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Posted Date: November 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11334911/v1

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Additional Declarations: No competing interests reported.

Health Risk Behaviours as Mediator between Locus of Control and Extracurricular Physical Activity Participation among Chinese Undergraduates

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Locus of control (LoC) is theoretically linked to health risk behaviours (HRB) and physical activity (PA), yet the mediating role of HRB in the relationship between LoC and extracurricular PA participation (PAP) remains underexplored among Chinese undergraduates. A cross-sectional design was employed with 372 full-time undergraduates from a provincial public university in Xinjiang, China, who completed the Multidimensional Health Locus of Control Scale, the Youth Risk Behaviour Surveillance System (university version), and the Physical Activity Rating Scale-3. Structural equation modelling with maximum likelihood estimation and Bootstrap mediation analysis (5,000 resamples, 95% bias-corrected confidence intervals) were conducted. LoC was positively associated with PAP ($r = 0.388$, $p < .01$) and negatively with HRB ($r = -0.276$, $p < .01$). The structural model demonstrated excellent fit ($\chi^2/df = 1.390$, CFI = 0.989, RMSEA = 0.032). HRB partially mediated the LoC–PAP relationship, with a direct effect of $\beta = 0.299$ (95% CI [0.186, 0.411]) and an indirect effect of $\beta = 0.060$ (95% CI [0.028, 0.109]); the variance accounted for (VAF) was 17%. Internal LoC promotes extracurricular PA both directly and indirectly by reducing HRB, suggesting that university health promotion interventions should simultaneously strengthen internal LoC and reduce health risk behaviours.

Keywords: locus of control, health risk behaviours, physical activity, mediation, Chinese undergraduates, structural equation modeling

Introduction

Physical inactivity has been identified by the World Health Organization (WHO) as one of the leading risk factors for global mortality, responsible for approximately 3.2 million deaths annually worldwide [1]. The Global Action Plan on Physical Activity 2018–2030, adopted by the World Health Assembly, set an ambitious target of a 15% relative reduction in the prevalence of insufficient physical activity (PA) among adults and adolescents by 2030 [2]. Despite these international declarations and policy frameworks, surveillance data consistently reveal that a substantial proportion of the global population—particularly young adults—fails to meet the recommended minimum of 150 minutes of moderate-to-vigorous PA per week [3]. The insufficiency of PA among youth populations has been linked to elevated risks of cardiovascular disease, obesity, type 2 diabetes, musculoskeletal disorders, and mental health conditions, creating a significant burden on healthcare systems worldwide [1]. Among university students, the transition from secondary education to higher education often marks a critical period of behavioural change, during which previously established PA habits deteriorate while

sedentary behaviours and health-compromising practices intensify [4]. This developmental transition is accompanied by newfound autonomy, reduced structured physical education requirements, and increased exposure to social environments that may normalise risk behaviours, collectively contributing to the well-documented decline in PA during the university years.

In China, the concern is particularly acute. The "Healthy China 2030" planning outline, issued by the Central Committee of the Communist Party of China and the State Council, explicitly identifies the promotion of PA and the reduction of health risk behaviours as national strategic priorities [5]. This landmark policy document set specific targets, including increasing the proportion of the population engaging in regular PA to over 40% and reducing the prevalence of chronic disease risk factors by 2030. However, empirical evidence paints a concerning picture: national surveys indicate that fewer than 20% of Chinese university students meet the WHO PA guidelines, and PA levels have declined progressively over the past two decades [6,7]. The prevalence of sedentary lifestyles, irregular sleep patterns, unhealthy dietary habits, and substance experimentation among Chinese undergraduates has risen alarmingly, creating a confluence of health risk behaviours (HRB) that undermine both physical and psychological well-being [8,9]. The Chinese Ministry of Education has repeatedly emphasised the need for universities to strengthen PA programmes and promote healthy lifestyles, yet institutional responses have been uneven and PA participation rates remain stubbornly low. Understanding the psychological determinants that drive or inhibit PA participation in this population is therefore of considerable scientific and policy significance.

Locus of control (LoC), a construct originally proposed by Rotter[10] within his social learning theory, refers to the extent to which individuals attribute the outcomes of their actions to internal versus external causes. Individuals with an internal LoC perceive that outcomes are contingent upon their own behaviour and effort, whereas those with an external LoC believe that outcomes are determined by fate, luck, chance, or powerful others. Rotter's foundational work established that LoC orientations develop through cumulative experiences of reinforcement and that these generalised expectancies profoundly influence subsequent behavioural choices. This construct has been widely applied in health psychology as a predictor of health-related behaviours, with internal LoC consistently associated with greater engagement in health-promoting activities and reduced involvement in health-compromising practices [11,12]. Wallston et al.[13] extended Rotter's unidimensional model to develop the Multidimensional Health Locus of Control (MHLC) Scale, which distinguishes three dimensions: Internal Health Locus of Control (IHLC), referring to the belief that one's own behaviour determines health outcomes; Powerful Others Health Locus of Control (PHLC), reflecting the belief that health outcomes are controlled by authority figures such as physicians; and Chance Health Locus of Control (CHLC), representing the belief that health outcomes are

determined by fate, luck, or chance. The MHLC framework has proven particularly useful in predicting health behaviours across diverse cultural contexts, as it acknowledges that individuals may simultaneously hold internal and external control beliefs to varying degrees [14].

