

Associations between Physical Activity and Emotional Health: The Mediating Role of Body Image and the Moderating Roles of Sex and BMI

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Abstract

Background: The present research sought to investigate the intervening function of body perception in the context of physical exercise and emotional well-being. Additionally, it aimed to examine the disparities between groups based on different genders and body mass index (BMI). **Methods:** A total of 282 college students were recruited. The level of physical activity, perception of one's body, and emotional health were evaluated via the International Physical Activity Questionnaire, the Body Imagery State Scale, The Depression, Anxiety, and Stress Assessment Scale (DASS - 21), along with the Positive and Negative Emotional State Inventory. An analysis of mediation effects was employed to examine the part that body imagery plays in the connection between physical activity and emotional well-being. This analysis was used to scrutinize the differences among groups. **Results:** The findings revealed that engaging in physical activity notably boosted positive feelings and mitigated negative feelings. Body perception serves as a crucial intermediary factor between physical activity and both positive and negative emotions. Moreover, the intermediary function of body perception was evident in the male group and the cohort possessing standard or overweight body mass index (BMI). **Conclusion:** These findings revealed the mechanism by which physical activity optimized emotional well-being by enhancing body image, and also provided an empirical basis for the development of gender and weight-specific emotional intervention strategies for different gender and BMI groups.

Keywords

Physical activity; emotional health; body image; sex differences; BMI.

1. Introduction

The high prevalence of emotional problems, such as depression and anxiety, has posed a significant threat to mental health. As a non-pharmacological intervention, physical activity has been widely demonstrated its effectiveness in promoting emotional well-being. Research findings demonstrated that physical activity enhances positive emotions and reduces symptoms of depression and anxiety, potentially through mechanisms such as improved self-esteem and resilience (Andermo et al., 2020). Additional evidence indicated that, in contrast to individuals with extended periods of sedentary conduct, those who participated in consistent physical exercise were more prone to encounter greater positive feelings and elevated levels of psychological assets (Hogan et al., 2015).

Prior research has extensively investigated the biological processes that account for the positive impacts of physical exercise on emotional states. Neuroimaging studies found Consistent engagement in physical exercise brings about changes in the size and functionality of the hippocampus and the prefrontal cortex, increases the integrity of white matter connectivity, and enhances neural processing efficiency, thereby contributing to improved emotional states (Erickson et al., 2015). Physical activity has been proven that reduces

excessive cortisol release and thereby alleviates depressive symptoms (Mahindru et al., 2023). A significant number of research endeavors have investigated the impacts of physical exertion on emotional well-being from a biological vantage point, while the psychological mechanisms—particularly those related to the body—have not been fully explored. Body image, defined as an individual's perceptions, evaluations, and emotional experiences related to their own body, has been proposed as a potential psychological pathway linking physical activity and emotional health (Grogan, 2021). A favorable body perception plays a vital role in sustaining behaviors that promote well-being, such as consistent physical exercise and nutritious eating habits (Grogan, 2006). Even though prior research has demonstrated that engaging in physical activity brings about substantial positive impacts on emotional well-being, the specific role of body image as a potential psychological mechanism in these relationships remains under-explored. Physical activity can improve individuals' positive body image. For example, one study found that strength training can help individuals improve muscle building and gain confidence in their body functions (Lubans et al., 2016). A distinct study conducted over the course of a year among teenagers showed that for adolescents who were assigned to the intervention group, their body image has been significantly increased. (Huang et al., 2007). Similarly, another intervention study conducted 16-week intermittent aerobic training (IAT) and continuous aerobic training (CAT). The results indicate that participants in both the IAT group and CAT group showed improvements in their positive body image (Kogure et al., 2020). Physical activity can help individuals shift their attention to body functions (such as strength and flexibility), rather than the social standards of body (Alleva & Tylka, 2021), which can improve physical abilities (Alleva et al., 2019).

