

## Article

# A School-Based Multilevel Intervention to Increase Physical Activity of Adolescents in Pakistan: From a Social-Ecological Perspective

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**Abstract:** This study aimed to develop an intervention strategy based on the social-ecological model's individual, interpersonal, and organizational levels for increasing adolescents' physical activity in Pakistan. Based on the social-ecological model, an 8-week intervention was conducted for 618 school students in Rawalpindi, Pakistan. A quantitative method with a quasi-experimental design was adopted, administering self-report measures before and after the intervention. Intervention materials were delivered by leaflet once a week to the intervention group. Repeated measure analysis of variance was applied to verify the intervention effects at pre- and post-test conditions. The results show that a significant intervention effect was identified from the repeated measure analysis of variance for the intervention group's physical activity participation compared to the control group from baseline ( $M = 12.01$ ,  $SD = 0.136$ ) to the 8-week post-test ( $M = 16.30$ ,  $SD = 0.125$ ). The intervention based on the social-ecological model has sufficiently and effectively improved physical activity among school adolescents in Pakistan.

**Keywords:** social-ecological model; physical activity; quasi-experimental; school-based; intervention



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## 1. Introduction

Physical activity (PA) is essential for physical and mental health [1–4]. Regular participation in PA contributes significantly to better health, combating obesity, maintaining a healthy weight, and managing risk factors for chronic disease [5,6]. PA participation appears to be inversely associated with obesity and the risk of metabolic and cardiovascular diseases, according to prior studies [7]. However, the individuals' PA participation is less than the recommended level of PA [8] as it was estimated that 81% of the adolescents in 2016 were inactive around the world [5]. It is believed that there might be certain factors affecting PA participation and combating inactivity [9–11]. An organizational framework to discover the essential elements influencing PA participation is the social-ecological model [12–14].

According to the social-ecological model, PA behavior is affected by multiple factors at the individual, interpersonal, organizational, community, and policy levels [13,14]. Interventions based on social-ecological factors may substantially increase PA [15]. The individual-level factors affecting PA may include attitude, self-efficacy, and motivation [16]. The research discovered that a more positive attitude was associated with increased average daily steps and leisure-time sports [16–18]. For example, ref. [17] recently found positive associations of attitude with leisure-time PA among students. Further, exercise motivation is regarded as a critical factor in sports participation and PA theoretically and empirically [16,19–22]. For instance, Courtney and his colleagues highlighted the importance of

motivation by exploring a strong positive correlation between the two [21]. Moreover, in previous reviews, several researchers discovered a direct correlation between self-efficacy and adolescents' PA, suggesting that the construct be further explored through intervention [22,23]. For example, self-efficacy was a significant predictor of PA in previous research examining the multilevel factors affecting adolescents' in-school PA [16,22]. Hence, an intervention study considering these factors needs attention.

Interpersonal factors such as social indicators have influenced PA behavior on numerous occasions. Previous research indicates that parental, peer, and teachers' support for PA is positively associated with its promotion [16,24–27]. Parents can assist adolescents by motivating them to engage in PA, acting as guardians for their sports activities, attempting to involve adolescents in a variety of activities, exercising alongside them, and spending time teaching them how to engage in PA or play any sport [24,28]. Further, adolescents who receive peer and parental support for PA are more physically active [25]. For example, a recent study reported that family and friends significantly influence the PA of school adolescents [26]. Moreover, adolescents who play or engage in physical activity with friends or peers are more active than those who are not involved in such activities [27]. Additionally, teachers' support for sports participation was associated with increased PA behaviors [29]. Therefore, an intervention based on such factors would help promote adolescents' PA.

In addition to individual and interpersonal factors, PA equipment, PA safety, PA facility, school policy, and culture for PA are essential to enhance adolescents' PA [16,25,26,30–32]. For example, the students' PA was closely linked to the availability of accessibility to PA resources, schools' greening, PA policy implementation in schools, and sports culture and atmosphere [22,26,30]. Previous research investigated high PA results when young people are exposed to school playgrounds, parks, gyms, equipment for recreation or sports, or the built environment [25,26]. Moreover, researchers revealed that adolescents with more access to PA resources or exercise equipment such as sports fields parks showed increased levels of PA [22,33,34]. Several review studies have shown that the promotion of PA at school is significantly influenced by organizational factors, such as school size, areas of activity, facilities, accessibility, equipment, and school PA policies [34,35]. It shows that the environmental characteristics are necessary for increasing PA [36]. Hence, an intervention study based on organizational factors would add significant literature to the body of knowledge.

Research has provided evidence on identifying and understanding factors affecting PA participation [9,11,16]. Further, intervention research has also been conducted exploring the higher PA of the school adolescents in the experimental group compared to the control group [30,37,38]. However, little is known about the intervention based on social-ecological factors (e.g., self-efficacy, motivation, attitude, social support, increasing PA environment, policy, and culture) influencing the adoption and maintenance of regular PA among school adolescents in Pakistan (Kiyani et al., 2021) where only 15.5% of the adolescents had recommended level of PA in 2009, according to the WHO [39]. An effective school-based PA intervention based on such factors in Pakistan would be very effective. Therefore, we aimed to investigate if an intervention based on the social-ecological factor would influence the PA of the Pakistani adolescents in school over time. The study expected increased exercise self-efficacy, exercise motivation, and exercise attitude to increase PA. It is further predicted that increasing teachers, peers, and family social support would enhance PA. Moreover, it is anticipated that PA would be increased by the availability of equipment, facility, safety, PA policy, and culture.

