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Extracurricular Engagement, Knowledge and Peer Norms: A Moderated Mediation Model of Drug-Risk Awareness

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ABSTRACT

The growing misuse of drugs among university students poses a major public health concern, particularly when prevention strategies overlook psychosocial and educational determinants of awareness. This study examines how extracurricular engagement (EE) enhances students' drug-risk awareness (DRA) through the mediating role of drug-risk knowledge (DRK) and under varying levels of perceived peer norms (PPN). Grounded in the Health Belief Model, Social Norms Theoryand the Knowledge-Attitude-Behaviour framework, extracurricular activities are conceptualised as social-learning environments that foster cognitive understanding and preventive awareness of drug harms. Using a quantitative, cross-sectional design, data were collected from 401 students across Saudi public universities through stratified random sampling. Partial Least Squares Structural Equation Modelling was used to test direct, mediating and moderated-mediation effects. Results indicate that DRK significantly mediates the relationship between EE and DRA, whereas PPN exert no significant moderating influence. Awareness accounts for 54.5% of the variance, while knowledge accounts for 27.6%. The study provides new empirical evidence on how educational and extracurricular interventions enhance awareness and build resilience among university students in the Arab context, highlighting the need for integrated prevention strategies that combine knowledge-based and participatory learning approaches.

KEYWORDS

Activity involvement, co-curriculars, drug dangers, drug literacy, peer pressure, social norms

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1. Introduction

Drug misuse has remained a constant global health issue among university students, as it undermines wellbeing, academic performanceand social stability. In its latest report, the United Nations Office on Drugs and Crime (UNODC, 2024) stated that over 296 million users in 2022 - a 23 percent increase compared to 10 years ago - speak volumes about youth trends. The problem is facilitated by easy availability, psychological stress, peer pressureand 'harmless' non-medical use misconceptions. Borsari and Carey (2001) and Su *et al.* (2025) noted this fact: young adults are usually risk-takers; therefore, students become influenced by various social elements that encourage the development of risky behaviour, prompting public-health and education authorities to examine how knowledge and awareness are formed within such contexts. Rapid modernisation and digital connectivity have been major features shaping youth lifestyles in this region. These developments create opportunities but also increase risky behaviours, not only in Saudi Arabia but among youth more broadly. National survey findings indicate that such behaviour remains below global averages, though it is steadily increasing with prescription stimulant use and social drug consumption on campuses (Alshehri *et al.*, 2025). Largely in response to campaigns by the National Committee for Narcotics Control and the Ministry of Education, governmental actions have yielded only limited short-term effects. Sustainable prevention should therefore rely on more than awareness slogans; it requires educational environments that cognitively and socially empower students. Structured engagement and participatory learning can nurture responsible choices and life-skills that build resilience (Rasouli and Samavi, 2025; Knifsend *et al.*, 2020).

Extracurricular engagement (EE) - defined as organised activities outside the formal curriculum - has long been considered a key dimension of holistic education. Student participation in voluntary groups or student government organisations has been associated with positive developmental outcomes such as self-efficacy, leadershipand moral reasoning (Eccles *et al.*, 2003). O'Donnell *et al.* (2024) similarly reported these associations in their recent work. From a health-promotion perspective, extracurricular contexts function as informal yet influential communication spaces in which peers exchange knowledge and internalise collective values related to responsibility and wellbeing (Yao *et al.*, 2023). Theoretically, these environments operate as social-learning laboratories where behaviours are shaped through observation, discussionand shared experiences (Bandura, 1986). Yet little is known about how such participation specifically enhances drug-risk knowledge (DRK) and awareness, particularly in non-Western or culturally sensitive settings such as Saudi Arabia. Clarifying this mechanism may help inform educational interventions that integrate cognitive learning with meaningful social interaction.

Knowledge and awareness, although closely related, hold distinct positions within behavioural-change theories. DRK refers to factual understanding of the physical, psychologicaland legal consequences of drug use (Tarhan *et al.*, 2023). Awareness is defined as the higher-order evaluation that combines cognitive assessment with emotional appraisal of personal vulnerability (Rogers, 1975). According to the Knowledge-Attitude-Behaviour (KAB) model (Fishbein and Ajzen, 2011), knowledge shapes attitudes that drive behavioural intentions. In the Health Belief Model (HBM) (Becker, 1974; Rosenstock *et al.*, 1988), perceived susceptibility and severity act as cues for undertaking preventive action. Thus, higher levels of knowledge should lead to greater awareness and a stronger inclination to avoid risks. However, evidence from various regions indicates that without reinforcing social and institutional supports, knowledge alone rarely produces meaningful behavioural change.

In Saudi universities, discourse about drugs is often confined to formal discussions; consequently, understanding how students acquire and transform information into conscious awareness requires examining informal learning environments such as

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extracurricular settings. Many health leaders or volunteers frequently encounter health-related content and integrate this information with personal meaning. Investigating this process clarifies how cognitive understanding develops into preventive awareness.