Moreover, a favorable body perception can boost positive feelings and reduce negative ones. Individuals who possess a positive view of their bodies are more inclined to embrace their physical imperfections, including skin problems, weight concerns, and body contours. (Wood-Barcalow et al., 2010). They also maintain physical health and mental health through a healthy lifestyle (Tylka & Wood-Barcalow, 2015). This not only reduces the incidence of anxiety and depression, but also significantly improves an individual's self-esteem, social adjustment, and life satisfaction (Zartaloudi et al., 2023). Therefore, body image has an important role in influencing emotional health, and body image may be a potential mechanism by which physical activity affects emotional health. However, existing research remains relatively limited in its focus on this topic, and specific mechanisms of action, especially in different populations, have not been fully explored. For example, one study found that in patients with cancer, high physical activity levels can significantly decrease their depression and anxiety symptoms. Most importantly, body image mediates the associations between physical activity and negative emotions (Zhang et al., 2021). Shang and colleagues (2021) investigated the mediating function of body image in the relationship between physical activity and subjective well-being among college students. Nevertheless, there is a need for further studies to examine how body image mediates the connection between physical activity and both negative and positive emotions in this group of students.

Gender and body mass index (BMI) could have an impact on the relational patterns between physical activity, body perception, and emotional health. On the one hand, it has been found that long-term physical activity can effectively reduce irritability and anxiety in males, while there were no significant changes in irritability and anxiety in females (Bhui & Fletcher, 2000). Another study found that the beneficial effects of physical activity on depression were more pronounced for females when compared to males (Zhang & Yen, 2015). To conclude, the current research sought to investigate the connections between physical exercise and emotional well-being—covering both positive and negative feelings—among university students. Additionally, it aimed to explore the mediating function of body perception and the moderating effects of gender and body mass index on these relationships. We hypothesized that:

(1) physical activity and body image would enhance positive emotions and reduce negative emotions; (2) The perception of one's own body would serve as a crucial intermediary factor between engaging in physical exercise and experiencing both positive and negative feelings; (3) The intervening function of one's perception is likely to differ among genders and across various body mass index (BMI) categories.

2. Methods

2.1. Participants

A total of 282 college students ($M_{\text{age}} = 23.17 \pm 2.66$, 178 females and 104 males) participated in the final sample. Every participant fulfilled the subsequent inclusion criteria: (1) being within the age bracket of 18 to 30 years; (2) absence of serious physical illness or diagnosed mental illness; and (3) the ability to independently complete the study questionnaires. Individuals taking part in the study were sourced through the Internet, and the data was gathered using the Questionnaire Star system.

2.2. Measures

The basic demographic information included age, sex, education, and BMI. According to previous studies, we categorized the groups into three distinct classifications as per the research by Liu et al. (2023). The first category was the under - weight group. The second was the normal group, encompassing those with a BMI ranging from 18.5 kg/m² (inclusive) to less than 24.0 kg/m². Lastly, the third category was the overweight group, which included individuals with a BMI equal to or greater than 24.0 kg/m².

IPAQ - Short was utilized to assess physical activity. This survey determines the level of physical activity during the preceding seven - day span. The IPAQ examines low - intensity, moderate - intensity, and high - intensity physical exertions through seven inquiries (Manzano - Sanchez et al., 2022). Consisting of six elements, it is graded on a 9 - point Likert - style scale. Elevated overall scores indicate a more positive body perception (Cash et al., 2002). The Depression Anxiety Stress Scales - 21 (DASS - 21) was employed to evaluate adverse emotions, specifically depression, anxiety, and stress. Moreover, PANAS was applied to measure positive and negative feelings. This scale consists of two sub - scales, each having 10 items, and is intended to concisely gauge an individual's emotional condition.

2.3. Statistical analysis

Firstly, data were screened to remove invalid responses, including incomplete questionnaires and those exhibiting obvious uncooperative behaviors. Outliers exceeding three standard deviations were eliminated based on the sample distribution. Secondly, Pearson correlation analysis was utilized to examine the correlations between physical activity level, body image, and both positive emotions and negative emotions. Next, to explore the mediating role of body image between physical activity levels and emotions (positive and negative emotions), two separate models were constructed. In Model 1, physical activity level served as the independent variable, positive emotions (assessed by PANAS positive subscale) as the dependent variable, and body image as the mediator. In Model 2, physical activity level was used as the independent variable, negative emotions (measured by both DASS and PANAS negative subscale) as the dependent variable, and body image as the mediator. Mediating effects were analyzed using PROCESS 3.5 macro version (Hayes, 2017). The significance of indirect effects was tested by bias-corrected confidence intervals (BCIs) generated based on 5,000 re-samples. Finally, separate mediating models were constructed to examine potential differences based on sex and BMI differences. Every statistical test employed a two - tailed approach.

