



NINE-MONTH INTERDISCIPLINARY PHYSICAL REHABILITATION IN FEMALE UNIVERSITY STUDENTS WITH CLASS I OBESITY AND CARDIOMETABOLIC RISK FACTORS: A DESCRIPTIVE REPORT OF PRE-POST FINDINGS



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ABSTRACT

Obesity in young women is associated with cardiometabolic, functional, and psychosocial limitations. This descriptive report summarizes verified pre-post findings from an underlying nine-month interdisciplinary physical rehabilitation study in 42 female university students aged 21-22 years with class I obesity at Uzhhorod National University, Ukraine. Twenty-four participants had been clinically classified with abdominal obesity and 18 with gluteofemoral obesity. The program combined structured exercise, daily walking, dietary behavior modification, motivational and psychological support, health education, and self-monitoring. At baseline, the abdominal group had a higher atherogenic coefficient (3.30 ± 0.35 vs. 2.56 ± 1.54) and Ruffier index (13.75 ± 1.93 vs. 11.59 ± 2.31), both documented as $p < .05$ in the original analysis. During the program, documented changes included a 7.42 cm reduction in waist circumference in the abdominal group, a 3.72 cm reduction in hip circumference in the gluteofemoral group, and fat-mass reductions of 2.52 kg and 2.14 kg, respectively. Mean self-esteem increased by approximately 12.5% in both groups, and SF-36 physical and mental component scores increased. The available study documentation did not include the individual-level raw dataset, complete adherence records, or full inferential outputs for reanalysis. Because the underlying study had no non-intervention control group, the findings are presented as descriptive within-sample changes and do not establish causal effectiveness.

Keywords: *cardiometabolic risk; descriptive report; female university students; obesity phenotype; physical rehabilitation; quality of life.*

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INTRODUCTION

Obesity remains a major health concern in young adults. More than 890 million adults were living with obesity in 2022, and global adult obesity prevalence has more than doubled since 1990 (World Health Organization [WHO], 2025). Obesity reflects interacting biological, behavioral, environmental, and psychosocial factors and is associated with cardiovascular disease, type 2 diabetes, musculoskeletal limitations, and other noncommunicable conditions.

University life can alter diet, sleep, sedentary behavior, and physical activity. A systematic review of physical-activity-based interventions among university students with overweight or obesity found improvements in BMI or other health indicators across many studies, although this evidence base remains smaller than that for broader adult populations (Pfisterer et al., 2022). The university setting is therefore relevant for structured programs that combine physical activity with sustainable behavior change.

Risk is not determined by total body mass alone. Central adiposity is more strongly associated with dyslipidemia, impaired glucose regulation, insulin resistance, and cardiovascular risk than peripheral fat distribution. Harmonized metabolic syndrome criteria emphasize waist circumference, triglycerides, HDL cholesterol, blood pressure, and fasting glucose, while waist thresholds require population-specific interpretation (Alberti et al., 2009). Evidence also supports the importance of visceral adiposity in cardiometabolic risk assessment (Valenzuela et al., 2023).

Exercise can improve body composition, cardiorespiratory fitness, muscular function, glucose metabolism, lipid profiles, and

psychological well-being even when total weight loss is modest. Evidence in young adults indicates outcome-specific benefits from aerobic and combined aerobic-resistance exercise (Hao et al., 2023). Studies in women living with obesity also support aerobic, resistance, and combined exercise for body-composition and fitness outcomes (Davis et al., 2024). A recent network meta-analysis further showed that exercise modality and intensity influence different body-composition outcomes in women with overweight and obesity (Song et al., 2026).

Obesity management also involves behavioral and psychosocial factors. Psychological distress, self-esteem, body-image concerns, and quality of life can influence motivation and long-term engagement in physical activity (Alves et al., 2024). This multidimensional perspective is consistent with the International Classification of Functioning, Disability and Health, which links body functions and structures with activity, participation, and contextual factors (World Health Organization, 2001).

