RELATIONSHIP BETWEEN INSOMNIA SYMPTOMS AND SUICIDAL IDEATION: THE

MODERATING ROLES OF ADVERSE CHILDHOOD EXPERIENCES AND SEX

by

by © Keltie J. Pratt

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Abstract

Data on adverse childhood experiences (ACEs), insomnia, suicidal ideation, and sex was extracted from 2012 cycle of the Canadian Community Health Survey-Mental health (CCHS-MH). The CCHS-MH is a national, cross-sectional survey that collected data to examine the links between mental health and social, demographic, geographic, and economic variables of Canadians. Participants were 2,687 respondents across Canada with complete data on questions pertaining to adverse childhood experiences, insomnia symptoms, and past 12-month suicidal ideation. Results indicated that 78% of the sample endorsed experiencing suicidal ideation within the past 12-months and 29% of the sample indicated currently experiencing insomnia symptoms (i.e., difficulty falling asleep or staying asleep most of the time/all of the time). Regarding ACEs, 29.7% of the sample endorsed never experiencing any type of childhood adversity while 50.7% endorsed experiencing between 1 and 3 adversities, and 19.6% endorsed experiencing 4 or more types of adversity. A single moderator analysis was conducted using PROCESS to examine whether the relationship between insomnia symptoms and past 12-month suicidal ideation is moderated by the number of types of ACEs experienced. The overall model was significant suggesting that individuals who experience more types of adversity will experience a stronger effect of insomnia symptoms on suicidal ideation. A moderated moderation analysis was also conducted. The overall model was significant; however, the three-way interaction was not significant, suggesting biological sex does not moderate the relationship between ACEs, insomnia symptoms, and suicidal ideation. These findings suggest that ACEs should be considered clinically when individuals present with challenges related to insomnia and that multi-modal treatment of insomnia may be beneficial at reducing the impact of ACEs and likelihood of suicide related behaviours.

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Contents

List of Tables

Chapter 1:

Insomnia, Suicide, and Adverse Childhood Experiences: An Overview

Overview

Sleep difficulties such as insomnia have been linked to several negative health and wellbeing outcomes. In particular, there is a strong association between insomnia and risk for suicide related behaviours such as suicidal ideation, suicide attempts, and completed suicide (Bishop et al., 2020; Perlis et al., 2016b; Pigeon et al., 2012). The connection between insomnia and suicide related behaviours is concerning because these are not uncommon challenges facing Canadians. For instance, 13% of the Canadian population suffers from a diagnosable insomnia disorder and 1 in 2 Canadian adults experiences insomnia related symptoms, such as trouble falling asleep or staying asleep (Morin et al., 2011; Public Health Agency of Canada, 2019). Suicide related behaviours also affect a significant proportion of the population. In Canada, suicide is the 12th leading cause of death, accounting for the death of approximately 4,000 Canadians each year (Statistics Canada, 2022). Further understanding of how insomnia and suicide related behaviours relate to each other is crucial for the development and implementation of effective treatment for those who experience these challenges.

Although the relationship between insomnia and suicide has been well established, there may be additional factors that influence the strength of this relationship. For example, experiencing adversity in childhood has been linked to several negative health, psychological, and emotional difficulties in adulthood (Felitti et al., 1998; Hughes et al., 2017; Petruccelli et al., 2019). These experiences are referred to as Adverse Childhood Experiences (ACEs) and can include experiencing physical, sexual, or emotional abuse; physical or emotional neglect; household challenges such as witnessing a parent or caregiver use alcohol or substances, or experience mental health challenges; exposure to intimate partner violence; parental separation or divorce; or criminal behaviour resulting in incarceration (Felitti et al., 1998). ACEs are

independently related to both insomnia and insomnia symptoms (Brown et al., 2022), as well as suicide related behaviours in adulthood (Choi et al., 2017; Dube et al., 2001; Thompson et al., 2019). Given the relationship between both ACEs and insomnia, and ACEs and suicide, it is possible that exposure to ACEs may impact the strength of the relationship between experiencing insomnia and increased risk of suicide related behaviours in adulthood.

As such, the purpose of this study is to examine whether exposure to adverse childhood experiences moderates the relationship between insomnia and risk of past 12-month suicidal ideation, and if so, to determine if this relationship is further moderated by sex. This chapter will provide an overview of the nuance of sleep disturbances, sleep theory, and what accounts for insomnia as a diagnosable condition versus insomnia symptoms, followed by a discussion of the well-established consequences that can result from having trouble with sleep. An overview of suicide, well-established risk factors for suicide, and theory as to why people engage in suicide and suicide related behaviour will follow. Finally, review of the ACEs literature, the consequences of experiencing childhood adversity, and the connection between ACEs and sleep as well as ACEs and suicide risk will also be presented. A brief exploration of how these three factors influence each other will be provided to outline the empirical and clinical importance of further understanding the relationship amongst these factors.

Insomnia and Sleep Disturbance

Insomnia is one of the most common sleep disorders with prevalence rates ranging from 6-48% depending on how insomnia is defined (i.e., insomnia symptoms, with or without daytime consequences, dissatisfaction with sleep, and insomnia disorder; Morin et al., 2006; Ohayon, 2002). In Canada, insomnia disorder affects approximately 13% of the population (Morin et al., 2011) and 1 in 2 adults have nighttime insomnia symptoms (e.g., trouble falling asleep or staying

3

asleep; Public Health Agency of Canada, 2019). Insomnia is also approximately 1.5 times more common in women than men (Suh et al., 2018). These differences have been attributed to a complex compilation of biological (e.g., hormonal, circadian typology, lower homeostatic drive), psychological (e.g., personality traits, vulnerability to stressful life events) and social factors (e.g., lower education, marital status) across the lifespan (Suh et al., 2018).

In the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition Text Revision (*DSM-5-TR*) insomnia is characterized as a predominant complaint of dissatisfaction with sleep quantity or quality associated with difficulty initiating and/or maintaining sleep and/or waking too early (APA, 2022). To meet criteria for a diagnosis of insomnia disorder, the individual must experience this disturbance at least three nights per week for a minimum of three months despite having adequate opportunity for sleep and must experience clinically significant impairment in one or more important areas of functioning (e.g., work, school, leisure). Further, the insomnia cannot be attributable to the effects of a substance such as prescription medication or recreational drugs and is not better explained by or occur exclusively during the course of another sleep-wake disorder (e.g., narcolepsy, parasomnias). Insomnia can be a symptom of other psychiatric disorders such as major depressive disorder, generalized anxiety disorder, or posttraumatic stress disorder. It is recommended that insomnia disorder be diagnosed concurrently should all necessary diagnostic criteria be met.

An important aspect of the diagnostic process for insomnia involves characterization of the individual's typical nightly sleep routine. This involves understanding the time they typically go to bed, how long it generally takes to fall asleep (sleep onset latency [SOL]), the frequency and duration of nighttime awakenings (wake after sleep onset [WASO]), their time out of bed, and their sleep efficiency (SE) as calculated by dividing total amount of sleep time by the total

amount of time spent in bed with the intent to sleep (Morin, 2006). While not outlined by the

DSM-5-TR, it is generally accepted that insomnia can be defined by a SOL and/or WASO of 30

minutes or longer, and a sleep efficiency rating below 85% (Morin, 2006). Beyond this

characterization, it can also be important to understand potential predisposing (e.g., family

history of insomnia) and precipitating (e.g., life stressor) factors, premorbid sleep function, and a

timeline of symptom onset.

In contrast to primary insomnia, "insomnia symptoms" refer not to a specific disorder but

to the experience of having difficulty initiating or maintaining sleep, or getting non-refreshing

sleep (Motivala, 2011). The prevalence of experiencing insomnia symptoms is high. Population

based estimates suggest that approximately one-third of adults report experiencing insomnia

symptoms but do not meet full criteria for an insomnia disorder diagnosis (APA, 2013). The

distinction between insomnia and insomnia symptoms is important as the use of each definition

typically implies different approaches to the measurement of sleep. For example, the use of

"insomnia symptoms" rather than "insomnia" may suggest that a full-scale evaluation of

insomnia criteria has not been conducted. For the purposes of this dissertation, evaluation of

participants' sleep disturbance will pertain to insomnia symptoms, specifically, how often the

participant has trouble going to sleep or staying asleep.

Insomnia Theory

For several decades, researchers have worked to establish theories of insomnia across

neurobiological, cognitive, behavioural, and emotional domains (Riemann et al., 2022). While

there is still no universally accepted model of insomnia (Levenson et al., 2014) several models

have been more readily adapted as explanations to why insomnia occurs.

One of the most commonly cited theoretical approaches to insomnia is the 3P model of insomnia (Spielman et al., 1987). The 3Ps refer to: 1) Predisposing factors which stem from the areas of (epi-)genetics and early life stressors that influence individual differences in brain function and personality; 2) Precipitating factors which usually relate to significant (and frequently stressful) life events that facilitate the onset of acute insomnia; and 3) Perpetuating factors which are often discussed in the context of physiological, cognitive, behavioural and/or emotional hyperarousal and that become out of balance with activity in sleep-inducing systems (Riemann et al., 2022). Sleep restriction therapy is proposed as the treatment method of choice within this framework, utilizing the restriction of time available for sleep, followed by the extension of time in bed as contingent upon improved sleep efficiency (Spielman et al., 1987). Currently, it is common for clinicians to utilize the Stimulus Control Model of insomnia in addition to the 3P model. The stimulus control model is based on Bootzin's (1972) assumption that insomnia may be the outcome of maladaptive sleep habits (e.g., staying in bed while awake). Moreover, that in insomnia, the original connection between the bed (stimulus) and the behaviour of sleep (response) has been lost or "unlearned". Therefore, in order to treat insomnia, individuals are required to engage in stimulus control (i.e., the failure to establish discriminative stimuli for sleep or the presence of stimuli that are incompatible with sleep; Espie, 2023) in order to re-learn the bed-sleep connection (Bootzin et al., 1991).

Another perspective of insomnia etiology was more recently proposed by Lundh and Broman (2000). They suggest that two kinds of psychological processes, sleep-interfering and sleep-interpreting, are involved in the development and maintenance of insomnia. Lundh and Broman (2002) argue that psychological vulnerability factors such as a high level of arousal and arousability, a tendency to worry, or emotional conflicts may predispose an individual to sleep-

interfering processes. Thereafter, an individual may engage in dysfunctional sleep-interpreting processes like sleep related beliefs and attitudes. Ultimately, within this model, individual psychology and cognitive stance influences the perception of insomnia and the complaint of insomnia and therefore the most appropriate method of treatment of insomnia will vary by individual presentation of the two psychological processes.

The Cognitive Model of Insomnia was proposed by Harvey (2002) which postulated that individuals who suffer from insomnia have a tendency to be overly worried about their sleep and the subsequent daytime impacts of poor sleep. This increase in negative cognitions around sleep initiates additional processes such as selective attention and monitoring, misperceptions about sleep and daytime deficits, dysfunctional beliefs, and counterproductive actions to prevent poor sleep from occurring and/or the consequences of poor sleep (Espie, 2023; Harvey 2002). Unfortunately, the likely consequences of engaging in such cascading cognitive events is that an individual can experience real sleep deficits, excessive and increasing catastrophic worry, and physiological arousal that impacts sleep onset and daytime functioning (Harvey, 2002). Within the Cognitive Model, Harvey argues that more iterations of these cognitive events increase the likelihood that a genuine deficit in sleep will develop.

According to the hyperarousal model, insomnia is characterized by increased arousal throughout the day and night in the physiological, cognitive, and cortical domains (Bonnet & Arand, 1997). Physiological arousal can include increased body temperature (Lack et al., 2008), increased heart rate (Bonnet & Arand, 1998), and increased cortisol levels (Dressle et al., 2022). Cognitive arousal can present as rumination and worry related to sleep and potential daytime consequences of poor sleep (Harvey, 2002; Riemann et al., 2010; Wicklow & Espie, 2000), as well as dysfunctional beliefs about sleep (Carney et al., 2010; Hertenstein et al., 2015), and meta-

cognitions about the functions and consequences of worry (Palagini et al., 2016; Waine et al., 2009). Cortical hyperarousal is demonstrated in increased fast frequencies of the sleep electroencephalography (EEG; Perlis et al., 2001; Reimann et al., 2010). Although many studies have indicated that hyperarousal in these domains is likely to play a role in the development and maintenance of insomnia, there remains a dearth of knowledge pertaining to the sources of hyperarousal and the interaction of hyperarousal domains (Dressle et al., 2023)

Most recently, Espie (2023) has articulated what they refer to as the Psychobiological Inhibition Model (PIM) of Insomnia. The goal of this model, as indicated by Espie, is to provide a "unifying conceptual theory capable of embracing multiple contributory pathways to the development and maintenance of insomnia, as well as offering a practical framework for making sense of the insomnia problem that a patient presents" (Espie, 2023, p. 2). The PIM establishes a framework that both accounts post hoc for insomnia and can create hypothesis to a priori test how insomnia might develop in individuals who sleep well (Espie, 2023). More specifically, the PIM puts forth that the four psychological processes that can be implicated in good sleep (i.e., adaptive conditioning; psychological and cognitive de-arousal, behavioural consolidation, and emotional neutrality) can also come together to inhibit the expression of normal good sleep (i.e., maladaptive conditioning; failure to de-arouse physiologically and cognitively, weak behavioural zeitgebers, and emotional intensity), and instead promote insomnia disorder. Espie (2023) stresses that Cognitive Behavioral Therapy for insomnia (CBT-I), the current best-practice clinical treatment approach for insomnia, has multiple active treatments (e.g., sleep restriction, stimulus control, sleep hygiene, relaxation) and therefore should be viewed not as *a* treatment but a treatment *approach* that emphasizes working collaboratively with patients to identify the

individuality of their insomnia presentation, and to derive a treatment formulation that enables the selection of optimal interventions.

