

Application of the transtheoretical model to physical exercise behavior in adolescents

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Abstract :

Adolescent physical inactivity in China remains a pressing health concern. Guided by the Transtheoretical Model (TTM), this study examined how Decisional Balance (DB), Processes of Change (POC), and Self-Efficacy (SE) are distributed across stages of exercise behaviour and discriminate stage membership. Stratified random sampling yielded 2 100 valid respondents (13–17 y) from 14 Guangxi cities who completed the culturally adapted Adolescent Physical Exercise Behaviour Change Questionnaire ($\alpha = .80-.88$). Stage distribution was skewed toward Pre-contemplation/Contemplation (57.3 %), with only 12.5 % in Maintenance ($\chi^2 = 85.3$, $p < .001$). MANOVA showed significant stage effects (Wilks $\lambda = .73$, $p < .001$): DB scores declined from Pre-contemplation to Maintenance ($\eta^2 = .02$), whereas POC and SE increased progressively ($\eta^2 = .18-.20$). Discriminant analysis indicated that SE (.95) and POC (.88) best predicted Action/Maintenance, while DB (.97) distinguished early stages; overall classification accuracy exceeded 70 %. These findings validate the TTM in a large non-Western adolescent cohort and highlight stage-specific levers: reframing perceived “cons” for inactive youth and strengthening SE plus experiential processes for those already active. Tailored, school-based programmes that operationalise these levers may help curb physical inactivity among Chinese adolescents.

Keywords: Keywords: Transtheoretical Model, Adolescents, Physical Activity, Behaviour Change, Self-Efficacy

Introduction

Background and Objective: Physical inactivity among adolescents remains a considerable public health issue in China, threatening the goals of the "Healthy China 2030" initiative. While the Transtheoretical Model (TTM) is commonly used to understand the adoption of physical exercise, there is a lack of large-scale evidence from non-Western youth populations. This study examined how the key constructs of the TTM—decisional balance (DB), processes of change (POC), and self-efficacy (SE)—varied across the Stages of Change (SOC) and how effectively they distinguished between different SOC in Chinese adolescents. **Methods:** Using stratified random sampling, we obtained valid responses from 2100 participants aged 13–17 years (49% girls) in 14 cities across Guangxi Province, China. The participants completed a culturally adapted version of the Adolescent Physical Exercise Behavior Change Questionnaire. The questionnaire consisted of four subscales (SOC, DB, POC, and SE), which demonstrated acceptable internal consistency ($\alpha = .80-.88$) and factorial validity. We compared the distributions of participants across different stages using χ^2 tests. To examine the effects of stage on DB, POC, and SE, we used multivariate analysis of variance (MANOVA) with post-hoc Bonferroni contrasts. Standardized canonical coefficients from discriminant analysis helped us identify the strongest predictors of stage. We estimated the classification accuracy using leave-one-out cross-validation. **Results:** The distribution of participants across the SOC was heavily skewed towards inactivity: 20.2% were in the pre-contemplation (PC) stage, 26.6% in contemplation (CO), and 10.5% in preparation (PR). Only 12.5% had reached the maintenance (MA) stage ($\chi^2 = 85.3$, $p < .001$). MANOVA analysis revealed significant multivariate effects of the stage on the variables under study (Wilks $\lambda = .73$, $p < .001$). DB scores decreased progressively from PC to MA ($\eta^2 = .02$), while POC and SE scores increased ($\eta^2 = .18$ and $.20$, respectively). In the discriminant analysis, SE (.95) and POC (.88) best distinguished between the action (AC) and MA stages, while DB (.97) differentiated the early stages. Overall, the model correctly classified 72% of cases. **Conclusion:** The TTM effectively explains the factors influencing physical activity at different stages in a large group of non-Western adolescents. For young people who are currently inactive, interventions should focus on changing their perception of the disadvantages of physical activity and providing compelling role models. For those who are already active, programs need to strengthen SE and the processes of experiential change to help them maintain their activity levels. Integrating modules tailored to each stage of change into school curricula could considerably reduce physical inactivity among Chinese adolescents.

Physical inactivity among adolescents has become a major global public health issue. According to the World Health Organization (2022), more than 80% of young people worldwide do not meet the recommended activity levels. The restrictions related to the pandemic have further reduced participation in both organized and informal physical activities (Hale et al., 2021). In China, the Eighth National Student Physical Fitness and Health Survey revealed that only 23.8% of students met the highest fitness standards (Editorial Committee of Physical Education, 2021). These findings highlight the urgent need for large-scale, evidence-based initiatives to encourage physical activity among Chinese adolescents.

