

The relationship between physical activity and academic engagement among college students-the mediating chain effect of trait mindfulness and self-efficacy

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Abstract

As a vital indication of academic success and adaptive behavior, academic engagement among college students has garnered significant interest in education. Yet, the relationship between physical activity and academic engagement has received little study, particularly among college students. This study investigates the relationship between academic engagement, self-efficacy, trait mindfulness, and physical activity among college students. This study studied 469 college students using SPSS and AMOS software, CFA, correlation, Bootstrap, and other statistical methods. Physical Activity Rating Measure, Mindful Awareness Attention Scale, General Self-Efficacy Scale, and College student academic engagement scale served as the basis for this study. According to studies, college students' physical activity can have both direct and indirect effects on their academic engagement via the chain mediation of trait mindfulness and self-efficacy. It is recommended that college students engage in physical activity while attending classes to develop long-lasting and consistent fitness routines. In addition to establishing a theoretical and empirical foundation for boosting the academic engagement of college students through physical exercise, this study is expected to increase our understanding of the internal mechanisms behind the effect of physical activity on academic engagement.

Keywords: physical activity; academic engagement; empirical research; college student

1. Introduction

The academic performance of college students is one of the most important indicators of the academic effectiveness of higher education. It serves as the primary metric for evaluating the quality of teaching delivered by educational institutions and as the primary metric for evaluating students' learning achievements. Thus, improving the academic performance of college students has always been a hot topic in higher education research. Academic engagement significantly impacts academic outcomes in higher education (Kahu, 2013). In addition, a rising corpus of scholarly research indicates that academic engagement is vital for learning (Fredricks, Blumenfeld, & Paris, 2004; Kuh, 2009; Trowler & Trowler, 2010; Zepke & Leach, 2010). Physical activity has been a vital aspect of human society since the beginning of modern civilization. Scholars initially felt the impact of academic study on physical activity on the physiological level. As society has begun to place a greater emphasis on this level, there has been a rise in interest in the psychological effects of physical activity. According to many studies (Van Dinther, Dochy, & Segers, 2011), physical activity is related to higher levels of self-efficacy. According to a few studies, it is also connected with higher levels of trait mindfulness (Wheatley, 2021). In addition, social and family environment elements

are the primary focus of most academic engagement studies (Bray, 2010; Swain & Hammond, 2011). Nonetheless, according to several studies, physical activity has been demonstrated to have a good effect on the academic engagement of pupils (Owen et al., 2018).

According to research on the impact of exercise kind and length on academic performance, individuals who exercise for 1-2 hours have superior academic achievement, and students who exercise frequently have consistently more confidence in their studies than those who do not (Shantakumar et al., 2022). There are still some difficulties with the various research on the effect of physical activity on academic engagement that have been linked. First, there is no evidence of a connection between physical activity and academic engagement. There is limited evidence on the association between physical activity and academic achievement in elementary and secondary students (Owen et al., 2018), and there is no research on the effect of physical activity on college students' study involvement. Second, while both domestic and international researchers have conducted studies on physical activity and traits such as self-efficacy, academic engagement, and mindfulness, the majority of these studies have focused on the direct relationship between the two (Reigal et al., 2020; Spitzer & Hollmann, 2013; Tsafou et al., 2017). However, no research has been conducted on the

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relationship between physical activity, trait mindfulness, self-efficacy, and academic engagement. Thus, it is vital to confirm the effect of physical exercise on the academic engagement of college students, as well as the relationships between physical activity and trait mindfulness, self-efficacy, and academic engagement. This study begins by summarizing the research issue and the pertinent theoretical foundations. Then, the "Physical Activity Rating Scale," "Mindful Awareness Attention Scale," "General Self-Efficacy Scale," and "College student academic engagement scale" are administered to college students. Using SPSS and Amos software, the reliability analysis, validity analysis, correlation analysis, regression analysis, and mediation effect test are conducted. The outcomes of the software evaluation are detailed. Conclusions and suggestions comprise the concluding part. The findings contribute to a greater understanding of the internal mechanisms underpinning the effect of physical exercise on academic engagement, as well as a theoretical and empirical basis for boosting college students' academic engagement via physical activity.

