An introduction to the etiology of
drug use and substance abuse

I. Introduction

There is a strong evidence-base regarding individual and community-level conditions and experiences that increase vulnerability to drug use initiation, escalation, abuse and addiction (Institute of Medicine Report, 2009). Decades of research have consistently documented the involvement of individual-level characteristics (e.g., biological and genetic predispositions, certain personality and temperamental traits, poor cognitive and emotional functioning, and detrimental effects of stress) in susceptibility to drug abuse. These traits interact with the harmful effects of poverty, economic inequality, family dysfunction, peers, and maltreatment on child and adolescent development in ways that increase liability for early initiation of drug use and eventual drug abuse(Aber, Yoshikawa, &Beardslee, 2012; Duncan &Murnane, 2011; National Research Council & Institute of Medicine, 2009). This literature review of the etiological factors in drug abuse is based on findings from numerous relevant disciplines that have contributed to this knowledge. Thus, we account for the ways in which these internal and environmental factors dynamically interact with each other to influence the complex behavioural pathways of children and adolescents. Involvement of each of these factors has implications for the ways in which children’s brains develop and function which, in turn, determines their ability to make sound decisions, problem solve, inhibit impulses, accurately perceive and process emotion, gauge consequences of their actions and ultimately self-regulate behaviour and emotions.

This viewpoint accounts for the immediate “micro-level” (family, school, and peer) and surrounding “macro-level” (e.g., neighbourhood, public policy, organizational behaviour) influences on the development and extent of behaviour through its effects on individual characteristics and, in particular, on brain function. Substantial advances have been made in understanding how these micro-level and macro-level factors impact the way in which the brain develops and maintain a healthy psychological state. While the factors will vary between individuals and no factor alone is sufficient to lead to drug abuse, there is likely some critical combination of the number of risk factors present and protective factors (e.g., nurturing environment, strong coping skills) that are absent that make the difference between having a brain that is primed for drug abuse versus one that is not. Reaching this threshold can be achieved by any number of potential combinations of external and personal factors and thus will be unique for each individual. Nevertheless, the important point is that brain development is so exquisitely sensitive to psychosocial experiences that the effects on the structure and function of the brain are measurable and these effects, in turn, have a direct impact on a child’s risky behaviours and susceptibility to substance abuse. And ultimately the implications of this research are that prevention policy has potential to strengthen protective factors and either reduce exposure to or minimize the effects of risk factors to redirect development away from risky behaviours such as substance abuse.

These advances now position the prevention sciences to implement programs and policies that more effectively target these influences and effects on development to improve ultimate outcomes for children. The evidence-based complement of interventions described in the Standards are based on this knowledge and, thus, designed to prevent initiation and escalation of drug use and related problems among children who are exposed to various risk conditions and experiences in combination with personal characteristics that heighten risk. These interventions operate to overcome adversity, increase resiliency skills and, on a policy level, reduce the level of exposure to deleterious factors. These “solutions” are believed to exert their effects through improvements in underlying brain and cognitive functions and corresponding skills that have been specifically implicated in mental health, emotional and behavioural problems and shown to be vulnerable to these micro-level and macro-level influences.

II. Developmental Sequencing

There are critical differences across stages of development and level of maturity that influence outcomes in individuals who are exposed to the above mentioned influences and who exhibit the personal characteristics that have been related to propensity to drug abuse. Each stage of development, from infancy to early adulthood, is associated with a certain expected range of intellectual ability, language development, cognitive, emotional and psychological functioning, and social competency skills that needs attention to prevent the onset of drug abuse. In infancy, responsiveness to the environment and caregivers’ interactions, and vice versa, and learning how to be effective in having needs met is of great importance for successful outcomes. Later, in early childhood, language, cooperation, control of emotions, collective conscience (cooperation), social and emotional skills (including perception of others’ emotions), and problem solving begin to develop and predict later social competence. Maintaining attention, controlling emotions, social inclusivity, effective communication and reception emerge in middle childhood. And in adolescence, social and emotional skills to establish stable relationships, sensitivity to needs of others, conflict resolution, prosocial skills, and impulse control are integral to self-regulation of emotion and behaviour which are predictive of favourable outcomes in early adulthood. Relatedly, delaying initiation of drug use in adolescence can be considered a goal for prevention policy. The influences listed above each have an impact on the tendency to begin using substances early in adolescence which has been repeatedly associated with risk for escalation and eventual abuse and addiction (Grant & Dawson, 1997; 1998). Early onset has also been related to a number of conduct problems including delinquency, risky sexual behaviour, and dropping out of school (Doherty et al., 2007; Hayatbakhsh et al., 2009; Mason et al., 2010). These findings have significant implications for prevention and public health policy.