3. Results

3.1. Descriptive results

As shown in Table 1, the mean age was 23.17 ± 2.66 years old, with 63.1% females and 36.9% males. In terms of education, 42.9% were undergraduate students, followed by 40.4% pursuing a master's degree, and 16.7% having less than a bachelor's degree. Regarding the BMI classification, 16.5% of participants were underweight, 68.8% fell within the normal weight range, and 13.7% were categorized as overweight.

Table 1. Descriptive results

	Range	Mean	SD
Age	18-30	23.17	2.66
Sex	178/104 (Female/male)		
Education	47/121/114 (less than bachelor, undergraduate, master)		
BMI	15.09-30.10	21.22	2.86
Physical activity Level	99.00-14292.00	1944.11	2244.83
Body image	6-54	32.75	10.37
PANAS positive emotion	12-45	29.63	6.57
PANAS negative emotion	11-55	27.65	7.88
DASS	0-63	15.40	12.94
Stress	0-21	6.04	4.63
Anxiety	0-21	4.72	4.39
Depression	0-21	4.64	4.64

3.2. Correlation results

Table 2 presents the outcomes of the Pearson correlation analysis. These findings indicate that there was a positive association between the level of physical activity and both body image and the positive emotions measured by the PANAS scale. Conversely, the level of physical activity exhibited a negative correlation with the total score of the DASS, as well as with stress, anxiety, and depression. Regarding the relationship between the level of physical activity and the negative emotions on the PANAS scale, the correlation was found to be non-significant. In terms of body image, it was negatively correlated with DASS total score, stress, anxiety, and depression, PANAS negative emotion, while body image was positively correlated to PANAS positive emotion.

Table 2. Pearson correlation analysis results

	1	2	3	4	5	6	7	8	9
Physical activity level	—								
Body image	.225***	—							
PANAS positive emotion	.181**	.512***	.583***	.624***	—				
PANAS negative emotion	-.108	-.201***	-.138*	-.104	-.083	—			
DASS	-.192**	-.259***	-.180**	-.175**	-.182**	.604***	—		
Stress	-.208***	-.221***	-.137*	-.149*	-.187**	.592***	.954***	—	
Anxiety	-.158*	-.255***	-.178**	-.159**	-.123*	.593***	.944***	.854***	—
Depression	-.177**	-.261***	-.197***	-.191**	-.206***	.536***	.949***	.860***	.839***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

3.3. Mediation results

Based on the correlation results, we constructed the mediation models with physical activity level as the independent variable, body image as the mediating variable, and PANAS positive emotions and DASS total score as the dependent variables, respectively. The results indicated that the direct effect of physical activity on PANAS positive emotions was not significant, whereas the indirect role of body image in the relationship between physical activity and PANAS positive emotions was significant. Conversely, physical activity had a direct negative influence on DASS, While physical activity has a negative effect on DASS, the positive effect of body image between physical activity and DASS is significant (Figure 1b).

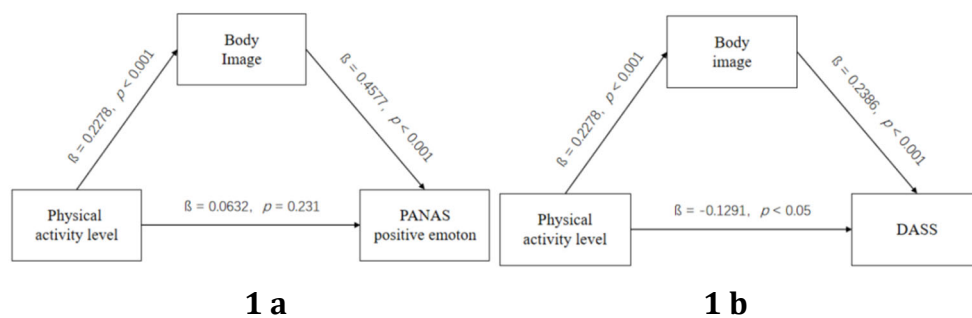


Figure 1. Mediation model among physical activity level, body image, and emotions.

3.4. Sex differences

To examine the sex differences, mediation models were performed for males and females, respectively. In males, the results indicated that the direct effect of physical activity on PANAS positive emotion was not significant, while the indirect effect of body image on the relationship between physical activity and PANAS positive emotion was significant (Figure 2a). Additionally, the direct effect of physical activity on the DASS was not significant, while the indirect effect of body image on the relationship between physical activity and DASS remained significant (Figure 2b).

