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Risk and protective factors of drug abuse among adolescents: a systematic review

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Abstract

Background: Drug abuse is detrimental, and excessive drug usage is a worldwide problem. Drug usage typically begins during adolescence. Factors for drug abuse include a variety of protective and risk factors. Hence, this systematic review aimed to determine the risk and protective factors of drug abuse among adolescents worldwide.

Methods: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was adopted for the review which utilized three main journal databases, namely PubMed, EBSCOhost, and Web of Science. Tobacco addiction and alcohol abuse were excluded in this review. Retrieved citations were screened, and the data were extracted based on strict inclusion and exclusion criteria. Inclusion criteria include the article being full text, published from the year 2016 until 2020 and provided via open access resource or subscribed to by the institution. Quality assessment was done using Mixed Methods Appraisal Tools (MMAT) version 2018 to assess the methodological quality of the included studies. Given the heterogeneity of the included studies, a descriptive synthesis of the included studies was undertaken.

Results: Out of 425 articles identified, 22 quantitative articles and one qualitative article were included in the final review. Both the risk and protective factors obtained were categorized into three main domains: individual, family, and community factors. The individual risk factors identified were traits of high impulsivity; rebelliousness; emotional regulation impairment, low religious, pain catastrophic, homework completeness, total screen time and alexithymia; the experience of maltreatment or a negative upbringing; having psychiatric disorders such as conduct problems and major depressive disorder; previous e-cigarette exposure; behavioral addiction; low-perceived risk; high-perceived drug accessibility; and high-attitude to use synthetic drugs. The familial risk factors were prenatal maternal smoking; poor maternal psychological control; low parental education; negligence; poor supervision; uncontrolled pocket money; and the presence of substance-using family members. One community risk factor reported was having peers who abuse drugs. The protective factors determined were individual traits of optimism; a high level of mindfulness; having social phobia; having strong beliefs against substance abuse; the desire to maintain one's health; high paternal awareness of drug abuse; school connectedness; structured activity and having strong religious beliefs.

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Conclusion: The outcomes of this review suggest a complex interaction between a multitude of factors influencing adolescent drug abuse. Therefore, successful adolescent drug abuse prevention programs will require extensive work at all levels of domains.

Keywords: Risk factor, Protective factor, Drug abuse, substance, adolescent

Introduction

Drug abuse is a global problem; 5.6% of the global population aged 15–64 years used drugs at least once during 2016 [1]. The usage of drugs among younger people has been shown to be higher than that among older people for most drugs. Drug abuse is also on the rise in many ASEAN (Association of Southeast Asian Nations) countries, especially among young males between 15 and 30 years of age. The increased burden due to drug abuse among adolescents and young adults was shown by the Global Burden of Disease (GBD) study in 2013 [2]. About 14% of the total health burden in young men is caused by alcohol and drug abuse. Younger people are also more likely to die from substance use disorders [3], and cannabis is the drug of choice among such users [4].

Adolescents are the group of people most prone to addiction [5]. The critical age of initiation of drug use begins during the adolescent period, and the maximum usage of drugs occurs among young people aged 18–25 years old [1]. During this period, adolescents have a strong inclination toward experimentation, curiosity, susceptibility to peer pressure, rebellion against authority, and poor self-worth, which makes such individuals vulnerable to drug abuse [2]. During adolescence, the basic development process generally involves changing relations between the individual and the multiple levels of the context within which the young person is accustomed. Variation in the substance and timing of these relations promotes diversity in adolescence and represents sources of risk or protective factors across this life period [6]. All these factors are crucial to helping young people develop their full potential and attain the best health in the transition to adulthood. Abusing drugs impairs the successful transition to adulthood by impairing the development of critical thinking and the learning of crucial cognitive skills [7]. Adolescents who abuse drugs are also reported to have higher rates of physical and mental illness and reduced overall health and well-being [8].

The absence of protective factors and the presence of risk factors predispose adolescents to drug abuse. Some of the risk factors are the presence of early mental and behavioral health problems, peer pressure, poorly equipped schools, poverty, poor parental supervision and relationships, a poor family structure, a lack of opportunities, isolation, gender, and accessibility to drugs [9]. The protective factors include high self-esteem, religiosity, grit, peer factors, self-control, parental monitoring, academic competence, anti-drug use policies, and strong neighborhood attachment [10–15].

The majority of previous systematic reviews done worldwide on drug usage focused on the mental, psychological, or social consequences of substance abuse [16–18], while some focused only on risk and protective factors for the non-medical use of prescription drugs among youths [19]. A few studies focused only on the risk factors of single drug usage among adolescents [20]. Therefore, the development of the current systematic review is based on the main research question: What is the current risk and protective factors among adolescent on the involvement with drug abuse? To the best of our knowledge, there is limited evidence from systematic reviews that explores the risk and protective factors among the adolescent population involved in drug abuse. Especially among developing countries, such as those in South East Asia, such research on the risk and protective factors for drug abuse is scarce. Furthermore, this review will shed light on the recent trends of risk and protective factors and provide insight into the main focus factors for prevention and control activities program. Additionally, this review will provide information on how these risk and protective factors change throughout various developmental stages. Therefore, the objective of this systematic review was to determine the risk and protective factors of drug abuse among adolescents worldwide. This paper thus fills in the gaps of previous studies and adds to the existing body of knowledge. In addition, this review may benefit certain parties in developing countries like Malaysia, where the national response to drugs is developing in terms of harm reduction, prison sentences, drug treatments, law enforcement responses, and civil society participation.

Methods

This systematic review was conducted using three databases, PubMed, EBSCOhost, and Web of Science, considering the easy access and wide coverage of reliable journals, focusing on the risk and protective factors of drug abuse among adolescents from 2016 until December 2020. The search was limited to the last 5 years to focus only on the most recent findings related to risk and protective factors. The search strategy employed was performed in accordance with the Preferred

Reporting Items for a Systematic Review and Meta-analysis (PRISMA) checklist.

A preliminary search was conducted to identify appropriate keywords and determine whether this review was feasible. Subsequently, the related keywords were searched using online thesauruses, online dictionaries, and online encyclopedias. These keywords were verified and validated by an academic professor at the National University of Malaysia. The keywords used as shown in Table 1.

Selection criteria

The systematic review process for searching the articles was carried out via the steps shown in Fig. 1. Firstly, screening was done to remove duplicate articles from the selected search engines. A total of 240 articles were removed in this stage. Titles and abstracts were screened based on the relevancy of the titles to the inclusion and exclusion criteria and the objectives. The inclusion criteria were full text original articles, open access articles or articles subscribed to by the institution, observation and intervention study design and English language articles. The exclusion criteria in this search were (a) case study articles, (b) systematic and narrative review paper articles, (c) non-adolescent-based analyses, (d) non-English articles, and (e) articles focusing on smoking (nicotine) and alcohol-related issues only. A total of 130 articles were excluded after title and abstract screening, leaving 55 articles to be assessed for eligibility. The full text of each article was obtained, and each full article was checked thoroughly to determine if it would fulfil the inclusion criteria and objectives of this study. Each of the authors compared their list of potentially relevant articles and discussed their selections until a final agreement was obtained. A total of 22 articles were accepted to be included in this review. Most of the excluded articles were excluded because the population was not of the target age range—i.e., featuring subjects with an age > 18 years, a cohort born in 1965–1975, or undergraduate college students; the subject matter was not related to the study objective—i.e., assessing the effects on premature mortality, violent behavior, psychiatric illness, individual traits, and personality; type of article such as narrative review and neuropsychiatry review; and because of our inability to obtain the full article—e.g., forthcoming work in 2021. One qualitative article was added to explain the domain related to risk and the protective factors among the adolescents.

Table 1 The search strings

Database	Search string
PubMed	adolescent OR teenager OR teen OR youth OR school-going children OR youngster OR pediatric* AND abuse OR addiction OR dependence OR habituation OR overdose OR misuse OR overuse OR use AND drug OR narcotic OR opioid OR psychoactive substance OR amphetamine OR cannabis OR ecstasy OR heroin OR cocaine OR hallucinogen* OR depressant OR stimulant OR marijuana OR illicit drug OR tranquilizers OR sedatives OR LSD OR Fentanyl OR illegal drug OR street drug OR club drug OR recreational drug OR substances AND risk factor OR protective factor OR predictive factor OR determinant OR cause
EBSCOhost	TX ("adolescent" OR "teenager" OR "teen' OR youth" OR "school-going children" OR "youngster" OR pediatric) AND TX ("abuse" OR "addiction" OR "dependence" OR "habituation" OR "overdose" OR "misuse" OR "overuse" OR "use") AND TX ("drug" OR "narcotic" OR "opioid" OR "psychoactive substance" OR "amphetamine" OR "cannabis" OR "ecstasy" OR "heroin" OR "cocaine" OR "hallucinogens" OR "depressant" OR "stimulant" OR "marijuana" OR "illicit drug" OR "tranquilizers" OR "sedatives" OR "LSD" OR "Fentanyl" OR "illegal drug" OR "street drug" OR "recreational drug" OR "substances") AND TX ("risk factor" OR "protective factor" OR "predictive factor" OR "determinant" OR "cause")
WoS	TS = ((("adolescent" OR "teenager" OR "teen' OR youth" OR "school-going children" OR "youngster" OR pediatric*) AND ("abuse" OR "ad-diction" OR "dependence" OR "habituation" OR "overdose" OR "misuse" OR "overuse" OR "use*") AND ("drug" OR "narcotic" OR "opioid" OR "psychoactive substance" OR "amphetamine" OR "cannabis" OR "ecstasy" OR "heroin" OR "cocaine" OR "hallucinogens" OR "depressant" OR "stimulant" OR "marijuana" OR "illicit drug" OR "tranquilizers" OR "sedatives" OR "LSD" OR "Fentanyl" OR "illegal drug" OR "street drug" OR "recreational drug" OR "sub-stances") AND ("risk factor" OR "protective factor" OR "predictive factor" OR "determinant" OR "cause")

Drug-related substances in this context refer to narcotics, opioids, psychoactive substances, amphetamines, cannabis, ecstasy, heroin, cocaine, hallucinogens, depressants, and stimulants. Drugs of abuse can be either off-label drugs or drugs that are medically prescribed. The two most commonly abused substances not included in this review are nicotine (tobacco) and alcohol. Accordingly, e-cigarettes and nicotine vape were also not included. Further, "adolescence" in this study refers to members of the population aged between 10 to 18 years [21].

Data extraction tool

All researchers independently extracted information for each article into an Excel spreadsheet. The data were then customized based on their (a) number; (b) year; (c) author and country; (d) titles; (e) study design; (f) type of substance abuse; (g) results—risks and protective factors; and (h) conclusions. A second reviewer crossed-checked the articles assigned to them and provided comments in the table.

