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Prospective association of interventions for at-risk families with illicit drug use among young students in
Taiwan

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Research paper

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Prospective association of interventions for at-risk families with illicit drug use among young students in Taiwan

Abstract

Background: Young people who use illicit drugs disproportionately experience multiple problems in individual, family, and school domains. With a focus on illicit-drug-using middle schoolers, the present study aims to characterize intervention services for risk indicators and to examine the prospective associations with reinitiated use throughout adolescence.

Methods: A retrospective cohort of 1605 adolescents was identified from the 2013–2016 national school-based indicated prevention program serving illicit-drug-using students in Taiwan. Reinitiated use of illicit drugs was confirmed by the Drug Abuse Big Datasets comprising police arrest records. Information concerning the history of intervention services—attention deficit hyperactivity disorder (ADHD) treatment, intervention for at-risk families, and school dropout consultation—was ascertained from national administrative data. A cohort of young adolescents from the general population ($n=809477$) was sampled for comparison. The Cox proportional hazards model was used to evaluate the risk of drug use.

Results: Nearly 80% of illicit-drug-involved middle schoolers used ketamine only, and 17% used amphetamine or methamphetamine. Over a four-year follow-up, 35% of middle schoolers were re-reported for drug use, with police arrest being the major source. A history of ADHD treatment was not linked with illicit drug use, whereas dropping out in early schooling can elevate middle schoolers' hazard by 46%. Notably, receiving services targeting at-risk families in late childhood can lower the hazard by 43%, with the reduction even greater when non-school-attending adolescents were included.

Discussion: To reduce progression into advanced drug involvement and substance use disorders, an integrated model of school-based interventions is urgently needed.

Keywords: adolescent; illicit drug use; indicated prevention; high-risk family; school dropout; cohort study

Introduction

Use of illicit drugs is a common health-comprising behavior in young people (Degenhardt, Stockings, Patton, Hall, & Lynskey, 2016). In many countries, the prevalence rates, types, and consumption levels of drugs in the present generation of adolescents are higher than those in previous generations (United Nations Office on Drugs and Crime, 2022). Evidence from secondary school surveys in the United States indicates that over 40% of adolescents had tried an illicit drug at least once by 12th grade (Miech et al., 2023), while the estimate among 15–16-year-old students was 17% in 35 European countries, with marijuana (16%), ecstasy (2.3%), and amphetamine (1.7%) being the most common drugs used (Mokinaro, et al., 2020). Drug use in young people not only serves as a leading risk factor for health burden but also adversely affects human capital accumulation (Bradley & Greene, 2013; Mokdad, et al., 2016). In 2013, for instance, 350 disability-adjusted life-years per 100,000 men and 219 per 100,000 women were attributed to the use of illicit drugs among individuals aged 15–19 years worldwide; the estimated burden was particularly substantial in Australasia and high-income North America (Degenhardt, et al., 2016).

Cumulative studies have explored an array of factors influencing experimental and persistent use of illicit drugs and substance use disorders emerging in the first two decades of life (Fegert, et al., 2009; Gray & Squeglia, 2018; Kliwer & Murrelle, 2007). At the individual level, male gender and mental disorders are two well-researched characteristics. Particularly, attention deficit hyperactivity disorder (ADHD), one of the most common mental disorders affecting children, has consistently been indicative of increased early-onset drug use and substance use disorders in young adulthood (Gudjonsson, Sigurdsson, Sigfusdottir, & Young, 2012; Molina, et al., 2018; Pampati, Buu, Hu, de Leon, & Lin, 2018), although some have argued that the association may be subject to other confounders, especially conduct disorders and treatment status (Fergusson, Horwood, & Ridder, 2007; Molina, et al., 2018; Molina, et al., 2023). To illustrate, data from Monitoring the Future revealed that the risk of recent substance use in young adulthood was not different between those ADHD-affected children who received stimulant therapy before the age of 10 and population controls (McCabe, Dickinson, West, & Wilens, 2016). Subsequent research showed the increased risk of cocaine, methamphetamine, and prescription stimulant misuse in later years was manifested only in those youth who initiated late stimulant therapy for short durations

(McCabe, et al., 2024).

Factors influencing one's drug involvement can operate beyond individual-level characteristics; family and school are undoubtedly two important contexts affecting children's risk of drug use and escalation (Kelly, Weier, & Hall, 2019). At the family or household level, certain compositional and functional features are indicative, such as poverty, single-parent family, family substance use, parental mental disorder, parent-child conflict, and unfavorable parenting style (Giordano, Ohlsson, Kendler, Sundquist, & Sundquist, 2014; Hoffmann & Cerbone, 2002; Jääskeläinen, Holmila, Notkola, & Raitasalo, 2016; Nakawaki & Crano, 2012). Noticeably, risk factors at the family level often cluster with or are mediated through others, which is especially common when family members (particularly parents) are involved in substance use. Family dysfunction and unfavorable parenting that arise because of substance-use-related chaotic living conditions, poverty, and even incarceration, together with easy access to substances and pro-substance norms, may increase children's drug use or problems (Hoffmann & Cerbone, 2002). With regard to protective factors, the role of parental monitoring appears more salient in early adolescence, whereas family relationship quality is more pronounced in mid-to-late adolescence (Van Ryzin, Fosco, & Dishion, 2012). As to school-level characteristics, school disengagement *per se* (e.g., missed attendance and suspensions from school) has been suggested as a strong predictor for school dropout, deviance engagement (as indexed by official arrest/police contact), and substance use during adolescence and young adulthood (Henry, Knight, & Thornberry, 2012). Nonetheless, empirical evidence has suggested that school disengagement and substance use can influence one another reciprocally or be the result of other factors (e.g., family poverty) (Wang & Fredricks, 2014).

To this point, several population-based studies have specifically assessed the probability of reinitiation or persistence over time in illicit drug-experienced young people (Bailey, Flewelling, & Rachal, 1992; Wittchen, et al., 2008), and findings concerning risk/protective factors were primarily focused on the individual level (e.g., gender, age, race/ethnicity) and drug characteristics (e.g., drug of primary interest and severity of involvement) (Coffey, Lynskey, Wolfe, & Patton, 2000; Lin, Jester, & Buu, 2016; Pampati, et al., 2018; Perkonig, et al., 2008). One of the few exceptions is a population-based cohort study comprising over 3000 young people aged 14–24 in Germany, which reported that past-year prevalence of cannabis use among baseline cannabis users was

47% during 4-year follow-up; younger age, peer drug use, and stressful life events were predictive for persistent use of cannabis (Perkonig, et al., 2008). Additionally, the Great Smoky Mountains Study provided longitudinal evidence that late-adolescence-limited problematic cannabis users were more likely to experience childhood family instability and dysfunction, but were less likely to have been expelled from school than persistent problematic users (Hill, Shanahan, Costello, & Copeland, 2017).

Earlier evidence of factors affecting the process (e.g., reinitiation and persistence) after drug initiation throughout adolescence has faced two significant limitations. First, most population-based studies investigating a transition or change in the use of illicit drugs often treated prior drug experience as a covariate (Chen & Jacobson, 2012; Hemphill, et al., 2011; Zych, Rodríguez-Ruiz, Marín-López, & Llorent, 2020), and only a few have acknowledged stage-dependent risk profiles (Coffey, et al., 2000; Perkonig, et al., 2008). Second, existing research on early predictors of reinitiation or relapse has been primarily conducted in populations or societies where the use of illicit drugs is relatively common, such as the United States and Australia (Chung & Maisto, 2006; Hemphill, et al., 2011; Molina, et al., 2018; Wittchen, et al., 2008). To date, evidence concerning reinitiation among young people in Taiwan is limited to clinical studies with a small sample size (Wang & Fredricks, 2014; You, et al., 2020). Given that the availability, social norms, and laws concerning illicit drugs are crucial macro-level factors, there is a need to inspect how early-life predictors may operate in societies wherein drug use among young people is infrequent and subject to social stigma.