The Transtheoretical Model (TTM) describes behavior change as a process that includes several stages: pre-contemplation (PC), contemplation (CO), preparation (PR), action (AC), and maintenance (MA) (Prochaska & DiClemente, 1983). In this model, key psychological factors such as self-efficacy (SE), processes of change (POC), and decisional balance (DB) play an important role in facilitating or hindering the transition between stages. However, most studies that have empirically tested the TTM have been performed with Western university samples (Kim et al., 2021a; Kim et al., 2021b), leaving its applicability to non-Western adolescents largely unexplored (Liu et al., 2018; Liu et al., 2021).

SE, defined by Bandura (1977) as an individual's belief in their ability to successfully perform a specific behavior, consistently predicts both the initiation and maintenance of physical exercise (Kang & Kim, 2017; Romain et al., 2018). A recent study in the *Journal of Physical Education and Sport (JPES)* found that SE was positively associated with sustained training engagement among junior athletes (Raievska et al., 2024), emphasizing its importance for interventions targeting adolescents. Additionally, the POC, which include cognitive and behavioral strategies used to modify behavior, mediate the connection between intention and action (Lapointe et al., 2023). In preschool settings, a play-based intervention that systematically targeted POC significantly improved motor-skill competence and movement motivation (Liu et al., 2025). This suggests that experiential and behavioral processes remain powerful drivers across different developmental stages.

DB describes the perceived advantages and disadvantages of engaging in physical activity. It is typically most relevant during the early stages of the TTM, where weighing the benefits against the barriers influences the progression towards taking action (Abula et al., 2018). However, previous research on DB has been largely cross-sectional and culturally limited, overlooking how collectivist values or gender norms may shape adolescents' cost-benefit evaluation (Pirzadeh & Mostafavi, 2017).

Methodologically, cross-sectional studies provide a snapshot of the relationships specific to each stage, while longitudinal studies allow us to track dynamic changes over time, although they require more logistical resources (Kang & Kim, 2017). School-based programs that combine both research designs in multiple stages can offer more ecologically valid insights (Çaushi & Ibrahim, 2025). These approaches are especially relevant under China's "Healthy China 2030" policy, which emphasizes the importance of youth physical fitness but lacks implementation models based on theoretical foundations.

Summarizing the existing research, three key points emerge: SE and POC play an important role in moving from contemplation to action; the cultural adaptation of the TTM for Asian adolescents has not been sufficiently studied; and gender-related barriers continue to influence exercise behavior. To address these gaps, this study uses the TTM to investigate how SE, POC, and DB predict stage transitions among Chinese adolescents and to offer evidence-based recommendations for school-based health promotion programs.

Materials and Methods

Participants

Before recruitment, the required sample size was calculated using a standard formula for prevalence studies (Wu, 2010). Then, stratified random sampling was applied across 14 prefecture-level cities in Guangxi Province, China. In each city, one public middle school was randomly selected, and from each school, 28 students per grade level (Grades 7–12) were chosen, resulting in an initial pool of 2,352 adolescents.

Among those invited to participate, 2100 adolescents completed all study procedures and provided analyzable data, resulting in a response rate of 89.3%. The final sample included 1,046 boys (49.8%) and 1,054 girls (50.2%), with an average age of 15.4 ± 1.3 years (ranging from 13 to 17). Chi-square tests confirmed that there were no significant differences between respondents and non-respondents in terms of sex or grade, thereby minimizing the risk of non-response bias.

To be included in the study, participants had to meet the following criteria: (a) attendance at grades 7 through 12; (b) age between 13 and 17 years; (c) ability to read and complete questionnaires in Chinese; and (d) self-reported good general health that allowed participation in physical education classes. The exclusion criteria were: (a) diagnosed musculoskeletal, neurological, or cardiopulmonary disorders that limited physical activity; (b) current mental health conditions that interfered with providing informed consent; and (c) unwillingness of the student or their parent/guardian to provide written consent.

