



Factors related to substance use among adolescents from six low-and middle-income countries

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ABSTRACT

Substance use is a common public health problem among adolescents in low- and middle-income countries (LMICs), however, factors that are associated with this condition are not clearly understood. The aim of the present study was to examine personal and interpersonal factors that contribute to risk for substance use among adolescents in six ASEAN (Association of Southeast Asian Nations) LMICs (i.e., Indonesia, Laos, Malaysia, Myanmar, Philippines and Thailand). Data of 57,825 adolescents (52.64% girls; median age = 14 years old) who participated in the Global School-based Student Health Survey (GSHS) were analysed. After the weighted prevalence was estimated for each country, multilevel models were employed to examine the influence of the risk factors on the prevalence of substance use across the countries. The results indicated a high prevalence of substance use among adolescents in all these six ASEAN LMICs. Alcohol use, smoking and drug use were more prevalent among adolescents in Thailand, Laos and Philippines.

Adolescents who were bullied and who had no close friends had a high prevalence of alcohol and drug use. Problematic drinking and smoking were more prevalent among older adolescents, and smoking and drug use were more prevalent among boys. Furthermore, frequent worry, loneliness and regular physical activity were found to predict adolescents' heavy and binge drinking. This study contributed to knowledge on risk factors for specific substance use among adolescents and drew attention for the urgent need to strengthen the intervention, law policies and professional support for reducing substance use in ASEAN LMICs.

1. Introduction

Adolescence is the period in human development characterised by increased experimentation with substance use (Johnston et al., 2018). However, the prevalence of substance use among adolescents varied across countries and continents. As reported by the United Nations Office on Drugs and Crime (UNODC, 2018), the prevalence of cannabis use among young people (aged 15–16 years) in North America and in Europe was 18% and 20%, respectively. Among adolescents in Africa, the overall prevalence of any substance use was 41.6%, with alcohol (40.8%) and tobacco (45.6%) being the most commonly used substances (Olawole-Isaac, Ogundipe, Amoo, & Adeloje, 2018).

The prevalence of alcohol use also varied across countries. According to the report by the Pan American Health Organization [PAHO], (2015), alcohol consumption in the Americas is higher on average than the rest of the world; however, it is important to note that although adolescents

in the Americas, on average, drink less frequently, they consume more per occasion when they drink. Results of the 2020 European School Survey Project on Alcohol and Other Drugs (ESPAD) showed a decline in smoking and drinking among 15–16-year-old school students in Europe, but an increased in cannabis use, with a weighted average of 17.3% (EMCDDA, 2021).

Country's income level has been used to explain for differences in the prevalence of substance use among young people across the continents and countries. Young people from low-and middle-income countries (LMICs) were reported to have higher prevalence of smoking than those in high-income countries (World Bank, 2017). Studies have also shown that individuals in East and Southeast Asia regions have more risks for developing problematic substance use which may be related to their fastest-growing methamphetamine market (UNODC, 2018). For example, the prevalence of current tobacco use among adolescents in Indonesia, Malaysia, Thailand, and the Philippines have been reported

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to range from 11 to 15%. As for alcohol, the current prevalence among young people in Thailand, Vietnam, and Philippines has been reported to range from 16 to 24% (Hong & Peltzer, 2019). The prevalence of lifetime cannabis and amphetamine use has been estimated to range from 0.9 to 1.0% and from 0.6% and 0.2%, in Malaysia and Vietnam, respectively (Peltzer & Pengpid, 2017). In terms of alcohol use, 1 in 10 pre-adolescents (aged less than 12 years old) from five ASEAN (Association of Southeast Asian Nations) LMICs (i.e., Indonesia, Laos, Philippines, Thailand and Timor-Leste) smoked tobacco, 8.1% consumed alcohol and over 4% have tried other drugs (i.e., marijuana and amphetamines) (Pengpid & Peltzer, 2019). On the basis of these findings, information on the profile of the substance use among adolescents in LMICs in South Asia and Pacific regions that have different income levels would enhance our knowledge on substance use in young people.