Adolescence is the peak period for experimentation with illicit drugs (Wittchen, et al., 2008). Retrospective and prospective studies have demonstrated that individuals who initiated drug use in adolescence, compared to their adult-onset counterparts, exhibit a higher risk of substance use disorder and a wide range of negative consequences manifested in physical, psychological, and social domains, including risky sexual behaviors, depression, low educational attainment, and incarceration (Bradley & Greene, 2013; Brook, Brook, Zhang, Cohen, & Whiteman, 2002; Chen, Storr, & Anthony, 2009a; Slade, et al., 2008). Nevertheless, not all individuals with an early onset of illicit use progressed to become persistent and problematic users. Considering that early onset *per se* may serve as a proxy marker for underlying social or genetic vulnerability (e.g., household adversity) or an important risk factor in the selection of pro-drug peer networks and reinforced

socialization (Galea, Nandi, & Vlahov, 2004; Kelly, et al., 2019), a comprehensive understanding of how social factors (e.g., family and school) contribute to abstinence or reinitiation may facilitate the development of tailored interventions or integrative services to achieve favorable developmental outcomes for young adolescents who experiment with drugs within the community.

Building upon a retrospective cohort of young adolescents registered in a national school-based indicated prevention program in Taiwan; the present study is the first to examine the occurrence of well-recognized risk factors at individual, family, and school levels among middle schoolers compared with the general population. Next, we investigated how the service experience for risk indicators was linked with the re-reporting of illicit-drug use throughout late adolescence.

Methods

Study Context

In Taiwan, the use of illicit drugs and non-medical use of certain controlled substances remain criminalized. As in several other East and Southeast Asian countries (Tettey, et al., 2013), amphetamine-type stimulants have emerged as the primary illicit drug threat since the 2010s. Ketamine, initially appearing as a party drug in the early 2000s, later gained popularity among young people and went on to become a candidate gateway drug. The prevalence estimates of illicit drug use in the underage population fall under 3% (Chen, et al., 2009b; Liao, et al., 2018), with ketamine, amphetamine, and 3,4-Methylenedioxymethamphetamine (MDMA) being the most used drugs in recent years. In accordance with the Narcotics Hazard Prevention Act and Juvenile Justice Act, adolescents are primarily dealt with by the juvenile court upon a positive drug test at the time of arrest for the use of Schedule I (primarily heroin) and II (primarily amphetamine and methamphetamine) and subjected to protective measures, such as consultation during school vacation, labor services, and child welfare placement. For the use of Schedule III (e.g., Ketamine) or IV (e.g., Alprazolam) drugs, adolescents generally receive school-based or community-based intervention, depending on school

enrollment status.

The Juvenile Justice Act mandates that frontline workers, such as social workers, police officers, and physicians, must report any illegal drug use by minors to government authorities, such as the Department of Social Welfare, within 24 hours of becoming aware of the situation. According to the investigation, students with a valid status who use drugs will receive school-based intervention, while those without this status will receive community-based intervention from social welfare agencies, as well as law enforcement, when necessary. The Ministry of Education (MOE) is the government agency designated to oversee the implementation of prevention/intervention programs on illegal drug use behaviors in school-attending students in Taiwan. In the context of a nine-year compulsory education (generally from 6 years old to the age of 15), the MOE is indeed the focal agency in charge of anti-drug efforts in the underage population.

Data Sources

The present study was built upon the Big Datasets of Drug Abuse, an integrated multisystem database for the intervention and treatment services delivered to individuals involved in illicit drug use and problems in Taiwan. For the records concerning the use of any illicit drugs, the present study retrieved the data from six data sources: the MOE's Drug Consultation and Management Dataset (DCMD), the Criminal Record Processing System (CRPS), the Administrative Penalty System for Schedule III/IV Substances (APS), the National Drug Control Center Database (NDCCD), the National Methadone Maintenance Treatment Database (NMMT, adults only), and the National Corrections Records (NCR, adults only). In addition, linked datasets included the High-Risk Family Management System Records and the National Health Insurance Research Database (NHIRD) from the Ministry of Health and Welfare, the MOE's School Dropout Reporting System, and the household registration record (Chen, et al., 2021; Pan, et al., 2021). Detailed descriptions of the data sources, years of coverage, and linkage process are provided in Supplementary Table 1 and Figure 1.

Study Design

We first identified a cohort of 1605 illicit-drug-using middle school-attending adolescents from the 2013–2016 DCMD. For young people in Taiwan, upon identifying the use of any illicit drug (mostly by a urine test) or drug-related activities (e.g., drug possession) by schoolteachers, school instructors, social workers (in school or community), or law enforcement officers, it is mandatory to confirm registered student status and, if positive, report (or make a referral) to his/her attending school's anti-drug task force. The time between case identification and reporting ranges from one to eight months, depending on the source and case complexity. Schools provided the indicated intervention primarily covering a brief assessment, anti-drug education, and follow-up evaluation (e.g., random urine test) (Ministry of Education, 2022). Each interventional service often lasts for approximately three months and may be extended upon an unfavorable evaluation (e.g., positive urine test).

Knowing that not all drug-using young adolescents had a valid student status, we then utilized the household registration record ($n = 809,477$; adolescents aged 12–14 — middle-school age in Taiwan) on January 1, 2015, to ascertain a cohort of 247 who had at least one record of drug use in the abovementioned five datasets in the preceding year (i.e., annual prevalence: 0.03% in 2014) for comparative purposes. An identical data-retrieval process and definitions of dependent, independent, and covariates were applied to both drug-using cohorts (i.e., 1605 middle schoolers and 247 young adolescents). All data were stored in the Health and Welfare Data Science Center, and the data linkage and analyses were processed using encrypted identification numbers. To ensure de-identification, any statistics with observations under three were not allowed to be presented.

Measures

Dependent variable

For illicit-drug-using middle schoolers ($n=1605$), the first record from the 2013–2016 DCMD was defined as the index report. Since the period of basic indicated prevention was three months, the endpoint was

defined as having the first record concerning drug use from the DCMD and any of three datasets (i.e., 2013–2020 CRPS, APS, and NDCCD) after the 90th day of the index report; and the time to have the re-reporting of illicit drug use (a proxy for reinitiated or persistent drug use) was calculated beginning with the index report and ending with day 1460 (i.e., four years). For illicit-drug-using young adolescents (n=247) in the community, the endpoint was defined as having the first record concerning drug use from any of the four datasets after the index report in 2015, with a 4-year follow-up period.

Independent variables

The independent variables of interest included the experience of risk indicators in the preceding five years of the index report from the agencies of child protection, healthcare, and education, specifically the high-risk-family program (HRF), pharmacological treatment for attention deficit hyperactivity disorder (ADHD), and re-enrollee consultation, respectively.