## 2. Research Method

### 2.1. Study Design

The study's design is quasi-experimental (non-equivalent control group) to see whether the intervention based on a social-ecological approach can significantly increase the PA level of adolescents at post-test compared to the control group. The intervention was multilevel, containing individual, interpersonal, and organizational factors affecting PA.

The intervention components were information-based and behavior change-based. The intervention material was provided to the experimental group's children, while the control group continued with their usual PA equipment. Then, both groups were tested for PA levels before (at baseline) and after intervention (at post-test 8 weeks after baseline). The flow chart of Study design is given in Figure 1.

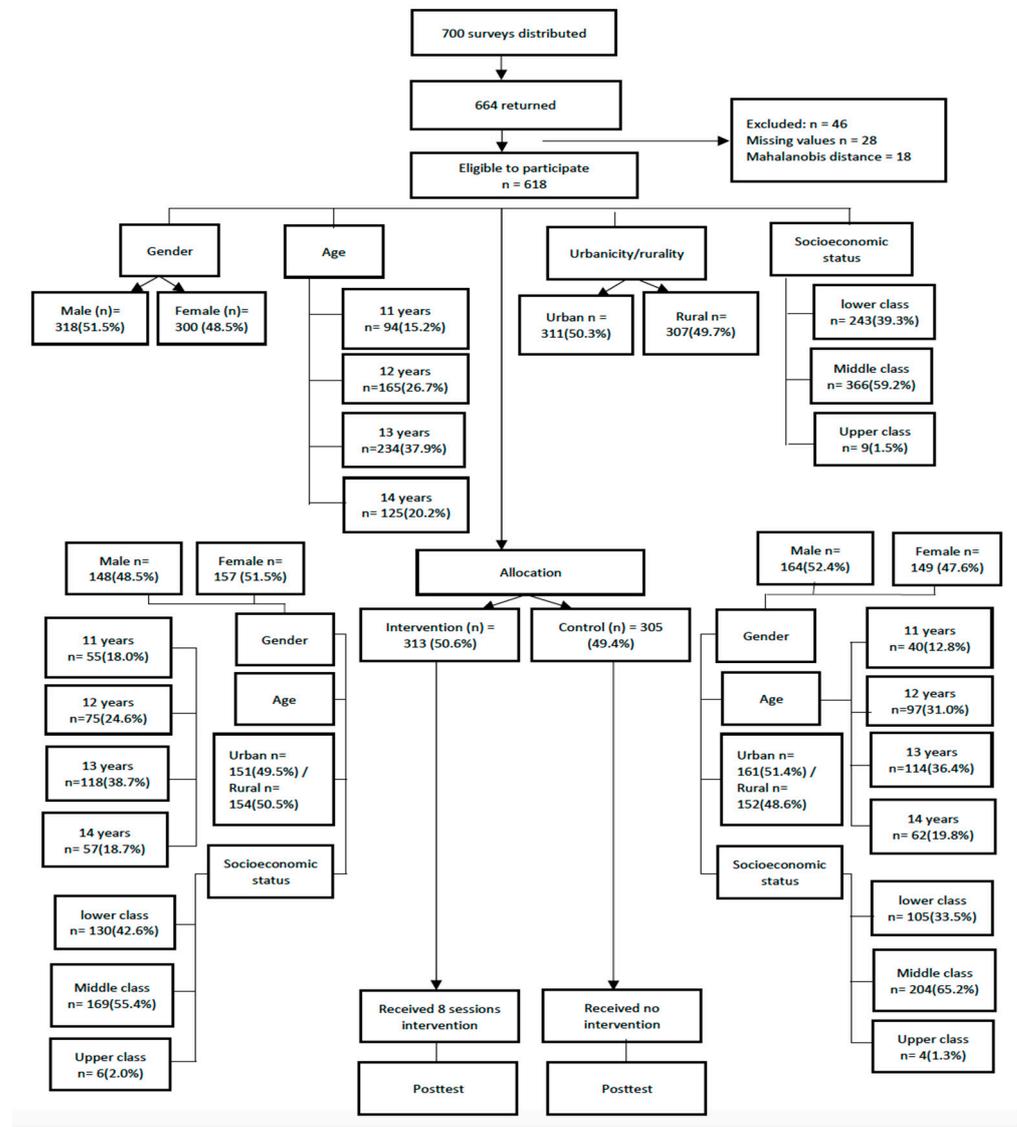


Figure 1. Study design.