Given these differential levels of competency throughout childhood and adolescence, the social and physical environmental factors outlined above are expected to have different effects on the individual depending upon developmental stage. Similarly, the phase of development must be considered when targeting interventions to particular risk factors, populations, and settings as the programs themselves will be received and processed differently given level of maturity in these processes. For example, executive cognitive functions (ECFs) are higher-order cognitive skills that are controlled by the front part of the brain – the prefrontal cortex – and include problem solving, decision making, forethought, impulse control, working memory, and abstract reasoning, among others. The development of ECFs is a multistage process starting in early childhood as the building blocks for ECF begin to form (Bell & Fox, 1992; Levin et al., 1991; Thatcher, 1991, 1992; Welsh et al., 1991). The more complex features of ECF, such as those listed above, only begin to surface in adolescence and do not coalesce until early adulthood (Fried & Smith, 2001). It is during adolescence that demands for coping with competing social, cognitive, biological, and academic changes are high and have important long-term implications for the emergence of risk behaviours (Petersen & Leffert, 1995; Pope et al., 2003; Thadani, 2002). Taking into account the level of development of ECF along with prevailing social demands of the individual helps to determine what interventions will work best – in terms of being understandable and executable – during adolescence as opposed to early ages when ECF is much less developed. Given the prominent role of ECF deficits as an etiological factor in drug abuse, these are important considerations. The same considerations are relevant for social and physical environmental risk factors which will exert different effects from a risk standpoint depending on the developmental period of exposure, as well as personal characteristics such as psychological disorders (e.g., depression and anxiety) which develop and evolve over time.

The take away message is, the earlier the intervention, the more effectively we can redirect behavioural pathways, increase resiliency, and reduce exposure to the potentially long-term adverse effects of the above etiological conditions, including the early use of drugs itself. Even very young children can manifest early predictors of future mental, emotional, and behavioural disorders which eventually increase risk for drug abuse. Three problems that are especially important to monitor and prevent during childhood are: (1) aggressive behaviour with other children, (2) uncooperative behaviour with teachers and adults, and (3) continual sadness or excessive worrying. Children who are more aggressive with other children are more likely to have problems making friends and are more likely to have serious behaviour problems, including criminal activity and drug abuse, as adolescents and adults. Children who refuse to follow instructions from teachers and adults are more likely to have difficulties in the classroom and more often find themselves in unsafe situations at home and in the neighbourhood. Persistent sadness or excessive worry can signal larger problems like depression or anxiety that can cause difficulties in many areas of life. Fortunately, a great deal is known about how to prevent, monitor, and even treat these problems to ensure children continue to reach their highest potential. And in all cases, an enriched environment, external supports, and high quality education is essential at all ages.

Importantly, however, adolescence and early adulthood is not too late for intervention given the tremendous amount of brain plasticity and maturation of cognitive and emotional regulatory functions that is taking place, providing a solid window of opportunity to improve outcomes. Many mental health, emotional, and behavioural problems result from impulsive, sensation-seeking activities among teenagers. The above information indicates that the problems important to monitor and prevent in adolescence include (1) early alcohol, tobacco, and other drug use, (2) violent and delinquent behaviours, (3) depression and suicide, and (4) risky sexual behaviours. And in adulthood, influences on these behaviours persist and also require address to prevent further escalation of use, addiction and relapse.

III. Macro-Level Influences

1. Poverty

Impoverished neighbourhoods with a high rate of single-parent families, racial segregation, inequality (based on race, sex, or other characteristics), homelessness, transiency and poorly equipped schools and teachers are well known to have high levels of child abuse, infant mortality, school dropout, academic failure, crime, delinquency, mental illness and substance abuse. And over the past thirty years, a large body of evidence has been amassed to help us better understand how overall conditions in impoverished communities lead to considerable detriments to child and adolescent development (see Blair, 2010).

On a societal level, poverty affects the quality of the environment as well as choices and opportunities that adults can access to help their children. It places a strain on social systems and supports, resulting in increased conflict, adverse effects on parent and child health, and a lack of cooperation among residents and with community organizations. As a result, teaching children effective social skills they will need to interact with peers and other adults is more difficult and less effective. Poor children are therefore much more likely to grow up to be poor adults and to raise children who suffer the same problems they experienced.

On a more individual level, poverty’s influence on families and parenting can lead to harmful effects on child and youth development in three ways: (1) by increasing stress among parents and caregivers, (2) by reducing their ability to invest in learning and educational opportunities, and (3) by compromising their ability to be involved, patient, responsive and nurturing parents to their children throughout development. Many studies have demonstrated that economic adversity is associated with disruptions in parenting behaviours and that psychological distress in parents is linked to substance abuse in children (Brody &Flor, 1998; Jackson, Brooks-Gunn, Huang, & Glassman, 2000).In part, these effects are due to the inability of distressed parents to attend to basic and emotional needs of the child and child maltreatment and neglect. Furthermore, the care giving environment for low income children is more likely to be disorganized and lacking in appropriate stimulation and support, thereby creating conditions that are stressful for children(Evans, 2004; McLoyd, 1998; Repetti, Taylor, & Seeman, 2002). And although stress in and of itself is not always harmful, in the context of an impoverished, high risk environment, stress impedes growth, leads to dysregulated physiological responses to stressful situations, increases risk for psychological disorders (e.g., depression, anxiety, and traumatic stress disorders) and compromises development of self-regulatory skills, which are key vulnerability factors in risky behaviours such as substance abuse and delinquency (see section on Stress Exposures and Reactivity). And further complicating outcomes, child care and educational programs offered in impoverished neighbourhoods are often either absent or bereft of rich and nurturing learning experiences. In combination with less access to health care in impoverished families and communities, children are at much higher risk of poor mental and physical health outcomes. Importantly, high quality care giving moderates the effects of poverty on child development (Evans et al., 2007), particularly for girls (Kumpfer et al., 2008).