The HRF, first implemented in 2004, was a nationwide intervention targeting families at risk of child maltreatment. Family-level risk indicators involve the conditions and events that make families unable to provide their children with adequate care or that adversely affect children's development, such as impoverishment, caregivers with untreated mental disorders, or family conflicts (Feng, 2009; Lin & Lee, 2016; Lin, 2017). Here, experience with the HRF was classified as “none,” “ever received” (i.e., those whose family had received HRF intervention, yet the case was closed before the index report), and “concurrently received” (whose family still received HRF intervention at the date of the index report in the DCMD).

Treatment history of ADHD within five years before the index report was ascertained from the NHIRD. Given that ADHD is primarily treated by medication in Taiwan, we confirmed that one has a diagnosis of ADHD by (i) having visited outpatient care at least twice within six months for a medical condition with a relevant ICD-code (ICD-9 CM in 314.00, 314.01, 314.1, 314.2, 314.8, 314.9, and ICD-10 in F90.0, F90.1, F90.2, F90.8, F90.9), and (ii) having received stimulant therapy (e.g., methylphenidate, atomoxetine, and clonidine) at least twice within six months (McCabe, et al., 2016; McCabe, et al., 2024). Those who received prescriptions at least two times within six months before the index report were categorized as having

concurrently received medication treatment.

Finally, at least nine years of education (generally starting from six years of age to 15) are compulsory in Taiwan. By law, “dropout” is defined as (i) being absent from school for three days or more without leave or cause, or (ii) having been transferred to the new school yet not to enroll. Here, we took advantage of the School Dropout Reporting System to retrieve the experience of dropout and re-enrollee consultation in the five years preceding the index report. Having received re-enrollee consultation in the previous six months means that resuming schooling and index drug use occur in the same semester.

Other covariates

Sociodemographic variables — including gender, age, family income level, and residential region — were obtained from the household registration record. Family income level, measured by the National Health Insurance premium (a proxy for the monthly salary level for the caregiver or guardian of children) in the year before the index report, was categorized into high-income, middle-income, and low-income. When the youngsters’ households had received national poverty aid (i.e., household total earned income was lower than 1.5-fold the lowest cost of living), family income was coded as poverty/near poverty. Residential regions of Taiwan were categorized into four groups: northern, central, southern, and eastern areas & outlying islands. For the index reporting, information pertaining to illicit drug involvement was obtained from the DCMD, including drug type, schedule level, and reporting source. Finally, for adults living in the same household, their engagement in any illicit drug-related activities (e.g., use or selling) was retrieved from the 2013–2016 DCMD and the other five drug-related datasets within five years of the index report. The present study defines those who had any illicit drug-related records in the other datasets in the year before the index report as non-school-initiated drug records, referred from sources such as police officers.

Data analysis

The distributions of individual-, family-, and illicit-drug-related characteristics for drug-using middle schoolers and young adolescents aged 12–14 in the general population were first summarized, followed by

contingency table analyses to examine differences. Next, the smoothed estimates of the cumulative hazard functions were plotted from the 90th day after the index report to the first record of drug use re-reporting (derived from any of the four illicit-drug-related datasets), day by day, to the end of the fourth year (i.e., day 1460).

Cox proportional hazard regression analyses were conducted to estimate the hazard ratios (HR) for three services directed at family, mental, and school risk indicators. The endpoint of follow-up was the re-reporting of illicit drug use, death, or the end of observation (i.e., 48 months), depending on whichever came first. The crude hazard ratio for each of the three intervention services was first obtained, followed by estimating the hazard ratio for each service with simultaneous adjustment for individual and familial characteristics (i.e., gender, residential region, family income, and illicit drug-involved adult household members) and drug-related characteristics (drug schedule and referred status) in Model I. Finally, all three intervention services were included in Model II. We also repeated the analyses for drug-using young adolescents ascertained from the general population in 2015, with registered student status being included in the final model.

Sensitivity analyses were performed to include either drug possession or drug use as the endpoint event and to take within-household correlation (i.e., two or more adolescents from the same household, 21 households) into account (see Supplementary Tables 2 & 3). All analyses were conducted using SAS version 9.4 (SAS Institute, Inc., Cary, North Carolina, USA).

Results

Table 1 summarizes the distribution of the selected characteristics of 1605 illicit-drug-using middle schoolers from the period of 2013–2016 and young adolescents in the 2015 general population. Drug-using students, compared with the general population, experienced more unfavorable family conditions, including receiving poverty aid (25.6% vs. 7.9%) and having at least one illicit-drug-involved adult in the household (15.9% vs. 2.1%). As to the experience of risk indicators, nearly one in nine drug-using middle schoolers received HRF intervention (11.5%) and one in three was an ever dropout, significantly higher than the 0.8% and

0.43%, respectively, in the general population. The experience of ADHD pharmacological treatment in drug-using middle schoolers (6.4% vs 4.4%) was slightly higher, yet the proportion of concurrent treatment is lower than that of the general population ($0.81/6.4=12.7\%$ vs. $1/4.41=22.7\%$). The majority of drug-using middle schoolers were engaged in schedule III or IV drugs, and 76% had a previous drug record. Finally, the re-reporting rate of illicit drug use among middle schoolers in the coming 4-year period was 34.9% (45% were from police records), slightly lower than 41.3% in drug-using young adolescents.

Insert Table 1 here

Figure 1a shows the cumulative incidence of re-reporting by the experience of receiving service for three risk indicators (i.e., HRF intervention, ADHD, and school dropout). By the end of the 48th month after the index report, the highest cumulative re-reporting was observed in middle schoolers with a history of ADHD treatment (40%) and dropout (37%). The statistical differences in the cumulative incidence emerged in dropout status ($p=0.02$) and the corresponding instantaneous hazard rate. A closer look found that the instantaneous hazard of re-reporting noticeably decreased in the first year and leveled off around the end of the 15th month (see Figure 1b).

Insert Figure 1

The estimated hazard ratios linking three risk indicators with re-reporting of illicit drug use in the four years are presented in Table 2. For middle schoolers, having received dropout consultation may elevate the hazard by 18% to 33% (ever received: $HR=1.18$, 95% $CI=0.98-1.43$; received in past six months: $HR=1.33$, 95% $CI=1.00-1.77$); similarly, ADHD pharmacological treatment may elevate the hazard (ever received: $HR=1.17$, 95% $CI=0.84-1.64$; concurrently received: $HR=1.39$, 95% $CI=0.62-3.10$). In contrast, having received HRF intervention in childhood may reduce the hazard of re-reported illicit drug use by 37% ($HR=0.63$, 95% $CI=0.42-0.93$). When taking all listed variables into account (see Model 2 in Table 2), the estimated risk becomes more salient. Receiving dropout consultation earlier may elevate the hazard by 46% (95% $CI=1.09-1.96$), and receiving HRF intervention may reduce the hazard of re-reporting by 43% (95% $CI=0.39-0.86$). Meanwhile, use of advanced illicit drugs may slightly increase subsequent risk of re-reporting throughout late adolescence (schedule I/II only: $aHR=1.27$; 95% $CI=1.00-1.61$; both: $aHR=1.38$; 95% $CI=0.96-1.97$). We also

repeated a series of sensitivity analyses for illicit drug-related behaviors (e.g., possession only and sale), illicit drug-taking within household correlation, and case-opening status (i.e., reporting only vs. reporting and consultation); the estimates for the HRF and dropout were generally similar (see Supplementary Tables 2–4). Finally, the post-hoc analyses on potential gender-related heterogeneity revealed that concurrent ADHD treatment-related increased hazard of drug use appeared more prominent in girls (aHR=2.9, see Supplementary Table 5).