Quality assessment tool

By using the Mixed Method Assessment Tool (MMAT version 2018), all articles were critically appraised for their quality by two independent reviewers. This tool has been shown to be useful in systematic reviews encompassing different study designs [22]. Articles were only

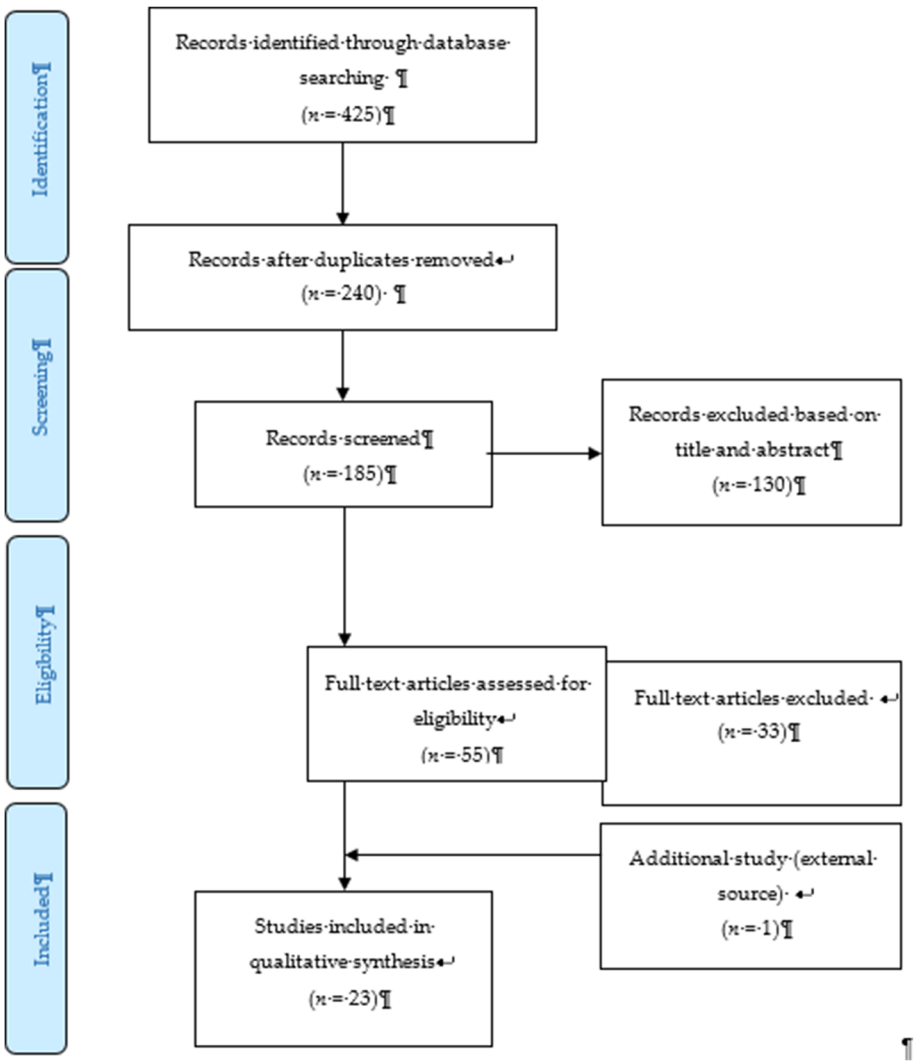

Fig. 1 PRISMA flow diagram showing the selection of studies on risk and protective factors for drug abuse among adolescents.2.2. Operational Definition

selected if both reviewers agreed upon the articles' quality. Any disagreement between the assigned reviewers was managed by employing a third independent reviewer. All included studies received a rating of "yes" for the questions in the respective domains of the MMAT checklists. Therefore, none of the articles were removed from this review due to poor quality. The Cohen's kappa (agreement) between the two reviewers was 0.77, indicating moderate agreement [23].

Results

The initial search found 425 studies for review, but after removing duplicates and applying the criteria listed above, we narrowed the pool to 22 articles, all of which are quantitative in their study design. The studies include three prospective cohort studies [24–26], one community trial [27], one case-control study [28], and nine cross-sectional studies [29–45]. After careful discussion, all reviewer panels agreed to add one qualitative study [46] to help provide reasoning for the quantitative results. The selected qualitative paper was chosen because it discussed almost all domains on the risk and protective factors found in this review.

A summary of all 23 articles is listed in Table 2. A majority of the studies (13 articles) were from the United States of America (USA) [25–27, 29–31, 34, 36–45], three studies were from the Asia region [32, 33, 38], four studies were from Europe [24, 28, 40, 44], and one study was from Latin America [35], Africa [43] and Mediterranean [45]. The number of sample participants varied widely between the studies, ranging from 70 samples (minimum) to 700,178 samples (maximum), while the

Table 2 Study characteristic and main findings

No	Year	Authors/ Country	Study objectives	Study design	Types of substance abuse	Result / findings Risk factors /Protective factors	Conclusion
1	2020	Dash et al. (USA)	To capture a time-sensitive report of the intersection of prescription opioid receipt and contextual risks for opioid misuse related to pain experience, mental health symptoms, and substance use at the adolescent and parental levels.	Cross-sectional	Opiod	Risk Factors 1) Pain catastrophe 2) Mother history of chronic pain (parents reported keeping opioids at home) and parent anxiety	Opioids at home as a risk factors for adolescent misuse
2	2020	Osborne et al. (USA)	To examine peer influence and parental guidance, in addition to peer and parental sources of alcohol, on patterns of prescription opioid use	Cross-sectional	Opiod	Risk factors 1) Close friend who used other substances 2) Alcoholic parents Protective Factors 1) Increased number of close friends	Increased number of close friends was a protective factor against prescription opioid
3	2020	Zuckermann et al.(Canada)	To investigate demographic and behavioral risk factors for non-medical use of prescription opioids.	Cross-sectional study	Opiod: oxycodone, fentanyl, other prescription pain relievers	Risk factors 1) lack of homework completion Protective Factors 1) School connectedness	School connectedness may lower the risk of non-medical use of prescription opioids, indicating that a school-based focus is justified.
4	2020	Spillane et al. (USA)	To examines the role of perceived availability and engagement in structured and unstructured activities on adolescent alcohol and marijuana use controlling for substance availability	Cross sectional	Marijuana	Risk Factors 1) Availability of unstructured activities	Perceived availability of and engagement in unstructured activities may present a risk, while perceived availability of and engagement in structured activities may serve as a protective factor for youth substance use
5	2020	Afifi et al.(Beirut)	To explore the association between bullying victimization and substance use in adolescents with low and high levels of religiosity.	Cross-sectional	Substance use	Risk Factors 1) Lower religiosity levels who had been bullied	Religiosity may be a potential moderator of the association between being bullied and substance use
6	2019	Marin S et al. (Iran)	To examine the relationship between optimistic explanatory style and cigarette smoking, hookah smoking, and illicit drug use among high school students in Sonqor county, Iran	Cross-sectional	Opium Cannabis Ecstasy Methamphetamine	Protective Factors 1) Optimism trait of an individual measured using Children Attributional Style Questionnaire (CASQ). 2) Higher scores of optimism protected students from using illicit drugs (Model 3: OR = 0.90, 95% CI: 0.85–0.95, $P < 0.001$). 3) Negative-stability and negative-globality domains of optimism were significantly higher among advanced-stage smokers and illicit drug users.	Optimism was found to be a protective factor against substance abuse.
7	2019	Schleimer et al. (Latin America: Chile, Uruguay, and Argentina)	1) To estimate associations between perceived availability and perceived risk of marijuana use and past-month marijuana use 2) To describe how these associations changed over time	Cross-sectional	Marijuana	Risk Factors 1) No/ Low perceived risk increase the odds of past-month marijuana use by 8.22 times compared to those who perceived moderate/great risk. 2) High perceived availability of drug: consistently associated with higher odds of past-month marijuana use. Protective Factors 1) Moderate/ High perceived risk of substance use. 2) Low perceived availability	Perceived risk and availability of marijuana are significant risk factors for adolescent marijuana use in the Southern Cone.
8	2019	Guttmannova et al. (USA)	To examine a set of marijuana-specific risk factors from multiple domains of development for marijuana use over the course of adolescence	Community Randomized-Controlled Trial	Marijuana	Risk Factors 1) Perception of lax community enforcement of marijuana laws regarding adolescent use 2) Low perception of harm 3) Rebelliousness traits 4) Parents with low education	A greater frequency of marijuana use was predicted among the identified risk factors.
9	2019	Doggett et al. (Canada)	To examine the association between various types of screen time sedentary behavior (STSBs)	Cross-sectional	Cannabis	Risk Factors 1) Total screen time sedentary behavior (internet use,	STSB is a risk factor for the tendency for individuals to use substances as a coping

Table 2 Study characteristic and main findings *(Continued)*

No	Year	Authors/ Country	Study objectives	Study design	Types of substance abuse	Result / findings Risk factors /Protective factors	Conclusion
			and cannabis use			messaging, playing video games, watching TV	mechanism.
10	2017	Wilson et al. (USA)	To examine associations among levels of trait mindfulness and opioid use behaviors.	Cross sectional	Opioid	- Study using a convenience sample of 112 youth (ages 14–24) was recruited during an episode of inpatient detoxification and residential treatment for opioid use disorders. - Youth had difficulties in emotion regulation (m = 104.2; SD = 2.41) and low mindfulness (m = 19.1; SD = 0.59). Risk Factors 1) Difficulty in regulating emotions Protective Factors 1) High level of mindfulness	Majority of youth presenting with opioid use disorders have impairments in emotion regulation and deficits in trait mindfulness.
11	2017	Li et al. (Macau)	To identify culturally relevant predictors of synthetic drug use among adolescents in Macao.	Cross sectional	Ketamine Ecstasy/MDMA Methamphetamine Tranquilizers Hybrid synthetic drugs	- The rates of synthetic use among male adolescents were higher than those among female adolescents for lifetime use (1.79% vs. 1.04%), past-year use (1.29% vs. 0.70%), and past-month use (1.03% vs. 0.44%). - Synthetic drug use was the most prevalent among fifth and sixth graders at the elementary school level. Risk Factors 1) Peer usage 2) Recreational use of time 3) Attitudes towards synthetic drugs 4) Availability of synthetic drugs	The investigated risk factors contribute to adolescent drug abuse.
12	2017	Luk et al. (USA)	To examine both direct and indirect effects of multiple parenting dimensions on substance use behaviors across Asian-Pacific Islander (API) and European American youth.	Prospective Cohort	Marijuana	- Mother's knowledge predicted fewer externalizing problems in Grade 8, which in turn predicted fewer substance use problems in Grades 9 and 12. - Father's warmth predicted better academic achievement in Grade 8, which in turn predicted fewer substance use problems in Grades 9 and 12, as well as alcohol and marijuana dependence in Grade 12. Risk Factors 1) Mother's psychological control Protective Factors 1) Father's knowledge	Promoting father's knowledge of adolescents' whereabouts can reduce substance use risks among both European and API Americans.
13	2017	De Pedro et al. (USA)	This study aims to fill this gap in the literature and inform programs aimed at reducing substance use among LGB youth	Cross-sectional	Marijuana, inhalants, prescription pain medication, and other illegal drugs	Protective Factors 1) school connectedness and school adult support	The results indicate a need for substance use prevention programs that integrate school connectedness and adult support in school
14	2017	Dorard et al. (France)	To investigate alexithymia in young outpatient cannabis misusers to determine whether the levels of alexithymia and the state and traits of anxiety and depression predict cannabis misuse by adolescents	Case control	Cannabis	- Study done on 120 young patients with cannabis dependence or abuse (DSM-IV-TR criteria evaluated with the MINI) and seeking treatment in an addiction unit + another 110 healthy control subjects. - Used self-reports for measuring alexithymia (TAS-20;BVAQ-B), depression (BDI-13), and states and traits of anxiety (STAI). - 35.3% of cannabis users were alexithymia Risk Factors 1) Difficulty in identifying feelings Protective Factors	Lower rate of alexithymics than in previous reports among substance abusers but higher than those reported in the control

