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Review article

Substance abuse among children

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ABSTRACT

Substance abuse (SA) among children is a recognized challenge for policymakers and law enforcement and has life-threatening consequences owing to the impact on the children's development and the consequent increase in vulnerability. This work outlines several important issues related to SA among children: (1) SA prevalence including onset, common examples, extent, and spectrum of SA; (2) the presence of new psychoactive substances, which are rapidly spreading worldwide with limitations regarding their prevalence, detection, and interventions; (3) street children and their recruitment in drug supply; (4) SA and substance use disorder pathways, risk and protective factors for the development of SA; (5) SA consequences in the case of early initiation, including deaths; and (6) current preventive interventions for the pediatric population. In conclusion, this challenge requires consistent and unremitting attention in order to execute effective prevention programs with continuous re-evaluation of the situation.

1. Introduction

The global substance abuse (SA) problem is a serious threat to public health and the safety of children [1]. Any SA at early age is likely to interfere with normal development and may have an impact on the child's future [2]. Initiation of SA at an early age has been associated with long-term physical, behavioral, social, and health risks [3]. In addition, the recreational use of drugs is an under-recognized cause of mortality and morbidity in children. It is currently a public health priority. Numerous adverse consequences are linked to substance use by children, not least of which is the increased risk of dependence among those who began smoking, drinking, and using substances before 18 years of age. Furthermore, most adults with substance use disorder (SUD) initiated use during childhood [4]. The present work aims to outline these issues.

Most countries define child as someone who is younger than 18 years [5]. The population in many parts of the world is relatively young. In 2016, more than 26% of the global population was aged 0–14 years and 16% was aged 15–24 years [6].

SA consists of a maladaptive pattern of substance use leading to clinically significant impairment or distress, including recurrent substance use which is hazardous or continuous despite persistent social or interpersonal problems. Substance use disorder (SUD) is the use of a substance despite experiencing problems due to this use. This term integrates SA and substance dependence into a single disorder [7].

2. Prevalence of drug abuse among children

SA is mostly initiated between 15 and 17 years of age, but can begin as early as the age of 10 years [3]. Most research suggests that early (12–14 years old) to late (15–17 years old) adolescence is a critical period for the initiation of substance use and that it may peak among young people aged 18–25 years [6].

The onset of substance use among preparatory and secondary students from Assiut Governorate in Egypt (n = 5476) was reported to be 61% in the 10–15-year-old group, followed by 31% among those 15–19 years old, and 8% among children younger than 10 years [8]. In 2013, another study was performed in eight Egyptian governorates (n = 40,083), which showed that 29.3% of the participants tried substances for the first time at the age of 16–19 years, while 19.4% tried substances at the age of 8–15 years [9].

The most common substance use differs from country to country depending on the social and economic environment.

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Cannabis remains the most commonly used drug. With the exception of tobacco and alcohol, cannabis is considered the most commonly used drug among young people. Its use is typically initiated in late adolescence and peaks in young adulthood. A global estimate by the UN is based on available data from 130 countries in 2016: 13.8 million young people (mostly students) aged 15–16 years used cannabis at least once in the previous 12 months. A high prevalence of cannabis use was reported in West and Central Europe (20%) and North America (18%) in 2016. A comparative study of substance use among university students (18–25 and older) in Bolivia, Colombia, Ecuador, and Peru in 2016 showed that cannabis was the most commonly used substance after alcohol and tobacco [6]. Cannabis is often used with other substances and the use of other drugs is typically preceded by cannabis use [10,11].

Alcohol is the most commonly abused substance among youth in the United States [12]. Although it is illegal for individuals under 21 years of age to drink alcohol in the United States, people from 12 to 20 years of age consume about one tenth (11%) of all alcohol consumed in that country. More than 90% of this alcohol is consumed in the form of binge drinks [12]. In 2013 in the United States, there were approximately 119,000 emergency room visits by persons aged 12–21 for injuries and other conditions linked to alcohol [13].