A substantial body of research has demonstrated positive associations between internal LoC and PA engagement. Steca et al.[12], in a large-scale study of Italian adults, found that IHLC was positively associated with regular exercise participation, whereas CHLC was negatively associated with PA. Similarly, Norman et al.[11] reported that internal LoC significantly predicted adherence to PA recommendations among British university students. Prospero et al.[15], in a recent study published in Scientific Reports, demonstrated that irritable bowel syndrome patients with internal LoC exhibited higher baseline PA levels and better physical capacity than their external LoC counterparts. In the Chinese context, studies have shown that internal LoC is positively correlated with PA among adolescents and young adults, though the strength of this association varies across studies and appears to be moderated by cultural factors [7,16]. The positive association between PHLC and PA observed in some studies suggests that, in cultures characterised by high respect for authority, the belief that powerful others influence health may also motivate PA engagement, particularly when authority figures actively promote exercise. Collectively, these findings suggest that individuals who perceive personal control over their health outcomes are more likely to adopt and maintain physically active lifestyles, though the specific pathways through which LoC influences PA remain incompletely understood.

HRB, as conceptualised by the Youth Risk Behaviour Surveillance System (YRBSS) developed by the Centers for Disease Control and Prevention (CDC), encompass a constellation of interrelated behaviours that threaten health and well-being, including unhealthy eating patterns, physical inactivity, inadequate sleep and mental health disturbances, addictive behaviours, and risky sexual or delinquent behaviours [8,17]. Rather than occurring in isolation, these behaviours tend to cluster, such that engagement in one risk behaviour elevates the probability of involvement in others [8]. This clustering phenomenon has important implications for understanding how psychological constructs such as LoC influence health outcomes: if internal LoC reduces the likelihood of engaging in multiple risk behaviours simultaneously, and if these risk behaviours in turn inhibit PA participation, then HRB may function as a mediating mechanism in the LoC–PA relationship. The co-occurrence of risk behaviours among university students is particularly concerning because the academic environment provides both opportunities and stressors that may simultaneously promote multiple risk behaviours while discouraging health-promoting activities such as regular exercise.

The inverse relationship between HRB and PA is well documented in the literature. Keating et

al.[4] reported that university students who engaged in higher levels of substance use, sedentary screen time, and irregular sleep patterns demonstrated significantly lower PA levels. Zhang et al.[9] found that health risk behaviours, particularly physical inactivity and addictive behaviours, were significant negative predictors of PA participation among Chinese college students. Theoretically, this inverse relationship can be understood through the lens of self-determination theory [18] and social cognitive theory [19]: individuals who lack self-regulatory capacity are more susceptible to impulsive, short-term gratification through risk behaviours, which compete with and displace the time, energy, and motivational resources required for sustained PA engagement. From a resource allocation perspective, risk behaviours such as excessive alcohol consumption, prolonged gaming, and irregular sleep deplete the physical energy, time, and psychological resources that would otherwise be available for exercise, creating a systematic displacement effect [8].

Mediation theory, as formalised by Baron and Kenny[20] and subsequently refined through bootstrap methods [21,22], provides the analytical framework for examining whether HRB transmit the effect of LoC on PA. Specifically, the proposed mediation pathway posits that: (a) LoC directly influences PA participation (path c′), reflecting the direct motivational and self-regulatory effects of perceived control; (b) LoC influences HRB (path a), such that internal LoC reduces the propensity for health-compromising behaviours; and (c) HRB influence PA participation (path b), such that greater engagement in risk behaviours diminishes PA. The indirect effect (a × b) represents the portion of the LoC–PA relationship that is transmitted through HRB, and the total effect (c) comprises both the direct and indirect pathways. This mediation model implies a dual mechanism whereby internal LoC promotes PA both directly, through enhanced perceived behavioural control and autonomous motivation, and indirectly, through the suppression of competing risk behaviours that would otherwise crowd out PA engagement.

The Chinese cultural context adds a unique dimension to this mediation model. China's collectivist cultural orientation, characterised by strong family interdependence, deference to authority, and a relatively high prevalence of external control beliefs, may attenuate the strength of internal LoC among Chinese undergraduates compared to their Western counterparts [23,24]. Chinese students may be more likely to attribute health outcomes to family expectations, institutional mandates, or social circumstances rather than personal agency, potentially weakening the direct LoC–PA link while amplifying the mediating role of HRB. Furthermore, the rapid social and economic transformations in China have created an environment in which health risk behaviours—including excessive smartphone use, irregular dietary patterns, and sleep deprivation—have become increasingly prevalent among university students [25], making the examination of HRB as a mediating mechanism particularly relevant. The one-child policy generation, now comprising the majority of university students, may

exhibit unique patterns of LoC and risk behaviour due to their upbringing in family environments characterised by intensive parental investment and protection, which may foster both external LoC tendencies and reduced self-regulatory capacity in the absence of parental supervision.

Despite the theoretical and empirical rationale for the LoC→HRB→PA mediation model, few studies have directly examined this pathway among Chinese undergraduates. Existing research has predominantly examined LoC and PA as bivariate relationships [11,12] or has explored personality traits rather than LoC as predictors of PA through HRB [26]. The study by Chen et al.[26], published in Scientific Reports, examined personality traits and health risk behaviours as predictors of PA among Chinese undergraduates and found that HRB partially mediated the personality–PA relationship, accounting for 23% of the total effect (VAF). However, LoC as a distinct psychological construct was not examined as a predictor in that study. Given that LoC represents a cognitive belief system rather than a dispositional trait, and given its established relevance to health behaviour in the Chinese context, investigating the LoC→HRB→PA pathway represents a meaningful extension of the existing literature. The distinction between LoC and personality is theoretically important: while personality traits are relatively stable dispositional characteristics, LoC is more malleable and responsive to interventions, making it a more practical target for university health promotion programmes.

Accordingly, the present study aimed to examine HRB as a mediator between LoC and extracurricular PA participation (PAP) among Chinese full-time undergraduates. Three hypotheses were formulated based on the preceding theoretical and empirical review (Fig. 1):

H1: Locus of Control is significantly and positively associated with extracurricular physical activity participation.