Peer influence remains among the strongest predictors of youth behaviour. Social Norms Theory (SNT) proposes that individuals act according to what they perceive as typical (descriptive norms) and socially accepted (injunctive norms) within their reference group (Perkins, 2003). By overestimating their peers' approval and usage of substances, students normalise risky practices. On the other hand, strong anti-drug attitudes make people less likely to take drugs and more likely to maintain abstinence. Cross-cultural studies have consistently found that peer-norm perception is a highly significant predictor of students' intentions regarding drug use or alcohol consumption. However, little is known about the interaction between peer norms and extracurricular involvement. Where structured engagement can promote positive social identities and group objectives around healthy behaviours in settings of high conformity pressure, it may offset negative peer influence (Knifsend *et al.*, 2020). Saudi Arabia's collectivist culture heightens the relevance of this interaction. While social approval strongly shapes youth conduct, recent reforms encourage openness and preventive education through youth empowerment initiatives under Vision 2030. Therefore, peer norms that modulate the relationship between involvement, knowledgeand awareness provide insight into culturally specific paths to prevention.

Saudi Arabia provides a unique context in which to study these dynamics. Over the last decade, Vision 2030 reforms have emphasised creating an active, health-aware society through student participation, volunteeringand leadership programmes. Universities have been encouraged to increase student clubs and community programmes that promote civic responsibility and wellbeing (Ministry of Education, 2024). However, there is limited empirical research assessing their cognitive or behavioural outcomes. Prior Saudi studies have typically measured knowledge and attitudes without investigating the underlying mechanisms linking engagement, awareness and social norms (Alshehri *et al.*, 2025). Accordingly, this study addresses a crucial gap by testing a moderated-mediation model that connects psychological, socialand educational determinants of drug-risk awareness (DRA). Specifically, it examines how EE influences awareness through DRK and whether perceived peer norms (PPN) condition this indirect pathway.

This research aims to clarify the mechanisms through which EE shapes students' awareness of drug-related risks. It investigates (a) the direct effect of EE on both DRK and awareness, (b) the mediating role of knowledgeand (c) the moderating influence of PPN. The study's theoretical contribution lies in integrating three complementary frameworks - HBM, KAB and SNT - into a unified moderated-mediation model that captures the cognitive and social processes underlying preventive behaviour. By situating these models within Saudi Arabia's evolving higher-education context, the study extends predominantly Western behavioural theories to an Arab-Islamic environment where drug discourse remains culturally sensitive. Conceptually, it positions EE as an educational and preventive strategy for building resilience and informed decision-making among youth, offering a theoretical foundation for university and national prevention programmes.

Following this introduction, the paper develops a comprehensive literature review and theoretical framework, elaborating on the relationships among the study constructs and presenting the conceptual model. Subsequent sections detail the methodology, data analysis and empirical results, followed by a discussion and conclusion highlighting implications for research, practiceand policy.

2. Literature Review and Theoretical Framework

2.1. Conceptualising Drug-Risk Awareness in Higher Education:

Awareness of drug risks is a primary aspect of preventive health behaviour. This awareness can be defined as knowledge and understanding at a personal level of the dangers associated with using substances, accompanied by recognising the seriousness of these dangers when misused. Therefore, apart from factual knowledge, risk awareness involves cognitive-affective appraisal founded mainly on social and cultural factors and experience (Tarhan *et al.*, 2023). DRA among university students shapes their intention either to abstain from or resist using drugs or other substances. University students are generally given more freedom when they enter university; hence, an increased tendency to engage in risky behaviours may be observed due to new peer groups and stressors related to student life (Borsari and Carey, 2001; Su *et al.*, 2025). However, a higher level of DRA among university students helps them make better-informed decisions based on choice rather than simply internalising preventive attitudes.

In Saudi Arabia and the Gulf region, culturally taboo discussions regarding drugs have long restricted open discourse about prevention (Alenazi *et al.*, 2023). However, the government has recently recognised - and articulated in national programmes such as the Saudi National Program for Drug Prevention and Vision 2030's Human Capability Development Program - that sustainable prevention must involve educational environments that proactively extend beyond punitive or awareness campaigns. Within these contexts, DRA emerges not only as a personal cognitive state but also as a socially embedded process influenced by peers, institutional cultureand educational interventions.

2.2. Extracurricular Engagement and Its Educational Value:

EE refers to students' participation in structured activities - such as clubs, volunteering, sports and leadership programmes- that extend learning beyond the formal curriculum (Fredricks and Eccles, 2010). Research evidence associates EE with positive developmental outcomes, including self-efficacy, academic achievement, civic engagementand psychosocial wellbeing (Eccles *et al.*, 2003; O'Donnell *et al.*, 2024). Scholars describe developmental ecologies as extracurricular activities that provide contextual settings for experiential learning, moral development and social identity formation (Salmela-Aro *et al.*, 2021).

In the context of health education, participation in extracurricular activities can foster informal learning about personal responsibility and wellbeing (Yao *et al.*, 2023). Group interaction, role modellingand the internalisation of social norms and values through diverse perspectives cultivate elements of prosocial development that discourage deviance among students (Yao *et al.*, 2023). Empirical evidence supports a negative relationship between student organisations and volunteering or service programmes on campus-based substance misuse, while showing a positive relationship with health-risk awareness (Sharp *et al.*, 2011). This relationship is similarly explained by socialisation mechanisms in which structured peer-group networks enable participants to interact more with responsible role models, thereby acquiring protective attitudes towards risk behaviours.

Despite this evidence, the literature remains largely fragmented in explaining the mechanisms through which EE enhances health-risk awareness. Most studies treat EE as a general correlate of wellbeing or academic success rather than as a determinant of specific health cognitions (Al Rasheed *et al.*, 2017). The present study addresses this gap by conceptualising EE as an antecedent of DRK and awareness,

grounded in learning and behavioural theories that elucidate how structured social participation shapes cognitive and attitudinal outcomes.