## 2.2. Participants

As schools have become integral settings to promote PA and healthy living behaviors, especially for developing protective strategies and preventing inactivity, overweight, and obesity [40–42], participants of this study were Pakistani adolescents (11–14 years old; see Table 1) of elementary schools who received a simple language statement containing a research outline and consent form for participants and parents. Seven hundred questionnaires were distributed among students in different schools. Of these, 664 questionnaires were returned, resulting in a response rate of 94.86%. The researcher screened data before conducting the analysis. Twenty-eight cases with missing values were removed. Mahalanobis distance was calculated, 18 outliers were found, and the cases were deleted. Finally, the sample consisted of 618 school adolescents (51.5% males, 48.5% females) with an age range of 11 to 14 years ( $M_{age} = 12.63$  years,  $SD = 0.97$ ). The students from rural areas were

49.7%, while those from urban areas were 50.3%. Adolescents with a disability were not included in the study.

Data were collected through self-reported measures administered by schoolteachers with the guidance of one of the researchers. All participants were divided into two groups: a control group containing 313 students (50.6%) and an intervention group having 305 students (49.4%). The students having a physical disability or unable to perform PA were not included in the study. Ethical approval was obtained from the Research Ethics Committee of Zhejiang University, the Board of Intermediate and Secondary Education in Rawalpindi (BISER), and school principals. Sampling was done in two stages by recruiting the schools as clusters at the first stage. Four schools (two for boys, 50%; and two for girls, 50%) were recruited to conduct this study. To complete the study, a letter was sent to the director of schools, the Board of Intermediate and Secondary Education in Rawalpindi (BISER). Then, the school principals were approached with a supporting letter from BISER recommending participation in the intervention. If a school on the list declined to participate, the letter was sent to the next school on the list, and only four schools consented. In the second stage, the non-probability method of convenience sampling continued to be used. The schools were situated in the same geographical area in Rawalpindi city of the Punjab Province of Pakistan.

### 2.3. Instruments for the Study

The data collection tool includes a set of questionnaires and demographic information of the participants. All the measures in the group have already been validated in the Pakistani setting in a previous study [16]. Demographic data of the students included age, gender, grade, weight, height, rural-urban status, and socioeconomic status. BMI was measured through self-reported weight and height through the formula:  $BMI = \text{weight (kg)} / \text{height}^2 \text{ (m)}$  [43].

#### 2.3.1. Social-Ecological Factors

For social-ecological factors, an exercise self-efficacy scale referenced in this study comes from [44]'s general PA self-efficacy scale, comprised of nine items asking students how confident they were that they could do PA on five or more days of the week. A recent study presented the validation of the scale in Pakistani culture [16]. The participants responded on a five-point scale from 1 = not confident to 5 = completely confident. Further, motivation for PA was measured with scales developed in a previous study [45] based on SDT [46–48]. There are three items on internal motivation: (1) I enjoy it; (2) It fits with how I see myself; and (3) It is personally important to me; and three items on external motivation: (1) I am required to do it; (2) My parents, other family members, or friends tell me to do it; and (3) I feel guilty if I do otherwise. All items were measured with five options (1 = not at all true to 5 = very true). Moreover, attitude toward exercise was assessed by using 5-point bipolar adjective scales suggested by Ajzen [49]. We evaluated instrumental (useful–useless, harmful–beneficial, wise–foolish, bad–good) and affective (enjoyable–unenjoyable, boring–interesting, pleasant–unpleasant, stressful–relaxing) components of attitude using adjectives that are commonly employed in the exercise domain. Previous research has suggested that the scale is valid and reliable [50,51]. However, the scale validation with a sample of Pakistani adolescents is presented in a recent study [16]. Social support was measured using items from a student survey that Amherst Health and Activity Study [52] used and validated in previous studies with some modifications [53,54]. Initially, the scale consisted of two components, family and friends only. Dishman and his colleagues [53] devised the item for teachers' support by using the words from friends' and family's support. All items were rated on 5-point scale. For organizational factors, PA environment was assessed through equipment (3 items), facility (4 items), and safety (3 items) components of the Robertson–Wilson scale [55] for assessing environmental characteristics. On the other hand, PA policy (7 items) and culture (2 items) were evaluated by the Zhang and Si scale [30]. All items were evaluated on 5-point Likert scale.

### 2.3.2. Physical Activity

PA was measured through a global school-based student health survey (GSHS), which is specifically designed for measuring adolescents' PA levels [56]. This questionnaire has been validated in Pakistan [56] and other Asian countries such as China [57]. It includes four questions inquiring about PA levels of the adolescents. The first question is, "During the past 7 days, on how many days were you physically active for a total of at least 60 min per day?" The response was ranged from "0 days" to "7 days". Adolescents who were doing at least 1 h of PA per day were considered physically active [57,58]. The second question was, "During the last 7 days, on how many days did you walk or ride a bicycle to or from school?" Adolescents who walked or rode a bicycle to or from school for at least 3 days per week were considered active [57]. The third question was, "During this school year, on how many days did you go to a physical education class each week?" The responses were ranged from "0 days to "5 or more days". Adolescents who attended physical education class at least 5 days a week were classified as physically active" [57]. The last question was about sedentary behavior, "How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other seated activities such as surfing the Internet?" The responses were "less than 1 h per day", "1 to 2 h per day", "3 to 4 h per day", "5 to 6 h per day", "7 to 8 h per day", or "more than 8 h per day". Adolescents who spent 3 or more hours sitting per day were considered inactive [57]. The combined PA behavior of the adolescents was calculated by summing the scores of the four above-mentioned survey items, with the highest possible scores being 24. A higher score indicated better PA behavior. In addition, the total PA of adolescents was grouped into the following quartiles: low (score 0–6), moderately low (score 7–12), moderately high (score 13–18), or high (score 19–24).