H2: Locus of Control is significantly and negatively associated with health risk behaviours.

H3: Health risk behaviours significantly mediate the relationship between locus of control and extracurricular physical activity participation.

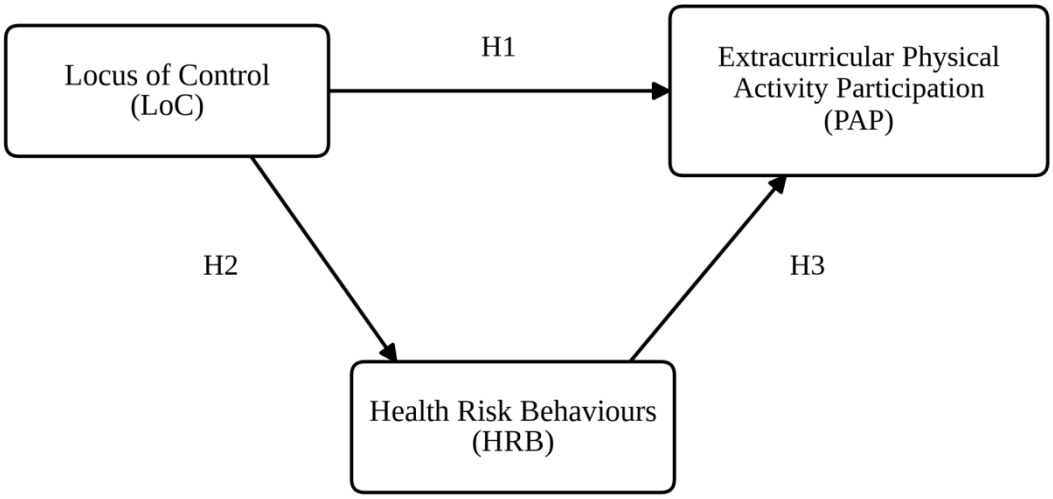


Fig. 1. Hypothesised conceptual model of the study. H1 and H2 denote the hypothesised direct paths linking locus of control (LoC), health risk behaviours (HRB), and extracurricular physical activity participation (PAP); the indirect path LoC → HRB → PAP corresponds to the hypothesised mediation effect (H3).

Methods

Participants

The study participants comprised 372 full-time undergraduate students recruited from a provincial public university in Xinjiang Uyghur Autonomous Region, China. A stratified random sampling strategy was employed to ensure representativeness across three key demographic strata: economic region of origin, gender, and year of study. With respect to economic region, participants were drawn from developed regions (n = 121, 32.5%), general regions (n = 107, 28.8%), and underdeveloped regions (n = 144, 38.7%), reflecting the economic diversity of China's provincial territories. The gender composition included 174 males (46.8%) and 198 females (53.2%). Year of study distribution was as follows: freshmen (n = 134, 36.0%), sophomores (n = 106, 28.5%), juniors (n = 81, 21.8%), and seniors (n = 51, 13.7%). Regarding age, 211 participants (56.7%) were under 20 years and 161 (43.3%) were aged 20 years or above. The sample size of 372 exceeded the minimum threshold of 200 recommended for structural equation modelling with maximum likelihood estimation [27], and satisfied the more stringent criterion of 10 observations per estimated parameter [28].

Procedure

A cross-sectional quantitative research design was adopted. Ethical approval was obtained from the Institutional Review Board (IRB) of SEGi University (Approval No.: SEGiEC/SR/FOELPM/132/2025–2026). All instruments were translated from English to Simplified Chinese using a standard translation–back-translation procedure involving two bilingual academics, followed by a pilot study (n = 30) to assess linguistic equivalence and instrument reliability. Data collection was conducted through paper-based questionnaires administered

face-to-face in classroom settings by trained research assistants. Participants were provided with standardised instructions and assured that there were no correct or incorrect responses. A total of 520 questionnaires were distributed, of which 486 were returned (response rate = 93.5%). After screening for incomplete responses, patterned responding, and outliers (z-scores exceeding ±3.29), 372 questionnaires were retained as valid, yielding a valid response rate of 71.5%. All participants provided written informed consent prior to data collection and were assured of confidentiality and voluntary participation. The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Instrumentation

Multidimensional Health Locus of Control Scale (MHLC). The 18-item MHLC Scale [13] was used to measure participants' health-related LoC across three dimensions: Internal Health Locus of Control (IHLC; 6 items, e.g., "I am directly responsible for my health"), Powerful Others Health Locus of Control (PHLC; 6 items, e.g., "My family has a lot to do with my becoming sick or staying healthy"), and Chance Health Locus of Control (CHLC; 6 items, e.g., "No matter what I do, I'm likely to get sick"). Each item was rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The composite LoC score was computed as the mean across all 18 items, with higher scores indicating a more internal LoC orientation. In the present study, Cronbach's alpha coefficients were 0.925 for IHLC, 0.919 for PHLC, and 0.923 for CHLC, indicating excellent internal consistency consistent with previously reported reliability estimates for the MHLC scale in Chinese populations.

Youth Risk Behaviour Surveillance System (YRBSS, University Version). The YRBSS, originally developed by the Centers for Disease Control and Prevention [17] and adapted for the Chinese university context, comprised 25 items measuring five dimensions of health risk behaviours: Unhealthy Eating (5 items), Lack of Physical Activity (5 items), Sleep and Mental Health Disturbances (5 items), Addictive Behaviours (5 items), and Risky Behaviours (5 items). Responses were recorded on a 5-point Likert scale (1 = never, 5 = always). The overall HRB score was calculated as the mean of all 25 items, with higher scores indicating greater engagement in health risk behaviours. In the pilot study, the overall Cronbach's alpha was 0.869. In the main study, subscale reliability coefficients ranged from 0.880 to 0.903, confirming satisfactory to excellent internal consistency across all dimensions.

