

The Importance of Physical Activity and Eating Behaviours for Fat and Muscle Mass in Young Men and Women

Dorota Łoboda^a, Jarosław Ocalewski^a, Beata Ziółkowska^a, Szymon Kuliś^b

^aKazimierz Wielki University of Bydgoszcz (Bydgoszcz, Poland)

^bJózef Piłsudski University of Physical Education in Warsaw (Warsaw Poland)

Purpose: The aim of the study was to determine the relationships between the level of physical activity and eating-related behaviors (such as emotional eating, habitual eating, and dietary restraint) and the amount of fat and muscle tissue in the bodies of young adults.

Methods: The study was conducted among 202 university students (103 women - age 21.44 ± 2.14 years, stature 167.91 ± 6.13 cm, body mass 62.08 ± 12.11 kg; 99 men - age 21.48 ± 1.93 years, stature 179.12 ± 7.11 cm, body mass 77.31 ± 15.32 kg) from two higher education institutions. Self-report questionnaires were used: the IPAQ (International Physical Activity Questionnaire) and the KZZJ (Eating Behavior Questionnaire). Anthropometric measurements and body composition analyses were also performed. Data were analyzed using Pearson's r correlations, Mann-Whitney U tests, Pearson's χ^2 tests, and structural equation modeling (SEM).

Results: Strong positive correlations were observed between emotional eating and the level of body fat. It was found that only individuals with high-intensity physical activity (over 1500 MET-min/week) had body fat levels within the normal range. For smaller adipose tissue, only the following correlations were statistically significant: intensive exercise around the house ($R = -.143$, $P = .043$), intensive physical activity in free time ($R = -.268$, $P < .001$) and moderate physical activity in free time ($R = -.188$, $P = .008$). For larger muscle tissue, the following correlations were statistically significant: intensive exercise around the house ($R = .140$, $P = .048$), intensive physical activity in free time ($R = .198$, $P = .005$). SEM models showed that psychological and physical activity-related variables explained 48% of the variance in body fat and 32% of the variance in muscle mass.

Conclusions: Physical activity, especially at a high intensity, plays a crucial role in maintaining a healthy body composition. At the same time, emotional eating contributes to increased body fat, particularly in women. The findings have practical applications for the prevention of overweight, obesity, and eating disorders among young adults.

Keywords: physical activity, eating behaviors, muscle tissue, fat tissue, young adults.

Introduction

Physical activity and diet are among the key components of a person's lifestyle. Additionally, unlike genetic resources or personal life history they are, like other lifestyle factors, subject to human control and can therefore be modified¹. This is particularly important given that, as researchers have indicated², proper nutrition and regular physical activity during childhood can reduce the risk of chronic diseases in later life. It turns out that young people, in particular, are showing increasing interest in physical activity and nutrition, using them both as strategies to control body shape and as a means to maintain or enhance physical health³⁻⁴. Physical activity and a healthy relationship with food also influence mental health and overall well-being⁵⁻⁶. At the same time, it has been observed that one of the maladaptive behaviors among students especially in response to difficult situations is emotional eating⁷. Meanwhile, Costa and colleagues⁸ argue that physical activity may play a potentially preventive role in the development of emotional eating. This conclusion is consistent with the findings of Grajek and colleagues⁴, who demonstrated that individuals with, among other things, low physical activity levels, poor diets, and elevated BMI values are more prone to eating under the

influence of affect. Simultaneously, there is a noted tendency among young people particularly women to engage in restrictive dieting (sometimes to the extent that it may indicate an eating disorder) and excessive physical activity, leading to adverse changes in both muscle and fat tissue⁹⁻¹⁰. Unfortunately, dietary restrictions implemented without professional supervision and physical activity mismatched to the body's capabilities can lead to numerous negative consequences for both somatic health and psychosocial functioning.

Although there have been studies conducted worldwide that correlated the variables of interest eating behavior, diet, and physical activity, firstly, they only considered emotional eating, and secondly, they were not implemented in Polish samples. For example, El Ansari et al.¹¹ found that lower levels of physical activity and poorer diet quality were associated with higher levels of emotional eating. In turn, Camilleri et al.¹² showed that emotional eating is strongly associated with low physical activity, stress, and negative body image, while Schultchen et al.¹³ proved that physical activity could support emotion regulation and reduce the desire for emotional eating. Koehler and Drenowatz¹⁴ proved that while physical activity increases energy expenditure, most exercisers increase energy intake in the diet (so-called compensatory eating).

Our study, in addition to emotional eating, also includes dietary restraint and habitual eating. These forms of eating behaviors result from the theoretical foundations of the tool we used (Eating Behavior Questionnaire)¹⁵. Its authors understand emotional eating as reaching for food in response to various affective states (mainly negative) e.g. sadness, anger despite the lack of physiological hunger. Dietary restrictions, on the other hand, consist in the conscious application of restrictions (quantitative and/or qualitative) in food consumption, motivated mainly by weight control and aesthetic considerations. Habitual eating, on the other hand, is understood as the tendency to eat food automatically, in certain situations (e.g. watching TV) without feeling physiological hunger.

The main aim of the present study was to examine the relationships between physical activity and the psychological aspects of eating (tendencies toward emotional eating, habitual eating, and dietary restraint) in young adults, and selected anthropometric indicators, i.e., fat and muscle body mass. Based on the literature¹⁶⁻¹⁹, it was hypothesized that there would be statistically significant relationships between BMI values, discrepancies between actual and desired body weight, eating behaviors, and the intensity of physical activity among the participants.