Each of the aforementioned models contributes new information to the understanding of how insomnia develops. While there may not yet be a consensus as to which model is the most accurate, continued exploration into the understanding of how and why insomnia occurs will likely contribute to better methods for prevention, identification, and intervention.

Consequences of Poor Sleep

The importance of sleep for maintaining an individuals' physical and mental health is well established and the consequences of experiencing poor sleep are significant (Colten & Altevogt, 2006). Over the past decade, many researchers have sought to explore various physical health problems and their association with experiencing insomnia and insomnia symptoms. Individuals with insomnia and insomnia symptoms have been found to be at a higher risk for physical health problems such as hypertension (Vgontzas et al., 2009), coronary heart disease (Laugsand et al., 2011), type 2 diabetes (Hein et al., 2018), poorer immune functioning (Savard et al., 2003), alterations in appetite-regulating hormones (Motivala et al., 2009) and subsequent development of metabolic syndrome (Troxel et al., 2010), increase in nocturnal systolic blood pressure (Lanfranchi et al., 2009), migraines and tension headaches (Odegard et al., 2011), and acute myocardial infarction (Laugsand et al., 2011). Moreover, insomnia is also associated with cardiovascular disease, the global leading cause of death (WHO, 2023). In a systematic review and meta-analysis of 13 prospective cohort studies, Sofi and colleagues (2014) investigated the association between insomnia (i.e., difficulty initiating or maintaining sleep or presence of restless, disturbed nights) and risk of developing and/or dying from cardiovascular disease in a sample of individuals who were free from cardiovascular disease at baseline. This analysis

included 122,501 individuals who were followed for a time ranging between three to 20 years. During this time, 6332 cardiovascular incidents were reported. Sofi and colleagues (2014) found that those suffering from insomnia had a 45%-increased risk of morbidity and/or mortality from cardiovascular disease compared to those who slept well (RR 1.45, 95% CI 1.29-1.62). The impact of insomnia also extends into older adulthood. Insomnia has recently been found to be independently associated with frailty in the older adult population, a condition which can increase individual vulnerability to adverse outcomes (Wen et al., 2023). In particular, Wen and colleagues (2023) conducted a meta-analysis of 12 observational studies including 16, 895 older adults (60-years-old or above). Through subgroup analyses Wen and colleagues (2023) found consistent associations between insomnia symptoms and frailty, including difficulty falling asleep (OR: 1.45), maintaining sleep (OR: 1.23), waking early (OR: 1.21), and experiencing non-restorative sleep (OR: 1.84). Importantly, insomnia is not only a risk factor for the development of physical health conditions, but it is also a common comorbidity with medical conditions such as diabetes, chronic obstructive pulmonary disease, arthritis, fibromyalgia, and other chronic pain conditions (APA, 2013). This relationship has been identified as bidirectional such that insomnia increases the risk of medical conditions and medical conditions increase the risk of insomnia (APA, 2013).

Similarly to physical health, researchers have also identified a bi-directional link between sleep disturbance, in particular insomnia, and mental health symptoms and disorders indicating that insomnia is a symptom of, a risk factor for, and a comorbidity of various mental health conditions (Biddle et al., 2019; Palagini et al., 2022). For example, in a cross-sectional and retrospective study comparing depression and anxiety in people with insomnia versus those without insomnia, Taylor and colleagues (2005) found that individuals with insomnia are 10

times more likely to experience clinically significant levels of depression and 17 times more likely to experience clinically significant levels of anxiety compared to individuals without insomnia (Taylor et al., 2005). Furthermore, Baglioni and colleagues (2011) conducted a meta-analysis summarizing 21 longitudinal epidemiological studies that include over 140,000 individuals. Results indicated that non-depressed individuals with insomnia were two times more likely to develop depression compared to individuals without insomnia. There is also evidence for insomnia to be associated with other mental health conditions. In a systematic review and meta-analysis exploring 13 longitudinal studies with follow-up periods of at least 12-months, Hertenstein and colleagues (2019) investigated insomnia as a predictor of the onset of depression, anxiety, alcohol abuse, and psychosis. Insomnia was found to be a significant predictor for depression, anxiety, and alcohol abuse and a potential predictor for psychosis (Hertenstein et al., 2019). Harvey and colleagues (2003) also indicate a link between sleep onset and maintenance difficulties and post-traumatic stress disorder. Given the substantial impact mental health challenges can have on overall wellbeing, it is unsurprising that chronic insomnia (i.e., insomnia lasting longer than three months) has also been associated with reduced quality of life (Morin et al., 2015) and even risk for suicide and related behaviours (Pigeon et al., 2012).

In addition to the direct consequences of poor sleep described above, there are also substantial indirect consequences for the individual and society more generally. For example, in a study conducted in Quebec, Canada, Daley and colleagues (2009) surveyed 948 adults about their sleep, health, use of health-care services and products, accidents, work absences, and reduced productivity to gain a better understanding of the direct (e.g., consultations, products, and testing) and indirect (e.g., absenteeism, reduced productivity) costs of insomnia and insomnia symptoms. Participants in this study were classified in three groups: insomnia

syndrome ($n = 147$, 15.4%), insomnia symptoms ($n = 308$, 32.3%), and good sleepers ($n = 493$,

51.7%). Overall, the total annual cost of insomnia was estimated at $6.6 billion (CDN). When

broken down, this equates roughly to $191.2 million for the direct costs associated with

insomnia-motivated health-care consultations, $36.6 million in transportation to and from these

consultations, $16.5 million for prescription medications, and $1.8 million for over-the-counter

products. Indirect costs related to insomnia-related absenteeism were estimated at $970.6

million, and insomnia-related productivity losses were estimated at $5.0 billion. Moreover, the

average annual combined direct and indirect costs per-person were $5,010 for those with

insomnia syndrome and $1,431 for those with insomnia symptoms, which is in stark contrast to

the $421 in costs for those who obtain good quality sleep (Daley et al., 2009). When adjusted for

inflation, these values equate to over $9 billion for the total cost of insomnia, $261.1 million in

direct costs, $49.9 million in transportation costs, $22.5 million for prescription medications,

$2.4 million for over-the-counter products, $1.3 billion in costs related to absenteeism, and $6.8

billion in productivity losses. Inflation adjusted personal costs for combined direct and indirect

costs are $6,842 for those with insomnia, $1,954 for those with insomnia symptoms, and $575

for those with good quality sleep. Despite these staggering costs, insomnia has traditionally been

unrecognized and thusly gone untreated due to barriers to assessment and management (Morin &

Benca, 2012; Morin et al., 2015).

 Insomnia is one of the most common sleep disturbances that impacts a large proportion of

the population. Poor sleep overall, and insomnia more specifically, are detrimental to an

individual's physical, psychological, and financial standing. Moreover, on a global scale this is

an issue that is extremely costly. By continuing to push for a deeper understanding of how

insomnia impacts mental health, it may be possible to target sleep disturbance early before other mental health and lifestyle problems develop, such as risk for suicide.

Suicide

Suicide is a global phenomenon that continues to affect the world's population, regardless of age, sex, gender, or socioeconomic status. Globally, approximately 700,000 people die by suicide each year (World Health Organization [WHO], 2021). In 2016, suicide was the 18th leading cause of death, accounting for 1.4% of all deaths worldwide (WHO, 2019). In Canada, the statistics are similarly grim, with suicide being the 12th leading cause of death, accounting for approximately 4,000 Canadians dying by suicide each year (Statistics Canada, 2022). Despite these staggering figures, suicide prevention has not been adequately addressed at the global level (WHO, 2021). The World Health Organization identifies the insufficient response as stemming from three major areas: a lack of awareness of suicide as a major public health problem, the stigma associated with mental disorders and suicide generally, and poor-quality data, noting that as few as 80 of 194 Member States have "good quality" vital registration data that can be used directly to estimate suicide rates (WHO, 2021). Suicide is a complex issue that relies on the collaboration between multiple sectors of society including health, education, labour, agriculture, business, justice, law, defense, politics, and the media (WHO, 2021) and it has been suggested that due to its complexity, prevention efforts should begin in childhood to set the stage for future health and well-being (Ports et al., 2017).

Suicide Risk Factors

The term 'suicidal behaviour' typically encompasses the broader behaviour of suicidal ideation, suicide plan, suicide attempts, and suicide (Bursztein & Apter, 2009). To better understand suicidal behaviour and how best to establish preventative care, many researchers and

organizations have worked to identify associated risk factors. The World Health Organization (2021) indicates that individuals who experience conflict, disaster, violence, abuse, loss, or a sense of isolation are at risk for engaging in suicidal behaviour. Further, suicide rates are high amongst those from vulnerable populations who experience discrimination such as refugees and migrants, Indigenous Peoples, LGBTQ+ and intersex individuals, and prisoners (WHO, 2021). In high-income countries, links have also been established between suicide and mental disorders, such as depression and alcohol use disorder (WHO, 2021).

Suicidal ideation has also been identified as a predictor for both immediate and long-term suicide risk (Britton et al., 2012; Brown et al., 2000). Britton and colleagues (2012) conducted a retrospective study examining the warning signs for suicide observed in the final day(s) of life of Veterans receiving healthcare through the Veterans Health Administration (VHA) in the United States ($N = 381$). Through a review of the clinical notes located in patient charts within the VHA Computerized Patient Record System, Britton and colleagues (2012) found that patient statements associated with suicidal ideation (e.g., life not being worth living, suicide plans or intent) had the strongest association with suicide within a week of contact with the VHA. Similarly, Simon and colleagues (2013) retrospectively explored whether responses to the Patient Health Questionnaire-9 (PHQ-9) were associated with subsequent suicide attempts or suicide death using a sample of 84,418 outpatients aged 13 and older. Overall, after adjusting for age, sex, treatment history, and overall depression, severity of suicidal ideation remained strongly associated with subsequent suicide attempt and suicide death over the following year. While immediate risk of suicidal behaviour among those reporting frequent suicidal ideation was low, increased risk emerged over several days and persisted for several months (Simon et al., 2013). In a recent systematic review and meta-analysis of cohort and control studies ($N = 51$) Large and

colleagues (2021) examined the strength of associations of suicidal ideation (i.e., suicidal ideas/ideation/thoughts/threats) and suicidal behaviour (i.e., self-harm/suicide attempt) with later suicide. The studies reported on 7,415,193 individuals. Both suicidal ideation and suicidal behaviours were significantly associated with suicide, however, no significant difference was found in the strengths of association. This finding suggests that the impact of suicidal behaviours are not more strongly associated with suicide than suicidal ideation. As such, the authors urge clinicians to consider suicidal behaviour and suicidal ideation equally when considering suicide risk (Large et al., 2021).

To identify factors associated with repeated suicide attempts and subsequent completed suicide Beghi and colleagues (2013) conducted a literature review examining 76 studies (13 cohort studies, 45 case-control studies, 18 cross-sectional studies) from around the world. Overall, the researchers identified that the strongest association with a future suicide attempt is a history of previous suicide attempts. Additional factors associated with future suicide attempts include: being a victim of sexual abuse, poor global functioning, having a psychiatric disorder, undergoing psychiatric treatment, depression, anxiety, or alcohol use or dependence. When examining factors associated with completed suicide, they identified the strongest factors as being of older age, high suicide ideation, and a history of suicide attempt(s). Additional factors that were not as strong included living alone, male sex, and alcohol abuse.

Van Orden and colleagues (2010) compiled a comprehensive list of literature to date on risk factors for lethal suicide behaviour. The researchers grouped risk factors based on degree of support that has been found between each factor and lethal suicide behaviour. In doing so they identified six risk factors with the most empirical support (i.e., greater than 15 studies), including: family conflict, mental disorders, previous suicide attempt(s), physical illness, social

isolation, and unemployment. Risk factors with 6-15 studies demonstrating associations included family history of suicide, impulsivity, incarceration, hopelessness, seasonal variation, and serotonergic dysfunction. Agitation, sleep, childhood abuse, exposure to suicide, homelessness, combat exposure, [low] openness to experience, self-esteem, and shame had the fewest empirical articles supporting the association between the factor and suicide. However, Van Orden and colleagues (2010) note that these factors may be robust risk factors of lethal suicide behaviour but at that time they may not have been studied as frequently as the others.

More recently, Favril and colleagues (2022) conducted a systematic review and meta-analysis of 37 psychological autopsy case-control studies comparing adults in the general population who died by suicide with those who did not. Forty risk factors were identified within the domains of sociodemographics, family history, clinical, and adverse life events. Within the sociodemographic domain, the strongest risk factors were social isolation (OR = 4.0), unemployment (OR = 3.8), and low socioeconomic status (OR = 2.8). The strongest risk factors within the family history domain included a family history of mental disorder (OR = 5.2), suicide (OR = 3.7), and attempted suicide (OR = 2.8). Within the clinical domain, any mental disorder (OR = 13.1), a history of psychiatric treatment (OR = 10.5) self-harm (OR = 10.1) and a previous suicide attempt (OR 8.5) had the strongest associations. For adverse life events, relationship conflict (OR = 5.0), legal problems (OR = 4.8) and family-related conflict (OR = 4.5) had the strongest associations with suicide.

As there are clearly a substantial number of factors that can increase an individual's likelihood of engaging in suicidal behaviours, continued exploration into understanding the nuance of these relationships is crucial. This deeper understanding will allow for the most comprehensive preventative strategies to be created and implemented in the hope of decreasing

such behaviours. To set the framework for continued exploration into these relationships, it is first important to understand the underlying theories of suicide related behaviour.