As substances use such as tobacco, alcohol and use of other psychoactive substances (e.g., marijuana, amphetamines) has been reported as a leading risk factor for premature death globally, it is important to identify factors that put adolescents at risk to developing problematic substance use. Studies that have examined risk factors of substance use in adolescents have focused on factors at the individual and interpersonal levels. On the individual level, sex has been reported to be a risk factor for substance use in adolescence. The use of certain drugs such as tobacco, marijuana and amphetamines has consistently been found to be higher in boys than in girls (Essau & de la Torre-Luque, 2021; Madruga et al., 2012; Kraus et al., 2018). By contrast, the role of sex in alcohol use has been inconsistent across studies (Patrick & Schulenberg, 2013; Swendsen et al., 2012). Other factors that are associated with adolescent's substance use include adolescent's physical and mental health. Specifically, studies have reported a strong link between unhealthy routines (i.e., absence of regular physical activity) and sedentary behaviour with substance use in adolescents, regardless of the confounding factors, such as sex, race or income level (Kristjansson, Sigfusdottir, Allegrante, & Helgason, 2008; Lebron et al., 2017; Lesjak, & Stanojevic-Jerkovic, 2015; Peltzer, 2010; Pengpid & Peltzer, 2019). Furthermore, there was a positive association between physical activity and alcohol use (e.g., Boyes, O'Sullivan, Linden, McIsaac, & Pickett, 2017; Brellenthin & Lee, 2018; Holligan, Battista, Groh, Jiang & Leatherdale, 2019) in that participation in team sports was strongly associated with alcohol use, whereas participation in individual or endurance sports was associated with lower use of all substances including alcohol (Brellenthin & Lee, 2018). Studies have also reported a positive association between psychological distress and substance use; this association has been explained in terms of the use of substance to cope with their psychological distress among adolescents with internalizing problems (e.g., anxiety) (Caselli, Bortolai, Leoni, Rovetto, & Spada, 2008; Memedovic et al., 2019; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007; Willem, Bijttebier, Claes, & Raes, 2011).

On the interpersonal level, adolescents' poor relationships with their significant others (i.e., parents and peers) have consistently been reported as a risk factor for problematic substance use (i.e., problematic tobacco, alcohol, and marijuana use) (Johnston et al., 2018). Moreover, adolescents (particularly girls) with poor parental relationship tend to report regular use of alcohol and binge drinking, and are at a high risk of using marijuana (Rusby, Light, Crowley, & Westling, 2018). It has been argued that adolescents who are socially withdrawn and those who frequently feel lonely (Qualter et al., 2013; Stickley, Koyanagi, Kuposov, Schwab-Stone, & Ruchkin, 2014) tend to use substance to cope with their poor relationship with their parents. Others argued that (Hong et al., 2014) adolescents who are victimised by peers and/or family members tend to avoid school and home environments, and are attracted to be affiliated with delinquent peers which in turn increase their risk of developing a problematic substance use.

While informative, it is unclear whether findings of the above studies that were conducted in high-income countries could be generalizable to adolescents in LMICs. Thus, the aim of the present study was to examine

individual and interpersonal factors that are associated with different patterns of substance use (i.e., tobacco, alcohol and illicit drugs) and to draw a country-specific profile of substance use among adolescents across six ASEAN LMICs. The factors that were included in our analyses were sex, age, engagement in physical activity, the presence of internalizing symptoms, being bullied, having loneliness feelings, having close friends; and feelings of being understood by the parents.

2. Method

2.1. GSHS data and study sample

Data came from the Global school-based Student Health Survey (GSHS) (publicly available data at <http://www.who.int/chp/gshs> and <http://www.cdc.gov/gshs>), which was developed by the World Health Organization in collaboration with the United States Centers for Disease Control and Prevention and other United Nations allies. The GSHS is a school-based survey conducted among students aged 13–17 years to collect data on health behaviours among adolescents which could inform the development of intervention and prevention programmes, and advocate for resources for school programmes and policies in the participating countries.

The GSHS used a cluster sampling design in two stages, firstly in schools and secondly in classrooms in order to produce nationally representative samples. Students completed a self-administered questionnaire under the supervision of trained survey administrators. Data were collected during a regular school time. The questionnaire was translated into the local language in each country and consisted of multiple-choice questions. Participation was voluntary for the students and confidentiality was ensured through anonymous participation. Country level ethics review boards approved the GSHS, and informed consent was obtained from the students, parents and/or school officials before the administration of the survey.

The present study analysed data of adolescents from six ASEAN LMICs (Indonesia, Laos, Malaysia, Myanmar, Philippines and Thailand) who participated in GSHS. All these countries were classified as LMICs by World Bank when the study was conducted between 2011 and 2017. The total sample size comprised 57,825 adolescents (52.64% girls; median age = 14 years old). Almost half of the participants were from Malaysia (44.11% of adolescents). Adolescents from Myanmar were the group with the lowest representation, being 4.91% of data. Further details on sample features are displayed in Table 1.