For drug-using young adolescents in the community, nearly one in ten did not receive any school-based indicated prevention (i.e., not having a registered student status) (see Table 3); their experience of three risk indicators was unanimously higher than their school-attending peers, such as dropping out of school (55% vs. 34.9%). After taking individual, family, and index drug characteristics into account, having received HRF intervention appeared to be the only risk indicator significantly associated with the hazard of drug use re-reporting (ever received: aHR=0.37, 95% CI=0.15–0.92).

Insert Tables 2 & 3 here

Discussion

In the context wherein the lifetime prevalence of illicit drug use in community-dwelling adolescents was below 1%, our results from the linkage of several national datasets can be summarized as follows. First, drug-involved adolescents disproportionately came from at-risk families and experienced school drop-out. Second, over the 4-year follow-up, 35% of middle schoolers were re-reported from at least one drug-related system (police arrest as the major source), and the risk of re-reporting noticeably decreased beginning in the sixth month and leveled off around the end of the 15th month. And finally, dropping out in early schooling may elevate middle schoolers' hazard of drug use by 46%. Receiving the service targeting at-risk families in late childhood may reduce the hazard by 43%, with the reduction even higher when non-school-attending adolescents in the community were included.

Re-reporting (a proxy for reinitiated or persistent use) in this cohort of young adolescents was slightly

lower than the relapse rates for young adults attending clinical treatment (e.g., 38% to 43%, respectively, during 3 to 7 years of follow-up) in Taiwan, and remarkably lower than those previously reported in several developed countries (e.g., ~60% in the first year) (Chung & Maisto, 2006; Wang, et al., 2018; You, et al., 2020). In addition to variations in drug of primary interest and availability in the community, this observation may indicate that drug-involved middle schoolers (i) were primarily experimental users, (ii) have closer ties to conventional institutions in the context of mandatory education (i.e., staying in school), and (iii) had more financial and network barriers to accessing drugs as compared with high schoolers or those in the workforce (Trucco, 2020). However, given that drug-involved middle schoolers who transitioned through adolescence may no longer stay in school, an urgent need exists to develop a health-oriented intervention program that requires community-based interagency collaboration, particularly in the process of school-to-school and school-to-work transition.

Consistent with previous studies conducted in Taiwan and other societies (Fegert, et al., 2009; Gray & Squeglia, 2018; Kliewer & Murrelle, 2007; You, et al., 2020), drug-use behaviors in adolescence are commonly situated in a web characterized by poverty, family dysfunction, and family members who used drugs. Since family is the primary source of attachment, nurturing, and socialization for a growing individual, the higher prevalence of multiple disadvantaged or unfavorable family conditions reinforced the importance of assessing drug-involved students in the context of their family environment when devising the indicated prevention. Importantly, as we focused on those who have initiated illicit drugs, the HRF program, which targets families at risk for child maltreatment in preadolescence, was found to significantly reduce the hazard of re-reporting over 4-year follow-up. Since the implementation of HRF is independent of the school-based indicated drug prevention in Taiwan, there are some indications that addressing the needs of families at risk for maltreatment in late childhood may provide a buffer against further involvement in illicit drug use and problems. Ignorance of dysfunctional family conditions and improper parenting practice, or poor coordination between education and social care services, may possibly limit the effectiveness of prevention by failing to recognize that the family serves as a potential system of support for change (Catalano, et al., 2012; Daniel, et al., 2009; Das, Salam, Arshad, Finkelstein, & Bhutta, 2016; Kuntsche & Kuntsche, 2016).

The experience of dropout among middle schoolers and young adolescents who use drugs is strikingly common (Townsend, Flisher, & King, 2007; Wang, et al., 2018). Quitting school in adolescence is a complex phenomenon arising from multiple pathways up and beyond individual characteristics (e.g., family circumstances and school climates) (Oelsner, Lippold, & Greenberg, 2011; Piko & Kovács, 2010; Weatherson, et al., 2018); even if adolescents return to school after dropping out, out-of-school networks might remain influential. Although we are limited in the ability to account for directionality between dropout with drug initiation, the lack of attachment to traditional social institutions (i.e., school) and affiliation with street-based social networks may build up one's bond with deviant peers, provide easy access to drugs, and even result in joining gang-related drug dealing; these could gradually internalize "deviance" as part of self-identity or a drug career (Kelly, et al., 2019). As cumulative reports have conceptualized "dropout" as a process rather than as an event, it is recommended that the component of selective and indicated drug prevention efforts could be integrated into school re-enrollee consultation programs, accompanied by increasing awareness of stressors or victimization experienced before and during students' dropout in the contextualized process (Dupéré, et al., 2015), such as the presence of substance users in social networks.

Consistent with prior research (Gudjonsson, et al., 2012; Molina, et al., 2018), our findings showed that the prevalence rates of ADHD treatment in those drug-using young adolescents (6%-7%) were slightly higher than 4.4% in the general population (Wang, et al., 2017). A closer look revealed that the hazard of re-reporting illicit drug use was not linked with ADHD treatment status. This observation underscores the importance of ADHD assessment and treatment as a key element that should be addressed in school-based programs to prevent the progression or even onset of substance use in young people (McCabe, et al., 2016; McCabe, et al., 2024). Nevertheless, since our analyses on ADHD did not specifically list those ADHD-affected youth (i) who received no medication treatment in the previous five years and (ii) who never sought treatment from those without ADHD treatment, we cannot rule out that potential bias may arise when drug reinitiation can be accelerated by ADHD undertreatment or underdiagnosis. Future research may also explore whether such reinitiation risk may vary by age at first ADHD diagnosis, initiation and persistence of stimulant therapy, delayed treatment, utilization of non-medication treatment, and underdiagnosis, especially among those who

became involved in the criminal justice system at a younger age.

Our study has some limitations that should be considered. First, the endpoint was defined by any positive records in the five drug-related administrative datasets, which may not reflect the status of actual use. Although these sources of information may reduce bias from social desirability, our estimates of drug reinitiation can be vulnerable to bias when the reporting process is linked with variables of interest or underestimated because the DCMD did not cover a full four-year follow-up. Similarly, the generalization from data involving school-attending adolescents only to young people, in general, should be warranted since the dropouts were not included. Second, information about the onset age and severity of drug use and service content of indicated prevention was not available; thus, we cannot be certain the cohort of middle schoolers or young adolescents were incident drug users, although the initiation of illicit drugs generally escalates after the transition into middle school in Taiwan. Third, drug availability, school environment, and policing efforts are known to vary by community. Although we have taken region into account by statistical adjustment, future research that integrates community-level composition and resources is urgently needed (Allen, Loeb, Narr, & Costello, 2021; Fallu, Brière, & Janosz, 2014; Prins, et al., 2022; Van Ryzin, et al., 2012; Wray-Lake, et al., 2012). Despite the limitations mentioned above, this is one of few population-based longitudinal studies exploring illicit drug use throughout adolescence and predictors in a society in which illicit drug-using behaviors remain uncommon in the underage population. A large sample size with administrative data linkage granted us the opportunity to explore the potential effects of risk indicators (rather than self-reporting) in multiple domains. Furthermore, datasets with cross-sectoral service records covered nearly the entire illicit drug service system. By linking one dataset to another, more characteristics concerning students and their families could be assessed with an appropriate temporal sequence.