Suicide Theory

Despite the staggering number of individuals affected by suicide, the study of suicide has faced significant challenges and few empirical theoretical models are available to provide insight and understanding into such behaviour (Klonsky et al., 2016; Prinstein, 2008). Potential reasons for these challenges and dearth of knowledge include a general lack of agreement on suicide related terminology, variability in measures of suicidality, as well as differences in the conceptualization of suicidal ideation as an experience in time versus an individual difference variable (Klonsky et al., 2016). Variability in cultural and religious perceptions of suicide can also impact reporting of suicide related behaviours (Klonsky et al., 2016). Moreover, individuals with suicidal behaviours are often excluded from clinical trials due to safety concerns (Rudd et al., 2001), and individuals who die by suicide are not available to take part in psychological assessments, which limit researchers in their choices of methodology (Klonsky et al., 2016; Van Orden et al., 2010). Van Orden and colleagues (2010) suggest that another potential reason for the limited understanding of causes and correlates of suicide may be the absence of comprehensive theory explaining suicide, as well as being able to identify future risk reliably and precisely. Moreover, they further identify that while there have been theories of suicide from biological, psychodynamic, cognitive-behavioural, and developmental/systems perspectives, the underlying challenge is that each of these theories is unable to fully encapsulate the diverse array of factors that are associated with lethal suicide behaviour (Van Orden et al., 2010). Moreover, it has been suggested that theories of suicide are lacking in their ability to distinguish between those who have suicidal ideation and those who attempt suicide (Klonsky et al., 2016). Recently,

however, the ideation-to-action framework, which encompasses several independent but related theories, has been offered to explain the transition from suicide ideation to suicide attempts (Klonsky et al., 2016) and provide some insight as to the factors involved in the development of suicidal related behaviours.

One such theory that falls within the ideation-to-action framework is the Interpersonal Theory of Suicide (IPTS). This theory was first presented by Joiner (2005) and further expanded upon by Van Orden and colleagues (2010). The IPTS is one of the first theories to explain possible reasons for why the vast majority of individuals who think about suicide do not go on to make a suicide attempt. The foundational assumption of this theory is, simply put, that individuals die by suicide "because they can and because they want to" (Van Orden et al., 2010, p. 581). The IPTS is comprised of three key constructs that are central to suicidal behaviour. Two of those constructs, thwarted belongingness (e.g., feelings of loneliness, lack of meaningful relationships, and social isolation) and perceived burdensomeness (i.e., the perception of being a burden to others) are primarily related to suicidal desire. The third construct, acquired capability for suicide (e.g., reduced fear of death, increased pain tolerance), is related to an individual's capability to engage in lethal self-injury. This theory implies that empirically supported risk factors for suicide (e.g., sleep, childhood abuse) exert their influence on an individual's desire for suicide by increasing their feelings of thwarted belongingness and perceived burdensomeness, and that an individual's acquired capability for suicide is associated with suicidal attempts. The relationship between these variables has been empirically supported. In a systematic review and meta-analysis, Chu and colleagues (2017) aimed to evaluate published and unpublished peer-reviewed literature ($N = 130$ articles) examining the relationship between interpersonal theory constructs and suicidal thoughts and behaviours. The included studies were primarily cross-

sectional (92.3%), published between 2011 and 2015 (91.6%), and conducted in the United States and Canada (83.9%). Although modest, the findings provided support for the interpersonal theory of suicide's hypotheses. The interaction of thwarted belongingness and perceived burdensomeness was significantly associated with suicide ideation and risk and the interaction between thwarted belongingness, perceived burdensomeness, and capability for suicide was significantly related to a greater number of past suicide attempts (Chu et al., 2017).

Other theories under the ideation-to-action umbrella include the Integrated Motivational-Volition model (IMV; O'Connor, 2011), Three-Step Theory (3ST; Klonsky & May 2015), and the Fluid Vulnerability Theory (FVT; Rudd, 2006). Each of these theories is rooted in the idea that the development of suicidal ideation and the progression from suicide desire to suicide attempt are distinct processes with distinct explanations (Klonsky et al., 2016).

The Integrated Motivational-Volitional model uses a similar structure to the IPTS. The IMV model takes into consideration a person's past experiences (pre-motivational phase) as well as their current situational factors (motivational phase) to predict the development of self-injurious thoughts (McClelland et al., 2021). Essentially, these phases suggest that certain life experiences can lead to feelings of defeat/humiliation (Klonsky et al., 2016). In the context of other moderators like poor coping skills, these feelings can lead to subsequent feelings of entrapment which then lead to beliefs about suicide being a viable solution, and thus intent to suicide (Klonsky et al., 2016). The third phase (volitional phase) considers that volitional moderators such as increased capability or impulsivity play a role in transitioning from self-injurious thoughts to self-injurious acts (Klonsky et al., 2016; McClelland et al., 2021).

The Three-Step Theory (3ST; Klonsky & May 2015) of suicide posits that pain, hopelessness, connectedness, and capacity to suicide explain the transition from experiencing

suicidal ideation to risk for suicide attempt(s). More specifically, Step 1 suggests that the combination of experiencing pain and hopelessness create and sustain suicidal ideation. Step 2 indicates that the escalation of ideation occurs when the intensity of the pain experienced outweighs a persons' sense of connectedness to others and the world. Step 3 suggests that suicidal ideation transitions to suicidal action when an individual has the capacity to attempt suicide. Capacity, in this case, can involve dispositional factors such as genetics and/or practical factors such as an understanding of what to use to suicide, how to use it, and access to means of suicide (Klonsky et al., 2016).

Lastly, the Fluid Vulnerability Theory (FVT; Rudd, 2006), embedded in cognitive theory, is a way to understand the short- and longer-term processes of suicide risk. FVT indicates that suicidality is time limited, and that the factors that precipitated the onset of a suicidal episode, and those that contribute to the severity and duration of the episode are fluid in nature and duration (Rudd, 2006). FVT indicates that the ability to prevent the transition from suicidal thought to suicidal action is based upon how effectively an individual's cognitive, affective, physiological, and behavioural aggravating factors are targeted (Rudd, 2006).

Taken together, the theories within the ideation-to-action framework offer important considerations of factors related to suicide, and importantly, the transition from suicidal ideation to suicidal action.

Insomnia Symptoms and Suicide

Prior to the 2000s, the relationship between sleep disturbance and risk for suicide was not well understood (Perlis et al., 2016b). In recent years, however, this relationship has garnered more empirical attention and as such, it is now widely accepted that sleep difficulties such as insomnia are reliable risk factors for suicidal ideation, suicide attempts, and completed suicide

(Bishop et al., 2020; Perlis et al., 2016b; Pigeon et al., 2012). In particular, in 2007 Bernert and Joiner published a critical review of the literature to date examining the relationship between sleep and suicidality and highlighted the common underlying neurobiological factors, biological and social zeitgebers (e.g., light exposure, temperature, work/school demands), and potential treatment implications. Overall, the review found evidence to support suicidal ideation and suicidal behaviours to be closely associated with sleep troubles such as insomnia (Bernert & Joiner, 2007). A meta-analysis conducted by Pigeon and colleagues (2012) examining 39 studies published from 1966-2011 found that sleep disturbance was significantly associated with an increased relative risk for suicidal ideation, suicide attempt, and completed suicide. When examining the relationship specifically between insomnia and suicidal behaviour ($n = 32$), Pigeon and colleagues (2012) found individuals with insomnia were 2.84 times as likely to experience suicidal behaviour (i.e., ideation, attempt, or completed suicide) than those without. More recently, Bishop and colleagues (2020) sought to retrospectively explore the associations between specific sleep disorders and suicide attempts using data from electronic medical records of patients involved with the U.S Department of Veterans Affairs who had a documented suicide attempt (either fatal or non-fatal) ($N = 60,102$) and matched data from a control group of non-attempters. Insomnia was associated with increased odds of a suicide attempt (OR = 5.62) and this relationship was maintained after controlling for PTSD, anxiety disorders, schizophrenia, bipolar disorder, and substance use disorders (OR = 1.51). Individuals who visited sleep medicine clinics prior to their first documented suicide attempt for difficulty with insomnia, sleep-related breathing disorder, and/or nightmares were 11% less likely to attempt suicide (OR = 0.89) suggesting that the assessment and treatment of sleep disorders should be considered as an avenue for treatment to augment suicide prevention efforts.

In a 30-year longitudinal community cohort study, 591 young adults from Switzerland were followed from 1979 to 2008 to assess the associations between sleep problems and suicidality (Rossler et al., 2018). Semi-structured interviews addressing areas related to past 12-month prevalence of various mental disorders, socio-environmental cofounders, and sleep problems were utilized at seven assessment points. Sleep problems were graded according to number of symptomatic days during the past 12-months and associated distress and were considered present if at least one of the following items was endorsed: trouble to get up in the morning; difficulties falling asleep; nighttime awakening; early awakening; worrying about not being able to sleep at night; partially too much sleep; being tired in the early evening; anxiety during the night; awakening with fear from nightmares; and falling asleep unintentionally. Suicidality was assessed via five items (coded as present vs. absent): 1) I would not mind being dead; 2) I had transient thoughts of harming myself; 3) I had serious persisting thoughts of harming myself; 4) I had clear and precise ideas of how to commit suicide; and 5) I made a suicide attempt. Items 1 and 2 were classified as mild and items 3-5 were classified as severe. The findings indicate that the prevalence of sleep problems increased with age. Suicidality decreased from age 20/21 to 40/41 and increased afterwards until age 49/50 (Rossler et al., 2018). Additionally, sleep problems (OR = 1.46) and suicidality (OR = 1.34) were slightly more prevalent in women than men. Moreover, both sleep problems and suicidality were related to concurrent mood (OR = 2.79; OR = 4.71) anxiety (OR = 2.29; OR = 2.15), and substance use disorders (OR = 1.54; OR = 1.55). Further, those with mild sleep problems had higher rates of suicidality compared to individuals with no sleep problems and those with moderate sleep problems had higher rates of suicidality than those with mild problems. Severe sleep problems were not significantly different from those with moderate sleep problems. The association

between sleep problems and suicidality persisted even after controlling for concurrent mood, anxiety, and substance use disorders and sociodemographic variables including sex. Importantly, when Rossler and colleagues (2018) further explored sleep problems a single symptom of insomnia (i.e., difficulty falling asleep) a significant relationship was found with subsequent suicidality. This relationship maintained its significance after controlling for concurrent mental disorders suggesting that symptoms of insomnia should be assessed as independent factors and not only as symptoms of other psychopathology. As the relationship between sleep problems such as insomnia and suicidality are clear, Rossler and colleagues highlight the importance of assessing for these conditions in clinical settings. Further, they argue that clinically increasing the consistency of sleep could decrease suicidality, and therapeutically treating suicidality could improve subsequent sleep problems.

Overall, these findings suggest an association between insomnia and increased suicide risk. Given that suicide accounts for approximately 4,000 Canadian deaths each year (Statistics Canada, 2022), and in line with the current literature, it is imperative to closely examine the impact of insomnia and insomnia symptoms on suicide to augment suicide prevention efforts in the future. Continuing to better understand how sleep difficulties like insomnia and insomnia symptoms influence this risk may help to inform future intervention opportunities with the goal of reducing suicidal thoughts and behaviours in individuals experiencing this type of sleep problem.

Sleep and Suicide Risk Theory

There are several theories as to why being awake at night confers risk for suicidality. For example, being awake at night may confer risk for suicidality as it may increase an individual's use of alcohol and/or other substances, reduce the availability of social support, or increase

accessibility to weapons (You et al., 2011; Vijayakumar et al., 2011). Additionally, being awake at night may intensify an individual's feelings of hopelessness, isolation, or distress (Perlis et al., 2016a; Perlis et al., 2016b). A further possibility, as suggested by Perlis, and colleagues (2016b) is that suicides that happen at night occur in large part because of a neurobiological/neurophysiological vulnerability that is present in all humans. More specifically, they argue that being awake during a time in which individuals are not biologically prepared to be (i.e., not sleep sated and/or in a circadian phase that is associated with alertness and higher cognitive functioning) results in hypofrontality (i.e., decreased frontal lobe function), a kind of brain activity that is associated with poor executive function and thus impacts the ability to make reasoned choices and potentially increasing the risk for suicide (Perlis et al., 2016b).

To begin to explore this theory, Perlis colleagues (2016b) reviewed the available literature on temporal patterning of death by suicide ($N = 9$). Findings from each of those studies suggest that the rate of suicide is higher during the day rather than at night. However, they highlight several limitations that suggests these findings are not as concrete as they appear. For example, they indicate that few studies differentiate between time of death and time of fatal injury; not all studies assessed for age and sex differences and/or how mode of suicide may assort differently regarding the circadian patterning of suicide; and variability is present across studies for their method of binning time and/or analyzing effects over time (Perlis et al., 2016b). The researchers further suggest that the most impactful limitation across all the studies is that none of them consider the proportion of the population that is awake at each time interval. As suicide is a behaviour that can only be accomplished when awake, Perlis and colleagues (2016b) state that the population of individuals at risk for engaging in this behaviour varies depending on the time of day. Therefore, while the absolute frequency of suicide risk was found to be lower at

night, this may not be representative of the risk for suicide being disproportionately higher at night than would be expected given the proportion of the population that is awake (Perlis, et al., 2016b).