Physical Activity Rating Scale-3 (PARS-3). The PARS-3 [29] was employed to measure extracurricular PA participation. This three-item scale assesses PA intensity (1 = light, 5 = vigorous), frequency (0 = never, 4 = daily), and duration (1 = <10 min, 5 = >60 min). The total PARS-3 score is computed as the product of intensity, duration, and frequency, yielding a score ranging from 0 to 100. The scale has been widely validated among Chinese university students and demonstrates acceptable test–retest reliability and concurrent validity with objective PA

measures [6,7]. In the present study, Cronbach's alpha was 0.973, indicating excellent internal consistency.

Statistical analysis

Data analysis was conducted using SPSS 26.0 and AMOS 27.0. The analytical procedures comprised four stages. First, descriptive statistics (means, standard deviations) and bivariate Pearson correlations were computed for all main variables. Second, the measurement model was evaluated through confirmatory factor analysis, examining Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), the Fornell–Larcker criterion for discriminant validity [30], and the heterotrait–monotrait ratio (HTMT) of correlations [31]. Multicollinearity was assessed using the variance inflation factor (VIF), and sampling adequacy was examined through the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. Third, structural equation modelling (SEM) with maximum likelihood estimation was employed to test the hypothesised LoC→HRB→PAP model. Model fit was evaluated using χ^2/df (< 3), goodness-of-fit index (GFI > 0.90), adjusted GFI (AGFI > 0.90), comparative fit index (CFI > 0.95), normed fit index (NFI > 0.90), incremental fit index (IFI > 0.95), relative fit index (RFI > 0.90), root mean square error of approximation (RMSEA < 0.08), and parsimonious GFI (PGFI) [28,32]. Fourth, mediation analysis was conducted using the Bootstrap method with 5,000 resamples and 95% bias-corrected confidence intervals [22]. The variance accounted for (VAF) was computed as the ratio of the indirect effect to the total effect, with VAF values between 20% and 80% indicating partial mediation [33]. The significance level was set at $p < 0.05$ throughout.

Results

Descriptive statistics and correlations

Table 1 presents the descriptive statistics and bivariate Pearson correlations among the main study variables. The mean LoC score was 3.4017 (SD = 0.936), with dimension-level means of 3.428 (SD = 1.133) for IHLC, 3.409 (SD = 1.116) for PHLC, and 3.367 (SD = 1.137) for CHLC. The mean HRB score was 3.115 (SD = 0.738), and the mean PAP score was 2.550 (SD = 1.240). All correlations among the main variables were statistically significant at $p < .01$. LoC was positively correlated with PAP (r = 0.388) and negatively correlated with HRB (r = −0.276). HRB was negatively correlated with PAP (r = −0.395). At the dimension level, IHLC, PHLC, and CHLC were all significantly and positively correlated with PAP (r = 0.325, r = 0.302, and r = 0.338, respectively). The three LoC dimensions were moderately intercorrelated (IHLC–PHLC: r = 0.539; IHLC–CHLC: r = 0.499; PHLC–CHLC: r = 0.556), reflecting the shared variance among the MHLC subscales while also indicating sufficient discriminability. These correlation patterns provided preliminary support for H1 and H2, and the significant LoC–HRB and HRB–PAP correlations established the prerequisite conditions for mediation

analysis [20].

Variable	M	SD	1	2	3	4	5	6
1. LoC	3.402	0.936	—					
2. IHLC	3.428	1.133	.539**	—				
3. PHLC	3.409	1.116	.499**	.556**	—			
4. CHLC	3.367	1.137	.487**	.512**	.508**	—		
5. HRB	3.115	0.738	−.276**	−.225**	−.231**	−.218**	—	
6. PAP	2.550	1.240	.388**	.325**	.302**	.338**	−.395**	—

Table 1. Descriptive statistics and correlations among main variables (N = 372)

Note. LoC = Locus of Control; IHLC = Internal Health Locus of Control; PHLC = Powerful Others Health Locus of Control; CHLC = Chance Health Locus of Control; HRB = Health Risk Behaviours; PAP = Physical Activity Participation. **p < .01.

Measurement model evaluation

The measurement model was evaluated through multiple criteria to establish construct reliability and validity. Cronbach's alpha coefficients were 0.825 for LoC, 0.891 for HRB, and 0.764 for PAP, all exceeding the threshold of 0.70 [28]. Composite reliability (CR) values were 0.869 for LoC, 0.913 for HRB, and 0.831 for PAP, all above the recommended criterion of 0.70. Average variance extracted (AVE) values were 0.557 for LoC, 0.617 for HRB, and 0.551 for PAP, all exceeding the minimum threshold of 0.50, confirming convergent validity [30]. Discriminant validity was assessed using the Fornell–Larcker criterion: the square root of AVE for each construct (√AVE: LoC = 0.746, HRB = 0.785, PAP = 0.742) exceeded the maximum inter-construct correlation (0.395), supporting discriminant validity. Additionally, the heterotrait–monotrait (HTMT) ratios were 0.612 for LoC–HRB, 0.545 for LoC–PAP, and 0.497 for HRB–PAP, all below the conservative threshold of 0.85 [31], further confirming discriminant validity. The KMO measure of sampling adequacy was 0.921, and Bartlett's test of sphericity was significant (χ^2 = 18,561.799, p < .001), supporting the suitability of the data for factor analysis. Multicollinearity diagnostics indicated VIF values of 1.132 for LoC and 1.176 for HRB, both well below the threshold of 10, indicating no problematic multicollinearity. Collectively, these results confirmed that the measurement model possessed adequate reliability, convergent validity, and discriminant validity, supporting the progression to structural model estimation.