2. Literature Review

Exercise is a physical activity that, depending on its intensity, frequency, and duration, affects health. Reviewing pertinent literature, the research on physical exercise focuses on the influence of chronic diseases, body obesity, and other aspects of general physical health (Haynos & O'Donohue, 2012; Janssen & LeBlanc, 2010). In recent years, however, research on physical exercise has moved to the psychological level, and a link between physical exercise and a variety of psychological concerns, including self-esteem, anxiety, and depression, has been verified (Bailey, 2006; Biddle & Asare, 2011; Daniels & Leaper, 2006; Rasberry et al., 2011; Rasmussen & Laumann, 2013; Samek et al., 2015).

Academic engagement, or student involvement and learning engagement, is derived from the social control theory (Hirschi, 2017) that describes students' willingness to participate in routine school activities. In reality, academic engagement involves all school-related activities, such as club membership, class participation, and other activities, as well as a passion for learning (Nystrand & Gamoran, 1989). Before class, moderate-intensity activities were proven to boost student learning engagement (Owen et al., 2018). One hour before class, Actigraph GT3X+ was used to track the quantity and intensity of physical activity. Students completed a questionnaire after class to assess their learning engagement, which was analyzed using a Linear mixed model (LMM). Several academics have established that physical exercise has a favorable effect on students' academic

performance and focus, despite the lack of studies demonstrating a correlation between the two variables. Using data from the China Education Tracking Survey (CEPS), one study analyzed the effect of physical activity on the academic performance of teenagers. Physical activity has been demonstrated to boost academic ability effectively. Another randomized controlled experiment indicated that physical activity increased elementary school pupils' concentration (Spitzer & Hollmann, 2013). Based on the preceding, this study proposes the following hypothesis:

H1: Physical exercise can positively predict college students' study engagement level.

Buddhism gave rise to mindfulness, a skill requiring awareness, focus, and recollection (Siegel, Germer, & Olendzki, 2009). Eventually, Kabat-Zinn integrated mindfulness into therapeutic psychology. Mindfulness can be expressed as either a psychological feature or a mental state. Hence, "state mindfulness" and "trait mindfulness" are two distinct forms of mindfulness. Whereas the latter is an acquired characteristic variable, the former relates to a state of self-awareness (Cahn & Polich, 2006).

In contrast to meditation, mindfulness is the awareness of the present moment, according to Kabat-Zinn, and meditation is one method for increasing mindfulness (Kabat-Zinn, 2003). Physical activity was substantially associated with trait mindfulness in a cross-sectional study of 305 Dutch adults (Tsafou et al., 2017), and systematic reviews supported this conclusion (Yang & Conroy, 2020). In a 59-participant controlled trial, physical activity was also found to affect mindfulness levels (Wheatley, 2021) positively. Throughout the second half of the 20th century, mindfulness-based therapies have been widely utilized in clinical practice and have demonstrated efficacy in treating various mental health conditions (Fischer et al., 2020). In addition, many meta-analyses indicate that enhancing mindfulness can positively affect mental health, work performance, and academic success (Carpenter et al., 2019; Karyadi, VanderVeen, & Cyders, 2014; Mesmer-Magnus et al., 2017; Sala et al., 2020). Medical students participated in a study on mindfulness training, and the results indicated that trait mindfulness and study engagement were greatly enhanced following the intervention (Bailey et al., 2019). In addition, the outcomes of trials with young children (Sciutto et al., 2021) and experiments with middle school students were comparable (Braun et al., 2019). Although there is no empirical research on the role of trait mindfulness as a mediator between physical exercise and study motivation, there is an essential link between trait mindfulness and study motivation, as well as between physical exercise and trait mindfulness. Based on the preceding, this study proposes the following hypothesis:

H2-1: Physical exercise among college students can positively predict trait mindfulness levels.

H2-2: Trait mindfulness in college students can positively predict the study engagement level.

H2-3: Trait mindfulness in college students mediates between physical exercise and study engagement.

