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Physical Activity and Academic Performance: The Mediating Effect of Self-Esteem and Depression

Sumaira Kayani [1,2], Tayyaba Kiyani [1], Jin Wang [1,*], María Luisa Zagalaz Sánchez [3,*], Saima Kayani [4] and Haroona Qurban [1]

[1] Department of Physical Education, Zhejiang University, XiXi Campus, 148 TianMuShan Road, Hangzhou 310028, China; 11603033@zju.edu.cn (S.K.); kiyani@zju.edu.cn (T.K.); 11403034@zju.edu.cn (H.Q.)
[2] Division of Continuing Education, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Punjab 46300, Pakistan
[3] Department of Didactics of Plastic and Body Musical Expression, University of Jaen, Las Lagunillas Campus, Building Humanities and Education Sciences I (D2), Unit: D2-125, 23071 Jaén, Spain
[4] Department of Education, Women University Azad Jammu and Kashmir, Bagh 12500, Pakistan; saima_kayani@wuajk.edu.pk
* Correspondence: jinwang47@live.cn (J.W.); lzagalaz@ujaen.es (M.L.Z.S.)

Received: 25 August 2018; Accepted: 19 September 2018; Published: 11 October 2018

Abstract: An important step to enhance the academic efficiency of students is increasing their physical activity. For this reason, it is necessary to see to what extent physical activity is related to the academic performance of the students and what might mediate this. A major objective of the study is to explore self-esteem and depression as mediators between physical activity and academic performance. On the basis of informed consent to participate in the study, 358 participants have been selected from Universities in Pakistan, and they were asked about their physical activity, depression during their study and self-esteem through self-report. Participants self-reported their self-esteem, level of depression and their physical activity through standardized measures; the Rosenberg Self-esteem scale (1965), the University stress scale (2016), and the short form of the International Physical Activity questionnaire (2003), respectively. Academic performance had been measured as the cumulative grade point average (CGPA) of the last two consecutive semesters. Self-esteem and depression were found to be significant mediators between physical activity and academic performance. The total effect of physical activity on academic performance was significant but smaller than the total indirect effect through mediators. Though total indirect effect is the combination of the effect of self-esteem and depression, but the larger contribution is of self-esteem which has been found to be the strongest mediator between physical activity and academic performance. The study has implications for future research, both in terms of testing the model and testing psychological constructs. Also, the study emphasizes that the importance of physical activity has to be kept in mind while designing a curriculum of an educational institution in order to foster sustainable development.

Keywords: physical activity; academic performance; self-esteem; depression; mediation effect

1. Introduction

The practice of physical exercise is extremely beneficial to health [1]. It has several health-related benefits for children and adolescents [2]. Growing literature has exposed a significant relationship between academic performance and physical activity [3]. There has been much interest in studies on the potential benefits of physical activity for the development of cognitive abilities over the last several years, strongly recommending physical activity as an effective instrument for building psychological well-being [4,5]. Physical activity makes people feel good about them through decreasing depression

or sadness, and rectifying and improving mood. The literature also shows that physical activity is linked with a subsequent decrease in mental problems, including depression and insanity [6].

Physical activity is now believed to be an established treatment against depression for adults [7]. Additionally, properly managed physical activities are important for processing information, particularly in adults [8]. As a result, the idea that a high level of physical activity is effective for increasing thoughtfulness, meditation, and, as a consequence, academic performance is attractive to the learners.

Sibley and E tnier reviewed 44 articles to examine the effect of physical activity on cognition in children [9]. These articles include 28 cross sectional studies and 16 intervention studies with age group 4 to 18 years. Taras reviewed 14 studies determining the relation between physical activity and academic performance [9]. These studies include studies from 1984 to 2004 from age group 5 to 18 years. The study summarized findings of these results and found no or a weak relation between physical activity and academic performance. It recommends that further analysis is required to study the relation between physical activity and performance. Trudeau and Shephard reviewed nine cross-sectional and seven experimental studies during 1966–2007 linking physical activity and academic performance among school children [10]. The study did not find any significant trend in the findings, and found that academic performance is not determined by the time allocated for physical activity.

Hillman et al., determined the narrative research to identify the impact of physical activity on cognitive abilities [11]. The research found no evidence for any harmful effects of increasing physical activity on academic performance. Tomporowski et al. provided narrative research on studies, determining the effects of physical activity on academic and cognitive performance [12]. The study concluded on the basis of research work that physical activity is important for increasing cognitive functioning and thus academic performance.

The literature cited several studies that report a direct effect of physical activity on academic performance. However, we reviewed literature and suggested that physical activity has a prime effect on depression and self-esteem, and so indirectly affect academic performance. More specifically, physical activity has a positive relation with self-esteem [13] that also has a positive impact on academic performance [14]. Moreover, we also found in the literature that physical activity has a negative relation with depression [15], which also has a negative relation with academic performance [16].