Structural equation model and model fit

The hypothesised structural equation model, specifying LoC as the exogenous predictor, HRB as the mediator, and PAP as the endogenous outcome, was estimated using maximum likelihood estimation in AMOS 27.0. As presented in Table 2, the model demonstrated excellent fit to the observed data across all indices: χ^2/df = 1.390 (< 3), PGFI = 0.696, GFI = 0.956 (> 0.90), AGFI = 0.940 (> 0.90), RMSEA = 0.032 (< 0.08), NFI = 0.961 (> 0.90), IFI = 0.989 (> 0.95), CFI = 0.989 (> 0.95), and RFI = 0.952 (> 0.90). These fit indices collectively indicated that the hypothesised model provided an acceptable representation of the covariance structure in the data [28,32]. The RMSEA value of 0.032, substantially below the 0.08 threshold

and with its upper 90% confidence interval below 0.05, indicated excellent model approximation. No modification indices suggested theoretically justifiable improvements, and the model was therefore retained without post hoc modifications.

Fit Index	χ^2/df	PGFI	GFI	AGFI	RMSEA	NFI	IFI	CFI	RFI
Value	1.390	0.696	0.956	0.940	0.032	0.961	0.989	0.989	0.952
Threshold	< 3	—	> 0.90	> 0.90	< 0.08	> 0.90	> 0.95	> 0.95	> 0.90

Table 2. Model fit indices for the structural equation model (N = 372)

Note. χ^2/df = chi-square to degrees of freedom ratio; PGFI = Parsimonious Goodness-of-Fit Index; GFI = Goodness-of-Fit Index; AGFI = Adjusted Goodness-of-Fit Index; RMSEA = Root Mean Square Error of Approximation; NFI = Normed Fit Index; IFI = Incremental Fit Index; CFI = Comparative Fit Index; RFI = Relative Fit Index.

Path estimates

Table 3 and Fig. 2 present the standardised and unstandardised path estimates for the structural model. The direct path from LoC to PAP was significant and positive (B = 0.498, β = 0.299, SE = 0.094, CR = 5.297, p < .001), supporting H1 and indicating that a one-standard-deviation increase in LoC was associated with a 0.299 standard deviation increase in PAP, controlling for the indirect pathway through HRB. The path from LoC to HRB was significant and negative (B = −0.201, β = −0.249, SE = 0.051, CR = −3.920, p < .001), supporting H2 and indicating that stronger internal LoC was associated with lower engagement in health risk behaviours. The path from HRB to PAP was significant and negative (B = −0.498, β = −0.241, SE = 0.120, CR = −4.136, p < .001), indicating that higher levels of health risk behaviours predicted lower extracurricular PA participation. All three paths were significant at p < .001, providing robust support for the hypothesised structural relationships.

Path	B	β	SE	CR	p
LoC → PAP	0.498	0.299	0.094	5.297	< .001
LoC → HRB	−0.201	−0.249	0.051	−3.920	< .001
HRB → PAP	−0.498	−0.241	0.120	−4.136	< .001

Table 3. Path estimates from locus of control to health risk behaviours and physical activity participation (N = 372)

Note. LoC = Locus of Control; HRB = Health Risk Behaviours; PAP = Physical Activity Participation; B = unstandardised estimate; β = standardised estimate; SE = standard error; CR = critical ratio.

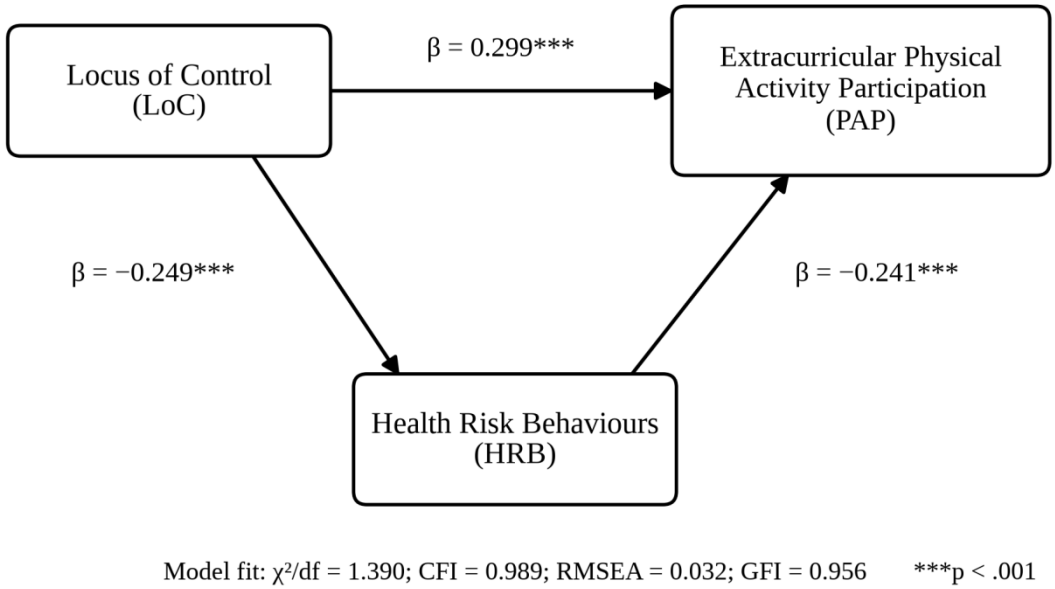


Fig. 2. Standardised path estimates of the hypothesised structural model (N = 372). Solid arrows represent statistically significant paths (***p < .001); model fit indices are reported within the figure.