Table 2 Study characteristic and main findings *(Continued)*

No	Year	Authors/ Country	Study objectives	Study design	Types of substance abuse	Result / findings Risk factors /Protective factors	Conclusion
						1) Difficulty in describing feelings	
15	2017	Kobulsky (USA)	To examine the relations between child physical and sexual abuse and early substance use among youths investigated by child protective services	Cohort	Marijuana Inhalants Hard drugs NMPD	- Significant indirect effects of physical abuse severity on early substance use were found through externalizing behavior problems in girls, with a significantly stronger relation found only between externalizing problems and early substance use in girls. Risk Factors 1) Girls: Physical abuse severity, externalizing problems	Significant gender differences in the effect of early substance from physical abuse.
16	2017	Chuang et al. (USA)	To examine the potential relationship between two self-reported risk factors (impulsivity and the presence of one or more behavioral addictions) and tobacco, alcohol, and marijuana use—or susceptibility to use these drugs in the future among nonusers—in an adolescent population	Cross-sectional	Marijuana	- Adolescents who had either impulsivity alone or at least two behavioral addictions alone were more likely to have used tobacco, alcohol, or marijuana compared to individuals who had neither risk factor (OR = 2.50–4.13), and- Individuals who endorsed both impulsivity and three or more behavioral addictions were the most likely to have used these drugs (OR = 9.40–10.13) Risk Factors 1) High impulsivity combined with more than 3 behavioral addictions.	High impulsivity was related to behavioral addictions in adolescents, and a combination of these two factors increased risk for drug use
17	2016	Khoddam, et al. (USA)	To study whether the relationship of conduct problems and several internalizing disorders with future substance use is redundant, incremental, or interactive in adolescents.	Cross-sectional	Marijuana	Risk Factors 1) Conduct Problems (CPs) 2) Major depressive disorder Protective Factors 1) Social phobia	CPs are a risk factor for substance use, as well as the nuanced interplay of internalizing-externalizing problems in the developmental psychopathology of adolescent drug use vulnerability.
18	2016	Gabrielli et al. (USA)	To identify the relations between maltreatment and SU behavior in a population known for a significant risk of SU behaviour—youth in foster care.	Cross-sectional	Alcohol Marijuana Cocaine Stimulants LSD Tranquilizers Opiates PCP Sniffed gases/ fumes Prescribed drugs	- 31% of participants reported past-year substance abuse. - Age of substance abuse onset was 11.08 years (Sd = 2.21 years) - Structural model with maltreatment predicting substance abuse severity demonstrated strong model fit with a significant path between maltreatment and substance abuse. Risk Factors 1) Maltreatment during stay in foster care.	Findings revealed a robust relationship between maltreatment, indicated by the severity and chronicity of experiences across types of maltreatment and substance use behavior severity.
19	2016	Traube et al. (USA)	1) To untangle two aspects of time in the growth process of polysubstance use: age or development and the length of time in the Child Welfare System (CWS). 2) To determine residential status as either a risk or protective factor	Cross-sectional	Alcohol Marijuana	- Analysis using longitudinal data from the National Survey of Child and Adolescent Well-Being ($n = 1178$). - Time- invariant characteristics of ethnicity and gender were not related to polysubstance use. - Increased proportions of the sample reporting the use of alcohol and marijuana (from 16 to 26% and from 9 to 18%, respectively). Risk Factors 1) Duration of stay in Child Welfare System (CWS)	Findings indicated that children who enter child welfare when they are older than age 15 are at increased risk of substance use, although those who enter the CWS at a young age may be at greater risk over time.
20	2016	Cecil et al. (UK)	1) To determine DNAm patterns at birth that are associated with adolescent substance use? 2) To identify DNAm markers that are associated with genetic and environmental influences	Cohort	Cannabis	- The sample comprised 244 youth (51% female) from the Avon Longitudinal Study of Parents and Children (ALSPAC). - At birth, epigenetic variation across a tightly interconnected genetic network ($n = 65$ loci;	Tobacco exposure during pregnancy may increase the risk of future substance use.

Table 2 Study characteristic and main findings *(Continued)*

No	Year	Authors/ Country	Study objectives	Study design	Types of substance abuse	Result / findings Risk factors /Protective factors	Conclusion
						qo0.05) was associated with greater levels of substance use during adolescence, as well as an earlier age of onset among users. - Several of the identified loci were associated with known methylation quantitative trait loci. - Collectively, these 65 loci were also found to partially mediate the effect of prenatal maternal tobacco smoking on adolescent substance use. Risk Factors 1) Prenatal tobacco smoking	
21	2016	Ogunsola et al. (Nigeria)	To compare the prevalence of substance use among in-school adolescents in urban and rural areas of Osun State, Nigeria, and identified risk and protective factors.	Cross-sectional	Substances use	Risk Factors 1) Private school attendance 2) having friends who use substances 3) mother having had tertiary education Protective Factors 1) Parental disapproval of substance use	The risk and protective factors for adolescent substance use somewhat differ for rural and urban areas
22	2015	Miech et al. (USA)	To determine whether e-cigarette use is part of a pattern towards extensive substance use.	Cross-sectional	Marijuana Prescription drugs	- The distribution of e-cigarette use is consistent with the distribution of most other substances. - Youth who use e-cigarettes are, on average, highly likely to use other substances, as well. Risk Factors 1) E-cigarette smokers	Exposure to e-cigarettes within the past 30-days, increases the prevalence of marijuana use and prescription drug use among adolescents.
23	2018	El Kazdouh et al. (Morocco)	To explore and understand factors that protect or influence substance use in adolescents.	Focus Group Discussion (FGD) analysis via Thematic Analysis	Any illicit drug	Risk Factors 1) Perceived benefits of drug abuse 2) Perceived availability of drugs (cheaper price) 3) Lack of parental supervision 4) Peer pressure from those who do drugs Protective Factors 1) Strong belief in maintaining good health 2) Good family support in giving advice 3) Strong religious beliefs	There are many interplay factors that contribute to the risk of developing drug abuse problems and protecting adolescents from drug abuse. Key prevention activities need to be targeted at each level to ensure healthy behaviors among adolescents.

qualitative paper utilized a total of 100 interviewees. There were a wide range of drugs assessed in the quantitative articles, with marijuana being mentioned in 11 studies, cannabis in five studies, and opioid (six studies). There was also large heterogeneity in terms of the study design, type of drug abused, measurements of outcomes, and analysis techniques used. Therefore, the data were presented descriptively.

After thorough discussion and evaluation, all the findings (both risk and protective factors) from the review were categorized into three main domains: individual factors, family factors, and community factors. The conceptual framework is summarized in Fig. 2.

DOMAIN: individual factor

Risk factors

Almost all the articles highlighted significant findings of individual risk factors for adolescent drug abuse. Therefore, our findings for this domain were further broken down into five more sub-domains consisting of personal/individual traits, significant negative growth exposure, personal psychiatric diagnosis, previous substance history, comorbidity and an individual's attitude and perception.

Personal/individual traits

Chuang et al. [29] found that adolescents with high impulsivity traits had a significant positive association with

drug addiction. This study also showed that the impulsivity trait alone was an independent risk factor that increased the odds between two to four times for using any drug compared to the non-impulsive group. Another longitudinal study by Guttmannova et al. showed that rebellious traits are positively associated with marijuana drug abuse [27]. The authors argued that measures of rebelliousness are a good proxy for a youth's propensity to engage in risky behavior. Nevertheless, Wilson et al. [37], in a study involving 112 youths undergoing detoxification treatment for opioid abuse, found that a majority of the affected respondents had difficulty in regulating their emotions. The authors found that those with emotional regulation impairment traits became opioid dependent at an earlier age. Apart from that, a case-control study among outpatient youths found that adolescents involved in cannabis abuse had significant alexithymia traits compared to the control population [28]. Those adolescents scored high in the dimension of Difficulty in Identifying Emotion (DIF), which is one of the key definitions of diagnosing alexithymia. Overall, the adjusted Odds Ratio for DIF in cannabis abuse was 1.11 (95% CI, 1.03–1.20).

Significant negative growth exposure

A history of maltreatment in the past was also shown to have a positive association with adolescent drug abuse. A study found that a history of physical abuse in the past is associated with adolescent drug abuse through a Path Analysis, despite evidence being limited to the female gender [25]. However, evidence from another study focusing at foster care concluded that any type of maltreatment might result in a prevalence as high as 85.7% for the lifetime use of cannabis and as high as 31.7% for the prevalence of cannabis use within the last 3-months [30]. The study also found significant latent variables that accounted for drug abuse outcomes, which were chronic physical maltreatment (factor loading of 0.858) and chronic psychological maltreatment (factor loading of 0.825), with an r^2 of 73.6 and 68.1%, respectively. Another study shed light on those living in child welfare service (CWS) [35]. It was observed through longitudinal measurements that proportions of marijuana usage increased from 9 to 18% after 36 months in CWS. Hence, there is evidence of the possibility of a negative upbringing at such shelters.

Personal psychiatric diagnosis

The robust studies conducted in the USA have deduced that adolescents diagnosed with a conduct problem (CP) have a positive association with marijuana abuse (OR = 1.75 [1.56, 1.96], $p < 0.0001$). Furthermore, those with a diagnosis of Major Depressive Disorder (MDD) showed a significant positive association with marijuana abuse.

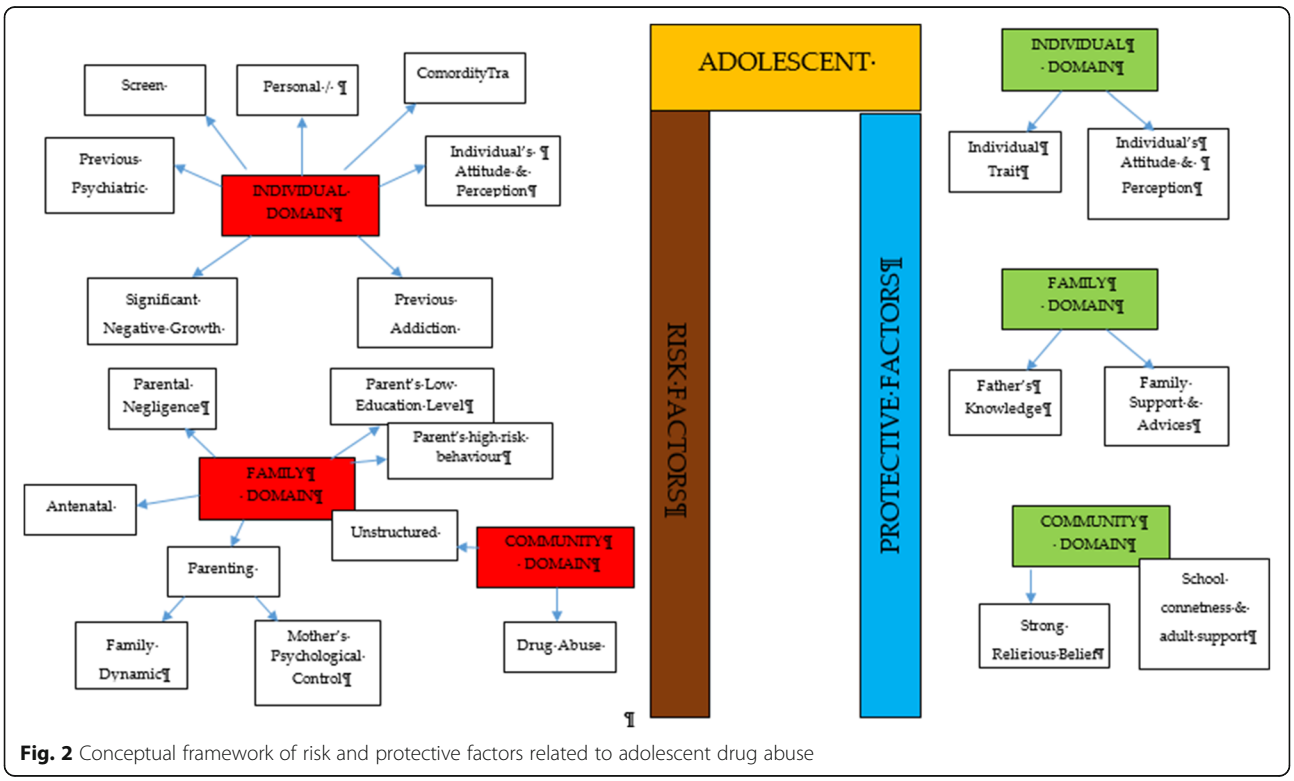

Fig. 2 Conceptual framework of risk and protective factors related to adolescent drug abuse

Previous substance and addiction history

Another study found that exposure to e-cigarettes within the past 30 days is related to an increase in the prevalence of marijuana use and prescription drug use by at least four times in the 8th and 10th grades and by at least three times in the 12th grade [34]. An association between other behavioral addictions and the development of drug abuse was also studied [29]. Using a 12-item index to assess potential addictive behaviors [39], significant associations between drug abuse and the groups with two behavioral addictions (OR = 3.19, 95% CI 1.25,9.77) and three behavioral addictions (OR = 3.46, 95% CI 1.25,9.58) were reported.