1.1. Theoretical Background

1.1.1. Physical Activity and Academic Performance

Over the last several years, society has witnessed serious consequences due to the lack of physical activity among students. The lack of physical activity is an antecedent condition for several illnesses, such as obesity and diabetes. The literature includes contemporary views on the impact of physical activity on learning procedure among students and recent studies show that regular exercise leads to better mental health [17]. Historically, it was believed that non-academic activities have a negative effect on academic performance [18]. In recent years, the relation between physical activity and academic performance have been analyzed from several viewpoints, such as evaluating the students' participation in physical activities with the view that these activities are related to academic performance [19,20]. These studies have reached to different contradictory findings on this issue. One group of researchers have found no relation between physical activity and academic performance [20]. Others have found positive relations between physical activity and academic performance [21] A comparison between students who are involved in physical activity and who are not involved has been conducted by Trudeau and Shephard [10], and it resulted in positive significant relationship between physical activity and academic performance indicating that academic performance is improved with increasing physical activity. Symons et al. found physical exercise to be effective in improving inter-neuronal connections and increasing attentiveness [22]. Strong et al.,

confirmed a positive impact of physical activities on health though it failed to find any relation with cognitive performance [23]. Lindner performed a study in Hong Kong and found a significant, but weak, correlation between academic result and physical activity participation [18]. Later, a similar study was conducted by Dwyer et al., in the context of Australian students and it found a weak correlation between academic results and physical activities [24].

1.1.2. Physical Activity and Depression

Depression is commonly described in terms of hopelessness, difficulty concentrating, lack of energy, agitation, restlessness, feelings of worthlessness or pessimism, and suicidal ideation [25]. However, there are a few studies on the relation between depression and physical activity on university students as most of the studies have been conducted on children and adolescents from different age groups linking their academic improvements with increasing physical activity [4]. The literature revealed that physical activity and exercise have constructive effects on depression [26]. It has been observed that people who do exercise and physical activity have less chances of exhibiting signs of anxiety and depression as compared to those who do not practice physical exercise. De Mello et al., and his colleagues and Paluska and Schwenk found that less active people tend to be more depressed than more active people and anxiety symptoms are improved with regular exercise and physical activity [27,28]. De Moor and others also found proper physical activity is effective for reducing depression in Brazil [29]. Surprisingly, though the advantages of routine physical activity on mental health are evident [30], it is not practiced by most of the people [27].

Various studies with cross-sectional design consistently reported a negative relation between physical activity and depression [31]. Additionally, recent studies have found that physical activity has an important influence on the mood for clinical, as well as non-clinical, samples [32]. Moreover, there is negative association between depression and physical activity in the case of adolescents as well as adults [33]. Importantly, a few time series studies have been conducted to determine the relation between depression and physical activity [34]. Jerstad observed bi-directional relation between physical activity and depression in that increase in physical activity reduces the risk of depression and in turn depression decreases physical activity [34]. One of the limitations the literature is that most of the studies have been performed on adolescents covering a short period of time [34]

1.1.3. Physical Activity and Self Esteem

The concept of self-esteem is associated with positive feelings about oneself [35]. Physical activity is considered to be important for physical as well as mental health. High self-esteem is positively associated with greater wellbeing [36]. Consistent exercise and activity leads to psychological well-being [37]. Physical activity has a positive significant relation with self-esteem in children [38] as well as in older adults [39]. Sonstreom and Morgan's model shows that physical activity is linked to self-esteem [13]. On the basis of this model, Sonstreom and Alfermann [13,40] found that physical activity is associated with a greater level of self-esteem while using a sample of adults and middle age people. Noordstar and his colleagues [41] found that variation in self-esteem is linked with sportsman abilities and physical activities ranging from moderate to extreme using a sample of children. Guinn et al. [42] found a significant positive change in self-esteem after doing exercise. Guinn and Jorgensen [43] also found self-esteem and physical activity to be related directly among children and adolescents. Gruber reviewed 27 studies and found that physical activity has a moderate relation with self-esteem in the case of pre-adolescents [44]. However, Walters and Martins [45] found an insignificant relation between self-esteem and physical activity.

1.1.4. Academic Performance and Self Esteem

Self-esteem is defined with reference to the self-image of an individual. The concept evolved from the hierarchy of needs theory, as proposed by Maslow, which included needs of esteem as one of the higher order need of individual. However, it is defined by several psychological studies that depend

on the dimensions that these studies considered and there are differences in the definition between one study and another. Rosenberg defined self-esteem as sense of worth that may be positive or negative based on what one's values. The concept of self-esteem shows significance for students and their parents. The activities that make students feel encouraged help them to build their capabilities and skills [46]. Many researchers found that an individual with high self-esteem has high level of efficiency and effectiveness. Rahmani implies that self-esteem serves as a driving force to address problems in life [47].