Mediation analysis

Table 4 and Fig. 3 present the results of the Bootstrap mediation analysis (5,000 resamples, 95% bias-corrected confidence intervals). The direct effect of LoC on PAP was significant (β = 0.299, 95% CI [0.186, 0.411]), accounting for 83% of the total effect. The indirect effect of LoC on PAP through HRB was significant (β = 0.060, 95% CI [0.028, 0.109]), as the confidence interval did not contain zero, meeting the established criterion for mediation significance [22]. This indirect effect accounted for 17% of the total effect. The total effect of LoC on PAP was β = 0.359 (95% CI [0.253, 0.464]). The variance accounted for (VAF) by the mediating effect was 17%. According to the criterion proposed by Sobaih and Elshaer[33], VAF values between 20% and 80% indicate partial mediation, while values below 20% suggest weak partial mediation and values above 80% indicate full mediation. Although the VAF of 17% falls slightly below the 20% threshold, the significance of the indirect effect (CI excluding zero) and the co-occurrence of significant direct and indirect effects collectively provide robust evidence for partial mediation [21,22]. H3 was therefore supported: HRB partially mediate the relationship between LoC and PAP among Chinese undergraduates. The positive indirect effect (β = 0.060) is the product of two negative coefficients (LoC→HRB: β = −0.249; HRB→PAP: β = −0.241), confirming that internal LoC reduces HRB, which in turn increases PAP.

Effect Type	β	95% CI	Proportion
Direct effect (LoC → PAP)	0.299	[0.186, 0.411]	83%
Indirect effect (LoC → HRB → PAP)	0.060	[0.028, 0.109]	17%
Total effect	0.359	[0.253, 0.464]	100%

Table 4. Mediation analysis of health risk behaviours between locus of control and physical activity participation (N = 372)

Note. LoC = Locus of Control; HRB = Health Risk Behaviours; PAP = Physical Activity Participation; β = standardised estimate; CI = bias-corrected confidence interval based on 5,000 Bootstrap resamples. VAF = Variance Accounted For = Indirect effect / Total effect = 0.060 / 0.359 = 17%.

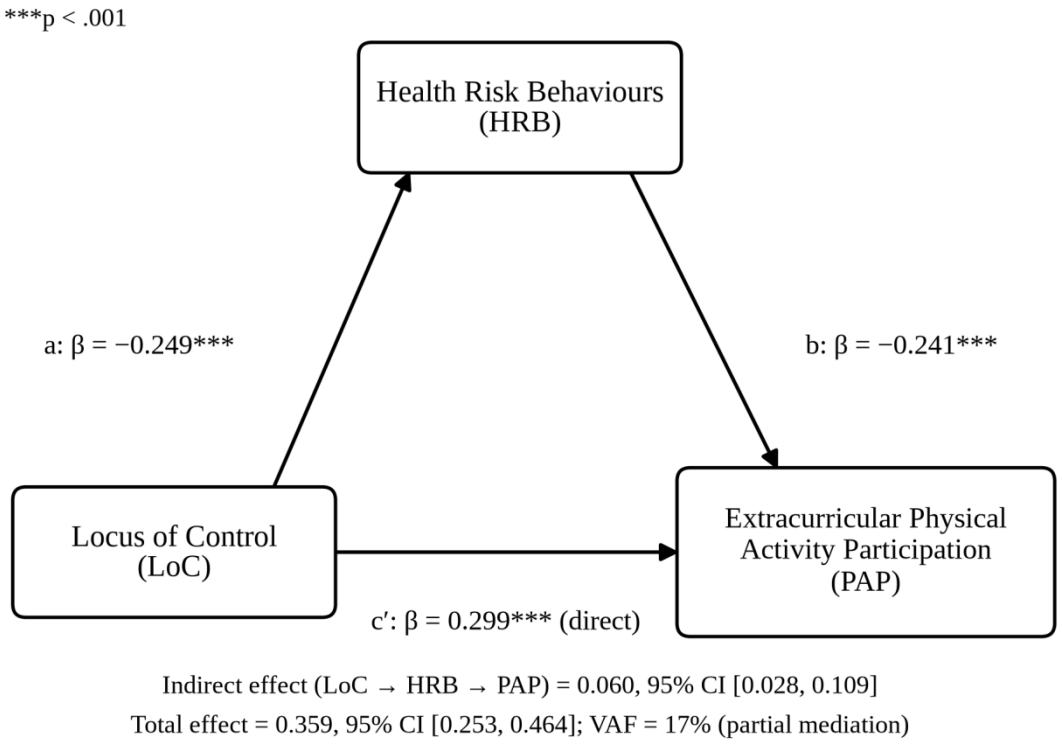


Fig. 3. Path diagram of the mediating role of HRB in the relationship between LoC and PAP. a, b and c′ denote the standardised coefficients of the respective paths (***p < .001); the indirect effect was estimated using bootstrap analysis with 5,000 resamples and 95% bias-corrected confidence intervals. VAF = variance accounted for.

Discussion

The present study examined health risk behaviours (HRB) as a mediator in the relationship between locus of control (LoC) and extracurricular physical activity participation (PAP) among Chinese full-time undergraduates. The findings provide empirical support for all three hypotheses and offer both theoretical and practical insights into the psychological mechanisms underlying PA engagement in the Chinese university context. The discussion that follows interprets each finding in relation to the existing literature, considers the Chinese cultural context, and derives practical implications for university health promotion.