Comorbidity

The paper by Dash et al. (2020) highlight adolescent with a disease who needs routine medical pain treatment have higher risk of opioid misuse [38]. The adolescents who have disorder symptoms may have a risk for opioid misuse despite for the pain intensity.

Individual's attitudes and perceptions

In a study conducted in three Latin America countries (Argentina, Chile, and Uruguay), it was shown that adolescents with low or no perceived risk of taking marijuana had a higher risk of abuse (OR = 8.22 times, 95% CI 7.56, 10.30) [35]. This finding is in line with another study that investigated 2002 adolescents and concluded that perceiving the drug as harmless was an independent risk factor that could prospectively predict future marijuana abuse [27]. Moreover, some youth interviewed perceived that they gained benefits from substance use [38]. The focus group discussion summarized that the youth felt positive personal motivation and could escape from a negative state by taking drugs. Apart from that, adolescents who had high-perceived availability of drugs in their neighborhoods were more likely to increase their usage of marijuana over time (OR = 11.00, 95% CI 9.11, 13.27) [35]. A cheap price of the substance and the availability of drug dealers around schools were factors for youth accessibility [38]. Perceived drug accessibility has also been linked with the authorities' enforcement programs. The youth perception of a lax community enforcement of laws regarding drug use at all-time points predicted an increase in marijuana use in the subsequent assessment period [27]. Besides perception, a study examining the attitudes towards synthetic drugs based on 8076 probabilistic samples of Macau students found that the odds of the lifetime use of marijuana was almost three times higher among those with a strong attitude towards the use of synthetic drugs [32]. In addition, total screen time among the adolescent increase the likelihood of frequent cannabis use. Those who reported daily cannabis use have a mean of 12.56 h of total screen time, compared to a mean of 6.93 h among those who reported no cannabis use. Adolescent with more time on internet use, messaging, playing video games and watching TV/movies were significantly associated with more frequent cannabis use [44].

Protective factors

Individual traits

Some individual traits have been determined to protect adolescents from developing drug abuse habits. A study by Marin et al. found that youth with an optimistic trait were less likely to become drug dependent [33]. In this study involving 1104 Iranian students, it was concluded that a higher optimism score (measured using the Children Attributional Style Questionnaire, CASQ) was a protective factor against illicit drug use (OR = 0.90, 95% CI: 0.85–0.95). Another study found that high levels of mindfulness, measured using the 25-item Child Acceptance and Mindfulness Measure, CAMM, lead to a slower progression toward injectable drug abuse among youth with opioid addiction (1.67 years, $p = .041$) [37]. In addition, the social phobia trait was found to have a negative association with marijuana use (OR = 0.87, 95% CI 0.77–0.97), as suggested [31].

Individual's attitudes and perceptions

According to El Kazdouh et al., individuals with a strong belief against substance use and those with a strong desire to maintain their health were more likely to be protected from involvement in drug abuse [46].

DOMAIN: family factors

Risk factors

The biological factors underlying drug abuse in adolescents have been reported in several studies. Epigenetic studies are considered important, as they can provide a good outline of the potential pre-natal factors that can be targeted at an earlier stage. Expecting mothers who smoke tobacco and alcohol have an indirect link with adolescent substance abuse in later life [24, 39]. Moreover, the dynamic relationship between parents and their children may have some profound effects on the child's growth. Luk et al. examined the mediator effects between parenting style and substance abuse and found the maternal psychological control dimension to be a significant variable [26]. The mother's psychological control was two times higher in influencing her children to be involved in substance abuse compared to the other dimension. Conversely, an indirect risk factor towards youth drug abuse was elaborated in a study in which low parental educational level predicted a greater risk of future drug abuse by reducing the youth's perception of

harm [27, 43]. Negligence from a parental perspective could also contribute to this problem. According to El Kazdouh et al. [46], a lack of parental supervision, uncontrolled pocket money spending among children, and the presence of substance-using family members were the most common negligence factors.

Protective factors

While the maternal factors above were shown to be risk factors, the opposite effect was seen when the paternal figure equipped himself with sufficient knowledge. A study found that fathers with good information and awareness were more likely to protect their adolescent children from drug abuse [26]. El Kazdouh et al. noted that support and advice could be some of the protective factors in this area [46].

DOMAIN: community factors

Risk factor

A study in 2017 showed a positive association between adolescent drug abuse and peers who abuse drugs [32, 39]. It was estimated that the odds of becoming a lifetime marijuana user was significantly increased by a factor of 2.5 ($p < 0.001$) among peer groups who were taking synthetic drugs. This factor served as peer pressure for youth, who subconsciously had desire to be like the others [38]. The impact of availability and engagement in structured and unstructured activities also play a role in marijuana use. The findings from Spillane (2000) found that the availability of unstructured activities was associated with increased likelihood of marijuana use [42].

Protective factor

Strong religious beliefs integrated into society serve as a crucial protective factor that can prevent adolescents from engaging in drug abuse [38, 45]. In addition, the school connectedness and adult support also play a major contribution in the drug use [40].

Discussion

The goal of this review was to identify and classify the risks and protective factors that lead adolescents to drug abuse across the three important domains of the individual, family, and community. No findings conflicted with each other, as each of them had their own arguments and justifications. The findings from our review showed that individual factors were the most commonly highlighted. These factors include individual traits, significant negative growth exposure, personal psychiatric diagnosis, previous substance and addiction history, and an individual's attitude and perception as risk factors.

Within the individual factor domain, nine articles were found to contribute to the subdomain of personal/individual traits [27–29, 37–40, 43, 44]. Despite the heterogeneity of the study designs and the substances under investigation, all of the papers found statistically significant results for the possible risk factors of adolescent drug abuse. The traits of high impulsivity, rebelliousness, difficulty in regulating emotions, and alexithymia can be considered negative characteristic traits. These adolescents suffer from the inability to self-regulate their emotions, so they tend to externalize their behaviors as a way to avoid or suppress the negative feelings that they are experiencing [41, 47, 48]. On the other hand, engaging in such behaviors could plausibly provide a greater sense of positive emotions and make them feel good [49]. Apart from that, evidence from a neurophysiological point of view also suggests that the compulsive drive toward drug use is complemented by deficits in impulse control and decision making (impulsive trait) [50]. A person's ability in self-control will seriously impaired with continuous drug use and will lead to the hallmark of addiction [51].

On the other hand, there are articles that reported some individual traits to be protective for adolescents from engaging in drug abuse. Youth with the optimistic trait, a high level of mindfulness, and social phobia were less likely to become drug dependent [31, 33, 37]. All of these articles used different psychometric instruments to classify each individual trait and were mutually exclusive. Therefore, each trait measured the chance of engaging in drug abuse on its own and did not reflect the chance at the end of the spectrum. These findings show that individual traits can be either protective or risk factors for the drugs used among adolescents. Therefore, any adolescent with negative personality traits should be monitored closely by providing health education, motivation, counselling, and emotional support since it can be concluded that negative personality traits are correlated with high risk behaviours such as drug abuse [52].

Our study also found that a history of maltreatment has a positive association with adolescent drug abuse. Those adolescents with episodes of maltreatment were considered to have negative growth exposure, as their childhoods were negatively affected by traumatic events. Some significant associations were found between maltreatment and adolescent drug abuse, although the former factor was limited to the female gender [25, 30, 36]. One possible reason for the contrasting results between genders is the different sample populations, which only covered child welfare centers [36] and foster care [30]. Regardless of the place, maltreatment can happen anywhere depending on the presence of the perpetrators. To date, evidence that concretely links maltreatment and substance abuse remains limited. However, a plausible explanation for this link could be the indirect effects of posttraumatic stress (i.e., a history of maltreatment)

leading to substance use [53, 54]. These findings highlight the importance of continuous monitoring and follow-ups with adolescents who have a history of maltreatment and who have ever attended a welfare center.

Addiction sometimes leads to another addiction, as described by the findings of several studies [29, 34]. An initial study focused on the effects of e-cigarettes in the development of other substance abuse disorders, particularly those related to marijuana, alcohol, and commonly prescribed medications [34]. The authors found that the use of e-cigarettes can lead to more severe substance addiction [55], possibly through normalization of the behavior. On the other hand, Chuang et al.'s extensive study in 2017 analyzed the combined effects of either multiple addictions alone or a combination of multiple addictions together with the impulsivity trait [29]. The outcomes reported were intriguing and provide the opportunity for targeted intervention. The synergistic effects of impulsiveness and three other substance addictions (marijuana, tobacco, and alcohol) substantially increased the likelihood for drug abuse from 3.46 (95%CI 1.25, 9.58) to 10.13 (95% CI 3.95, 25.95). Therefore, proper rehabilitation is an important strategy to ensure that one addiction will not lead to another addiction.

The likelihood for drug abuse increases as the population perceives little or no harmful risks associated with the drugs. On the opposite side of the coin, a greater perceived risk remains a protective factor for marijuana abuse [56]. However, another study noted that a stronger determinant for adolescent drug abuse was the perceived availability of the drug [35, 57]. Looking at the bigger picture, both perceptions corroborate each other and may inform drug use. Another study, on the other hand, reported that there was a decreasing trend of perceived drug risk in conjunction with the increasing usage of drugs [58]. As more people do drugs, youth may inevitably perceive those drugs as an acceptable norm without any harmful consequences [59].

In addition, the total spent for screen time also contribute to drug abuse among adolescent [43]. This scenario has been proven by many researchers on the effect of screen time on the mental health [60] that leads to the substance use among the adolescent due to the ubiquity of pro-substance use content on the internet. Adolescent with comorbidity who needs medical pain management by opioids also tend to misuse in future. A qualitative exploration on the perspectives among general practitioners concerning the risk of opioid misuse in people with pain, showed pain management by opioids is a default treatment and misuse is not a main problem for the them [61]. A careful decision on the use of opioids as a pain management should be consider among the adolescents and their understanding is needed.

Within the family factor domain, family structures were found to have both positive and negative associations with drug abuse among adolescents. As described in one study, paternal knowledge was consistently found to be a protective factor against substance abuse [26]. With sufficient knowledge, the father can serve as the guardian of his family to monitor and protect his children from negative influences [62]. The work by Luk et al. also reported a positive association of maternal psychological association towards drug abuse (IRR 2.41, $p < 0.05$) [26]. The authors also observed the same effect of paternal psychological control, although it was statistically insignificant. This construct relates to parenting style, and the authors argued that parenting style might have a profound effect on the outcomes under study. While an earlier literature review [63] also reported such a relationship, a recent study showed a lesser impact [64] with regards to neglectful parenting styles leading to poorer substance abuse outcomes. Nevertheless, it was highlighted in another study that the adolescents' perception of a neglectful parenting style increased their odds (OR 2.14, $p = 0.012$) of developing alcohol abuse, not the parenting style itself [65]. Altogether, families play vital roles in adolescents' risk for engaging in substance abuse [66]. Therefore, any intervention to impede the initiation of substance use or curb existing substance use among adolescents needs to include parents—especially improving parent–child communication and ensuring that parents monitor their children's activities.

Finally, the community also contributes to drug abuse among adolescents. As shown by Li et al. [32] and El Kazdouh et al. [46], peers exert a certain influence on other teenagers by making them subconsciously want to fit into the group. Peer selection and peer socialization processes might explain why peer pressure serves as a risk factor for drug-abuse among adolescents [67]. Another study reported that strong religious beliefs integrated into society play a crucial role in preventing adolescents from engaging in drug abuse [46]. Most religions devalue any actions that can cause harmful health effects, such as substance abuse [68]. Hence, spiritual beliefs may help protect adolescents. This theme has been well established in many studies [60, 69–72] and, therefore, could be implemented by religious societies as part of interventions to curb the issue of adolescent drug abuse. The connection with school and structured activity did reduce the risk as a study in USA found exposure to media anti-drug messages had an indirect negative effect on substances abuse through school-related activity and social activity [73]. The school activity should highlight on the importance of developmental perspective when designing and offering school-based prevention programs [75].