Methods

Participants

A total of 202 individuals participated in the study, including 103 women (age 21.44 ±2.14 years, stature 167.91 ±6.13 cm, body mass 62.08 ±12.11 kg) and 99 men (age 21.48 ±1.93 years, stature 179.12±7.11 cm, body mass 77.31±15.32 kg). The respondents were recruited from two universities (fields of study: Physical Education and Psychology and Management and Civil Engineering). The project included all students from the randomly selected universities and programs who gave informed consent to participate. The average age of participants was 21.82±2.03 years. Students who were simultaneously employed accounted for 43.6% of the sample, and the vast majority over 71.29% came from urban areas. A total of 60.40% assessed the economic situation of their household as good or very good. The research project was conducted between 2021 and 2022. The study involved young adults and was carried out by two dietitians and a psychologist. All participants provided written informed consent prior to their inclusion in the study. The research was conducted in full compliance with the ethical standards of the 1964 Declaration of Helsinki and its subsequent amendments.

Experimental design

In this study, two self-report instruments were used to measure the main variables (physical activity and eating-related behaviors), along with a demographic questionnaire to control for secondary variables and to collect basic information about the participants. All questionnaires were completed individually by the participants in a controlled university setting, with a researcher available to address any uncertainties. The International Physical Activity Questionnaire (IPAQ – long form, past 7 days) was used to assess participants' levels of physical activity. The IPAQ expresses physical activity in MET-minutes/week, which enables easy classification of respondents into one of three activity categories: insufficient (below 600), sufficient (600–1500 or 600–3000), or high (above 1500 or 3000 MET-min/week). The long version of the IPAQ consists of five independent sections addressing physical activity related to: work, transportation, domestic chores, recreation and sports, and time spent sitting²⁰⁻²¹. The reliability of the IPAQ is characterized

by good repeatability, with a median Spearman correlation coefficient of approximately 0.81.²⁰⁻²² The Eating Behavior Questionnaire (EBQ) was used to assess the respondent's psychological approach to eating²³. This three-factor tool comprises 30 statements to which participants respond with “yes” or “no.” As a three-dimensional instrument, the EBQ enables the diagnosis of the following types of disordered eating behavior: 1) eating without physiological hunger (the “habitual eating” factor), 2) eating under the influence of emotions (the “emotional eating” factor), and 3) eliminating certain food products to control body weight (the “dietary restriction” factor). The higher the total and subscale scores, the greater the intensity of disordered eating behaviors. The reliability of the tool is satisfactory; Cronbach's alpha is .89²⁴. Additionally, the demographic questionnaire included questions on gender, age, educational and occupational activity, desired body weight, and similar factors. Anthropometric measurements were also taken, including body weight in kilograms (RADWAG, country Poland, model C315.100/200.OW-1), height in centimeters (Tanita, Japan, model DC-13C), three circumferences: arm, waist, and hips (measuring tape), skinfold thickness (caliper), and body composition (Tanita, Japan, model DC-13C). Measurements were taken early in the morning, on an empty stomach, in light clothing and without shoes. All questionnaires were completed individually by the participants in a controlled university setting, with a researcher available to address any uncertainties.

Statistical analysis

Statistical analyses were performed using STATISTICA 13 and (IBM v.25.0, Chicago, IL, USA). The significance level *P* was set at .05. To examine the relationship between fat and muscle tissue and eating behaviors and physical activity, Pearson's correlations were applied. To determine differences in fat and muscle tissue based on physical activity, Student *t* test and Pearson's χ^2 test were used (including reference norms for body fat content: women <25%, men <20%)²⁵(skewness and kurtosis of the variables: body fat and muscle mass ranged from -.04 to .57). Participants were classified into these groups based on data from the IPAQ questionnaire and the criteria proposed by Biernat and colleagues²⁴. To identify which psychological factors related to eating behavior, physical activity, and diet best explained the outcome variables “fat tissue” and “muscle tissue,” Structural Equation Modeling (SEM) was applied, using Maximum Likelihood Estimation (ML). We conducted the analysis and indicated the required sample size to detect an effect of at least 90 individuals (alpha = 0.05, effect size *f* = 0.3, power = 0.80, and two latent variables and two observed variables)²⁵. Model fit was assessed using the CMIN index²⁶, with CMIN/df = 0 (fit was determined based on the criterion CMIN > 2.00 indicating lack of fit)²⁷. It was assumed that if the indicators NFI, CFI, GFI, and AGFI were close to or equal to 1, and RMSEA < .05, the model was considered a good fit to the data sample²⁸.

Results

Correlational analysis between eating behavior, diet, physical activity, body fat and muscle mass

To begin with, Pearson's *r* correlation coefficient was used to assess the relationships between all highlighted variables: eating behaviors, indices of healthy diet, unhealthy diet, and overall diet quality, percentage of body fat and muscle mass, physical activity, age, and gender. A moderate positive correlation was found between emotional eating and habitual overeating (*R* = .367, *P* < .001), indicating that the more individuals tend to eat in response to emotions, the more frequently they also engage

in overeating. Additionally, emotional eating was strongly associated with overall eating behaviors in the studied sample ($R = .819, P < .001$). This suggests that the greater the intensity of emotion-driven eating, the higher the general tendency to display disordered eating behaviors. Furthermore, a negative correlation was found between dietary restrictions and emotional eating ($R = -.186, P < .01$), meaning that the more restrictive the respondent's dietary behaviors, the less likely they are to eat in response to emotions.