To examine the frequency of completed suicide per hour while taking into consideration the percent of individuals awake at each hour Perlis and colleagues (2016a) used data from the National Violent Death Reporting System (NVDRS) and the American Time Use Survey (ATUS) to conduct an archival analysis. Over 35,000 recorded suicides were included in the analyses and the findings indicated that the majority of suicides were committed at night. Overall, 63.9% of suicides occurred between midnight and 6am and with peak frequency (16.3%) occurring at 2am. Contrary to the findings of previous studies, the authors found that when the proportion of the population that is awake at a given hour is considered, suicides are more likely to occur at night. Based on this finding Perlis and colleagues (2016a) suggest that suicide risk can be reduced by ensuring individuals are not awake during a time in which they are disproportionately vulnerable. Therefore, they highlight the importance of targeted treatment for insomnia and nightmares and an increase in the allocation and utilization of psycho-social resources available at night to reduce the risk of suicide.

As the relationship between insomnia and suicide related behaviours has been well established, it is important to explore additional factors that may have the potential to impact the strength of this relationship. One such factor that has yet to be thoroughly explored is the role of experiencing adversity in childhood. Experiencing adversity in childhood has been independently associated with increased risk for experiencing both insomnia (Bader et al., 2007, Gregory et al., 2006) and suicide and related behaviours in adulthood (Choi et al., 2017; Dube et al., 2001; Thompson et al., 2019). As such, it is possible that experiencing adversity in childhood

may in turn influence the relationship between insomnia and suicide in adulthood. The following section reviews the literature on Adverse Childhood Experiences (ACEs) and its relationship with both insomnia/insomnia symptoms and suicide related behaviours.

Adverse Childhood Experiences

Adverse childhood experiences are defined as potentially traumatic events that occur before the age of 18. These events may include experiencing physical, sexual, or emotional abuse; physical or emotional neglect; household challenges such as witnessing a parent or caregiver use alcohol or substances or who experiences mental health challenges; exposure to intimate partner violence; separation or divorce; or criminal behaviour resulting in incarceration (Felitti et al., 1998). Ellis and Dietz (2017) have suggested that structural and contextual forms of trauma, sometimes referred to as 'adverse community experiences', such as structural violence, living in extreme poverty, and homelessness may also be sources of trauma and adversity in childhood.

Prevalence of Adverse Childhood Experiences

Adverse childhood experiences are relatively common. In a seminal study regarding the relationship between ACEs and health risk behaviour and disease in adulthood, Felitti and colleagues (1998) found that of the over 8,000 individuals included in their study, 50.5% of them had experienced at least one childhood adversity. Since then, Merrick, and colleagues (2018) used the Behavioral Risk Factor Surveillance System (BRFSS), an annual, nationally representative telephone survey on health-related behaviours, health conditions, and use of preventive services in the United States to highlight updated ACE prevalence. Their findings demonstrated that of the 214,157 respondents, 61.55% reported at least one ACE, and 24.64% reported experiencing three or more. Additionally, factors such as race, education level, income,

employment, and sexuality impacted the reported number of experiences. More experiences were reported by those who identified as Black, Hispanic, or multiracial; those with less than a high school education; those with an income lower than $15,000 per year, those who were unemployed or unable to work, and those identifying as gay/lesbian/bisexual (Merrick et al., 2018). In a subsequent study using the same data from the BRFSS but including 11 additional states, Giano and colleagues (2020) found 57.8% of the 211,376 individuals surveyed reported experiencing at least one ACE and 21.5% experiencing three or more. In addition, Giano and colleagues (2020) replicated the findings from Merrick et al. (2018) such that multiracial individuals, those with lower income, those with lower education, and those who identified as gay/lesbian/bisexual experienced more ACEs. The authors also noted that females reported significantly more ACEs than males and that individuals in the 25-34 age range also had significantly higher mean ACE scores. These research findings suggest that a significant proportion of individuals experience ACEs and those within marginalized groups are often the most directly impacted.

In terms of the prevalence of specific ACE types, Crouch and colleagues (2019) conducted a cross-sectional analysis using interview data from the 2016 National Survey of Children's Health (NSCH). Parent/guardian-reported child ACE exposure was provided for 45, 287 children. In their study, ACES were defined as: parental separation or divorce, parental death, witnessing household violence, witnessing neighbourhood violence, household mental illness, household incarceration, household substance abuse, racial/ethnic mistreatment, and economic hardship. The authors found that experiencing economic hardship (22.5%) and parental/guardian divorce and separation (21.9%) were the most prevalent ACEs. Less than ten percent of the sample reported experiencing the remaining ACES, with experiencing the death of

a parent or guardian (2.9%) as the least prevalent ACE (Crouch et al., 2019). The large-scale

national surveys demonstrate the burden of ACEs among adults living within the United States.

The findings of the previously mentioned research highlight the unfortunate reality that many

individuals have experienced events of childhood adversity, which is common across

sociodemographic characteristics, again with those from more marginalized groups at higher risk

of exposure than others.

Recently, Joshi and colleagues (2021) addressed the dearth of information regarding

prevalence data for ACEs across Canada. In their cross-sectional analysis of the Canadian

longitudinal study on aging, the authors provided prevalence estimates of individual ACEs by

sociodemographic variables for individuals aged 45 to 85 years ($N = 44817$). Their results

indicated that childhood exposure to physical abuse, intimate partner violence, and emotional

abuse were the most prevalent types of ACEs reported. Almost two thirds of the sample (61.6%;

$n = 25933$) reported exposure to at least one ACE and 35.6% of the sample reported exposure to

two or more ACEs. When separating the sample based on sex, men were more likely to report

experiencing physical abuse when compared to women (36.3% vs. 32.1%); whereas women

were more likely to report experiencing sexual abuse (31.7% vs. 12.7%), emotional abuse

(27.8% vs. 23.3%), neglect (4.9% vs. 3.6%), intimate partner violence (27.2% vs. 22.4%), and

living with a family member with mental health challenges (21.5% vs. 16.5%) when compared to

men. The authors indicated that these findings are consistent with those found in other Canadian

studies except for their findings of higher rates of sexual and emotional abuse (Joshi et al., 2021).

Canadian research has indicated prevalence rates of exposure to physical abuse to be 26%,

sexual abuse between 7% and 15%, emotional abuse to be between 14% and 17%, intimate

partner violence to be between 6% and 26%, parental divorce or separation to be between 11%

and 17.6%, and poor parental mental health to be 20.6% (Afifi et al., 2014; Afifi et al., 2016; England-Mason et al., 2017; Joshi et al., 2021; Ligier et al., 2019; McDonald et al., 2015; Shields et al., 2016). While these figures are staggering, Joshi and colleagues (2021) also note that, when compared to Canada, locations outside of Canada[1] have higher rates of physical abuse (28.5% vs. 22.9%), emotional abuse (20.5% vs. 19.6%), neglect (2.9% vs. 2.8%), death of a parent (16.4% vs. 15.2%), parental divorce or separation (9.1% vs. 7.9%). However, Canada had higher rates of sexual abuse (14.6% vs. 14.2%) and living with a family member with mental health problems (20.7% vs. 16%). These reported figures highlight the challenge ACEs pose for Canadians and emphasize the need for continued prevention and intervention efforts.

Impact of Adverse Childhood Experiences on Health and Wellbeing

Exposure to ACEs can negatively impact an individual's overall health and wellbeing across the lifespan. Felitti and colleagues (1998) evaluated retrospectively and prospectively the long-term impact of abuse and household dysfunction experienced in childhood. Their study involved mailing questionnaires about childhood exposure to abuse and household dysfunction to individuals following their visit to a medical clinic ($n = 9,508$). Overall, they found the higher the ACE score (i.e., the total number of 'yes' responses to the 10 types of exposures), the greater the risk of experiencing risky health behaviours, chronic health conditions, low quality of life potential, and even early death. For example, as the number of childhood exposures increased from zero to four or more, prevalence and risk[2] increased for: smoking (6.8%-16.5%; OR 1.0-2.2), severe obesity (5.4%-12.0%; OR 1.0-1.6), physical inactivity (18.4%-26.6%; OR 1.0-1.3), depressed mood (14.2%-50.7%; OR 1.0-4.6), alcoholism (2.9%-16.1%; OR 1.0-7.4), use of illicit drugs (6.4%-28.4%; OR 1.0-4.7), injection of illicit drugs (0.3%-3.4%; OR 1.0-10.3), having

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[1] Exact locations not specified
[2] After adjusting for age, gender, race, and educational attainment.

greater than 50 intercourse partners (3.0%-6.8%; OR 1.0-3.2), having a history of sexually

transmitted infections (5.6%-16.7%; OR 1.0-2.5), and suicide attempts (1.2%-18.3%; OR 1.0-

12.2) (Felitti et al., 1998). These findings highlight the vast array of negative implications that

can arise throughout an individual's life following exposure to ACEs.

In a meta-analytic review of 37 studies examining the impact of experiencing multiple

ACEs, Hughes and colleagues (2017) similarly found that individuals who have experienced a

greater number of ACEs are at increased risk for health complications when compared to those

reporting no ACEs. More specifically, those who reported more than four ACEs were 1 to 1.5

times more likely to be physically inactive, overweight or obese, or have diabetes, 2 to 3 times

more likely to smoke, engage in heavy alcohol use, rate their health as poor, have cancer,

cardiovascular disease, or respiratory disease, and 3 to 10 times more likely to have multiple

sexual partners, have anxiety, begin having sex at an earlier age, become pregnant as a teenager,

experience low life satisfaction, have depression, use illicit drugs, have problematic alcohol use,

experience sexually transmitted infections, be a victim of violence, be a perpetrator of violence,

and have problematic drug use. Most relevant to the current study, Hughes and colleagues (2017)

found individuals reporting more than four ACEs were 30 times more likely to experience a

suicide attempt than those reporting none. Hughes and colleagues (2017) highlight the

importance of intervention following exposure to childhood adversity as the outcomes most

strongly associated with multiple ACEs are those that have risks for the next generation (e.g.,

violence, mental illness, and substance use) and thus the potential to continue perpetuating the

cycle of ACEs.

More recently, Petruccelli and colleagues (2019) identified 96 articles in their systematic

review and meta-analysis of health outcomes associated with ACEs in the CDC-Kaiser ACE

scale (Felitti et al., 1998), identifying exposure to multiple ACEs to be associated with a wide variety of medical and psychological/behavioural outcomes. The findings highlight a graded relationship indicating that the more ACEs an individual has (one ACE vs. four or more ACEs), the higher the odds ratio was for experiencing negative medical outcomes. Specifically, ischemic heart disease (OR 0.88-2.30), gastrointestinal disease (OR 1.18-1.50), respiratory disease (1.46-2.60), stroke (OR 1.01-2.00), somatic pain/headache (OR 1.23-2.00), and sleep disturbance (OR 1.23-1.56). Additionally, graded relationships were identified amongst ACEs and psychological/behavioural outcomes including tobacco use (OR 1.24-1.90), alcohol problems (OR 1.46-4.31), depressed mood (OR 1.42-3.16), risky sexual behaviour (OR 1.36-2.79), illicit drug use (OR 1.61-3.66), behaviour problem (OR 1.90-2.00), poor health/quality of life (OR 1.32-2.67), being a victim of violence (OR 1.59-5.04), psychological distress (OR 1.23-5.60), panic and anxiety (OR 1.27-6.80), and hallucinations (OR 1.05-1.50). Similar to Hughes and colleagues (2017), suicide attempts were the riskiest outcome with individuals who reported four or more ACEs being over seven times more likely than those reporting no ACEs to attempt suicide. As the outcome of these experiences are clearly diverse, Petruccelli and colleagues (2019) argue that all professionals should be aware of the impacts of ACEs and screen for them regularly.

Taken together, the breadth of literature noting the prevalence and impact of ACEs highlights the importance of prevention, screening, and intervention. ACEs affect a substantial proportion of individuals, and it is possible that these estimates are low as some cases likely go unreported. Given the importance of better understanding ACEs in the totality of their impact, the current study will take a closer look at the potential role that ACEs play in the relationship between insomnia symptoms and suicidal ideation.

Adverse Childhood Experiences and Sleep

Despite strong empirical support demonstrating the potential negative health consequences that can occur following adverse childhood experiences, the existent literature examining adverse childhood experiences and the subsequent impact on sleep is relatively limited, with most studies being published within the last decade (Brown et al., 2022). A recent systematic review conducted by Brown and colleagues (2022) identified just 43 articles examining the associations between child maltreatment (i.e., abuse and/or neglect experienced before age 18) and behavioural sleep disturbances in adulthood. Of the studies that were identified, the majority were conducted in North America ($n = 30$), were cross-sectional in design ($n = 35$), utilized primarily self-report measures for childhood maltreatment ($n = 41$) and sleep ($n = 35$), and few assessed insomnia symptoms specifically ($n = 8$). Overall, their findings suggested a robust association between child maltreatment and behavioural sleep disturbances. The authors note that the relationship between these variables shifts as a function of maltreatment characteristics, type of behavioural sleep disturbance assessed (e.g., sleep duration, sleep quality, insomnia symptoms, nightmares), the use of subjective versus objective measures, and study design. Based on their findings the authors argue that potential long-term consequences of child maltreatment may be mitigated by providing treatment for behavioural sleep disturbances.