According to Bandura, self-efficacy is the degree of confidence in one's ability to achieve the intended outcome. Self-efficacy interacts with the external environment and other factors to significantly influence outcomes (Bandura, 2012). A task is also less likely to be completed if self-efficacy is low while it is being performed (Peechapol et al., 2018). Physical activity has a favorable effect on adolescents' levels of self-efficacy, according to an inquiry and analysis of 167 adolescents in Spain (Reigal et al., 2020). Another 15-week pilot intervention trial demonstrated significant increases in self-efficacy following a physical exercise intervention among middle-aged and elderly participants (Holler et al., 2019). Furthermore, research on specific populations demonstrates that physical exercise interventions greatly enhance self-efficacy (Blake, Stanulewicz, & McGill, 2017; Jo, Rossow-Kimball, & Lee, 2018; Nooijen et al., 2015).

Moreover, multiple academic studies have demonstrated the link between mindfulness and self-efficacy. Among 97 first-year college students, Heath, Joly, and Carsley (2016) discovered a substantial correlation between self-efficacy and mindfulness. In an analysis of the trait mindfulness and self-efficacy levels of 552 Asian Enlightenment managers, Becker and Whitaker (2018) discovered that managers with higher trait mindfulness levels also had higher self-efficacy levels (Becker & Whitaker, 2018). Students must possess a certain amount of self-efficacy to cultivate a higher education; self-efficacy is essential to student achievement. Self-efficacy has been shown to influence study motivation. A survey of 231 experimental psychology students revealed, for instance, that self-efficacy can predict students' level of study involvement (Wijaya et al., 2018).

Moreover, a meta-analysis supported these results (Chang & Cheng Chien, 2015). 687 Chinese college students' survey revealed that self-efficacy mediates the relationship between physical activity and academic procrastination (Ren et al., 2021). Based on the preceding, this study proposes the following hypothesis:

H3-1: Physical exercise in college students can positively predict self-efficacy.

H3-2: Trait mindfulness in college students can positively predict self-efficacy.

H3-3: Self-efficacy in college students can positively predict study engagement.

H3-4: Self-efficacy plays a mediating role between physical exercise and study engagement in college students.

In conclusion, this study aims to examine the mediating roles of trait mindfulness and self-efficacy in the relationship between physical exercise and college students' academic engagement. College students will serve as the study's subjects. Based on this, a research model is built (Fig.1).

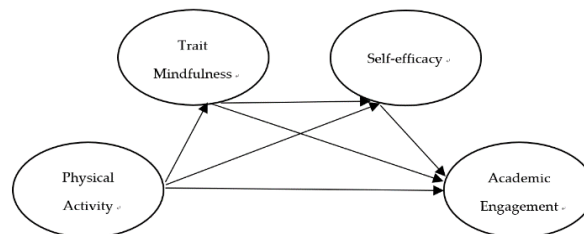


Figure 1. research model

3. Materials and Methods

3.1 The research objects

With the online questionnaire distribution platform, 617 questionnaires were distributed randomly to college students across the United States. The quality of questionnaires was regulated by using IP limitations, man-machine verification, the establishment of screening questions and answer time constraints, among other approaches. 469 legitimate surveys were recovered after eliminating 13 invalid questionnaires by technology and 135 low-quality questionnaires by hand. There were 205 male participants, or 43.7%, 264 female participants, or 56.3%; 384 non-sports majors, or 81.9%; and 85 physical education majors, or 18.5%.

3.2 Research tools

3.2.1 Physical Activity Rating Scale

The physical Activity Rating scale (Yuqing, Ying, & Yuhui, 2022) was revised based on the Japanese scholar and the actual situation of Chinese college students participating in physical activity. The scale consists of only three elements. The degree of physical exercise is determined by the type (intensity), duration, and frequency of physical activity. Here is the formula for computing the grade for physical exercise: Physical activity score = intensity (time-1) frequency; the higher the score, the more physical activity was performed. In this study, Cronbach's alpha coefficient for this scale was 0.709, indicating its strong reliability.