The 2018 World Drug Report highlighted the critical challenge related to the tramadol crisis in some countries in Africa and other regions [6]. An Egyptian study that was carried out in Sharkia Governorate in 2013 among preparatory and secondary school students (n = 204) showed that the most common substance used by students was tramadol (83.3%) [14]. This high prevalence of tramadol use was supported by a previous Egyptian study (2010), which reported 32.1% prevalence of tramadol use among children and adolescents who presented to the Emergency Unit of the Poison Control Center of Ain Shams University Hospitals in Egypt for toxicological assessment [15].

An Egyptian study performed in 2014 among preparatory and secondary school students (n = 5476) in Assiut Governorate showed that cigarettes was the most common substance used (89.80%), followed by hashish (5.30%), beer and alcohol (1.80%), and tramadol (1.50%) [8]. In 2013, another study reported that cannabis was the drug mostly misused in Egypt; alcohol was a distant second among the population aged 15+ in eight governorates (n = 40,083) [9]. A study conducted in focus groups recruited from two different Egyptian areas (Cairo and Alexandria) found that smoking cigarettes and using hashish were the most common practices, and that tramadol was the drug of choice reported by all. Inhalant misuse is also prevalent among early adolescents [16]. Another small Egyptian study in 2011 was carried out in Menoufiya Governorate (n = 150) revealed the most prevalent substance of abuse was tobacco (15.3%) and cannabis (2%) [17].

The extent of drug use among young people remains higher than that among older people [6]. Moreover, the use of substances that have emerged more recently is reportedly much higher among young people. Most drug use and associated health consequences are highest among young people [6]. The changing perceptions of the risks associated with substance use and a debate around substance legalization that in turn might have influenced their use and could explain the rise in substance use [6,18].

It is important to report estimations of the annual prevalence in order to assess changes in the extent of substance use. Between 2006 and 2016, data about the use of any substance in the United States showed no change in the prevalence rate among those aged 12–17 [6]. The increase in past-year cannabis use among those aged 15–24 in Western Europe countries has been much less pronounced, and substance use seemed to be stable (or with minimal changes) during the 2005–2014 period. In France, cannabis use among those aged 15–24 showed an increase during the same period [6].

In 2017, the national Egyptian survey of substance use reported the prevalence of substance use among secondary school students (n = 5048 in 146 schools) in 13 governorates as being 12.8, 7.7, and 8.3% for smoking, psychoactive substances, and alcohol, respectively. The minister revealed that 36% of persons who called the hotline for consultation and seeking treatment were children (< 18 years old) during the first half of 2017 [19].

Polysubstance use remains common among both recreational and regular users. However, polysubstance use among young adults is linked to an increased risk of developing long-term problems and engaging in acute risk-taking through binge drinking or binge use of stimulants such as "ecstasy" [20].

Evidence collected in some countries shows examples of combinations of substances typically used by young people. In Europe, a wide variation in the patterns of polysubstance use among the population of drug users was reported, ranging from occasional alcohol and cannabis use to the daily use of combinations of heroin, cocaine, alcohol, and benzodiazepines [6]. In a Brazilian survey among students, cannabis, amphetamines, inhalants, tranquillizers, and hallucinogens were the most frequently used substances along with alcohol [21]. Cannabis, cocaine, and ecstasy were the most commonly reported substances concurrently used among university students in Bolivia, Colombia, Ecuador, and Peru in 2016 [6].

3. New psychoactive substances (NPS)

The European Monitoring Center for Drugs and Drug Addiction in 2015 reported approximately 560 NPS with almost 380 detected in the last 5 years only [22]. There are limitations regarding the prevalence data of NPS usage. The recent rapid proliferation and diversity of NPS have made it difficult for surveys to keep up and accurately reflect the use of new drugs [23]. Because of alterations in their molecular structure, they are usually not detected on commonly used drug screens. Moreover, pediatricians face a greater challenge because the clinical presentation in younger patients may be different than that reported for adults [22].

In the United States, the most prevalent classes of NPS used are synthetic cannabinoid receptor agonists (SCRA), synthetic cathinones (SC), and new synthetic opioids (NSO). An American survey found that, aside from alcohol and tobacco, SCRA are the third most popular drug among 10th- and 12th- graders after marijuana and amphetamines, and the fourth most popular among 8th-graders after marijuana, inhalants, and amphetamines. Nearly half of calls regarding SCRA (48.8%) between 2009 and 2012 involved patients aged 13–19 years. The number of emergency visits related to SCRA increased from 11,406 in 2010 to 28,531 in 2011. More specifically, emergency department visits involving teenagers aged 12–17 years doubled (3780 visits in 2010, 7584 in 2011) and for patients aged 18–20 years they tripled (1881 in 2010, 8212 in 2011) within 1 year. Annual self-reported SC use by US adolescents has remained fairly constant since 2012 at around 1% of 8th-, 10th-, and 12th-graders. On the other hand, there are scarce data available about the prevalence of NSO use [22].