Academic achievement is referred to as knowledge that is obtained by an individual during the academic period for a subject or group of subjects that one learns in an academic year such as a semester. Vialle et al. [48] claims that academic performance is not merely dependent upon the degree of intellectual energy, but rather on many other constructs, such as motivation, self-esteem, and social factors. This shows that academic achievement is a multi-faceted concept that is covered by several social, emotional, and personality factors.

The relation between self-esteem and academic performance is highlighted by a few studies that claim that self-esteem is positively related with academic performance i.e., high self-esteem encourages high performance, as Bankston and Zhou [49] states that high self-concept leads to high academic performance.

There are many studies that have found a positive relation between self-esteem and academic performance [50]. These studies claim that a higher level of self-esteem is associated with higher levels of academic performance as students are developed with optimistic feelings for themselves on account of previous achievements. Aryana [51] determined the relation between self-esteem and academic performance on a sample of 100 students taken from Azerbaijan and found that there is a significant positive association between academic performance and self-esteem. One study found that an individual with high self-esteem tends to have high academic performance. Doodman et al. [52] determined the relation between self-esteem and academic performance in Lamerd, obtaining a sample of 169 students out of population of 300. Out of 169, 73 were male and 96 were female. The study found a significant relation between self-esteem and academic performance.

On the basis of previous research, it is reasonable to say that the relation between self-esteem and academic performance is positive with a few studies differing from the majority. Thus, the present study is different in a sense that it studies the relation between self-esteem and academic performance while using a sample from university students.

1.1.5. Academic Performance and Depression

Depression is a feeling formulated by tension, anxiety, and worries that are associated with the stimulation of the nervous system [53]. A high level of depression makes life difficult and problematic. Depression is included in diverse forms of emotional and behavioral disorders. Students who are victim of any kind of emotional and behavioral disorder demonstrate negative attitudes towards their studies, such as low interest in learning and poor performance in examinations [54]. The psychological symptoms for depression among students include feelings of nervousness, going blank during exams, falling asunder while doing any task, and low interest in difficult subjects. Additionally, academic performance increases or decreases inversely with depression [55]. The importance of investigating depression among university students has been acknowledged by students as well as researchers.

McCarty [56] found depression as one of the major determinants of academic performance that is found to have a harmful effect on educational performance. Surprisingly, we do not find many studies that exhibit the relation between high levels of depression and low levels of academic performance. Aronen et al. [57] found that depression has several detrimental effects on students, such as diminishing memory and creating distraction among students. However, in a few studies, although researchers have found significant effects of depression on academic performance, they do not only show negative effects on students. These studies also claim that depression has a positive

effect on academic performance. Vitasari et al. [54] found that high level of depression is associated with a low level of academic performance.

The studies have found that the students with high level of depression have low memory, lack of concentration, low confidence and poor way of thinking. Whitakar Sena et al. [16] observed that a high level of depression is associated with a low level of academic performance, particularly in the case of weak students.

1.1.6. Physical Activity and Academic Performance with Mediation of Depression and Self Esteem

The literature that we investigated only shows direct impact of physical activity on performance. We do not find any study that determines indirect impact of PA on academic performance with the mediation of depression and self-esteem, except Dorfman [58], who explored the mediation effect of psychological well-being between physical fitness and academic achievement. However, on the basis of the literature, we propose that improved physical activity decreases depression [37] and indirectly increases academic performance [56]. Moreover, we also propose that improved physical activity increases self-esteem [4], which also increases academic performance [50].

The major objective of this research is to determine the impact of physical activity on academic performance with the mediation of self-esteem and depression. After a careful review of the literature, we have formulated following hypotheses:

Hypothesis 1 (H1). Physical activity (PA) is positively associated with academic performance (AP).

Hypothesis 2 (H2). Physical activity is negatively significantly associated with depression (DEP).

Hypothesis 3 (H3). There is positive significant association between physical activity and self-esteem (SE).

Hypothesis 4 (H4). There is a positive significant relation between academic performance and self-esteem.

Hypothesis 5 (H5). There is a significant negative relation between academic performance and Depression.

Hypothesis 6 (H6). The relation between physical activity and academic performance is significantly mediated by self-esteem and depression.