When analyzing eating behaviors and the diet quality index, a weak but significant positive correlation was observed ($R = .156, P < .05$). This means that the more disordered the eating behaviors, the higher the overall diet quality index. However, a strong negative correlation was found between the unhealthy diet index and the overall diet quality index ($R = -.638, P < .001$), indicating that the healthier the diet, the lower its overall quality. Analysis of body composition in relation to eating behaviors and diet showed a moderate positive correlation between emotional eating and body fat percentage ($R = .382, P < .001$). This suggests that the more a person eats in response to affect, the higher their body fat level. Moreover, a weak but significant positive correlation was found between overeating and physical activity ($R = .147, P < .05$), suggesting that physically active individuals are more likely to consume larger food portions—possibly due to increased appetite from calorie loss or as a form of reward for physical effort. A statistically insignificant trend was observed: increased MET intensity was associated with lower fat content ($R = -.110, P = .118$). MET values were not related to muscle tissue content in the body composition ($R = .028, P = .694$). In addition, it was shown that women, compared to men, reported higher levels of emotional eating ($R = .344, P < .001$) and more unfavorable dietary patterns ($R = -.251, P < .001$). It was also assessed whether the context of physical activity (e.g., vigorous work activity, moderate work activity, cycling for transportation, walking for transportation, vigorous gardening, moderate gardening, leisure walking, vigorous leisure activity, moderate leisure activity) was associated with eating behaviors. Vigorous physical activity during leisure time was linked to lower emotional eating ($R = -.141, P = .041$) and greater dietary restrictions ($R = .177, P = .012$). Meanwhile, moderate physical activity around and within the home was associated with less dietary restriction ($R = -.175, P = .013$ and $R = .143, P = .044$, respectively).

Fat tissue, muscle mass and the level of physical activity

In the next step of the analyses, the relationship between physical activity and the proportion of body fat in body composition was examined. To analyzing physical activity intensity, two groups were identified:

- Group 1 – high level ($n = 96$);
- Group 2 – sufficient + insufficient level ($n = 106$) (due to the small number of participants with an insufficient level of activity, ($n = 5$), this group was merged with the sufficient level group).

Participants were classified into these groups based on data from the IPAQ questionnaire and the criteria proposed by Biernat and colleagues²⁹. Statistical significance analysis showed no differences in body fat content ($t(200) = .992, P = .322$) or muscle mass ($t(200) = .921, P = .358$) depending on whether participants belonged to Group 1 or 2. Additionally, normative values of body fat content were considered [$<25\%$ for women, $<20\%$ for men²⁰]. Pearson's χ^2 test was applied ($\chi^2 = .40, P = .525, C = .04$), which revealed no association between group membership (Group 1 vs. Group 2) and normative fat content. Therefore, a series of Pearson's χ^2 tests was conducted to explore

the relationship between physical activity intensity and body fat content, considering six specific physical activity criteria:

- Group 1 – high activity: 3 or more days of vigorous activity totaling at least 1500 MET-min/week ($N = 17$);
- Group 2 – high activity: 7 or more days of any combination of activities (walking, moderate, or vigorous) exceeding 3000 MET-min/week ($N = 79$);
- Group 3 – sufficient activity: 3 or more days of vigorous activity, no less than 20 minutes per day ($N = 42$);
- Group 4 – sufficient activity: 5 or more days of walking or vigorous activity, no less than 30 minutes per day ($N = 56$)²⁹.

Each group from 1 to 4 was then compared to the sum of the remaining groups (e.g., Group 1 compared with Groups 2+3+4; Group 1+2 compared with Groups 3+4, Group 1+2+3 compared with Group 4). It was found that only individuals in Group 1 those engaging in three or more days of vigorous physical activity (at least 1500 MET-min/week) had a significantly higher likelihood of having body fat within normative levels compared to the rest of the sample ($\chi^2 = 5.88, df = 1, P = .015$). Thus, vigorous physical activity appears to be a key factor in maintaining normal body fat levels.

Fat tissue, muscle mass and type of activity

Next, the context of physical activity (i.e., vigorous activity at work, moderate work activity, cycling for transport, walking for transport, vigorous gardening, moderate gardening, leisure walking, vigorous leisure activity, moderate leisure activity) was analyzed in relation to body fat and muscle mass.

Statistically significant negative correlations with lower fat content were found for:

- Vigorous physical activity around the home ($R = -.143, P = .043$),
 - Vigorous leisure-time activity ($R = -.268, P < .001$),
 - Moderate leisure-time activity ($R = -.188, P = .008$).
- Statistically significant positive correlations with greater muscle mass were found for:
- Vigorous physical activity around the home ($R = .140, P = .048$),
 - Vigorous leisure-time activity ($R = .198, P = .005$).

Fat tissue, muscle mass and WHO recommendations

In the next step, the impact of time spent in moderate and vigorous leisure-time physical activity on body fat and muscle mass was examined, following World Health Organization (WHO) recommendations (75–150 minutes/week of vigorous physical activity, 150–300 minutes/week of moderate physical activity)³⁰.

Two analyses were conducted to assess which durations significantly affect fat and muscle tissue:

1. Comparison of body fat and muscle mass between individuals with <75 minutes vs. ≥ 75 minutes of vigorous physical activity;
2. Comparison for <150 minutes vs. ≥ 150 minutes of moderate physical activity.

Student's t tests were used, and to determine the size of the effect of physical activity for variance in muscle and fat tissue, Cohen's D test were conducted. In these analyses, the dependent variable was either muscle or fat tissue, and the independent variable was group membership or non-membership (see Tab. 1).

The statistically significant impact of both moderate (150–300 minutes per week) and vigorous (75–150 minutes per week) leisure-time physical activity on muscle and fat tissue was demonstrated. The effect size estimate (Cohen's D) indicated a moderate effect of the association between intensity physical

Table 1. Summary of statistical analyses results (*t*-student, Cohen's *d*) explaining muscle tissue and fat tissue due to the time of intensive and moderate activity in leisure time (n=202)

Analysis	Group	Muscle tissue			Fat tissue		
		<i>M</i> ; <i>SD</i>	<i>t</i> (<i>df</i>); <i>P</i>	Cohen's <i>d</i>	<i>M</i> , <i>SD</i>	<i>t</i> (<i>df</i>); <i>P</i>	Cohen's <i>d</i>
Analysis 1	Int. Act. <75 <i>N</i> =113	50.22; 11.51	-2.86(200) .005	.407	22.65; 8.87	4.89(200) <.001	.697
	Int. Act. >75 <i>N</i> =89	54.73; 10.64			16.75; 8.06		
Analysis 2	Mod.Act. <150 <i>N</i> =168	51.11; 10.79	-3.11(200) .002	.555	20.99; 9.12	3.42(200) .001	.703
	Mod.Act. >150 <i>N</i> =34	57.61; 12.52			15.36; 6.72		

P – level of statistical significance; *t*(*df*) – Student *t* statistic value (degrees of freedom); Cohen's *d* – Cohen's *d* test value, Int. Act. - Intensive activity; Mod.Act. - Moderate activity Physical activity thresholds were established based on WHO recommendations (75–150 minutes/week of vigorous physical activity, 150–300 minutes/week of moderate physical activity).

activity >75 minutes/week and moderate physical activity >150 minutes/week and fat tissue (.697 vs. .703, respectively). Smaller and moderate effect sizes (Cohen's *D*) were found for explaining muscle mass (.407 vs. .555, respectively).