Of even greater impact, youths who are homeless, street-involved or forced to work at a very young age generally have a history of severe adversity, such as maltreatment, caregivers with substance abuse and other mental illnesses, instability and transiency, malnourishment, sexual assault, violence (experienced and witnessed), and, for some, kidnapping and coercion (Sayem & Kidd, 2013). And in all such cases, environmental conditions are extraordinarily unhealthy, including the inability to meet basic physical needs, exposure to toxic substances, and severely stressful circumstances (see section of Stress Exposures and Reactivity). There is an exceptionally high incidence of behavioural and psychological problems in these youth, including abuse of multiple substances, suicide attempts, and Post-Traumatic Stress Disorder (PTSD), as a result (Meltzer et al., 2012; Nada et al., 2010; Prasad & Prasad, 2009). In each of these scenarios, there is a lack of available services or supports (starting with assessments to identify and address particular needs) to lift children out of these circumstances (Marshall & Hadland, 2012). With increased availability of badly-needed services for these children, plus political and health care involvement, there is potential for them to develop skills that would improve their chances of success in school and life so that they do not fall further and further behind (Hudson & Nandy, 2012).

As a result of these findings, there is a call for increased efforts to reduce poverty and to avoid the detrimental consequences on child development, particularly with respect to learning the skills needed to escape poverty and succeed in life. The focus of prevention efforts is currently on facilitating the implementation of comprehensive programs and services in high poverty neighbourhoods, although it is critical for policy to further enact programs to alleviate the sources of poverty.

2. Social Environment: Norms, Cohesiveness, Prejudice, and Global Conflict

The social environment of the neighbourhood has important implications for risk for drug abuse because it shapes social norms, enforces patterns of social control, influences perception of risk of substance use, and effects stress responses ([Institute of Medicine, 2003](http://www.sciencedirect.com/science/article/pii/S0376871612001342#bib0110)).Laws and law-enforcement are helpful to neighbourhoods, but informal social controls and norms are even more important for maintaining neighbourhood viability, including issues such as observable violence, child maltreatment, public consumption of illegal drugs and other risky behaviours. Decades of research have shown that the risk for drug use is related to the prevailing norm toward drug use in the social environment, including the neighbourhood, schools, families, and especially peers during adolescence (Elek et al., 2006). Relatedly, perceptions of risk of substance use, which come largely from the neighbourhood, peers and family, influence whether children and adolescents will take part. Those who believe substances will harm the body or mind, or will get them into trouble are less likely to use. For example, a large-scale survey conducted by the Center of Addiction and Substance Abuse (CASA) in the USA found that about half of the high school students questioned believed that substance use is very dangerous. However, those teens who view substance use favourably in terms of the benefits of substance use (e.g., being cool or population, weight control, self-medication, stress relief, or coping) are more likely to smoke, drink and use other drugs than those who perceive use less favourably or have stronger perceptions of risk (CASA, 2011).

Social cohesion is an indicator of attachment to and satisfaction with the neighbourhood and its residents and, thus, involves trust and support for one another in a community. It is a critical factor for neighbourhoods striving to raise children successfully. In socially cohesive neighbourhoods, people can depend on each other for help when needed, maintain norms for positive social behaviour and communication in the neighbourhood, support each other in guiding children and adolescents, and collectively problem solve.Strong social cohesion has been shown to positively influence various health outcomes, including all-cause mortality (Martikainen et al., 2003), mental health ([Almedom, 2005](http://www.sciencedirect.com/science/article/pii/S0376871612001342#bib0020)), physical activity (Lindstrom et al., 2001; McNeill et al., 2006) and self-rated health (Mohnen et al., 2011; [Poortinga, 2006](http://www.sciencedirect.com/science/article/pii/S0376871612001342#bib0185)). High social cohesion has also been suggested to be associated with lower drug use among adolescents (Winstanley et al., 2008), fewer perceived youth drug problems (Duncan et al., 2002) and lower drug-related mortality (Anderson and Baumberg, 2006). Thus, social cohesion can be considered a protective factor when present.

Despite governments’ best attempts to reduce disparity, certain racial, ethnic, income and gender groups continue to receive differential treatment and have restricted access to the goods and services available in their society. Research has focused on understanding discrimination both as social processes that impact on identifiable groups and as social acts experienced by individual members of that group. Discriminatory attitudes, policies and practices limit the power, status and wealth of these groups which contributes to patterns of social isolation and concentrated poverty. In turn, residents in these poor neighbourhoods tend to experience lower levels of, for example, physical and mental health, educational attainment, and employment, and exhibit higher levels of risk behaviours such as drug abuse than residents of neighbourhoods that are more advantaged.