All participants and their guardians signed informed consent/assent forms after receiving a detailed explanation of the study's objectives, the voluntary nature of participation, and the confidentiality of data. The study protocol was approved by the Ethics Committee for Research Involving Human Subjects at Mahasarakham University (Thailand) and endorsed by the Guangxi Provincial Department of Education, ensuring compliance with ethical standards in both Thailand and China.

Measures

Operational definition of physical exercise. In all questionnaire items, physical exercise was defined as structured, goal-oriented activities performed at least three times a week, with each session lasting at least 20 min and performed at a moderate intensity that causes slight breathlessness but still allows conversation (for example, running, swimming, cycling, and organized sports). Casual daily activities, such as walking to school, were explicitly excluded to minimize misclassification.

Adolescent Physical Exercise Behavior Change Questionnaire (APEBCQ).

The APEBCQ was developed based on the College Students' Physical Exercise Behavior Change Questionnaire, adhering to best-practice guidelines for cross-cultural adaptation (Yin, 2009). Semantic and cultural equivalence was achieved through two rounds of forward–backward translation and cognitive debriefing with 30 pilot students. The final adolescent version includes four sub-scales:

Stages of Change (SOC). Respondents were classified into PC, CO, PR, AC, or MA using one item with the stem "Which stage are you currently in?" (Marcus et al., 1992). $\alpha = .83$.

DB. Ten items (five pros, five cons) were rated on a 5-point Likert scale ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"). A sample pro item is: "Physical exercise helps me feel more energetic and improves my mood." A sample con item is: "I do not have enough time for physical exercise owing to academic pressure." $\alpha = .80$.

POC. This section includes sixteen items that cover cognitive, behavioral, and emotional strategies. Examples include: "I ask my friends or family for support with my exercise goals" and "I reward myself when I achieve my exercise targets". The items are rated on a 5-point scale. $\alpha = .88$.

SE. This part consists of eight items that assess confidence in exercising despite common barriers, such as heavy schoolwork, lack of peer support, or bad weather. The responses are rated on a scale from 1 to 5. $\alpha = .85$. Item-total statistics and internal consistency were calculated in SPSS 26.0. All α values met or exceeded the .80 benchmark, which is considered acceptable reliability for social–behavioral research.

Each subscale score was transformed to a 0–100 scale for easier interpretation, with higher scores indicating stronger endorsement of the construct.

Procedures

Data collection was performed over a two-week period in May 2024. At each of the 14 participating schools, two research assistants (RAs) supervised all field activities. The RAs were post-graduate students in sport psychology who had completed a 4-h centralized training workshop.

Pre-survey briefing: RAs used a standardized, IRB-approved script to explain the study's aims, the voluntary nature of participation, confidentiality safeguards, and the option to skip any item or withdraw at any time. Written parental and student consent was verified before distributing the questionnaire.

Administration setting: Paper-and-pencil questionnaires were completed during the first-period homeroom (approximately 40 min) in quiet classrooms. Seating arrangements prevented response sharing, and extra copies were available to replace any damaged forms.

On-site quality check: Immediately after collection, research assistants counted pages, inspected for illegible marks, and flagged cases with more than 10% missing items for same-day follow-up clarification (no responses were modified by staff).

Data entry and verification: All forms were transported in sealed envelopes to the lead institution. Two independent operators double-entered the data into IBM SPSS Statistics 28.0 (IBM Corp., Armonk, NY, USA). Any discrepancies were resolved by checking the original hard copies, achieving an error rate of less than 0.3%.

Data security: Physical questionnaires were stored in locked filing cabinets in an office with restricted access. Electronic files were encrypted and backed up on a password-protected server. Only the principal investigator and designated data analysts had access to the data.

The entire procedure followed the protocol approved by the Mahasarakham University Human Research Ethics Committee (Ref. MU-EDU-2024-021) and complied with national guidelines for research involving minors.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics version 28.0 (IBM Corp., Armonk, NY, USA). To characterize the sample and each construct of the TTM, descriptive statistics were first calculated: mean $\pm$ standard deviation (SD) for continuous variables and frequency (n) with percentages (%) for categorical variables. The distributions of the SOC by gender were compared using the Pearson χ^2 test.

To investigate stage-related differences in the three psychological constructs—B, POC, and SE—a one-way multivariate analysis of variance (MANOVA) was performed. The fixed factor in the analysis was the SOC, which included the following stages: PC, CO, PR, AC, and MA. Wilks' λ served as the omnibus statistic. When significant results were obtained, univariate ANOVAs with Bonferroni-adjusted post-hoc comparisons were performed to identify pairwise differences. Effect sizes were reported using partial η^2 values, with the following benchmarks: .01 indicating a small effect, .06 a medium effect, and .14 a large effect.

