47.67 %) was significantly higher than among males (35.89 %). The detection rate of latent musculoskeletal risks among participants aged 36-45 years (38.46 %) was significantly higher than among younger groups. Significant

heterogeneity of fitness-intervention risks exists across gender and age subgroups, highlighting demands for personalized assessment and intervention schemes.

3.2 Baseline-Balance Testing for Cohort-Study Groups

The prospective cohort included 216 valid

participants. Baseline-balance test results of core variables are presented in Table 2. SMD values of all core indicators were below 0.11 (Li Y, Zhang H & Wang L., 2022), confirming comparable

baseline characteristics between assessment group and control group without obvious inter-group confounding bias for subsequent outcome comparison.

Table 2. Baseline-characteristic comparison between two participant groups

Baseline indicator	Assessment group (n=112)	Control group (n=104)	SMD value
Age (years)	29.47±7.16	29.79±7.34	0.044
Baseline body-fat percentage (%)	24.73±5.28	24.98±5.36	0.047
Baseline lean-body-mass (kg)	48.65±6.79	48.79±6.92	0.020
RMR (kcal/d)	1582.46±209.83	1590.28±215.17	0.037
PSQI score (points)	8.26±2.14	8.19±2.20	0.032

3.3 Comparison of Primary Outcome Indicators After 24-Week Intervention

After 24-week standardized intervention, significant inter-group differences were observed

in core body-composition indicators. Linear mixed-effects models demonstrated statistically significant group-by-time interaction effects (Table 3).

Table 3. Comparison of 24-week core body-composition outcome indicators

Outcome indicator	Assessment group (n=112)	Control group (n=104)	P-value	Partial η^2
Body-fat-percentage change Δ BF% (%)	-4.81±1.73	-3.26±1.85	<0.001	0.138
Lean-body-mass change Δ FFM (kg)	+2.17±0.94	+1.33±1.02	<0.001	0.125

The assessment group achieved significantly greater body-fat reduction and lean-body-mass gain than the control group. Partial η^2 values of 0.138 and 0.125 represented moderate-to-large intervention effects, proving that interventions guided by five-dimensional comprehensive assessment significantly optimize core fat-loss-muscle-gain body-composition outcomes and outperform conventional

single-dimensional-assessment workflows.

3.4 Comparison of Secondary Outcome Indicators After 24-Week Intervention

Statistically significant inter-group differences existed in three secondary outcomes: training-goal achievement rate, adverse-event incidence and training dropout rate (Table 4).

Table 4. Quantitative comparison of secondary outcome indicators

Outcome indicator	Assessment group	Control group	Statistic	P-value
Goal-achievement rate (%)	66.96 (75/112)	44.23 (46/104)	$\chi^2=11.17$	0.001
Adverse-event incidence (%)	8.93 (10/112)	22.12 (23/104)	OR=0.34	0.004
Training dropout rate (%)	16.07 (18/112)	31.73 (33/104)	-	0.006

After adjusting for confounders via multivariate logistic regression, risk-reduction rate was calculated by formula:

$$\text{Riskreductionrate}=(1-\text{OR})\times 100$$

The risk of training-related adverse events in the assessment group was only 34 % of that in the control group (OR=0.34, 95 %CI: 0.16-0.71), corresponding to a 66 % risk reduction. Training dropout rate decreased by 15.66 % and

goal-achievement rate rose by 22.73 % in the assessment group, fully verifying that this assessment system improves training compliance and intervention success rates.

3.5 Mediating-Effect and Subgroup-Analysis Results

Mediating-effect analysis adopted standardized Bootstrap resampling models. Calculation formula for proportion of mediating effect:

$$\text{Proportionofmediatingeffect}=\frac{\text{Standardizedmediating-effectvalue}}{\text{Standardizedtotal-effectvalue}}\times 100$$

Mediating-effect results revealed significant partial mediating effect of improved goal-rationality cognition along the pathway “five-dimensional-assessment intervention → body-composition optimization”. The mediating-effect proportion reached 31.4 %, explaining 31.4 % of total intervention effects. Mechanistically, the five-dimensional comprehensive assessment optimizes training schemes not only through risk screening and precise metabolic matching, but also indirectly improves fat-loss-muscle-gain outcomes by correcting unreasonable training expectations and optimizing cognition, representing a core psychological mechanism sustaining long-term system effectiveness.

