Physical Activity and Interpersonal Adaptation in Chinese Adolescents After COVID-19: The Mediating Roles of Self-Esteem and Psychological Resilience

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Abstract
Previous studies have implied that physical activity profoundly influences interpersonal adaptation. However, this effect and its mechanisms have not been directly verified, especially for adolescents. This study examines the association between physical activity and interpersonal adaptation in adolescents through self-esteem and psychological resilience after the coronavirus disease 2019 (COVID-19) pandemic. Participants included 542 Chinese adolescents (aged 13–18 years; 242 boys and 300

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Girls). Adolescents in China anonymously completed a series of questionnaires, including the PARS-3 Scale of PE Activity Grade (PARS-3), the Self-esteem Scale (SES), the Resilience Scale for Adolescents (RSCA), and the Interpersonal Adaptation Scale. The results showed that physical activity positively correlated with self-esteem, psychological resilience, and interpersonal adaptation. Additionally, self-esteem and psychological resilience serially mediated the impact of physical activity on interpersonal adaptation. The findings highlight the positive impact of physical activity on adolescent interpersonal adaptation by strengthening positive psychological resources in the post-pandemic era.

**Keywords**
adolescent, physical activity, interpersonal adaptation, self-esteem, psychological resilience

**Introduction**
Coronavirus disease 2019 (COVID-19) emergency measures, including the closure of schools, recreation centers, and other public places, have resulted in widespread disruption to adolescents’ lives and routines (Cost et al., 2021). Emerging literature from countries experiencing a high prevalence of COVID-19, such as China, Canada, and the United Kingdom, suggests a significant psychological impact on adolescents (Cost et al., 2021; Wright et al., 2021; Zhang et al., 2020). The COVID-19 pandemic has also severely affected how adolescents communicate with friends and amplified negative aspects of interpersonal relationships (Mheidly et al., 2020). Interpersonal adaptation, such as adolescents’ ability to establish and maintain connections with others, is likely to facilitate healthy interpersonal relationships (Li & Li, 2015; Wang et al., 2020).

Interpersonal adaptation describes the psychological ability to adjust the interpersonal environment to develop positive relationships and obtain support from others (Wang et al., 2010). Such adaptation contributes to socialization and mental health throughout adolescence. Previous research has concluded that interpersonal adaptation is significantly associated with psychological well-being (Tse & Yip, 2009). Additionally, adolescents with good interpersonal adaptability are more likely to develop better social and cognitive competence and learn more about the skills of managing conflict throughout adolescence. In contrast, poor interpersonal adaptability is the most troubling aspect of adolescent adaptation (Zeng & Zhang, 2009). A study has verified that adolescents with negative interpersonal adaptation are generally more likely to experience psychological and behavioral problems, such as loneliness, depression, and aggression (Zhang et al., 2015). Therefore, it is greatly significant to explore the protective determinants of interpersonal adaptation among adolescents after COVID-19.
It has been suggested that physical activity is a protective factor of interpersonal adaptation (Sun et al., 2019; Yan et al., 2020). Several studies have indicated that physical activity is an essential factor in preventing severe complications from future pandemic viruses and contributing to better mental health during the COVID-19 prevention and control period (Carriedo et al., 2020; Chen et al., 2020; Wright et al., 2021). The benefits of physical activities may generalize the development of adolescent interpersonal adaptability. On the one hand, physical activity has the function of self-adjusting or transforming the interpersonal environment (Xiong et al., 2011) and is one of the social activities that can accelerate interpersonal interaction. Socialization theories also claim that exercise actually encourages interpersonal adaptability due to engagement in social activities (Schaefer et al., 2011). Consistent with this idea of significant involvement in social activities, college students who actively participate in physical activity have reported higher levels of interpersonal adaptation (Liu & Qu, 2017). People who exercise frequently exhibit lower levels of fatigue, depression, and anxiety and have more positive emotional experiences. This helps improve their adaptability in the interpersonal environment compared with those who do not exercise at all (Fredrickson, 2004; Thøgersen-Ntoumani et al., 2014). Physically inactive adolescents tend to be excluded by their peers (Schaefer et al., 2011), which is not conducive to developing interpersonal adaptability. Moreover, physical activity is a behavioral strategy that links to adaptability. Sun et al. (2019) consistently verified the influence of physical activity on adolescents’ social adaptation. As a vital aspect of social adaptation, interpersonal adaptation should also benefit from physical activity. However, no similar studies have been conducted on the direct impact of physical activity on adolescent interpersonal adaptation, especially after COVID-19. The mechanisms through which adolescents engage in more physical activity and have higher levels of interpersonal adaptation remain unclear. To address this gap, the present research aimed to clarify the association between physical activity and adolescents’ interpersonal adaptation and its mechanisms in the post-pandemic era.