To summarize the analyses of the collected research data, an attempt was made to identify which of the key variables—emotional eating, physical activity, and diet—explain the proportion of fat and muscle tissue in body composition. For

this purpose, Structural Equation Modeling (SEM) was applied. The dependent variables were body fat content (Fig. 1) and muscle mass (Fig. 2), while the independent variables included: emotional eating, unhealthy diet index, healthy diet index, moderate physical activity >150 minutes, vigorous physical activity >75 minutes, and gender. To estimate the parameters in the model, the authors used Maximum Likelihood Estimation (ML).

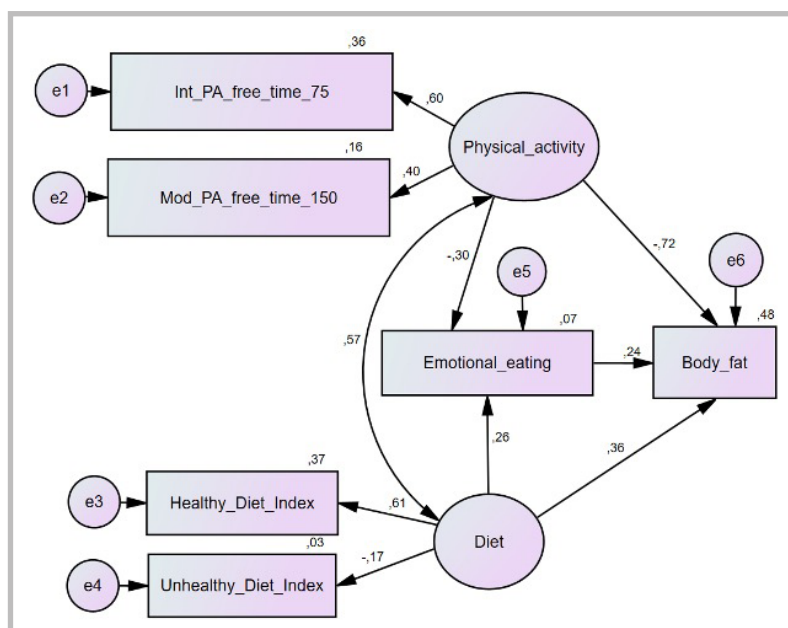


Figure 1. Emotional eating, leisure-time physical activity, diet, gender and adipose tissue – structural equation modeling (SEM) (n=202) Int_PA_free_time_75 – intensive activity in free time; Mod_PA_free_time_150 – moderate activity in free time; Emotional_eating – emotional eating from The Eating Behavior Questionnaire, Healthy_Diet_Index and Unhealthy-Diet-Index –indexes from Kompan Questionnaire, Body_fat – adipose tissue (%). The values given by the arrows are standardized regression weights (SRW). SEM indexes of fit: CMIN=12.21, *P*=.663; CMIN/DF= .814; GFI= .990; AGFI= .959; CFI= 1.00; NFI= .915; HOELTER index = 1006 (critical N for a significance level of .01), RMSEA < .001

The model explaining body fat is well-fitted to the data, as indicated by a non-significant χ^2 value (CMIN = 12.21, *P* = .663)²⁶. The CMIN/df value = .814 also supports model acceptance (a value of CMIN > 2.00 indicates poor fit)²⁷. The indices NFI = .915, CFI = 1.00, GFI = .990, and AGFI = .959

are close to or equal to 1, the HOELTER index = 1006 (critical N for a significance level of .01), and the RMSEA value < .001 confirms an excellent model fit²⁸. The arrangement of variables explains 48% of the variance in body fat. Model body fat is predicted by: physical activity (standardized regression weights

(SRW)= -.722), emotional eating (SRW= .241) and diet (SRW= .361). In this model, intensity physical activity (SRW=.603) is more important than moderate physical activity (SRW=.398).

The higher the physical activity, the less body fat and emotional eating has a positive association with body fat.

