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Revealing Intentions of Substance Abuse: How Adverse Childhood Experiences and Sensation-seeking Affect Adolescents in High-risk Areas

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ABSTRACT

Drug addiction continues to be a significant global social issue affecting both individuals and society. Adolescents are recognised as the most vulnerable group and the primary contributors to drug addiction statistics. Factors such as psychosocial development, peer influence, adverse childhood experiences, and curiosity contribute to early substance use. This study investigates the factors influencing substance abuse intention (SAI) among adolescents living in high-risk areas of Peninsular Malaysia, utilising the Theory of Planned Behaviour (TPB) as its primary framework. It specifically explores the mediating role of adverse childhood experiences (ACE) and the moderating effect of sensation seeking. Data were gathered from 112 adolescents using homogeneous convenience sampling. Analysis was conducted utilising Partial Least Squares structural equation modelling (PLS-SEM). Results indicate that attitude, subjective norms, and sensation seeking serve as direct predictors of SAI. A partial mediating effect of ACE was found in the relationship between subjective norms and SAI, while sensation seeking significantly moderated the relationship between attitude and SAI. These findings illuminate the considerations that adolescents in at-risk areas make regarding substance abuse, providing valuable information for policymakers to address these factors and prevent early substance use among adolescents. By introducing three new psychological constructs, this study expands the TPB's application for predicting intentions in substance abuse research. It also addresses a significant gap in understanding the critical

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factors influencing adolescent substance abuse. A deeper understanding of these factors can enhance awareness of where intervention strategies may be more effective.

Keywords: Adverse childhood experiences, sensation seeking, substance abuse intention, theory of planned behaviour

INTRODUCTION

Drug addiction is widely recognised as a chronic and multifaceted condition, as well as a form of social pathology that poses a serious threat to human health and societal well-being. Globally, nearly 292 million people aged 15 to 64, or about one in every 18 individuals, were estimated to have used drugs in the previous 12 months (United Nations Office on Drugs and Crime, 2024). Reflecting this global trend, Malaysia also experienced a concerning rise in drug abuse, with a prevalence of 436 individuals per 100,000 population. Recent national statistics show an 11.27 percent increase in recorded drug users, reaching a total of 130,788 in 2023. Notably, youth remain the most affected group, as individuals aged 15-39 make up 63.2 percent of drug-related cases; an increase of 4.2 percent from previous years, while adolescents aged 14-19 account for an additional 1.98 percent of identified users (National Anti-Drug Agency [NADA], 2020). Various initiatives and strategies have been implemented to address the issue of drug addiction among youth, aligning with NADA's aims to reduce this rate to 400 or fewer per 100,000 residents by 2025. This target aligns with the United Nations Sustainable Development Goal (SDG) 3, target 3.5, which aims to improve the prevention and treatment of substance abuse while supporting the vision of safe, resilient communities outlined in SDG 16. The prevalence indicators emphasise the scale of the challenge and the essential importance of coordinated, multisectoral action in achieving the National Drug Policy's goal of drug-free families, communities, and workplaces.

Adolescents are particularly susceptible to drug addiction due to the interplay of multiple vulnerability and risk factors (Ersche et al., 2020). This period represents a critical transition during which adolescents and young adults are more vulnerable to substance initiation and misuse. Substance exposure during adolescence has been shown to markedly increase the risk of later substance use disorders (Kirsch & Lippard, 2022), which naturally heighten their curiosity and interest. Within the Theory of Planned Behaviour (TPB), adolescent curiosity shapes attitudinal belief. However, its translation into intentions to use substances depends on subjective norms and perceived behavioural control. Affiliation with substance-using peers and permissive or conflicted family climates elevates injunctive and descriptive norms that favour use, while low-income family functioning and perceived ease of access erode control beliefs, thereby strengthening intentions to experiment or use (Bunu et

al., 2023; Latt et al., 2024; Nakibuuka & Nalubega, 2022).

Curiosity is a normative adolescent phenomenon because adolescents are developmentally predisposed. However, when compounded with poor environmental factors, this process may become a strong risk factor that leads to further substance use. Based on the TPB, the intention to engage in substance use depends on three constructs, namely, attitudinal beliefs, subjective norms, and perceived behavioural control. Peer influence, in particular, affiliation with drug-using peers is pivotal in the formation of normative beliefs, whereas familial risk factors such as poor functioning, history of substance use can weaken behavioural control and self-efficacy (Bunu et al., 2023; Latt et al., 2024; Nakibuuka & Nalubega, 2022). Socioeconomic disadvantage, including poverty and inadequate socioeconomic support, may heighten the risk of substance misuse by increasing exposure to stress, hopelessness, and psychological depression among vulnerable youth (Kamal et al., 2024). The interaction of dysfunctional family conditions and environmental deprivations may contribute to adverse childhood experiences (ACEs) and early adversity, which have been linked to earlier initiation of substance use and greater vulnerability to problematic substance use among young people (Meadows et al., 2024; Mongan et al., 2025). Previous studies show that cumulative exposure to ACEs significantly increases an individual's likelihood of substance dependence, and greater ACE scores are also associated with severe substance dependence trajectories or poorer treatment outcomes (Bogetić et al., 2023). This association is also enhanced by sense-seeking, a state of personality characterised by an interest in new, extreme experiences, as well as an openness to risks associated with them. The results show that ACEs such as emotional abuse and neglect may influence sensation-seeking among emergent adults, thus increasing their risk-taking tendency (Babad et al., 2021). However, there are minimal studies on ACE, sensation seeking, and adolescents' substance abuse in the Asian context. Thus, this study was designed to investigate its relationship in the local context, and the data will contribute to relevant agencies and policymakers in preventing adolescents' involvement in drug abuse.