The implications of discrimination and social exclusion for child development arise from both a structural and cultural perspective. Structural inequalities lead to adverse educational, health and behavioural outcomes are largely due to differential access to material needs, such as adequate nutrition, quality housing and schools, as well as the increased exposure to environmental toxins, and hazards. Adding to the challenges is the lack of effective coping strategies that often characterize disadvantaged children. These problems tend to be compounded in individuals with an immigrant status. Cumulative adversity in immigrants, including language and legal status barriers (Omelas et al., 2001), perceived discrimination (Tran et al., 2010), and acculturation issues have all been related to risk for substance abuse and mental health problems. Those issues coupled with poor access to services and social supports and a lack of neighbourhood collectivist efficacy compound the problem (Chou, 2012; Rodgers et al., 2009; Sachem et al., 2012).

Even more alarming are the effects of war and political instability on child development, which disrupts basic services such as housing, transportation, communication, sanitation, water, and health care. War and political conflict often result in orphaned children or children separated from their parents who are now relegated to the streets to fend for themselves. Political conflicts have produced millions of children worldwide who are refugees, usually in a foreign country (Ezra, 2012). They are often exposed to violence, both personally and as observers, and are more likely to be infected with disease, living in severely unhealthy conditions, injured, murdered, traumatized, and victimized. In some countries, they are forced to become soldiers themselves and are exposed to unspeakable acts of cruelty and violence against others and themselves. The stress and unhealthy environments and experiences associated with these atrocities interfere with healthy child development, leading to deficits and delays in numerous functional domains, as well as high rates of psychological disorders, particularly PTSD and eventual alcoholism, drug abuse and addiction (Ezra, 2012; Prasad & Prasad, 2009). Although war and conflict are inevitabilities, there are societal and political responses that can mitigate their effects on children and improve outcomes. Children need to be defended on a governmental level and protected from these conditions, prohibiting them from entering war zones as soldiers or victims, and overall keeping them out of harm’s way. At the same time, rehabilitation needs, such as for shelter, food and clean water, must be addressed. They will also require psychosocial support to overcome damage to psychological and emotional functions and redirect them toward education and a civil society.

3. Physical environment

Many aspects of the physical environment can harm young people's development (Leventhal & Brooks-Gunn, 2000; Shonkoff & Phillips, 2000).Physical design of the neighbourhood affects social relations, crime and drug use. Decayed and abandoned buildings, ready access to alcohol and drugs, urbanization of the area, and neighbourhood deprivation are also associated with drugs, crime, violence, and accidents. Neighbourhood quality is also associated with a prevalence of fast food restaurants, encouraging a diet that is relatively devoid of essential nutrients and physical toxins (e.g., lead, cadmium) which directly affects nutrition, health and, in turn, psychological state.

Neighbourhood disorder is a concept representing an area characterized by vandalism, graffiti, noise, and dirt. Neighbourhood disorder has been negatively associated with physical functioning and self-reported health. More recently, the neighbourhood context has been found to be particularly influential for low-income urban youth due to the high level of exposure to drug activity, disorder, and violence in their neighbourhoods, all of which may influence drug use (Furr-Holden et al., 2011). Residents tend to consume more alcohol when they perceive more neighbourhood disorder ([Hill and Angel, 2005](http://www.sciencedirect.com/science/article/pii/S0376871612001342#bib0100)) and the influence of neighbourhood disorder/ efficacy on substance use may be mediated by psychological distress ([Hill and Angel, 2005)](http://www.sciencedirect.com/science/article/pii/S0376871612001342#bib0100).

Exposure to certain toxins during the prenatal period and early childhood have been strongly and consistently linked to functional deficits (e.g., cognitive dysfunction and psychological disorders) (Bellinger, 2012) that have, in turn, been associated with risk for substance abuse and other forms of psychopathology. The neurotoxic effects of lead, cadmium, mercury, manganese, arsenic and other heavy metals are well established. Even only moderately elevated levels of lead exposure, in particular, have been shown to lead to mental retardation. Lower levels, however, have also been related to hyperactivity and violence in children. Although the research is scant with respect to their direct association with substance abuse, exposures are more definitively related to personal characteristics (e.g., psychiatric disorders, cognitive deficits, etc.) that are known to increase risk for substance abuse.

Prenatal exposure to cigarette smoke and second-hand smoke in early childhood have both been shown to increase propensity in the children not only to smoke and eventually become dependent on nicotine, but also to exhibit externalizing (conduct problems such as aggression) and internalizing (e.g., depression and anxiety) symptoms (Cornelius et al., 2012; Goldschmidt et al., 2012). Additional studies have found that early exposure to smoke leads to a decline in cognitive function which, as described below, is strongly associated with risk for other problems including substance abuse (Piper & Corbett, 2012).

Prenatal drug and alcohol exposure are associated with the development of behavioural problems in the offspring in childhood and adolescence, including eventual drug abuse (DiNieri et al., 2011; Sithisarn et al., 2012). Drugs of abuse readily pass through the placental barrier to enter the brain and body of the developing foetus. Alterations in neurological systems associated with self-regulation, reward and motivation, due to the properties of the drug(s) pregnant women are using, appear to be the mechanism by which prenatal drug exposure affects the child. The effects of these sorts of prenatal exposures on mental health and behaviour will tend to exacerbate any pre-existing genetic susceptibilities of the individual.