Of the available research related to childhood adversity and sleep, some has identified a dose-dependent response suggesting that as childhood adversity experiences increase, so does poor sleep. For example, in a Finnish population-based study, Koskenvuo and colleagues (2010) examined survey data from approximately 26,000 individuals to determine if childhood adversities predicted poor sleep in working age adults (i.e., 20-54 years of age). Their results

indicated that self-reported quality of sleep was rated as "poor" by 14% of participants. For childhood adversities, 42% of participants reported experiencing one to two adversities while 19% reported three to six adversities. Importantly, a graded association was found between childhood adversities and quality of sleep such that those who had experienced more adversities (three to six) were more likely to report poor quality of sleep (Koskenvuo et al., 2010). Specifically, Koskenvuo and colleagues (2010) demonstrated that "poor quality", and "quite-poor quality" of sleep, were four times and three times, respectively, more common among those with multiple childhood adversities.

In a follow-up secondary analysis of the data collected for the foundational ACE study conducted with members of the Kaiser Health Plan (Felitti et al., 1998), Chapman and colleagues (2011) examined the relationship between multiple ACEs and the likelihood of reported sleep difficulty in adulthood. Sleep difficulty was defined as individuals endorsing experiences of having difficulty, now or ever, falling asleep or staying asleep and/or feeling tired even after a good night's sleep. Chapman and colleagues classified three types of childhood abuse (emotional, physical, and sexual) and five types of household dysfunction during childhood (exposure to substance abuse, mental illness, witnessed domestic violence, criminal behaviour in the household, and parental separation/divorce) as ACEs. Those who responded "yes" to one or more of the questions in a category were defined as having been exposed to that type of adversity. Total ACE scores were determined by summing the total number of exposures (range: 0-8) with higher scores indicating a higher number of endorsed adverse experiences. Due to a small number of individuals endorsing scores higher than five, Chapman and colleagues combined ACE scores of five or more into one category ($n = 1089$). Their findings indicate that the higher the ACE score the higher the prevalence of trouble falling asleep, staying asleep, or

feeling tired after sleeping. Of the individuals who endorsed five or more ACEs, 45.3% of them had trouble falling asleep/staying asleep and 33.5% of them felt tired after sleeping. Comparatively, of the individuals endorsing zero ACEs, 27.2% of them had difficulty falling/staying asleep and 18.9% felt tired after sleeping. Like previous studies, the findings of this study indicated a dose dependent relationship between ACEs and health outcomes, and specifically difficulty sleeping, such that as ACE scores increase so does the risk of difficulty falling asleep, staying asleep, and feeling rested after sleeping.

When examining the associations between sleep and specific types of childhood adversities, the strongest associations were found for a frequent fear of a family member and serious conflicts in the family (Koskenuvo et al., 2010). Further, the risk of poor quality of sleep was found to be substantially higher for those with poor relationships with their parents and multiple childhood adversities (3-6 adversities) compared to those with no adversities and good relationships with their parents. Individuals who reported a poor relationship with their mother during childhood, and who had experienced three to six adversities, reported poor sleep 10 times more often than those with good relationships and no adversities (Koskenvuo et al., 2010). The odds ratio of poor quality of sleep for those with good child-mother relationships and three to six adversities was 3.21 (2.56-4.01). Significant associations were also found for quality of sleep and other factors such as long-term financial difficulties, divorce of parents, severe illness of a family member, and alcohol problem of a family member. Overall, these findings highlight the impact early-life experiences can have on health, specifically quality of sleep, and well-being over the lifespan.

In a systematic review of the literature regarding ACEs and sleep difficulty, Kajeepeta and colleagues (2015) identified 30 studies documenting the association between sleep disorders

(e.g., insomnia, nightmare distress, sleep paralysis, sleep deprivation) and a history of childhood adversity. Their literature search was open to observational, cross-sectional, prospective cohort, retrospective cohort, and case-control studies as well as randomized trials. ACEs were limited to events occurring before 18 years of age and could have been assessed using self-report, family member report, or through information extracted from police records. The outcome measure, sleep disorders, included any measure of sleep disorder and/or quality and was assessed at 18 years or older either subjectively, objectively, or via clinical diagnosis. Of the 30 articles included in the review, 14 were conducted in the US, and eight were conducted with an entirely female sample. The most reported ACE was child sexual abuse, and the most reported sleep-related outcome was self-reported sleep disturbance. Overall, in their examination of the literature, Kajeepeta and colleagues (2015) found that ACEs were associated with multiple sleep disorders and disturbances in adulthood.

When discussing insomnia specifically, Kajeepeta and colleagues note that research indicates individuals with a history of ACEs have different sleep characteristics than those without such a history. For example, in a sleep laboratory study utilizing polysomnography and actigraphy to assess the association between ACEs (determined via Childhood Trauma Questionnaire) and sleep in adults suffering from primary insomnia ($N = 59$), Bader and colleagues (2007) found those who reported moderate to severe ACEs ($n = 27$) had a greater proportion of awakenings during sleep time compared to those who reported low or no ACEs (3.4% vs. 2.3%, $p = 0.003$). Further, those who reported moderate to severe ACEs had a greater proportion of movement during sleep time (5.8% vs. 4.4%, $p = 0.012$), lower sleep efficiency (76.5% vs. 87.2%, $p = 0.023$), and greater proportion of time spent moving during sleep time (23.3% vs. 12.7%, $p = 0.008$) when compared to those who reported low or no ACEs.

Additionally, a history of abuse and neglect explained the variance in sleep onset latency (39%), sleep efficiency (37%), number of bodily movements (40%) and moving time (36%).

Further, in a longitudinal prospective study conducted in New Zealand, Gregory and colleagues (2006) examined the association between childhood exposure to family conflict and insomnia at 18 years of age ($N = 993$). To assess exposure to family conflict, parents were asked to complete the Conflict Subscale of the Moos Family Environment Scale when their children were 7, 9, 13, and 15 years of age. Parents were then asked to assess sleep problems at nine years of age using a dichotomous scale (yes/no). Specifically, parents were asked to report whether their child had trouble falling asleep, awakened in the night without being able to fall back to sleep, or woke up early in the morning. At this time point children were classified with a sleep problem if their parents reported that they had experienced at least one of these difficulties for a minimum of four weeks ($n = 82$). Additionally, insomnia in this study was evaluated using *DSM-IV* criteria via standardized interview when the child turned 18 years of age ($n = 138$). Their findings support that individuals with insomnia at 18 years had experienced greater levels of family conflict at each of the time points assessed (7 years: OR = 1.22; 9 years: OR = 1.24; 13 years: OR = 1.37; and 15 years: OR = 1.45). Additionally, a dose-response relationship was found such that reports of high family conflict at a greater number of assessment points were associated with a higher probability of insomnia at 18 years. Individuals with one report were 1.39 times more likely to experience insomnia at 18 years. Those with two reports were 1.72 times more likely and those with three or more reports of high family conflict were 2.4 times more likely as those with no reports to experience insomnia.

Based on the above findings and the overall findings that ACEs are associated with insomnia and other sleep disorders, Kajeepeta and colleagues (2015) argue that a better

understanding of these relationships is of significant clinical importance. Specifically, they note that individuals with ACEs and insomnia may require a different, more complex form of treatment such as the inclusion of Interpersonal Psychotherapy in addition to specific insomnia treatment in comparison to those without a history of ACEs (Kajeepeta et al., 2015; Pigeon et al., 2009). Finally, the authors argue that a better understanding of the relationship between sleep and ACEs may illuminate sleep as being an important mediator between ACEs and other serious health outcomes.

In a Canadian context, Baiden and colleagues (2015) assessed the relationship between insomnia and ACEs with a sample of Canadian adults who took part in a national health survey. ACEs were measured using six questions that asked respondents about experiences of physical and/or sexual abuse that may have happened to them prior to the age of 16, either at school, in their neighbourhood, or in their family. Sleep was measured as a binary variable and was assessed using the question "How often do you have trouble going to sleep or staying asleep?" Responses were rated on a 5-point scale from 1 (*none of the time*) to 5 (*all of the time*). Participants who reported having trouble sleeping "most of the time" or "all of the time" were considered to have troubled sleep.

The findings determined that of 14.2% (*n* = 2,748) of respondents identified having trouble sleeping (Baiden et al., 2015). When examining the type of adversity experienced and its relationship to troubled sleep, Baiden and colleagues determined that in comparison to individuals who did not experience ACEs, those who experienced unwanted sexual touching, fondling, or kissing were 2.87 times more likely to have troubled sleep; those who had experienced a physical attack were 2.45 times more likely to have troubled sleep; those who were slapped in the face, hit, or spanked by an adult were 1.41 times more likely to have troubled

sleep; and those who experienced multiple incidents of adversities were 2.13 times more likely to have trouble sleeping (Baiden et al., 2015). Of note, Baiden and colleagues do not specify whether the multiple incidents of adversities group constituted multiple experiences with one type of adversity (e.g., multiple experiences of unwanted sexual touching) or a combination of experiences (e.g., unwanted sexual touching plus experiencing a physical attack). Upon further examination, Baiden and colleagues determined that for each additional experience of childhood adversity, the odds of having trouble sleeping were predicted to increase by a factor of 10%, net the effect of all the other factors. These results provide population-based evidence that echo findings from other countries indicating that individuals who experience ACEs have a higher likelihood of experiencing trouble sleeping later in life. Additionally, these findings indicate that the type of adversity is also an influential factor.

Currie and colleagues (2021) recently explored the impact of frequent physical and emotional child abuse on adult sleep among a sample of Western Canadian women. Frequent physical abuse was assessed by the question: "Did a parent or other adult in the household often or very often push, grab, slap or throw something at you so hard that you had marks or were injured?" Frequent emotional abuse was assessed by the question: "Did a parent or other adult in the household often or very often swear at you, insult you, put you down, humiliate you, or act in a way that made you afraid that you might be physically hurt?" Adult sleep quality was self-reported using the Pittsburgh Sleep Quality Index (PSQI). Overall, the findings indicated women who experienced physical abuse and emotional abuse had sleep problem scores 1.8 and 1.7 points higher, respectively, than those who had not. The authors also indicate that almost all of the women who reported physical child abuse also reported emotional child abuse, suggesting the associations may be representative of a combined impact of abuse for some women.

Despite the available research examining the impact of ACEs on sleep being somewhat limited, what is available appears to consistently support that individuals who have a history of ACEs have a higher likelihood of experiencing some form of sleep difficulties later in life. As suggested by Brown and colleagues (2022) intervening to target behavioural sleep difficulties may be an effective way to mitigate the impact of childhood maltreatment and adversity. Moreover, intervention may potentially reduce the experience of suicide related behaviours later in life.

Adverse Childhood Experiences and Suicide

Similar to the influence of exposure to adversity in childhood and experiencing sleep disturbances in adulthood, recent research has highlighted the association between adverse childhood experiences and an increased risk for suicidal ideation and suicide attempts in adulthood (Choi et al., 2017; Dube et al., 2001; Thompson et al., 2019). Childhood abuse (sexual abuse, physical abuse, and neglect) is a significant risk factor for suicide (Devries et al., 2014; Evans et al., 2005; Miller et al., 2013). For example, Afifi and colleagues (2008) sought to determine the sections of psychiatric disorders and suicide ideation and attempts that were attributable to childhood physical abuse, sexual abuse, and witnessing domestic violence. Utilizing data from the US National Comorbidity Survey Replication ($n = 5,692$) they found that, after adjusting for age, marital status, income, education, ethnicity, each adverse childhood event, having any psychiatric disorder, and psychiatric comorbidity, women were 1.54 times more likely to experience suicidal ideation and 2.39 times more likely to attempt suicide if they had experienced physical abuse. Women who experienced sexual abuse were 1.51 times more likely to experience suicidal ideation and 3.24 times more likely to attempt suicide than those who did not experience sexual abuse. Those who witnessed violence were 1.30 times more likely

to have suicidal ideation and 1.78 times more likely to attempt suicide. Among men, experiencing physical abuse increased the risk of suicidal ideation to 2.14 times and suicide attempts to 3.34 times. Those who experienced sexual abuse were 1.34 times more likely to have suicidal ideation and 2.28 times more likely to attempt suicide. Finally, those who witnessed violence were 1.79 times as likely to have suicidal ideation and 1.28 times more likely to attempt suicide.

When examining the impact of the number of adversities experienced and their connection to suicidal ideation and attempts, and after adjusting for age, marital status, income, education, ethnicity, having any psychiatric disorder, and psychiatric comorbidity, women who experienced three ACEs were 3.49 times as likely to have suicidal ideation and 13.07 times as likely to have an attempted suicide in comparison to those who reported none. For comparison, men who experienced three ACEs were 2.72 times as likely to have had suicidal ideation and 6.63 times as likely to have a suicide attempt. However, these results should be interpreted with caution as the authors note that the sample sizes for men who experienced three adverse events and suicidal ideation and attempts were low ($n = 6$ and $n = 7$, respectively). In what Afifi and colleagues consider to be a striking finding, their results indicate that if childhood physical abuse, sexual abuse, or having witnessed violence did not occur, the prevalence of suicide attempts would have been reduced by approximately 33% for men and a staggering 50% for women.