### 2.4. Intervention

The intervention included individual, interpersonal, and organizational level changes. The purpose of the intervention was to increase the daily PA of the adolescents. The objective was addressed in an eight-session intervention for students (Appendix A). The main component of the intervention was eight information-based and behavior change-based intervention sessions for students, including teacher-led PA opportunities and activities. The intervention was based on original research in the target population, related review articles, and the social-ecological model of health behavior [13,14].

A member of the research team delivered the intervention in 8 weeks of sessions. Each session lasted approximately 45 min of PE class in the school. The first session of the intervention was devoted to informing students about PA's benefits and changing their attitude towards doing PA. The second session was focused on enhancing students' motivation to perform more and more PA, and emphasis was placed on increasing their self-efficacy. The endured ability of students to perform PA under different conditions was discussed. In the third session, social support by teachers and peers was emphasized. The major aim of this session was to change students' attitude to performing PA with their peers; and increase their awareness about the importance of teachers' role in promoting PA behavior among students. The fourth session was about family support for PA. In this session, the family was instructed through students' diaries to encourage their child to do PA and play with them in their free time. Then, there were sessions to discuss the PA environment and policy in the class. The theory class discussed PA equipment, facility, safety, policy, and culture. In the fifth session, the low-cost PA equipment was provided to students to practice PA in the class. The teacher led the activities with the provided material performed in the playground during PE practical class and breaks. In the sixth session, PA safety rules were delivered to the students through lectures and leaflets describing safety measures. The seventh session was to introduce PA policy and culture to the students. The eighth session was the last session in which all activities of the previous sessions were revised. PA opportunities were provided to students in PE practical class and the breaks.

The students were encouraged to participate in PA during break time and were asked to share their experiences. All modules were revised while practicing PA during this session.

### 2.5. Analysis

Descriptive statistics were computed using mean and standard deviation (SD). For measuring PA levels, frequency and percentages were calculated after recoding the original variable into low, moderately low, moderately high, and high PA levels. The Chi-square test was also applied to verify whether the percentage change between intervention and control groups was statistically different. General linear mixed model and repeated measure ANOVA (RMA) was used to analyze the intervention effects at baseline and post-test and to assess the difference between control and intervention groups at post-test. Group differences in PA level and psychological determinants before and after the intervention were analyzed using an effect size. Mean and SDs were calculated to verify the change in social-ecological factors and PA participation before and after the intervention.

### 3. Results

The details of demographic variables are given in Table 1. Chi-square was applied for categorical data, and a *t*-test was used for continuous normal data. Findings revealed no statistically significant differences in gender, age, geographical area, or BMI between the control and experimental groups. However, PA levels of control and intervention groups were significantly different for socio-economic status (SES). Hence, SES was controlled for the study.

**Table 1.** Demographic characteristics.

Demographics	Control (n = 313)	Intervention (n = 305)	<i>t</i> / $\chi^2$	<i>p</i> < 0.05
Boys (n (%))	164 (52.40)	148 (48.52)	0.926	0.336
Age (years) (Mean (SD))	12.63 (0.94)	12.58 (0.99)	0.672	0.502
Age (years) (n (%))				
11	40 (12.78)	55 (18.03%)		
12	97 (30.99)	75 (24.59%)		
13	114 (36.42)	118 (38.69%)	5.359	0.147
14	62 (19.81)	57 (18.69%)		
Geographic area (n (%))				
Rural	152 (48.56)	154 (50.49%)	0.230	0.631
SES (n (%))				
Lower	105 (33.55)	130 (42.62)		
Middle	204 (65.18)	169 (55.41)	6.241	0.044
Upper	4 (1.28)	6 (1.97)		
BMI (Mean (SD))	17.00 (2.28)	17.10 (2.37)	−0.518	0.605

Note: *p*-value is based on Chi-square for categorical data and *t*-test for continuous normal data.

Table 2 indicates the PA levels of the adolescents in intervention and control groups at baseline and post-tests. Based on the total score, PA was categorized into four categories: low PA (0–6), moderately low PA (7–12), moderately high PA (13–18), and high PA (19–24). The variable was recoded into 1, 2, 3, and 4 for low PA, moderately low PA, moderately high PA, and high PA, respectively. Further, Chi-square analysis was applied, and findings indicated a statistical difference between intervention and control groups after intervention. For instance, from the table, you can see that the number of students performing moderately high levels of PA in the intervention group dramatically increased from 104 to 270. Likewise, the number of students in the high PA category increased from 0 to 28. Additionally, no students were doing the low level of PA in the intervention group; however, those doing moderately low decreased to 7 at post-test from 188 at baseline. Conversely, students' numbers in the control group did not make any meaningful difference in the post-test condition.