Limitations

We adopted a review approach that synthesized existing evidence on the risk and protective factors of adolescents engaging in drug abuse. Although this systematic review builds on the conclusion of a rigorous review of studies in different settings, there are some potential limitations to this work. We may have missed some other important factors, as we only included English articles, and article extraction was only done from the three search engines mentioned. Nonetheless, this review focused on worldwide drug abuse studies, rather than the broader context of substance abuse including alcohol and cigarettes, thereby making this paper more focused.

Conclusions

This review has addressed some recent knowledge related to the individual, familial, and community risk and preventive factors for adolescent drug use. We suggest that more attention should be given to individual factors since most findings were discussed in relation to such factors. With the increasing trend of drug abuse, it will be critical to focus research specifically on this area. Localized studies, especially those related to demographic factors, may be more effective in generating results that are specific to particular areas and thus may be more useful in generating and assessing local control and prevention efforts. Interventions using different theory-based psychotherapies and a recognition of the unique developmental milestones specific to adolescents are among examples that can be used. Relevant holistic approaches should be strengthened not only by relevant government agencies but also by the private sector and non-governmental organizations by promoting protective factors while reducing risk factors in programs involving adolescents from primary school up to adulthood to prevent and control drug abuse. Finally, legal legislation and enforcement against drug abuse should be engaged with regularly as part of our commitment to combat this public health burden.

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Authors' contributions

Manuscript concept, and drafting AMN and RI; model development, FI, NI and NA.; Editing manuscript MRH, MRAN, NSS,; Critical revision of manuscript for important intellectual content, all authors. The authors read and approved the final manuscript.

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Data availability and materials

All data generated or analysed during this study are included in this published article.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Secretariat of Research Ethics, Universiti Kebangsaan Malaysia, Faculty of Medicine, Cheras, Kuala Lumpur (Reference no. UKMPPI/111/8/JEP-2020.174(2). Dated 27 Mac 2020.

Consent for publication

Not applicable.

Competing interests

The authors AMN, RI, FI, MRM, MRAM, NA, NI NSS declare that they have no conflict of interest relevant to this work.

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Parental Knowledge/Monitoring and Adolescent Substance Use: A Causal Relationship?

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Abstract

Address correspondence to William Pelham, Department of Psychiatry, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA, 92093, < wpelham@ucsd.edu>.

We have no known conflicts of interest to disclose. The study was not preregistered. Data used in the preparation of this article were obtained from the Adolescent Brain Cognitive Development[SM] (ABCD) Study (https://abcdstudy.org), held in the NIMH Data Archive (NDA). This is a multisite, longitudinal study designed to recruit more than 10,000 children age 9–10 and follow them over 10 years into early adulthood. The ABCD Study® is supported by the National Institutes of Health and additional federal partners under award numbers U01DA041048, U01DA050989, U01DA051016, U01DA041022, U01DA051018, U01DA051037, U01DA050987, U01DA041174, U01DA041106, U01DA041117, U01DA041028, U01DA041134, U01DA050988, U01DA051039, U01DA041156, U01DA041025, U01DA041120, U01DA051038, U01DA041148, U01DA041093, U01DA041089, U24DA041123, and U24DA041147. A full list of supporters is available at https://abcdstudy.org/federal-partners.html. Additional support for this work was made possible from supplements to U24DA041123 and U24DA041147, the National Science Foundation (NSF 2028680), and Children and Screens: Institute of Digital Media and Child Development Inc., the National Institute on Alcohol Abuse and Alcoholism (AA030197), and the National Institute on Drug Abuse (DA055935). A listing of participating sites and a complete listing of the study investigators can be found at https://abcdstudy.org/Consortium_Members.pdf. ABCD consortium investigators designed and implemented the study and/or provided data but did not necessarily participate in analysis or writing of this report. This manuscript reflects the views of the authors and may not reflect the opinions or views of the NIH or ABCD consortium investigators. The ABCD data repository grows and changes over time. The ABCD data used in this report came from the ABCD 4.0 data release (DOI: 10.15154/1523041), the ABCD COVID-19 Survey First Data Release (DOI: 10.15154/1520584), and the ABCD COVID-19 Survey Second Data Release (DOI: 10.15154/1522601). DOIs can be found at https://nda.nih.gov/study.html?id=1299, https://nda.nih.gov/study.html?&id=1041, and https://nda.nih.gov/study.html?&id=1225. Code for analysis is available from the first author upon request. The authors have no conflict of interests to declare.
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Objective: Many studies have shown that parental knowledge/monitoring is correlated with adolescent substance use, but the association may be confounded by the many pre-existing differences between families with low vs. high monitoring. We attempted to produce more rigorous evidence for a causal relation using a longitudinal design that took advantage of within-family fluctuations in knowledge/monitoring during the COVID-19 pandemic.

Method: 8,780 youth (ages 10.5–16.6 years) at 21 sites across the U.S. completed up to seven surveys over 12 months. Youth reported on their parents' knowledge/monitoring of their activities and their substance use in the past month. Regressions were fit to within-family changes in youth-perceived knowledge/monitoring and substance use between survey waves. By analyzing within-family changes over time, we controlled for all stable, *a priori* differences that exist between families with low vs. high levels of youth-perceived knowledge/monitoring.

Results: Youth initially denying substance use were significantly more likely to *start* reporting use when they experienced a decrease in the level of perceived knowledge/monitoring (RR=1.18; $p<.001$). Youth initially endorsing substance use were significantly more likely to *stop* reporting use when they experienced an increase in the level of perceived knowledge/monitoring (RR=1.06; $p<.001$). Associations were similar or larger when adjusting for several time-varying potential confounders.

Conclusion: In a large, sociodemographically diverse sample, within-family changes in youth-perceived parental knowledge/monitoring over time were robustly associated with changes in youths' engagement in substance use. Findings lend support to the hypothesis that youth-perceived parent knowledge/monitoring is causally related to substance involvement in early adolescence.

Keywords

parental knowledge; parental monitoring; substance use; adolescence

Introduction

Substance use during early adolescence is associated with risk of negative health consequences in both the short- and long-term (e.g., Tapert et al., 2001). One factor that predicts less alcohol and drug use during adolescence is parental monitoring: the extent to which parents "structure the child's home, school, and community environments, and track the child's behavior in those environments" (Dishion & McMahon, 1998, p. 66). Dozens of studies have confirmed that low parental knowledge/monitoring is associated with increased use of alcohol, cannabis, and other drugs throughout adolescence (Lac & Crano, 2009; Ryan et al., 2015; Yap et al., 2017).

However, the evidence linking parental knowledge/monitoring to adolescents' substance use remains primarily correlational rather than causal (Crouter & Head, 2002; Racz & McMahon, 2011; Stattin et al., 2010). No study has experimentally isolated the causal effect of knowledge/monitoring on adolescent use by randomizing families to different levels of knowledge/monitoring. Instead, these studies have documented that low knowledge/monitoring and substance use tend to co-occur within cross-sectional samples (e.g., DiClemente et al., 2001) or that low parental knowledge/monitoring prospectively predicts substance use over time (e.g., Steinberg et al., 1994).

These designs comprise weak evidence of a causal relationship because there are many other ways in which families with low vs. high knowledge/monitoring differ, and these other factors (rather than knowledge/monitoring) could explain the discrepancy in youth substance use. Indeed, reviews indicate considerable overlap in the antecedents of parental knowledge/monitoring (Crouter & Head, 2002; Racz & McMahon, 2011) and adolescent substance use (Donovan, 2004). For example, both constructs are prospectively predicted by youth biological sex at birth, early temperament, defiance, and conduct problems; parental education, employment, marital status, and alcohol use; parent-child relationship quality; parental warmth; and peer antisociality. Because these variables precede both parental knowledge/monitoring and youth substance use during adolescence, they may serve as confounding variables, introducing a non-causal association.

The absence of strong causal evidence is troubling because many etiological models (Donovan, 2019; Racz & McMahon, 2011) and family-based intervention programs (Kuntsche & Kuntsche, 2016; Van Ryzin et al., 2016) rely on the assumption that an increase in parental knowledge/monitoring will cause a decrease in offspring substance use. If parental knowledge/monitoring merely predicts substance use, but does not cause it, then a clinical focus on increasing parental knowledge/monitoring to prevent or reduce substance use is misplaced and wastes intervention resources. If parental knowledge/monitoring merely predicts substance use, but does not cause it, then our etiological theories are misattributing the impact of other important factors to parental knowledge/monitoring.

Analysis of Within-Family Changes as Strategy to Improve Causal Inference

Randomizing families to low vs. high levels of parental knowledge/monitoring would produce the strongest causal evidence, but this design faces both practical and ethical obstacles (West et al., 2008). The current study pursued an alternative approach to establishing more rigorous evidence of a causal relation by analyzing within-family changes in youth-perceived parental knowledge/monitoring over time in a sample of 8,780 families assessed seven times over 12 months. As described above, when we compare knowledge/monitoring *between* families, the association between parental knowledge/monitoring and substance use can be confounded by the many pre-existing differences between families with low vs. high knowledge/monitoring. However, when we compare knowledge/monitoring *within* a given family over time, pre-existing, stable differences between families with low vs. high knowledge/monitoring (e.g., youth biological sex at birth, parental education, youth temperament) can no longer explain why knowledge/monitoring and substance use covary. Thus, analyzing within-family changes in knowledge/monitoring over time (rather than between-family levels of monitoring) can help address the issue of confounding variables and support stronger causal inference (Keijsers, 2016).

Another way to strengthen causal inference is to measure changes in monitoring and substance use over a shorter interval. Prior longitudinal studies have typically measured knowledge/monitoring at waves 1+ years apart (Racz & McMahon, 2011), whereas our assessments were spaced approximately 5–11 weeks apart. The shorter the interval between measurements, the less likely that a within-family change in some other factor causing both monitoring and substance use will occur. For example, over the course of one year, a family

may move neighborhoods, the parents may divorce, or the youth may substantially change their friend group, with each change potentially affecting both knowledge/monitoring and substance use and explaining their covariation over time in that family. Yet each of these within-family changes is less likely to occur between measurements taken 5–11 weeks apart.

We applied this within-family design under conditions likely to reflect greater within-person variability and exogenous sources of within-family change: the coronavirus disease 2019 (COVID-19) pandemic. The COVID-19 pandemic produced large and time-varying disruptions to families' daily lives, as many youth transitioned between in-person, hybrid, and remote schooling; many parents transitioned between in-person and remote work; stay-at-home orders were issued then rescinded; and youths' contact with family and friends waxed and waned. Thus, within-family variability in knowledge/monitoring may be greater during the COVID-19 pandemic than over similar periods in other years, improving statistical power for the within-family analyses that can better address confounding factors. In addition, there were many potential sources of within-family changes in knowledge/monitoring that were external to the family—e.g., changes in local infection rates and public health precautions, employer work-from-home policies, school format. Thus, within-family changes in knowledge/monitoring during the COVID-19 pandemic may be less dependent on pre-existing youth, parent, and family characteristics, improving their suitability for causal inferences.

Potential Moderators of the Causal Effect

It is also important to understand how the causal effect of parental knowledge/monitoring may vary across adolescents. We focus on three potential moderating variables that have been explored in previous research (Racz & McMahon, 2011): youth biological sex at birth, age, and externalizing spectrum psychopathology. The association between knowledge/monitoring and alcohol/drug use was stronger among biological females at birth in both within-study (Rusby et al., 2018) and between-study (Lac & Crano, 2009) comparisons. Longitudinal, school-based samples have found that the association between knowledge/monitoring and substance use tends to weaken from early to middle and late adolescence (Mak et al., 2020; Van Ryzin et al., 2012). Finally, considering externalizing psychopathology, the association between knowledge/monitoring and substance use was stronger among teens with Attention-Deficit/Hyperactivity Disorder than among matched controls (Walther et al., 2012), though in another study the association did not vary as a function of disinhibitory temperament at age 6 years (Rioux et al., 2016). None of these previous studies addressed the issue of confounding.