Self-esteem refers to a positive attitude and emotional experience based on self-evaluation in social practice, which is a high degree of identity of individuals to all aspects of themselves (Sonstroem, 1998). An abundance of literature has attempted to establish a link between physical activity participation and self-esteem and found a strong correlation between the two (Arbinaga et al., 2018; Dorak, 2015). Self-esteem is considered to be the variable with the highest payoff in terms of the psychological benefits obtained from participation in physical activity (Li & Li, 2015). The predictive role of physical activity participation on high self-esteem was also proposed in Liu et al.’s (2015) meta-analysis of 25 randomized controlled trial studies of samples of adolescents and children. Another study on self-esteem intervention through physical activity further supported this conclusion: Arbinaga et al. (2018) found more significant increases in self-esteem levels among three exercise groups than in a no-exercise group in a controlled study of the placebo effect.

It is worth noting that adolescents need to integrate into a social or interpersonal atmosphere and feel that they belong. Self-esteem, an internal psychological monitor of
social belongingness (Leary & Baumeister, 2000), is essential to adolescents. Such a psychological system adapts and maintains a certain degree of interpersonal relationships, even determining their nature and quality. Previous research has shown that self-esteem positively affects interpersonal relationships (Liu & Wei, 2008). When adolescents report higher self-esteem levels, they cope better with interpersonal pressure, appear to have more interpersonal trust, and thus make, adapt to, and maintain good interpersonal relationships. In line with this, Ju et al. (2011) found that the level of interpersonal adaptation increases with self-esteem improvement, which is perhaps because adolescents generally exhibit an inherent desire to maintain interpersonal relationships, originating from their need for belonging and approval (Leary & Baumeister, 2000). Conversely, adolescents with low self-esteem report being influenced by relatively minor rejection experiences, then protect themselves against this hurt by self-protectively reducing their dependence on the interpersonal relationship (Liu et al., 2016); in other words, they show difficulty in interpersonal adaptation. Therefore, it would be reasonable to expect that physical activity may affect interpersonal adaptation by promoting self-esteem after the COVID-19 pandemic.

Empirical research has found that psychological resilience is another psychological benefit of physical activity (Yolanda et al., 2021). Psychological resilience may also be a positive psychological resource for adolescent interpersonal adaptation (Xu & Yang, 2017). Thus, another mediator variable between physical activity and interpersonal adaptation that we explore in the current study is psychological resilience.

Psychological resilience is a positive resource defined as a developable and positive capacity to bounce back from adversity, conflict, and failure (Carriedo et al., 2020). Three main groups of protective factors related to psychological resilience have been identified: family cohesion (e.g., parental support, communication skills), social resources (e.g., community support, environment, social activity), and personal dispositions (individual characteristics, self-regulation, self-esteem) (Hjemdal et al., 2011; Luthar et al., 2010; Zolkoski & Bullock, 2011). One specific protective factor, physical activity, has also gained a more important role in helping adolescents recuperate from the mental health problems they experienced during the quarantine of the COVID-19 crisis (Chen et al., 2020). Physical activity seems to lead to positive psychological outcomes, and adolescents who enrolled in physical activity obtained higher psychological resilience values (Yoshikawa et al., 2016). Likewise, adolescents who participated in physical activity frequently reported higher scores for protective factors related to psychological resilience than others who were physically less active in both Norwegian and Chinese samples (Hjemdal et al., 2006; Hu, 2019). A recent study involving a randomized controlled trial also showed a significantly increased psychological resilience based on physical activity during the COVID-19 prevention and control period (Yolanda et al., 2021).