**Table 2.** PA levels of control and intervention groups at baseline and post-test.

Time	PA Level	Control n = 313	Intervention n = 305	Chi-Square	p-Value
Baseline	Low (n (%))	10 (3.2)	13 (4.3)	0.942	0.624
	Moderately Low (n (%))	203 (64.9)	188 (61.6)		
	Moderately High (n (%))	100 (31.9)	104 (34.1)		
	High (n (%))	0	0		
Post-test	Low (n (%))	9 (2.9)	0	288.79	0.000
	Moderately Low (n (%))	200 (63.9)	7(2.3)		
	Moderately High (n (%))	103 (32.9)	270 (88.5)		
	High (n (%))	1	28 (9.2)		

The experimental treatment (intervention group vs. control group) was used as intergroup variables, and the time factor (pre-test vs. post-test) was used as the intragroup variables. A  $2 \times 2$  repeated measurement analysis of variance was used to test the effectiveness of the intervention in promoting adolescents' PA in school. The results in Table 3 indicate that a significant interaction effect from the intervention was identified for PA participation in the intervention group compared to the control group for the two time-points ( $F_{(1, 616)} = 416.23, p < 0.001, \eta^2 = 0.403$ , see Table 3). There is a statistically significant combined effect of time and group together on PA participation by the adolescents. The effect size is 0.403, meaning a 40.3% difference in PA participation can be attributed to the interaction term supporting that adolescents' PA is promoted by an intervention based on social-ecological factors. The time effect from baseline to the 8-week post-test was also statistically significant ( $F_{(1, 616)} = 437.84, p < 0.001; \eta^2 = 0.415$ ), and 41.5% of the difference in PA participation can be due to time. Similarly, the group effect was very significant ( $F_{(1, 616)} = 338.03; p < 0.001, \eta^2 = 0.345$ ), explaining 34.5% difference in PA participation.

**Table 3.** Interaction effect on PA of the adolescents at school.

PA Level	Measurement Stage	Control Group (n = 313) M (SD)	Intervention Group (n = 305) M (SD)	Treatment x Interaction F	p	Effect Size $\eta_p^2$
Mean score	Pre-test	11.35 (0.135)	12.01 (0.136)	416.23	0.0001	0.403
	Post-test	11.40 (0.123)	16.30 (0.125)			

Compared to baseline results, there are significant differences between students in the intervention group and those in the control group for their social-ecological characteristics at two different time points (Table 4). The results express that the interaction of time and group for all individual-level factors such as self-efficacy ( $F_{(1, 616)} = 16.49, p < 0.05; \eta^2 = 0.064$ ), motivation ( $F_{(1, 616)} = 38.751, p < 0.05; \eta^2 = 0.059$ ), and attitude ( $F_{(1, 616)} = 42.862, p < 0.05; \eta^2 = 0.065$ ) is statistically significant, explaining 6.4%, 5.9%, and 6.5% variance in PA participation, respectively. It means that the exercise self-efficacy, motivation for PA, and attitude towards PA among adolescents were significantly affected by the combined effect of time and group. It can also be elucidated that the mean score for self-efficacy, motivation, and attitude increased while moving from baseline to post-test.

**Table 4.** Intervention effect on psychological determinants.

Psychological Determinants	Time	Control Group (n = 313) M (SD)	Intervention Group (n = 305) M (SD)	Treatment x Interaction F	p	Effect Size $\eta_p^2$
Individual factors						
Self-efficacy	Pre-test	2.859 (0.669)	2.802 (0.769)	16.491	0.000	0.064
	Post-test	2.922 (0.593)	3.073 (0.812)			
Motivation	Pre-test	2.845 (0.745)	2.879 (0.712)	38.751	0.000	0.059
	Post-test	2.843 (0.747)	3.113 (0.745)			
Attitude	Pre-test	2.738 (0.587)	2.806 (0.597)	42.862	0.000	0.065
	Post-test	2.740 (0.592)	2.990 (0.610)			
Interpersonal personal factors						
Family social support	Pre-test	3.17 (0.792)	3.36 (0.808)	37.916	0.000	0.058
	Post-test	3.16 (0.809)	3.66 (0.520)			
Friend social support	Pre-test	3.02 (1.193)	3.10 (1.196)	62.943	0.000	0.093
	Post-test	3.00 (1.188)	3.63 (0.548)			
Teacher social support	Pre-test	3.01 (1.194)	3.11 (1.200)	105.719	0.000	0.146
	Post-test	2.99 (1.193)	3.54 (0.716)			
Organizational and environmental factors						
Equipment	Pre-test	2.677 (0.867)	2.673 (0.863)	2.690	0.101	0.004
	Post-test	2.637 (0.853)	2.686 (0.947)			
Facility	Pre-test	2.730 (0.739)	2.636 (0.771)	17.210	0.000	0.027
	Post-test	2.731 (0.739)	2.777 (0.862)			
Safety	Pre-test	2.755 (0.727)	2.724 (0.870)	6.970	0.009	0.011
	Post-test	2.755 (0.727)	2.828 (0.831)			
Culture	Pre-test	2.947 (0.655)	3.100 (0.835)	8.128	0.005	0.013
	Post-test	2.942 (0.652)	3.006 (0.756)			
Policy	Pre-test	2.929 (0.755)	3.015 (0.666)	17.948	0.000	0.028
	Post-test	2.911 (0.741)	3.057 (0.658)			