2.3. Theoretical Foundations:

2.3.1. The Health Belief Model

HBM is among the most enduring frameworks for explaining health-related decision-making. Initially developed by Becker (1974) and later refined by Rosenstock *et al.* (1988), HBM posits that individuals are more likely to adopt preventive behaviours when they perceive themselves as susceptible to a health risk, believe in the severity of its consequences and recognise the benefits of taking action. At the core of this model is the concept of perceived awareness, which refers to how individuals evaluate the likelihood and seriousness of risks.

DRA aligns closely with the constructs of perceived susceptibility and perceived severity in the context of this study. Students who are aware of the dangers associated with substance misuse are less likely to engage in risky behaviour. Such perceptions can be enhanced through extracurricular, non-formal learning environments that embed health messages; for example, volunteering, sports or student clubs increase exposure to prosocial norms and information on health, thereby enhancing perceived self-efficacy to resist drugs (Rasouli and Samavi, 2025).

HBM also highlights the role of cues to action - external or internal triggers that prompt individuals to adopt preventive behaviours. Extracurricular programmes can serve as such cues by providing peer-led discussions, mentorship and campaigns that stimulate awareness and behavioural reflection. Thus, the HBM provides a theoretical explanation for how EE can indirectly influence DRA by shaping cognitive beliefs about vulnerability, severity and the benefits of preventive action.

2.3.2. Knowledge-Attitude-Behaviour Framework

The KAB model, derived from cognitive-behavioural theory, suggests that knowledge acquisition is the first step towards attitude formation, which subsequently shapes behaviour (Fishbein and Ajzen, 2011). Within this framework, DRK represents the informational foundation upon which students build their awareness and attitudes towards substance use. Empirical research demonstrates that accurate knowledge about drug risks is positively associated with preventive attitudes and intentions to abstain (Tarhan *et al.*, 2023; Alshehri *et al.*, 2025).

However, the KAB relationship is rarely linear. Knowledge influences behaviour primarily through awareness and attitudinal mediation. Knowledge of the physiological, legal and social consequences of substance misuse increases cognitive awareness of perceived risk, which in turn motivates avoidance behaviour (Sharp *et al.*, 2011). Such knowledge transmission can be structured within extracurricular activities involving health education or leadership training. It is, however, better reinforced through experiential learning, whereby students can contextualise abstract information within real social situations.

Integrating the KAB framework into the current model justifies the mediating role of DRK between EE and DRA. EE enhances exposure to relevant information and prosocial discussions, which in turn elevates knowledge levels; this improved knowledge subsequently fosters stronger risk awareness and preventive cognitions. Hence, the KAB model provides the cognitive pathway linking engagement to awareness.

2.3.3. Social Norms Theory

While the HBM and KAB frameworks explain individual cognition, SNT addresses the social environment that shapes behaviour. According to SNT (Perkins, 2003), individuals' behaviours are heavily influenced by their perceptions of what others do (descriptive norms) and approve of (injunctive norms). Misperceptions - such as believing that peers commonly use drugs or view substance use as acceptable - can increase an individual's likelihood of participation. Conversely, perceiving anti-drug norms can strengthen deterrent attitudes (Papakonstantinou *et al.*, 2025).

PPN thus play a moderating role in shaping how students translate knowledge into awareness. For instance, even when students acquire factual DRK, the impact on their awareness may weaken if their social environment normalises substance use. Conversely, in peer contexts emphasising responsibility and wellbeing, knowledge is more likely to evolve into strong awareness and preventive behaviour.

Recent studies confirm this moderating influence. Pedersen *et al.* (2017) found that university students' perceptions of peers' approval of substance use significantly predicted their own drug-risk perceptions and preventive intentions. Similarly, in collectivist cultures where social belonging is particularly salient, peer norms exert even greater influence (Pedersen *et al.*, 2017). The present study extends SNT by examining how PPN interact with EE- another social domain - to influence cognitive outcomes.

2.4. Linking TheoriesInto a Moderated Mediation Framework:

The integration of HBM, KABand SNT provides a multidimensional explanation of how students develop DRA. From the HBM perspective, awareness reflects perceived severity and susceptibility, influenced by cues such as educational interventions. The KAB framework provides the cognitive sequence through which EE fosters knowledge, which then enhances awareness. The SNT adds the social layer, emphasising that these relationships operate within peer-influenced environments. Together, these theories justify a moderated mediation model, in which knowledge mediates the engagement-awareness relationship, while peer norms moderate the strength of this indirect effect.

EE can thus be understood as both a source of information and a socialisation mechanism. Students participating in structured activities are exposed to institutional messages about responsibility and health, facilitating knowledge development. However, whether this knowledge translates into strong awareness depends partly on the perceived normative climate. In environments where substance use is socially disapproved, the effect of knowledge on awareness and attitudes is stronger. Conversely, in less restrictive or more permissive environments, this relationship is weaker. This framework provides a solid theoretical basis for Saudi universities, where cultural norms emphasise collective responsibility and moral conduct. In this context, peer norms are not only social influences but also reflect broader cultural values. Consequently, the model integrates both individual-level cognitive processes and contextual social dynamics.