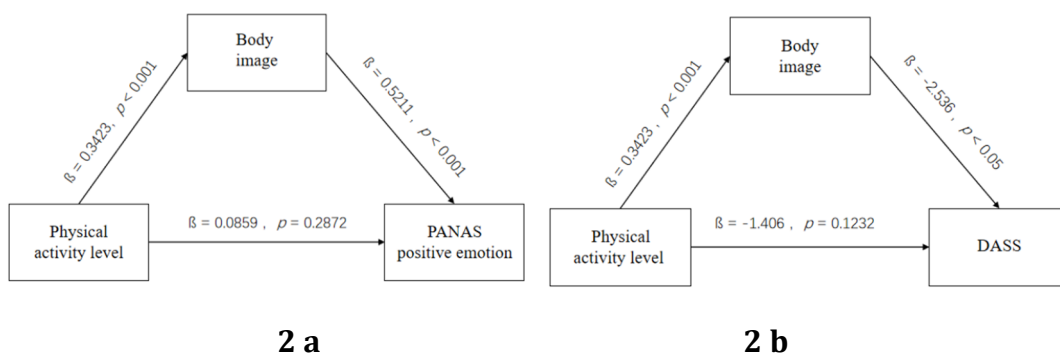


Figure 2. Mediation model among physical activity level, body image, and emotions in males

In females, neither the direct effect of physical activity level on PANAS positive emotion nor the indirect of body image between these relationships was significant. Regarding DASS, neither the direct effect of physical activity level on DASS nor the indirect of body image between these relationships were significant.

3.5. BMI differences

To examine the sex differences, the mediation models were performed in the underweight group, normal group, and overweight group, respectively. The results indicated that only in the

normal BMI group, the direct effect of physical activity on PANAS positive emotion was not significant, while the indirect role of body image between physical activity on PANAS positive emotion was significant (Figure 3a). In addition, the direct effect of physical activity on DASS was not significant, while the indirect role of body image between physical activity on DASS remained significant (Figure 3b). In the overweight group, the direct effect of physical activity on PANAS positive emotion was not significant, while the indirect role of body image between physical activity on PANAS positive emotion remained significant (Figure 3c). None of the direct effects nor the indirect effects were significant in the BMI underweight group.

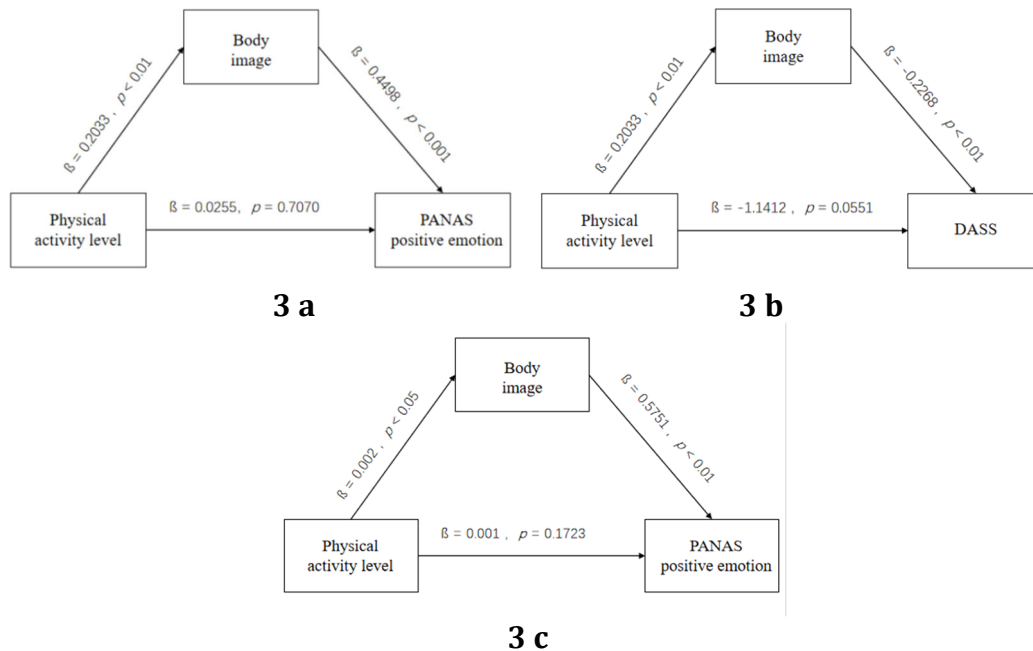


Figure 3. Mediation model among physical activity level, body image, and emotions in normal BMI group

4. Discussion

The present study indicated that physical activity improved positive emotions and reduced negative emotions, and body image mediated the associations between physical activity level and emotional health. Most importantly, the mediating role of body image between the relationships of physical activity level and emotional health were only remained significant in males, normal and overweight BMI groups. These findings revealed the mechanism by which physical activity optimized emotional well-being by enhancing body image, and also provided an empirical basis for the development of gender- and weight-specific emotional intervention strategies for different gender and BMI groups.