LITERATURE REVIEW

The TPB suggests that intention is the primary predictor of behaviour, and it is shaped by attitude, subjective norms, and perceived behavioural control (Ajzen, 2005). These constructs represent views on the behaviour, any perceived social expectations, and perceived ability to execute or resist such behaviour (Fishbein and Ajzen, 2010). TPB is also extensively used in both health and risk research due to its parsimonious but adaptable model to predict intention in a variety of contexts, and longitudinal research findings suggest that its results remain constant over time (Hagger and Hamilton, 2023). TPB, therefore, offers a theoretically sound explanation of the intentions of adolescents to use substances.

Attitude and Substance Abuse Intention

Adolescents' attitude towards substance use is among the leading determinants of substance abuse, with a positive attitude more likely to increase abuse than a negative attitude (Garcia-Cerde et al., 2021). These attitudes are shaped by various factors, including age, gender, religion, environment, socioeconomic status, and educational background; however, the findings of empirical evidence on these factors tend to contradict one another. Young people, due to their increased curiosity, may have a positive attitude towards alcohol and substance use; however, this positive disposition may decline with age. In a study of 174 medical students, Shafiq et al. (2006) found that senior students rated substances as less beneficial than junior students. A similar pattern was reported among 400 Jordanian high school students, where Haddad et al. (2010) found that 65% of respondents viewed substance use as a serious issue, with older students showing greater awareness than younger students. Although males have traditionally shown higher rates of substance use disorders than females, the gender gap has been narrowing over time (McHugh et al., 2018). Indeed, research indicates that adolescent girls may be more likely than boys to engage in polydrug and alcohol use (Garcia-Cerde et al., 2021).

Changes in social environment and cultural context may shape adolescents' attitudes and intentions towards substance abuse. A comparative study of Middle Eastern adolescents living in Los Angeles, California, and Beirut, Lebanon, found that a longer duration of residence in the United States was associated with a greater likelihood of substance abuse among both Muslim and Christioan adolescents (Badr et al., 2014). At the same time, substance use remains an important public health concern in Middle Eastern countries. Evidence from a systematic review of youth in the Eastern Mediterranean region suggests that attitudes and subjective norms are significantly associated with intentions to use substances, highlighting the importance of sociocultural influences in shaping substance-related perceptions and behaviours (El Khoury et al., 2019). Therefore, we hypothesise:

> H1. Attitude is positively associated with intention to abuse substances among adolescents in at-risk communities.

Subjective Norms and Substance Abuse Intention

Social influence plays an important role in substance abuse among adolescents. Subjective norms refer to an individual's perception of social approval or disapproval regarding a particular behaviour, especially from important referent groups, and this perceived social pressure may shape behavioural intention (Ajzen, 1991). Research indicates that the influence of referent groups and environment on adolescent substance abuse intention is very potent, where the onset of cannabis use is

associated with drug use among friends and time spent in bars and discos, and the predictive effects of subjective norms on binge drinking intention was more potent when accessed in a bar than in the library (Cooke & French, 2011; Guxens et al., 2007). According to (Dir et al., 2017), a key socio-developmental determinant of binge drinking among female adolescents is peer influence, while males are more vulnerable to binge drinking because of gendered norms that socially accept and even sometimes reward boys for binge drinking. Although peer influence on adolescent substance abuse is usually manifest during adolescence, latent influences that emerge after adolescence are also possible. For instance, Visser et al. (2013) presented evidence that having alcohol users as friends during adolescence increases the likelihood of alcohol abuse during young adulthood. Also, many children in the United States live with a parent who misuses alcohol or other substances, and this exposure may increase their vulnerability to later substance use problems (Straussner & Fewell, 2011; Usher et al., 2015). A recent study found an indirect association between older siblings' cannabis and e-cigarette use and adolescents' later substance use intention (Maiya et al., 2023). Therefore, we hypothesise:

H2. Subjective norms are positively associated with intention to abuse substances among adolescents in at-risk communities.

Perceived Behavioural Controls and Substance Abuse Intention

According to Ciranka and van den Bos (2021), adolescents are active explorers and learners whose propensity for risk-taking may increase when they encounter opportunities to explore, take risks and adapt to their environment. Perceived behavioural control refers to an individual's perceived ease or difficulty in performing a particular behaviour (Ajzen & Madden, 1986). Within the Theory of Planned Behaviour, perceived behavioural control is one of the strongest predictors of actual behaviour because, together with intention, it serves as a direct predictor of behaviour (Ajzen, 2011). A meta-analytic study of the moderating effects of perceived behavioural control on all TPB constructs in 39 health-related studies found that the stronger people believe they can control a particular behaviour, the more likely they are to act on their intentions. Research indicates that young people's behavioural control beliefs over consuming substances vary from their control beliefs over obtaining them (Orbell et al., 2001). This finding highlights the key role that the environment plays in controlling beliefs about substance abuse. A longitudinal study involving 514 children of alcoholic parents and matched controls found that slower rates of increase in bahavioural control were associated with a greater likelihood of alcohol and illicit drug use during adolescence, while higher initial levels of resiliency were linked to a lower likelihood of early alcohol use

(Wong et al., 2006). Similarly, in a study of early adolescents in at-risk communities characterised by widespread substance abuse problems, perceived behavioural control is the predominant factor that predicts substance use intention (Huang et al., 2014). Therefore, we hypothesise:

> H3. Perceived behavioural control is positively associated with intention to abuse substances among adolescents in at-risk communities.