The prevalence of illicit drug use derived from community-based surveys in Taiwan has consistently fallen in the lower bounds of estimates reported elsewhere in the Asia region and in the rest of the world (Degenhardt, et al., 2016). Nonetheless, we found it alarming that one in five drug-involved middle schoolers have already used amphetamine or other scheduled I/II drugs other than the gateway drugs (e.g., ketamine); the use of advanced illicit drugs was even more prevalent when non-registered students were included (scheduled

I/II: 27.5% for young adolescents). These findings may be due to the increased availability and accessibility of amphetamine-like stimulants in the community (Tettey, et al., 2013). Since the use of schedule I/II drugs is still conceptualized as criminal in Taiwan, this subgroup of middle schoolers often became involved with the juvenile justice system (Wang, et al., 2018); we therefore recommend that the collaboration between juvenile justice with behavioral health and social care systems (e.g., child protection services) facilitate young people's engagement in intervention/treatment services at school or in the community (Elkington, Lee, Brooks, Watkins, & Wasserman, 2020). In addition, juvenile justice needs the infrastructure that can support the implementation of family-based intervention to improve caregivers' interaction and problem-solving skills, enhance emotional connections and communication, and increase understanding of substance use in a supportive way.

The findings, based on the linkage of several national administrative datasets, contribute a comprehensive, in-depth look at the factors linked with the re-reporting of illicit drug use beyond drug and individual levels. Our work may provide some practical recommendations for policy and practice. First, the social welfare program should integrate the provision of intervention for underage substance use in the service programs targeting vulnerable families characterized by social disadvantage (e.g., poverty), criminal justice issues, and mental health problems; interventions (e.g., the Strengthening Families Program and the UNODC Global Family Skills Initiative) and core components addressing communication, parental monitoring, and resilience building should be considered (El-Khani, et al., 2024; Velleman, Templeton, & Copello, 2005). For services addressing family conflict and neglect, it is important to increase caregivers' awareness of the signs and consequences of illicit drug use at a young age and the ways of finding professional help in the community for their child when necessary (European Monitoring Centre for Drugs and Drug Addiction, 2008). Second, empirical evidence supports that school-based intervention on illicit use behaviors had better outcomes when parent sessions were included (Dishion, Kavanagh, Schneiger, Nelson, & Kaufman, 2002; Winters, Fahnhorst, Botzet, Lee, & Lalone, 2012). Given the high prevalence of dysfunctional households (as indexed by the service experience of high-risk families) among drug-using middle schoolers, it is recommended that school-based brief intervention should include more components relevant to life skills training and motivational interviewing while strategically building partnerships with families (e.g., parents) (Kelly, et al., 2019). For middle schoolers at risk

or having a history of dropout, the educational system has to foster coalitions with key stakeholders in the community (e.g., outreach workers, police officers, healthcare providers, and volunteer organizations), focusing efforts on enhancing social inclusion, reducing exposure to the pro-drug social network (e.g., gangsters), and foster resiliency for family or community adversity (European Monitoring Centre for Drugs and Drug Addiction, 2008).

In conclusion, more than one in three illicit-drug-using middle schoolers reinitiated the use of at least one illicit drug over the 4-year follow-up in Taiwan. The hazard of use was significantly elevated by earlier experience of dropping out and reduced by receiving social care services targeting families at risk for child maltreatment. To reduce progression into advanced drug involvement in young people, early intervention with integrated services and evidence-based development-tailored strategies are urgently needed (Wittchen, et al., 2008). Future research efforts should focus on strategies to early identify at-risk young adolescents and deliver brief interventions, particularly for those experiencing family adversity and school maladjustment.

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CRediT authorship contribution statement

Yi-Nuo Lee: Writing - original draft, Formal analysis, Data curation. Tan-Wen Hsieh: Writing - review & editing, Writing - original draft, Project administration, Methodology, Data curation, Conceptualization. An-Jou Chen: Writing - review & editing, Methodology, Data curation. Jen-Huoy Tsay: Writing - review & editing, Methodology. Chuan-Yu Chen: Writing - review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declared that neither competing financial interests nor personal relationships could have appeared to influence the work reported in this paper.

References

- Allen, J. P., Loeb, E. L., Narr, R. K., & Costello, M. A. (2021). Different factors predict adolescent substance use versus adult substance abuse: Lessons from a social-developmental approach. *Development and Psychopathology*, 33, 792-802.
- Bailey, S. L., Flewelling, R. L., & Rachal, J. V. (1992). Predicting continued use of marijuana among adolescents: The relative influence of drug-specific and social context factors. *Journal of Health and Social Behavior*, 51-65.
- Bradley, B. J., & Greene, A. C. (2013). Do health and education agencies in the United States share responsibility for academic achievement and health? A review of 25 years of evidence about the relationship of adolescents' academic achievement and health behaviors. *Journal of Adolescent Health*, 52, 523-532.
- Brook, D. W., Brook, J. S., Zhang, C., Cohen, P., & Whiteman, M. (2002). Drug use and the risk of major depressive disorder, alcohol dependence, and substance use disorders. *Archives of General Psychiatry*, 59, 1039-1044.
- Catalano, R. F., Fagan, A. A., Gavin, L. E., Greenberg, M. T., Irwin, C. E., Ross, D. A., & Shek, D. T. (2012). Worldwide application of prevention science in adolescent health. *The Lancet*, 379, 1653-1664.
- Chen, C.-Y., Storr, C. L., & Anthony, J. C. (2009a). Early-onset drug use and risk for drug dependence problems. *Addictive Behaviors*, 34, 319-322.
- Chen, P., & Jacobson, K. C. (2012). Developmental trajectories of substance use from early adolescence to young adulthood: Gender and racial/ethnic differences. *Journal of Adolescent Health*, 50, 154-163.
- Chen, W. J., Chen, C.-Y., Wu, S.-C., Wu, K. C.-C., Jou, S., Tung, Y.-C., & Lu, T.-P. (2021). The impact of Taiwan's implementation of a nationwide harm reduction program in 2006 on the use of various illicit drugs: trend analysis of first-time offenders from 2001 to 2017. *Harm Reduction Journal*, 18, 1-11.
- Chen, W. J., Fu, T.-C., Ting, T.-T., Huang, W.-L., Tang, G.-M., Hsiao, C. K., & Chen, C.-Y. (2009b). Use of ecstasy and other psychoactive substances among school-attending adolescents in Taiwan: national surveys 2004–2006. *BMC Public Health*, 9, 1-8.
- Chung, T., & Maisto, S. A. (2006). Relapse to alcohol and other drug use in treated adolescents: Review and reconsideration of relapse as a change point in clinical course. *Clinical Psychology Review*,

26, 149-161.