And finally, the media is one of the most insidious influences on social norms and other messages that are favourable toward drug use (Feinstein et al., 2012). Adolescents in particular spend a great deal of time being entertained by television, radio, movies, the internet, magazines and smart phones, more so than they spend with family or even friends. In essence, these messages can make substance abuse appear to be a normative behaviour and can alter attitudes about the safety of drug use. As such, social media has been repeatedly linked to initiation of substance use (Feinstein et al., 2012). It is even possible to purchase drugs through the internet and cell phones, maintaining relative privacy. Both adolescents and adults are influenced by messages that drug use will help with mood, coping with stress, and improving performance.

IV. Micro-level Influences

1. Parenting and Family Functioning

The home environment is the single most profound influence on early child development in multiple domains of functioning (NRC & IOM 2000), and the effects of poor parenting in particular are longstanding (Springer et al., 2007). Intervening at the level of parental conditions that directly impact parenting behaviour is crucial in order to improve child outcomes. As such, the positive ways in which parents interact with their children can have a huge impact on children’s overall development. The social and emotional regulatory skills children need to resist substance use and other problem behaviours have to be instilled very early in life, if not in infancy. Parenting and family continue to be important through adolescence when youth expect more autonomy and have more opportunities for risky behaviours. Consistent research shows that adolescent brains have still not matured to the point that adolescents can restrain their most risky impulses and often express poor decision making ability even under normative circumstances (Ernst, 2008). The onset of drug use during adolescence, therefore, is common and has even more detrimental effects than during adulthood.

It is crucial that prevention efforts focus on parenting techniques that foster healthy development; e.g., appropriate discipline practices, warmth, affection, positive attention, secure attachment, involvement, limit setting, supervision and monitoring, and positive reinforcements for acceptable behaviours. Conversely, parenting behaviours that are harsh, restrictive, emotionally triggered, inconsistent, hostile, and/or high in conflict often lead to negative behavioural outcomes in children. And abuse, neglect and domestic violence, in particular, threaten every aspect of children’s development. Children exposed to high rates of these types of stress and conflict show more behavioural and emotional maladjustment, especially aggression, than children in families experiencing lower levels of conflict; they are two to four times more likely to have high levels of mental and physical health issues compared to national norms (Herrenkohl et al., 2012). And aggression has been closely linked with multiple problems in adolescence, including delinquency, early onset and escalation of drug use and risky sexual behaviours particularly among boys (see above). On the other hand, although less aggressive generally, girls’ tend to be more sensitive to family-centred and relational problems (Maccoby 1998; Pepler and Craig 1999) that could heightened susceptibility to stress and mental health issues which, in turn, may contribute to the early onset of drug abuse and other risk behaviours. Additionally, structural and functional characteristics of the family (e.g., cohesion, supportive, communicative) are equally as influential in a child’s development of resiliency skills. Preventing poor outcomes (e.g., drug abuse) in children exposed to these conditions often involves training in parent skills, relieving the stressors and mental health problems that caregivers with poor skills often exhibit, and trauma prevention and treatment strategies (Shay & Knutson, 2008).

2. Schools and Educational Opportunities

Attendance in school, at the very basic level, is protective against poor outcomes on multiple levels. Not all countries have a sufficient number of schools and not all parents can afford to send their children to school. Policies to ensure that all children are able to attend school can exert a preventive effect; an opportunity that has a particularly powerful protective effect for children with self-regulatory problems (Henry et al., 1999). Over and above that basic fact is that effective schools can ensure that most young people develop the cognitive, social, and emotional regulation skills that they need to succeed in life and avoid risk behaviours. The quality of the school environment, its teachers, curriculum, and students’ social networks in school are major socializing influences on student learning and behaviour. Unqualified teachers, ineffective teaching practices, and low-quality curriculum lead to academic failure (Ball, 2000; Darling-Hamond, 2000; Shulman, 1987) which will prevent young people from succeeding in a variety of social domains in childhood and later in adulthood. Lack of a good education leads to lower levels of cognitive functioning, poor social skills, high levels of stress, and perceptions of inadequacy and failure, each of which is associated with risk for drug abuse and other poor health outcomes (Keating & Hertzman, 1999 ). And eventually poor quality education results in an inability to compete in the workforce and obtain jobs that pay a good wage for doing satisfying work (Jimmerson, 1999) which is also associated with substance abuse.

On another level, a lack of supports within the schools for children/adolescents with learning disabilities and mental health concerns often mean that disadvantaged or special needs youth fail to receive the attention they require to overcome their challenges. In the absence of adequate educational support and/or targeted school programs, learning disabilities and mental health problems increase risk for drug abuse (Mason, 2010). Teaching students the academic and social skills necessary to succeed in school and in life also requires that schools address social and emotional concerns that could interfere with learning and classroom management (Adelman & Taylor, 1999).Lack of parent involvement in their children’s education is also a risk factor for drug abuse; parental involvement is crucial for student learning as well as self-regulation of behaviour and emotions (Rutter & Maughan, 2002; Slavin, 1984; 1994). On the other hand, a child’s attachment to school is a component of resilience, suggesting that effective and responsive teachers, an evidence-based curriculum, classroom reinforcements, positive school culture, opportunities for school participation, and maintaining school building structures may play an important role in drug abuse prevention.

