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The e□ects of mobile phone addiction on learning engagement of Chinese college students - the mediating role of phy2175gica

of physical activity and academic self-e cacy in this relationship.

Methods This study was conducted from March to June 2024, using the Mobile Phone Addiction Scale, Learning Engagement Scale, Physical Activity Scale, and Academic Self-E□cacy Scale among college students from eight universities in Shaanxi Province. The survey was conducted using the Chinese online questionnaire platform "Questionnaire Star,"and 4,562 valid questionnaires were □nally obtained. SPSS 29.0 and AMOS 29.0 were used for data analysis and structural equation model testing.

Results The results revealed signi□cant negative correlations between mobile phone addiction and learning engagement (r = -0.434, $p < 0.01$), physical activity (r = -0.732, $p < 0.01$), and academic self-e□cacy (r = -0.338, $p < 0.01$). Conversely, there were signi□cant positive correlations between learning engagement and physical activity ($r = 0.335$, $p < 0.01$), and academic self-e□cacy ($r = 0.717$, $p < 0.01$). The study's hypothesized model demonstrated a good overall □t, with indices including $\chi^2/df = 4.213$, RMSEA = 0.040, and GFI, AGFI, NFI, and CFI all exceeding 0.90. Mobile phone addiction was found to directly impact learning engagement (point estimate = -0.150, $p < 0.001$) and indirectly

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valid data points were retained based on the screening principles of “reverse question test,” “regularity,” and “too short a period to ll out the questionnaire.” Finally, 4,562 valid data points were retained as the sample of this study, including the e ective recovery rate of the data

integrates the correlation between the items within the questionnaire, and AVE re ects the questionnaire's convergent validity. According to the meticulous testing of these critical indicators, all variables exhibited Cronbach's alpha coe cients exceeding 0.8, CR values surpassing 0.7, and AVE values above 0.5, surpassing the recommended thresholds of 0.7, 0.7, and 0.5, respectively. Consequently, the measurement model presented in this paper demonstrates a robust level of reliability and excellent convergent validity, thereby ensuring the reliability and precision of this study's ndings. e outcomes of the reliability test are presented in Table 1.

Statistical analysis

Using Amos 29.0 software, a structural equation modeling (SEM) framework was employed. e SEM was visually inspected to ensure its suitability for a sample size ten times the number of measured variables. ere were 43 variables in this study, and the e ective sample comprised 4,562 individuals, which adequately ful lled the requirements for data analysis. "Statistical signi cance" was established at a P-value threshold of less than 0.05, and the Bootstrap method was employed to test the mediation e ect, with the reporting of a 95% con dence interval.

Results

Common method bias test

is study may be a ected by common methodological biases because the data were obtained through anonymous questionnaires lled out by respondents. According to Zhou Hao et al. [38], it is crucial to control the data collection procedures, rstly to ensure that the research instrument is a questionnaire suitable for the Chinese

di erences in mobile phone addiction, learning engagement, physical activity, and academic self-e cacy were not signi cant ($p > 0.05$).

Descriptive statistics and correlation analysis

e descriptive statistics and correlation results of the

Table 4 Model fit indices

Evaluation indicators	Model Fit value	Judgment standard
χ2/df	4.213	<5.000, acceptable;<3.000, good fit
RMSEA	0.040	<0.080, good fit
CFI	0.991	>0.900, good fit
GFI	0.985	>0.800, acceptable;>0.900, good fit
AGFI	0.947	>0.800, acceptable;>0.900, good fit
NFI	0.990	>0.900, good fit
IFI	0.991	>0.900, good fit

Analysis of the mediating effect of physical activity and academic self-efficacy

To validate the mediating roles of physical activity and academic self-efficacy, we employed the bias-corrected non-parametric percentile Bootstrap method to test their mediation effects between mobile phone addiction and learning engagement. With a Bootstrap sample size of 5,000, 95% confidence intervals (CIs) were computed. If the 95% CI for the standardized path coefficients does not include zero, it signifies a significant mediation effect.

The results displayed in Table 5 indicate that the 95% CI for the mediation path from mobile phone addiction to learning engagement through physical activity is [-0.122, −0.048], confirming a significant mediation effect and validating research hypothesis H2. Similarly, the 95% CI for the mediation path through academic self-efficacy is [-0.746, −0.141], indicating a significant mediation effect and validating research hypothesis H3. Furthermore, the 95% CI for the mediation path involving both physical activity and academic self-efficacy is [-0.110, −0.080],

The mediating role of physical activity between mobile phone addiction and learning engagement

[2] Physical activity and academic self-e cacy function as chain mediators in the link between mobile phone addiction and learning engagement.

Limitations of the study

is present study has some limitations. First, it only explored the mediating mechanism between mobile