

# The Relationships between Physical Exercise and Social and Emotional Skills in Adolescents: A Machine Learning-Based Multidimensional Empirical Analysis

Jun Yan,<sup>1,2</sup> Tianci Lu<sup>1</sup>

1. Yangzhou University, Yangzhou 225127, China.
2. Jiangsu Research Center for Student Mental Health Intervention through Physical Exercise, Yangzhou 225127, China.

**Abstract:** Based on the data of 7,073 Chinese adolescents who participated in the OECD's Survey on Social and Emotional Skills 2019, the study seeks to analyze the relationships between physical exercise and individual domains of social and emotional skills in teenagers, as well as the factors influencing the relationships, using the Gradient Boosting Machine algorithm and the SHAP framework. Significant findings include that physical exercise could substantially enhance the adolescents' social and emotional skills across all domains, with comparatively stronger effects on emotion regulation and engaging with others; that strengthening physical exercise is of particularly vital significance for socioeconomically disadvantaged adolescents; and that the positive effects of physical exercise on social and emotional skills increased with age in the teenagers; and that gender was an insignificant factor in the relationships between physical exercise and social and emotional skills.

*Best Evidence in Chinese Education* 2026; 22(1):2055-2059

DOI: 10.15354/bece.26.ar005

---

*How to Cite:* Yan, J., & Lu, T. (2026). The relationships between physical exercise and social and emotional skills in adolescents: A machine learning-based multidimensional empirical analysis. *Best Evidence in Chinese Education*, 2026, 22(1):2055-2059.

---

**Keywords:** Physical Exercise, Social and Emotional Skills, Adolescents, Machine Learning, LightGBM Algorithms

---

**About the Author:** Jun Yan, College of Physical Education, Yangzhou University, Yangzhou 225127, China. E-mail: [yanjun@yzu.edu.cn](mailto:yanjun@yzu.edu.cn)

Tianci Lu, Jiangsu Research Center for Student Mental Health Intervention through Physical Exercise, Yangzhou 225127, China.

**Correspondence to:** Jun Yan at Yangzhou University in China.

**Conflict of Interests:** None

**Funding:** No funding sources declared.

**AI Declaration:** The author affirms that artificial intelligence did not contribute to the process of preparing the work.

---

© 2026 Insights Publisher. All rights reserved.



Creative Commons NonCommercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (<http://www.creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed by the Insights Publisher.

## **Introduction**

**P**REVIOUS RESEARCH have revealed that physical exercise can enhance adolescents' social and emotional skills, such as confident articulation, self-regulation, cooperation, staying optimistic, and maintaining self-respect. According to Social Interaction theory, physical exercise, especially team-based physical activity, provides individuals with ideal opportunities to interact with others. Through this interactive process, they learn to handle interpersonal relationships, resolve conflicts, and behave as supportive and empathetic partners. Also, physical exercise contributes to spiritual growth, including moral cultivation and character building, making it a valuable vehicle for fostering social and emotional skills. Based on relevant literature review, this study proposes the following research hypotheses:

H1: Physical exercise is effective in enhancing adolescents' social and emotional skills, with more significant promotive effects on their skills in emotional regulation and social interaction due to its distinctive social attributes.

H2: The interactions between demographic variables, such as gender, age, and family socioeconomic status (SES), and physical exercise have varying effects on adolescents' social and emotional development.

## **Research Aim and Methodology**

The study focuses on how physical exercise affects social and emotional development in adolescents. It aims to analyze the significance of physical exercise for individual domains of social and emotional skills, as well as how demographic factors, such as gender, age, and family SES, interact with physical exercise to pose effects on the development of these skills.

It sources data from the OECD's Survey on Social and Emotional Skills (SSES) 2019. The original datasets were screened to draw only data of Chinese adolescents. Participants with missing values regarding the established variables were excluded, resulting in a final sample of 7,073 Chinese adolescents aged 10 to 16.

Physical Exercise, Gender, Age, and Family SES are the feature variables in the study. Physical Exercise is measured with the item "STQM03611" from the questionnaire, with response options as follows: 1 = No time, 2 = 1–60 minutes per day, 3 = 1–4 hours per day, 4 = More than 4 hours per day. Gender is recoded as: 0 = Male, 1 = Female. Age is calculated as "2019 – the year of birth." Family SES is scored based on the composite index accounting for parental education, parental occupation, and family assets, with higher values indicating higher SES. The five domains of social and emotional skills, namely, Open-mindedness, Task Performance, Engaging with Others, Collaboration, and Emotional Regulation, are the target var-

ables. Every domain comprises three skills, and each skill is measured by scores from eight question items. The OECD’s questionnaire adopts a Likert 5-point scale.

Data cleaning was performed using SPSS 29.0 to filter out participants with values required for research variables missing, and variables impacted were recoded. With the adoption of Python 3.8.18, Jupyter Notebook was employed to split the data into training (80%) and test (20%) sets using the `train_test_split` method, while setting the random seed as `random_state=42`. This division allows the model to be tested on fresh data, thereby providing an objective evaluation of its generalizability. The Light Gradient Boosting Machine (hereinafter referred to as LightGBM) algorithm was used for machine learning modeling. During the model training process, GridSearchCV was used for 5-fold cross-validation hyperparameter optimization to identify the optimal hyperparameter combination for the model. The `MultiOutputRegressor` wrapper was applied to encapsulate GridSearchCV, extending a single regression model to a multi-output regression task to simultaneously predict multiple target variables. Finally, the feature importance ranking and predictive powers of independent variables for various domains of social and emotional skills were analyzed using the SHAP framework.

## **Research Findings**

The results reveal that physical exercise plays a significant role in fostering adolescents’ social and emotional skills across all domains. The model predicts the strongest effect of physical exercise on Emotional Regulation, followed by Engaging with Others, Open-mindedness, Task Performance, and Collaboration. Scientific physical exercise not only directly improves physical health but also bolsters emotional states of adolescents. Teenagers who engage in higher levels of physical exercise typically demonstrates stronger interpersonal competences. Physical exercise is effective in increasing adolescents’ curiosity, tolerance, and creativity, the three basic skills in the domain of open-mindedness. It also fosters the development of responsibility, self-control, and perseverance within the domain of task performance while simultaneously enhancing empathy, trust, and cooperation, which belong to the domain of collaboration, in adolescents.

The interactions of Age, Family SES, and Gender with physical exercise affect adolescents’ social and emotional skills to varying degrees. The interaction between Age and physical exercise is positively related to social and emotional development in adolescents, particularly among older adolescents with higher levels of physical activity. The effect of the interaction between Family SES and physical exercise is also significant. Even among teenagers with low family SES, physical exercise can still partially play the

compensatory role for deficits in social and emotional skills. This finding is of particular significance for socioeconomically disadvantaged adolescents. The interaction between Gender and physical exercise has a minimal effect on adolescents' social and emotional skills, indicating that physical exercise offers relatively equal opportunities for social and emotional development in both male and female adolescents.

---

*The Chinese version of this article has been published in Sports and Science, 2025; 46(03): 88-99. The English version has been authorized for being publication in BECE by the author(s) and the Chinese journal.*

*颜军 & 陆天赐. (2025). 体育锻炼何以影响青少年社会情感能力——基于机器学习的多维实证分析. 体育与科学, 46 (03): 88-99.*

*Received: November 14, 2025*

*Revised: December 29, 2025*

*Accepted: January 05, 2026*