3. Peer influences

As children move through elementary school, peer relationships become increasingly influential in the development of social skill sets, attitudes, exposures to new experiences, and learning “normative” behaviours, whatever those may be in their predominant peer groups. For example, exposure to violence, drug use and crime can be an extension of peer influence. The peer environment plays a particularly profound role in early adolescent development of social skills that layers onto what caregivers had provided but can supersede parental influences on teen behaviour(e.g., Dishion, Bullock, & Granic, 2002; Dishion, Poulin & Medici Skaggs, 2000). This effect is heightened when time is spent together primarily in unstructured contexts such as on the street or in parks. Similarly, the use of social networking technology removes the family and parents from the direct interactions children and teens would otherwise have that provide an opportunity to be influential in their lives. On these websites and through social networking venues, extensive messaging is often exchanged that is favourable to substance abuse; the extent of access to these sites has been associated with alcohol and other drug use (Moreno et al., 2010). On the other hand, parental monitoring rules and positive family relationships and modelling have potential to reduce negative peer influences that occur directly or through social networks, including the reducing proneness to substance use (Kiesner et al., 2010). And most recently, social networking technologies are being used to exert positive effects by providing services and supportive messages to children who need them most (e.g., homeless, delinquent, or stressed) (Rice et al., 2011). The implications of these findings for prevention are obvious; parents’ use of rules to monitor adolescents’ activities and encouraging healthy outside-the-home activities are critical to reducing peer influence.

This period of development is characterized by important changes, including a new and growing emphasis on social interactions, autonomy, and opportunities for risky situations and behaviours. In tandem, there is tremendous growth in brain plasticity concluding in the mid to late 20s with connections being made between neural systems responsible for goal setting, impulse control, emotion regulation, and decision making. This combination of biological and social developments is, in a way, unfortunate in that it presents the adolescent with potentially dangerous opportunities to engage in risk taking behaviours with greater potential for negative consequences, but with reduced capacity to resist these impulses. And the presence of peers further undermines these cognitive processes (Chen et al., 2011). Thus, on the one hand, adolescence is a period of heightened vulnerability to risky behaviours, even from a normative perspective. And on the other hand, this amplified period of development provides for a unique window of opportunity to effectively intervene and have a lasting positive impact on future behaviours and successes. It is this period of life that drug use onset and subsequent escalation is most common; thus interventions that focus on peers no later than early adolescence have potential to significantly reduce its development.

There is a growing body of evidence that girls may be differentially influenced by peers than boys. For example, they are more than to initiate drug use if their social network of friends and partners are using or introduces drugs or alcohol to them (Frajzyngier et al.,2007). Also, concerns about peer approval, depression and body image – all interrelated – play a role in susceptibility to drug use in girls (Schinke et al., 2008). Also, the early onset of puberty in girls plays a role in their propensity to engage in substance abuse and other risky behaviours. Girls may be attracted to the status of older, deviant males, and early-maturing girls are more likely to date at younger ages and to affiliate with older male peers who are inclined toward risk taking activities and who will involve these girls in their antisocial behaviour (Magnusson et al., 1990; Weichold et al., 2003). The onset of puberty is also associated with increased conflict among parents and teens around issues such as dating, selection of friends, and shifting behavioural expectations (Paikoff & Brooks-Gunn, 1991; Ge et al., 1996; Kim & Smith, 1998; Sagrestano et al., 2999). Haynie(2003) found that earlier pubertal onset was associated with higher levels of conduct problems, and that conflict with parents, exposure to peer deviance, and involvement in romantic relationships mediated the link between puberty and high risk outcomes. Furthermore, residing in a disadvantaged neighbourhood appears to further exacerbate the effect of peers for both sexes (Ge et al., 2002; Obeidallah et al., 2004). Such contextual differences may provide varying modelling, exposure, and reinforcement of risky activities. Thus, contextual variables such as school, parenting, and neighbourhood context may accentuate the relations between pubertal timing, peer influences, parenting and family, and problem outcomes.

4. Personal Characteristics

Fundamental characteristics of the individuals who are exposed to or experience the conditions described above are of great importance in this process of influences and outcomes. First, personality, temperament, intellect, neurobiological integrity, and the development of stress and coping responses will help to determine what an individual’s response may be to the prevailing influences, contributing to eventual outcomes. Thus, there is an interaction effect. Second, knowledge regarding these characteristics in combination with the susceptibility and protective factors we outlined determine what interventions are most suitable and have the greatest potential to benefit any given individual or subgroup. And third, we can expect to see favourable change in these characteristics to some extent if the intervention is positively influencing its targets. Below we describe those characteristics that have been consistently found to be associated with risk for drug abuse and can be considered etiological conditions.