Psychological resilience, it should be noted, promotes positive adaptation and restrains problem behaviors, including peer interaction problems (Sun et al., 2013). As for the reasons, first, the characteristics of the psychological flexibility of resilience can help adolescents allocate cognitive resources and adapt to the ever-changing
environment, including the interpersonal environment (Waugh et al., 2011). Although resilient people are still likely to experience negative emotions following stressful or traumatic events, they can maintain strong empathy and problem-solving abilities. This means that those with higher psychological resilience levels can reflect on their actions, have good social skills, and are compassionate toward others (Bunce et al., 2019), which is crucial for interpersonal adaptation. In this sense, the higher the psychological resilience level, the better the ability to deal with interpersonal problems and adapt to the ever-changing interpersonal environment. Kinman and Grant (2011) found that resilience is closely related to emotional intelligence, social skills, and empathy in a study with 240 social work students from the UK. Similarly, a study on the relevant issues of social adaptation showed that psychological resilience plays a positive role in predicting the social adaptability of Chinese adolescents (Xu & Yang, 2017).

Interpersonal adaptation, as a vital part of social adaptation, also benefits from high psychological resilience levels. Furthermore, Masten and Tellegen (2012) claimed that psychological resilience is a process or mechanism underlying positive adaptation, finding that adolescents with high psychological resilience levels should have good interpersonal adaptability. Thus, adolescents who participate in physical activity are more likely to raise their positive psychological resources, while psychological resilience can protect and, ultimately, contribute to the development of interpersonal adaptability.

Nevertheless, psychological resilience was negatively affected by the COVID-19 pandemic (Carriedo et al., 2020). Fortunately, self-esteem has a beneficial effect on psychological resilience. Research has revealed that self-esteem is a critical internal source of psychological resilience (Tian et al., 2018). Moreover, it can explain the overall structure of psychological resilience and even protect the latter (Windle et al., 2008). In this regard, as a protective factor, self-esteem is a great support system to promote the development of adolescent psychological resilience (Tian et al., 2018). For instance, in a cross-sectional study, Dang and Michelle (2014) proposed that self-esteem played a vital role in the psychological resilience of adolescents. Several studies have also suggested a positive effect of self-esteem on psychological resilience (Bajaj, 2017; Martínez-Martí & Ruch, 2016). According to the framework of terror management theory (TMT; Greenberg et al., 1986), self-esteem serves as an anxiety buffer, contributes to positive adolescent development, and facilitates psychological resilience. Therefore, self-esteem and psychological resilience, as two kinds of positive psychological resources, may have a serial mediating effect on the association between physical activity and adolescents’ interpersonal adaptation.

Above all, the current study aimed to examine the relationship between physical activity and adolescent interpersonal adaptation and whether self-esteem and psychological resilience mediate this effect. The mediation model is shown in Figure 1. We expected that higher physical activity levels would be associated with higher levels of self-esteem and psychological resilience, which improve adolescent interpersonal adaptation.
Methods

Participants

Participants included 570 adolescents from three middle schools (grades 7–11) in Wuhan, Hubei Province, China, who volunteered to participate in the study. All participants reported themselves to be in good health and had no history of neurological illness. All participants gave informed consent. After excluding questionnaire responses with missing answers or regular answers, a total of 542 valid questionnaires were received. The 542 respondents were between the ages of 13 and 18; 242 (44.6%) were boys, and 300 (55.4%) were girls. The mean (standard deviation) age of the adolescents was 15.4 (1.64) years.

Procedures

Before data collection, we obtained assent from adolescents and informed consent from the school administrators and teachers. A paper questionnaire in Chinese was used in this study. To maintain the quality of the investigation, the adolescents were gathered in a large assembly room in each middle school to complete their questionnaires for 30 minutes with the help of two researchers.

Measures

Physical Activity. The amount of adolescents’ physical activity was measured with the Chinese version of the Scale of Physical Activity Grade (PARS-3; Liang, 1994), which comprises three items. The scale measures the amount of physical activity in terms of three factors: the intensity of physical activity, the duration of one physical activity, and the frequency of physical activity in the past month. The scoring method of physical activity was the intensity of physical activity × (the duration of one physical activity - 1) × the frequency of physical activity in the past month. All items were scored with a 5-
point scale ranging from 1 to 5 points, respectively. The total score was 0–100 points, with higher points representing more physical activity. Previous research has demonstrated that this scale is valid for assessing physical activity in samples of Chinese adolescents (Jiao et al., 2020). The internal consistency coefficient for the present sample was $\alpha = 0.80$.