In the United Kingdom, 10% of individuals aged 15–24 years have tried NPS compared with 8% in Europe. According to a survey in England and Wales (2013–2014), the prevalent substances among 16–24-year-olds were generally the more traditional ones: cannabis (15.1%), cocaine (4.2%) and ecstasy (3.9%), and nitrous oxide (7.6%) [23]. In the past few years, two popular NPS – known as Strox and Voodoo (SCAR) – have hit the Egyptian market [24]. Nevertheless, to our knowledge, there are no publications available on the prevalence of NPS use among Egyptian children.

Such estimations are of utmost importance as they give us indication of the extent of these new dangerous substances.

The use of NPS has grown rapidly over the past decade in contrast to the prevalence rates for the use of internationally controlled drugs, which generally seem to have stabilized in the same time period. Producing and marketing NPS holds the promise of high profits without penalty in the case that these substances are not covered by the respective country's legislation [25].

4. Street children

There are two expected scenarios regarding the spectrum of substance use among young people: (i) club drugs such as "ecstasy", methamphetamine, and cocaine are common among rich children and (ii) inhalants among poor street children [26].

The existence of street children is a global phenomenon with considerable variation between high-, middle-, and low-income countries regarding factors that drive children to the streets [27]. Street children not only live, survive, and grow up in an unsafe environment, but they also might be abused by local gangs or criminal groups to engage in street crimes or sex work [6]. The most commonly used substances among those living on the streets are likely to be inhalants, which include glue, paint, and correction fluid. These substances that induce rapid euphoria are usually abused because of their low price and availability. At the same time, many street children are exposed to physical and sexual abuse, and substance use is part of their coping mechanism in the harsh street-life environment [26].

Studies on substance use among street children in resource-constrained settings reported that inhalants were the most common substance used, putting lifetime prevalence of their use among street-involved children and youth at 47% [28]. While the use of inhalants was found in all regions, use of cocaine among street-involved children was reported mainly in South and Central America, and alcohol use mostly in Africa as well as South and Central America [29]. The prevalence of use was higher among those categorized as children of the street (i.e., homeless children), compared with children on the street (i.e., children who have a home but spend the day and most of the night on the street) [27,30].

An Ukrainian study reported that 15% of the street children are substance injectors and 75% were sexually active [26]. In a study from Pakistan, cannabis and glue were the most commonly used substance among street children (80% and 73%, respectively), while 9% smoked or sniffed heroin and 4% injected it [26]. In a Canadian study among street-involved youth, 43% of participants reported injecting drugs, in particular methamphetamine, heroin, or cocaine [31]. A Brazilian study reported that more than half of the participants had been sexually active before the age of 12 with more than three sexual partners in the previous year [31].

Street children remain one of the most vulnerable and stigmatized groups. They are exposed to abuse and violence, drug use, and other behaviors that put them at high risk of HIV and tuberculosis infection. Despite these vulnerabilities, they are often the most likely to be omitted from receiving any form of social or healthcare support to correct their condition [32].

In addition to violence, abuse, and sexual activity with multiple partners, more than half (62%) of street children in a study from Egypt (n = 857 from Cairo and Alexandria governorates) had used drugs, while only 3% reported current use of injecting drugs. Over one-third (35%) reported alcohol consumption, and this was more common among males than females [33].

Young people may be involved in the drug supply chain. They may be recruited by organized crime groups and coerced into working in the drug supply chain starting from cultivation, production, trafficking to local-level dealing. The recruitment of children for drug trafficking is preferred by organized crime groups for many reasons: first, the recklessness associated with younger age groups, even when faced with the police; second, their obedience; and third, drug traffickers perceive children as cheap, expendable, easily controlled, and often able to operate under the police's radar and to smuggle illegal substances across borders [6].