More recently, Afifi and colleagues (2014) used data from the 2012 Canadian Community Health Survey: Mental Health to explore the prevalence of child abuse and its relation to mental disorders as well as suicidal ideation and attempts in Canada. They found that 32% of the adult population ($n = 23,395$) had experienced physical abuse, sexual abuse, and/or

had been exposed to intimate partner violence during childhood and that experiencing any of these types of adverse events was significantly associated with suicidal ideation (OR = 4.1) and suicide attempts (OR = 6.1). When broken down by type of adversity, those who experienced any physical abuse were 3.5 times more likely to experience suicidal ideation and 4.7 times more likely to attempt suicide. Those who experienced sexual abuse were 4.6 times more likely to experience suicidal ideation and 4.7 times more likely to attempt suicide, compared to those who did not experience sexual abuse. Exposure to intimate partner violence increased risk of suicidal ideation by 3.8 times and suicide attempts by 6.3 times. Similarly, in a study of suicidal ideation and attempts of 387 US adults who had experienced childhood physical abuse, sexual abuse, and/or emotional abuse, Briere and colleagues (2016) found that in the month following the completion of the survey, 14.2% (*n* = 55) of adults reported some degree of suicidal ideation, and 2.3% (*n* = 9) reported an active or passive suicide attempt. Furthermore, suicidality was associated with all three types of abuse and those who attempted suicide had experienced higher rates of childhood sexual and physical abuse compared to those with no suicidality or suicidal ideation alone (sexual abuse: 77.8% vs. 16.4% vs. 10.9%, respectively; physical abuse: 77.8% vs. 30.3% vs. 29.1%). Moreover, they also found that sexual and physical abuse were predictive of recent active/passive suicide attempts, but not ideation alone, whereas emotional abuse predicted both ideation and attempts (Briere et al., 2016). The authors suggest that these findings may support the notion that ideation without attempts may be less related to past trauma and that attempts may reflect "greater lethal intention" related to the experience of abuses in childhood (Briere et al., 2016, p. 3071).

Further, in a retrospective study of risk of suicide attempts and adverse childhood experiences Dube and colleagues (2001) assessed survey data from 17,337 US adults regarding

their experiences with child abuse, household dysfunction, and suicide attempts. Their findings indicated the lifetime prevalence of having at least one suicide attempt was 3.8%. Additionally, those who reported having experienced emotional, physical, or sexual abuse were 3-5 times more likely to attempt suicide at some point in their lives. More specifically, 14.3% (OR = 5.0) of individuals who had experienced emotional abuse had attempted suicide at some point in their life, along with 7.8% (OR = 3.4) of those who experienced physical abuse, and 9.1% (OR = 3.4) of those who experienced sexual abuse. More recently, using data from the National Longitudinal Study on Adolescent Health, Thompson and colleagues (2019) examined the relationship between adverse childhood experiences and suicidal attempts and ideation in adulthood ($N = 9,421$). After adjusting for depression, delinquency, alcohol problems, drug use, impulsivity, gender, age, race, and urbanicity, the researchers found individuals who experienced physical abuse as a child were 2.01 times more likely to experience suicidal ideation and 1.91 times more likely to make a suicide attempt. Of those who experienced sexual abuse, findings indicated they were 2.56 times more likely to experience suicidal ideation and 2.79 times more likely to attempt suicide. Moreover, individuals who experienced emotional abuse were 2.38 times more likely to ideate and 2.36 times more likely to attempt suicide.

To further our understanding of ACEs and suicidal behaviour, Fuller-Thomson and colleagues (2016) also utilized the 2012 Canadian Community Health Survey-Mental Health data to investigate the association between childhood sexual abuse, childhood physical abuse, and parental domestic violence and lifetime suicide attempts in a sample of 22,559 Canadian adults. Results indicated that childhood sexual abuse, childhood physical abuse, and witnessing parental domestic violence were associated with an increased likelihood of attempting suicide across the lifespan and that these relationships are independent of one another (Fuller-Thomson

et al., 2016). Fuller-Thomson and colleagues suggest that these findings underscore important implications for intervention. For example, they offer that clinicians and those in helping roles should be aware that being indirectly involved in violence also poses risk for suicide and related behaviours (Fuller-Thomson et al., 2016). Moreover, the authors also explored the potentially moderating role of sex in the relationship between ACEs and lifetime suicide attempts but did not find strong evidence to suggest that sex acts as a moderator. Additionally, the authors also found depression, anxiety, substance abuse, and chronic pain each partially mediates the relationship. These results contribute to the growing body of work exploring the additional factors that contribute to the relationship between ACEs and suicide risk.

Taken together, there is strong evidence to support the impact that ACEs can have on the risk for suicidal ideation and suicide attempts and this line of research highlights the importance of preventing ACEs from occurring. In recognizing the complexity of such a task, these findings also emphasize the importance of implementing ACE screening procedures and suicide prevention strategies to better assist those who have such histories.

Current Study

Despite research identifying independent relationships between: (1) insomnia and suicide, (2) childhood adversities and insomnia, and (3) childhood adversities and suicide; there have been no known studies to date that explore the potential interaction amongst these three variables. The current study aims to examine whether the relationship between insomnia symptoms and past 12-month suicidal ideation in a sample of Canadian adults changes as a result of exposure to childhood adversity. The primary objectives of this dissertation are as follows:

1) To examine factors associated with the presence of suicidal ideation, insomnia, and the combination among a community sample of Canadian adults.

2) To examine whether the number of adverse childhood experiences moderates the relationship between insomnia symptoms and past 12-month suicidal ideation among a community sample of Canadian adults.

3) To examine whether adverse childhood experiences' effect on the relationship between insomnia symptoms and past 12-month suicidal ideation is dependent upon biological sex.

Ultimately, if experiencing childhood adversities strengthens the relationship between insomnia symptoms and suicidal ideation in adulthood, it can be argued that additional screening measures for experiences of childhood adversity should be implemented in health and clinical settings to identify individuals who may be at risk for suicide related behaviours. Additionally, such a finding would highlight a need to determine the best treatment approach to reduce the impact of ACEs in individuals who have presented with concerns of insomnia and who are at risk for suicide related behaviours.

Chapter 2:

Associations between Insomnia Symptoms and Adverse Childhood Experiences on Past 12-

month Suicidal Ideation in Canadian Adults

Abstract

OBJECTIVE: This cross-sectional study assessed the moderating role of adverse childhood experiences (ACEs) on the relationship between insomnia symptoms and past 12-month suicidal ideation. This study also assessed the interaction between adverse childhood experiences and sex as moderators.

METHOD: This study constituted a secondary analysis of data collected from the Canadian Community Health Survey-Mental health (CCHS-MH) 2012 cycle, a national, cross-sectional survey that collected data to examine the links between mental health and social, demographic, geographic, and economic variables of Canadians. Participants in the current study answered all pertinent questions regarding adverse childhood experiences, insomnia symptoms, and past 12-month suicidal ideation. The final sample included 2,687 respondents.

RESULTS: Prior to the main analyses, univariate and multivariate binomial logistic regressions were conducted to determine the factors associated with past 12-month suicidal ideation, insomnia, and the combination of the two. A single moderator analysis was conducted using PROCESS to examine whether the relationship between insomnia symptoms and past 12-month suicidal ideation is moderated by the number of ACEs experienced. The overall model was significant. A multiple moderation analysis was also conducted. The overall model was significant, however, the three-way interaction was non-significant suggesting that sex does not influence the role of ACEs in the relationship between insomnia symptoms and suicidal ideation.

CONCLUSION: These results suggest that as the number of childhood adversities experienced increases the relationship between insomnia symptoms and suicidal ideation becomes significantly stronger. Additionally, these results suggest there does not appear to be a moderating role of biological sex.

Introduction

Over the past 20 years researchers have begun to establish strong connections between sleep difficulties, such as insomnia, and the role these challenges play in increasing risk for suicide related behaviours including suicidal ideation, suicide attempts, and completed suicide (Bishop et al., 2020; Perlis et al., 2016b; Pigeon et al., 2012). Canadian Statistics regarding both insomnia and suicide highlight how widespread these challenges are in the Canadian population. For example, research has found that Insomnia Disorder affects approximately 13% of the population (Morin et al., 2011) and 1 in 2 adults have nighttime insomnia symptoms (e.g., trouble falling asleep or staying asleep; Public Health Agency of Canada, 2019). Additionally, suicide is a major problem in Canada as it accounts for approximately 4,000 Canadian deaths each year (Statistics Canada, 2022).

Suicidal ideation, suicidal behaviours, and completed suicide are closely associated with sleep troubles such as insomnia and that this relationship has been shown to exist in the general population as well as among veterans, college students, and adolescents (Bernert & Joiner, 2007; Bishop et al., 2020; Goldstein et al., 2008; Pigeon et al., 2012; Shi et al., 2021). Overall, while the existence of a relationship between insomnia symptoms and suicide related behaviours is well-established, much less is known about how additional factors, such as experiencing adversities in childhood, can impact this relationship.

Adverse childhood experiences (ACEs) refer to potentially traumatic events that occur in an individual's life prior to age 18-years-old. ACEs can occur in the form of experiencing physical, sexual, or emotional abuse; experiencing physical or emotional neglect; or observing household adversities such as a parent or caregiver engage in substance use or experience mental health challenges or exposure to intimate partner violence (Felitti et al., 1998). Canadian

47

statistics have estimated the prevalence of exposure to physical abuse to be 26%, sexual abuse to

be between 7% and 15%, emotional abuse to be between 14% and 19.6%, exposure to intimate

partner violence to be between 6% and 26%, parental divorce or separation to be between 7.9%

and 17.6% and poor parental mental health to be 20.6% (Afifi et al., 2014; Afifi et al., 2016;

England-Mason et al,, 2017; Joshi et al., 2021; Ligier et al,, 2019; McDonald et al., 2015; Sheilds

et al., 2016). These experiences have also been linked to increased risk for significant, varied,

lifelong physical, psychological, and emotional consequences, including increased risk for sleep

disturbance and suicide related behaviours (Baiden et al., 2015; Felitti et al., 1998; Hughes et al.,

2017; Koskenvuo et al., 2010; Petruccelli et al., 2019). Moreover, one of the most consistent

findings within the childhood adversity literature highlights a dose-response relationship between

exposure to adversity and the above-mentioned increased risk. Specifically, experiencing 4 or

more ACEs tends to substantially increase risk for negative outcomes (Felitti et al., 1998;

Hughes et al., 2017; Petruccelli et al., 2019).

Research exploring sleep and ACEs has independently suggested that each of these

factors individually confer an increased risk for suicide and suicide related behaviours (e.g.,

Grigsby et al., 2020; O'Rourke et al., 2020). However, no studies to date have examined the

potential moderating relationship of adverse childhood experiences on the relationship between

insomnia symptoms and suicidal ideation. Therefore, the purpose of the current study is to

determine whether the relationship between insomnia symptoms and past 12-month suicidal

ideation is moderated by the number of childhood adversities experienced within a community

sample of Canadian adults.

The current study explored the factors associated with past 12-month suicidal ideation,

insomnia, and the combination as well as the potential moderating role of experiencing

adversities in childhood on the relationship between insomnia symptoms and past 12-month suicidal ideation. Overall, the goal was to better understand if experiencing more childhood adversities moderates the relationship between insomnia symptoms and suicidal ideation within a Canadian context. Informed by prior research, the current study aims to test two primary hypotheses:

1) ACEs will moderate the relationship between insomnia symptoms and suicide risk, such that the association between insomnia symptoms and suicide risk will be significantly stronger among those who score higher in ACEs.

2) Sex will moderate the moderator such that women who report having experienced a greater number of ACEs will have higher rates of insomnia symptoms and higher risk of suicide than men.

Ultimately, should a relationship be demonstrated, this information could prove helpful in establishing consistent screening protocols to identify experiences of childhood adversity to be implemented in health and clinical settings. Additionally, this work may contribute to highlighting the need to determine best practice intervention approaches for individuals who have experienced childhood adversities and are struggling with insomnia symptoms to help mitigate the risk for suicide and suicide related behaviours.

Method

Participants

This study used data from the Canadian Community Health Survey-Mental health (CCHS-MH) 2012 cycle (Statistics Canada, 2013). The CCHS-MH is a national, cross-sectional survey that collected data to examine the links between mental health and social, demographic, geographic, and economic variables of Canadians.

Participants were recruited for the CCHS-MH using a 3-stage strategy. First, geographical areas referred to as "clusters" were selected, then households within each cluster were sampled, and finally, one respondent per household was randomly selected to participate. To be eligible to participate, individuals were required to be 15 years of age or over and living in one of the ten Canadian provinces. The number of households sampled from each province was proportionate to the population of the province. Approximately 3% of the target population were excluded from the study including individuals from the three territories, persons living on reserves or other Aboriginal settlements, full-time members of the Canadian Armed Forces, and the institutionalized population.

Data collection

Data collection for the CCHS-MH occurred between January to December 2012 (Statistics Canada, 2013). Data collection utilized Computer-assisted interviewing (CAI). This method of interviewing was selected for two reasons. First, CAI offers a case management system and data transmission functionality. Second, CAI allows for customization of the interviews based on each individuals' characteristics and survey responses. Interviews were conducted either in person or over the phone with the majority (87%) being conducted in person. Proxy interviews were not permitted. In total, 25,113 valid interviews were conducted during this period with the overall combined (household and person) response rate of 68.9% (Statistics Canada, 2013).

Minimizing nonresponse

To ensure the best possible response rate, multiple steps were taken to minimize non-response (Statistics Canada, 2013). Prior to beginning each collection period, introductory letters and brochures explaining the purpose of the survey and how the data would be used were sent to

the sampled households (Statistics Canada, 2013). Interviewers were encouraged to make initial contact via telephone, reschedule interviews if the timing was inconvenient, and on occasion, visit selected households on different days at different times in attempt to connect with the interviewee and maximize the response rate (Statistics Canada, 2013). Additionally, when an individual refused to participate in the survey, a letter was sent explaining the importance of the survey and contact via telephone or a house visit was made by a senior interviewer or project supervisor (Statistics Canada, 2013).

Weighting

In order to derive meaningful estimates from the survey that are representative of the entire population, rather than only the sample, each person included in the sample represents multiple members of the population as well as themselves (Statistics Canada, 2013). This process involves calculating a sampling weight for each participant based on the number of individuals in the total population that are represented by that participant (Statistics Canada, 2013).