**Self-Esteem.** Adolescent self-esteem was measured with the Chinese version of the Rosenberg Self-Esteem Scale (SES), which comprises 10 items (e.g., “I feel that I am a person of worth, at least on an equal plane with others”). The adolescents were asked to directly report whether they believed these descriptions were in line with themselves. Each item was scored with a 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Responses were averaged across the 10 items, with a higher average score representing a greater level of self-esteem. The Chinese version of this scale has demonstrated satisfactory reliability and validity (Liu & Wang, 2017). The internal consistency coefficient for the present sample was $\alpha = 0.84$.

**Psychological resilience.** Adolescent psychological resilience was measured with the Chinese version of the Scale of Adolescent Resilience (Hu & Gan, 2008), which consists of 27 items (e.g., “I believe that adversities can stimulate or motivate people to make progress”). Adolescents were instructed to report whether these descriptions of the 27 items were in line with themselves on a 5-point scale, ranging from 1 (not at all) to 5 (exactly). Scores across the 27 items were averaged, with a higher average score representing a higher resilience level. Previous research has demonstrated that this scale is valid for assessing resilience in samples of Chinese adolescents (Tian et al., 2018). In the present study, the internal consistency coefficient for the sample was $\alpha = 0.83$.

**Interpersonal Adaptation.** Adolescent interpersonal adaptation was measured with the interpersonal adaptation subscale of the Chinese version Adolescent Social Adjustment Assessment Scale (ASAAS), which was compiled by Zhou et al. (2008) and revised by Yu (2009). This measurement tool comprises 12 items (e.g., “I often comfort and encourage my friends when they are sad or unhappy”), which have been verified to have good reliability and validity for assessing interpersonal adaptation in samples of adolescents (Wang et al., 2020). Adolescents were instructed to report whether the descriptions of the 12 items were in line with themselves. Their responses were scored on a scale of 1–5, ranging from 1 (not at all) to 5 (exactly). The final score was calculated by averaging the score of the 12 items; the higher the average score, the greater the level of interpersonal adaptation. The internal consistency coefficient for the present sample was $\alpha = 0.86$.

**Statistical Analysis**

The missing values were replaced by means. Since all the data in this study were collected using scales, Harman’s single factor test was used to prevent measurement
errors caused by common method bias before further statistical analysis. Descriptive
statistics, correlation analyses, and analyses of the mediating effect were calculated
using SPSS 25.0. Subsequently, the mediating effect of the test was calculated using
SPSS Process 3.5.

Results

We conducted the common variance analysis to measure whether common method
biases were present. The first common factor interpretation rate was 21.73%. This result
was less than the critical standard of 40% (Podsakoff et al., 2003), which indicated that
the measurement instruments had no problem with common method biases in this
study.

Descriptive statistics (means and standard deviations) and Pearson correlation
coefficients for physical activity, interpersonal adaptation, self-esteem, and psycho-
logical resilience are presented in Table 1. The correlation matrix showed that physical
activity was positively associated with interpersonal adaptation ($r = 0.22, p < 0.01$),
indicating that physical activity was a protective factor for interpersonal adaptation in
the sample of Chinese adolescents. Physical activity was positively related with self-
esteme ($r = 0.29, p < 0.01$) and psychological resilience ($r = 0.24, p < 0.01$). Moreover,
self-esteem was positively related with psychological resilience ($r = 0.47, p < 0.01$) and
interpersonal adaptation ($r = 0.46, p < 0.01$). Finally, there was a significant positive
correlation between interpersonal adaptation and psychological resilience ($r = 0.57, p < 0.01$).

Next, as two potential mediators, self-esteem and psychological resilience were
entered into a mediation model to examine whether they mediated the link between
physical activity and interpersonal adaptation in adolescents. Sex and age were taken as
the control variables, physical activity as the independent variable, interpersonal
adaptation as the dependent variable, and self-esteem and psychological resilience as
the mediating variables. All variables in the model entered the regression analysis after
standardized treatment. The regression analysis (Table 2) showed that the direct effect
of physical activity on interpersonal adaptation was not significant ($\beta = 0.037, p = 0.306$) in the serial mediation model; however, the total indirect effect of physical
activity on adolescent interpersonal adaptation ($\beta = 0.213, p < 0.001$) was significant.

| Variable                  | $M \pm SD$   | 1   | 2     | 3   | 4   |
|---------------------------|--------------|-----|-------|-----|-----|
| 1 Physical activity       | 29.61 ± 29.53| —   |       |     |     |
| 2 Self-esteem             | 2.96 ± 0.42  | 0.29**| —   |     |     |
| 3 Psychological resilience| 3.44 ± 0.43  | 0.24**| 0.47**| —  |     |
| 4 Interpersonal adaptation| 3.60 ± 0.60  | 0.22**| 0.46**| 0.57**| —  |

$N = 542$. **$p < 0.01$. 