2.2. Measures

To address the aims of the present study, the following variables in the GSHS questionnaire were chosen. Substance use variables were:

Alcohol use: The following GSHS question was used to measure 30-day alcohol use: "During the past 30 days, on how many days did you have at least one drink containing alcohol?" Regular use was considered by taking alcohol drinks 20 or more days a month.

Problematic alcohol use involves two facets: binge drinking and heavy drinking (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Binge drinking was defined as engaging in episodes of 4 or more drinks for women and 5 or more drinks for men at the same time or within a couple of hours of each other on at least 1 day in the past month. Heavy drinking refers to having at least 60 g of pure alcohol at least once in the past 30 days (WHO, 2020) or consuming more than 4 drinks on any day or more than 14 drinks per week for men and consuming more than 3 drinks on any day or more than 7 drinks per week for women (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). *Problematic alcohol use was measured by the question, "During the past 30 days, on the days you drink alcohol, how many drinks did you usually drink per day?"* Binge drinking was considered by having at 4 or more drinks for women and 5 or more drinks for men per day. Heavy drinking was

Table 1
Descriptive statistics across selected ASEAN low- and middle-income countries (LMICs).

variable	Country						χ^2	ES
	Indonesia	Laos	Malaysia	Myanmar	Philippines	Thailand		
n	11,124	3663	25,493	2828	8756	5877		
Sex (boys)	45.81	45.6	50.01	46.27	45.56	43.12	141.76	0.04
Age ¹	14	17	15	14	14	13	8081.82	0.17
Substance use ²								
Alcohol use	0.2	0.8	0.3	0	0.3	1.5		
Binge drinking	0.4	13.5	0.8	0	2.8	6.1		
Heavy drinking	0.2	1.3	0.2	0	0.3	2.2		
Smoking	0.3	0.1	0.6		0.4	1.1		
Marijuana	0.3	0.1	0.3		0.7	1.5		
Amphetamine	0.4	0.4	0.3		0.3	1.4		
Personal risk factors								
Worried	42.54	34.15	26.2	31.05	42.85	37.48	1402.85	0.11
Physical activity practice (4 days a week or more)	19.4	23.7	30.18	21.66	15.2	24.71	1014.96	0.09
Interpersonal risk factors								
Bullied								
No	79.41	88.23	82.63	50.52	50.46	69.01	4934.77	0.17
Occasionally	18.73	11.01	14.95	46.85	43.2	25.51		
Frequently	1.86	0.76	2.42	2.64	6.34	5.49		
Loneliness (Sometimes or almost always)	47.12	33.08	36.31	45.27	64.99	38.9	2421	0.14
Close friends (yes)	97.09	95.39	96.88	96.16	95.83	93.81	158.92	0.04
Understood by parents (Sometimes or almost always)	70.49	46.46	56.19	79.46	59.12	54.17	1456.95	0.11

Note. Proportion of cases is displayed.

¹ Arithmetic mode.

² The weighted 12-month prevalence was the outcome for substance use, except for the case of amphetamine use (weighted lifetime prevalence). Data from Myanmar adolescents were just available for alcohol use and derived outcomes (with prevalence rates lower than 0.01), but not for the rest of outcomes. Association of Southeast Asian Nations (ASEAN). All the χ^2 contrast tests were significant with $p < .01$. ES = Effect size estimate (Cramer's V).

measured as consuming more than 4 drinks on any day or more than 14 drinks per week for men and consuming more than 3 drinks on any day or more than 7 drinks per week for women.

Regular smoking: It was measured by using the question, “During the past 30 days, on how many days did you use any tobacco products other than cigarettes, such as shisha/hookah, electronic cigarettes, snuff, chewing tobacco, pipe, curut, cigar, cigarillo, or bidis?” Regular use was considered by smoking 20 or more cigarettes a month.

Other drugs. Marijuana use was measured by the question, “During the past 30 days, how many times have you used marijuana?” Regular use of marijuana was considered when adolescent reported a use of 10 times or more a month. Finally, amphetamine use was defined as using the substance 10 times or more in the entire life, taking into account of the low prevalence rates of amphetamine use during adolescence (Peltzer & Pengpid, 2017).