Knowledge of Substances and Substance Abuse Intention

Adolescents generally become more aware of substance use as they grow older, partly because this stage of life is often marked by curiosity and exploration. However, their understanding of substance-related symptoms, withdrawal, and treatment remains relatively limited (El Khoury et al., 2019). Greater age is aften associated with better knowledge of substance use, as shown by Haddad et al. (2010), who reported that more than a quarter of students considered their knowledge to be very good, especially regarding the harmful effects of substances on the body and society. Adolescents also tend to receive substance-related information from those around them, particularly peers (Macdonald & Howard, 2020; Manuel et al., 2024). At the same time, media and online platforms have become increasingly influential sources of such information (Engel et al., 2024; Hendriks et al., 2020; Kong et al., 2019). It is important to note that knowledge of the harmful effects of substances does not always translate to avoidance. A study of secondary school students in Kenya found that three-quarters of students were aware of the health risks associated with drug use; however, almost an equal number of participants in the study knew a schoolmate who was on drugs (Ndetei et al., 2010). A recent systematic review of studies on cannabis knowledge and risk perception among adolescents found that intention to use and current usage of cannabis reduce with higher levels of knowledge and/or perception of risk (Harrison et al., 2024). Also, research indicates that although at-risk youths may rely heavily on trusted friends for drug information, they also use the internet to obtain additional information about side effects and associated risks before trying them (Macdonald & Howard, 2020). Therefore, we hypothesise:

> H4. Knowledge of substance use is negatively associated with intention to abuse substances among adolescents in at-risk communities.

Mediating role of adverse childhood experiences

Though the TPB primarily deals with immediate psychological variables, it can also incorporate more background variables, like personality, social setting, and life experiences that would indirectly influence intention via attitudes, social norms, and control beliefs (Ajzen, 2005; Fishbein and Ajzen, 2010). This concept is common in health behaviour studies, in which

TPB has typically been integrated with larger developmental and environmental frameworks to more effectively understand behaviour (Conner & Norman, 2015). It is particularly crucial during adolescence, as this period of life is characterised by heightened peer influence, life stress, and brain alterations that influence reward seeking and self-control (Romer et al., 2017). This is why, the inclusion of developmental risk factors and personality traits into TPB is theoretically justified when their roles are clearly articulated.

Adverse Childhood Experiences (ACEs) are defined as stressful or harmful events in childhood, which may impact the emotional control, coping skills, and thinking patterns, which consequently influence the way adolescents interpret social situations and the way they evaluate risky behaviour (Cicchetti, 2016). Developmental theory demonstrates that early adversity may alter the path of development and predispose a child to unhealthy coping or a high risk of making dangerous decisions later in life (Cicchetti, 2016). Within an extended TPB model, ACE could be considered a process that assists in explaining why certain adolescents tend to translate positive attitudes or lax social norms regarding substance use more often than others into actual intention. Simply put, early adversity could render certain young people more susceptible to stress or social pressure, which can strengthen the connection between their beliefs and their intentions.

Research indicates that ACE is associated with adolescent risk-taking partly because it reduces self-control, which implies that its effects are typically mediated by psychological mechanisms as opposed to being direct (Wang et al., 2025). Studies also reveal that adolescent risk taking is best explained by interactions of several factors, particularly how stressful environments affects thinking and emotions that influence decision-making (Bozzini et al., 2020). Corresponding results indicate that challenging life circumstances modulate risk behaviour via mental and self-regulation capacities (Jia et al., 2021). This evidence, combined with the factors discussed earlier, contributes to the notion that ACE can be a mediator in a more extended TPB framework since it illustrates how background experiences influence intentions. In this model, ACE is conceptualised as mediating the relationship between TPB belief components (attitudes, norms and perceived behavioural control) and substance use intention.

Research indicates that exposure to traumatic experiences before the age of 11 years increases adolescents' likelihood of using cannabis, cocaine, prescription medicine, and other drugs (Carliner et al., 2016). Childhood traumatic experiences range from emotional and physical neglect to experiences of physical, emotional, and sexual abuse, and prevalence varies across the world, with North and South American countries ranking the highest (Zhang et al., 2020). In non-Western countries like China, childhood maltreatment has also been positively associated with non-medical prescription opioid use (Lei et

al., 2018). Other indicators of adverse childhood experiences include parental separation or divorce, domestic violence, household mental illness, family member imprisonment, and household substance abuse (Baglivio & Epps, 2014).

For many adolescents who have experienced childhood trauma, substance use may function as a maladaptive coping strategy for managing distress. Previous studies suggest that stress exposure is associated with greater substance use risk among adolescents, while trauma-exposed individuals may report using substances to temporarily reduce stress or avoid uncomfortable feelings (Charles et al., 2017; Froelich et al., 2022). In addition, adverse childhood experiences, including physical and emotional abuse, sexual abuse, neglect, and household substance abuse have been positively associated with adolescent substance use and later substance use severity (Halpern et al., 2018; Kobulsky et al., 2018; Usher et al., 2015). Therefore, we hypothesise.

H5a. Adverse childhood experiences will mediate the relationship between attitude and substance abuse intention.

H5b. Adverse childhood experiences will mediate the relationship between subjective norms and substance abuse intention.