3.2.2 Mindful Awareness Attention Scale

The Mindful Awareness Attention Measure was applied and demonstrated excellent validity and reliability in pupils (Deng et al., 2012). However, the Sinicization scale

was shown to have high reliability and validity in Chinese (Brown & Ryan, 2003). The scale is a 15-item, one-dimensional scale with a 6-point scoring system, where 1 usually indicates always and 6 rarely indicates, resulting in 6 points. The intermediate scores were 2, 4, and 5, with higher scores indicating a higher trait mindfulness level. According to Cronbach's alpha, the dependability of the scale utilized in this experiment is good at 0.923. According to the confirmatory factor analysis results, $X^2/DF = 2.873$, $GFI = 0.927$, $AGFI = 0.903$, $TLI = 0.939$, $NFI = 0.922$, $CFI = 0.948$, $RMSEA = 0.063$, $SRMR = 0.042$, and the fitting index of this scale was good.

3.2.3 General Self-efficacy Scale

The translated and improved Global Self-Efficacy Measure has excellent reliability and validity among college students. The scale is unidimensional with ten components and a four-point scoring system. 1 indicates an entirely incorrect response and awards 1 point, whereas 4 indicates a perfectly correct response and 4 points. The intermediate degrees are correspondingly 2 and 3 points. An intermediate degree consists of two to three points. According to Cronbach's alpha, the reliability of the scale utilized in this study is high at 0.898. The confirmatory factor analysis results were as follows: $X^2/DF = 3.874$, $GFI = 0.94$, $AGFI = 0.91$, $TLI = 0.93$, $NFI = 0.93$, $CFI = 0.95$, $RMSEA = 0.078$, and $SRMR = 0.040$. The fitting index of the scale was high.

3.2.4 College Student Academic Engagement Scale

The college student academic engagement scale was developed using the Utrecht Work Engagement Scale-Student. The scale is redesigned based on the learning characteristics of Chinese college students. Even though the scale is divided into three dimensions — motivation, energy, and concentration — there is a considerable link between the dimensions, and the independence of each subscale is weak, making the scale unidimensional. The scale consists of 17 elements, each with a seven-point value: 1 never indicates, 1 always indicates, meter 7 points, middle level 2, 3, 4, 5, 6 points, and higher scores imply

greater academic engagement. In this study, the three dimensions subscales had Cronbach's values of 0.879, 0.915, and 0.872, respectively, while the entire scale had a Cronbach's coefficient of 0.958, indicating that the scale was reliable. $X^2/DF = 3.118$, $GFI = 0.910$, $AGFI = 0.881$, $TLI = 0.949$, $NFI = 0.938$, $CFI = 0.957$, $RMSEA = 0.067$, and $SRMR = 0.004$. The fit index of the scale was satisfactory, and the AVE values for each dimension ranged from 0.550 to 0.644. Its convergent validity and a range of CR values between 0.871% and 0.916% demonstrate the combination's high reliability.

3.2.5 Statistical Processing

SPSS 23.0 was utilized in this study to analyze the reliability of each scale and the data. Subsequently, Amos 26.0 was used to do confirmatory factor analysis on each scale to determine if the fitting index of each scale met the requirements. The Amos26.0 research model was deployed to test mutations using the standard technique. Last, SPSS 23.0 was used for correlation analysis, regression analysis, and mediation effect testing to validate the research model's hypotheses.

4. Results

4.1 Common method variation test

There are still some common method biases because this research primarily uses a self-report scale, even though the questionnaire items were previously hidden in a random design. Therefore, a subsequent inspection is required. The possible error variable control method was employed to test the common method variation of the data after data collection. Table 1 displays the test results. The model with the potential variable of standard method deviation was compared with the original model: $\Delta SRMR = 0.016$ (< 0.05), $\Delta RMSEA = 0.007$ (< 0.05), $\Delta CFI = 0.027$ (< 0.1), $\Delta TLI = 0.025$ (< 0.1), $\Delta IFI = 0.027$ (< 0.1). This indicates that the model does not show significant improvement after adding the common method factor, so it can be considered that there is no apparent standard method bias problem.

Table 1

Results of common method variation test

Model	SRMR	RMSEA	CFI	TLI	IFI
The original model	0.053	0.050	0.912	0.908	0.913
The model with common method bias latent variable	0.037	0.043	0.939	0.933	0.940

4.2 Analysis of correlation

Physical exercise, trait mindfulness, self-efficacy, and academic engagement underwent Pearson bivariate correlation analyses. According to Table 2, self-efficacy, academic engagement, and

trait mindfulness were all significantly positively linked with physical exercise ($P < 0.01$). Self-efficacy and academic engagement were positively linked with trait mindfulness ($P < 0.01$). Additionally, self-efficacy and academic engagement had a strong positive association ($P < 0.01$).