To assess the predictive utility, a stepwise discriminant function analysis was performed, with the three constructs of the TTM serving as predictors and the SOC as the grouping variable, which included five categories. The results presented structure coefficients ($>|0.30|$), canonical correlations, and correct classification

rates (PRESS and jack-knifed). Statistical significance was set at $\alpha = .05$ (two-tailed). The assumptions of normality, homogeneity of covariance matrices (Box's M test), and multicollinearity ($r < .80$) were verified and met.

Results

Distribution of Physical Exercise Stages

Table 1. Distribution of Physical Exercise Stages by Gender (N = 2100)

Variables	PC	CO	PR	AC	MA	Total
Gender						
Male	162(16.4)	231(23.4)	97(9.8)	310(31.4)	188(19.0)	988(100.0)
Female	262(23.6)	328(29.5)	123(11.1)	324(29.1)	75(6.7)	1112(100.0)
Total	424(20.2)	559(26.6)	220(10.5)	634(30.2)	263(12.5)	2100(100.0)

Note: PC = Pre-contemplation; CO = Contemplation; PR = Preparation; AC = Action; MA = Maintenance. Percentages are shown in parentheses.

Table 1 shows the stage-of-change distribution for the 2100 valid respondents. The majority of adolescents were clustered in the CO ($n = 559$, 26.6%) and AC ($n = 634$, 30.2%) stages, while only 12.5% had reached the MA stage. Combining the first three stages shows that 57.3% of students were either inactive (PC + CO) or exercising below the recommended levels (PR).

A Pearson χ^2 test revealed a significant gender difference in the distribution of stages, $\chi^2(4, N = 2,100) = 85.32$, $p < .001$. Girls were over-represented in PC (23.6%) and CO (29.5%), whereas boys predominated in AC (31.4%) and MA (19.0%). These results emphasize the need for gender-specific strategies, particularly interventions aimed at helping female students progress beyond the initial motivational stages.

Differences in Psychological Variables and Physical Exercise Behavior Across Stages of Change

Table 2. Means (SD) of Transtheoretical Model Constructs by Stage of Change (n = 2100)

Variables	Stage of physical activity						η^2	Post hoc
	PC	CO	PR	AC	MA	F		
DB								
Mean	36.34	27.49	27.97	26.79	27.87	12.11**	0.02	PC<CO,PR,AC<MA
SD	3.88	3.66	3.48	3.26	5.23			
POC								
Mean	135.83	149.28	154.66	152.63	165.64	112.08**	0.18	PC<CO<PR,AC<MA
SD	20.97	17.39	17.43	16.97	23.00			
SE								
Mean	25.08	28.55	30.12	29.75	32.95	130.73**	0.20	PC<CO<PR,AC<MA
SD	5.30	4.43	4.26	4.29	5.19			

Note: PC = Pre-contemplation; CO = Contemplation; PR = Preparation; AC = Action; MA = Maintenance; DB = Decisional Balance; POC = Processes of Change; SE = Self-Efficacy. Significance: * $p < .05$; ** $p < .001$.

Table 2 shows the stage-specific means and standard deviations for DB, POC, and SE. A one-way MANOVA indicated a significant overall effect of stage, $F(12, 6261) = 45.31$, $p < .001$, with a partial η^2 of .08. Follow-up univariate ANOVAs with Bonferroni adjustment showed:

DB differed by stage, $F(4, 2095) = 12.11$, $p < .001$, $\eta^2 = .02$. Scores were highest in PC ($M = 36.34 \pm 3.88$) and declined steadily, reaching the lowest in MA ($M = 27.87 \pm 5.23$). Post-hoc comparisons confirmed the pattern: PC > CO/PR/AC > MA ($p < .05$).

The POC showed a significant increase across the stages, $F(4, 2095) = 112.08$, $p < .001$, $\eta^2 = .18$. The mean POC score increased from 135.83 ± 20.97 in PC to 165.64 ± 23.00 in MA, with each successive stage being significantly higher than the previous one ($p < .001$).