5. Mental Health and Personality Traits

Internalizing (e.g., PTSD, depression, and anxiety disorders) and externalizing (e.g., Conduct Disorder (CD), Attention Deficit Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD), and Antisocial Personality Disorder (ASPD)) mental health disorders are strongly and consistently related to risk for drug abuse (Elkins et al., 2007; Tarter et al., 1999; Sinha, 2001; Kandel et al., 1997; Wills et al., 1995). Individuals with these disorders are more likely to abuse drugs and at an earlier age than those without such disorders (De Bellis, 2002; Rowe et al., 2004). Adolescents and adults are also at heightened risk for continued drug use to ameliorate their psychiatric symptoms (Brown & Wolfe, 1994; Keane & Wolfe, 1990; Saladin et al., 1995) and for being resistant to treatment (Tomlinson et al., 2004). The presence of these disorders may exacerbate stress reactivity problems and exert a different effect on developmental pathways to drug abuse. For instance, individuals with internalizing disorders tend to have higher levels of arousal in brain systems responsible for stress responses which may lead to a tendency to self-medicate the anxiety and depression this process produces. For those with externalizing disorders, there tends to be a low level of arousal in these systems, which has been associated with a relative lack of regard for consequences and a need for additional stimulation. In individuals with mental health problems, daily social challenges may eventually generate stress responses—becoming sensitive to more minor events occurs as an increasing number of tasks become more difficult to master and/or produce anxiety and decrement in self-efficacy. Moreover, the likelihood of effectively meeting social task challenges is diminished as doing so requires intact neurocognitive and emotional functions (see below), which are often compromised in psychiatric disorders (Kovacs &Goldston, 1991).

A difficult temperament and particular personality characteristics have also been consistently shown to be related to heightened risk for substance misuse (Moffitt, 1993; Moffitt et al., 1993). Individuals who exhibit a high level of impulsivity, aggressiveness, sensation or novelty-seeking, negative affect, impaired judgment, high activity levels, risk taking tendencies, lack of regard for negative consequences, lack of pain avoidance responses and abnormal levels of arousal in response to stress have all been strongly associated with risk for substance abuse (see Kreek et al., 2005). While manifestations differ depending upon age and maturity level, these traits tend to be fairly persistent throughout childhood and adolescence. Of great importance in terms of prevention, normal adolescence is characterized by greater reward anticipation, sensitivity, and novelty or sensation seeking—particularly social rewards (e.g., peer regard, gains in social status). It follows that adolescence is the period during which drug use onset is most common. And those adolescents who exhibit an especially high level (relative to the general population of adolescents) of any combination of the traits listed above are at heightened risk. Although temperament and personality are considered to be relatively stable, innate characteristics across the lifespan, their expression can be altered or redirected through psychosocial means to decrease liability for substance abuse. Thus, it is critical that prevention programs are devised to specifically redirect this developmental track. Prevention strategies will be most effective if they focus on these underlying traits, in conjunction with particular forms of environmental supports as indicated by the needs of targeted individuals, their families, and their neighbourhoods.

6. Neurological Development

Numerous studies show that interactions between certain neurological traits and environmental conditions have potential to influence the development of a sequence of behaviours that bias the individual toward drug abuse outcomes (e.g., Krueger et al., 2002). One pathway to drug abuse is believed to originate in a deviation in neurological development, expressed as cognitive and emotional regulatory deficits which are thought to underlie problem behaviours that often precede drug abuse. Problems with ECFs and the inability to regulate and accurately perceive emotions are a focus given considerable evidence that deficits and delays in these areas during childhood and adolescence are linked with the early onset of conduct problems (Hill, 2002; Lahey et al., 1995; Lynam& Henry, 2001), delinquency (Brickman et al., 1984; Lynam& Henry, 2001; Moffitt & Henry, 1989a,b; Spellacy, 1977; White et al., 1994), and drug abuse (Deckel&Hesselbrock, 1996; Giancola et al., 1996, 1998; Giancola & Tarter, 1999). And even in younger children, deficits or delays in the building blocks for ECFs and emotional regulation have been repeatedly associated with these behaviours as well (Cole et al., 1993; Speltz et al., 1999). Compounding these neurological disadvantages are detrimental environmental conditions, such as stress, adversity, maltreatment, poor nutrition, and other negative experiences that compromise brain development and can cause measurable damage to these functions.

Poor self-regulation of behaviour as a result of such deficits and delays vary as a function of developmental stage; for young children, they may be manifested as poor school readiness and delayed academic achievement, aggressiveness, conduct problems, negative affect, insensitivity to consequences, sensation-seeking, impulsivity, and poor decision making and problem-solving ability. Over time, these behaviours increase risk for early drug use and conduct disorder in adolescence and risk for drug abuse and addiction by young adulthood. Revitalizing impoverished neighbourhoods, supporting families, and providing tailored evidence-based solutions for children have long‐standing positive effects on brain development and functioning that, in turn, are likely to reduce problem behaviours such as drug abuse.