The direct effect of LoC on PAP (β = 0.299, p < .001) confirmed H1, indicating that undergraduates with a more internal LoC orientation reported significantly higher levels of extracurricular PA participation. This finding is consistent with the theoretical propositions of Rotter[10] and Wallston et al.[13], which posit that individuals who attribute health outcomes to their own behaviour are more motivated to engage in health-promoting actions, including regular PA. Empirically, this result aligns with previous studies reporting positive associations between internal LoC and PA among Italian adults [12], British university students [11], and clinical populations [15]. The magnitude of the direct effect (β = 0.299) suggests that LoC exerts a

moderate influence on PA participation, consistent with meta-analytic estimates of the LoC–health behaviour relationship [11]. Importantly, the significance of the direct effect indicates that internal LoC promotes PA through mechanisms beyond the reduction of risk behaviours, potentially including enhanced self-regulatory efficacy, autonomous motivation as conceptualised in self-determination theory, and perceived behavioural control as specified in the theory of planned behaviour [18,19]. Individuals with internal LoC are more likely to set exercise goals, persist in the face of barriers, and attribute setbacks to controllable factors, all of which facilitate sustained PA engagement.

The significant negative path from LoC to HRB ($\beta = -0.249$, $p < .001$) supported H2, demonstrating that undergraduates with a more internal LoC reported lower engagement in health risk behaviours. This finding is consistent with the broader health psychology literature, which has established that internal LoC is associated with reduced substance use, healthier dietary choices, better sleep hygiene, and lower engagement in delinquent or risky behaviours [8,14]. Theoretically, individuals who perceive personal control over their health outcomes are more likely to appraise risk behaviours as self-defeating and to exercise self-regulatory capacity to resist short-term temptations in favour of long-term health benefits [19]. Conversely, individuals with an external LoC orientation, who believe that health outcomes are determined by chance or powerful others, may perceive risk behaviours as less consequential and feel less empowered to alter their behavioural patterns [10]. The magnitude of this effect ($\beta = -0.249$) indicates that LoC exerts a modest but significant influence on the propensity to engage in clustered risk behaviours, suggesting that internal LoC serves as a protective factor against the co-occurrence of multiple health-compromising practices.

The significant negative path from HRB to PAP ($\beta = -0.241$, $p < .001$) indicated that greater engagement in health risk behaviours was associated with lower extracurricular PA participation. This finding corroborates previous research demonstrating inverse relationships between risk behaviour clusters and PA among university students [4,9]. The negative HRB–PAP association can be interpreted through a resource allocation framework: health risk behaviours such as excessive alcohol consumption, irregular sleep, and prolonged sedentary screen time deplete the time, energy, and motivational resources available for PA engagement [8]. Furthermore, the clustering of risk behaviours may create mutually reinforcing behavioural patterns—for instance, irregular sleep leads to daytime fatigue, which reduces exercise motivation, which in turn further disrupts sleep quality—creating a self-perpetuating cycle that systematically displaces PA [4]. From a self-determination theory perspective, risk behaviours may be pursued as amotivated or externally regulated activities that undermine the development of intrinsic motivation for PA, as they provide alternative sources of short-term gratification that compete with the delayed rewards associated with regular exercise [18].

The mediation analysis revealed that HRB partially mediated the LoC–PAP relationship, with an indirect effect of β = 0.060 (95% CI [0.028, 0.109]) and a VAF of 17%, supporting H3. This result indicates that internal LoC promotes PA not only directly but also indirectly by reducing health risk behaviours, which in turn frees resources and creates conditions more conducive to PA engagement. The positive sign of the indirect effect (0.060) is the product of two negative paths (LoC→HRB: −0.249 × HRB→PAP: −0.241), confirming the suppressive mechanism: internal LoC suppresses HRB, and the reduction in HRB in turn facilitates PAP. The VAF of 17% suggests that the indirect pathway through HRB accounts for a modest but meaningful proportion of the total LoC–PAP effect. While this proportion is smaller than the 23% VAF reported for the personality traits–HRB–PA pathway by Chen et al.[26], it is notable that LoC and personality traits represent distinct psychological constructs: LoC reflects cognitive belief systems about control, whereas personality traits (e.g., conscientiousness, extraversion) reflect dispositional tendencies. The smaller VAF for LoC may reflect the more cognitive and less behavioural nature of LoC as a predictor, such that LoC exerts a relatively stronger direct effect on PA through motivational and self-regulatory pathways, while its indirect effect through HRB reduction, though significant, is comparatively modest. The finding that the VAF falls slightly below the 20% partial mediation threshold proposed by Sobaih and Elshaer[33] warrants careful interpretation: the significance of the indirect effect (Bootstrap CI excluding zero) and the simultaneous significance of the direct effect provide robust evidence for partial mediation regardless of the VAF magnitude [21,22]. As Hayes[21] has argued, any significant indirect effect constitutes evidence of mediation, and the distinction between partial and full mediation is less important than the substantive interpretation of the indirect pathway.

The Chinese cultural context offers important insights for interpreting these findings. China's collectivist cultural orientation, characterised by strong family interdependence and deference to authority, may foster relatively stronger external LoC beliefs among Chinese undergraduates compared to Western populations [23,24]. In the present sample, the mean LoC score (M = 3.402) on a 6-point scale suggests a moderate LoC orientation, slightly above the scale midpoint, indicating that participants did not strongly endorse either internal or external control beliefs. This finding is consistent with research suggesting that Chinese young adults, exposed to both traditional collectivist values and modern individualistic influences, may develop hybrid control beliefs that combine personal agency with recognition of external constraints. The positive correlation between PHLC and PAP (r = 0.302) is particularly noteworthy in the Chinese context, where trust in authority figures—including teachers, coaches, and healthcare providers—may serve as a culturally specific pathway to PA engagement, complementing the internal LoC route emphasised in Western theoretical models. These cultural nuances suggest that interventions targeting LoC in Chinese university settings should not exclusively focus on strengthening internal control beliefs but should also leverage the potentially facilitative role

of respected authority figures in promoting PA.