Study variables

Insomnia Symptoms

To measure insomnia symptoms, this study followed the procedure used by Baiden and colleagues (2015) and Garland and colleagues (2018). Insomnia symptomatology was assessed using the question "How often do you have trouble going to sleep or staying asleep?" Responses were rated on a 5-point Likert scale from 1 (*none of the time*) to 5 (*all of the time*). Participants who reported having trouble sleeping "most of the time" or "all of the time" were considered to have insomnia symptoms. As per Baiden and colleagues (2015), the insomnia symptom variable was treated as a dichotomous variable (insomnia symptoms/no insomnia symptoms).

Past 12-month Suicidal Ideation

To measure past 12-month suicidal ideation, participants were asked: (1) Have you ever seriously considered committing suicide or taking your own life? If the client endorsed this question with a "yes" response, then a follow-up question was asked: (2) Has this happened in the past 12 months? Possible responses included (1) Yes; (2) No; or (3) Not applicable/Don't Know/Refuse to answer. Responses to the question pertaining to the past 12 months that are coded as "Yes" were used to represent past 12-month suicidal ideation.

Adverse Childhood Experiences

Adverse childhood experiences were measured following the procedure used by Baiden and colleagues (2015). Specifically, ACEs were operationalized using six questions asking survey respondents 18 years and older about physical or sexual events that may have happened to them at home, at school, in their family, or in their neighbourhood before they turned 16-years-old: (1) How many times did you see or hear any one of your parents, stepparents, or guardians hit each other or another adult in your home? (2) How many times did an adult slap you on the face, head, or ears or hit or spank you with something hard to hurt you? (3) How many times did an adult push, grab, shove, or throw something at you to hurt you? (4) How many times did an adult kick, bite, punch, choke, burn you, or physically attack you in some way? (5) How many times did an adult force you or attempt to force you into any unwanted sexual activity, by threatening you, holding you down, or hurting you in some way? (6) How many times did an adult touch you against your will in any sexual way? Responses to these questions were initially coded as 1 (*never*) to 5 (*more than 10 times*). Responses coded 2 or higher received a score of 1 to indicate the experience occurred for that individual. Total scores ranged from 0 (never endorsed experiencing *any* of the 6 questions asked) to 6 (endorsed experiencing *all* of the 6 questions asked *at least once*). A new variable, 'total ACEs' was

derived by summing the number of adversities endorsed by participants. For example, if a participant endorsed experiencing ACE 1 at least once and ACE 2 at least once, their derived total ACE value was two. This derived value was utilized as a moderating variable.

Control Variables

Control variables include: age (20-29 years, 30-39 years, 40-49 years, 50-59 years, and 60 years and older), sex (male or female), annual personal income (no income/<$10,000, $10,000-$19,999, $20,000-$29,999, $30,000-$39,000, $40,000-$49,000, $50,000 and above), marital status (married, common law, formerly married, single/never married), past 12-month major depressive episode, and past 12-month generalized anxiety disorder.

Results

Data analysis

Data was analyzed using SPSS 27.0 and PROCESS version 4.0 (Hayes, 2013). The original dataset included responses from 25,113 individuals. Prior to conducting the main analyses, the dataset was cleaned by removing data from participants who had never thought about committing suicide or taking their own life (n = 21,672), as well as those with 0-4 responses missing to the questions about ACEs (n = 328), and those missing insomnia information (n = 2). Outliers were identified using Mahalanobis distance, Cook's distance, and leverage values with those who failed 2 of 3 checks being removed from the sample (n = 424). The Hosmer and Lemeshow test was non-significant and therefore demonstrated goodness of fit. The final sample included 2,687 respondents.

Participant characteristics

Descriptive statistics were used to characterize the sample's demographic and clinical characteristics (Table 1). Of the 2,687 respondents, more than 54% were aged 20-49 years old. The majority of participants were female (56%) and either single (33.3%) or married (31.1%).

Almost 29% of participants disclosed personal income within the $20,000 to $29,000 range. Regarding suicidal ideation, 78% (n = 2,095) endorsed experiencing suicidal ideation within the past 12-months. Regarding sleep, 29% of respondents (n = 778) indicated they were currently experiencing insomnia symptoms (i.e., difficulty falling asleep or staying asleep most of the time/all of the time). In terms adverse childhood experiences, 29.7% (n = 798) of respondents reported never experiencing any type of childhood adversity, 50.5% of 1,363 respondents (n = 1,363) endorsed experiencing between 1 and 3 adversities, and 19.6% of respondents (n = 526) endorsed experiencing 4 or more types of adversities. Independent t-tests were conducted to identify any group differences. There was a statistically significant difference between those with insomnia symptoms and those without insomnia symptoms on past 12-month suicidal ideation, $t(2685) = 6.681$, $p = .000$. Those who did not have insomnia symptoms had a higher mean suicidal ideation score of 1.81 (SD = .39) than those who did have insomnia symptoms 1.70 (SD = .460). There was also a statistically significant difference between males and females on past 12-month suicidal ideation, $t(2685) = 3.458$, $p = .001$. Females had a higher mean suicidal ideation score of 1.80 (SD = .40) compared to the mean male score of 1.75 (SD = .43).

Table 1. Participant demographic characteristics ($N = 2687$)

Variables	Sample Size (N)	%
Age		
20-29 years	534	19.9
30-39 years	485	18.0
40-49 years	453	16.9
50-64 years	812	30.2
60 and above	403	15.0
Sex		
Male	1181	44.0
Female	1506	56.0
Personal income		
Less than $10,000	124	4.6
$10,000-$19,999	471	17.5
$20,000-$29,999	724	26.9
$30,000-$39,999	458	17.0
$40,000-$49,999	252	9.4
$50,000 or more	658	24.5
Marital status		
Married	837	31.1
Common-law	306	11.4
Widowed	160	6.0
Divorced/separated	479	17.8
Single	896	33.3
Major depressive episode:		
Past 12-month		
Yes	453	16.9
No	2209	82.2
Generalized anxiety disorder:		
Past 12-month		
Yes	252	9.4
No	2402	89.4
Insomnia symptoms		
Yes	778	29.0
No	1909	71.0
ACEs		
0	799	29.7
1	626	23.3
2	416	15.5
3	319	11.9
4	245	9.1
5	87	3.2
6	195	7.3

Table 1 (continued)

Variable	Sample Size (N)	%
Suicidal ideation: Past 12-month		
Yes	2095	78.0
No	592	22.0

Factors associated with insomnia symptoms

Separate univariate binomial logistic regression models were used to identify significant independent factors associated with insomnia symptoms (Table 2). All significant independent variables were entered into a multivariate binomial logistic regression. Overall, the model was significant ($\chi2(19) = 249.833$, p < .0001) and these predictors explained 13% of the variance (Nagelkerke R^2). The multivariate model correctly classified 74.0% of cases.

In the multivariate model, participants who were 40-49 years old (adjusted odds ratio [AOR] = 1.748 [1.273, 2.398], *p* < .001), 50-64 years old (AOR = 1.807 [1.343, 2.431], *p* < .001) and 65 years and older (AOR = 1.452 [1.006, 2.094], *p* = .046) were more likely to report insomnia symptoms than those who were 29 years and younger. Individuals who reported a personal income of less than $10,000 (AOR = 1.598 [1.017, 2.513], *p* = .042), between $10,000-$19,999 (AOR = 1.988 [1.490, 2.653], *p* < .001), and between $20,000-$29,000 (AOR = 1.557 [1.193, 2.033], *p* .001) were more likely to endorse insomnia symptoms compared to those with higher personal income. Individuals with a past 12-month depressive episode (adjusted odds ratio [AOR] = 2.517 [1.974, 3.208], *p* < .001), past 12-month generalized anxiety (AOR = 1.751 [1.296, 2.366], *p* < .001), had experienced at least one ACE (AOR = 1.326 [1.081, 1.627], *p* = .007) were all significantly more likely to report insomnia symptoms. Individuals who reported past 12-month suicidal ideation were less likely to report insomnia (AOR = 0.734 [0.589, 0.916], *p* = .006). At the multivariate level, sex and marital status were no longer significantly associated with insomnia symptoms.

Table 2. Factors associated with insomnia symptoms (n=778)

	Univariate logistic regression analysis		Multivariate logistic regression analysis	
	Odds ratio [95%CI]	*p*	Adjusted odds ratio [95%CI]	*p*
Age				
20-29 years (ref)	1		1	
30-39 years	0.924 [0.692, 1.233]	.590	1.104 [0.805, 1.514]	.538
40-49 years	1.493 [1.130, 1.972]	*.005*	1.748 [1.273, 2.398]	*<.001*
50-64 years	1.532 [1.199, 1.959]	*<.001*	1.807 [1.343, 2.431]	*<.001*
65 and above	1.259 [0.940, 1.685]	.122	1.452 [1.006, 2.094]	*.046*
Sex				
Male (ref)	1		1	
Female	1.335 [1.126, 1.582]	*<.001*	1.199 [0.993, 1.448]	.059
Personal income				
<$10,000	1.638 [1.074, 2.497]	*.022*	1.598 [1.017, 2.513]	*.042*
$10,000-$19,999	2.435 [1.876, 3.160]	*<.001*	1.988 [1.490, 2.653]	*<.001*
$20,000-$29,999	1.726 [1.356, 2.198]	*<.001*	1.557 [1.193, 2.033]	*.001*
$30,000-$39,999	1.169 [0.882, 1.549]	.277	1.180 [0.873, 1.595]	.280
$40,000-$49,999	0.997 [0.701, 1.416]	.985	0.999 [0.694, 1.439]	.997
$50,000 or more (ref)	1		1	
Marital status				
Single (ref)	1		1	
Common-law	0.936 [0.701, 1.249]	.652	0.981 [0.719, 1.338]	.903
Widowed	1.383 [0.972, 1.969]	.072	1.353 [0.879, 2.082]	.170
Divorced/separated	1.290 [1.018, 1.635]	*.035*	1.049 [0.789, 1.394]	.742
Married	0.805 [0.650, 0.995]	*.045*	0.820 [0.636, 1.057]	.125
Major depressive episode: Past 12-month				
No (ref)	1		1	
Yes	3.573 [2.900, 4.403]	*<.001*	2.517 [1.974, 3.208]	*<.001*
Generalized anxiety disorder: Past 12-month				
No (ref)	1		1	
Yes	3.225 [2.477, 4.197]	*<.001*	1.751 [1.296, 2.366]	*<.001*
ACEs				
No (ref)	1		1	
Yes	1.362 [1.126,1.648]	*.001*	1.326 [1.081, 1.627]	*.007*
Suicidal ideation: Past 12-month				
No (ref)	1		1	
Yes	0.526 [0.435, 0.638]	*<.001*	0.734 [0.589, 0.916]	*.006*

Significant associations are italicized

Factors associated with past 12-month suicidal ideation

Separate univariate binomial logistic regression models were used to identify significant independent factors associated with past 12-month suicidal ideation (Table 3). All significant independent variables were entered into a multivariate binomial logistic regression. Overall, the model was significant ($\chi2(17) = 297.108$, p < .0001) and these predictors explained 16.5% of the variance (Nagelkerke R^2). The multivariate model correctly classified 79.5% of cases.

In the multivariate model women were more likely than men to report past 12-month suicidal ideation (adjusted odds ratio [AOR] = 1.583 [1.286, 1.949], *p* < .001). Those who reported a personal income of $20,000-$29,000 were less likely than any other group to report past 12-month suicidal ideation (AOR = 0.704 [0.522, 0.950], *p* < .05). Those who reported being in a common-law relationship were significantly more likely to report past 12-month suicidal ideation (AOR = 1.462 [1.023, 2.089], *p* < .05). Individuals with past 12-month depressive episode (AOR = 0.232 [0.181, 0.297], *p* < .001), past 12-month generalized anxiety 0.490 [0.360, 0.667], *p* < .001), and insomnia symptoms (AOR = 0.738 [0.593, 0.920], *p* = .007) were less likely to report past 12-month suicidal ideation. At the multivariate level, those aged 50 and older, those with an income between $10,000-$19,999 and $30,000-$39,999, those divorced/separated or married were no longer significantly associated with past 12-month suicidal ideation.