Table 1. Descriptive Statistics and Correlation Matrix of All Variables.
Table 2. Hierarchical Regression Analyses with Interpersonal Adaptation as the Dependent Variable.

| Variable            | Interpersonal Adaptation |          | Self-Esteem  |          | Resilience |          | Interpersonal Adaptation |          |
|---------------------|--------------------------|----------|--------------|----------|------------|----------|--------------------------|----------|
|                     | $\beta$ | $SE$ | $t$ | $\beta$ | $SE$ | $t$ | $\beta$ | $SE$ | $t$ | $\beta$ | $SE$ | $t$ |
| Sex                 | 0.032 | 0.085 | 0.757 | -0.067 | 0.083 | -1.632 | 0.109 | 0.076 | 2.878*** | 0.013 | 0.07 | 0.374 |
| Age                 | -0.018 | 0.026 | -0.420 | -0.014 | 0.025 | -0.339 | -0.042 | 0.023 | -1.105 | 0.007 | 0.021 | 0.198 |
| Physical activity   | 0.21 | 0.042 | 5.045*** | 0.292 | 0.041 | 7.074*** | 0.11 | 0.039 | 2.803** | 0.037 | 0.036 | 1.024 |
| Self-esteem         | — | 0.438 | 0.039 | 11.121*** | 0.24 | 0.04 | 6.023*** | 0.444 | 0.039 | 11.249*** |
| Psychological resilience | — |  |  |  |  |  |  |  |  |  |
| $R^2$               | 0.048 | 0.09 | 0.243 | 0.369 | — | — | 8.992*** | 17.638*** | 43.094*** | 62.597*** |
| $F$                 | 8.992*** | 17.638*** | 43.094*** | 62.597*** |

$N = 542$. **$p < 0.01$, ***$p < 0.001$. Sex was dummy coded (boy = 1, girl = 2). All variables in the model were entered into the regression equation after standardized treatment.
Physical activity had a significant positive impact on self-esteem ($\beta = 0.292, p < 0.001$) and psychological resilience ($\beta = 0.11, p = 0.005$); self-esteem had a significant positive impact on psychological resilience ($\beta = 0.438, p < 0.001$) and interpersonal adaptation ($\beta = 0.24, p < 0.001$); and psychological resilience had a positive impact on interpersonal adaptation ($\beta = 0.444, p < 0.001$).

Following the method proposed by Hayes (2013), the mediation effect was tested using model six of the SPSS process 3.5 component. The results in Table 3 show that none of the 95% confidence intervals of the indirect path coefficients of physical activity on interpersonal adaptation contained 0. All indirect path coefficients of physical activity to interpersonal adaptation were significant. Specifically, physical activity not only affected interpersonal adaptation through self-esteem to psychological resilience but also through a single mediating effect of self-esteem/psychological resilience.

**Discussion**

The present research explored the association between physical activity and Chinese adolescents’ interpersonal adaption after the COVID-19 pandemic. We reasoned that physical activity should positively predict adolescents’ interpersonal adaption and that this effect may be mediated by self-esteem and resilience.

As expected, the results revealed that physical activity positively affects adolescents’ interpersonal adaptation. This result extends socialization theories (Schaefer et al., 2011), deepening our understanding by applying them to the association between physical activity and interpersonal adaptation. First, physical activity can serve as an approach to socialization. As is widely known, disease containment measures including

**Table 3. Test of the Mediation Effect Model.**

| Path | Standardized Path Coefficient | 95% Confidence Interval | Relative Mediating Effect, % |
|------|-------------------------------|-------------------------|-----------------------------|
| Total indirect effect | 0.176***<br>Mediation path | 1.258 0.235 | 82.63 |
| Physical activity → self-esteem → interpersonal adaptation | 0.07***<br> | 0.042 0.108 | 32.86 |
| Physical activity → psychological resilience → interpersonal adaptation | 0.049***<br> | 0.0146 0.083 | 23.00 |
| Physical activity → self-esteem → psychological resilience → interpersonal adaptation | 0.057***<br> | 0.035 0.081 | 26.76 |

$N = 542$. ***$p < 0.001$.  