The risk factors were grouped under individual and interpersonal levels. On the individual level, the factors considered were: sex, age, the frequency of being physically active, (the related question was “During the past 7 days, on how many days were you physically active for a total of at least 60 min per day?”); and the presence of internalizing symptoms related to rumination and worry (the related question was “During the past 12 months, how often have you been so worried about something that you could not sleep at night?”). On the interpersonal level, the factors considered were: being bullied in last month, measured by the question “During the past 30 days, on how many days were you bullied?”; loneliness feelings, measured by the question: “During the past 12 months, how often have you felt lonely?”; having close friends; and feelings that your parents or guardians understand their problems and worries.

2.3. Data analysis

Weighted prevalence was estimated for each of the chosen ASEAN countries. In addition, descriptive statistics for the risk factors were compared across countries using the Pearson's χ^2 test for independent

samples. To prevent from type I error, inflation meaningful between-group differences (i.e., those with at least medium effect size: Cramer's $V \geq 0.30$) were considered due to the large sample size in analysis (Lin Jr., Shmueli, & Lin, 2013).

Multilevel binary regression was used to identify factors that are associated with regular/problematic substance use (i.e., regular smoking, alcohol use, binge drinking, heavy drinking, marijuana use and amphetamine use). We used the country as a multilevel factor to determine the fixed effects of risk factors controlling for random effects derived from country of provenance. A model comparison rationale was followed. In this regard, three regression models with increasing number of covariates were calculated: unconstrained model (model without covariates), model with sociodemographic covariates (sex and age) and full model (model with all the aforementioned individual and interpersonal covariates). The Akaike information criterion (AIC) was used for model comparison, with lower AIC values indicating a better model fit. The conditional R^2 was used as a model effect size estimate, accounting for explained variance by the entire model (including both fixed and random effects).

All the analyses were conducted using the R software (R Core Team, 2017), with packages lmerTest, questionr, and psych).

3. Results

Country-specific descriptive features of sample are displayed in Table 1. On sociodemographic variables and risk factors, significant differences were found between countries but effect size was either small or marginal. These differences were therefore considered not meaningful. Weighted prevalence rates of substance use were low across substances, with the highest rates in Thailand for all substances. The prevalence of binge drinking was high in all the six countries.

The multilevel regression revealed that the model with all the covariates (full model) showed a better result, due to its lower AIC across outcomes (see Table 2). In other words, the explored risk factors seemed to be important in explaining the prevalence of substance use. In a same

Table 2
Predictors of drug use prevalence among adolescents in selected ASEAN LMICs.

	Alcohol use	Binge drinking	Heavy drinking	Smoking	Marijuana	Amphetamine
Age	1.52 (1.27,1.82)	1.84 (1.69,2.00)	2.04 (1.70,2.44)	1.64 (1.39,1.93)	1.02 (0.87,1.20) ^{ns}	1.03 (0.87,1.21) ^{ns}
Sex (ref.: boy)						
Girl	0.31 (0.22,0.45)	0.73 (0.64,0.84)	0.48 (0.36,0.65)	0.15 (0.10,0.23)	0.25 (0.17,0.37)	0.20 (0.13,0.30)
Personal risk factors						
Worried (ref.: never/rarely)						
Sometimes or almost always	1.90 (1.36,2.67)	1.77 (1.55,2.03)	2.21 (1.64,2.97)	1.71 (1.26,2.31)	1.92 (1.37,2.69)	1.84 (1.30,2.60)
Physical activity (ref.: less than 4 days/week)						
Regularly	0.68 (0.46,1.01) ^{ns}	1.33 (1.15,1.54)	2.00 (1.50,2.67)	1.45 (1.08,1.95) ^{ns}	0.99 (0.68,1.43) ^{ns}	0.84 (0.57,1.23) ^{ns}
Interpersonal risk factors						
Bullied (ref.: no)						
Occasionally	2.49 (1.71,3.64)	1.24 (1.06,1.45) ^{ns}	1.81 (1.31,2.51)	1.59 (1.12,2.26) ^{ns}	2.80 (1.92,4.09)	4.32 (2.90,6.43)
Frequently	8.26 (5.17,13.22)	1.95 (1.46,2.61)	3.51 (2.15,5.73)	6.08 (4.06,9.13)	7.33 (4.60,11.67)	13.77 (8.60,22.05)
Loneliness (ref.: never/rarely)						
Sometimes or almost always	0.89 (0.63,1.26) ^{ns}	1.41 (1.23,1.63)	1.22 (0.91,1.66) ^{ns}	1.06 (0.78,1.44) ^{ns}	1.49 (1.05,2.12)*	1.59 (1.12,2.27) ^{ns}
Close friends (ref.: no)						
Yes	0.57 (0.33,0.99)	1.30 (0.93,1.82) ^{ns}	0.96 (0.52,1.76) ^{ns}	0.39 (0.25,0.61)	0.35 (0.22,0.55)	0.78 (0.43,1.42) ^{ns}
Understood by parents (ref.: never/rarely)						
Sometimes or almost always	0.65 (0.47,0.90)	0.89 (0.78,1.01) ^{ns}	0.77 (0.58,1.02) ^{ns}	0.82 (0.61,1.08) ^{ns}	0.63 (0.45,0.87)	0.98 (0.70,1.37) ^{ns}
Random-effects SD	1.06	2.05	1.27	0.79	0.68	0.65
AIC						
Unconstrained	3394.62	11484.52	3373.22	3657.46	3146.91	3065.72
Sociodemographic	3268.39	11083.4	3221.33	3412.06	3011.28	2909.11
Full	1846.9	8199.6	2272.38	2277.28	1808.7	1709.17
R ²						
Unconstrained	0.18	0.49	0.27	0.12	0.2	0.13
Sociodemographic	0.24	0.49	0.35	0.34	0.29	0.26
Full	0.39	0.59	0.45	0.39	0.32	0.36

