

## COMMENTARY

# The dual crisis of depression and physical inactivity in Chinese adolescents: A call for integrated family–school–community collaborative interventions

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Adolescent mental health has become a pressing global concern, with depression rates rising rapidly in China. A comprehensive meta-analysis of 439 studies comprising 1,497,524 participants estimated the pooled point prevalence of depressive symptoms among Chinese children and adolescents at 26.17% (95% CI 25.00–27.41%).<sup>1</sup> These figures translate into millions of young people affected by elevated depressive symptom scores, yet many of those with elevated symptom scores may remain undiagnosed or untreated due to limited mental health resources, pervasive stigma, and low help-seeking rates.

Concurrently, a less recognized but equally concerning crisis is unfolding: physical inactivity among Chinese youth. A 2016–2017 national survey of 70,605 students aged 6–17 years found that the prevalence of insufficient physical activity in China was 84.3% (95% CI: 80.8–87.9%).<sup>2</sup> These two crises are intimately connected. Physical inactivity is hypothesized to contribute to neurobiological vulnerabilities that may predispose adolescents to depression, while depression itself may diminish motivation and energy for physical engagement, creating a potentially self-reinforcing cycle that is particularly difficult to break during adolescence. Physical inactivity should not be examined in isolation. The 24-hour movement behavior framework recognizes that physical activity, sedentary behavior, and sleep collectively influence adolescent health.<sup>3</sup>

A growing body of evidence supports exercise as a potentially beneficial intervention for adolescent depression. A meta-analysis of randomized controlled trials found that exercise intervention had a moderate and positive effect at post-intervention follow-up (SMD = −0.65, 95% CI: −1.03 to −0.27,  $p < 0.01$ ), although heterogeneity and certainty limitations should be acknowledged.<sup>4</sup> However, the social–psychological pathways through which exercise confers mental health benefits warrant closer attention.

Recent research has suggested that physical exercise alleviates adolescent depression by reinforcing parent–child bonds and improving peer connections based on cross-sectional mediation analyses.<sup>5</sup> Studies have also suggested the chain mediating roles of social support, self-esteem, social competence, and interpersonal relationships. These findings suggest that the social dimension of physical activity may be as critical as the physiological dimension in conferring mental health benefits.

Unlike whole-school approaches that treat physical activity as one component among many, our framework positions it as the central integrative mechanism linking family, school, and community. In China's highly competitive educational environment, promoting physical activity solely as an individual health behavior is insufficient. We propose a family-school-community collaborative framework. At the family level, parents should be encouraged to be active co-participants in youth sports, as family involvement is hypothesized to strengthen parent-child bonds and support adolescent mental health. At the school level, structured physical activity should be recognized as a platform for peer relationship building and stress relief, with peer-led interventions as one illustrative approach. At the community level, communities must provide safe, accessible, and affordable spaces for physical activity, particularly for disadvantaged adolescents. Community-based referral pathways, such as the "hospital-school-home-community" model, have been proposed as illustrative approaches. As an illustrative institutional example, a children's rehabilitation hospital in Jining has piloted a Sports Promotion Health Center that operationalizes this integrative approach. Its Partial Hospitalization Program (PHP) integrates psychological counseling, physical activity, and social skills training for adolescents with school refusal and related emotional difficulties, supporting their return to school and family

life. This example illustrates how the proposed framework can be operationalized at the institutional level, though systematic evaluation is needed. Implementation in China faces several barriers. In rural areas, nascent mental health infrastructure and shortages of trained professionals threaten feasibility. The exam-oriented education system prioritizes academic achievement over social-emotional learning, undermining implementation fidelity. In socioeconomically disadvantaged communities, parental migration limits family-level engagement. Addressing these barriers requires task-shifting approaches that train teachers as intervention deliverers, culturally adapted content, and sustained governmental investment.

Sustainability and equitable access require attention to training needs, cultural adaptation, and long-term maintenance. School staff need ongoing training and supervision to deliver physical activity interventions with fidelity. Programs should be adapted to local cultural norms—for example, incorporating traditional group activities that align with collectivistic values. Equitable access demands that interventions be designed for delivery in under-resourced settings, with simplified protocols and reduced reliance on digital tools where connectivity is limited. A conceptual framework for the proposed model is presented in Table 1, identifying stakeholders, intervention components, hypothesized mediators, expected outcomes, implementation settings, and evaluation indicators across

**Table 1. Conceptual framework of the integrated family-school-community collaborative model**

| Dimension               | Family level                                                                                                       | School level                                                                                                                                                 | Community level                                                                                                                               |
|-------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Key stakeholders        | Parents/guardians; grandparents (in migrant families); siblings                                                    | Teachers; physical education instructors; school counselors; peer leaders                                                                                    | Community health workers; sports organizations; primary care providers; local government                                                      |
| Intervention components | Family co-participation in youth sports; structured home-based physical activities; parent-child exercise routines | Structured physical activity sessions integrated into school day; peer-led exercise groups; environmental modifications (e.g., accessible sports facilities) | Accessible and affordable physical activity spaces; community-based referral pathways; integrated hospital, school, home, and community model |
| Hypothesized mediators  | Parent-child bonding; intergenerational communication; family cohesion                                             | Peer relationships; social support; sense of belonging; stress relief                                                                                        | Community connectedness; social networks; reduced stigma                                                                                      |
| Expected outcomes       | Improved parent-child relationship quality; increased adolescent physical activity at home                         | Enhanced peer relationships; reduced depressive symptoms; improved school engagement                                                                         | Increased physical activity participation; improved access to mental health support; reduced social isolation                                 |
| Implementation settings | Home environment; community sports facilities                                                                      | School campuses; gymnasiums; playgrounds                                                                                                                     | Community centers; sports clubs; primary care clinics                                                                                         |

(Cont'd...)

Table 1. (Continued)

| Dimension               | Family level                                                                                           | School level                                                                          | Community level                                                                                |
|-------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Evaluation indicators   | Parent–child relationship scale; adolescent-reported family cohesion; home physical activity frequency | Peer relationship quality; depressive symptom scores (e.g., PHQ-9); school attendance | Community participation rates; access to mental health services; social connectedness measures |
| Coordination mechanisms | Regular parent–teacher communication; shared activity calendars                                        | School–family liaison; peer leader training and supervision                           | Inter-agency referral protocols; shared data systems; joint training programs                  |

family, school, and community levels.

We acknowledge the predominance of cross-sectional designs and the need for more rigorous longitudinal and intervention studies. Future research should prioritize randomized controlled trials comparing exercise modalities, mechanistic studies testing mediating pathways, and implementation research evaluating family–school–community collaborative models.

Nonetheless, the converging evidence supports physical activity as a potentially strategic, potentially low-cost, non-pharmacological intervention that may serve as a supportive component of prevention and supportive care, rather than a substitute for professional assessment or established treatment. We call upon mental health professionals, educators, and policymakers in China to recognize physical activity not merely as a lifestyle recommendation but as a tangible intervention strategy, one that works in part by strengthening the social relationships that adolescents need most.

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Conflict of interest

The authors declare they have no competing interests.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

Not applicable.

Further disclosure

During the preparation of this work, the authors used DeepSeek (version V3) solely for language polishing and editing, including improvements in grammar, fluency, and readability. The tool was used under strict human guidance and control. AI was not involved in study design, data analysis or interpretation, or conclusion drawing. All AI-assisted content was manually reviewed and verified by the authors for accuracy and originality. The authors take full responsibility for the final content of the manuscript.

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