The present study showed that body image played a significant mediating role in the promotional effects on emotional health, which was consistent with previous studies. For example, one study indicated in old women with cancer, 30-minute weekly exercise can significantly reduce their depression, anxiety, and psychological distress. Most importantly, body image played a mediating role between these associations (Zhang et al., 2021). In young adults, one study also showed that physical activity enhanced subjective well-being by improving body image (Shang et al., 2021). Similarly, research by (Greenleaf et al., 2009) suggests that engaging in physical activity helps individuals develop more positive body imagery, which in turn improves mental health (Greenleaf et al., 2009). The intermediary function of body perception between physical exertion and emotional states could, in part, stem from the close association between body perception and personal characteristics (Allen &

Celestino, 2020). For example, a research study (Allen et al., 2018) has revealed that individuals who expressed a lower degree of satisfaction with their physical appearance were more prone to exhibit elevated levels of neuroticism. Moreover, they tended to display diminished levels of extraversion, openness to new experiences, and conscientiousness. In addition, individuals with negative body image are more concerned with weight and body appearance (Allen & Celestino, 2020). High neuroticism, as well as low extraversion and conscientiousness. (Allen & Celestino, 2020).

In this study, we found that only in males, does body image mediate the associations between physical activity levels and emotions. Previous studies have found that men tend to link body image to self-confidence and a sense of power, perceiving a positive body image as a means to enhance their social performance (Grogan & Richards, 2002). Moreover, men may exhibit a stronger preoccupation with body image in response to sociocultural pressures, especially after the mass media promoted the ideal male body such as “well-proportioned and muscular”, and that this body image may be more motivating for men to be active in physical activity (Mishkind et al., 1986). In contrast, females exhibit different patterns from males. Females experienced significantly more teasing than males when playing sports, not only from same-sex patterns but also frequently from opposite-sex peers (Slater & Tiggemann, 2011). As a result, women tend to evaluate their body image more negatively, are more susceptible to body image distress, and place greater emphasis on appearance (Muth & Cash, 2006). In summary, the mediating role of body image was validated in the male group in this study, but not in the female group. The reason for this discrepancy may lie in the fact that females are more susceptible to external evaluations and social pressures (Gaspar et al., 2011). Additionally, men typically focus more on strength and self-expression rather than just changes in appearance when engaging in physical activity or exercise, which allows them to more effectively promote emotional well-being through enhanced body image (Mishkind et al., 1986).

In the current research, it was discovered that body image serves as a crucial mediator between physical exercise and emotional health, but this phenomenon is exclusive to individuals with normal or obese body mass index (BMI) and no significant mediating role was found in the lean groups. It has been noted that obesity and overweight are usually associated with lower emotional intelligence (EI) (Gilyana et al., 2023), lower cognitive, and lower emotional skills (Christodoulou, 2010). In addition, studies have shown that a healthy BMI is associated with fewer depressive symptoms, a phenomenon that may not only be physiologically driven by BMI itself but is also partly related to socio-cultural pressures and external evaluations (Luppino et al., 2010).

Firstly, the quantity of individuals involved in the sample was relatively small. Additionally, this was a cross-sectional study, this study could not reveal causal relationships. Finally, the variables on body perception in this study were limited to body image. Future research could be further extended to include other relevant variables, such as body esteem, to enrich the understanding of the relationship between body perception and mental health. For example, it has been shown that physical activity not only helps to build a more positive body image for individuals but also enhances self-esteem, which further improves overall well-being (Shang et al., 2021).

5. Conclusion

This research investigated the connection among physical exercise, self - perception of one's body, and emotional health, along with the disparities between genders and different body mass index (BMI) groups. The findings indicated that engaging in physical activity notably boosted positive feelings and lessened negative ones. Moreover, body image served as a mediator in these relationships, particularly within the normal and overweight BMI Cohort and

among males. This current study offered empirical evidence for comprehending how physical activity impacts emotional well-being via body image. Additionally, it underscored the varying moderating effects of gender and BMI.

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