Note. The 12-month prevalence of drug use, except for amphetamine use (lifetime prevalence). Class of reference was no use. Ref. = Category of reference. OR = Odds ratio. CI₉₅ = 95% confidence interval of estimate. AIC = Akaike information criterion. R² = Conditional adjusted R². The unconstrained model refers to model without covariates. The sociodemographic model refers to model with participant' sex and age as covariates. The full model refers to model with all the covariates. Association of Southeast Asian Nations (ASEAN). All the coefficients with $p < .01$, except: ^{ns} No significant ($p > .01$).

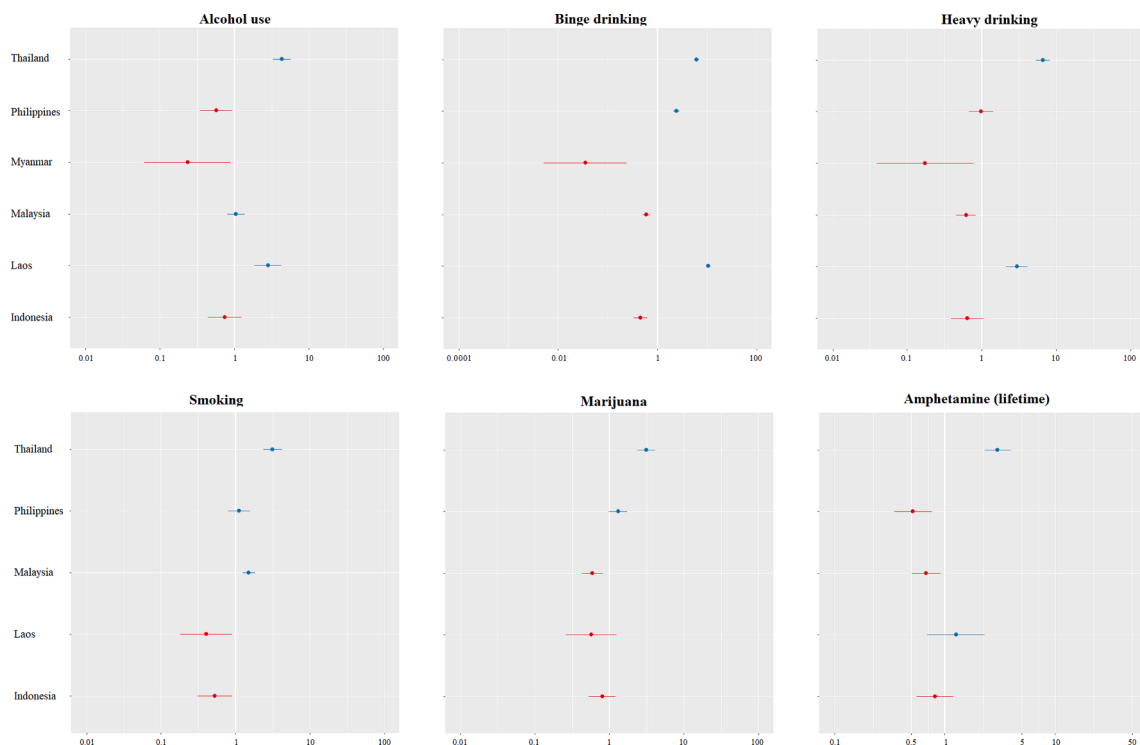


Fig. 1. Random-effects variability of adolescent drug use across the ASEAN LMICs. Note. The 12-month prevalence for drug use, except for amphetamine use (lifetime prevalence). Dots refer to point estimates of deviations with 95% confidence interval (line).