- Coffey, C., Lynskey, M., Wolfe, R., & Patton, G. (2000). Initiation and progression of cannabis use in a population-based Australian adolescent longitudinal study. *Addiction*, 95, 1679-1690.
- Daniel, J. Z., Hickman, M., Macleod, J., Wiles, N., Lingford-Hughes, A., Farrell, M., Araya, R., Skapinakis, P., Haynes, J., & Lewis, G. (2009). Is socioeconomic status in early life associated with drug use? A systematic review of the evidence. *Drug and Alcohol Review*, 28, 142-153.
- Das, J. K., Salam, R. A., Arshad, A., Finkelstein, Y., & Bhutta, Z. A. (2016). Interventions for adolescent substance abuse: An overview of systematic reviews. *Journal of Adolescent Health*, 59, S61-S75.
- Degenhardt, L., Stockings, E., Patton, G., Hall, W. D., & Lynskey, M. (2016). The increasing global health priority of substance use in young people. *The Lancet Psychiatry*, 3, 251-264.
- Dishion, T. J., Kavanagh, K., Schneiger, A., Nelson, S., & Kaufman, N. K. (2002). Preventing early adolescent substance use: A family-centered strategy for the public middle school. *Prevention Science*, 3, 191-201.
- Dupéré, V., Leventhal, T., Dion, E., Crosnoe, R., Archambault, I., & Janosz, M. (2015). Stressors and turning points in high school and dropout: A stress process, life course framework. *Review of Educational Research*, 85, 591-629.
- El-Khani, A., Asif, M., Shahzad, S., Bux, M. S., Maalouf, W., Khoso, A. B., Chaudhry, I. B., Van Hout, M.-C., Zadeh, Z., & Tahir, A. (2024). Assessing the efficacy of a brief universal family skills programme on child behaviour and family functioning in Gilgit-Baltistan, Pakistan: protocol for a feasibility randomised controlled trial of the Strong Families programme. *BMJ Open*, 14, e081557.
- Elkington, K. S., Lee, J., Brooks, C., Watkins, J., & Wasserman, G. A. (2020). Falling between two systems of care: Engaging families, behavioral health and the justice systems to increase uptake of substance use treatment in youth on probation. *Journal of Substance Abuse Treatment*, 112, 49-59.
- European Monitoring Centre for Drugs and Drug Addiction. (2008). *Drugs and Vulnerable Groups of Young People* (Vol. 2). Luxembourg: Office for Official Publications of the European Communities.
- Fallu, J.-S., Brière, F. N., & Janosz, M. (2014). Latent classes of substance use in adolescent cannabis users: predictors and subsequent substance-related harm. *Frontiers in Psychiatry*, 5, 9.
- Fegert, J., Schepker, R., Keller, F., Ludolph, A., Plener, P., & Williamson, A. (2009). Preventing later

substance use disorders in at-risk children and adolescents: A review of the theory and evidence base of indicated prevention. *European Monitoring Centre for Drugs and Drug Addiction, Lisbon, Portugal.*

- Feng, J. Y. (2009). The emerging of a policy for preventive services to the at-risk families in Taiwan—the function of pressure group on the incremental policy decision making. *Journal of Asian Public Policy*, 2, 344-353.
- Fergusson, D. M., Horwood, L. J., & Ridder, E. M. (2007). Conduct and attentional problems in childhood and adolescence and later substance use, abuse and dependence: results of a 25-year longitudinal study. *Drug and Alcohol Dependence*, 88, S14-S26.
- Galea, S., Nandi, A., & Vlahov, D. (2004). The social epidemiology of substance use. *Epidemiologic Reviews*, 26, 36-52.
- Giordano, G. N., Ohlsson, H., Kendler, K. S., Sundquist, K., & Sundquist, J. (2014). Unexpected adverse childhood experiences and subsequent drug use disorder: a Swedish population study (1995–2011). *Addiction*, 109, 1119-1127.
- Gray, K. M., & Squeglia, L. M. (2018). Research Review: What have we learned about adolescent substance use? *Journal of Child Psychology and Psychiatry*, 59, 618-627.
- Gudjonsson, G. H., Sigurdsson, J. F., Sigfusdottir, I. D., & Young, S. (2012). An epidemiological study of ADHD symptoms among young persons and the relationship with cigarette smoking, alcohol consumption and illicit drug use. *Journal of Child Psychology and Psychiatry*, 53, 304-312.
- Hemphill, S. A., Heerde, J. A., Herrenkohl, T. I., Patton, G. C., Toumbourou, J. W., & Catalano, R. F. (2011). Risk and protective factors for adolescent substance use in Washington State, the United States and Victoria, Australia: A longitudinal study. *Journal of Adolescent Health*, 49, 312-320.
- Henry, K. L., Knight, K. E., & Thornberry, T. P. (2012). School disengagement as a predictor of dropout, delinquency, and problem substance use during adolescence and early adulthood. *Journal of Youth and Adolescence*, 41, 156-166.
- Hill, S., Shanahan, L., Costello, E. J., & Copeland, W. (2017). Predicting persistent, limited, and delayed problematic cannabis use in early adulthood: findings from a longitudinal study. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56, 966-974. e964.
- Hoffmann, J. P., & Cerbone, F. G. (2002). Parental substance use disorder and the risk of adolescent drug abuse: an event history analysis. *Drug and Alcohol Dependence*, 66, 255-264.
- Jääskeläinen, M., Holmila, M., Notkola, I. L., & Raitasalo, K. (2016). Mental disorders and harmful

- substance use in children of substance abusing parents: a longitudinal register-based study on a complete birth cohort born in 1991. *Drug and Alcohol Review*, 35, 728-740.
- Kelly, A. B., Weier, M., & Hall, W. D. (2019). The age of onset of substance use disorders. In *Age of Onset of Mental Disorders: Etiopathogenetic and Treatment Implications* (pp. 149-167). Switzerland: Springer.
- Kliewer, W., & Murrelle, L. (2007). Risk and protective factors for adolescent substance use: findings from a study in selected Central American countries. *Journal of Adolescent Health*, 40, 448-455.
- Kuntsche, S., & Kuntsche, E. (2016). Parent-based interventions for preventing or reducing adolescent substance use—A systematic literature review. *Clinical Psychology Review*, 45, 89-101.
- Liao, J.-Y., Huang, C.-M., Lee, C. T.-C., Hsu, H.-P., Chang, C.-C., Chuang, C.-J., & Guo, J.-L. (2018). Risk and protective factors for adolescents' illicit drug use: A population-based study. *Health Education Journal*, 77, 749-761.
- Lin, C.-H., & Lee, M.-J. (2016). A comparative policy analysis of family preservation programs in the US and in Taiwan. *Journal of Child and Family Studies*, 25, 1131-1144.
- Lin, H.-C., Jester, J. M., & Buu, A. (2016). The relationships of cigarette and alcohol use with the initiation, reinitiation, and persistence of cannabis use. *Journal of Studies on Alcohol and Drugs*, 77, 113-120.
- Lin, Y.-C. (2017). Exploration and Recommendations for Practical Work with High-Risk Families of Children and Youth. *Community Development Journal Quarterly*, 159, 160-167.
- McCabe, S. E., Dickinson, K., West, B. T., & Wilens, T. E. (2016). Age of onset, duration, and type of medication therapy for attention-deficit/hyperactivity disorder and substance use during adolescence: a multi-cohort national study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 55, 479-486.
- McCabe, S. E., Figueroa, O., McCabe, V. V., Schepis, T. S., Schulenberg, J. E., Veliz, P. T., Werner, K. S., & Wilens, T. E. (2024). Is age of onset and duration of stimulant therapy for ADHD associated with cocaine, methamphetamine, and prescription stimulant misuse? *Journal of Child Psychology and Psychiatry*, 65, 100-111.
- Miech, R. A., Johnston, L. D., Patrick, M. E., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2023). Monitoring the Future National Survey Results on Drug Use, 1975-2022: Secondary School Students. In Ann Arbor, MI: Institute for Social Research, University of Michigan. Ministry of Education. Net Enrollment Rate of Each Level of Schools. from

https://www.gender ey.gov.tw/gecdb/Stat_Statistics_Query.aspx?sn=47GZM8ADiLa2XmWLaL6UjA%40%40&statsn=SzkhKs3R1tSucXEiKsq39Q%40%40&d=&n=189749.