H5c. Adverse childhood experiences will mediate the relationship between PBC and substance abuse intention.

H5d. Adverse childhood experiences will mediate the relationship between knowledge of substance use and substance abuse intention.

Moderating Role of Sensation Seeking

It is also possible to include moderators in the extended TPB models since individuals differ in the strength of the link between beliefs and intention. Moderation is used when a factor changes the strength of a relationship, and statistical methods may be used to test moderators along with mediators to better understand behaviour (Hayes, 2022). Personality traits are strong candidates for this role because they influence adolescents' responses to rewards, risks`, and social circumstances. Research evidence shows that not all adolescents make rational decisions; some are more impulsive, and individual differences can help explain these variations (Maslowsky et al., 2019). Sensation seeking, i.e. preference for new and exciting experiences, is one such trait. It is closely associated with risky behaviour and reward-oriented decision making which may enhance the impact of favourable attitudes on intention (Maslowsky et al., 2019; Romer et al., 2017; Zuckerman, 2007). Studies building on TPB also demonstrate that personality traits can affect its pathways, which justifies adding them as moderators (Van Le et al., 2023).

Taken together, the suggested model is theoretically sound as it retains the core TPB framework but situates it within a broader developmental and personality framework. According to developmental

theory, early adversity may result in later risk through psychological mechanisms (Cicchetti, 2016), and studies indicate that these effects are typically indirect rather than direct (Wang et al., 2025). At the same time, individual differences help explain why certain adolescents act more strongly on their beliefs than others, which reinforces the moderating role of sensation seeking (Hayes, 2022; Maslowsky et al., 2019; Zuckerman, 2007). The integration of these ideas aligns with the existing studies showing that multi-factor models that include beliefs, life experiences, and personality are most appropriate for explaining adolescent risk intentions (Bozzini et al., 2020; Jia et al., 2021; Romer et al., 2017; Van Le et al., 2023).

Sensation seeking refers to an individual's propensity to seek novel, intense, and risky experiences (Arnett, 1994). For adolescents and adults alike, sensation seeking is a basic psychological need and a significant predictor of intrinsic motivation (González-Cutre et al., 2016). Sensation seeking may be especially salient during adolescence and emerging adulthood, as this developmental period is often characterised by identity exploration, instability, self-focus, and experimentation, all which may increase openness to substance-related risk-taking (Arnett, 2005). Consistent with this view, earlier research found that the sensation seeking was linked to alcohol and marijuana use during adolescence (Bates et al., 1986). Prior research shows that positive disposition towards alcohol and cannabis use in early adolescence has been associated with higher sensation seeking (LaSpada et al., 2020). In addition, youth exposed to substance-using family environments may be more vulnerable to later substance-related problems, although Straussner and Fewell (2011). Is better suited as a broad background source than as direct evidence for positive attitudes towards substance use. Meldrum et al. (2022) found that greater exposure to adverse childhood experiences was associated with developmental patterns marked by lower impulse control and higher sensation seeking, which in turn were linked to greater delinquency. Based on this, the following hypothesis is proposed:

H6a. Sensation seeking is associated with intention to abuse substances among adolescents in at-risk communities.

H6b. Sensation seeking will moderate the relationship between attitude and substance abuse intention among adolescents in at-risk communities.

METHODOLOGY

Participants

The population of the study consists of adolescents living in high-risk drug use areas, as well as in hotspot areas identified by the NADA. Approximately 9,939,491 individuals reside in 155 high-risk areas (NADA, 2020). According to the United Nations Population Fund (UNFPA, 2020), individuals aged 10 to 19 years represent approximately 15% of the total population,

corresponding to 1,490,923 individuals in the targeted areas. To determine an appropriate sample size, this study employed Cochran's formula, using a 95% confidence interval and a ±5% margin of error as recommended by Chaokromthong and Sintao (2021) and Cochran (1977). The minimum required sample size for this study is 385 respondents. To ensure greater reliability and account for potential non-responses or incomplete questionnaires, the sample size was rounded up to 400 respondents.

Sampling Procedure

This study employed multistage sampling, beginning with the selection of areas based on four zones (northern region, central region, east coast, and southern region) in Peninsular Malaysia, using simple random sampling from a list of high-risk drug areas. Four states (Kedah, Kelantan, Johor, and Selangor) were randomly chosen from these zones, representing each country's geographic regions. Afterwards, researchers selected the location based on a list of high-risk drug areas. Two districts were selected for each state. Adolescents 18 years old or younger living at high risk met the inclusion criteria as respondents. Data collection was conducted with the approval of the Ethics Committee for Research Involving Human Subjects at Universiti Putra Malaysia (reference no: JKEUPM-2022-969). The process involved various approaches within the community. For residential areas, researchers and enumerators sought permission from the village or residential area chief to inform them about the research. They requested their assistance in disseminating information to residents. In public areas, such as residential parks or other public spaces, researchers obtained consent from the parents or guardians of adolescent respondents. For respondents without immediate parental or guardian presence, researchers distributed questionnaires to selected adolescents, requesting them to take the forms home, obtain parental or guardian consent, and return the completed questionnaires the next day. A trained enumerator worked with the researcher to collect the data, assess the respondents' reading ability in Malay, and explain the questionnaire content to prevent misinterpretation.