2. Materials and Methods

2.1. Participants

Participants have been selected on the basis of informed consent to participate in the study. A sample of 358 students was studied in terms of their physical activity, depression during their study and self-esteem through self-report. The survey was conducted from early October, 2017 to late December, 2017. Seven experienced teachers (including the researcher herself) from the selected universities administered the questionnaire survey. All of the respondents were told about the purpose of the research, the variables involved, and items on each questionnaire before they took the survey. On the average, the respondents completed the self-esteem scale in 3 min, the university stress scale in 10 min and the international physical activity questionnaire in around 10 min. So, it took hardly 25 min to finish survey. The analyzed sample was comprised of 358 undergraduate students (M age = 20.30, SD = 1.149, 46.1% girls, 53.9% boys) from five different Universities in urban and rural areas of Pakistan. Since there is evidence for differences between rural and urban settings, for example in the physical activity or physical fitness level of people [59], the Universities included were chosen so that approximately the same number of them were located in urban (n = 3) and rural areas (n = 2).

Analyses of the students' geographical area (M = 1.65, SD = 0.479) and the family income (M = 2.29, SD = 0.845) provide evidence that the present sample is representative for a large population of same-aged students from different social classes. Originally, the participants were 390, out of which 32 cases had to be excluded because of missing data for different variables. The response rate was 91.7%. The high response rate reflected the use of on-site questionnaires, teachers' proper guidance, and questionnaire verification after its completion.

In order to detect outliers, Mahalnobis distance values were calculated as χ^2 at $p = 0.001$, df = 4, which is equal to the number of variables [60]. According to chi-square distribution table, 32 cases having Mahalnobis distance values greater than 18.47 were identified as outliers, which had been excluded from data.

2.2. Measures

Data has been calculated by using the standardized research tools:

2.2.1. Physical Activity

The short version of the International Physical Activity Questionnaire [61] consisted of seven items containing three indicators, light, moderate, and vigorous activity, and has now been used in many international studies to measure physical activity. An example item is "During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace; carrying light loads, and doubles tennis? Do not include walking" (Appendix A). There was also a question about time spent by students in sitting which is not included in analysis. Means of the weekly minutes for all the three activities have been taken for the analysis in order to keep all variables' mean scores regular. In the present study, this measure has been adopted to assess self-reported physical activity in the sample. It has been extensively tested for reliability and validity [62]. The test-retest reliability of the tool has been calculated. The coefficient for that was 0.862.

2.2.2. Academic Performance

CGPA has been taken as a latent variable for measuring the academic performance of students. GPA, for the last consecutive semesters, has been considered as observed variables for the study. The test-retest reliability was 0.986.

2.2.3. Self-Esteem

English version [63] of uni-dimensional Rosenberg Self-esteem Scale [46] was used to measure the self-esteem of students. It is a widely used instrument that has been tested for reliability and validity in many settings. It was consisted of 10 items, an example item of which is "I feel that I'm a person of worth, at least on an equal plane with others" (Appendix B). The response was generated on a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Cronbach alpha was calculated for the measure, which was 0.825, which shows that the measure was reliable to an acceptable extent.

2.2.4. University Stress Scale

Depression had been measured in terms of stress. In order to measure depression of participants during their study, a 21 items University stress scale was adopted, which provides an index to measure both the categories of stress experienced by university students, as well as the overall intensity of the stress experienced [64]. One example of items is "Academic/coursework demands" (Appendix C). All of the items were evaluated on a four point Likert scale ranging from 0 (Not at All) to 4 (Constantly). Cronbach's α for the tool was 0.807.

All of the alpha values met the benchmark of 0.65 [65] (Table 1).

Table 1. Descriptive statistics, Mean differences, SD, Correlations, and regression coefficients.

Test Variables	Means	SD	1.AP	2.PA	3.SE	4.DEP	Cronbach's Alpha	Regression Coefficients	Sig.
1. Academic Performance (AP)	3.1258	0.64501	1	-	-	-	0.986	-	-
2. Physical activity (PA)	3.1530	1.2985	0.222 **	1	-	-	0.862	0.164	0.034
3. Self-esteem (SE)	2.7782	0.51745	0.408 **	0.304 **	1	-	0.825	0.671	0.000
4. Depression (DEP)	2.0608	0.52764	−0.269 **	−0.352 **	−0.146 *	1	0.807	−0.335	0.000
R-square	0.0786		-	-	-	-	-	-	-
Adjusted R Square	0.0779		-	-	-	-	-	-	-
F	46.174 ***		-	-	-	-	-	-	-

- N = 358, * $p < 0.05$, ** $p < 0.01$, (2-tailed), *** $p < 0.001$.

2.3. Parallel Mediation Model

A parallel mediation model has been used in the study. It is a basic mediation model (4b) from Hayes PROCESS templates [66]. We had hypothesized (Figure 1) that physical activity (X) would indirectly affect academic performance (Y) through two mediators: self-esteem (M1) and depression (M2).