The underlying study examined a nine-month interdisciplinary rehabilitation program in female university students with class I obesity. The present article reports verified summary findings available from that study. It does not treat phenotype-tailored exercise as a randomized comparison. Abdominal and gluteofemoral phenotype labels are used only to organize descriptive findings from the original clinical classification.

The report addresses three questions: (1) What baseline anthropometric, metabolic, and physical profiles were documented for the abdominal and gluteofemoral groups? (2) What descriptive pre-post changes were documented across anthropometric, physical, functional, self-esteem, and quality-of-life



outcomes? (3) What practical and methodological implications can be drawn from these documented changes without inferring comparative or causal effectiveness?

METHOD

Study Design, Setting, and Data Basis

The underlying research used a longitudinal single-group pre-post intervention design at the Faculty of Health and Physical Education, Uzhhorod National University, Uzhhorod, Ukraine. The intervention lasted nine months. Assessment and rehabilitation planning were organized with reference to the International Classification of Functioning, Disability and Health (World Health Organization, 2001).

This manuscript is a descriptive report of summary findings from the underlying dissertation study and associated study documents available for journal preparation. The individual-level raw dataset and full statistical output files were not available for reanalysis. No new hypothesis testing was performed for this revision. Only numerical values, procedures, and statistical statements that could be traced to the available documentation were retained. Information that could not be verified was not reconstructed or inferred.

Participants and Obesity Classification

The study documentation identified 42 female university students aged 21-22 years with class I obesity. Class I obesity was operationalized as BMI from 30.0 to less than 35.0 kg/m², consistent with adult BMI categories (Centers for Disease Control and Prevention [CDC], 2024). The documented BMI range was 30.02-31.96 kg/m², with a mean of 30.59 ± 0.48 kg/m². Twenty-four participants were classified with

abdominal obesity and 18 with gluteofemoral obesity.

The available documents indicate that fat-distribution phenotype was determined using waist and hip anthropometry. Waist circumference and waist-to-hip ratio are established markers of central adiposity and cardiometabolic risk (World Health Organization, 2011). However, the exact numeric cut-off used in the original classification was not documented in the materials available for this report. The phenotype labels are therefore reported as the original clinical classifications and cannot be independently reproduced from the surviving documentation.

Exclusion criteria documented in the study were secondary or symptomatic hypertension, chronic renal failure, severe liver dysfunction, psychiatric disorders, pregnancy, and acute inflammatory disease. The available documentation did not specify the recruitment channel, sampling strategy, or a prospective sample-size calculation. These elements are therefore not reconstructed in this report.

Outcome Measures

The original study used a multidimensional assessment framework. Because no prospectively designated primary endpoint was documented in the available materials, this report does not present a formal primary-secondary outcome hierarchy. It instead groups outcomes by domain and reports only values that can be verified from the study documentation.

Anthropometry and body composition. Body weight, BMI, waist circumference, and hip circumference were recorded. Body fat percentage was assessed with an Omron BF-511 bioelectrical impedance device. Blood pressure was also assessed. Detailed assessor-training



procedures and repeated-measure reliability procedures were not documented in the materials available for this report.

Metabolic indicators. Laboratory assessment included total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, fasting glucose, and an oral glucose tolerance test. The study also reported an atherogenic coefficient. These variables reflect cardiometabolic risk domains, but the documentation does not support a formal metabolic syndrome diagnosis for each participant (Alberti et al., 2009).

Physical activity. Habitual physical activity was assessed with the 27-item long form of the International Physical Activity Questionnaire, covering occupational, transportation, domestic, and leisure-time activity (Craig et al., 2003).

Physical condition. The Ruffier index was used as an indicator of cardiovascular response and recovery after a standardized squat-based task. Higher values indicate a less favorable response (Guo et al., 2018). The exact category thresholds used in the original rehabilitation protocol were not available, so this report emphasizes continuous index values where documented.