2.5. Empirical Evidence and Hypotheses Development:

2.5.1. Extracurricular Engagement and Drug-Risk Knowledge

Previous studies have found that participation in co-curricular or extracurricular activities positively enhances students' cognitive development and the process of acquiring information (Knifsend *et al.*, 2020; Fernandes, 2019). In wellness contexts, participation in wellness programmes and peer-facilitated initiatives increases knowledge about specific risks, such as mental health problems and substance misuse (Rasouli and Samavi, 2025). Given that extracurricular programmes often involve awareness campaigns, volunteering, and leadership roles, students engaged in these activities are more likely to encounter and retain health-related

information. Based on this evidence, the following hypothesis is proposed:

H1:EE has a positive and significant effect on university students' DRK.

2.5.2. Drug-Risk Knowledge and Awareness

The link between knowledge and awareness has been extensively documented in health communication research. Researchers have found that knowledge about the risks of drugs is significantly associated with heightened perception of risk and avoidance behaviour (Tarhan *et al.*, 2023). Among university students, accurate information on the side effects, legal implications and social costs of substance use fosters higher awareness and more responsible attitudes (Alshehri *et al.*, 2025). According to the KAB model, knowledge is a cognitive prerequisite for the formation of awareness.

H2:DRK has a positive and significant effect on university students' DRA.

2.5.3. Extracurricular Engagement and Drug-Risk Awareness

Empirical findings indicate that students actively involved in extracurricular activities demonstrate stronger resistance to risky behaviours, higher self-controland greater awareness of health issues (Eccles *et al.*, 2003; Sharp *et al.*, 2011). Through experiential learning, social responsibility and exposure to preventive messages, extracurricular programmes foster reflective awareness of personal and collective wellbeing. Based on this evidence, the following hypothesis is proposed:

H3:EE has a positive and significant effect on university students' DRA.

2.5.4. The Mediating Role of Drug-Risk Knowledge

While engagement may directly influence awareness, its impact is likely transmitted through enhanced knowledge. Students participating in structured activities acquire factual understanding of drug-related consequences, which subsequently shapes their perception of risk severity and susceptibility (Al Rasheed *et al.*, 2017). Empirical evidence from public health education supports the mediating role of knowledge between educational exposure and awareness (Papakonstantinou *et al.*, 2025). Based on this evidence, the following hypothesis is proposed:

H4:DRK mediates the relationship between EE and university students' DRA.

2.5.5. The Moderating Role of Perceived Peer Norms

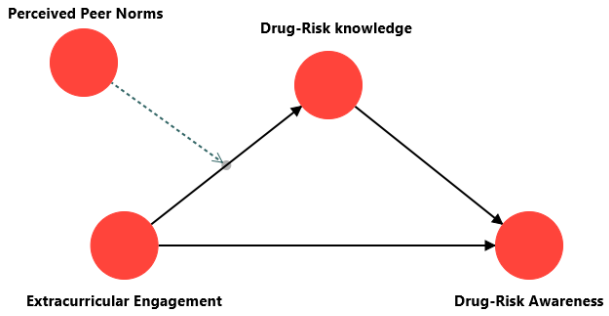
Peer norms influence how individuals interpret and act on their knowledge. When peers disapprove of drug use, the social environment reinforces awareness; conversely, when peers are permissive, awareness may be undermined (Pedersen *et al.*, 2017). Consequently, PPN can condition the indirect effect of engagement on awareness through knowledge. Within the Saudi context, where collectivist values and social approval strongly shape youth behaviour, this moderating effect is particularly salient. Based on this rationale, the following hypothesis is proposed:

H5:PPN moderate the indirect effect of EE on DRA through DRK, such that the relationship is stronger under low-permissive peer norms.

2.6. Conceptual Model:

Based on the integrated theoretical perspectives and empirical evidence discussed above, the conceptual model in Figure 1 hypothesises a positive direct and indirect relationship between EE and DRA, mediated by DRK. PPN are posited as a moderator of the indirect pathway. This model represents a moderated mediation framework capturing both the cognitive and social processes underlying awareness formation among Saudi university students.

Figure 1. Conceptual model



3. Materials and Methods

3.1. Study Constructs:

Within the research context, the measurement scales for the study variables were adapted from relevant literature. EE was measured using a multidimensional seven-item scale adapted from Fredricks and Eccles (2010), Fernandes (2019) and Knifsend *et al.* (2020). DRK was measured with an eight-item scale adapted from Alshehri *et al.* (2025). DRA was assessed using a reflective five-item scale adapted from Tarhan *et al.* (2023). Finally, PPN were measured with an eight-item reflective scale adapted from Dieterich *et al.* (2013) and Pedersen *et al.* (2017).

3.2. Description of Study Population and Sample Selection Method:

This study targets students enrolled in public universities in the Kingdom of Saudi Arabia. According to official statistics released by the Council of Universities' Affairs (2025), total enrolment in public universities reached 985,215 students across 28 universities in all geographical regions of the Kingdom at the end of 2024. A stratified random sampling technique was employed to ensure representative coverage. The appropriate sample size for a large, finite population such as 985,215 students was calculated using the Taro Yamane formula (Yamane, 1967; Oluigbo *et al.*, 2024):

$$n = \frac{\mathrm{N}}{1 + N\,(e)^2}$$

Where n = required sample size, N = population size and e = margin of error (±5%).Accordingly, the calculated sample size for this study is 400 respondents from the population of 985,215 students enrolled in Saudi public universities.