vein, the model with all the covariates explained more than 30% of outcome variance across outcomes, as shown by the conditional R^2 . Based on the multilevel regression (full model), factors that were related to drug use were: being male, being frequently bullied (predictor with the highest loading: being bullied occasionally was also important but with less loading) and being worried sometimes or almost always. Specifically, adolescents who were frequently bullied showed elevated risk of developing regular substance use, especially in relation to regular alcohol use ($OR = 8.26$, $CI_{95} = 5.17, 13.22$) and amphetamine use ($OR = 13.77$, $CI_{95} = 8.60, 22.05$). Moreover, adolescents who worry frequently showed higher risk of developing heavy drinking patterns compared to those who did not worry on a frequent basis ($OR = 2.21$, $CI_{95} = 1.64, 2.97$). Our results also showed some drug-specific factors. Older, compared to younger age put adolescents at higher risk of developing regular alcohol use and problematic drinking (the highest risk was shown for heavy drinking, with $OR = 2.04$, $CI_{95} = 1.70, 2.44$) and smoking. Further analyses showed that loneliness predicted binge drinking ($OR = 1.41$, $CI_{95} = 1.23, 1.63$) and regular physical activity predicted binge and heavy drinking behavior ($OR > 1.30$, $p < .01$ for both outcomes). The lack of close friends put adolescents at higher risk of regular alcohol use, smoking and marijuana use. Finally, feelings of being understood by parents were shown as a protective factor of regular alcohol use and marijuana use.

Regarding country-specific effects, the regression models revealed relatively low random-effects (between-country) variability, with higher standard deviation seen for binge drinking (see Table 2). Fig. 1 displays the predicted prevalence estimates derived from the regression models (adjusted for all the covariates). Laos and Thailand showed higher prevalence of alcohol use, as well as binge and heavy drinking, than the remaining ASEAN countries. Thailand and Philippines showed higher prevalence of marijuana use and amphetamine use and Thailand, Malaysia and Philippines showed higher prevalence of smoking.

4. Discussion

The present study examined individual and interpersonal factors that associated with the prevalence of substance use among adolescents in relation to country-specific factors in six ASEAN LMICs. The major strength of this study was its large sample size, consisting of 57,825 adolescents from six LMICs in ASEAN. Our findings could be summarised as follows: First, there was a high prevalence of substance use among adolescents in Indonesia, Myanmar, Thailand, Laos, Malaysia and Philippines. This finding supported the previous reports (e.g., UNODC, 2018; World Bank, 2017) which showed the high prevalence of substance use among adolescents in LMICs that are located in South-East Asia and Pacific Islands. Our findings furthermore showed regular substance use as being more prevalent among adolescents in LMICs from the South-East Asia and Pacific Islands compared to adolescents in European, American and African countries (EMCDDA, 2021; ESPAD, 2020; Olawole-Isaac, Ogundipe, Amoo, & Adeloje, 2018; PAHO, 2015 & UNODC, 2018). UNODC (2018) had previously stated that people in East and South-East Asian countries are at more risks for problematic substance use because these regions have the world's fastest-growing methamphetamine market and at the same time they are located on the drug trafficking routes. For example, our results that the highest prevalence rate of substance use among adolescents in Thailand for all types of substances could be related to geographical issues as some Thailand's border areas may be part of trafficking routes within illegal substance markets. Opium, heroin, and methamphetamine are being smuggled at the Thai border (ONCB, 2013). Moreover, the volume of alcohol marketing have been problematic for Thai government due to alcohol industry supporting drinking as an integral part of socialisation to provide economic and social benefits (Kaewpramkusol, Senior, Nanthamongkolchai, & Chenhall, 2019).