Functional movement capacity. Movement quality was assessed with the Functional Movement Screen, which evaluates seven fundamental movement patterns using ordinal scoring for mobility, stability, and neuromuscular control (Cook et al., 2006a; Cook et al., 2006b). Acceptable interrater reliability has been reported when trained

assessors administer the screen (Minick et al., 2010). Study-specific category cut-offs were not available for verification.

Self-esteem. Self-esteem was assessed with the Dembo-Rubinstein approach modified by A. M. Prikhozhan. The method uses direct ratings on trait scales and has recognized adaptations in psychological assessment (Bakholdina et al., 2014). Mean scores are reported because category thresholds used in the original protocol were not available.

Quality of life. Health-related quality of life was assessed using the 36-item Short Form Health Survey. The SF-36 includes eight health domains and supports physical and mental health component interpretation, with higher scores indicating better perceived health (Ware & Sherbourne, 1992; McHorney et al., 1993).

Interdisciplinary Physical Rehabilitation Program

The program combined structured exercise, daily walking, dietary behavior modification, motivational and psychological support, health education, self-monitoring, and complementary rehabilitation procedures. It progressed through preparatory, main, and maintenance periods. Exercise content was individualized according to documented physical condition, functional needs, and the original obesity-phenotype classification. The available protocol does not document a formal comparative rationale that would permit phenotype-specific components to be evaluated as distinct treatments.

Table 1. FITT-oriented summary of the nine-month interdisciplinary rehabilitation program

Period	FITT / program component	Documented prescription
Preparatory Months 1-2	Frequency	Morning exercise daily; fitness-based kinesitherapy 3 sessions/week; motivational/psychological support 1 session/week; daily walking.



Period	FITT / program component	Documented prescription
Main Months 3-7	Intensity	Numeric exercise-intensity target was not documented in the available study materials.
	Time	Morning exercise 10-15 min; fitness sessions 45-50 min; motivational/psychological support about 60 min/session.
	Type / activity volume	General exercise, yoga elements, Zumba fitness, aqua fitness; approximately 8,000-10,000 steps/day.
	Co-components	Dietary behavior modification, massage, SPA procedures, aromatherapy, music therapy, multimedia health education, and self-monitoring.
	Frequency	Fitness-based kinesitherapy 3 sessions/week; daily walking.
	Intensity	General exercise about 50-75% of maximal oxygen consumption; selected exercise up to 85-90%. The method used to establish or monitor VO ₂ max was not documented.
	Time	Approximately 55-60 min/session.
	Type / activity volume	Zumba fitness, aqua fitness, functional training, Pilates, body-weight exercise, and resistance-oriented exercise; approximately 10,000-12,000 steps/day.
	Individualization / co-components	Exercise content was individualized by documented physical condition, functional needs, and the original obesity-phenotype classification. Behavioral, motivational, and complementary components continued.
	Support components	Motivational support, psychological support, self-management, and continued health-behavior reinforcement.
Maintenance Months 8-9	Frequency	Continued individualized activity and psychological support. Exact weekly exercise frequency was not documented.
	Intensity	Progression according to physical condition and rehabilitation goals; exact numeric targets were not documented.
	Time	Full session duration was not documented in the available materials.
	Type / goal	Continued physical and functional activity with emphasis on independent activity habits and maintenance.
	Support components	Motivational support, psychological support, self-management, and continued health-behavior reinforcement.

Statistical Reporting

The original study documentation described descriptive statistics, the Shapiro-Wilk test for distributional assessment, Student's t-test or Wilcoxon test for dependent observations, the Mann-Whitney test for independent-group

comparisons, and Pearson or Spearman correlation coefficients as appropriate. Analyses were conducted using STATISTICA and Microsoft Excel, but software version numbers were not documented.