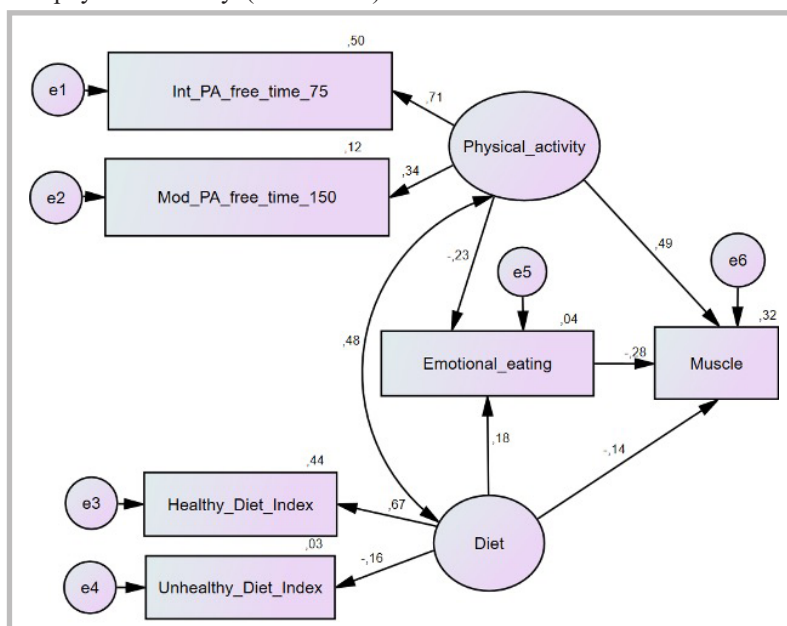


Figure 2. Emotional eating, leisure-time physical activity, diet, and gender in relation muscle mass structural equation modeling (SEM) (n=202). Int_PA_free_time_75 – intensive activity in free time; Mod_PA_free_time_150 - moderate activity in free time; Emotional_eating - emotional eating from The Eating Behavior Questionnaire, Healthy_Diet_Index and Unhealthy-Diet-Index –indexes from Kompan Questionnaire, Muscle – muscle mass. The values given by the arrows are standardized regression weights (SRW). SEM indexes of fit: CMIN=12.21, $P=$.663; CMIN/DF= .814; GFI= .990; AGFI= .959; CFI= 1.00; NFI= .915; HOELTER index = 1006 (critical N for a significance level of .01), RMSEA < .001

We conducted the same SEM but divided into women and men. In the SEM model for only women, the variables explain 69% of body fat. The correlation between diet and physical activity in the model for women is strong and equal to $R=$.892, while in the general model for women and men it is $R=$.569. In the SEM model for only men, the variables explain 29% of body fat. The explanatory model for muscle tissue is well fitted to the data, as indicated by a non-significant χ^2 value (CMIN= 12.21, $P=$.663)²⁶ The CMIN/df= .814 value also allows the model to be accepted (a CMIN>2.00 relationship indicates a mismatch)²⁷. The indices NFI= .915, CFI= 1.00, GFI= .990 and AGFI= .959 are close to or equal to 1, the HOELTER index=1006 (critical N' for a significance level of .01), and the RMSEA value < .001, confirming a very good fit²⁸. The system of variables explains 32% of the variance in muscle mass. Model muscle mass is predicted by: physical activity (SRW= .487), emotional eating (SRW= .284) and diet (SRW= -.137). In this model, intensity physical activity (SRW=.708) is more important than moderate physical activity (SRW=.339). Increased physical activity promotes greater muscle mass. Emotional eating has a negative association with muscle mass.

We conducted the same SEM but divided into women and men. In the SEM model for only women, the variables explain only 8% of muscle mass. In this SEM model for women, physical activity (SRW= .205) is less associated with muscle mass than in the model for men and woman (SRW= .487). In the SEM model for only men, the variables explain 29% of muscle mass.

Discussion

The present study identified several statistically significant

associations between physical activity levels, eating behaviors, and body composition among young adults, highlighting the complex interplay of lifestyle factors that shape fat and muscle mass. Importantly, the data must be interpreted within the limits of a correlational design, which precludes causal inferences but offers meaningful insight into behavioral patterns. Notably, higher levels of emotional eating were positively associated with greater body fat percentage, a finding consistent with previous research suggesting that affect-driven eating may contribute to excessive adiposity accumulation^{17,4}.

Gender differences observed in the study, specifically higher emotional eating among women, may reflect the combined effects of hormonal fluctuations, stronger emotional reactivity, and greater sociocultural pressure related to body image. Physiologically, high-intensity physical activity above 1500 MET-min/week likely exerts a stronger influence on body fat reduction due to increased post-exercise oxygen consumption, enhanced fat oxidation, and greater catecholamine-driven lipolysis. These mechanisms help explain why activity intensity, rather than volume alone, was predictive of healthier body composition. The findings support the need for sex-sensitive and intensity-specific health recommendations.

In contrast, emotional eating demonstrated a negative association with muscle mass, potentially indicating a link between maladaptive eating behaviors and diminished lean body tissue³¹. Moreover, individuals engaging in intense leisure-time physical activity exhibited both lower levels of emotional eating and higher levels of dietary restraint, supporting the notion that physical exertion may serve a regulatory function in affective and appetite-related processes^{32,18}. This interpretation aligns with affect regulation frameworks and the self-regulation model

of behavior, which posits that physically active individuals possess greater psychological resilience and executive control in response to stress and affective triggers^{33,17}.

One particularly salient observation was that only participants meeting criteria for high-intensity physical activity (exceeding 1500 MET-min/week) exhibited body fat percentages within recommended norms. This supports earlier findings by Martinez-Avila et al.¹⁹, who demonstrated favorable changes in body composition following structured physical training. Interestingly, total physical activity volume was not associated with body composition outcomes, underscoring the importance of intensity and context rather than mere quantity in shaping metabolic and somatic indicators^{34,35}. While the positive correlation between physical activity and dietary restraint may reflect health-conscious behavior, it also raises concerns about potential risk for restrictive or disordered eating, particularly in populations sensitive to body image norms. This duality is echoed in prior work by Gicquel¹⁰ and Casper⁹, who noted that body image pressures among young adults may lead to a convergence of high physical activity and unhealthy eating control strategies. From a theoretical standpoint, the results support Costa et al.'s¹⁷ hypothesis that physical activity can play a protective role against emotional eating by enhancing emotional regulation. This aligns with broader models of self-determined health behavior, suggesting that individuals who are intrinsically motivated to engage in physical activity are more likely to adopt balanced dietary habits and less likely to rely on food for emotional coping^{18,34}.

The elevated emotional eating scores among women may be influenced by both hormonal fluctuations such as those associated with the menstrual cycle and psychosocial factors, including societal expectations about thinness and emotional expression. Prior studies (e.g., Klump et al.³⁵; Parylak et al.,³⁶) have indicated that women tend to experience stronger affective reactions to stress and may use food as a form of self-regulation more frequently than men. This is compounded by internalized body image ideals and a higher prevalence of affective disorders, such as anxiety and depression, both of which are associated with emotional eating³⁷⁻³⁸.