Subgroup analysis indicated no significant gender difference in intervention effects ($P>0.05$). Intervention effects were slightly stronger among the 26-45-year-old middle-young subgroup than among the 18-25-year-old youth subgroup (Wang J & Liu S., 2023), possibly because middle-young participants presented more prominent exercise-cognitive biases, metabolic abnormalities and latent injuries, leaving larger improvement space for standardized assessment-guided interventions.

3.6 Sensitivity-Analysis Results

Multiple imputation handled missing data, and samples with extreme baseline body-fat-percentage and lean-body-mass values were excluded before remodelling for sensitivity testing. The inter-group differences, direction and significance of core outcomes remained unchanged before and after adjustment, with fluctuations of partial η^2 and OR values below 5 %. Intervention-effect results were robust against missing data and extreme samples.

4. Discussion

4.1 Industrial Practical Implications Derived from

Cross-Sectional Population Characteristics

Cross-sectional data from 581 participants demonstrated widespread baseline problems among Asian fat-loss-muscle-gain fitness clients: 41.48 % held unreasonable training goals, 27.19 % had latent musculoskeletal risks, and more than one-third suffered from sleep-schedule and exercise-behavior defects. This confirms limitations of conventional single-dimensional assessment: homogenized training schemes produce poor intervention efficacy alongside high injury and dropout rates. Fitness interventions require personalized precise training supported by multi-dimensional assessment.

4.2 Intervention Effects and Core Mechanisms of the Five-Dimensional Assessment System

Results from the 24-week prospective cohort clearly demonstrated that the five-dimensional comprehensive-assessment system optimizes intervention outcomes across three core dimensions: fat-loss-muscle-gain efficacy, training safety and long-term compliance. Breaking drawbacks of conventional single-dimensional assessment, it builds a complete closed-loop intervention logic: risk screening-metabolic matching-behavior correction-psychological empowerment-goal calibration. Multi-dimensional synergies support fitness interventions.

4.2.1 Core Intervention Benefits

Compared with conventional industrial single-dimensional assessment, personalized interventions guided by five-dimensional assessment achieved quantified gains:

- **Body-composition optimization:** Training and dietary schemes were matched using multi-dimensional data including metabolic baselines and joint function to avoid ineffective training and

excessive fat loss. Compared with the control group, body-fat reduction increased by 1.55 % and lean-body-mass gain increased by 0.84 kg in the assessment group, realizing coordinated fat loss, mass preservation and muscle gain.

- **Improved training safety:** Physiological-function screening identified latent musculoskeletal risks for pre-emptive intervention to avoid hidden injury hazards. The incidence of training-related adverse events dropped from 22.12 % to 8.93 %, greatly lowering sports-injury risks.
- **Enhanced training compliance:** Quantitative goal-rationality scoring corrected users' cognitive biases, reducing frustration induced by over-ambitious or misaligned expectations, effectively lowering mid-course dropout rates and securing long-term intervention effects.

4.2.2 Key Action Mechanisms

Mediating-effect analysis revealed dual action pathways and supplemented gaps in existing theories:

- **Direct physiological-intervention pathway:** Precise assessment of physiology, metabolism and behavior enables matching of individual training load, dietary structure and daily-schedule schemes, resolving homogenization and poor adaptability of conventional schemes and improving fat-loss-muscle-gain efficiency and training safety at the physical level.
- **Indirect psychological-mediation pathway:** Improved goal cognition exerted significant mediating effects (31.4 % mediating-effect proportion) (Smith J, Brown A & Davis K., 2022). Correcting unreasonable training expectations and shaping appropriate cognition enhanced user initiative and persistence, constituting a core mechanism sustaining long-term intervention efficacy and offsetting academic over-emphasis on physiology while neglecting psychology.

4.3 Innovations Compared with International Authoritative Researches and Guidelines

Authoritative ISSN and ACSM exercise guidelines only provide theoretical recommendations for fat-loss-muscle-gain interventions without implementable quantitative standards or practical workflows. Most European-American studies adopt single-dimensional assessments based on Caucasian samples with poor clinical adaptability for Asian physical traits.