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curfews, quarantines, and school closures were implemented by several countries during the COVID-19 outbreak period. Yet, every coin has two sides. Social distancing measures may successfully slow the spread of COVID-19 infections and relieve public health systems (Elmer et al., 2020). However, they have an impoverishing impact on the interaction and socialization among adolescents. The means to interact with each other are constantly changing for adolescents after the COVID-19 outbreak. In this situation, the benefit of physical activity stands out. Adolescents who participate in physical activity (e.g., playing basketball or football) must interact with others for motor skills or teamwork, even solving conflicts through sports. Physical activity can, thereby, be a social method (Li & Zizzi, 2018) through which adolescents interact with one another, promote self-adjustment, transform the interpersonal environment, enhance their capacity for communication, and build friendships.

Communication in physical activity can be an easy start that does not require contextual information and is more conducive to promoting interpersonal adaptation for adolescents than general social occasions. During such general social occasions, adolescents may feel confused and uncomfortable. For example, adolescents might need in-depth knowledge of a specific topic to understand and respond to others. As such, physical activity is a better way (they can choose the language or body language) for adolescents to express a feeling or interact with peers. Additionally, physical activity can reduce hostility and sensitivity in interpersonal interactions (Xiong et al., 2011). Adolescents who physically exercise frequently or occasionally are accepted by their peers, thus experiencing the benefits of interpersonal adaptation. Therefore, adolescent interpersonal adaptability actually benefits from engagement in physical activity. Conversely, the development and improvement of interpersonal adaptability may be negatively affected by the scant channels of interaction for physically inactive adolescents.

This study found that physical activity increased self-esteem, which was associated with the interpersonal adaptation of adolescents. In other words, adolescent self-esteem played a mediating role in the relationship between physical activity and interpersonal adaptation. Physical activity is a critical way of developing adolescent self-esteem. The body function of adolescents who liked to participate in physical activities improved (for example, their muscle strength increased) after COVID-19, and their physical self-perceptions improved accordingly. Self-esteem levels increase as the levels of the subdomains of self-esteem (e.g., physical self-perceptions) increase (Sonstroem, 1998). Additionally, the positive effect of physical activity on emotion and mental health also allowed adolescents to maintain a positive self-evaluation and further benefitted their interpersonal adaptation. Thus, as the highest payoff among the psychological benefits of physical activity (Li & Li, 2015), self-esteem is a vital protective factor for adolescents’ interpersonal adaptation. As far as we are aware, our study is the first in the literature to report such a result. Our finding supports the socialization theories (Schaefer et al., 2011), which posit that when social activities satisfy individuals’ basic psychological needs, their increased self-esteem level will motivate adaptability development. This finding is also in line with the sociometer theory (Leary & Baumeister,
which proposes that self-esteem is a subjective monitor of one’s relational evaluation; essentially, it is a sociometer that monitors the quality of interpersonal relationships and even motivates behaviors to promote acceptance. This means that adolescents with high self-esteem are predisposed to seek and maintain interpersonal relationships, which encourages behaviors to promote acceptance even when relational devaluation is not an immediate problem, thereby promoting interpersonal adaptation. The present study highlights the importance of physical activity to increase self-esteem and then increase interpersonal adaptation levels for adolescents after COVID-19.

Furthermore, consistent with previous studies (Hjemdal et al., 2006; Hu, 2019), this research showed that those who engaged in physical activity obtained higher values of psychological resilience. As another goal, we examined the mediating effect of psychological resilience in the relationship between the physical activity and interpersonal adaptation of adolescents. The results implied that adolescent interpersonal adaptation could be protected by psychological resilience, which was enhanced by physical activity after COVID-19. This finding supported the characteristics of the psychological flexibility of resilience (Waugh et al., 2011). Psychological resilience may be a significant quality for adolescents as it may help them adapt positively to interpersonal interaction and enhance their growth. This result also supports the challenge model of psychological resilience (Masten & Tellegen, 2012), which suggests that the appropriate risk level could accelerate the adolescents’ potential to overcome interpersonal stress, thus generally resulting in positive development outcomes.