The present report does not reanalyze individual-level data. Exact p-values, confidence intervals, standardized effect sizes, paired-change standard deviations, missing-data procedures, multiplicity procedures, and phenotype-by-time interaction analyses were not available in the documentation used for this report. Accordingly, $p < .05$ is retained only where that threshold was explicitly documented in the original analysis. All other changes are reported descriptively. No claim of differential response between phenotypes is made.

Ethical Considerations

The study documentation states that participation was voluntary and that all participants provided informed consent before assessment and rehabilitation. Confidentiality and protection of participant information were described as study principles. The materials available for this manuscript did not include the name of an approving ethics committee, an approval number, or an approval date. Formal ethics approval therefore cannot be independently verified from the surviving documentation and should be confirmed by the originating institution before publication.

RESULT

Descriptive Statistics of Student Athletes' Speaking Scores

The documented sample included 42 participants: 24 (57.1%) with abdominal obesity and 18 (42.9%) with gluteofemoral obesity. Mean body fat percentage was similar in the available summaries, at $38.24 \pm 0.46\%$ and $38.04 \pm 0.38\%$, respectively. The original analysis documented a higher atherogenic coefficient in the abdominal group (3.30 ± 0.35

vs. 2.56 ± 1.54 , $p < .05$) and a higher Ruffier index (13.75 ± 1.93 vs. 11.59 ± 2.31 , $p < .05$). Mean oral glucose tolerance values were 7.83 ± 1.82 mmol/L and 6.08 ± 1.31 mmol/L, respectively, but an exact comparison p-value was not available.

Table 2. Documented baseline characteristics of the participants

Characteristic	Abdominal obesity	Gluteofemoral obesity
Participants, n (%)	24 (57.1%)	18 (42.9%)
Obesity classification	Class I	Class I
BMI, kg/m ²	Overall sample: 30.59 ± 0.48 ; range 30.02-31.96	Overall sample: 30.59 ± 0.48 ; range 30.02-31.96
Body fat, %	38.24 ± 0.46	38.04 ± 0.38
Atherogenic coefficient	3.30 ± 0.35	2.56 ± 1.54
Oral glucose tolerance test, mmol/L	7.83 ± 1.82	6.08 ± 1.31
Ruffier index, a.u.	13.75 ± 1.93	11.59 ± 2.31
Baseline physical-condition profile	58.3% classified at a low level	38.9% moderate; 22.2% above average
Baseline functional-movement profile	66.7% classified at a critical level	Numerical baseline category distribution not available

These baseline findings are consistent with evidence that central adiposity can carry



greater cardiometabolic risk than total adiposity alone (Valenzuela et al., 2023). They also illustrate why waist-related measures can add clinically relevant information beyond BMI (World Health Organization, 2011). Because the original phenotype threshold cannot be independently reconstructed, these patterns should be interpreted as descriptive findings within the original clinical classification.

Documented Anthropometric and Metabolic Changes

The available summaries documented a 7.42 cm reduction in waist circumference (7.97%) in the abdominal group and a 3.72 cm reduction in hip circumference (4.50%) in the gluteofemoral group. Fat mass decreased by 2.52 kg (6.61%) and 2.14 kg (5.63%), respectively. In the abdominal group, the atherogenic coefficient changed from 3.30 ± 0.35 to 2.77 ± 0.47 . Complete pre-post laboratory values were not available for every metabolic measure, so no broader claim of metabolic normalization is made.