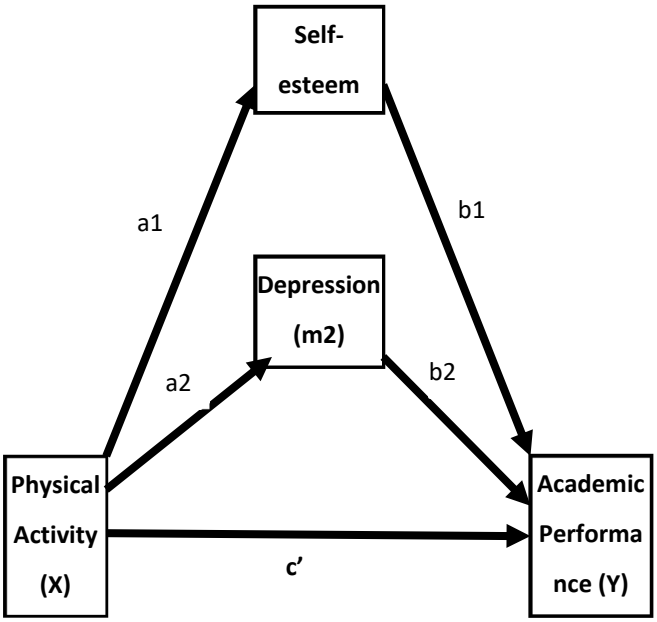

Figure 1. Hypothesized Model.

Firstly, the individual direct effects were calculated through the following paths:

M1 on X (a1)
M2 on X (a2)
Y on M1 (b1)
Y on M2 (b2)
Y on X (C′) which is direct effect of X on Y

Secondly, the specific indirect paths and total indirect effect were calculated as:

Indirect effect of X on Y via M1 = a1 × b1= a1b1

Indirect effect of X on Y via M2 = a2 × b2= a2b2
Total indirect effect via m1& m2 = a1b1 + a2b2

Finally, the total effect (c) was found out as = a1b1 + a2b2 + c'

2.4. Procedure

The first step was to inform authorities in the Universities about our research plans and objectives and obtain formal permission to approach students. After the permission, seven teachers from the included universities were contacted, who agreed to commit themselves to get the survey filled by the students. Then, self-report questionnaires were completed under the supervision of teachers during a regular semester time. All of the participants had signed an informed consent form approved by the Institutional Review Board before their participation in the study. Data were treated with confidentiality. It was hypothesized that both of the mediators significantly mediate between the independent and dependent variable. Pearson correlation coefficients were calculated for all the study variables. Then, a multiple mediation model was estimated by using the Hayes Process model 4b. To identify the direct and indirect effects of physical activity on academic performance, regression coefficients and bootstrapping was used to generate a confidence interval for the mediation effects. The analyses yielded that there was significant mediation effect of both mediators supporting the major hypothesis.

2.5. Analyses

All of the analyses were conducted through SPSS version 20 (IBM: Chicago, USA). In preliminary analysis, data were checked for accuracy. It was found that there were no missing values in data. Correlation was used in order to see the relationship among all the included variables. Outliers were tested as regression analyses (to test H1–H5) had been conducted because independent variable (x) and mediators (M) were expected to predict depending or outcome variable (Y).

For testing the major hypothesis-6 of the study, Hayes Process was used, which is considered as more powerful and effective method than its alternatives [67] 5000 bootstrapping-based resamples have been selected. Boot strapping does not have any assumption of normal distribution.

3. Results

3.1. Preliminary Analyses

3.1.1. Exploratory Factor Analyses (EFA)

First, exploratory factor analyses (EFA) while using principal component analysis with Varimax rotation were run with random half of the sample. It revealed that physical activity, self-esteem and depression measures constituted three interpretable separate factors with an Eigen value greater than one. These factors accounted for 61.180% of the total variance. The loading on self-esteem ranged from 0.782 to 0.888, the loading on depression ranged from 0.686 to 0.853, while the loading on physical activity ranged from 0.738 to 0.879. It can be concluded that all of the tools used in the study under consideration are all valid.

3.1.2. Confirmatory Factor Analysis (CFA)

Then, confirmatory factor analysis verified the final factor structure of the three constructs under study. The three factor structure presented a good fit for the data having CFI = 0.0931, TLI = 0.954, RMSEA (root mean square error approximation) = 0.047 (95% confidence interval), and χ^2 = 191.073, df = 46. All of the factor loadings were significant ($p > 0.001$) as it was above 0.738 for self-esteem and physical activity and above 0.686 for depression.