3.3. Data Collection and Analysis Techniques:

This study applied a quantitative research design and used a self-administered questionnaire to collect primary data from students enrolled in public universities in Saudi Arabia. To improve the tool's validity and ensure its relevance and applicability, the questionnaire was piloted with a small sample of 30 university students to check reliability. It was subsequently reviewed and refined by a panel of academics and experts.Data were collected during May, August and September 2025. Questionnaires were distributed to 450 students, and 401 completed surveys were returned, yielding a response rate of 89.1%. The questionnaire was organised into five sections. The first section gathered demographic information, while the remaining four sections focused on the study variables. Respondents assessed items related to EE, DRAand PPN using a five-point Likert scale, while DRK items were measured using a 'know/don't know' format.Descriptive statistical analyses were conducted using SPSS v.29.2022 and Microsoft Excel v.15.2013. In addition, structural equation modelling (Smart-PLS SEM v.4.1.1.5) was employed to test the study hypotheses.

4. Results

4.1. Demographic Characteristics of Respondents:

The authors took deliberate measures to ensure diversity and representativeness within the study sample. Of the 401 completed responses, 310 (77.3%) were male and 91 (22.7%) were female. Additionally, 78.6% of respondents were under the age of 20. The universities from which students received the questionnaire were selected to represent different regions of the Kingdom: King Saud University and Imam Mohammad Ibn Saud Islamic University for the central province; King Faisal University and Imam Abdulrahman Bin Faisal University for the eastern province; King Abdulaziz University and Umm Al-Qura University for the western province; King Khalid University and Jazan University for the southern province; and Northern Borders University and University of Hail for the northern province. The proportion of respondents from each university varied, ranging from 3.5% at Northern Borders University, the lowest, to 24.4% at King Faisal University. Descriptive statistics indicated that mean values ranged from 3.42 to 4.12, while standard deviations ranged from 0.962 to 1.198, suggesting that the data were moderately dispersed around the mean.

4.2. The Outer Model:

4.2.1. Validation of Measurement Constructs

Convergent validity was assessed to determine whether items designed to measure a particular construct correlated with other items measuring the same construct. All standardised factor loadings met the thresholds proposed by Hair *et al.* (2022), with values exceeding the minimum acceptable level of 0.50 and most approaching or exceeding the ideal threshold of 0.70. In addition, the average variance extracted (AVE) was calculated. AVE values for each construct exceeded the minimum of 0.50 recommended by Fornell and Larcker (1981). As shown in Table 1, all four constructs (EE, DRK, DRA and PPN) demonstrated acceptable to excellent convergent validity, with AVE values above 0.50 and factor loadings ranging from 0.532 to 0.866. Moreover, all constructs exhibited excellent internal consistency, with Cronbach's α values ranging from 0.702 to 0.913 and rho_a values ranging from 0.752 to 0.921. These results indicate that the measurement model for these latent constructs is robust and statistically valid.

Table 1. The measurement model validity analysis

Factors	Items	Convergent Validity		Internal Consistency	
		λ	AVE	α	rho_a
Extracurricular Engagement (EE)	EE1	0.866	0.621	0.897	0.904
	EE2	0.836			
	EE3	0.795			
	EE4	0.768			
	EE5	0.776			
	EE6	0.735			
	EE7	0.728			
Drug-Risk Knowledge (DRK)	DRK1	0.568	0.522	0.702	0.752
	DRK2	0.532			
	DRK3	0.549			
	DRK4	0.729			
	DRK5	0.652			
	DRK6	0.652			
	DRK7	0.615			
	DRK8	0.568			
Drug-Risk Awareness (DRA)	DRA1	0.808	0.529	0.850	0.861
	DRA2	0.793			
	DRA3	0.732			
	DRA4	0.741			
	DRA5	0.714			
	DRA6	0.629			
	DRA7	0.645			
Drug-Risk Awareness (DRA)	PPN1	0.850	0.623	0.913	0.921
	PPN2	0.841			
	PPN3	0.811			
	PPN4	0.791			
	PPN5	0.763			
	PPN6	0.786			
	PPN7	0.763			
	PPN8	0.695			

4.2.2. Evaluation of Construct Distinctiveness

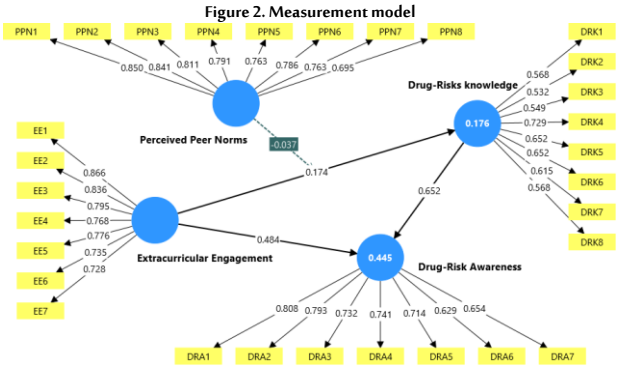
Discriminant validity, a key component of construct validity, was examined to assess the extent to which each construct in the model is distinct from the others. This assessment ensures that the intended independent constructs do not exhibit statistically significant correlations with each other, thereby demonstrating the accuracy of the measurement model in capturing conceptually distinct variables. The procedures outlined by Fornell and Larcker (1981) were applied to confirm discriminant validity.

Table 2. Construct discriminant validity assessment

Factors	DRA	DRK	EE	PPN
DRA	0.727			
DRK	0.490	0.567		
EE	0.595	0.348	0.788	
PPN	-0.076	-0.210	0.038	0.789

Table 2 shows that each factor in the proposed model is clearly distinct from the others. All diagonal values are higher than the corresponding correlation values, confirming discriminant validity across all constructs in line with the standards set by Hair *et al.* (2022) and Fornell and Larcker (1981). Discriminant validity was further assessed using the heterotrait-monotrait (HTMT) ratio. According to the recommended threshold of 0.90 suggested by Henseler *et al.* (2015), all HTMT values for the constructs were below the cut-off point, indicating that the variables are empirically distinct and suitable for subsequent structural equation modelling.