Similarly, interpersonal factors such as family social support ( $F_{(1, 616)} = 37.916, p < 0.05; \eta^2 = 0.058$ ), friends' social support ( $F_{(1, 616)} = 62.943, p < 0.05; \eta^2 = 0.093$ ), and teachers' social support ( $F_{(1, 616)} = 105.719, p < 0.05; \eta^2 = 0.146$ ) affecting PA participation had time-varying trends for intervention group in comparison to the control group. The variance explained by family support, friends' support, and teachers' support is 5.8%, 9.3%, and 14.6%, respectively, and the average score for PA social support increased as we moved from baseline to post-test.

The interaction effect for organizational factors such as facility ( $F_{(1, 616)} = 17.210; p < 0.05, \eta^2 = 0.027$ ), safety ( $F_{(1, 616)} = 6.970; p < 0.05, \eta^2 = 0.011$ ), culture ( $F_{(1, 616)} = 8.128; p < 0.05, \eta^2 = 0.013$ ), and policy ( $F_{(1, 616)} = 17.948; p < 0.05, \eta^2 = 0.028$ ) from baseline to the post-test was statistically significant for the intervention group. The variance explained by the variables in PA participation were 2.7%, 1.1%, 1.3%, and 2.8% respectively. However,

the interaction term was insignificant for PA equipment ( $F_{(1, 616)} = 2.690$ ;  $p > 0.05$ ,  $\eta^2 = 0.004$ ). Moreover, the mean scores of all organizational factors affecting PA participation were increased with time for the intervention group.

#### 4. Discussion

The current study investigated the effect of multilevel school-based intervention targeting the PA of Pakistani adolescents at schools. Considering the identified determinants of PA behavior, the theoretical model of the intervention was first and foremost based on the social-ecological model [13,14]. It presents a novel contribution to the body of knowledge by exploring multilevel intervention influencing PA in a low-income country such as Pakistan, where less than a quarter of the target population was found to be active [39].

##### 4.1. Intervention Effects on Physical Activity

It is observed from the results that the PA level of the adolescents in the control and experimental groups was very low at the beginning. It lay between low to moderately high, and no adolescent was doing high PA in any group. The average PA level increased significantly in the intervention group compared to the mean PA in the beginning, and the average PA of the adolescents in the intervention group was higher than that of the control group at post-test compared to the pre-test. The major findings suggest that a significant interaction effect from the multilevel intervention was identified for PA participation in the intervention group compared to the control group for the two-time points. Further, a substantial effect from baseline to the 8-week post-test and the individual group effect was also identified. The PA level was increased from moderately low to moderately high. The study echoes the results of Si and his colleagues [15] who tested the efficacy and sustained impact of an intervention based on the social-ecological model's interpersonal and organizational level factors to promote 13–15 years old adolescents engaging in school PA. The authors found significant intervention effects for the duration and daily PA. The result was also in line with the randomized controlled trial of [38], who explored a significant increase in PA level among school students through a multicomponent intervention. This implies that the combined effect of time and group plays a beneficial role in explaining PA behaviors of the adolescents at school. Further, a dramatic difference was found in the average minutes per week of the school adolescents in the experimental group compared to the control group [37].

##### 4.2. Intervention Effects on Individual Level Factors

The current study inferred a significant effect for intervention underpinned by individual, interpersonal, and organizational correlates of PA. The findings of our study are in line with the systematic review of Hynynen [59], in which he reported significant improvement in self-efficacy leading to enhance PA of the adolescents after the intervention. Similarly, the previous research reported that adolescents with higher levels of self-efficacy for PA generally possess higher PA levels [22,23,25]. The results of our study are also in agreement with the past intervention based on exercise motivation aiming to increase adolescents' PA. The researchers confirmed the importance of exercise motivation for improvement in PA behavior (Schwarzer et al., 2011). Further, both theory and research provided the evidence for increased motivation yielding higher levels of PA [16,19–22]. Moreover, the present study reported that intervention based on attitude towards exercise significantly explained adolescents' PA. Supporting these lines, previous research found a significant association between exercise attitude and PA of adolescents in Pakistan [16].

##### 4.3. Intervention Effects on Interpersonal Factors

Social support for PA has consistently been reported to enhance PA behavior in-school adolescents [25,28]. In addition, the present study inferred that integrating PA in family, peers', and teachers' contexts significantly increased PA among school adolescents. A possible explanation of our results is in line with a previous intervention study in which

authors suggested that intervention based on social support significantly increased school PA [15]. Along this line, a recent study in Pakistan exhibited family support for PA significantly predicting PA behavior in school adolescents [16]. A systematic review on social-ecological factors affecting school adolescents' PA participation disclosed that peers', parents', and teachers' support significantly explained PA behavior [25]. Further, research with the adolescents of low-income communities showed the significant intervention effects for social support from teachers [60]. Moreover, the current study results also coincide with the argument provided by the past research, which found that positive peer relationships foster involvement in PA among adolescents [28]. However, there is a contradiction between the present study results and those of Kiyani and his colleagues [16], carried out to investigate predictors of PA among Pakistani students in schools. Rather unexpectedly, the results revealed that perceived peers' and teachers' support were not associated with the PA of the school adolescents [16]. That may be because the study was conducted during the COVID pandemic situation in the country, and the schools were opened off and on. Hence, interventions increasing parents', teachers', and peers' influence on adolescents' PA behavior may be worthwhile.