With regard to the link between high-intensity physical activity and lower body fat, the data align with research on metabolic adaptations to vigorous exertion. High-intensity exercise leads to greater energy expenditure per unit of time, increased post-exercise oxygen consumption, and enhanced fat oxidation. Moreover, vigorous physical activity may modulate appetite-regulating hormones, contributing to more favorable energy balance outcomes compared to moderate or low-intensity activity. These mechanisms help explain why intensity, rather than overall volume, was a critical determinant of normal body fat percentage in our sample.

These behavioral patterns must also be understood within a broader sociocultural context. Among young adults, lifestyle choices are often shaped by internalized social norms, including the idealization of thinness and muscularity, as well as exposure to peer and media-driven appearance standards³⁶⁻³⁷. As noted by Rodgers et al.³¹, such sociocultural pressures may simultaneously encourage health-promoting behaviors and contribute to maladaptive eating practices. The present findings reinforce this dual dynamic: students with lower physical activity and suboptimal dietary habits demonstrated significantly higher levels of emotional eating⁴.

Taken together, these findings underscore the importance of interpreting health behaviors not in isolation, but within a biopsychosocial framework that considers psychological

regulation, motivational processes, and societal influences. They also expand on existing literature by demonstrating that the quality and intensity of physical activity particularly during discretionary time bear important associations with both eating patterns and physiological health indicators among emerging adults.

It should be noted that the authors of the project recognize its limitations. First, the study was designed in a correlational model using self-report tools, which makes causal inference impossible. Second, not all secondary variables that could have a confounding nature were controlled (e.g. daily diet, burden of diseases and disorders, lifestyle understood not only in terms of diet and physical activity). Third, although our goal was to verify the assumed relationships in the student population, the selection of a sample within one city and only two fields of study is not fully representative. It would be worth, for example, selecting a comparison group people in young adulthood who are not students. Fourth, an experimental study using an intervention in the form of planned and controlled physical activity and possibly a properly selected diet would give much better results. Fifth, we would have greater confidence in the results and description of paths in SEM if we increased the sample size. Another limitation involves the use of self-report instruments, which are susceptible to various biases, including recall inaccuracies and social desirability effects. For instance, participants may overestimate physical activity levels or underreport maladaptive eating behaviors to align with perceived norms. Although both the IPAQ and EBQ have demonstrated acceptable psychometric properties, including reliability and validity in past research, future studies may benefit from complementing these tools with objective measurements such as accelerometers or dietary tracking applications to enhance data accuracy.

Practical Applications

According to the authors of the research project, the collected results obtained both through self-description and anthropometric measurements have application potential. It has been proven that even moderate physical effort is associated with lower fat tissue content, only intensive one is correlated with higher muscle tissue levels. It has also been noted that higher intensity of physical activity is accompanied by a lower tendency to eat under the influence of emotion. These results should be used in the prevention of overweight and obesity and eating disorders, as well as to formulate recommendations regarding physical activity for people with excessive body mass and for those who want to sculpt their muscles. However, it is necessary to accompany this with the supervision of specialists who can protect the patients from, for example, overtraining, addiction to physical activity or the use of an irrational diet and supplementation. The findings suggest that interventions aiming to reduce body fat and improve muscle mass among young adults should emphasize not only regular, but also high-intensity physical activity. Given the strong link between emotional eating and excess fat, particularly in women, it is essential to incorporate psychoeducational components that address emotional regulation and adaptive coping strategies. University settings offer an ideal environment to implement such initiatives. Specific recommendations include developing structured fitness programs tailored to students' schedules, offering workshops on emotional eating and stress management, and integrating routine screening for disordered eating behaviors within student health services. These measures could enhance both physical and mental health outcomes in this vulnerable population.

Conclusions

The findings of the present study confirm that both the level of physical activity and the nature of eating behaviors are significant predictors of body composition in young adults—specifically, fat and muscle mass. The data demonstrated that only vigorous leisure-time physical activity, exceeding 1500 MET-minutes per week, was associated with a body fat percentage consistent with established reference standards. In contrast, both vigorous and moderate physical activity were found to positively influence muscle mass, provided that the activity was performed regularly and in accordance with the weekly duration thresholds recommended by the World Health Organization. Additionally, emotional eating emerged as one of the most detrimental behavioral factors associated with increased body fat levels. This relationship was particularly pronounced among female participants, suggesting a heightened susceptibility to using food as a strategy for emotional regulation within this group. Conversely, individuals reporting greater levels of dietary restraint were less likely to engage in emotional eating, potentially indicating variability in self-regulatory capacities within the study population. The study underscores the importance of the complex interplay between psychological, dietary, and physical activity-related factors in shaping the somatic health profile of young adults. These results contribute to the existing body of literature and may inform the development of multidimensional interventions aimed at enhancing psychophysical well-being in this population. Such interventions should emphasize not only personalized physical activity plans but also psychoeducational efforts focused on healthy eating habits and the cultivation of adaptive emotional coping strategies. Professional supervision is essential to ensure the safe and effective implementation of these programs and to mitigate the risk of adverse consequences associated with self-directed approaches, such as overtraining, compulsive exercise, or disordered eating behaviors.

Acknowledgments

The authors gratefully thank the students for their cooperation during the study.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Ethical Committee approval

Permission from the Research Ethics Committee at the University of Economy in Bydgoszcz (permission no.: ZP/1/2024) (Bydgoszcz, Poland)

ORCID

Dorota Łoboda ID <http://orcid.org/0000-0001-8784-9258>
Jarosław Ocalewski ID <http://orcid.org/0000-0002-5863-4124>
Beata Ziółkowska ID <http://orcid.org/0000-0002-9864-4634>
Szymon Kuliś ID <http://orcid.org/0000-0002-0810-7086>

Topic

Sport Nutrition

Conflicts of interest

The authors have no conflicts of interest to declare.

Funding

No funding was received for this investigation.