Figure 2. Measurement model



4.2.3. Explanation Power of the Model (R^2)

To assess the explanatory power of the proposed model and the proportion of variance in the dependent variables accounted for by the independent variables, the coefficient of determination (R^2) was employed. The results indicate that DRA is moderately predicted by the independent variables, with the model explaining 54.5% of the variance in university students' awareness of drug risks. This suggests that the model effectively captures the main determinants of the construct. Additionally, the model accounts for 27.6% of the variance in DRK, representing weak-to-moderate explanatory power and indicating that additional factors may influence this construct. Based on these findings and in accordance with Hair *et al.* (2022), the model demonstrates satisfactory explanatory power overall and is suitable for hypothesis testing.

4.2.4. Variance Explained (f^2)

The effect size (f^2) was calculated to assess the extent to which each independent variable influences the dependent variable in the proposed model. According to the criteria of Cohen (1988) and Hair *et al.* (2022), the results presented in Table 3 indicate that the effect sizes of the independent variables on the dependent variables range from nominal to large (f^2 = 0.007 to 0.371). These findings provide a deeper understanding of the comparative influence and practical significance of each predictor, confirming that the EE construct is a key driver of university students' knowledge and awareness regarding drug-related risks.

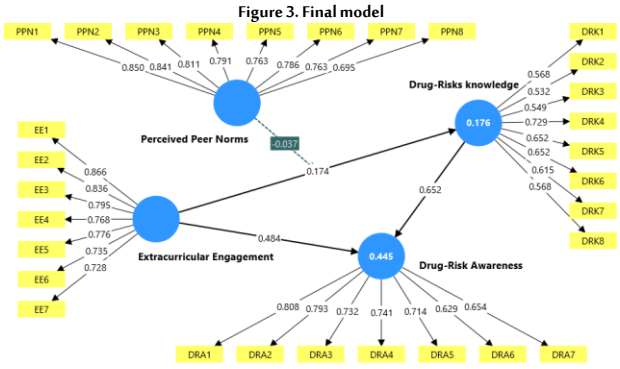
Table 3. Variance explained/squared effect size (f^2)

Factors	DRA	DRK
DRA		
DRK	0.164 (Medium)	
EE	0.371 (Large)	0.152 (Medium)
PPN		0.059 (Small)
PPN x EE		0.007 (Nominal)

4.2.5. Model Fit Evaluation

Model goodness-of-fit was assessed to evaluate the adequacy of the proposed model across the measurement model, structural model and overall framework. The results show that the SRMR values (saturated model = 0.052, estimated model = 0.072) fall below the recommended threshold of 0.08, in line with the guidelines of Hair *et al.* (2022) and Henseler *et al.* (2015), indicating good model fit. Overall, these goodness-of-fit measures suggest that the model provides a satisfactory representation of the observed data and is suitable for hypothesis testing.

Figure 3. Final model



4.3. Hypotheses Evaluation:

The significance of the path coefficients was tested to evaluate how well the proposed theoretical model aligns with the primary data. The results of the hypothesis tests are presented in Tables 4 and 5.

Table 4. Direct path estimates

Pathway	Standardised Coefficient	σ	Observed t-value	Sig.	Result
H-1: EE ->DRK	0.174	0.021	8.348	0.000	√**
H-2: DRK ->DRA	0.652	0.085	7.688	0.000	√**
H-3: EE -> DRA	0.484	0.038	12.762	0.000	√**

Significant at P = 0.000**

As indicated in Tables 3 and 4 and depicted in Figure 3, the results of the hypothesis tests strongly support the conceptual model, highlighting robust direct relationships among the study constructs for students enrolled in public universities in Saudi Arabia. EE has a significant positive direct impact on DRK (β = 0.174, f^2 = 0.152, p = 0.000), confirming that students who actively participate in extracurricular activities tend to have greater understanding of drug-related risks.Additionally, DRK shows a strong significant positive direct impact on DRA (β = 0.652, f^2 = 0.164, p = 0.000), indicating that university students with higher knowledge about drugs are more aware of their associated risks, thereby confirming the mediating role of knowledge in shaping awareness. Moreover, EE demonstrates a strong significant positive direct impact on DRA (β = 0.484, f^2 = 0.371, p = 0.000), supporting the view that participation in extracurricular activities directly enhances university students' DRA. This suggests that students engaged in organised activities are more likely to develop a preventive mindset regarding drug risks. Collectively, hypotheses H1, H2 and H3 are supported.