Table 2

Mean, standard deviation, and correlation of each variable

Variable	Physical exercise	Trait mindfulness	Self-efficacy	Academic engagement
Physical exercise	1.000			
Trait mindfulness	.227**	1.000		
Self-efficacy	.362**	.551**	1.000	
Academic engagement	.375**	.653**	.765**	1.000
Mean	29.066	4.661	2.901	5.305
Sd	19.920	0.780	0.579	0.937

*represent P<0.05, **represent P<0.01

4.3 Regression analysis and mediation effect test

To test the mediating effect of trait mindfulness and self-efficacy between physical exercise and academic engagement, gender and significance were added as control variables in the mediating effect analysis, which was carried out using the Process 4.1 program created by Hayes. The regression results are displayed in Table 3; the regression coefficient is 0.31, and the t value is 6.85 (P<0.01), indicating that physical exercise among college students can significantly and positively predict trait mindfulness. College students' physical exercise could positively predict self-efficacy, specifically, the regression coefficient was 0.24, t value was 6.19 (P<0.01); college

students' trait mindfulness could positively predict self-efficacy, specifically the regression coefficient was 0.48, t value was 12.57 (P<0.01); and college students' physical exercise could positively and significantly predict academic engagement, specifically the regression coefficient was 0.12, t value was 4.2. The trait of mindfulness in college students could predict academic engagement positively; precisely, the regression coefficient was 0.33, and the t-value was 10.54 (P<0.01). Self-efficacy among college students might predict academic engagement positively; precisely, the regression coefficient was 0.52, and the t-value was 15.56 (P<0.01). The path coefficients of the mediation model are shown in Figure 2.

Table 3

Regression analysis results between variables

The regression equation		Fit index	Regression coefficient	Significant
Variable	Predictor variable	R ²	β	t
Trait mindfulness	Gender	0.09	0.06	1.30
	Major		-0.04	-0.94
	Physical exercise		0.31	6.85**
Self-efficacy	Gender	0.38	0.00	0.12
	Major		0.14	3.71**
	Physical exercise		0.24	6.19**
	Trait mindfulness		0.48	12.57**
Academic engagement	Gender	0.69	-0.01	-0.46
	Major		0.10	3.73**
	Physical exercise		0.12	4.22**
	Trait mindfulness		0.33	10.54**
	Self-efficacy		0.52	15.56**

**represent P<0.01

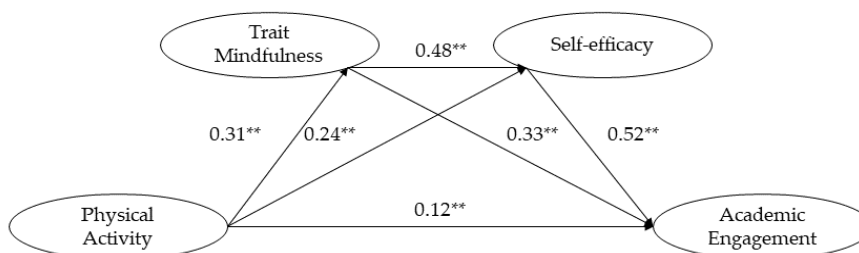


Figure 2. Path coefficient of the chain mediation model

**represent P<0.01.

The mediating effect was also examined using the Bootstrap method (Bootstrap sampling 5000 times, 95% confidence interval). As can be seen in Table 4, the total mediating effect value was 0.35, and the confidence interval did not include 0, indicating that the total mediating impact was significant. The mediating impact specifically can be broken down into three paths: First, the mediating effect path Ind1 comprising physical exercise -> trait mindfulness -> academic engagement had an effect value of 0.12 with a confidence interval that did not include 0, indicating that trait mindfulness had a significant mediating influence on this path. Second, the effect value

was 0.14 on the mediating impact path Ind2, which included physical exercise -> self-efficacy -> academic engagement. The confidence interval did not include 0, indicating that self-efficacy significantly mediated this path. Significantly, the mediating effect path Ind3 of physical exercise -> trait mindfulness -> self-efficacy -> academic engagement was 0.09. The confidence interval did not contain 0, indicating that trait mindfulness and self-efficacy significantly mediated the relationship between physical exercise and academic engagement. Additionally, all of the contrast mediating effects' confidence intervals encompassed 0, indicating that they were insignificant.