Second, there are some variations in the most common types of substances being used by adolescents across these LMICs. Marijuana and

amphetamine use were more prevalent among adolescents in Thailand and in the Philippines compared to other ASEAN LMICs, but was similar to the high prevalence rates of drugs in North America and Europe (EMCDDA, 2021; ESPAD, 2020; UNODC, 2018). In addition to the aforementioned geographical factors, other possible reasons for the high prevalence of substance use in Thailand might be related to economic problems, political conflicts, high crime rates, unemployment, and poverty (e.g., Saingam, 2018) and it could be speculated that substances were used to cope with these problems. In addition, inadequate rehabilitation services for drug offenders in Thailand may cause young people to be exposed to those dealing with drugs or affiliated to those with drug problems. Like in Thailand, the reasons for more prevalent use of these substances in the Philippines can be attributed to its geographical location as a transit hub for the illegal drug trade (Ranada, 2016). Thailand, Malaysia and Philippines were also the LMICs with higher prevalence rate of regular smoking among adolescents which was similar to the prevalence rates observed in African countries (Olawole-Isaac, Ogundipe, Amoo, & Adeloje, 2018). This can be explained by socioeconomic and political reasons in these regions. For example, in the Philippines, smoking is socially acceptable and that cigarettes are for young people, and as such this behavior tend to support the tax system from tobacco in the country (Baring, Lee, Maria, & Liu, 2017). Malaysia showed the highest prevalence of smoking followed by Thailand. Moreover, smoking products were the mostly used substances followed by binge drinking among adolescents in Malaysia. Similar to those found among adolescents in Africa (Olawole-Isaac, Ogundipe, Amoo, & Adeloje, 2018), the high rates of smoking in Malaysia might be related to cigarettes being easily accessible by adolescents (Hammond et al., 2008) and lack of restrictions for under-age purchases of cigarettes.

Third, in all ASEAN LMICs, binge drinking was found to be more prevalent than other problematic patterns of substance use as found in the case of American countries (PAHO, 2015). However, alcohol use, binge and heavy drinking were more prevalent among adolescents living in Laos, Thailand and Malaysia than those living in other ASEAN-LMICs. One possible reason of this high rate of alcohol use both within and between the LMICs would be the income level of these countries. As reported by WHO (2018), alcohol consumption is common in low income countries due to the lack of or insufficient national policies on alcohol use (e.g., legal age limit for buying alcohol). For instance, Malaysia showed the highest prevalence of regular alcohol use after Thailand and Laos and binge drinking was the most prevalent pattern of substance use among adolescents in this country. This finding supported previous reports which indicated an increased use of alcohol (8.9% to 10.2%) among adolescents from the year 2012 to 2017 (IPH 2012, 2017). It has been reported that alcohol drinks are also easily available in coffee shops and supermarkets in Malaysia with lack of under-age limitations in purchases (Hasani et al., 2021). The insufficient regulations for alcohol purchases may cause adolescents to be more susceptible to early initiation of alcohol in Malaysia and draws attention on urgent needs for legal regulations (WHO, 2018). In this context, it is important to note that the percentage of national policies on alcohol use is much higher in high- (around 67%) than in low-income countries (around 15%). Because of the lack of national policies for legal age limit for buying alcohol in the LMICs that participated in the present study (WHO, 2018), it is therefore not surprising that our findings showed adolescent's age to predict the prevalence of substance use. For instance, older adolescents had higher prevalence of regular alcohol use and problematic drinking (i.e. the highest risk was shown for heavy drinking). This finding also supported previous research (e.g., Johnston et al., 2018; World Health Organization WHO, 2018) and stresses the importance of developing age specific policies in ASEAN LMICs for alcohol which could be more easily accessible by adolescents than other kinds of substances. Differences in alcohol consumption across countries may also be explained by the country's national religion. Muslim countries (e.g., Indonesia and Malaysia) may restrict alcohol consumption more strictly than Buddhist countries (e.g., Thailand and Laos) where there is

no restriction in alcohol use. This finding confirms previous studies which indicated that Muslim countries consume less alcohol than non-Muslim countries because Islam prohibits the consumption of alcoholic beverages (WHO, 2014). This finding also implies the need to explore the role of religion on substance use behaviour by future research.