Table 5. Indirect and moderated mediation path estimates

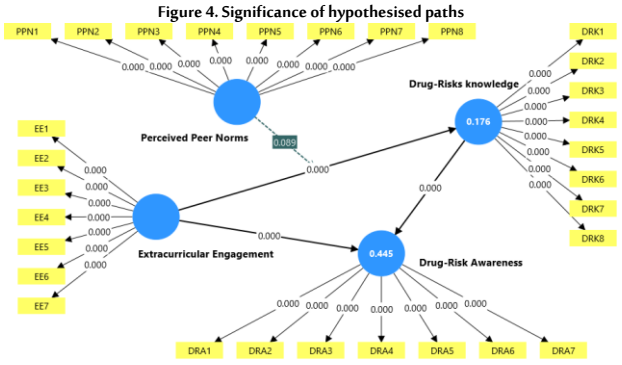
Pathway	Standardised Coefficient	σ	Observed t-value	Sig.	Result
H-4: EE ->DRK ->DRA	0.114	0.020	5.731	0.000	√**
H5: PPN x EE ->DRK ->DRA	-0.024	0.015	1.652	0.089	X

Significant at P = 0.000**

Regarding the indirect relationship, DRK exhibits a significant, partially mediating positive effect on the relationship between EE and DRA (β = 0.114, t = 5.731, p = 0.000). This finding confirms that university students who actively participate in extracurricular activities acquire greater drug-related knowledge, which in turn enhances their awareness of drug risks. In other words, knowledge partially transmits the influence of engagement on awareness. Collectively, hypothesis H4 is strongly supported.

The moderated mediation analysis indicates that the standardised coefficient (β = −0.024) is small and negative, suggesting a very weak moderating effect of PPN on the indirect relationship between EE and DRA through DRK. Furthermore, the t-value (1.652) and p-value (0.089) fall below the threshold for statistical significance ($p < 0.05$), indicating that the effect is not significant. These results demonstrate that PPN do not significantly alter how engagement in extracurricular activities influences students' DRA via knowledge. In other words, the positive impact of EE on knowledge and awareness occurs independently of peer influence levels. Consequently, hypothesis H5 is not supported.

Figure 4. Significance of hypothesised paths



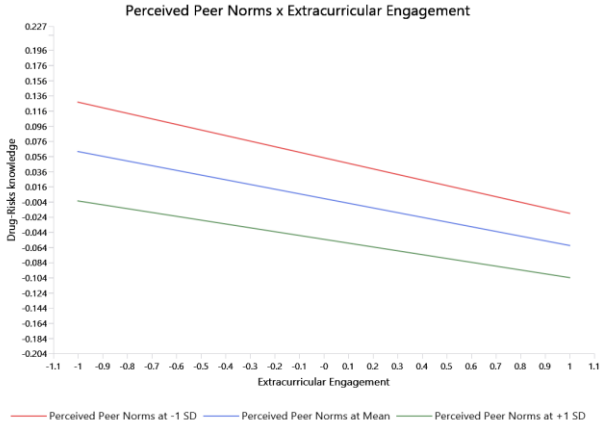
4.4. Simple Slope Examination:

To further explore the interaction effect, a simple slope analysis was conducted to examine the moderating impact of PPN on the relationship between EE and DRA through DRK, following the procedures recommended by Aiken and West (1991) and Dawson (2014) (see Table 6 and Figure 5).

Table 6. Simple slope results

Levels of PPN	Extracurricular Engagement -> Drug-Risk Knowledge -> Drug-Risk Awareness
Perceived Peer Norms at +1 SD	0.090
Perceived Peer Norms at -1 SD	0.138
Perceived Peer Norms at Mean	0.114

Figure 5. Interaction plot showing the moderating effect of PPN on the relationship between EE and DRK via DRA



The simple-slope analysis results presented in Table 6 and Figure 5 indicate that the indirect relationship between EE and DRA through

DRK varies only slightly across levels of perceived peer norms PPN. Overall, the findings highlight that engagement in extracurricular activities promotes students' DRA primarily through enhanced DRK, and this relationship remains consistent across different peer norm conditions.

5. Discussion

5.1. Overview of Findings:

This study aimed to examine how EE influences university students' awareness of drug-related risks through DRK and across varying levels of PPN. Using data from 401 Saudi university students, the findings provide robust empirical support for most of the hypothesised relationships, confirming that EE plays a pivotal role in shaping students' cognitive and attitudinal outcomes. Specifically, EE significantly predicted both DRK and awareness, with DRK partially mediating this relationship. However, the moderating effect of PPN on the indirect pathway was not statistically significant, indicating that the impact of engagement on awareness operates largely independently of peer norm perceptions.

The results provide evidence of the ways in which extracurricular activities function as psychosocial and educational contexts, fostering preventive awareness and promoting health-related cognition among youth. They also support the theoretical integration of HBM, KAB frameworkand SNT in explaining how students internalise DRA within university settings.

5.2. The Role of Extracurricular Engagement in Fostering Preventive Awareness:

The study further found a strong positive correlation between extracurricular participation and awareness of drug risks, highlighting the transformative potential of co-curricular activities as informal learning environments. This aligns with previous evidence that student engagement fosters psychosocial competence, resilience and moral reasoning (Eccles et al., 2003; O'Donnell et al., 2024). Through collaboration, leadershipand shared responsibility, students acquire both the cognitive and social skills needed to navigate health-related risk situations.

Theoretically, the findings validate two dimensions of the HBM: cues to action and perceived benefits. Structured extracurricular activities serve as channels through which institutional messages on wellbeing and responsibility provide such cues, activating preventive cognitions. Within the broader framework of Saudi Vision 2030, integrating health-oriented themes into extracurricular programmes enhances awareness and wellbeing, positioning these activities as practical tools for preventive education and holistic student development.