- Mokdad, A. H., Forouzanfar, M. H., Daoud, F., Mokdad, A. A., El Bcheraoui, C., Moradi-Lakeh, M., Kyu, H. H., Barber, R. M., Wagner, J., & Cercy, K. (2016). Global burden of diseases, injuries, and risk factors for young people's health during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*, 387, 2383-2401.
- Mokinaro, S., Vincente, J., Benedetti, E., Cerrai, S., Colasante, E., Arpa, S., Chomynova, P., Kraus, L., Monshouwer, K., & Spika, S. (2020). ESPAD Report 2019: Results from European School Survey Project on Alcohol and Other Drugs. In. Luxembourg
- Molina, B. S., Howard, A. L., Swanson, J. M., Stehli, A., Mitchell, J. T., Kennedy, T. M., Epstein, J. N., Arnold, L. E., Hechtman, L., & Vitiello, B. (2018). Substance use through adolescence into early adulthood after childhood-diagnosed ADHD: findings from the MTA longitudinal study. *Journal of Child Psychology and Psychiatry*, 59, 692-702.
- Molina, B. S., Kennedy, T. M., Howard, A. L., Swanson, J. M., Arnold, L. E., Mitchell, J. T., Stehli, A., Kennedy, E. H., Epstein, J. N., & Hechtman, L. T. (2023). Association between stimulant treatment and substance use through adolescence into early adulthood. *JAMA Psychiatry*, 80, 933-941.
- Nakawaki, B., & Crano, W. D. (2012). Predicting adolescents' persistence, non-persistence, and recent onset of nonmedical use of opioids and stimulants. *Addictive Behaviors*, 37, 716-721.
- Oelsner, J., Lippold, M. A., & Greenberg, M. T. (2011). Factors influencing the development of school bonding among middle school students. *Journal of Early Adolescence*, 31, 463-487.
- Pampati, S., Buu, A., Hu, Y.-H., de Leon, C. F. M., & Lin, H.-C. (2018). Effects of alcohol and cigarette use on the initiation, reinitiation, and persistence of cannabis use from adolescence to emerging adulthood. *Addictive Behaviors*, 79, 144-150.
- Pan, W.-H., Wu, K. C.-C., Chen, C.-Y., Chu, Y.-R., Wu, S.-C., Jou, S., Lu, T.-P., Tung, Y.-C., Hsu, J., & Chen, W. J. (2021). First-time offenders for recreational ketamine use under a new penalty system in Taiwan: incidence, recidivism and mortality in national cohorts from 2009 to 2017. *Addiction*, 116, 1770-1781.
- Perkonigg, A., Goodwin, R. D., Fiedler, A., Behrendt, S., Beesdo, K., Lieb, R., & Wittchen, H. U. (2008). The natural course of cannabis use, abuse and dependence during the first decades of life. *Addiction*, 103, 439-449.

- Piko, B. F., & Kovács, E. (2010). Do parents and school matter? Protective factors for adolescent substance use. *Addictive Behaviors*, 35, 53-56.
- Prins, S. J., Kajeepeta, S., Hatzenbuehler, M. L., Branas, C. C., Metsch, L. R., & Russell, S. T. (2022). School health predictors of the school-to-prison pipeline: substance use and developmental risk and resilience factors. *Journal of Adolescent Health*, 70, 463-469.
- Slade, E. P., Stuart, E. A., Salkever, D. S., Karakus, M., Green, K. M., & Ialongo, N. (2008). Impacts of age of onset of substance use disorders on risk of adult incarceration among disadvantaged urban youth: A propensity score matching approach. *Drug and Alcohol Dependence*, 95, 1-13.
- Tetty, J., Wong, Y., Levissianos, S., Eichinger, N., Soe, T., Kelley, S., & Umapornsakula, A. (2013). Patterns and trends of amphetamine-type stimulants and other drugs: Challenges for Asia and the Pacific. In *A Report from the Global SMART Programme* (pp. 1-162). Vienna.
- Townsend, L., Flisher, A. J., & King, G. (2007). A systematic review of the relationship between high school dropout and substance use. *Clinical Child and Family Psychology Review*, 10, 295-317.
- Trucco, E. M. (2020). A review of psychosocial factors linked to adolescent substance use. *Pharmacology Biochemistry and Behavior*, 196, 172969.
- United Nations Office on Drugs and Crime. (2022). World Drug Report 2022. In. Vienna: United Nations Publication.
- Van Ryzin, M. J., Fosco, G. M., & Dishion, T. J. (2012). Family and peer predictors of substance use from early adolescence to early adulthood: An 11-year prospective analysis. *Addictive Behaviors*, 37, 1314-1324.
- Velleman, R. D., Templeton, L. J., & Copello, A. G. (2005). The role of the family in preventing and intervening with substance use and misuse: a comprehensive review of family interventions, with a focus on young people. *Drug and Alcohol Review*, 24, 93-109.
- Wang, L.-J., Chen, M.-Y., Lin, C.-Y., Chong, M.-Y., Chou, W.-J., You, Y.-H., Tsai, C.-P., Chen, Y.-S., & Lu, S.-F. (2018). Difference in long-term relapse rates between youths with ketamine use and those with stimulants use. *Substance Abuse Treatment, Prevention, and Policy*, 13, 1-9.
- Wang, L.-J., Lee, S.-Y., Yuan, S.-S., Yang, C.-J., Yang, K.-C., Huang, T.-S., Chou, W.-J., Chou, M.-C., Lee, M.-J., & Lee, T.-L. (2017). Prevalence rates of youths diagnosed with and medicated for ADHD in a nationwide survey in Taiwan from 2000 to 2011. *Epidemiology and Psychiatric Sciences*, 26, 624-634.
- Wang, M. T., & Fredricks, J. A. (2014). The reciprocal links between school engagement, youth problem

- behaviors, and school dropout during adolescence. *Child Development*, 85, 722-737.
- Weatherson, K. A., O'Neill, M., Lau, E. Y., Qian, W., Leatherdale, S. T., & Faulkner, G. E. (2018). The protective effects of school connectedness on substance use and physical activity. *Journal of Adolescent Health*, 63, 724-731.
- Winters, K. C., Fahnhorst, T., Botzet, A., Lee, S., & Lalone, B. (2012). Brief intervention for drug-abusing adolescents in a school setting: Outcomes and mediating factors. *Journal of Substance Abuse Treatment*, 42, 279-288.
- Wittchen, H. U., Behrendt, S., Höfler, M., Perkonigg, A., Lieb, R., Bühringer, G., & Beesdo, K. (2008). What are the high risk periods for incident substance use and transitions to abuse and dependence? Implications for early intervention and prevention. *International Journal of Methods in Psychiatric Research*, 17, S16-S29.
- Wray-Lake, L., Maggs, J. L., Johnston, L. D., Bachman, J. G., O'Malley, P. M., & Schulenberg, J. E. (2012). Associations between community attachments and adolescent substance use in nationally representative samples. *Journal of Adolescent Health*, 51, 325-331.
- You, Y.-H., Lu, S.-F., Tsai, C.-P., Chen, M.-Y., Lin, C.-Y., Chong, M.-Y., Chou, W.-J., Chen, Y.-S., & Wang, L.-J. (2020). Predictors of five-year relapse rates of youths with substance abuse who underwent a family-oriented therapy program. *Annals of General Psychiatry*, 19, 1-8.
- Zych, I., Rodríguez-Ruiz, J., Marín-López, I., & Llorent, V. J. (2020). Longitudinal stability and change in adolescent substance use: A latent transition analysis. *Children and Youth Services Review*, 112, 104933.