7. Stress Exposures and Reactivity

Repeated exposure to stressors, such as poverty, child abuse or divorce, compromise the development of neural systems that underlie social, behavioural, cognitive, and emotional functioning in profound ways(Davidson, 1994; de Haan et al., 1994). Stress exposures can further disrupt hormonal systems (e.g., cortisol) that regulate these functions (Huether, 1998); chronically elevated levels of stress hormones can impair learning, memory, decision making, and other functions that normally support self-regulation of behaviour (Nelson & Carver, 1998; Spools, 1996). Studies also show effects of stress on physiological responses such as heart rate and skin conductance which, when disrupted, are associated with poor behavioural and emotional regulation and cognitive and coping skill deficits (Gunner & Nelson, 1994; Sinha et al., 1998; Sabot, 1993). These physiological and behavioural stress responses activate the same neural systems underlying the positive reinforcing effect of drugs (Kalians& Duffy, 1989; Piazza & Le Moil, 1996; Kobo& Le Moil, 1997), potentially reinforcing drug-taking behaviours. As a result, when an individual experiences a great deal of stress or adversity, these neurologically-based processes are affected and lead to poor ability to cope with stress, both behaviourally and physiologically. In these cases, there is often impaired coordination between social, cognitive, psychological, and emotional responses; such impairments have been found to increase drug-seeking behaviour (Robinson &Berridge, 1993, 2000). Thus, drug taking may occur as a maladaptive behavioural and physiological response to stressful experiences (Shiffman, 1982).

The life course pathways of individuals who initiate and escalate drug use are also influenced by the extent to which they experience stress (Cottler et al., 2001; De Bellis, 2002; Giancoia et al., 2000; McFarlane, 2000). Studies show that increase in marijuana, alcohol, and tobacco use is preceded by high stress levels, poor social support, and avoidant coping efforts (Kaplan et al., 1986; Newcomb &Bentler, 1988; Wills et al., 1996; Cronkite & Moos, 1984; Pohorecky, 1991). Of note, girls appear to experience not only a greater number of negative life events during adolescence than boys, but also are more likely to experience interpersonal stressors and be adversely affected by them (Ge, Conger, Lorenz, and Simons 1994). For example, PTSD often antedates drug abuse in girls but occurs more often after drug abuse in boys, perhaps suggesting the females self-medicate their symptoms, whereas males may be more likely to experience a trauma due to the risk situations associated with drug abuse (Deykin&Buka, 1997). Females are also at increased risk for substance abuse when exposed to the stressors of family violence and alcoholism (Chermack, Stoltenberg, Fuller, and Blow, 2000). Thus, sex differences should be taken into account in identifying factors that contribute to drug abuse and in the development of a prevention or treatment plan.

Theories of addiction propose that motivation to improve mood after exposure to acute and chronic stressors is a main factor in drug use and relapse (Baker et al., 2004; Conger, 1956; Sher&Levenson, 1982; Khantzian, 1985). Increased sensitivity to consequences or an adaptive coping style may provide insulation from a poor outcome, perhaps preventing initiation or escalation of drug use (Cooper et al., 1988; Wills et al., 2002). On the other hand, stress exposures may be more strongly related to drug use in the presence of a psychiatric disorder (Hahsesy et al., 2002) and poor parenting, family dysfunction, and adverse neighbourhood characteristics may exacerbate negative behavioural outcomes such as drug abuse (Field et al., 1998; Grant et al., 2000; Patterson et al., 1992; Wills & Cleary, 1996). In sum, the changes in biological and psychological processes induced by stress are strongly related to early onset of drug use (Sinha, 2001) and may predict the escalation of drug use, relapse, and intractability.

V. Preventive Implications of Etiological Research

There is considerable evidence that the myriad of behavioural problems, often characterized by poor self-regulation (e.g., drug abuse, violence, traumatic stress and mood disorders), are preventable; based on that knowledge, several evidence-based programs (EBPs) have emerged from various disciplinary perspectives. EBPs that focus on socio-emotional and cognitive functioning, development of which is particularly vulnerable to adverse psychosocial and environmental influences, may redirect and possibly normalize specific dimensions of a child’s developmental pathway in behavioural, emotional, mental, and physical (e.g., brain function and fitness) domains. The effects of appropriately targeted interventions may be particularly remarkable for children who are disadvantaged by poverty and other social ills. Research that integrates multiple disciplines to better understand influences and outcomes related to drug abuse have directed us toward solutions for these problems that target underlying mechanisms and not solely drug abuse, per se. In other words, it is vital that we address the factors that lead eventually to drug abuse prior to its development, the key principle behind prevention science. Aggressive behaviour, mood disturbance, poor stress management and coping skills, impulsivity, poor decision making, and other manifestations of a lack of self-regulation are all targets for prevention of drug abuse.

The integrity of the way in which the brain develops in children is a prerequisite for adaptive responses to socio-environmental challenges and thus, to favourable responses to intervention. Thanks to vast brain plasticity throughout childhood there is a great deal of variability in the way children develop in response to environmental inputs. This scenario throughout the early childhood and adolescence provides an optimal window of opportunity for intervention. When neurodevelopment is on course or shows a trend toward improvement, overall intervention outcomes are likely to be favourable. In contrast, existing or emergent neurodevelopmental deficits or delays may compromise intervention effects, potentially explaining differential outcomes in response to even the most highly regarded and efficacious programs. A comprehensive evidence-based set of solutions(programs and policies) to prevent psychopathology and eventually drug abuse operates to enhance developmental indicators of brain function in multiple domains. This approach will, in turn, improve the ability to self-regulate behaviour and reduce risk for drug abuse.