Current Study

The goal of this study was to test a core assumption undergirding many etiological models and clinical interventions: that low parental knowledge/monitoring causes increased substance use among adolescents. We hypothesized that within-family, month-to-month changes in youth-perceived parental knowledge/monitoring would be associated with within-family, month-to-month changes in youth substance use, consistent with a causal relationship. We also hypothesized that the within-family association of changes in youth-

perceived parental knowledge/monitoring and substance use would be stronger among youth who were biological females at birth, who were older in age, or who exhibited a pre-existing externalizing spectrum disorder.

Method

Sample and Design

Data were drawn from the Adolescent Brain and Cognitive Development[SM] (ABCD) Study, a prospective, longitudinal cohort. Entry criteria were minimal and the cohort was intended to reflect normal variability in adolescent development (Volkow et al., 2018). Youth (*N*=11,880) were recruited at 21 study sites across the United States in the years 2016–2018, primarily using school-based ascertainment—see Garavan et al. (2018) for details. Youth were 9 or 10 years old at study entry. 48% of youth were biological females at birth. Fifty two percent of youth were White, 15% were Black, 20% were Hispanic, 2% were Asian, and 11% were of another racial/ethnic identification. Fifty-eight percent of parents/guardians were married. Maximum parent educational attainment within families was as follows: high school degree or less (14%), some college or Associate Degree (25%), Bachelor's degree (24%), Master's degree (22%), professional degree (10%). Thirty-nine percent of families reported total annual household income above $75,000.

All procedures were approved by the UCSD Human Research Protection Program (HRPP). Beginning in May 2020, ABCD Study® families were sent links to complete a series of web-based surveys measuring the impacts of the COVID-19 pandemic. Youth were 10.5–14.6 years old (mean=12.4, *SD*=0.9) at the beginning of these surveys, which spanned one year. Survey waves were spaced 5–11 weeks apart: wave 1 (May 16, 2020), wave 2 (June 23, 2020), wave 3 (August 4, 2020), wave 4 (October 8, 2020), wave 5 (December 13, 2020), wave 6 (March 2, 2021), and wave 7 (May 17, 2021). There were separate links for youth and parent; youth were asked to complete the survey in private. A total of 8,780 youth completed a total of 34,747 surveys (94–97% of parents completed the corresponding parent survey). Table S1 compares those completing each survey wave to each other and to the full ABCD Study® sample. There were no meaningful differences between completers of survey waves 1–7. However, youth who were Black or whose parents had low education, low income, or were unmarried were underrepresented in survey waves 1–7 relative to the full ABCD Study® sample (Table S1). These differences were addressed through weighting, as described below.

Measurement of Youth Substance Use

At each survey wave, youth completed several items measuring substance use, modeled on previous ABCD Study® assessments (Lisdahl et al., 2018) and the Monitoring the Future Study 2020 interview (Miech et al., 2020). Youth reported the number of days in the past 30 days on which they: (a) had a drink containing alcohol; (b) used a nicotine product (cigarette; electronic nicotine delivery system; cigar, hookah, pipe; smokeless tobacco, chew/snus); (c) smoked, vaped, or ate a cannabis product (flower, concentrate, edible); (d) misused any prescription drug; (e) sniffed liquids, sprays, or gases to get high; or (f) used any other drugs. As expected given the age of participants, the majority of reported use

(70%) occurred on just 1–2 days in the past month. Previous literature suggests the impact of parental knowledge/monitoring is similar across alcohol/drug classes (Lac & Crano, 2009; Mak et al., 2020; Yap et al., 2017) and preliminary analyses indicated the same was true in these data. Thus, following Pelham et al. (2021), we collapsed responses to items (a)-(f) into a dichotomous indicator of any substance use the past 30 days. The proportion of youth endorsing use of any substance ranged from 3.0% to 4.0% across survey waves 1–7 (n=821 youth ever reported substance use). Among endorsements of use, 37% were of alcohol, 34% were of a nicotine product, 9% were of a cannabis product, 10% were of a prescription drug (i.e., misuse), and the remaining 10% were of inhalants or other drugs.

Measurement of Youth-Perceived Parental Knowledge/Monitoring

Parental knowledge/monitoring was measured via youth perceptions. At each survey wave, youth rated the following four items on a five-point Likert scale ranging from *never* to *almost always*, thinking of the past week: (1) “How often do your parents/guardians know where you are?”, (2) “If you are at home when your parents or guardians are not, how often do you know how to get in touch with them?”, (3) “How often do you talk to your mom/dad or guardian about your plans for the coming day, such as your plans about what will happen at school (or school-at-home) or what you are going to do?”, and (4) “How many times do you and your parents/guardians eat dinner together?” (Karoly et al., 2016). This scale reflects the broad conceptualization of monitoring taken in the vast majority of published literature (Handschuh et al., 2020; Racz & McMahon, 2011), tapping parents’ knowledge of and communication about youths daily activities as well as involvement in their daily lives. Factor analyses supported a unidimensional conceptualization and scoring (omega=0.49–0.55 across survey waves 1–7). To improve measurement properties (McNeish & Wolf, 2020), we fit an item response theory model (Samejima, 1969) to item responses at survey wave 1 and used this model to estimate a latent variable score (i.e., theta) for all participants, at all survey waves. All subsequent analyses use the estimated value on the latent parental knowledge/monitoring variable (i.e., theta). The distribution of theta remained similar across survey waves 1–7 (Table S2), with correlations over time ranging r=0.51–0.67. See supplement for psychometric analyses and sensitivity analyses that examined findings for each scale item separately, replicating the pattern of findings in our primary results.

Measurement of Time-Varying Covariates During Pandemic

As described above, the advantage of analyzing within-family changes in knowledge/monitoring and substance use is that any factor that remains stable from one survey wave to the next (e.g., youth biological sex at birth) cannot explain covariation between within-family changes in knowledge/monitoring and substance use. This strategy rules out a broad class of potential confounders. However, factors that change within a family from one survey wave to the next could still confound the association between changes in knowledge/monitoring and substance use. Thus, we measured and adjusted for several time-varying covariates that could cause within-family changes in parental knowledge/monitoring and youth substance use. We developed a list of such variables based on theory and review of the literature. We then reviewed the assessment battery to determine whether the identified variable was measured and therefore could be adjusted for. Selection of confounding

variables is a difficult process requiring both substantive and methodological judgment (Miller & Chapman, 2001). We attempted to increase confidence in this process by (a) describing in detail our criteria and rationale for selecting each potential confounder (Table S6) and (b) comparing findings while adjusting for different sets of potential confounders, in case any selection was improper. We included 10 time-varying covariates, grouped into three sets for analyses—these are described next (see Table S2 for descriptive statistics and reliability/validity information).

Youth Factors—Youth completed a 4-item measure of perceived stress in the past month (omega reliability=0.65; Cohen et al., 1983) and rated the intensity of their worry about COVID-19 during the past week (*not at all* to *extremely*).

Parent Factors—Parents rated how much they were able to enjoy things (*never* to *most of the time*) and the intensity of their worry about COVID-19 (*not at all* to *extremely*) during the past week (NIH Intramural Research Program Mood Spectrum Collaboration, 2020).

Household Events—Youth indicated whether they were currently in school (online or in-person). Parents indicated whether the youth had tested positive for COVID-19, the family engaged in social distancing during the past week, anyone in the household was at increased risk for COVID-19 due to work, the household went without telephone service in the past month due to lack of payment, or the household suffered another indicator of material hardship.

Measurement of Other Variables

Parent Use of Alcohol, Cannabis, and Nicotine—At Survey 2, parents reported whether they had used alcohol, nicotine (cigarettes/electronic nicotine delivery system), or cannabis (flower/vaping) in the past 30 days.

Pre-Existing Youth Externalizing Spectrum Disorders—Prior to the pandemic, parents had completed a self-administered, computerized, modified Kiddie Structured Assessment for Affective Disorders and Schizophrenia (KSADS; Kobak et al., 2020) to evaluate whether youth met DSM 5 criteria for psychiatric disorders. For each participant, we used data from the most recently completed KSADS, which occurred a median of 10.5 months before the first survey during the COVID-19 pandemic (IQR=[7.3, 13.5]). We created a binary indicator of whether youth met DSM 5 criteria for any of the following externalizing spectrum diagnoses: Attention-Deficit/Hyperactivity Disorder[1] (combined or predominantly hyperactive/impulsive presentation), Oppositional Defiant Disorder, or Conduct Disorder. 8% of youth met criteria for 1+ externalizing spectrum diagnosis.

Analytic Plan

Analyses were conducted in R v 4.1.3 (R Core Team, 2022). Observations were weighted during analysis to account for longitudinal attrition between the full ABCD Study® sample

[1]Criterion C for the DSM 5 diagnosis of Attention-Deficit/Hyperactivity Disorder (i.e., symptoms present in multiple settings) was not required for diagnosis in the ABCD 3.0 data release. All other criteria were required.

and the subset of participants completing each survey wave (i.e., missing data). We estimated inverse probability weights (Seaman & White, 2013), which can produce unbiased estimates assuming a Missing at Random mechanism and comprise a standard approach for addressing missing data in surveys. After applying these weights, completers of each survey wave were sociodemographically similar to the full ABCD Study® sample at baseline, exhibiting the composition described above under **Sample** (see supplement for details).

There are many models for longitudinal data, each of which addresses different research questions (Grimm et al., 2016; Selig & Little, 2012). Our goal was to control for all pre-existing, stable differences between families with different levels of knowledge/monitoring, thereby yielding stronger evidence for a causal relation. Accordingly, we selected an approach called first differencing that is recommended for by methodologists for this purpose (Allison, 1990; Cameron & Trivedi, 2005; Cunningham, 2021; Wooldridge, 2010). First differencing is a special case of the latent change score model (Grimm et al., 2016). Longitudinal data are transformed to reflect a series of within-family changes between pairs of temporally adjacent measurements ($\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$). Regressions are fit to the differenced data ($\Delta Y_{i,t} = \Delta X_{i,t} + \cdots + e_{i,t}$). Any confounding factor (C) that remains constant between two adjacent timepoints cannot possibly explain covariation between changes in knowledge/monitoring and substance use, because that factor has remained constant (i.e., $\Delta C_{i,t} = 0$). Thus, investigating the relation between knowledge/monitoring and substance use within a first differenced model rules out confounding by all factors invariant between surveys. As first differencing may be unfamiliar to psychologists, the supplement provides a detailed description of the technique, its applicability, and its relation to other longitudinal models.

Preliminaries—We have claimed that within-family *changes* in knowledge/monitoring will be much less dependent on pre-existing youth, parent, and family factors than are between-family *levels* of knowledge/monitoring, rendering within-family changes less vulnerable to confounding by these pre-existing factors. We verified this claim empirically by examining the correlation of levels and changes in parental knowledge/monitoring during the COVID-19 pandemic with 51 pre-existing, potential confounding factors measured at ABCD Study® assessments in 2018/2019: demographic characteristics; pre-pandemic parental knowledge/monitoring, parental warmth, and family conflict; youth school involvement, school disengagement, and grade point average; parent alcohol and drug use; neighborhood safety; youth psychiatric problems and diagnoses; accessibility of substances in the community; parent rules about substance use; and youth impulsivity and fluid reasoning (see Table S7 for complete list). Figure 1 shows the distribution of correlations. As expected, many of the pre-existing factors were correlated with the *level* of parental knowledge/monitoring at sizeable magnitudes (maximum $|r| = 0.49$; Figure 1, Panel A). In contrast, these same pre-existing factors exhibited negligible to very weak correlations with within-family *changes* in parental knowledge/monitoring (maximum $|r|=0.05$; Figure 1, Panel B). Because these pre-existing factors have minimal association with changes in parental knowledge/monitoring, they no longer comprise plausible confounders of the observed association between knowledge/monitoring and substance use.