Table 1. Characteristics of illicit-drug-using middle schoolers and the general population, 2013–2016

Variables	Middle schoolers		General population		P-value ^a
	n=1605	%	n=809477	%	
<u>Individual and family characteristics^b</u>					
Gender					<0.00001
Female	529	32.96	387178	47.83	
Male	1076	67.04	422299	52.17	
Family income level					<0.00001
High income	90	5.61	146436	18.09	
Middle income	527	32.83	394521	48.74	
Low income	520	32.40	194877	24.07	
Poverty & near poverty	411	25.61	64127	7.92	
Illicit-drug-involved adults in the household					<0.00001
No	1350	84.11	792425	97.89	
Yes	255	15.89	17052	2.11	
<u>Service experience for risk indicators^b</u>					
High-risk-family intervention					<0.00001
None	1421	88.53	802849	99.18	
Ever received	108	6.73	4826	0.60	
Concurrently received	76	4.74	1802	0.22	
ADHD pharmacological treatment					<0.00001
None	1502	93.58	773792	95.59	
Ever received	90	5.61	27565	3.41	
Concurrently received	13	0.81	8120	1.00	
Re-enrollee consultation					<0.00001
None	1044	65.05	805987	99.57	
Ever received	131	8.16	1914	0.24	
Received in past six months	430	26.79	1576	0.19	
Four-year survival status					<0.00001
Alive	1589	99	808784	99.91	
Dead	16	1	693	0.09	
<u>Index report characteristics^b</u>					
Drug schedule ^c	1605		247	100.0	<0.00001
III, IV, & coffee sachets only	1305	81.31	143	57.89	
I & II only	221	13.77	59	23.89	
Both (I/II & III/IV)	77	4.80	9	3.64	
Drug type ^d					0.62
Ketamine	1331	82.93	185	74.90	
Amphetamine	267	16.64	32	12.96	
Poly-drug use	85	5.30	14	5.67	
Referred status (prior drug-related records)					0.03
No	1217	75.83	203	82.19	
Yes	388	24.17	44	17.81	
<u>Four-year follow-up</u>					
Re-reported illicit drug use					0.05
No	1045	65.11	145	58.7	
Yes	560	34.89	102	41.3	
Re-reported illicit drug-related behaviors					0.14
No	950	59.19	134	54.25	
Yes	655	40.81	113	45.75	

Notes:

- Comparison between middle schoolers and the general population (individuals aged 12–14 on January 1, 2015) was by chi-square test for categorical variables.
- The columns may not add up to 100% due to missingness.
- A total of 247 young adolescents who had at least one illicit drug use record in the prior year before the index date were identified; past-year prevalence=0.031%.
- The columns for middle schoolers may add up to over 100% due to polydrug use.

Table 2. Factors associated with re-reporting of illicit drug use among middle schoolers in four-year follow-up, n=1605

Variables	Univariate ^a			Model 1 ^{a,b}			Model 2 ^{a,c}		
	HR	95% CI	P-value	aHR	95% CI	P-value	aHR	95% CI	P-value
<u>Service experience for risk indicators</u>									
High-risk-family intervention (Ref: None)									
Ever received	0.63	0.42-0.93	0.02	0.63	0.42-0.93	0.02	0.57	0.39-0.86	0.007
Concurrently received	1.12	0.77-1.63	0.56	1.16	0.79-1.69	0.45	1.10	0.75-1.61	0.64
ADHD pharmacological treatment (Ref: None)									
Ever received	1.17	0.84-1.64	0.36	1.08	0.77-1.52	0.67	1.10	0.79-1.54	0.6
Concurrently received	1.39	0.62-3.10	0.43	1.32	0.59-2.96	0.51	1.29	0.57-2.91	0.54
Re-enrollee consultation (Ref: None)									
Ever received	1.33	1.00-1.77	0.05	1.40	1.05-1.87	0.02	1.46	1.09-1.96	0.01
Recently received	1.18	0.98-1.43	0.08	1.25	1.03-1.52	0.02	1.29	1.06-1.56	0.01
<u>Individual and family characteristics</u>									
Gender (Ref: Female)									
Male	1.29	1.07-1.55	0.007	--	--	--	1.30	1.07-1.57	0.008
Family income level (ref: High income)									
Middle income	0.99	0.68-1.45	0.97	--	--	--	0.94	0.64-1.38	0.76
Low income	0.99	0.68-1.46	0.97	--	--	--	0.96	0.65-1.41	0.82
Poverty & near poverty	1.02	0.69-1.51	0.91	--	--	--	1.01	0.68-1.50	0.96
Illicit-drug-involved adults in the household (Ref: None)									
At least one	1.11	0.89-1.38	0.35	--	--	--	1.04	0.83-1.30	0.73
<u>Index report characteristics</u>									
Drug schedule (Ref: III & IV)									
I & II	1.41	1.13-1.77	0.003	--	--	--	1.27	1.00-1.61	0.049
Both (I/II & III/IV)	1.48	1.04-2.10	0.03	--	--	--	1.38	0.96-1.97	0.08
Referred status (prior drug-related records) (Ref: No)									
Yes	1.30	1.08-1.56	0.005	--	--	--	1.20	0.98-1.46	0.08

Notes:

a. Cox regression analysis; HR: hazard ratio; aHR: adjusted hazard ratio; CI: confidence interval.

b. Model 1 estimated the risk of service, one variable at a time, with simultaneous adjustment for index report & individual and family characteristics.

c. Model 2 estimated the hazard ratio of three risk indicators with simultaneous adjustment for index report characteristics & individual and family characteristics.

Table 3. Selected service experience for risk indicators associated with re-reporting of illicit drug use among drug-using young adolescents in the community, n=247^a

Variables	n	%	HR	Univariate ^b		Final Model ^{b,c}		
				95% CI	P-value	aHR	95% CI	P-value
<u>Service experience for risk indicators</u>								
High-risk-family intervention								
None	205	83.00	1.00	--	--	1.00	--	--
Ever received	27	10.93	0.35	0.14-0.86	0.02	0.37	0.15-0.92	0.03
Concurrently received	15	6.07	0.53	0.20-1.45	0.53	0.62	0.22-1.75	0.37
ADHD pharmacological treatment								
None	230	93.12	1.00	--	--	1.00	--	--
Ever received	12	4.86	1.52	0.66-3.46	0.32	1.96	0.82-4.67	0.13
Concurrently received	5	2.02	1.64	0.52-5.18	0.40	1.07	0.29-3.94	0.91
Re-enrollee consultation								
None	111	44.94	1.00	--	--	1.00	--	--
Ever received	60	24.29	0.74	0.43-1.26	0.26	0.86	0.49-4.50	0.59
Recently received	76	30.77	1.28	0.83-1.97	0.27	1.49	0.90-2.45	0.12
<u>School-based indicated drug prevention</u>								
No	25	10.12	1.00	--	--	1.00	--	--
Yes	222	89.88	0.58	0.32-1.03	0.06	0.75	0.36-1.56	0.44

Note:

- Ascertained from the general population aged 12–14 on January 1, 2015.
- Cox regression analysis; HR: hazard ratio; aHR: adjusted hazard ratio; CI: confidence interval.
- The final model estimated the hazard ratio of three risk indicators and registered student status with simultaneous adjustment for index report characteristics (i.e., referred status and drug schedule) & individual and family characteristics (i.e., gender, living region, family income level, and illicit-drug-involved adults in the household).

Figure 1. Cumulative incidence and hazard re-reporting of illicit drug use among middle schoolers in four-year follow-up