Table 3. Documented anthropometric and metabolic changes during the nine-month program

Outcome	Abdominal obesity	Gluteofemoral obesity
Waist circumference	-7.42 cm (-7.97%)	Numerical change not available in study documentation
Hip circumference	Numerical change not available in study documentation	-3.72 cm (-4.50%)
Fat mass	-2.52 kg (-6.61%)	-2.14 kg (-5.63%)
Atherogenic coefficient	3.30 ± 0.35 at baseline to 2.77	Numerical follow-up value not available in

Outcome	Abdominal obesity	Gluteofemoral obesity
	± 0.47 after intervention	study documentation
Carbohydrate metabolism	Complete pre-post laboratory values not available for verification	Complete pre-post laboratory values not available for verification

The direction of these anthropometric changes is consistent with evidence that exercise can reduce waist circumference, body fat percentage, BMI, and fat mass in women with overweight and obesity, although the magnitude of benefit varies by exercise modality (Song et al., 2026). Exercise training can also improve blood-lipid profiles (Smart et al., 2025). In the present study, however, exercise was delivered together with walking, diet-related behavior modification, psychological support, health education, and self-monitoring. The contribution of any single component cannot be isolated.

Physical Condition, Physical Activity, and Functional Movement

Documented changes in physical condition, physical inactivity, and functional movement are summarized in Table 4. The values are descriptive because complete category thresholds and outcome-specific inferential statistics were not available for reanalysis.

Table 4. Documented physical-condition, physical-activity, and functional-movement findings

Indicator	Abdominal obesity	Gluteofemoral obesity
Physical-condition category change	58.3% (n = 14) moved to a better category	Above-average category increased by 66.7 percentage points (n = 12)



Indicator	Abdominal obesity	Gluteofemoral obesity
Above-average physical condition	Increased by 37.5 percentage points (n = 9)	Increased by 66.7 percentage points (n = 12)
Physical inactivity	Decreased by 8.33 percentage points	Decreased by 11.1 percentage points
Functional movement	20.83% moved from acceptable to optimal; acceptable category increased by 37.53 percentage points	Optimal category increased by 38.9 percentage points
Inferential information	Overall physical-condition improvement reported at $p < .05$; exact test statistic unavailable	Overall physical-condition improvement reported at $p < .05$; exact test statistic unavailable

The program progressed from lower-volume preparation to more demanding activity during the main period and then to a maintenance phase. Such progression is consistent with current evidence favoring exercise prescription tailored to baseline capacity, tolerance, and intended outcomes rather than one uniform modality (Poon et al., 2026). The nine-month duration was also longer than many university-based interventions summarized by Pfisterer et al. (2022). These comparisons provide context but do not establish that the program caused the documented changes.

Self-Esteem and Health-Related Quality of Life

Mean self-esteem increased from 55.56 ± 5.56 to 62.49 ± 4.04 in the abdominal group and from

55.56 ± 5.79 to 62.52 ± 4.38 in the gluteofemoral group. Relative changes calculated from the documented group means were 12.47% and 12.53%, respectively.

Table 5. Documented changes in self-esteem

Phenotype	n	Before, mean $\pm$ SD	After, mean $\pm$ SD	Change
Abdominal obesity	24	55.56 ± 5.56	62.49 ± 4.04	+6.93; +12.47%
Gluteofemoral obesity	24	55.56 ± 5.79	62.52 ± 4.38	+6.96; +12.53%

Psychological and motivational support were part of the broader rehabilitation program. This is relevant because psychological distress, self-esteem, and quality of life can influence engagement in weight-management behavior and physical activity (Alves et al., 2024). The design does not permit attribution of the self-esteem change to a specific program component.

SF-36 physical and mental component scores also increased in both groups. Values are presented as score points on a 0-100 scale, not as percentages.

Table 6. Documented SF-36 physical and mental component scores

Component / group	n	Before	After	Change
Physical / abdominal	24	45.09	50.03	+4.94 points; +10.96%
Mental / abdominal	24	39.22	43.79	+4.57 points; +11.65%



Component / group	n	Before	After	Change
Physical / gluteofemoral	18	59.22	62.03	+2.81 points; +4.75%
Mental / gluteofemoral	18	44.12	45.56	+1.44 points; +3.26%

The abdominal group showed larger descriptive increases in both SF-36 components, but these values should not be interpreted as evidence of a superior phenotype-specific response. Baseline scores differed, formal interaction testing was unavailable, and regression to the mean cannot be excluded.