The number of children younger than 16 years arrested on suspicion of supplying drugs has been increasing in recent years in various countries as well as in the United Kingdom. Data from over 40 countries show that about 3% of people arrested or cautioned for possession of drugs in 2015 were aged under 18 [6].

Egyptian authorities have tried to eliminate drug dissemination sources among children and have been performing routine investigations of school bus drivers in 103 schools in seven governorates since 2015. The prevalence of substance use among this group dropped from 12% in 2015 to 2.4% in 2017 [19].

5. Pathways to SA and SUD

The interplay of many factors may facilitate the vulnerability of young people to substance use. These factors lie at the personal, micro (family, schools, and peers), and macro (socioeconomic and physical environment) levels. This vulnerability is mainly determined by the presence of risk factors and the absence of protective factors that make a difference in susceptibility to substance use. Knowledge of the risk factors that determine whether users will continue on a path to harmful use of substances is important to better understand, predict, and properly intervene in these distinct etiological pathways. On the other hand, an abundance of positive experiences, such as protective factors, can strengthen the neural connections underlying self-regulation, impulse control, and executive decision-making [6].

It is of great importance to understand the biology of the development of the neurological system. Brain development is sensitive to psychosocial experiences. Such experiences affect the brain (developmentally and physiologically) and have a direct impact on a child's ability to self-regulate and on their susceptibility to substance use. Normal development during adolescence is characterized by heightened levels of impulsivity and novelty-seeking, in part due to dramatic fluctuations in hormone levels that affect brain development and other systems. Mental health is also an effective element. Mood and anxiety disorders double the risk of developing SUD [6].

The prefrontal cognitive regulation of subcortical regions is somewhat functionally disconnected throughout adolescence. This translates into the natural tendency of adolescents to act on emotional stimuli, with little cognitive control [34]. In addition, brain circuits, such as the ventral striatum, that are involved in processing rewards, show rapid maturation during the adolescent years, heightening sensitivity to rewarding experiences. This development may play a unique role in the initiation of substance use in early to mid-adolescence [35].

Studies have demonstrated the associations between increasing levels of emotional and physiological stress (poverty, child maltreatment, and divorce) and decreases in behavioral control with higher levels of impulsivity and maladaptive behaviors [36]. Stress exposures disrupt both the hormonal and the physiological systems that regulate cognitive and behavioral functions, impairing learning, memory, decision-making, and other functions that normally support the self-regulation of behavior [37]. These biological stress responses activate the same neural systems that underlie the positive reinforcing effects of drugs [38]. Adverse experiences, especially in early life, have the potential to modify gene expression or suppression. Ongoing

environmental change can further modify epigenetic processes (the interaction between genes and the environment), either for better or worse [39].

Regarding micro-level factors that may vary across cultures such as parent, family, and peer influences, an Egyptian study in 2011 confirmed that bad relationships between children and their families, conflicts between family members, and physical abuse by a family member are significantly higher among children with SA. Moreover, peers have a significant role in SA [17].

Another Egyptian study (2012) was conducted with focus groups aged 12–14 years and 15–18 years. The respondents reported that peer pressure from friends stood out as the most common reason to start and to continue using substances, followed by adverse life events and having a parent or family member who used substances. Strict parenting, religious influences, having non-user friends, and living in good neighbourhoods were among the reasons perceived by youth as preventing them from using substances or helping them to quit substance use [16].

6. Consequences of SA

One of the goals of prevention programs is to increase awareness in society regarding consequences of SA. Usually, chronic use of substances is associated with deficits in domains including physical health, cognitive functioning, educational achievement, and psychology. It also involves overall impairment in social competencies and relationships [40]. Physical health problems experienced by young drug users include an increased risk of overdose, accidental injury such as motor car accidents or falls, and attempted suicide.

Especially in the case of drug abuse among children, regular substance use can affect growth and development and profoundly compromise their neurodevelopment. Substance-induced alterations affect mainly memory, attention, and executive functions [41]. The use of multiple substances confers greater health risks and negative consequences, as well as poorer outcomes.