Author-s contribution

Conceptualization, D.Ł. and B.Z.; methodology, D.Ł.; software, B.Z.; validation, B.Z. and J.O.; formal analysis, J.O.; investigation, D.Ł.; resources, D.Ł. and J.O.; data curation, D.Ł. J-O.; writing—original draft preparation, D.Ł. and B.Z. D-Ł.; writing—review and editing, S.K.; visualization, J.O. and S.K.; supervision, S.K.; project administration, D.Ł. All authors have read and agreed to the published version of the manuscript.

References

1. Ostreĝa, W. Aktywność fizyczna jako kluczowy element zdrowego stylu życia. Instytut Matki i Dziecka. Zakład Zdrowia Dzieci i Młodzieży; Warszawa 2017.
2. Neuhouwer ML. The importance of healthy dietary patterns in chronic disease prevention. *Nutr. Res.* 2018; 70:3–6. doi.org/10.1016/j.nutres.2018.06.002
3. Depa, J, Ramón Barrada J, Roncero M. Are the Motives for Food Choices Different in Orthorexia Nervosa and Healthy Orthorexia?" *Nutr.* 2019; 11, no. 3: 697. doi. org/10.3390/nu11030697
4. Grajek, M, Krupa-Kotara, K, Białek-Dratwa, A, Staśkiewicz, W, Rozmiarek, M, Mistowska E, Sas-Nowosielski K. Prevalence of Emotional Eating in Groups of Students with Varied Diets and Physical Activity in Poland. *Nutr.* 2022, 14, 3289. doi.org/10.3390/nu14163289
5. Huang JH, Li RH, Tsai LC. Relationship between Depression with Physical Activity and Obesity in Older Diabetes Patients: Inflammation as a Mediator. *Nutr.* 2022;14:4200. doi.org/10.3390/ nu14194200.
6. Conde-Pipó J, Bouzas C, Zurita-Ortega F, Olea-Serrano F, Tur J.A, Mariscal-Arcas M. Adherence to a Mediterranean Diet Pattern, Physical Activity, and Physical Self-Concept in Spanish Older Adults. *Nutr.* 2022;14:2404. doi. org/10.3390/nu14122404
7. Zhou, J, Chen Y, Ji, S. et al. Sleep quality and emotional eating in college students: a moderated mediation model of depression and physical activity levels. *J Eat Disord.* 2024; 12,155. doi.org/10.1186/s40337-024-01107-8.
8. Costa ML, Costa MGO, de Souza MFC, da Silva DG, Vieira DADS, Mendes-Netto RS. Is Physical Activity Protective against Emotional Eating Associated Factors during the COVID-19 Pandemic? A Cross-Sectional Study among Physically Active and Inactive Adults. *Nutr.* 2021 Oct 28;13(11):3861. doi.org/ 10.3390/nu13113861.
9. Casper RC. Might Starvation-Induced Adaptations in Muscle Mass, Muscle Morphology and Muscle Function Contribute to the Increased Urge for Movement and to Spontaneous Physical Activity in Anorexia Nervosa? *Nutr.* 2020, 12, 2060. doi: doi.org/10.3390/nu12072060
10. Gicquel L. Anorexia nervosa during adolescence and young adulthood: Towards a developmental and integrative approach sensitive to time course. *J Physiol. - Paris*, 2013; 107(4), 268–277. doi.org/10.1016/j.jphysparis.2013.03.010