Measures

Consistent with TPB and additional constructs, eight independent variables were included in the survey: attitude towards substance use, subjective norms, perceived behavioural control, adverse childhood experiences, sensation seeking, and knowledge. The dependent variable was substance use intention in the future. All variables were measured using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Substance abuse intention was assessed using a 9-point scale by adopting items from scholars (Ajzen, 2006; Bait Ajzoon, 2017; Cabral, 2022; Ma et al., 2018). A higher score indicated a stronger intention to use substances in the future. Examples of items in this instrument are "I intend to smoke a cigarette", "If it is allowed

by law, I will use kratom, " etc. Attitudes towards substance use were assessed using an 11-item inventory adapted from Ajzen (2006), Bait Ajzoon (2017), and Fok & Tsang (2). A higher score indicated a positive evaluation of substance use—examples of these items included: 'For me, people who vape look cool'; 'Everyone who tries drugs will eventually regret it'. Subjective Norm was measured with 12 items (Ajzen, 2006; Mereish et al., 2017; Zaleski & Aloise-Young, 2013). Higher scores indicate high social approval for substance use, for instance, 'my friends feel it's not wrong if I smoke', 'my parents forbade me to vape', and 'there's someone close to me drinking wine/ beer in front of me'. PBC was measured using an eight-item inventory (Ajzen, 2006; Tavousi et al., 2009). Higher scores indicate that respondents perceive greater ease or difficulty in performing the behaviour and demonstrate more confidence in their ability to resist substance use under challenging situations, items such as 'getting a vape in my area is easy if I want'; 'taking prohibited substances, e.g. kratom/marijuana/shabu or not, it's up to me'), Substance use knowledge was assessing respondents' understanding of substance user symptom and substance use harmfulness with 20 items inventory. This measure was developed by adapting information from NADA on the symptoms of substance use and its harmfulness (Gaiha et al., 2021). ACE is measured by 13 items adapted from a previous study (Felitti et al., 1998). with items such as "I live in an unsafe environment", "I often do not have enough food to eat", and "I have experienced abuse from a family member." "Higher scores indicate adolescents experienced house challenges, neglect, and abuse. Sensation seeking was measured by an 8-item inventory adapted from The Brief Sensation Seeking Scale (BSSS) (Stephenson et al., 2003) with items such as "I enjoy travelling without planning", "I enjoy doing thrilling activities", and "I seek new and exciting experiences, even if it means breaking the rules". A higher score indicates a high tendency to pursue new and different sensations, feelings, and experiences in risky activity. Additionally, the substance use behaviour of the respondent is measured by items which include the first experience with substance use, whether it was voluntary, forced, or influenced by friends, and how many of their friends were involved in these behaviours. For example: "my first experience with smoking was..." and "number of friends who use drugs: ...".

ANALYSIS

Demographic Analysis

Phase 2 data collection was conducted after the data analysis of the EFA with updated measures. The sample comprises 400 respondents (54.8%) identified as female, while 181 (45.3%) identified as male. As shown in Table 1, the respondents ranged from 13 to 18 years, with a mean age of 15.99 years (SD = 1.672). The sample population is predominantly Malay, with 341 respondents (85.3%) identifying as such. The Chinese ethnic group constitutes the

Table 1
Respondent's background

Variable	Frequency= n (%)
Gender	
Male/ boy	181 (45.3%)
Female/girl	219 (54.8%)
Age (in years)	
13-15	159 (39.8%)
16-18	241 (60.2%)
Mean = 15.99, SD. =1.672, Min = 13, Max = 18	
Ethnicity	
Malay	341 (85.3%)
Chinese	48 (12.0%)
Indian	7 (1.8%)
Bumiputera Sabah and Sarawak	2 (0.5%)
Others	2 (0.6%)
Education level	
Form 1- Form 5	266 (66.4%)
Drop out and enrol in vocational college	99 (24.8%)
Completed secondary education	34 (8.5%)
Drop out	1 (0.3%)
Parent marital status	
Married/living together	339 (84.0%)
Divorce/separated	29 (7.8%)
Widowed	32 (8.1%)

second largest category, with 48 respondents (12.0%). Other ethnic groups include Indian (7 respondents, 1.8%), Bumiputera Sabah and Sarawak (2 respondents, 0.5%), and others (2 respondents, 0.6%). This distribution highlights a significant majority of Malay respondents, reflecting the ethnic composition of the broader population. The educational background of respondents varies, with the majority currently enrolled in secondary education. Specifically, 266 respondents (66.4%) attended form 1 to form 5. Vocational school students constitute 24.8% of the sample (99 respondents). A smaller portion of the sample has completed secondary education (34 respondents, 8.5%), and only one respondent (0.3%) has dropped out. This distribution emphasises a strong engagement in formal education among the respondents. Most respondents come from households where parents are married or living together, comprising 339 respondents (84.0%). Households with divorced or separated parents account for 7.8% (29 respondents), and those with widowed parents make up 8.1% (32 respondents). This data indicates that a significant majority of the respondents

experience family structures with married or cohabitating parents.

The data from Table 2 indicate the type of substance used among respondents. Electric cigarette/vape use is the most common, followed by cigarette smoking, alcohol consumption, and lastly, illicit drug use. Specifically, 20.3% of respondents have used electric cigarettes/vapes, 15.3% have smoked cigarettes, 10.0% have consumed alcohol, and only 2.3% have used illicit drugs. The high prevalence of non-users across all categories suggests that while some experimentation or use of substances exists, it is not widespread among the respondents.