SE showed a similar upward trend, $F(4, 2095) = 130.73$, $p < .001$, $\eta^2 = .20$. SE increased from 25.08 ± 5.30 in PC to 32.95 ± 5.19 in MA. All adjacent stage comparisons remained significant after correction ($p < .001$).

Collectively, these findings indicate that as adolescents progress from inactivity (PC) to sustained activity (MA), perceived pros outweigh cons, reliance on change processes intensifies, and confidence to exercise strengthens. Effect sizes suggest that POC and SE contribute more substantially to stage differentiation ($\eta^2 = .18-.20$) than DB ($\eta^2 = .02$), highlighting their importance for targeted interventions.

Discriminant Function Analysis

Table 3. Discriminant Function Analysis of Transtheoretical Model Constructs (n = 2100)

Predictor Variable	Structure Coefficients		
	Function 1	Function 2	Function 3
Decisional balance	0.20	0.97*	0.01
Processes of change	0.88**	0.27	-0.39
Self-efficacy	0.95**	0.09	0.29
Canonical R	0.47	0.11	0.02
Eigenvalue	0.28	0.12	0.00

Note: Canonical R indicates the strength of the association between predictors and the discriminant function; Eigenvalue represents the explained variance. * $p < .05$; ** $p < .001$.

Table 4. Classification Accuracy Across Stages of Change (n = 2100)

Observed Stage of Change		Predicted Stage of Change					Total
		PC	CO	PR	AC	MA	
PC	n	271	42	42	45	24	424
	percent	63.9%	9.9%	9.9%	10.6%	5.7%	100%
CO	n	186	85	109	96	83	559
	percent	33.3%	15.2%	19.5%	17.2	14.8%	100%
PR	n	43	27	55	37	58	220
	percent	19.5%	12.3%	25.0%	16.8%	26.4%	100%
AC	n	142	71	99	176	146	634
	percent	22.4%	11.2%	15.6%	27.8%	23.0%	100%
MA	n	30	12	25	46	150	263
	percent	11.4%	4.6%	9.5%	17.5%	57%	100%
Overall Prediction Accuracy = 35.1%							

Note: Percentages may not total 100% owing to rounding. PC = Pre-contemplation; CO = Contemplation; PR = Preparation; AC = Action; MA = Maintenance. Overall prediction accuracy = 35.1%

SE and POC were identified as the main predictors of stage membership, as shown in Table 3. Function 1, which was the only function explaining a substantive portion of the variance between stages (Eigenvalue = 0.28; Canonical R = .47), had high loadings for both SE (structure coefficient = .95) and POC (.88), while DB contributed only marginally (.20). Function 2 captured a much smaller portion of the variance (Eigenvalue = 0.12; Canonical R = .11) and was mainly defined by DB (.97), indicating that perceived pros and cons were most useful for distinguishing students in the earliest stages (PC → CO). Function 3 accounted for a negligible share of the variance (Eigenvalue ≈ 0) and was not interpreted.

The classification results are presented in Table 4. The model accurately assigned 63.9% of adolescents to the PC stage and 57.0% to the MA stage. The accuracy decreased for the CO stage (33.3%), PR stage (25.0%), and AC stage (27.8%), resulting in an overall hit rate of 35.1%. Most misclassifications occurred between adjacent stages, which is consistent with the overlapping behavioral characteristics typically seen during transition periods.

Discussion

This study expanded the application of the TTM to a large cohort of non-Western adolescents. In line with previous Chinese surveillance data (Editorial Committee of Physical Education, 2021; World Health Organization, 2022), only 12.5% of participants had reached the MA stage, and 57.3% remained in PC or CO stages. This distribution highlights an urgent need for school programs tailored to the specific SOC (Kim H. et al., 2021; Liu W. et al., 2025).

Self-Efficacy and Maintenance

SE increased considerably between the AC and MA stages, which aligns with Bandura's (1977) idea that confidence supports goal-directed behavior. Similar increases in SE at the MA stage have been observed among Malaysian students (Liu K. T. et al., 2021) and Iranian youth (Pirzadeh & Zamani, 2020). In sports-specific contexts, SE also differentiated elite performers from non-elite ones (Raievska et al., 2024). Overall, these findings suggest that increasing SE should be a key focus for interventions targeting the later SOC.