#### *4.4. Intervention Effects on Organizational Factors*

Moreover, the study explored various organizational factors which played an important role in improving adolescents' PA behavior. Specifically, PA facility, PA safety, PA policy, and PA culture positively explained adolescents' PA, except for PA equipment. These findings are consistent with those previously obtained by other researchers [15,22,26,30,32]. Thus, the provision of institutional factors in terms of facility, safety, policy measures, and sports culture contribute to the formation of PA habits among the students [22,26]. In this regard, a review of the interventions based on institutional factors explored availability, accessibility, the greening of school sports venues, and the recognition, implementation, propaganda, and sports culture atmosphere have significant effects on PA in adolescents [30]. However, the result that an increase in PA equipment led to PA enhancement was opposite to the outcome of our study. The researchers found that the intervention based on the school policy and environment had obvious effects on the health promotion of adolescents [30]. The findings of the current study are aligned with a previous study which suggested that the school environment is a necessary element for school-based interventions to enhance PA [36]. In contrast to the present study, the most recent empirical research and systematic review found inconclusive associations between school PA policies and PA [31,61]. The opposite results may be due to age differences of study samples. Moreover, the organizational factors may influence PA behavior indirectly through social support or personal factors, hence, future investigation in this regard is suggested.

#### *4.5. Implications*

The results of this study have important educational and health implications for adolescents, given the effectiveness of individual, family, and school-level interventions for promoting PA of the individuals [16,62]. The findings have suggested that intervention based on individual, interpersonal, and organizational factors contribute to increasing the probability of participation in sport and PA practices. Further, it is certain that the individual and interpersonal levels of the social-ecological model account more for PA participation. Conversely, organizational factors explained less variance in the target variable. Moreover, organizational level factors have indirectly affected PA in the previous study [63], and finding the mediation effects of individual and interpersonal factors for organizational elements affecting PA. Furthermore, the study points out that the educational and health institutions ought to encourage parental, peer, and teacher support toward PA practice in the family and organizations by providing the resources necessary to remove time and economic barriers to PA [16,64].

#### 4.6. Limitations and Future Directions

Although the study has several strengths having a sound basis on a social-ecological model, designing and implementing the school-based intervention in a south Asian country such as Pakistan, and considering the multilevel influences on adolescents' PA, the study has some limitations. For example, the study used self-reported measures to collect PA behavior and its individual, interpersonal, and organizational correlations. The objective measures of PA alongside self-report measures in the future may generate different results. Forthcoming intervention studies should also use large enough sample sizes to allow multilevel analyses to account for clustering within classes and schools. The study has established results based on one aspect of the informants, such as adolescents. Although students' judgment is usually more predictive than the significant others (Barr-Anderson et al., 2010), further research should consider and triangulate the information collected by parents, teachers, or peers regarding several aspects affecting students' PA. Moreover, the study does not include follow-up and future trials should include long-term follow-ups to verify the stability of the findings.

#### 5. Conclusions

The study findings have shown significant substantial interaction effects to explain PA. Adolescents in the intervention group got their PA promoted at post-test in comparison to control group and a significant positive effect of intervention underpinned by the social ecological model on school-based PA of the adolescents was highlighted. It is revealed that not only the individual level factors, but also interpersonal and organizational factors played an important role in explaining adolescents' PA at school. It is important that future researchers and policy makers should continue to recognize the individual, interpersonal, organizational, and environmental factor for changing and increasing adolescents' PA by integrating all variables together. The educational programs should promote daily PA, walking to the schools, and attending physical education classes at school to reduce sedentary behavior and increase PA. The study would be beneficial for educationists and health practitioners for developing interventions for school adolescents. Hence, the study may be a significant piece of research in the body of knowledge.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical considerations.

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

### Appendix A. The Intervention Components and Content

Sessions	Intervention Factors	Aims	Activity	Form of Intervention	Material Provided	Mode of Delivery
Session 1	Strengthen the concept of PA Exercise attitude Exercise motivation	Providing introduction to PA and its benefits. Changing attitude towards doing PA by	In group session in PE theory class, the researcher gave a presentation on PA benefits for health and wellbeing by using colored postcards/leaflets, making them ready to participate in activities. Practicing PA in practical class of PE, and during lunch breaks.	Informational approach Behavior change-based approach	Colored leaflets on PA health benefits PowerPoint presentation A group rules sheet Consequences of doing PA Diary sheets for home assignment	Face to face in class Home assignments for doing activity Group activities in the ground
Session 2	Exercise motivation Exercise self-efficacy	Motivating them to do more and more PA enhancing their ability to do PA	The session started with revision of previous session. The explanation on increasing self-efficacy and motivation for PA were given by boosting students for participation in PA, and increasing their ability to do PA. PA was practiced by the students in PE practical class and during the breaks. Students were encouraged to participate more and more in activity and stop sitting and remain inactive.	Information-based approach Behavior change-based approach	PowerPoint presentation Colored leaflets Positive climate for increasing PA Assignment sheet	Face to face in class Home assignments for doing activity Practicing PA in class and playgrounds