The analysis reveals that 28.0% (n = 112) of the respondents have experimented with at least one type of substance. This indicates that over a quarter of the respondents have engaged in some form of substance use, whether it be cigarettes, electronic cigarettes/vapes, alcohol, or illicit drugs. Conversely, 72.0% (n = 288) of respondents are classified as non-experimenters, meaning they have not tried any of the listed substances. The majority suggests a general trend of abstinence from substance use among the respondents.

Table 3 and 4 revealed that 28% of the study participants had at least tried one type of substance. There was a significant difference in mean substance use intention between substance experimenters and non-experimenters, $(152.171) = 5.360$, $p < 0.001$, d -704. The average substance use intention score for non-experimenters was 1.2167, lower than the average substance use intention score for substance experimenters (1.5794).

Table 2
Lifetime substance-use experience by substance type among respondents

Variable	Frequency= n (%)
Cigarette	
Yes	61(15.3%)
No	339 (84.8%)
Electric cigarette/ vape	
Yes	81 (20.3%)
No	319 (97.0%)
Alcohol	
Yes	40 (10.0%)
No	357 (89.3%)
Missing	3 (0.8%)
Illicit drug	
Yes	9 (2.3%)
No	387 (96.8%)
Missing	4 (1.0%)

Despite the complete sample consisting of 400 adolescents, only 112 respondents reported prior substance use. As the construct of intention is more significant and predictive for those with direct experience of the activity, a multivariate analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM) was performed solely on this subgroup. This approach enables a concentrated analysis of the psychosocial factors affecting the intention to maintain interest in substance use among those who have a history of such behaviour.

Analysis

The current study's model was validated using partial least squares structural equation modelling (PLS-SEM) version 3.2.8 software. A bootstrapping procedure comprising 5000 subsamples was carried out in the validation process, and all constructs were measured reflectively. The effects of attitude, subjective norms, perceived behavioural control, and knowledge of substance use, and the mediating role of adverse childhood experiences, were concurrently examined, while the moderating role of sensation seeking in the attitude-substance abuse intention relationship was examined using the product indicator moderation method. The mean effect was statistically significant at ($p < .05$) as the confidence interval did not include zero.

Preliminary Analysis.

The study employed a measurement model in its analysis framework, necessitating the examination of convergent and discriminant validity, as well as the reliability of measurements at the scale level. In line with work by Hair et al. (2019), the first

Table 3
Substance experimentation status

Variable	Frequency= n (%)
Substance experimenters	112 (28.0%)
Non-experimenters	288 (72.0%)

Table 4
Differences between substance use intention scores between substance experimenters and non-experimenters

	Substance experimenters (n=112)		Non-experimenters (n=288)					
	M	SD	M	SD	Df	t	p	Cohen's d
SUI	1.5794	0.65985	1.2167	0.44643	152.171	-5.360	<0.001	-0.704

measure of the reflective PLS-SEM models is indicator loadings and internal consistency reliability. The authors indicate that the loadings should exceed 0.5, and the composite reliability should be regarded as good at a point between 0.70 and 0.90. The findings of the present study establish that all the indicators have loadings greater than 0.50, and the composite reliability ranges from 0.78 to 0.91, including subjective norms, sensation seeking, and substance abuse intention.

After establishing internal reliability, convergent and discriminant validity were assessed. Convergent validity was evaluated using Average Variance Extracted (AVE), with all constructs exceeding the 0.50 threshold, indicating satisfactory results (Hair et al., 2017). Discriminant validity was examined using the Fornell and Larcke (1981), and Henseler et al. (2015) methods. According to Fornell and Larcker, each construct's AVE square root should be greater than its inter-construct correlations. As shown in Table 5, this requirement was met, confirming that the constructs in this study possess adequate discriminant validity.

According to Hair et al. (2019), acceptable values for HTMT for conceptually different constructs should not exceed 0.85, while values for conceptually similar constructs should not exceed 0.90. The results, as shown in Table 5, reveal that the values of HTMT for all constructs in the study's model do not exceed the acceptable threshold.

RESULTS

Structural Model

Findings from the bootstrapping analysis conducted to assess the substance abuse intention model revealed that three of the five direct hypotheses tested in the study were supported by significant associations at the p = 0.05 level (Table 3). Attitude was found to be a significant and positive predictor of substance abuse intention (β = 0.251, t = 3.2, SD = 0.079, f^2 = 0.114, p = 0.001). This suggests that hypothesis H_1 is supported. In contrast, the results did not find a significant effect of perceived behavioural control (β = -0.208, t = 1.026, SD = 0.094, f^2 = 0.019, p = 0.305) and knowledge of the substance use (β = -0.174, t = 1.731, SD = 0.101, f^2 = 0.051, p = 0.084). Therefore, hypotheses H_2 and H_4 were rejected.

The results, as shown in Table 6, reveal that subjective norms were significantly and positively associated with substance abuse intention (β = 0.198, t = 2.727, SD = 0.073, f^2 = 0.074, p = 0.006). Consequently, this confirms hypothesis H_3. Also, the path coefficient of sensation seeking was significantly associated with substance abuse intention (β = -0.208, t = 2.662, SD = 0.078, f^2 = 0.096, p = 0.008). Therefore, hypothesis H_{6a} is supported.