This study innovatively integrates fragmented guideline theories into a standardized quantifiable five-dimensional comprehensive-assessment system. It adds quantitative scoring for training-goal rationality, filling gaps in quantified fitness-goal management. Drawing upon large-sample real-world cohorts of Asian adults, it overcomes limitations of small-sample laboratory-based studies featuring poor population adaptability and low external validity, providing data support and practical paradigms for refined commercial-fitness interventions targeting Asian populations.

4.4 External Validity and Application Boundaries

This study was performed in premium domestic commercial fitness studios among paying personal-training clients who possess certain training compliance, economic capacity and health demands, receiving highly standardized interventions. Therefore, conclusions apply to refined personal-training scenarios within commercial fitness, but cannot be directly generalized to untutored self-training by the general public, competitive-sports specialized training or chronic-disease rehabilitation training. Clarifying application boundaries enhances academic rigour and offers clear directions for future scenario-expansion research.

4.5 Research Limitations and Future Prospects

4.5.1 Research Limitations

- 1) A non-randomized prospective-cohort design was adopted. Despite baseline-balance verification and confounder adjustment, unobserved confounding variables may still interfere; causal-inference power is inferior to randomized controlled trials (RCT).
- 2) Intervention follow-up lasted merely 24 weeks, only verifying short-term intervention effects, unable to reflect long-term influences of the system on

body-composition maintenance, sports-injury recurrence and training compliance.

- 3) Study sites were restricted to premium commercial fitness studios; chain-fitness-clubs and community-fitness-venues were not covered, limiting external scenario generalizability of the model.

4.5.2 Future Prospects

- 1) Conduct multi-centre large-sample RCT studies to strengthen confounding-bias control and upgrade levels of causal evidence.
- 2) Extend follow-up duration to 12 months or longer to explore long-term intervention efficacy and sustained application value of the assessment system.
- 3) Develop online intelligent-assessment systems using digital-technology tools to simplify assessment workflows, lower usage thresholds, adapt to diversified fitness scenarios and improve model generalizability and implementation capacity.

5. Conclusions

Based on cross-sectional and 24-week real-world-cohort data from Asian-adult fitness populations, this study verified application value of the five-dimensional pre-training assessment system. Unreasonable training goals and latent exercise risks are prevalent among this population. Compared with conventional single-dimensional assessment, the five-dimensional system precisely adapts to individual training requirements, effectively optimizes body-composition indicators, raises training-goal achievement rates and reduces sports-injury and dropout rates. Improved goal cognition plays an important mediating role. This quantifiable and implementable system provides support for scientific and refined development of commercial fitness.

Acknowledgements

We sincerely thank all participants completing surveys and intervention follow-ups, thank three domestic premium fitness studios for research-site and data-collection support, thank all project team members and statistical analysts for their hard-working contributions, and

acknowledge funding support from relevant fund projects.

References

- American College of Sports Medicine. (2022). *ACSM's Guidelines for Exercise Testing and Prescription*. 11th ed. Philadelphia: Wolters Kluwer, 89-126.
- International Society of Sports Nutrition. (2020). ISSN position stand: Diet, body composition, and physical performance. *Journal of the International Society of Sports Nutrition*, 17(1), 45.
<https://doi.org/10.1186/s12970-020-00423-z>.
- Li Y, Zhang H, Wang L. (2022). Correlation of personalized fitness assessment with body composition improvement in commercial fitness crowds. *Chinese Journal of Sports Medicine*, 41(5), 368-375.
<https://doi.org/10.3969/j.issn.1000-6710.2022.05.006>.
- Smith J, Brown A, Davis K. (2022). Real-world effectiveness of multi-dimensional pre-exercise evaluation on body composition modification in Asian adults. *Medicine & Science in Sports & Exercise*, 54(8), 1623-1631.
<https://doi.org/10.1249/MSS.00000000000002987>.
- Wang J, Liu S. (2023). Exercise psychological cognition, goal rationality and training adherence in fitness population. *China Sport Science*, 43(2), 56-64.
<https://doi.org/10.8198/jss.2023.02.007>.