Regression Modeling—Analyses 1–3 report regression models fit with the following common structure. Observations were clustered on study site, family, and youth to account for non-independence (repeated measures) via Horvitz-Thompson-type standard errors (Lumley, 2003). In Analysis 1, we fit standard, between-family models to verify that the previously documented associations between knowledge/monitoring and substance use were present in this data. In Analysis 2, we fit the first differenced, within-family models that can provide more rigorous evidence of causal relations. In Analysis 3, we fit both standard and first-differenced models to examine moderation of the association between knowledge/monitoring and substance use.

In Analysis 1, we regressed a dichotomous indicator of youth substance use in the past 30 days (yes/no) on parental knowledge/monitoring. Next, we add fixed effects for youth age and survey wave, parent substance use, and family demographics to check the robustness of the association.

In Analysis 2, we fit regressions to the differenced data. Note that within each interval, substance use at time 1 constrains the possible direction of within-family change: a change in youth substance must be positive (0→1) if the youth is initially denying substance use and a change must be negative (1→0) if the youth is initially endorsing substance use. Thus, we included fixed effects for the level of substance use at the first timepoint in the difference interval and the interaction of the differenced parental knowledge/monitoring variable with that level. This parameterization estimates the effect of within-family change in knowledge/monitoring on the probability of within-family change in substance use, conditional on whether the youth is initially denying or endorsing use. As in Analysis 1, we fit additional specifications to check the robustness of the association. We added fixed effects for the three groups of time-varying covariates that we identified as potential confounding variables (see Appendix): changes in youth perceived stress and worry about COVID-19, parent anhedonia and worry about COVID-19, and household events.

In Analysis 3, we tested whether the association between youth substance use and parental knowledge/monitoring varied by youth biological sex at birth, age, or presence of a DSM-5 externalizing spectrum disorder. We fit regressions including the main effect of parental knowledge/monitoring, the main effect of the moderator, and the interaction thereof. Fixed effects for survey wave were included. First-differenced models were fit to the differenced versions of the knowledge/monitoring and substance use variables.

Results

Analysis 1: Standard (Between-Family) Models

Table 1 reports regressions relating youth-perceived parental knowledge/monitoring to youth substance use. In a univariate regression (Model 1), youth-perceived parental knowledge/monitoring was negatively associated with youth substance use (coefficient [Coef.]=−1.30, standard error [S.E.]=0.14, $p < .001$). Youth were 1.3 percentage points less likely to report substance use for each 1 *SD* increase in perceived parental knowledge/monitoring. The association remained statistically significant (ps≤.002) and of similar magnitude when adjusting for youth age, survey wave, parent alcohol, nicotine, and cannabis use; and

demographic variables (Models 2–4). Figure 2, Panel A shows the rates of youth substance use within deciles of perceived parental knowledge/monitoring. Youth in the bottom 10% of perceived parental knowledge/monitoring were 2.7 times more likely to report substance use than youth in the top 10% of perceived knowledge/monitoring (6.4% vs. 2.4%).

Analysis 2: First Differenced (Within-Family) Models

Table 2 reports regressions relating within-family changes in youth-perceived parental knowledge/monitoring and within-family changes in youth substance use. In a univariate regression (Model 1), within-family changes in youth-perceived parental knowledge/monitoring were negatively associated with within-family changes in substance use both for use initially denying use (Coef.= −0.41, SE=0.10, p<.001) and initially endorsing use Coef.= −4.35, SE=1.30, p<.001). The association remained of similar magnitude or grew larger when adjusting for changes in the 10 time-varying covariates (Models 2–6). Figure 2, Panel B graphs the estimated probability of change in substance use as a function of the within-family change in youth-perceived knowledge/monitoring (Table 2, Model 1). Among youth initially denying substance use, relative to no change, a 1-standard-deviation *decrease* in perceived knowledge/monitoring was associated with being 0.4 percentage points more likely to *initiate* substance use (cf. base rate=2.3%; relative risk [RR]=1.18). Among youth initially endorsing use, relative to no change, a 1-standard-deviation *increase* in perceived knowledge/monitoring was associated with being 4.4 percentage points more likely to *stop* substance use (cf. base rate=71%, RR=1.06).

Analysis 3: Moderation Analyses

Table S3 reports regressions testing moderation of the association between youth-perceived parental knowledge/monitoring and youth's substance use. In the standard models, the interaction with youth-perceived knowledge/monitoring was statistically significant for child age (p=.02) but not for youth biological sex at birth (p=.20) or history of externalizing spectrum diagnosis (p=0.18). The association between youth-perceived knowledge/monitoring and substance use was stronger among older youth (simple slopes: age 11: −0.58, age 13: −1.53, age 15: −2.47). In the first differenced models, there were two statistically significant interactions. Among youth initially denying substance use, changes in perceived knowledge/monitoring were more strongly associated with changes in substance use among biological females at birth (Coef.= −0.78) than biological males at birth (Coef.= −0.15) (p=.02). Among youth initially endorsing substance use, changes in perceived knowledge/monitoring were more strongly associated with changes in substance use among youth with (Coef.= −18.3) versus without (Coef.= −3.1) history of externalizing spectrum diagnosis (p=.02). The remaining interactions were not statistically significant (ps=.47-.99).

Discussion

The assumption that parental knowledge/monitoring is causally related to adolescent substance use undergirds existing etiological models and clinical interventions. The present study provided more rigorous empirical support for that assumption. In a diverse, community-based, early-to-mid adolescent sample, we exploited within-family fluctuations

in parent knowledge/monitoring during the COVID-19 pandemic to better support causal inferences about its association with adolescent substance use. We found that month-to-month, within-family changes in youth-perceived parental knowledge/monitoring were associated with month-to-month, within-family changes in youth substance use.

A Causal Relationship?

Previous literature linking parental knowledge/monitoring to adolescent substance use had the limitation that families with low vs. high knowledge/monitoring differ in many ways, and these other ways (rather than knowledge/monitoring) could explain differences in adolescent substance use. To improve rigor, we analyzed within-family changes in youth-perceived parental knowledge/monitoring that were (1) demonstrably unrelated to a broad swathe of antecedent factors (Figure 1), (2) unrelated to all factors that remained constant between two surveys 5–11 weeks apart, and (3) statistically adjusted for several time-varying potential confounders. We continued to observe a robust association between knowledge/monitoring and substance use in this within-family analysis ruling out many potential confounders, lending support for the hypothesis of a causal relationship. Consistent with previous findings (Lac & Crano, 2009), the effect size was largest for the scale item directly measuring parent knowledge (Table S4).

In moderation analyses, we found evidence suggesting the causal effect of youth-perceived knowledge/monitoring was stronger among biological females at birth and among youth with a history of externalizing spectrum disorder. Both findings replicate previous work (Lac & Crano, 2009; Rusby et al., 2018; Walther et al., 2012) using a more rigorous design that rules out many confounders as explanations for the differences by biological sex at birth or externalizing disorder. The mechanisms explaining each finding merit further study. Perhaps males are less responsive to parental influence during adolescence due to greater affiliation with deviant peer groups (Dishion et al., 2004). Perhaps knowledge/monitoring is especially important when youth are more prone to impulsive decision making, as are youth with externalizing diagnoses (Beauchaine et al., 2017).

Opposite Direction of Causation—Relative to the published literature (Stattin et al., 2010), our findings better rule out the possibility that the association between knowledge/monitoring and substance use is exclusively explained by youths' substance use causing parental knowledge/monitoring. Previous studies have typically measured knowledge/monitoring 1+ years apart (Racz & McMahon, 2011): over the course of years, it is plausible that youth repeatedly using substances despite rules to the contrary could cause parents to disengage and reduce their knowledge/monitoring (Kerr et al., 2008). In contrast, we measured youth-perceived knowledge/monitoring just 5–11 weeks apart: it is less plausible that parents would disengage and reduce their knowledge/monitoring in the weeks immediately following what for many youth in our sample was a single isolated instance of use.

Stronger Evidence for a Causal Relationship, but Still Not Experimental—Our design provided more rigorous evidence for a causal relationship, but it was not a randomized trial. In our within-family analyses, there may have remained important

differences between the observations with low vs. high knowledge/monitoring that could independently explain the differences in youth substance use (i.e., residual confounding): for example, changes in parents' work arrangements. We did not measure all possible confounders, and a single study cannot "prove" causality. Thus, findings should not be regarded as definitive evidence of causality. Further strengthening the evidence for causality will require replication using other quasi-experimental designs (e.g., Lippold et al., 2014) that address confounding in different ways, with different measured confounders, as well as replication in different populations (e.g., treatment-seeking families) and conditions (e.g., outside the pandemic).

Generalizability of Findings

Findings were obtained in a large, nationwide, sociodemographically diverse sample. However, there are several constraints on generalizability. First, while data collection during the COVID-19 pandemic improved our ability to conduct analyses of within-family changes, it may also be viewed as a limitation. Parental knowledge/monitoring may have lesser or greater impact outside the context of an ongoing pandemic. Reassuringly, these pandemic data reflected the same robust association between knowledge/monitoring and substance use (Figure 2, Panel A) found in prior samples assessed before the pandemic (Lac & Crano, 2009; Ryan et al., 2015; Yap et al., 2017). In addition, because we analyzed *change* in knowledge/monitoring and substance use, the potential existence of pandemic-related alterations in the general *levels* of these constructs do not threaten the first differenced models. For example, in a given family, if parents began working from home during the pandemic, knowledge/monitoring may have been higher than outside the pandemic context, but this could not explain why changes in knowledge/monitoring *within* that family were related to changes in substance use.

Second, youth were 10.5–16.5 years old across observations and the overall prevalence of substance use was low (~12% of youth). Though youth were instructed to complete surveys in private to enhance disclosure, they may have underreported substance use. Moreover, the effect of parental knowledge/monitoring may differ in late adolescence, when youth are using substances more frequently (Miech et al., 2020) and are better equipped to circumvent parent attempts at supervision. Correlational studies suggest that the association between knowledge/monitoring and substance use attenuates across mid-to-late adolescence (Van Ryzin et al., 2012), so the causal effect may be smaller than was observed herein. Third, this was not a treatment-seeking sample. The dynamics around parental knowledge/monitoring may differ when youth and parent have an extended history of conflict, parent is especially distressed about youth's behavior, or the youth is regularly abusing substances with friends.

Implications for Etiological Models and Clinical Interventions

Our findings support the hypothesis that parental knowledge/monitoring is a causal determinant of alcohol/drug use during early-to-mid adolescence. As such, they support the inclusion of parental knowledge/monitoring as not just as a predictive risk/resilience factor but as a causal mechanism underlying the etiology of adolescent substance use (Donovan, 2019). In addition, they support the continued focus of family-based interventions to reduce adolescent substance use on increasing parental knowledge/monitoring. Indeed,

the one-fourth of family-based prevention programs that do *not* currently include a focus on knowledge/monitoring may become more efficacious by adding that component (Van Ryzin et al., 2016). In addition, the timescale of our measurements should reassure parents: the protective effects of increased monitoring do not require years to manifest but rather can manifest over just a few weeks.

Limitations

Some limitations have already been discussed—the design was not experimental, data were collected in the context of a pandemic, and youth in late adolescence were not included. Two other limitations are important to note. First, we relied on youth report of knowledge/monitoring and substance use and could not validate these reports against more objective measures, such as parent and youth agreement on the occurrence of events or urine toxicology (Wade et al., 2022). Our findings pertain to youth-perceived parental knowledge/monitoring—we did not measure parenting behaviors directly. Second, we used a broadband measure of parental knowledge/monitoring that does not distinguish between parent- and youth-driven components (Guilamo-Ramos et al., 2010; Stattin & Kerr, 2000), so we were unable to parse separate facets of the knowledge/monitoring construct.