3.1.3. Descriptive Statistics

Table 1 shows descriptive statistics; mean values and standard deviations and a correlation matrix for all of the study variables. Correlation matrix exhibits a significant association between physical activity and academic performance and the mediators under study i.e., self-esteem and depression. The correlation coefficient for PA and AP was 0.222 supporting hypothesis 1. Similarly, the correlation between PA and DEP was significant with the coefficient −0.352. It supports hypothesis 2, while for PA and SE, it was 0.304, supporting hypothesis 3. On the other hand, there was a positive relation between AP and SE with $r = 0.408$, which supports hypothesis 4. On contrary, AP and DEP were negatively associated with $r = -0.269$ which supports hypothesis 5. Baron and Kenny [68] recommended that mediators must be significantly associated with both the independent and dependent variables. In order to establish the significance of study variables, all were analyzed through regression to judge whether to include them in the path model or not. After analyses, it was found that both mediators could be included in path model. Independent variable explained 6.12% ($t = 4.32$, R-square = 0.0786, $p = 0.000$) variance on its own. Hence, Hypothesis 1 to Hypothesis 5 was supported.

3.2. Major Analysis

It was hypothesized that the effect of physical activity on academic performance is mediated both by self-esteem and depression (Figure 1). So, there are two parallel mediators in the model. The model was estimated through Process model 4 [69]. Four models have been estimated. The outcome variable is academic performance and the explaining variable is physical activity, while two are the mediators i.e., self-esteem and depression with sample size 358. Table 2 describes all of the direct and indirect effects.

Table 2. Path Coefficients for Parallel Mediation Model.

Path	Effect	Boot-LLCI	Boot-ULCI	SE	T	*P*-Value
Total Effect	1.826	0.687	1.987	0.218	4.613	0.000
Direct Effect (c′)	0.613	0.189	0.895	0.228	2.817	0.000
IV-M1(a1)	0.932	0.205	0.986	0.037	4.726	0.000
IV-M2(a2)	−0.389	−0.404	0.213	0.134	2.321	0.000
M1-DV(b1)	1.13	0.447	1.632	0.203	2.830	0.000
M2-DV(b2)	−0.412	0.182	0.437	0.095	3.439	0.000
Total indirect effect	1.213	0.598	1.863	0.232	4.325	0.000
IV-M1-DV(a1b1)	1.053	0.456	1.732	0.312	3.565	0.000
IV-M2-DV(a2b2)	0.160	−1.841	0.425	0.58	−1.410	0.000

Note = This is path coefficients for parallel mediation model of Hayes process model 4, Indirect effects and 95% Confidence interval predicting academic performance (N = 358), SE is standard error, IV = Independent variable (Physical activity), DV = dependent variable (academic performance), M1&M2 = parallel mediators (self-esteem & depression); a1, a2, b1, b2 are regression coefficients for X1 & X2 respectively; while b1, b2 are the regression coefficients for M1 & M2 respectively. Boot-LLCI and Boot-ULCI are the abbreviations for lower limit bootstrap confidence interval and upper limit bootstrap confidence interval respectively.

3.2.1. Direct Effects

Separate regression models have been estimated for the entire paths. Firstly, self-esteem, the first mediator, is regressed on physical activity (path a1) and the unstandardized coefficient reported here is 0.932, which indicates that physical activity is strongly predicted by self-esteem and it is statistically significant as p values is 0.000 and 95% confidence interval is between 0.205–0.986.

Secondly, depression is regressed on physical activity (path a2). Again we have an unstandardized coefficient, which is negative and statistically significant. The coefficient of effect is −0.389 and the confidence interval is between −0.404 to 0.213 ($p < 0.0001$).

Similarly, in the model academic performance is regressed on self-esteem (path b1) and it is found that there is a positive effect (1.13). On the hand, a negatively significant coefficient (−0.412) was the result when academic performance is regressed on depression (b2).

The direct effect is explored by regressing academic performance on physical activity, which is 0.613 (CI = 0.189–0.895, $p < 0.0001$).

3.2.2. Indirect Effects

The regression model predicts academic performance from self-esteem, depression, and physical activity. Through all of the mediators, we can see a strong positive effect for self-esteem (a1b1 = 1.053, CI = 0.456–1.732) and a negative effect for depression (a2b2 = 0.160, CI = −1.841–0.425). This shows that both mediators are significantly associated to physical activity and academic performance, because bootstrap CI is above zero while controlling for demographic variables, but most of the indirect effect is due to self-esteem as a1b1 is 1.053 while a2b2 is 0.160.

3.2.3. Total Effect

The direct effect of physical activity on academic performance (c′) is 0.613 (CI = 0.189–0.895, $p < 0.0001$) (Figure 2). In contrast, the total indirect effects via both mediators (a1b1 + a2b2) is 1.213 (CI = 0.598–1.863). Consequently, the total effect (a1b1 + a2b2 + c′) of X on Y is 1.826. Therefore, the total effect (c = 1.826, CI = 0.687–1.987) of physical activity on academic performance is due to an indirect path, as the coefficient for direct effect (c′ = 0.613) is smaller than the total indirect effect (1.213). Hence, it supports hypothesis 6 that self-esteem and depression are significant mediators between physical activity and academic performance.