11. El Ansari W, Suominen S, Samara A. Eating Habits and Dietary Intake: Is Adherence to Dietary Guidelines Associated with Importance of Healthy Eating among Undergraduate University Students in Finland? *Cent Eur J Public Health* 2015; 23(4):306-313| doi: 10.21101/cejph.a4195
12. Camilleri GM, Méjean C, Kesse-Guyot E, Andreeva VA, Bellisle F, Hercberg S, Péneau S. The associations between emotional eating and consumption of energy-dense snack foods are modified by sex and depressive symptomatology. *J Nutr* 2014;144:1264–73.7
13. Schultchen D, Reichenberger J, Mittl T, Weh TRM, Smyth JM, Bleichert J, Pollatos O. Bidirectional relationship of stress and affect with physical activity and healthy eating. *Br J Health Psychol.* 2019 May;24(2):315-333. doi: 10.1111/bjhp.12355. Epub 2019 Jan 22. PMID: 30672069; PMCID: PMC6767465.
14. Koehler K, Drenowatz C, Editorial: Understanding the Interaction Between Physical Activity and Diet for the Promotion of Health and Fitness 2022 *Front. Nutr.*, 13 January 2022 Sec. Sport and Exercise Nutrition Volume 8 - 2021 | <https://doi.org/10.3389/fnut.2021.835535>
15. Ogińska-Bulik N. Psychologia nadmiernego jedzenia. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2004
16. Christofaro Diego GD, Werneck AO, Tebar WR, Lofrano-Prado MC, Botero JP, Cucato GG, Malik N, Correia MA, Ritti-Dias RM, Prado WL. Physical Activity Is Associated With Improved Eating Habits During the COVID-19 Pandemic. *Front Psychol.* 2021; 12, doi.org/10.3389/fpsyg.2021.664568
17. Costa, ML, Costa MG, Cândido de Souza M, Góes da Silva D, Aliete Dos Santos Vieira D, Mendes-Netto RS. Is Physical Activity Protective against Emotional Eating Associated Factors during the COVID-19 Pandemic? A Cross-Sectional Study among Physically Active and Inactive Adults. *Nutr.*, 2021; 13(11), 3861. doi.org/10.3390/nu13113861
18. Fernandes V, Rodrigues F, Jacinto M, Teixeira D, Cid L, Antunes R, Matos R, Reigal G, Hernández M, Morales S, Monteiro D. How Does the Level of Physical Activity Influence Eating Behavior? *SDT.* 2023; 13. 5001-801. doi.org/10.3390/life13020298.
19. Martinez-Avila WD, Sanchez-Delgado G, Acosta FM, Jurado-Fasoli L, Oustric P, Labayen I, Blundell JE, Ruiz JR. Eating Behavior, Physical Activity and Exercise Training: A Randomized Controlled Trial in Young Healthy Adults. *Nutr.*. 2020 Nov 29;12(12):3685. doi.org/10.3390/nu12123685. PMID: 33260423; PMCID: PMC7760390.
20. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, M.Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International Physical Activity Questionnaire: 12-country reliability and validity. *Med. Sci.Sport Exerc.* 2003 35: 1381-139. doi: 10.1249/01.MSS.0000078924.61453.FB.
21. Sjöström M, Ekelund U, Poortvliet E, Hurting-Wennlof A, Yngve A. Assessment of physical activity using IPAQ – version 4 – and activity monitors – CSA. *Measurement Phys Educ Exerc* 2000; Sci. 4:263-264
22. Tomioka K, Iwamoto J, Sacki, Okamoto N. Reliability and Validity of the International Physical Activity Questionnaire (IPAQ) in Elderly Adults: The Fujiwara-kyo Study. *J. Epidemiol.* 2011;21(6):459-65. doi: 10.2188/jea.je20110003. Epub 2011 Sep 24
23. Ogińska-Bulik N, Putyński L. Kwestionariusz Moje Zwyczaje Żywniowe: konstrukcja i własności psychometryczne. *AUL. Folia Psychologica* ; 2000, 4, 25-33
24. Gerbing D, W. Anderson JC. Monte Carlo evaluations of goodness-of-fit indices for structural equation models. *Sociol. Res.*, 1993, 21(2), 132–160. doi.org/10.1177/00491241920210020
25. Bredella MA. Sex Differences in Body Composition, *Adv Exp Med Bol.* 2017;1043:9-27.doi:10.1007/978-3-319-70178-3-2.
26. Soper DS. A-priori Sample Size Calculator for Structural Equation Models [Software], 2025. Available from <https://www.danielsoper.com/statcalc>.
27. Byrne B. *Coping with Bullying in School.* Dublin, 1989: Columba Press. doi.org/10.1080/033233198017012
28. Browne MW, Cudeck R. Alternative Ways of Assessing Model Fit." *Testing Structural Equation Models*, red. Kenneth A. Bollen i J. Scott Long, Sage, 1993, ss. 136–162.
29. Biernat E, Stupnicki R, Gajewski AK. Międzynarodowy Kwestionariusz Aktywności Fizycznej (IPAQ) – wersja polska. *Physical Education and Sport*, 2007 51(1), 47–54
30. Wytyczne WHO dotyczące aktywności fizycznej i siedzącego trybu życia: omówienie. Kopenhaga: Biuro Regionalne WHO na Europę; 2021. Licencja: CC BY-NC-SA 3.0 IGO.
31. Rodgers RF, O'Flynn JL, Bourdeau A, Zimmerman E. A biopsychosocial model of disordered eating: Integrating biological, psychological, and sociocultural factors. *Appetite*, 2016, 107, 192–205. doi.org/10.1016/j.appet.2016.08.019
32. Christofaro DGD, Werneck AO, Tebar WR, Lofrano-Prado MC, Botero JP, Cucato GG, Malik N, Correia MA, Ritti-Dias RM, Prado WL. Physical Activity Is Associated With Improved Eating Habits During the COVID-19 Pandemic. *Front Psychol.* 2021, 12, 664568. doi.org/10.3389/fpsyg.2021.664568
33. Baumeister RF, Vohs KD, Tice DM. The Strength Model of Self-Control. *Curr. Dir. Psychol.* 2007 16(6), 351–355. <https://doi.org/10.1111/j.1467-8721.2007.00534.x>
34. Teixeira PJ, Silva MN, Mata J, Palmeira AL, Markland D. Motivation, self-determination, and long-term weight control. *Int J Behav Nutr Phys Act.*, 2015, 12, 102. doi.org/10.1186/s12966-015-0261-9
35. Klump KL, Culbert, KM, Sisk, CL. Sex differences in binge eating: Gonadal hormone effects across development. *Annu. Rev. Clin. Psychol.* 2017 13, 183–207. doi.org/10.1146/annurev-clinpsy-032816-045111
36. Parylak SL, Koob GF, Zorrilla EP. The dark side of food addiction. *Physiology & Behavior*, 2011, 104(1), 149–156. doi.org/10.1016/j.physbeh.2011.04.063
37. Macht, M. How emotions affect eating: A five-way model. *Appetite*, 2008; 50(1), 1–11. doi.org/10.1016/j.appet.2007.07.002
38. Tanofsky-Kraff M, Cohen ML, Yanovski SZ, Cox C, Theim KR, Keil M, Reynolds JC, Yanovski JA. A prospective study of psychological predictors of body fat gain among children at high risk for adult obesity. *Pediatrics.* 2006 Apr;117(4):1203-9. doi: 10.1542/peds.2005-1329. PMID: 16585316; PMCID: PMC1863068.
39. Neuhouwer ML. The importance of healthy dietary patterns in chronic disease prevention. *Nutr. Res.* 2018;70:3–6. doi.org/10.1016/j.nutres.2018.06.002
40. Łoboda D, Ocalewski J, Ziółkowska B, Kuliś Sz. Diet and

eating behaviour of university youth in the context of body fat and muscle mass; *AK*, 2024 18 , Issue.4; doi. 10.51371/issn.1840-2976.2024.18.4.

41. Stice E, Presnell K. The body project: Promoting body acceptance and preventing eating disorders. *Oxford University Press.*, 2007

Corresponding information:

Received: 26.05.2025.

Accepted: 21.06.2025.

Correspondence to: Dorota Łoboda PhD
University: Kazimierz Wielki University in
Bydgoszcz, Chodkiewicza, 30
85-064, Bydgoszcz Poland
E-mail: dloboda2@ukw.edu.pl