Mediating Role of Adverse Childhood Experiences

As Table 7 reveals, the relationship between attitude and substance abuse intention was significant in the direct model. However,

Table 5
Measurement model (discriminant validity)

		Fornell-Lacker Criterion							HTMT									
	Constructs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**	**6**	**α**	**rho_A**	**CR**	**AVE**
1	ACE	0.72													0.87	0.90	0.89	0.527
2	A	0.21	0.72						0.23						0.72	0.85	0.81	0.524
3	SAI	0.43	0.50	0.76					0.44	0.55					0.89	0.89	0.91	0.588
4	PBC	-0.16	-0.07	-0.16	0.72				0.19	0.29	0.19				0.85	0.79	0.85	0.527
5	SS	0.17	0.03	-0.19	0.14	0.75			0.33	0.25	0.19	0.23			0.9	1.05	0.91	0.567
6	SN	0.25	0.25	0.41	0.12	0.03	0.74		0.31	0.36	0.53	0.43	0.19		0.61	0.57	0.78	0.55
7	KSU	-0.13	-0.22	-0.45	0.13	0.15	-0.15	0.77	0.17	0.23	0.47	0.15	0.17	0.28	0.89	0.94	0.92	0.599

Table 6
Structural model result

H	**IV**	**DV**	**Path Coefficient**	**Critical Ratio**	**Significance**	**Conclusion**
H1	A	SAI	0.251	3.2	0.001	Significant
H2	PBC	SAI	-0.208	1.026	0.305	Not significant
H3	SN	SAI	0.198	2.727	0.006	Significant
H4	KSU	SAI	-0.174	1.731	0.084	Not significant
H6a	SS	SAI	-0.208	2.662	0.008	Significant

Table 7
Mediation result

H			**95% CI Bootstrap BC**		
	Path Direction	**β**	**P**	**LB**	**UB**
H5a	A->ACE->SAI	0.049	0.161	-0.014	0.122
H5c	PBC->ACE->SAI	-0.065	0.397	-0.171	0.134
H5b	SN->ACE->SAI	0.087	0.045	0.019	0.186
H5d	KSU->ACE->SAI	-0.016	0.751	-0119	0.074

in the presence of adverse childhood experiences, the relationship between attitude and substance abuse intention was insignificant (β = 0.049, t = 1.401, p = 0.161). Additionally, in the direct model, the effect of perceived behavioural control on substance abuse intention was not significant, and when controlling for adverse childhood experiences, the relationship remained insignificant (β = -0.065, t = 0.847, p = 0.397). However, the size of the standard coefficient decreased. This suggests that adverse childhood experiences did not mediate the relationship between both attitude and perceived behavioural control and substance abuse intention. Therefore, hypotheses H_{5a} and H_{5c} are not supported.

Subjective norm had a significant and positive association with substance abuse intention in the direct model. A became significant. Additionally, the inclusion of adverse childhood experiences also yielded a significant relationship (β = 0.087, t = 2.002, p = 0.045). Thus, adverse childhood experiences partially mediate the relationship between subjective norms and substance abuse intention, and hypothesis H5b is supported. The result shows that adverse childhood experiences did not mediate the relationship between knowledge of substance use and substance abuse intention (β = -0.016, t = 0.318, p = 0.751); therefore, hypothesis H_{5d} is not supported. With adverse childhood experiences included as a mediator in the model, R^2 values for adverse childhood experiences and substance abuse intention were 0.126 and 0.596, respectively.

Moderating Role of Sensation Seeking

The results of the moderation analysis revealed a significant relationship between attitude and substance abuse intention (β = 0.251, t = 3.2, p = 0.001) and a significant association between sensation seeking and substance abuse intention (β = -0.208, t = 2.662, p = 0.008). The interaction effect of attitude and sensation seeking had a significant association with substance abuse intention (β = -0.152, t = 1.979, p = 0.048). Therefore, sensation seeking played a moderating role in the relationship between attitude and substance abuse intention, and hypothesis H_{6b} is supported.

DISCUSSION

The primary aim of this study was to identify the determinants of substance abuse intention and to examine the moderating role of sensation seeking and the mediating role of adverse childhood experiences (ACEs) among adolescents residing in at-risk communities in Peninsular Malaysia. The results indicate that attitude, subjective norms, and sensation seeking are the most significant direct predictors of substance abuse intention. The influence of attitude aligns with previous findings by Donaldson et al. (2016), Garcia-Cerde et al. (2021), and Mao et al. (2009), who reported that a favourable attitude towards substance use is associated with increased use of cigarettes, prescription stimulants, and other drugs among adolescents and young adults. This suggests that adolescents in high-risk settings may have become desensitised

to the risks of substance use, potentially due to its normalisation within their social environment. A pro-substance attitude may also be reinforced by perceived benefits of substance use, which are often culturally or socially embedded.

The findings of this study also reveal that subjective norms are positively associated with adolescents' substance abuse intention, confirming findings of (Shafiq et al., 2006; Visser et al., 2013) that peer influence is the leading determinant of alcohol and substance abuse during adolescence. Our finding also echoes those of (Macdonald & Howard, 2020; Melkman, 2015) that peer and deviant peer influence are pivotal to substance abuse patterns of at-risk youths. Findings also suggest that if adolescents in at-risk communities consider substance abuse as socially acceptable, it may increase their intention to abuse substances because of their desire for approval and social acceptance. Given the increased prevalence of social media use among adolescents, peers may also increase adolescents' risk of substance abuse through interaction on social media. (Yoo et al., 2016) found that exposure to pro-smoking messages on social media amplifies and reinforces smoking norms among young people, while also increasing their smoking intentions.