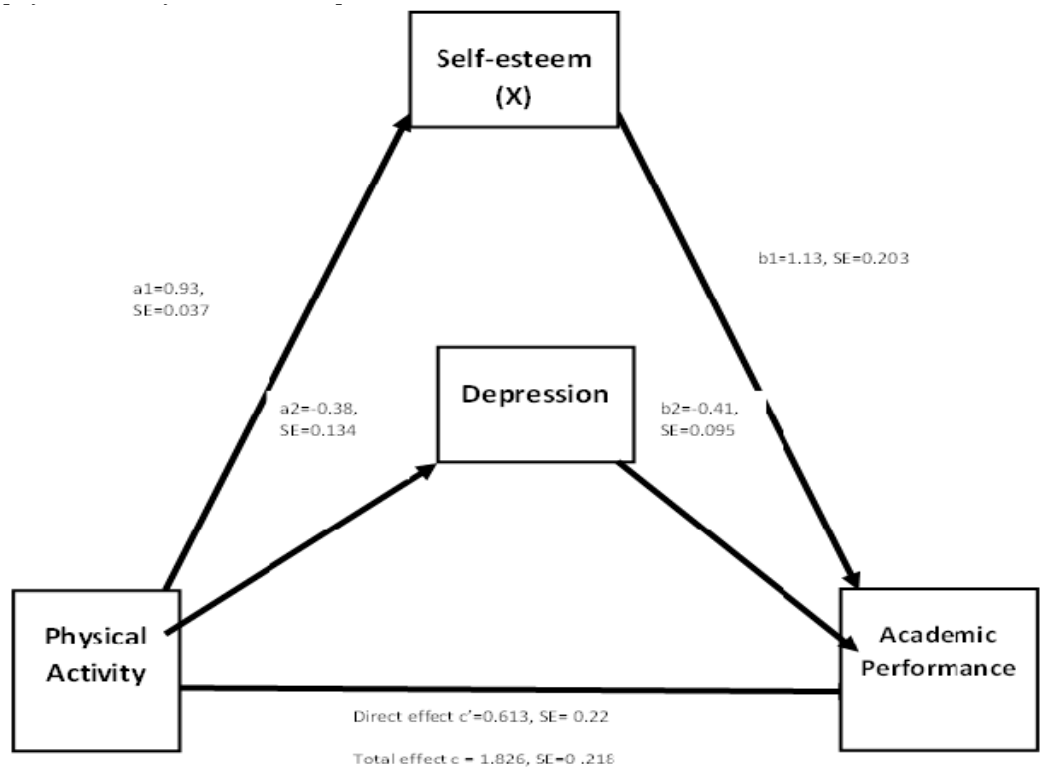

Figure 2. Path diagram for parallel mediation model.

4. Discussion

It was aimed in this study to find out the relationships between physical activity, academic performance, self-esteem, and depression. It also examined whether the relationship between physical activity and academic performance is mediated by self-esteem and depression.

The major findings of the present research are (1). Physical activity, academic performance, and self-esteem are positively related; (2) Physical activity, academic performance and depression are

negatively associated; and, (3). Self-esteem and depression play a significant mediating role in the relationship between physical activity and academic performance [58].

Most of the studies have used physical fitness as a predictor variable for academic performance and success [58,70,71]. But, in this study, physical activity has been used. Many studies reported correlational findings, while connecting physical activity and academic performance [72]. It is the strength of the present study that it has examined the mediators between these two variables.

The pattern of the findings in the present research are in line with the results reported in Dorfman's [58], and other studies [73–75] exhibiting positive correlation among self-esteem, physical activity and academic performance, and negative correlations among depression, physical activity, and academic performance. But, correlations among all of the constructs that are involved in the present study are much lower, except for self-esteem and academic performance. The authors in the current study have discovered physical activity as a significant but weak explaining variable for academic performance.

A systematic review explored evidence of association between cognition and physical activity [76]. Higher cognitive activity and understanding is linked with positive psychological concepts, like self-esteem [73]. On the other hand, depression and anxiety disorders lead to decrease in information processing [77].

In the case of direct effects, physical activity has been identified as significantly related to self-esteem [4] and an important factor for enhancing it. The present study shows that students who are engaged in physical activity have a greater level of self-esteem. Physical activity has also proved to enhance self-esteem, which could reduce depression [78]. Self-esteem has also found to have a significant positive impact on academic performance [14,50,73]. Further, in the case of using self-esteem as a mediating variable, we found a strong and significant positive relation between physical activity and academic performance. This demonstrates that physical activity has a strong relationship with academic performance with self-esteem as a mediating variable i.e., it was found to be a strong mediator of the relationship between physical activity and the academic performance of university students. [58].