Medical research shows that those who use cannabis before the age of 16 face the risk of acute harm and increased susceptibility to developing SUD (1:6 of those who initiate substance use in adolescence develop cannabis use disorders) and mental health disorders including personality disorders, anxiety, and depression [10,11]. The prevalence of SUD among preparatory and secondary school students in Assiut Governorate in Egypt ($n = 5476$) was 22.9%. The prevalence of abuse/dependence was 28.50%, with occasional and recreational use of drugs being higher (34.63%) than regular use (27.15%). The prevalence of SUD in the group aged 12–16 years was 50%, while in group aged $>$ 19 years it was 49.68% [14].

Death as a result of substance use is the extreme outcome. Globally, deaths directly caused by substance use increased by 60% from 2000 to 2015 [6]. Excessive drinking is responsible for over 4300 deaths per year among underage youth in the United States [42]. Deaths resulting from SUD account for a higher proportion of mortality among younger people including children, with almost one quarter (23%) of deaths among those aged 15–29 years, mostly related to opioid use. Europe followed by the Americas rank in the top two for recorded deaths among different age groups, including children. Deaths resulting from SUD account for a higher proportion of mortality among males than females (2/1) aged 15–29 years [6].

7. Current preventive intervention for the pediatric population

Contributions to the emergence of SA in the pediatric population are multifactorial [43]. A suggested proposal for three-dimensional healthy lifestyle pyramids already includes non-smoking as well as non-alcohol and non-drug consumption as a requirement for the acquisition of healthy habits at young ages [4].

In addition to legislations, the success of prevention can be achieved by correcting misconceptions through health education and workshops. One of the misconception was mentioned in the 2018 World Drug Report, that all young people are equally vulnerable to substance use because of their ignorance of the scientific evidence about SA [6]. In this context, the Egyptian authority established a health education program among students to correct misconceptions about substance use. This program is aimed at increasing awareness among 2 million young persons in educational and youth institutes in Egypt [19].

In regard to substance use, research in Arab countries was assessed in 2014: It was found that research in this field was largely neglected [44]. Therefore, it is recommended to set up governmental funding with a main goal. Indeed, advanced understanding of the biology of addiction involves the translation of this knowledge into improved prevention, treatment, and policy strategies. As an example, the use of instructions derived from cognitive behavioral therapies for addiction in adult tobacco smokers has been shown to increase connectivity between prefrontal cortical regions implicated in behavioral control and subcortical regions implicated in cravings [45]. This proves the importance of basic research in support and aiding practical work, especially prevention.

The American Academy of Pediatrics (AAP) has highlighted the importance of the role of pediatricians regarding the prevention of SA and the diagnosis and management of problems related to SA. Pediatricians should include discussion of SA as part of routine healthcare, starting with the prenatal visit. They should incorporate SA prevention into daily practice, acquire the skills necessary to identify young people at risk for SA, and provide assessment, intervention, and treatment as necessary [46].

The AAP recommends a ban on all tobacco advertising in all media, limitations on alcohol advertising, avoiding exposure of young children to substance-related (tobacco, alcohol, prescription drugs, illegal drugs) content on television and in movies, incorporating the topic of advertising and media into all SA prevention programs, and implementing media education programs in the classroom [47]. The same was noted in relation to tramadol: The unplanned indirect media advertising of tramadol abuse through movies and television series also played a significant role in promoting tramadol abuse [15]. A national survey in Egypt in 2017 of substance use found that 72% of students got their knowledge from media and television series. Therefore, the ministry of social insurance in Egypt introduced financial penalties in such cases [19].

Reducing substance uses require community-based efforts to monitor the activities of youth and decrease access of youth to such substances. Many strategies for the prevention of underage drinking were suggested as an example, such as enforcement of minimum drinking age laws, national media campaigns targeting youth and adults, increasing alcohol excise taxes, reducing youth exposure to alcohol advertising, and development of comprehensive community-based programs [13].

8. Conclusion

This review article of SA among children highlights important related issues to help identify this significant problem and recognize the associated threats. These threats affect not only the youth but also the community as a whole, especially with the rapid development of NPS. In conclusion, SA is a complex challenge

that requires consistent and unremitting attention. Thus, effective prevention programs against SA for children are of utmost importance with continuous re-evaluation, which requires community-based efforts and legislations.

Disclosure of interest

The authors declare that they have no competing interest.

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