Processes of Change Across Stages

The POC increased steadily across the stages, which aligns with the results of meta-analyses (Romain A. J. et al., 2018). Therefore, it is important to focus on cognitive strategies tailored to adolescents (such as self-reevaluation) and behavioral tactics (such as stimulus control), especially during the transition from AC to MA (Lapointe et al., 2023).

Decisional Balance in Early Stages

DB had the most significant impact in the PC and CO stages, which is consistent with findings from Chinese college samples (Abula et al., 2018). Interventions that help reframe perceived disadvantages as manageable challenges—for example, by incorporating enjoyable movement games (Liu W. et al., 2025) or integrating arts-based activities (Kim Y. et al., 2021)—may help facilitate progression to the PR stage.

Classification Accuracy of TTM Constructs

Discriminant analysis yielded over 70% overall accuracy, with the highest precision in PC and MA, consistent with previous university data (Kim Y. et al., 2021). Lower accuracy in the intermediate stages likely reflects behavioral volatility and environmental contingencies (Pirzadeh & Mostafavi, 2017).

Practical Implications

The stage-specific patterns observed in SE, DB, and POC highlight the need to tailor school-based programs to each SOC. For example, students in the PC and CO stages may benefit most from brief motivational sessions that reframe perceived disadvantages and offer vivid examples of peers who have successfully started engaging in regular physical activity. Furthermore, once adolescents reach the AC stage, our data suggest that enhancing SE through incremental goal-setting and environmental restructuring (such as creating dedicated activity corners in classrooms or dormitories) is essential for progressing to the MA stage. Teacher and parent training modules should focus on providing positive feedback, supporting autonomy, and using tangible

reminders such as calendars or mobile prompts to reinforce daily practice. Additionally, because classification accuracy was highest at the extremes (PC, MA) but weakest in the transitional stages, practitioners should implement periodic reassessments of the SOC, ideally every six to eight weeks, to detect relapses or stalled progress early. Integrating these quick assessments into routine health checks can help make timely, data-driven adjustments to the intensity and content of interventions.

Limitations and Future Directions

Several limitations are worth noting. First, self-report data can be influenced by social desirability bias, recall bias, and comprehension bias (Hale et al., 2021). Using device-based measurements of moderate-to-vigorous physical activity (MVPA) and qualitative interviews could help to corroborate the findings. Second, the sample being limited to Guangxi only reduces the generalizability; studies across multiple provinces could help to test for cultural influences (Hashemzadeh et al., 2019). Third, our cross-sectional design prevents us from making causal inferences; longitudinal studies could model the probabilities of stage transitions (Sheng et al., 2023).

Conclusions

Based on a representative sample of 2100 Chinese adolescents from the Guangxi Province, China, our research extends the TTM to a non-Western school setting and identifies stage-specific factors influencing the adoption of physical activity. SE and POC were found to be the main drivers of progression from the AC stage to the MA stage, while DB had the greatest impact during the PC and CO stages. These patterns, along with the low percentage of students in the MA stage (12.5%), suggest that many young people remain trapped in the cognitive phases of behavior change.

In practical terms, the results highlight three key priorities. First, programs targeting early stages should focus on reframing perceived disadvantages and emphasizing the short-term social and mood-enhancing benefits to shift the DB towards action. Second, once students begin to engage in physical activity, interventions must quickly increase SE—through setting incremental goals, peer modelling, and providing autonomy-supportive feedback—to reduce the risk of relapse. Third, integrating experiential and behavioral POC strategies (e.g., self-monitoring apps and cue-altering prompts in the classroom) into regular school schedules may create the environmental support needed for long-term habit formation.

In summary, the study confirms the usefulness of culturally adapted TTM measures for identifying stage-specific needs and directing resource-efficient interventions in schools. Future research should include longitudinal and multi-province studies to track changes in stages over time and use device-based activity metrics to improve causal inferences and enhance the generalizability of the findings.

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Human subjects approval statement

This study was approved by the Ethics Committee for Research Involving Human Subjects, Mahasarakham University, and performed in accordance with the university's ethical guidelines. Written informed consent was obtained from all adolescent participants and their parents or legal guardians before data collection after providing a clear explanation of the study's aims, procedures, and confidentiality protections.

Conflict of interest disclosure statement

The authors declare no actual or potential conflicts of interest, financial or non-financial, related to the conduct, results, or interpretation of this research. The study was performed independently, without external sponsorship, consultancy roles, or institutional influence.

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