Conclusion

In a large, longitudinal study, within-family, month-to-month changes in the level of youth-perceived parental knowledge/monitoring were robustly associated with within-family, month-to-month changes in youth substance use. Findings place the existing role of knowledge/monitoring in etiological models and clinical interventions on stronger causal footing. The field would benefit from more studies estimating the relevant causal parameters in different populations (e.g., treatment-seeking youth), under different histories (e.g., older youth with established regular substance use), and using different quasi-experimental designs (e.g., discordant twin design).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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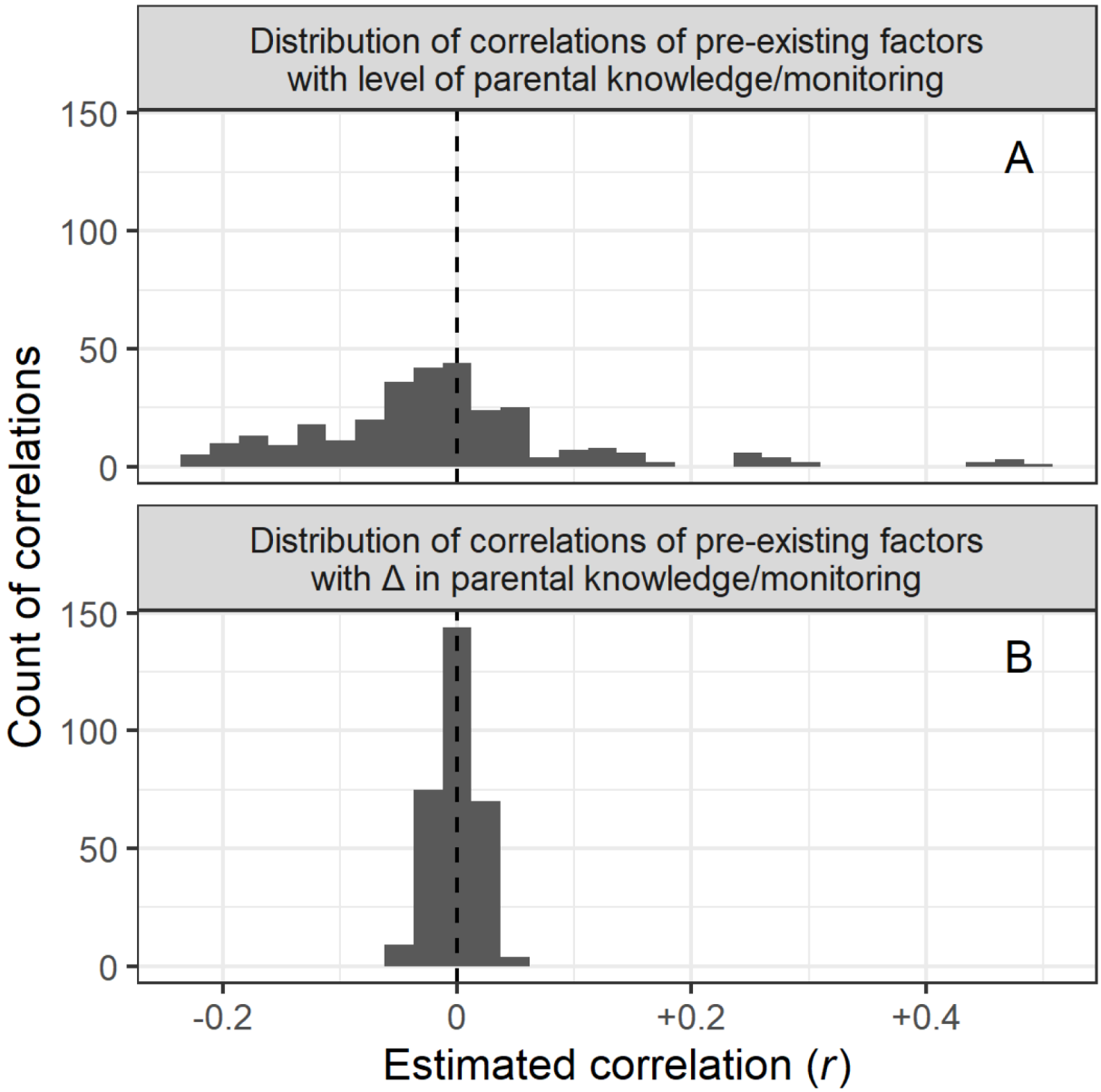

Figure 1. Distribution of Correlations of Pre-Existing Potential Confounding Factors with Levels and Changes in Youth-Perceived Parental Knowledge/Monitoring During the COVID-19 Pandemic

Note. We examined how the levels of (Panel A) and changes in (Panel B) parental knowledge/monitoring at seven waves of surveys during the COVID-19 pandemic correlated with 54 pre-existing factors that were plausible causes of both knowledge/monitoring and youth substance use during the COVID-19 pandemic (i.e., confounders): demographics; pre-pandemic parental knowledge/monitoring, parental warmth, and family conflict; youth school involvement, school disengagement, and grade point average; parent alcohol and drug use; neighborhood safety; youth psychiatric problems and diagnoses; accessibility of substances in the community; parent rules about substance use; and youth impulsivity and fluid reasoning (see Table S7 for complete list). The upper panel (A) shows there were many sizeable correlations of pre-existing factors with *levels* of parental knowledge/

monitoring; each of these factors comprises a potential confounding factor introducing non-causal association between knowledge/monitoring and substance use. The lower panel (B) shows the same pre-existing factors exhibit negligible correlation with within-family *changes* in parental knowledge/monitoring; thus, as desired, moving to the first differencing framework is successful in eliminating a large amount of potential confounding bias.

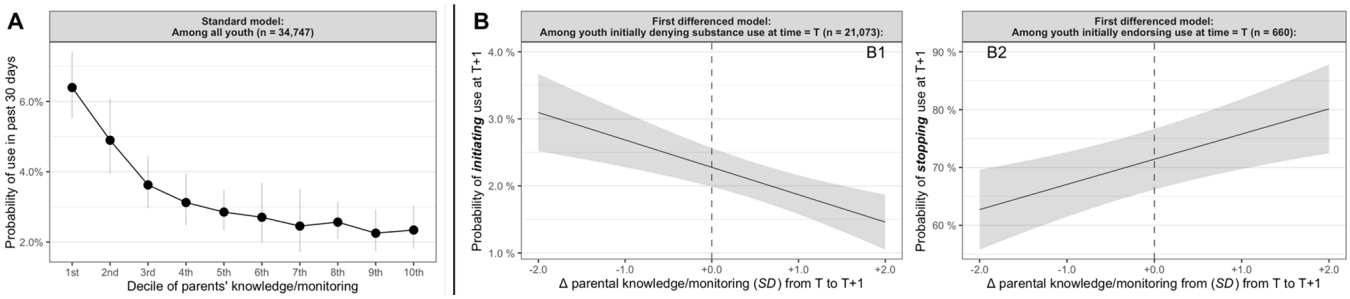

Figure 2. Associations Between Youth-Perceived Parental Knowledge/Monitoring and Youth Substance Use

Note. Panel A: Based on 34,747 observations of 8,780 youth. Dots indicate mean prevalence of substance use in past 30 days within each decile of parental knowledge/monitoring and vertical bars indicate 95% confidence intervals about the mean. Confidence intervals per logistic method. Panel B: Based on 21,733 differenced observations of 6,069 youth. Panel A (left) shows model-estimated probability of reporting substance use (y-axis) as a function of the within-family change in parental knowledge/monitoring (x-axis), among those not reporting any substance use at the previous survey wave. Panel B (right) shows model-estimated probability of denying substance use (y-axis) as a function of the within-family change in parental knowledge/monitoring (x-axis), among those not reporting any substance use at the previous survey wave. In other words, Panel A graphs how changes in parental knowledge/monitoring were related to transitions *out of* reporting substance use from one survey to the next and Panel B graphs how changes in parental knowledge/monitoring were related to transitions *into* reporting substance use from one survey to the next. “T” and “T+1” refer to time = T and time = T+1: two successive survey waves. Dashed vertical line indicates no change in parental knowledge/monitoring from one survey wave to the next. Grey ribbons indicate 95% confidence intervals about the estimated probabilities.

Table 1

Standard Regression Models for Association Between Youth-Perceived Parental Knowledge/Monitoring and Youth Use of Any Substance

Independent Variable	Dependent Variable: youth use of any substance in past 30 days (no/yes)							
	Model 1		Model 2		Model 3		Model 4	
	Coef (SE)	*p*	Coef (SE)	*p*	Coef (SE)	*p*	Coef (SE)	*p*
Level of parental knowledge/monitoring	−1.30 (0.14)	<.001	−1.24 (0.15)	<.001	−1.30 (0.27)	.002	−1.26 (0.15)	<.001
Number of youths	8,780		8,780		6,804		8,482	
Number of observations	34,747		34,747		13,541		33,580	
Covary youth age?	No		Yes		Yes		Yes	
Covary survey wave?	No		Yes		No		Yes	
Covary parent substance use: past-month use of alcohol, nicotine, cannabis?	No		No		Yes		No	
Covary demographics: youth biological sex at birth, youth race/ethnicity, parent education, parents married?	No		No		No		Yes	

Note. Coef = coefficient, SE = standard error, *p* = *p*-value for test of statistical significance of coefficient. Four different models were fit (Models 1–4), differing in which covariates were included: the bottom four rows of table indicate which covariates were included in each. All models clustered on site, family, and youth. Parental knowledge/monitoring is scaled by *SD* of the estimated latent variable score at survey 1. Coefficients and standard errors multiplied by 100 to be interpretable as percentage points. Demographics were measured at study entry: youth was biological female at birth; youth is Black, Hispanic, Asian, or another non-White racial/ethnic category; maximum education among biological parents; and biological parents are married. Number of observations could vary across models due to missing data in the covariates that were included in each model. Number of observations is markedly lower for Model 3 because parent substance use covariates were measured only at survey waves 2, 4, and 6.

Table 2

Regression Models for Association Between First Differences in Youth-Perceived Parental Knowledge/Monitoring and Youth Use of Any Substance

Independent Variable	Dependent Variable: Δ youth use of any substance in past 30 days (no/yes)											
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coef (SE)	*p*	Coef (SE)	*p*	Coef (SE)	*p*	Coef (SE)	*p*	Coef (SE)	*p*	Coef (SE)	*p*
Δ in parental knowledge/monitoring, when initially denying substance use	−0.41 (0.10)	<.001	−0.40 (0.10)	<.001	−0.39 (0.10)	<.001	−0.45 (0.10)	<.001	−0.62 (0.12)	<.001	−0.60 (0.12)	<.001
Δ in parental knowledge/monitoring, when initially endorsing substance use	−4.35 (1.30)	<.001	−4.34 (1.28)	<.001	−3.41 (1.38)	.01	−4.28 (1.35)	.001	−5.22 (1.40)	<.001	−4.63 (1.37)	<.001
Number of youths	6,069		6,069		6,069		5,727		5,414		5,414	
Number of observations	21,733		21,733		21,732		20,330		17,907		17,906	
Covary survey wave?	No		Yes		Yes		Yes		Yes		Yes	
Covary Δ terms for youth factors: perceived stress, worry about COVID-19?	No		No		Yes		No		No		Yes	
Covary Δ terms for parent factors: ability to enjoy things, worry about COVID-19?	No		No		No		Yes		No		Yes	
Covary Δ terms for household events: youth tested positive for COVID-19, youth completing schooling, engagement in social distancing, household at increased risk for COVID-19 due to work or use of public transit, household without telephone service due to lack of payments, household suffered a material hardship?	No		No		No		No		Yes		Yes	

Note. Coef = coefficient, SE = standard error, *p* = p-value for test of statistical significance of coefficient. Six different models were fit (Models 1–6), differing in which covariates were included: the bottom four rows of table indicate which covariates were included in each. All models clustered on site, family, and youth. Change in parental knowledge/monitoring is scaled by *SD* of the estimated latent variable score at survey 1. Coefficients and standard errors multiplied by 100 for reporting. See Appendix for details of covariates included in Models 2–6. Number of observations could vary across models due to missing data in the covariates that were included in each model.

* *p* < .05

** *p* < .01

*** *p* < .001