Fourth, the results supported previous research (e.g., Essau & de la Torre-Luque, 2021; Madruga et al., 2012; Kraus et al., 2018) and indicated that tobacco, marijuana and amphetamine use were more prevalent among males than females. Interestingly, this gender difference was associated with geographical differences (e.g., Iran, USA, Brazil, Bulgaria, Cyprus, Greece, Romania) and other individual factors (e.g., parent's psychopathology). Specifically, substance use was also more prevalent among adolescents with internalizing problems. For example, heavy drinking (i.e., consuming 4 or more drinks for women and 5 or more drinks for men on 5 or more days in the past month) was higher among adolescents with high compared to low level of rumination and worry, during the past 12 months. Similarly, adolescents who worried more frequently that prevented them to sleep at night also reported more heavy drinking than those who did not have such worries. This finding is in agreement with previous research which indicated that internalizing symptoms (e.g., worry, anxiety) may also put individuals at higher risk to develop problematic substance use and support the explanation that individuals use substances to escape from their psychological distress (Caselli, Bortolai, Leoni, Rovetto, & Spada, 2008; Meier, Beardslee, & Pardini, 2020; Memedovic et al., 2019; Nolen-Hoeksema, Stice, Wade, & Bohon, 2007; Rothenberg et al., 2020; Willem et al., 2011). Thus, internalizing symptoms should be explored in terms of their role as either risk or moderating factors of substance use among adolescents in LMICs. Although some studies have shown that physical activity and exercise are healthy lifestyle act as protective factors for substance use (Pengpid & Peltzer, 2019), our results interestingly indicated that adolescents who were more physically active reported more binge and heavy drinking behavior. Our finding could be related to the nature of the physical activity in that social factors in team sports would be positively associated with alcohol use among adolescents as a way of coping with competition (e.g., Boyes et al., 2017; Brellenthin & Lee, 2018; Holligan, Battista, Groh, Jiang & Leatherdale, 2019). At the same time, social factors (e.g., peer influences) could have a significant effect on adolescents' tendencies to develop substance use behaviour due to peer influences as adolescents may desire to explore peer-related risk-taking behaviours and may model their peers in team sports. Moreover, adolescents who are socially involved in a sports team may be adapted to the culture of sport where substance use is a common practise through peer modeling.

Fifth, regular alcohol and amphetamine use were more prevalent among adolescents who were more frequently bullied by their peers, whereas regular alcohol and marijuana use was more prevalent among adolescents who felt being less understood by their parents. In addition, binge drinking was more common among adolescents who reported feeling lonely and had few close friends, and among those who consumed other substances (i.e., alcohol, tobacco, marijuana) on a regular basis. These results supported the findings of previous studies (e.g., Arcadepani, Eskenazi, Fidalgo & Hong, 2021; Da Silva & Martins, 2020; Fergusson, Swain-Campbell, & Horwood, 2002; Johnston et al., 2018; Rusby, Light, Crowley, & Westling, 2018; Van Ryzin, Fosco, & Dishion, 2012; Vannucci, Fagle, Simpson & Ohannessian, 2021) and can also be interpreted as supporting the argument that adolescents who have been victimised by their peers consume substances to "feel better" (Powers & Matano, 1996). Furthermore, adolescents who are victimised by peers and/or family members are likely to avoid school and home environments which may increase the risk of being with delinquent peers who consume substance use (Hong et al., 2014). Others argued that, consuming substance is a way to cope with loneliness (e.g., Ingram, et al., 2020; Qualter et al., 2013; Stickley, Koyanagi, Koposov, Schwab-Stone, & Ruchkin, 2014). Using this maladaptive way of coping with

psychological distress may be related to the lack of psychological counseling services for adolescents in ASEAN LMICs (Shatkin & Belfer, 2004). The implication of this finding is that more laws, policies and intervention/prevention programmes are needed to reduce or stop peer bullying, to support resiliency building among adolescents and to promote healthy parenting in LMICs.

Some limitations of this study should be noted and taken into account when interpreting our findings. GSHS data were based on self-report questionnaires which might be associated with recall biases and social desirability. Further studies should include parents and teachers in order to more eliminate this limitation. Substance problem is a highly stigmatised condition in LMICs. Therefore, it is likely that the adolescents did not report the full account of their substance use. To overcome this methodological limitation, future studies should include objective measures to test the consumption of illicit drug such as urine test. Furthermore, the GSHS has a cross-sectional design, which limits drawing conclusion about causality.

In conclusion, this study has demonstrated that substance use among adolescents in ASEAN LMICs is a common public health problem. The findings also drew attention for the urgent need to develop or strengthen the intervention, law policies and professional support with the aim of reducing risky behaviours and more specifically substance use among adolescents in these countries and especially in Thailand, Malaysia, Laos and Philippines by also taking individual, interpersonal and geographical risks into account. It is hoped that future research will expand on these findings and will draw a clear profile of multifactorial risks (e.g., of substance use among adolescents in all LMICs).

CRedit authorship contribution statement

Fatos Ozeylem: Conceptualization, Writing, Review and editing.
Alejandro de la Torre-Luque: Conceptualization, Data curation, Formal analysis, Methodology, review and editing.
Cecilia A. Essau: Conceptualization, Data curation, Resources, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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