Sessions	Intervention Factors	Aims	Activity	Form of Intervention	Material Provided	Mode of Delivery
Session 3	Teachers and peers support	Encouraging students to participate in PA and reducing inactivity by making students play with their peers in pairs and in groups supervise and guide their activities.	<p>The session started with revision of previous session.</p> <p>In this session, the teacher led activities were performed in the classes and in the playground</p> <p>Teachers motivated students to practice more and more PA and sit less.</p> <p>Praise the students' PA.</p> <p>They explained strengthening PA is good for health.</p> <p>Teachers explained them on how to perform effective PA and guided the way to achieve PA goals.</p> <p>Students were instructed to do PA with one another, appreciate others' PA, cooperate in doing PA, and share their experiences with one another.</p>	<p>Information-based approach</p> <p>Behavior change-based approach</p> <p>Discussion</p> <p>Explanation</p> <p>Sharing PA experience</p> <p>Cooperation in doing PA</p>	<p>PowerPoint presentation</p> <p>Colored leaflets</p> <p>Instructions on how to perform PA</p> <p>Positive group climate for doing PA</p>	<p>Face to face in class</p> <p>Teacher-led group activities in PE</p> <p>practical class and playground</p> <p>Making students pairs and groups for peer activities</p>
Session 4	Family support	Giving awareness to family to encourage their child for doing PA, and to play with them in their free time.	<p>The session started with revision of the previous session.</p> <p>Ask students, "Do parents encourage students to do physical activities in their free time at school"? or the siblings play with them?</p> <p>Posters were presented with family doing PA with their children</p> <p>Students were asked to do PA with their parents and siblings in their free time.</p> <p>Students were given home assignments on their diaries to instruct their siblings and parents to play with them and do PA with them.</p> <p>The home assignments also included instructions on encouraging children to participate in PA and provide them support for PA verbally and physically by playing with them.</p>	<p>Behavior change-based approach</p> <p>Encouraging PA</p> <p>Cooperating in doing PA</p>	<p>Colored leaflets</p> <p>Assignment sheet</p>	<p>Face to face in class</p> <p>Home assignments for doing activity with their family (parents and siblings)</p>

Sessions	Intervention Factors	Aims	Activity	Form of Intervention	Material Provided	Mode of Delivery
Session 5	School PA equipment and facilities	Providing low-cost PA equipment to students for practicing PA	<p>The session started with revision of previous session.</p> <p>then PA equipment was discussed and explained to students</p> <p>Introduce the PA facilities available at school</p> <p>Recall the specific location based on the pictures of school PA equipment. PA opportunities were provided to students in PE practical class. Instructions were given on how to use them, and activities were performed within the class and the playgrounds. Questions and answers related to PA, school equipment, and facilities.</p>	<p>Information-based approach</p> <p>Behavior change-based approach</p>	<p>Colored prints or leaflets on different PA activities with the provided material</p> <p>Demonstration of PA behavior</p>	<p>Face to face in class</p> <p>Activities in class and in the playgrounds</p>
Session 6	PA safety	To introduce safety rules for PA and doing PA in a safe environment.	<p>Review what has been learned before.</p> <p>Explain and make sure that PA is being performed safely inside the school.</p> <p>Teach safety rules to students.</p>	<p>Information-based approach</p>	<p>PowerPoint presentation</p> <p>Colored leaflets</p>	<p>Face to face in class</p>
Session 7	PA policy and culture	To teach school PA policy to students and explain if there is PA culture in the school.	<p>The session started by reviewing the last session</p> <p>Discuss PA policy and what the school is implementing</p> <p>PA policy rules were posted in the schools</p> <p>Introduce “promoting PA, 2027 Plan”</p> <p>Ten minutes”, “Exercise for one hour every day”.</p>	<p>Information-based approach</p> <p>Behavior change-based approach</p>	<p>PowerPoint presentation</p> <p>Colored leaflets</p> <p>Banners</p>	<p>Face to face in the class</p> <p>Perform PA according to PA policy in the school</p>

Sessions	Intervention Factors	Aims	Activity	Form of Intervention	Material Provided	Mode of Delivery
Session 8	Call on students to participate in PA	To revise all activities held in previous sessions.	<p>The session started with revision of previous session.</p> <p>This was the concluding session in which all the sessions were revised briefly, and the activities were performed with low-cost PA equipment within class and outside the classes in the grounds during breaks. It was followed by doing activities by students and exchange and share experiences.</p> <p>Discuss with students and ask about their experiences.</p>	Behavior change-based approach	Colored prints Banners Discussion	Face to face in class In practical class and in the grounds

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