Table 4

Mediating effect analysis results

Path	Effect	BootSE	BootLL CI	BootUL CI	The proportion of the total effect
Ind1+Ind2+Ind3 : total mediating effect	0.35	0.04	0.27	0.42	71%
Ind1 : physical exercise -> trait mindfulness ->academic engagement	0.12	0.03	0.07	0.17	24%
Ind2 : physical exercise -> self-efficacy ->academic engagement	0.14	0.03	0.09	0.20	29%
Ind3 : physical exercise -> trait mindfulness -> self-efficacy ->academic engagement	0.09	0.02	0.06	0.12	18%
Ind1-Ind2 : Contrast mediating effect	-0.02	0.04	-0.11	0.06	-
Ind1-Ind3 : Contrast mediating effect	0.03	0.02	-0.01	0.07	-
Ind2-Ind3 : Contrast mediating effect	0.05	0.03	-0.01	0.12	-

5. Discussion

This study confirms the validity of hypothesis H1, which is consistent with previous research on middle school students (Owen et al., 2018), that physical activity can positively predict the level of academic engagement among college students. These results may be attributable to the ability of physical exercise to increase serotonin and -endorphin -endorphin production, which in turn stimulates the hypothalamic-pituitary-adrenal axis. The intellectual engagement of college students will grow due to these modifications, which will also directly affect their emotional state, excite the hippocampal cell, and result in other physiological changes. Given this information and the findings of previous studies, it is plausible to conclude that physical activity positively predicts academic engagement at all ages; nevertheless, specific conclusions must be substantiated. The findings of this study indicate that increasing college students' physical activity positively affects their academic engagement. In contrast, academic engagement is a wide indicator incorporating many elements that influence academic success, such as family and environment and classroom learning engagement. The prediction that physical activity will enhance academic

performance is, therefore, not supported by the findings of this study.

This study established hypotheses H2-1 and H2-2 and is consistent with the findings of leading researchers (Bailey et al., 2019; Wheatley, 2021) by demonstrating that physical exercise can positively predict the level of trait mindfulness among college students and that trait mindfulness can positively predict the level of academic engagement. The results indicate that a physical exercise intervention can assist college students in enhancing their trait mindfulness. Incorporating mindfulness as a character attribute can also enhance academic engagement. Mindfulness is a regular personality feature whose rapid alteration cannot be accomplished. Hence, a long-term and sustained physical exercise intervention is necessary to provide the desired effect, as short-term physical exercise has no discernable effect on trait mindfulness enhancement. This study supports the validity of hypothesis H2-3, which proposes that trait mindfulness mediates the connection between physical exercise and academic engagement. Physical activity can increase academic engagement both directly and indirectly through mindfulness. Increasing trait mindfulness is therefore necessary for enhancing academic engagement