The practical implications of these findings are threefold. First, university health promotion programmes should incorporate interventions designed to strengthen internal LoC, such as mastery-based PA experiences, goal-setting workshops, and self-monitoring activities that reinforce the perception of personal control over health outcomes [14]. Attribution retraining, which teaches students to attribute PA successes to personal effort and controllable factors, may be particularly effective in shifting LoC orientations. Second, given the mediating role of HRB, interventions should simultaneously address risk behaviour reduction, targeting the clustered nature of health-compromising behaviours through integrated programmes that address unhealthy eating, sleep disturbances, and addictive behaviours alongside PA promotion [8]. Cognitive-behavioural strategies, motivational interviewing, and mindfulness-based interventions have shown promise in reducing multiple risk behaviours simultaneously among university students. Third, in the Chinese cultural context, interventions should harness the influence of trusted authority figures—including university faculty, health educators, and family members—to reinforce PA engagement and risk behaviour avoidance among students with strong PHLC orientations. Such integrated, multi-component interventions are more likely to achieve sustained behaviour change than programmes targeting either LoC or HRB in isolation, and they align with the systems-based approach advocated by the Healthy China 2030 initiative.

Limitations and future directions

Several limitations of the present study should be acknowledged. First, the cross-sectional design precludes causal inferences about the directional relationships among LoC, HRB, and PAP. Although the hypothesised LoC→HRB→PAP pathway was supported by the structural equation model and is consistent with theoretical expectations, alternative causal directions cannot be ruled out. For instance, regular PA participation may strengthen internal LoC beliefs through repeated experiences of mastery and control, creating a reciprocal causal loop. Similarly, reductions in HRB may enhance perceptions of personal control rather than vice versa. Future research should employ longitudinal or experimental designs to establish the temporal and causal ordering of these variables. A longitudinal study tracking LoC, HRB, and PA across multiple time points during the university years would be particularly valuable in disentangling reciprocal causation.

Second, all measures were based on self-report, which is susceptible to social desirability bias, recall inaccuracy, and common method variance. Although the procedural and statistical remedies employed—including assurance of anonymity, reverse-coded items, and the Fornell–Larcker and HTMT discriminant validity tests—mitigate these concerns, future studies could incorporate objective PA measures (e.g., accelerometry, smartphone-based activity tracking)

and informant reports to triangulate self-report data and reduce common method bias.

Third, the sample was drawn from a single provincial public university in Xinjiang, China, limiting the generalisability of the findings to other institutional types (e.g., national key universities, private institutions), geographic regions, or cultural contexts. The demographic composition of the sample, with a slight female majority (53.2%) and a preponderance of students from underdeveloped economic regions (38.7%), may not reflect the broader Chinese undergraduate population. Multi-site studies with larger and more diverse samples are needed to examine the robustness and generalisability of the mediation model. Cross-cultural comparative studies examining the LoC→HRB→PA pathway in collectivist versus individualist societies would be particularly illuminating.

Fourth, the present study treated LoC as a composite score across the three MHLC dimensions. While this approach facilitated parsimonious modelling, it precluded examination of the potentially differential effects of IHLC, PHLC, and CHLC on HRB and PAP. Future research should explore dimension-specific pathways, particularly given the culturally relevant role of PHLC in the Chinese context. Additionally, future studies should consider incorporating moderating variables—such as gender, year of study, and socioeconomic status—to examine whether the LoC→HRB→PAP mediation model operates differently across demographic subgroups. The inclusion of additional psychological variables, such as self-efficacy, autonomous motivation, and perceived behavioural control, would enable the testing of more comprehensive models that capture the full complexity of the determinants of PA among Chinese undergraduates.

Conclusion

This study provides empirical evidence that health risk behaviours partially mediate the relationship between locus of control and extracurricular physical activity participation among Chinese full-time undergraduates. The findings demonstrate that internal LoC promotes PA engagement both directly and indirectly: directly through enhanced motivational and self-regulatory processes, and indirectly by reducing engagement in health risk behaviours that compete with and displace PA. The structural equation model exhibited excellent fit, and the Bootstrap mediation analysis confirmed the significance of the indirect pathway (VAF = 17%). These results extend the existing literature by establishing the LoC→HRB→PAP mediation model in a previously underexamined population and cultural context, complementing prior research on the personality–HRB–PA pathway [26]. The practical implications emphasise the need for integrated university health promotion programmes that simultaneously strengthen internal LoC, reduce health risk behaviours, and leverage culturally specific pathways to PA engagement, including the facilitative role of trusted authority figures in the Chinese collectivist context. As China continues to pursue the Healthy China 2030 objectives, evidence-

based interventions targeting the psychological and behavioural determinants of PA among university students remain a public health imperative.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgements

W.L. would like to express his gratitude to all those who provided invaluable assistance throughout the research process.

Funding

This work was supported by the 2025 Undergraduate Education Teaching Reform Research Project of the Xinjiang Production and Construction Corps (Grant No. BTBKXM-2025-Y92) and the Higher Education Scientific Research Planning Project of China Association of Higher Education (No. 25TY0317).

Author contributions

Conceptualization, W.L. and B.L.; methodology, W.L. and H.W.; software, H.W. and W.L.; validation, Z.L. and B.L.; formal analysis, W.L. and E.H.W.; data curation, W.L.; writing—original draft preparation, W.L.; writing—review and editing, J.L. and E.H.W.; supervision, W.L. and B.L. All authors have read and agreed to the published version of the manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval

Prior to data collection, ethical clearance was obtained from SEGi University (Approval No.: SEGiEC/SR/ FOELPM/132/2025–2026).

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