5.3. Mediating Role of Drug-Risk Knowledge:

The mediation results indicate that DRK serves as a central cognitive mechanism linking EE and awareness. Consistent with the KAB framework (Fishbein and Ajzen, 2011), knowledge gained through structured participation enhances students' understanding of the physiological, legal and social consequences of substance use, thereby increasing their awareness and intentions to avoid risks. The partial mediation suggests that, in addition to cognitive learning, affective and experiential aspects of engagement - such as empathy, leadership and moral commitment - may also contribute to the formation of awareness. These findings underscore the importance of future research examining how emotional and experiential components of engagement complement knowledge in shaping preventive attitudes.

5.4. Non-Significant Moderation by Perceived Peer Norms:

Contrary to SNT expectations, PPN did not significantly moderate the indirect relationship between EE and DRA through DRK. This suggests that students involved in structured, prosocial activities may be less influenced by peer permissiveness, as such environments provide alternative reference groups and institutional moral reinforcement (Knifsend *et al.*, 2020). In Saudi Arabia's collectivist and value-driven context, family, religiousand institutional norms likely exert stronger behavioural control than peers (Alenazi *et al.*, 2023; AlSayyari and AlBuhairan, 2018).

The weak negative coefficient nonetheless indicates that permissive norms could slightly attenuate awareness formation, highlighting the need for more nuanced, multi-level analyses of normative influences. Theoretically, this mediating relationship strengthens the integration between the HBM and KAB models. While HBM emphasises perceived susceptibility and severity, the KAB framework provides a cognitive mechanism for how these perceptions are constructed through knowledge acquisition. The present study demonstrates that extracurricular involvement offers both the informational input and social reinforcement necessary to enhance awareness - a combination that has received limited empirical attention in the Arab higher education context.

5.5. Theoretical Implications:

This study contributes to health and behavioural science by integrating cognitive and social frameworks - the HBM, KAB frameworkand SNT - into a single moderated-mediation model explaining how knowledge interacts with social contexts to shape awareness. This integration provides a holistic understanding of preventive cognition by combining personal and environmental determinants.

First, the study extends the HBM by situating perceived awareness within educational and social participation domains. Extracurricular activities serve as institutionalised 'cues to action', demonstrating that health awareness can emerge not only from clinical or behaviouralprogrammes but also from everyday university life. Second, it strengthens the KAB framework by establishing knowledge as a mediating mechanism in an organic educational setting, rather than through artificially controlled interventions. Third, applying SNT in Saudi Arabia's collectivist, value-oriented culture offers new insights into the theory's cross-cultural applicability. The absence of strong moderation by peer norms suggests that normative influence may operate differently in hierarchical or religion-based societies, where institutional and moral factors exert greater behavioural control. These findings highlight the need for culturally sensitive extensions of SNT that consider institutional collectivism as a boundary condition.

5.6. Practical and Policy Implications:

The findings offer actionable insights for both universities and policymakers. First, extracurricular activities institutionalised as preventive education tools should be made mandatory rather than optional. Health awareness and drug-risk education can be integrated into clubs, volunteering programmesor leadership workshops within student affairs orientations or community service requirements. Such programmes can strongly support awareness initiatives by training student leaders to act as credible messengers who normalise preventive behaviour and correct misconceptions, aligning with both the HBM's cue-to-action principle and SNT's focus on normative restructuring. Second, policymakers should leverage extracurricular frameworks to advance Vision 2030 goals of fostering a physically and mentally resilient generation. The Ministry of

Education and the National Committee for Narcotics Control can coordinate extracurricular programmes on mental health, stress management and substance-use prevention. Third, awareness campaigns should combine evidence-based knowledge with emotional messaging. Interactive or gamified e-learning - such as quizzes delivered through social media - can increase engagement while reinforcing accurate understanding. Finally, in the Saudi context, intrinsic motivation and moral awareness are more effectively nurtured when religious and ethical perspectives on health and self-control are incorporated into student programmes.

5.7. Limitations and Directions for Future Research:

The study's cross-sectional design limits causal inference; future longitudinal research could establish temporal sequencing. Self-reported data may be subject to social desirability bias, and incorporating qualitative or behavioural measures would strengthen validation. As the study focused on Saudi public universities, future comparisons with private or regional institutions could reveal contextual differences. The non-significant moderation by peer norms highlights the value of multi-level analyses that distinguish personal from collective normative influences. Finally, future research should examine emotional and motivational mediators - such as self-efficacy or moral obligation - to clarify the non-cognitive pathways linking engagement and awareness.

6. Conclusion

This study contributes to the literature on how university-level extracurricular involvement shapes students' DRA both cognitively and socially. It develops a holistic model explaining the formation of preventive awareness in higher education through the integration of the HBM, KAB frameworkand SNT. A case study of Saudi public universities provides empirical evidence that knowledge and awareness of drug risks can be fostered through extracurricular activities, with knowledge serving as a significant mediating mechanism. Although PPN did not moderate this relationship, the findings suggest that structured engagement can function as a protective social context, strengthening students' health cognitions independently of peer influence.

Theoretically, this research advances behavioural and educational literature by extending cognitive and social models into an Arab-Islamic context, offering insights into how non-formal educational structures can foster health literacy and resilience. Practically, it urges universities to integrate drug-risk education within student engagement initiatives and encourages policymakers to recognise extracurricular programming as a key component of preventive health policy. In light of the diverse social and psychological pressures facing today's youth, universities should implement proactive, evidence-based engagement strategies that go beyond traditional awareness campaigns. By situating academic development within community, responsibility and moral frameworks, such approaches can support sustainable prevention, enabling students to lead healthy, safe and purposeful lives.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

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Conflict of Interest

The authors declare no conflict of interest.

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