Interpretation, Practical Implications, and Limitations

The main value of this report is its multidimensional description of a prolonged rehabilitation program in female university students with class I obesity. The findings show that participants within the same BMI category had different documented cardiometabolic and physical profiles and that favorable changes were documented across several domains during the nine-month period. These observations support assessment beyond body weight alone.

From a sport-science and rehabilitation perspective, assessment may reasonably integrate central adiposity, body composition, physical condition, movement capacity, habitual physical activity, psychological status, and quality of life. Current evidence indicates that aerobic, resistance, combined, and higher-intensity modalities influence obesity-related outcomes differently, supporting individualized exercise prescription (Song et al., 2026; Poon et al., 2026).

The limitations are substantial. First, the underlying study had no non-intervention control group. Maturation, spontaneous behavior change, seasonal effects, and regression to the mean therefore cannot be separated from program-associated change. Second, the sample consisted of 42 women from one university, with small phenotype subgroups. Third, phenotype allocation was not randomized, and the exact classification threshold was not available for independent verification. Fourth, multiple exercise, dietary, psychological, educational, self-monitoring, and complementary components were delivered together, so component-specific effects cannot be isolated.

Fifth, the available documentation did not include the individual-level raw dataset, full inferential outputs, attendance and adherence records, adverse-event counts, complete recruitment details, or post-program follow-up. Sixth, IPAQ is a self-report measure and is susceptible to recall and social-desirability bias despite established measurement properties (Craig et al., 2003). Seventh, the number of outcomes raises the possibility of chance findings, while multiplicity procedures were not available for verification. Finally, formal ethics approval details could not be verified from the surviving documentation. These limitations reduce reproducibility and require the results to be interpreted as descriptive rather than confirmatory.

Future research should use controlled designs, prospectively specify primary outcomes, preserve complete intervention-fidelity and adverse-event records, report exact effect estimates and confidence intervals, and include post-program follow-up. If obesity phenotype is examined as a potential modifier of response, this should be tested using prespecified interaction analyses rather than separate within-group comparisons.



CONCLUSION

The available study documentation describes baseline cardiometabolic and physical differences between female university students classified with abdominal and gluteofemoral obesity and documents favorable changes during a nine-month interdisciplinary rehabilitation period. These changes included reductions in regional circumference and fat mass, more favorable physical and functional classifications, increases of approximately 12.5% in mean self-esteem, and higher SF-36 physical and mental component scores.

These findings should be interpreted as descriptive within-sample observations. The underlying study lacked a control group, phenotype-tailored content was not randomized, and the individual-level dataset and complete inferential outputs were not available for reanalysis. The report therefore does not establish causal effectiveness or comparative superiority between phenotypes.

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DECLARATIONS

Author Contribution Statement

M.M.D. was responsible for conceptualization and study design, literature review, participant

recruitment, development and implementation of the rehabilitation program, data collection, statistical analysis in the underlying study, interpretation of the documented findings, and manuscript preparation. The author has read and approved the final revised manuscript.

AI Disclosure Statement

The authors used ChatGPT and Midjourney during the preparation of this work for language polishing, structural refining, and ensuring academic tone. After using the tool, the authors thoroughly reviewed and edited the content as needed and takes full responsibility for the content of the publication. The authors declare that this research was prepared, researched, and written based on original experimental data, while AI was utilized solely as an editorial aid for clarity and flow.

Conflicts of Interest

The author declares no conflict of interest related to the research, authorship, or publication of this article.

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Declaration of Originality

This manuscript is an original journal-format descriptive report developed from an underlying dissertation study. It uses only study procedures and numerical summaries that could be verified in the documentation available for journal preparation. The author is responsible for ensuring that the article does not duplicate previously published reports derived from the same study.



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