Our finding on the significant effects of sensation seeking was significant but surprisingly negative. Suggesting that low sensation seeking is associated with the substance abuse intention of at-risk adolescents. This is in contrast with previous studies (Charles et al., 2017; Kamel et al., 2021; LaSpada et al., 2020; Melkman, 2015), which finds an association between high sensation seeking and increased likelihood of substance abuse. Likely reasons for our unconventional finding are that low sensation-seeking adolescents in at-risk communities may still experience significant emotional and psychological stressors, and may require support, the lack of which may increase their substance use intention. For these adolescents, increased substance abuse intention may not be a result of the thrill, adventure and novelty associated with sensation seeking; however, low sensation seekers may be inclined to abuse substances as a result of a lack of parental support, which may increase anxiety and depression and their chances of substance abuse (Fröjd et al., 2007; Lai et al., 2015; Rioux et al., 2019).

However, findings from the study showed that perceived behavioural control exerts an insignificant effect on substance abuse intention. Likely reasons for this are that, as research suggests, although abusers control beliefs over consuming substances may be high, their beliefs over obtaining those substances may be limited (Orbell et al., 2001). Consequently, findings from this study contradict previous research (Huang et al., 2014), which finds perceived behavioural control to be a leading factor in substance abuse intention of adolescents in at-risk communities. This study also found that knowledge of substance use did not exert a significant effect on substance abuse intention. This finding contradicts previous studies (Harrison et al., 2024), which finds

that an increase in knowledge of substances is associated with reduced current use and intention to use.

When considering the mediating role of adverse childhood experiences, this study finds that adverse childhood experiences partially mediate the relationship between subjective norms and substance abuse intention. This implies that adverse childhood experiences can shape how adolescents in at-risk communities perceive and internalise societal expectations about substance abuse. This finding is consistent with previous studies (Maiya et al., 2023; Usher et al., 2015), which find that childhood trauma can normalise substance abuse, particularly for adolescents whose immediate family members are substance abusers. This study's findings also suggest that adolescents who consider substance abuse as a coping mechanism are more likely to abuse substances themselves. This is consistent with previous studies (Cabanis et al., 2021; Costanzo et al., 2023). Substance abuse can be a buffer for distressing emotions for children who have undergone developmental trauma, helping them distance themselves from associated painful memories.

CONCLUSION

The findings support the hypothesis that sensation seeking moderates the effects of attitude on substance abuse intention. Specifically, the negative coefficient beta observed indicates that lower levels of sensation seeking weaken the positive influence of attitude on the intention to use substances. In other words, adolescents with low sensation-seeking tendencies are less likely to form favourable attitudes towards substance use, which in turn diminishes their intention to engage in such behaviour. This finding aligns with previous studies suggesting that low sensation seekers generally exhibit less favourable attitudes towards substance use and are at lower risk of engaging in it (Everett & Palmgreen, 1995; Palmgreen et al., 2001). However, the current findings diverge from those of Puente et al. (2008), who reported that sensation seeking amplifies the association between attitude and substance use, suggesting that this relationship may be context-dependent and influenced by environmental or cultural factors specific to the adolescent population under study.

Contributions of the Study

Overall, this study contributes to the theory of planned behaviour by incorporating knowledge of substance use and sensation-seeking as complementary predictors, sensation-seeking as a moderator, and adverse childhood experiences as a mediator, thereby extending the pertinency of TPB to studies of public health issues and high-priority populations. The findings demonstrate that, compared to attitude, subjective norms, and sensation-seeking, knowledge of substance use and perceived behavioural control are less influential determinants of substance abuse intention of at-risk adolescents. The finding on the mediating role of adverse childhood experiences demonstrates how developmental adversities open a

pathway through which risky normative beliefs can influence intention formation to abuse substances. Suggesting that adverse childhood experiences can increase adolescents' susceptibility to misconceptions coming from peers about the benefits of using substances.

Theoretical Implications of the Study

This study's findings validate the core assumptions of the TPB, which suggest that attitude and subjective norms are essential predictors of behavioural intention, while perceived behavioural control is not. The significant effect of sensation seeking on intention suggests that including relevant dispositional constructs in the TPB is crucial when researching risky behaviours. The mediating role of adverse childhood experiences suggests that subjective norm, as a TPB construct, is less contemporaneous, linking it to developmental history. Finally, the moderating effect of sensation seeking indicates that the relationship between attitude and intention to abuse substances is not uniform for all at-risk adolescents but may depend on individual characteristics. It also suggests that attitude may be a more potent motivator to abuse substances for at-risk adolescents who are less prompted by sensation-seeking.

Practical Implications of the Study

The findings of the study offer guidance for designing preventive and curative substance abuse interventions for adolescents. The significant positive effect of attitude on substance abuse intention suggests that targeted preventive interventions should focus on debunking the beliefs at-risk adolescents have about the incentives associated with using substances while emphasising the associated health and legal risks. Alternative coping mechanisms for stress associated with adverse childhood experiences should be incorporated into curative interventions. Similarly, the positive effects of subjective norms suggest that curative interventions should incorporate normative re-education comprising peer-based education and mentorship into campaigns against adolescent substance abuse while disproving the misconceptions of the social acceptability and prevalence of substance use in high-risk and general populations. Lastly, interventions may include assessments to identify at-risk adolescents' levels of developmental psychopathology and sensation-seeking for more personalised interventions.

Ethics Review Board Clearance

This study complied with the ethical guidelines and was approved by the Universiti Putra Malaysia Ethics Committee (reference number JKEUPM-2022-969).

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