In addition, depression was found to be a significant predictor for academic performance, which is in line with a number of studies [56,79]. Physical activity was also found here to have a significant negative relation with depression. This is similar to other studies [37,80]. As far as the indirect relation is concerned, we found that physical activity has a negative effect on academic performance when depression is the mediator. This shows that, with an improved level of physical activity, depression is reduced and that ultimately improves academic performance [58]. Physical activity is now believed to be established treatment against depression for adults [7].

The literature contains several studies that report the direct effects of physical activity on academic performance. However, we reviewed literature that suggested that physical activity has a primary effect on depression and self-esteem and an indirect effect on academic performance. More specifically, physical activity has a positive impact on self-esteem [13] that also has positive impact on academic performance [14]. Moreover, we also found in the literature that physical activity has a negative impact on depression [70] and also has a negative relation with academic performance [16].

There has been great interest in studies on the potential benefits of physical activity for the development of cognitive abilities over the last several years, especially those that strongly recommend physical activity as an effective instrument for building psychological well-being [5,81].

Finally, physical activity in students is a public health concern [23,82,83]. Although, too much physical activity is often discouraged, because it drains energy and affects academic concentration [84], yet it is generally recommended to provide and promote physical activity in school settings [85]. Physical activity has been recommended as a tool for developing students' cognitive activity by providing intervention programs that may include motor exercise and aerobics, which have positive effects on the brain [86]. Therefore, the importance of physical activity has to be kept in mind while

designing the curriculum of an educational institution, as it aims at increasing academic performance of students by decreasing depression, stress and anxiety; and by enhancing self-esteem.

5. Strengths and Limitations

While there is considerable work on the relation between physical activity, physical fitness, and academic performance, relatively few studies have investigated both constructs through psychological well-being. The present work focuses on the interference of self-esteem and depression in relation to physical activity and academic performance. It has several strengths, like the application of Hayes modeling and bootstrapping in analysis, gives insights into the mechanism mediating the relation between physical activity and academic performance with Pakistani students who had never been investigated about their physical activity and academic performance in relation to psychological well-being, and also provides a deeper understanding of mental health, academic performance, and physical exercise. Even so, it contains some limitations. The study is cross sectional in nature. A longitudinal design with a large sample may generate different results. Next, the instruments for assessment that were used in this study are all subjective measures, as they are self-report measures of physical activity, self-esteem and depression of the participants. Researchers could measure the underlying constructs with additional objective measures. Another limitation of the study is that the academic performance has only been considered in terms of CGPA for the last two consecutive semesters' grade point averages (GPAs). The other aspects of measuring academic performance could be used. The present study is also limited to the university students. So, the findings are only represented to that particular age. Additional studies could also be undertaken with students of varying age. The study is only mediation analysis. Age could be taken as a moderator in order to present the study in different way i.e., the multiplicative effect could also be included. The study can be conducted with a sample from other developing countries to increase generalizability. To sum up, structural equation modeling could have been used instead of the Hayes Process to perform multiple mediation modeling. All such limitations could be taken into account in future research.

Author Contributions: The first author Sumaira Kayani and the second author T.K. equally contributed to writing the original draft, the conceptualization, data collection, formal analysis and methodology, Saima Kayani contributed in data collection. H.Q. contributed towards writing method section. J.W. provided resources and administered the project. M.L.Z.S. reviewed the article.

Funding: This work is supported by the authors themselves.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

International Physical Activity Questionnaire Short form

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, running, fast bicycling, or fast swimming?
2. How much time did you usually spend doing vigorous physical activities on one of those days?
3. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace; carrying light loads, and doubles tennis? Do not include walking.
4. How much time did you usually spend doing moderate physical activities on one of those days?
5. During the last 7 days, on how many days did you walk for at least 10 min at a time?
6. How much time did you usually spend walking on one of those days?
7. During the last 7 days, how much time did you usually spend sitting on a weekday?

Appendix B

Rosenberg's Self-Esteem Scale

1. On the whole, I am satisfied with myself.
2. At times I think I am no good at all.
3. I feel that I have a number of good qualities.
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I certainly feel useless at times.
7. I feel that I'm a person of worth, at least on an equal plane with others.
8. I wish I could have more respect for myself.
9. All in all, I am inclined to feel that I am a failure.
10. I take a positive attitude toward myself.

Appendix C

University Stress Scale

1. Academic/coursework demands
2. Procrastination
3. University/college environment
4. Finances and money problems
5. Housing/accommodation
6. Transport
7. Mental health problems
8. Physical health problems
9. Parenting issues
10. Childcare
11. Family relationships
12. Friendships
13. Romantic relationships
14. Relationship break-down
15. Work
16. Parental expectations
17. Study/life balance
18. Discrimination
19. Sexual orientation issues
20. Language/cultural issues
21. Other demands

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