through exercise, and trait mindfulness serves as a partial moderating factor. In developmental psychology, wisdom, self-actualization, and self-transcendence are all positive psychological attributes. Qualified experts have discovered that high levels of mindfulness can increase the development of these positive psychological traits: compassion, empathy, and self-control (Whitehead, Bates, & Elphinstone, 2020). Students with a high degree of mindfulness are more likely to have robust psychological attributes and be optimistic and self-confident on campus, which can help them avoid academic burnout and increase their academic engagement. In addition, the timing, intensity, and frequency of physical activity in the campus life of college students are often unpredictable due to the influence of unrelated factors. In exercise psychology, trait mindfulness is a mediating or independent variable and an outcome variable. Therefore, it is required to perform an additional study on the particular physical exercise intervention that can effectively enhance trait mindfulness. This study's findings supported the validity of hypotheses H3-1 and H3-2 by demonstrating that mindfulness can favorably predict the relationship between physical activity and characteristic Self-efficacy. Consistent with previous research (Heath et al., 2016; Holler et al., 2019), the findings indicate that college students can raise their self-efficacy through exercise or trait mindfulness. According to a large number of research, physical activity, and self-efficacy are closely correlated (Anderson & Feldman, 2020). Self-efficacy can benefit from both short-term and long-term physical exercise (Jo et al., 2018), and trait mindfulness also significantly positively affects self-efficacy (Becker & Whitaker, 2018; Heath et al., 2016). Some study, however, suggests that trait mindfulness may have a negative influence on self-efficacy. Specifically, Firth and AM et al. discovered that only one of the three experimental groups increased self-efficacy, whereas the other two groups of the mindfulness intervention decreased it (Firth et al., 2019). Inconsistent outcomes may be due to the direct mindfulness intervention's propensity for mixed effects, which may be influenced by environmental circumstances and individual differences in mindfulness training that render it useless for some individuals. In addition, an online reminder is utilized rather than on-site research completion. The absence of offline monitoring may result in the formation of paradigm false memories, which will reduce self-efficacy (Wilson et al., 2015). The findings also demonstrate that self-efficacy in college students can positively predict academic engagement and that self-efficacy mediates the relationship between physical activity among college students and academic engagement, supporting the

validity of hypotheses H3-3 and H3-4 and confirming the findings of previous research (Chang & cheng Chien, 2015; Sharmin et al., 2019). This illustrates that college students' self-efficacy may be strengthened through intervention, and improving self-efficacy is one of the key ways in which physical activity influences the level of academic engagement among college students. Self-efficacy also functions as a mediator in this association.

6. Conclusion

This study used the Physical Activity Rating Scale, Mindful Awareness Attention Scale, General Self-Efficacy Measure, and College student academic engagement scale to randomly survey 469 college students via an online questionnaire distribution platform. SPSS 23.0 and Amos 26.0 were applied for regression analysis and study of the mediating effect, respectively. The results demonstrate that college students' physical activity can, directly and indirectly, affect their study motivation via trait mindfulness and self-efficacy. Because study involvement and academic success cannot be equated, the data cannot establish that physical exercise can influence academic performance. Hence, it is recommended that college students actively engage in physical activity and build long-lasting and consistent exercise routines. In addition, there should be a greater emphasis on physical education courses in college curricula. More diverse physical education courses should be developed to increase students' study motivation and mental health. Future studies should therefore focus on the diversification of physical education curriculum development, forming a university sports system, and promoting physical activity among college students in these locations.

7. Theoretical Implications, Practical Implications, and Future Directions

This study has contributed a vital model based on academic engagement and physical exercise to the corpus of knowledge. According to the findings of this study, college students' participation in various physical activities can aid in improving their performance. When strategic measures are made to improve the kids' academic performance, their academic performance improves. Moreover, the students' awareness and sense of self-efficacy considerably impact their performance. Existing research has given little attention to these characteristics. Therefore these findings are novel to the academic literature. So, the findings of this study must be regarded as noteworthy in the literature for the progress of

academics' understanding of the connection between physical activity and academic accomplishment. Future researchers will use these implications as a foundation for their research and to properly comprehend the topic. Yet, the originality of this study also derives from its contribution to a dependable framework in the body of knowledge.

In addition, this study has advanced practical implications that college administrations must address to increase students' comprehension and performance. As the pupils' athletic performance and physical activities are significantly enhanced, they will gain a deeper comprehension of their strategic performance. In addition, the accuracy of health information provided to pupils must be enhanced over time, and they must acquire a habit of physical activity. Hence, the academic performance of the pupils will be enhanced in terms of their actions and

comprehension. The necessary healthy physical activities in various mega sports events should be organized for college students to boost their learning and mental health. By addressing these criteria, the pupils' performance could be reliably improved. In addition to college students, these findings can be utilized in schools to improve kids' performance through physical activity.

This research model is ultimately designed to accommodate the key findings. But, academics will be expected to follow some potential suggestions in the future. Future research should examine the moderating effect of students' health literacy. Moreover, diverse demographics should be recruited for data collecting, with school pupils given preference. So, it is necessary to collect data from female students to establish how they perceive this research. Future researchers are also advised to employ a multigroup analysis for their findings.

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