An ever-changing interpersonal environment affected by the prevention and control of COVID-19 presents challenges and opportunities for adolescents to transcend themselves. Adolescents with high psychological resilience scores tend to have more positive emotions in stressful situations and more psychological flexibility in response to stressful interpersonal tasks. For this reason, psychological resilience helps adolescents adapt to the ever-changing environment, including the interpersonal atmosphere, especially the ever-changing ways of interacting and socializing with each other during the prevention and control period of COVID-19. The present study is the first to apply these theories in the context of positive psychological resources and interpersonal adaptability by demonstrating that those participating in physical activity frequently experience an increase in psychological resilience, which may give them a greater chance of developing interpersonal adaptation. This result further highlights the idea that psychological resilience is one of the explanatory mechanisms for why adolescents are more likely to develop interpersonal adaptability by participating in physical activities.

Interestingly, in the mediation analysis, the bootstrap result revealed a statistically significant indirect effect of physical activity on interpersonal adaptation through the serial mediating roles of self-esteem and psychological resilience. Physical activity has few side effects and is relatively cost-effective (Liu et al., 2015). Increased self-esteem through physical activity can enhance adolescent indomitable ability. This makes it less likely for adolescents to be affected by critical thoughts, negative beliefs, or relatively
minor experiences of rejection, helping to focus on current issues in interpersonal interaction, thereby contributing to higher levels of optimism and psychological resilience. The high psychological resilience levels further promote the development of interpersonal adaptability. This result is consistent with a previous study (Barton et al., 2012) that suggested that adolescents who participate in physical activity frequently report higher self-esteem levels and have more of other positive psychological resources, which provide support for psychological resilience.

Next, relying on the broaden-and-build theory of positive emotion (Fredrickson, 2004), positive psychological resources maintained by physical activity provide a protective effect for adolescents’ interpersonal adaptation after COVID-19. The impact of self-esteem on adolescent psychological resilience observed in the present results is similar to that found by previous research results (Bajaj, 2017; Martinez-Martinez & Ruch, 2016). Psychological resilience is one of the positive psychological variables, which benefits from self-esteem. This result also verified the framework of the TMT (Greenberg et al., 1986), which holds that self-esteem is a crucial protective factor of psychological resilience. As a protective factor, self-esteem has a positive effect on adolescent psychological resilience and is a great support system to promote the latter (Tian et al., 2018). In summary, physical activity may maintain higher self-esteem levels to protect psychological resilience against the impact of COVID-19 and then contribute to adolescent interpersonal adaptation.

**Limitations and Future Research**

This study explored the mechanism of the effect of physical activity on the interpersonal adaptation of adolescents. Although the study offers theoretical and practical implications, it has several limitations. First, the data were collected through adolescents’ unilateral reports and, thus, might be affected by participants’ response bias. In the future, data from teachers’ evaluations and parents’ observations of adolescents can be added for a more comprehensive assessment. Second, this study revealed the internal mechanism of the effect of physical activity on adolescents’ interpersonal adaptation from the perspective of positive psychology. Future research should, therefore, focus on whether there are other mediating roles in the association between physical activity and adolescents’ interpersonal adaptation, such as meta-emotion and interpersonal self-efficiency. Furthermore, researchers have emphasized that social and cultural contexts are also factors that should be considered (Martin et al., 2014) when discussing issues related to adolescents. Thus, future research on the factors influencing adolescents’ interpersonal adaptation can examine the role of their social and cultural contexts.

**Conclusion**

In the present study, we examined the mediating effects of self-esteem and psychological resilience on the association between physical activity and the interpersonal
adaptation of adolescents after COVID-19. The results revealed that physical activity significantly positively correlated with self-esteem, psychological resilience, and interpersonal adaptation. In the mediation analysis, the bootstrap result showed a statistically significant indirect effect of physical activity on interpersonal adaptation, through the serial mediating roles of self-esteem and psychological resilience. Physical activity may not affect adolescents’ interpersonal directly but may improve interpersonal adaptation levels indirectly through self-esteem and psychological resilience. In conclusion, this research provided evidence for the importance of physical activity in formulating self-esteem, psychological resilience, and interpersonal adaptation. It suggested that physical activity plays a vital role in developing and maintaining positive psychological resources for adolescent interpersonal adaptation after COVID-19.

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