Table 3. Factors associated with past 12-month suicidal ideation (n=2095)

	Univariate logistic regression analysis		Multivariate logistic regression analysis	
	Odds ratio [95%CI]	*p*	Adjusted odds ratio [95%CI]	*p*
Age				
20-29 years (ref)	1		1	
30-39 years	1.298 [0.972, 1.734]	.077	1.302 [0.938, 1.808]	.115
40-49 years	1.283 [0.956, 1.722]	.097	1.356 [0.961, 1.913]	.083
50-64 years	1.345 [1.041, 1.737]	*.023*	1.378 [0.999, 1.900]	.050
65 and above	1.544 [1.126, 2.116]	*.007*	1.233 [0.827, 1.839]	.304
Sex				
Male (ref)	1		1	
Female	1.379 [1.149, 1.656]	*<.001*	1.583 [1.286, 1.949]	*<.001*
Personal income				
<$10,000	0.665 [0.418, 1.056]	.084	0.838 [0.504, 1.395]	.497
$10,000-$19,999	0.580 [0.434, 0.776]	*<.001*	0.819 [0.587, 1.143]	.240
$20,000-$29,999	0.613 [0.471, 0.799]	*<.001*	0.704 [0.522, 0.950]	*.022*
$30,000-$39,999	0.708 [0.525, 0.956]	*.024*	0.804 [0.577, 1.119]	.196
$40,000-$49,999	0.862 [0.593, 1.255]	.439	0.832 [0.561, 1.235]	.362
$50,000 or more (ref)	1		1	
Marital status				
Single (ref)	1		1	
Common-law	1.698 [1.222, 2.359]	*.002*	1.462 [1.023, 2.089]	*.037*
Widowed	1.455 [0.961, 2.203]	.076	1.159 [0.693, 1.938]	.574
Divorced/separated	1.361 [1.045, 1.774]	*.022*	1.144 [0.828, 1.580]	.415
Married	1.482 [1.182, 1.857]	*<.001*	1.073 [0.813, 1.416]	.617
Major depressive episode: past 12 months				
No (ref)	1		1	
Yes	5.471 [4.406, 6.794]	*<.001*	0.232 [0.181, 0.297]	*<.001*
Generalized anxiety disorder: past 12 months				
No (ref)	1		1	
Yes	0.238 [0.182, 0.311]	*<.001*	0.490 [0.360, 0.667]	*<.001*
ACEs				
No (ref)	1			
Yes	1.181 [0.969, 1.439]	.100		
Insomnia symptoms				
No (ref)	1		1	
Yes	0.526 [0.435, 0.638]	*<.001*	0.738 [0.593, 0.920]	*.007*

Significant values are italicized

Factors associated with insomnia symptoms and past 12-month suicidal ideation

Separate univariate binomial logistic regression models were used to identify significant independent factors associated with insomnia symptoms (Table 4). All significant independent variables were entered into a multivariate binomial logistic regression. Overall, the model was significant ($\chi 2(14) = 48.287$, p < .0001) and these predictors explained 2.8% of the variance (Nagelkerke R^2). The multivariate model correctly classified 79.8% of cases.

In the multivariate model, individuals aged 40-49 years old (adjusted odds ratio [AOR] = 1.523 [1.082, 2.143], *p* = .016), 50-64 years old (AOR = 1.649 [1.200, 2.267], *p* = .016) were significantly more likely to report both insomnia symptoms and past 12-month suicidal ideation compared to those aged 20-29 years. Compared to men, women were more likely to report experiencing both insomnia symptoms and past 12-month suicidal ideation (adjusted odds ratio (AOR = 1.293 [1.057, 1.583], *p* = .013). Only those individuals who reported a personal income of $10,000-$19,999 were significantly more likely than those with an income of $50,000 and above to report both insomnia symptoms and past 12-month suicidal ideation (AOR = 1.730 [1.277, 2.344], *p* < .001). At the multivariate level, those age 60 and above, those with an income between $20,000-$29,999, and those who were widowed were no longer significantly associated with insomnia symptoms and past 12-month suicidal ideation.

Table 4. Factors associated with insomnia symptoms and past 12-month suicidal ideation (n=542)

	Univariate logistic regression analysis		Multivariate logistic regression analysis	
	Odds ratio [95%CI]	*p*	Adjusted odds ratio [95%CI]	*p*
Age				
20-29 years (ref)	1		1	
30-39 years	0.931 [0.668, 1.298]	.674	1.062 [0.751, 1.502]	.733
40-49 years	1.327 [0.964, 1.826]	.083	1.523 [1.082, 2.143]	*.016*
50-64 years	1.507 [1.140, 1.992]	*.004*	1.649 [1.200, 2.267]	*.002*
65 and above	1.398 [1.009, 1.939]	*.044*	1.396 [0.946, 2.060]	.093
Sex				
Male (ref)	1		1	
Female	1.386 [1.142, 1.682]	*<.001*	1.293 [1.057, 1.583]	*.013*
Personal income				
<$10,000	1.336 [0.828, 2.157]	.235	1.414 [0.866, 2.309]	.166
$10,000-$19,999	1.820 [1.362, 2.432]	*<.001*	1.730 [1.277, 2.344]	*<.001*
$20,000-$29,999	1.361 [1.037, 1.786]	*.026*	1.315 [0.988, 1.750]	.060
$30,000-$39,999	1.098 [0.802, 1.505]	.559	1.108 [0.802, 1.531]	.533
$40,000-$49,999	1.125 [0.769, 1.645]	.544	1.127 [0.769, 1.653]	.540
$50,000 or more (ref)	1		1	
Marital status				
Single (ref)	1		1	
Common-law	1.129 [0.818, 1.559]	.459	1.100 [0.792, 1.526]	.570
Widowed	1.570 [1.065, 2.312]	*.023*	1.266 [0.808, 1.983]	.303
Divorced/separated	1.303 [0.995, 1.706]	.054	1.044 [0.770, 1.414]	.783
Married	0.955 [0.750, 1.217]	.711	0.860 [0.656, 1.129]	.277
Major depressive episode: past 12 months				
No (ref)	1			
Yes	1.271 [0.998, 1.619]	.052		
Generalized anxiety disorder: past 12 months				
No (ref)	1			
Yes	1.207 [0.885, 1.645]	.235		
ACEs				
No (ref)	1			
Yes	1.200 [0.969, 1.485]	.094		

Significant values are italicized

Moderating effect

To test the first hypothesis, a single moderator analysis (Model 1) was conducted using PROCESS to examine whether the relationship between insomnia symptoms and past 12-month suicidal ideation is moderated by the number of ACEs experienced. All moderations were uncentered. The moderation was first conducted unconditionally (see Table 5).

A conditional moderation was then conducted including age, sex, marital status, personal income, past 12-month major depressive episode, and past 12-month generalized anxiety diagnosis as covariates (see Table 6). The overall model was significant (see Table 7) and explained 17% (Nagelkerke R^2) of the variance.

The interaction between insomnia symptoms and number of ACEs experienced was statistically significant ($b = .14$, 95% C.I. [.02, .25], $p = .02$). The conditional effect of insomnia symptoms on past 12-month suicidal ideation showed a corresponding significant association. To explore the conditional effects of the focal predictor at values of the moderator, moderator probes were set to 16th percentile ($b = .05$, 95% C.I. [-.26, .36], $p = .75$), 50th percentile ($b = .19$, 95% C.I. [-.05, .43], $p = .13$) and 84th percentiles ($b = .60$, 95% C.I. [.28, .93], $p = .00$; see Table 8). These results identify ACEs as a positive moderator of the relationship between insomnia symptoms and past 12-month suicidal ideation. This indicates that the strength of the effect of insomnia symptoms on past 12-month suicidal ideation increases as an individual experiences more ACEs. The Johnson-Neyman significance region indicates that individuals who experience greater than 1.31 ACEs demonstrate a significant effect of insomnia symptoms on past 12-month suicidal ideation.

Table 5. Unconditioned moderation of the effect of insomnia symptoms on past 12-month suicidal ideation by number of adverse childhood experiences

Variables	Coefficient	SE	Z	p	LLCI	ULCI
Insomnia symptoms (X)	.28	.14	1.98	.05	.00	.56
ACEs (M)	-.26	.09	-3.11	.00	-.43	-.10
X × M	.19	.05	3.66	.00	.09	.30
Constant	.71	.25	2.83	.00	.22	1.20

Note.
LLCI = lower level of the 95% confidence interval; and ULCI = upper level of the 95% confidence interval.

Table 6. Conditioned moderation of the effect of insomnia symptoms on past 12-month suicidal ideation by number of adverse childhood experiences

Variables	Coefficient	SE	Z	p	LLCI	ULCI
Insomnia symptoms (X)	.05	.16	.32	.75	-.26	.36
ACEs (M)	-.14	.09	-1.48	.14	-.32	.04
X × M	.14	.06	2.39	.02	.02	.25
Age	.02	.02	1.18	.24	-.01	.05
Sex	.45	.10	4.25	.00	.24	.65
Marital Status	-.04	.03	-1.20	.23	-.10	.02
Income	.06	.03	1.91	.06	.00	.13
Depression	1.44	.13	11.51	.00	1.20	1.69
Anxiety	.71	.16	4.51	.00	.40	1.02
Constant	-3.78	.49	-7.71	.00	-4.75	-2.82

Note.
LLCI = lower level of the 95% confidence interval; and ULCI = upper level of the 95% confidence interval.

Table 7. Model Fit – Model 1

Model	-2LL	ModelLL	*df*	*p*	McFadden	CoxSnell	Nagelkrk
Model 1 Unconditioned	2776.20	57.58	3.00	.00	.02	.02	.03
Model 1 Conditioned	2452.78	298.51	9.00	.00	.11	.11	.17

Table 8. Model 1 Conditional Effect of Focal Predictor at Values of the Moderator

ACE Total	Effect	*SE*	*Z*	*p*	LLCI	ULCI
.90	.18	.13	1.38	.17	-.07	.42
1.20	.22	.12	1.80	.07	-.02	.45
1.31	.23	.12	1.96	.05	.00	.46
1.50	.26	.12	2.24	.03	.03	.48
1.80	.30	.11	2.65	.01	.08	.52

Note.

LLCI = lower level of the 95% confidence interval; and ULCI = upper level of the 95% confidence interval.

Moderated Moderation

To test hypothesis 2, a moderated moderation analysis (Model 3) was conducted using the PROCESS macro to examine whether the interaction effect between insomnia symptoms and ACEs was further moderated by sex. As with the previous analysis, all moderations were uncentered. The moderated moderation was first conducted unconditionally (see Table 9).

A conditional moderation was then conducted including age, marital status, personal income, past 12-month major depressive episode, and past 12-month generalized anxiety diagnosis as covariates (see Table 10).

The overall model was statistically significant (see Table 11) and explained 17% (Nagelkerke R^2) of the variance. The interaction between insomnia symptoms and ACEs experienced was non-significant, $b = .30$, 95% C.I. [-.10, .70], $p = .14$. The two-way interaction between insomnia and sex was non-significant, $b = .36$, 95% C.I. [-.26, .98], $p = .26$. The two-way interaction between ACEs and sex was non-significant ($b = .20$, 95% C.I. [-.18, .59], $p = .59$. Similarly, the higher order three-way interaction between insomnia symptoms, ACEs, and sex was also non-significant, $b = -.10$, 95% C.I. [-.34, .14], $p = .41$. As the higher-order interaction was non-significant, no probing analysis was conducted. Taken together, there does not appear to be a moderation of the moderation at the level of biological sex.

Table 9. Unconditioned moderation of the effect of insomnia symptoms on past 12-month suicidal ideation by number of adverse childhood experiences depending on sex

Variables	Coefficient	SE	Z	p	LLCI	ULCI
Insomnia symptoms (X)	-.28	.48	-.59	.55	-1.22	.66
ACEs (M)	-.48	.31	-1.54	.12	-1.09	.13
X × M	.29	.19	1.53	.13	-.08	.65
Sex	-.32	.51	-.62	.54	-1.32	.69
X × Z	.38	.29	1.29	.20	-.20	.95
M × Z	.12	.18	.68	.50	-.23	.48
X × M × Z	-.05	.11	-.48	.63	-.27	.16
Constant	1.20	.85	1.41	.16	-.47	2.86

Note.

LLCI = lower level of the 95% confidence interval; and ULCI = upper level of the 95% confidence interval.

Table 10. Conditioned moderation of the effect of insomnia symptoms on past 12-month suicidal ideation by number of adverse childhood experiences depending on sex

Variables	Coefficient	SE	Z	p	LLCI	ULCI
Insomnia symptoms (X)	-.52	.52	-1.00	.32	-1.54	.50
ACEs (M)	-.48	.34	-1.39	.16	-1.15	.19
X × M	.30	.20	1.49	.14	-.10	.70
Sex (Z)	-.23	.56	-.42	.68	-1.32	.86
X × Z	.36	.32	1.13	.26	-.26	.98
M × Z	.20	.20	1.03	.30	-.18	.59
X × M × Z	-.10	.12	-.83	.41	-.34	.14
Age	.02	.02	1.22	.22	-.01	.05
Marital Status	-.04	.03	-1.21	.23	-.10	.02
Income	.07	.03	1.93	.05	.00	.13
Depression	1.44	.13	11.50	.00	1.20	1.69
Anxiety	.71	.16	4.50	.00	.40	1.02
Constant	-2.71	1.00	-2.72	.01	-4.66	-.76

Note.

LLCI = lower level of the 95% confidence interval; and ULCI = upper level of the 95% confidence interval.

Table 11. Model Fit – Model 3

Model	-2LL	ModelLL	*df*	*p*	McFadden	CoxSnell	Nagelkrk
Model 3 Unconditioned	2758.69	75.09	7.00	.00	.03	.03	.04
Model 3 Conditioned	2451.04	300.25	12.00	.00	.11	.11	.17

Discussion

The purpose of the present study was to explore factors associated with insomnia, suicidal ideation, and the combination, to determine whether the experience of childhood adversities moderate the relationship between insomnia symptoms and past 12-month suicidal ideation, and examine whether sex further moderated this relationship using a large National community sample of Canadian adults. Associations observed were present among those with a lifetime history of suicidal ideation. Previous research has explored the independent relationships between insomnia and suicide, insomnia and ACEs, and ACEs and suicide; however, no research to date has explored the potentially moderating impact of ACEs on the relationship between insomnia symptoms and suicidal ideation. Given the recent theory associated with the role that poor sleep can have in the engagement with suicide related behaviours (Perlis et al., 2016a; Perlis et al., 2016b), and the longstanding knowledge about the negative implications of childhood adversities, it was important to explore the relationship amongst these variables to identify if ACEs may be an important consideration when treating insomnia, with the possibility that doing so reduces later suicidal ideation.

This study first explored the factors associated with insomnia, past 12-month suicidal ideation, and the combination. Results indicated individuals who were 40 years and older, made less than $29,000, had past 12-month depression, past 12-month anxiety, and at least one ACE were more likely to report insomnia symptoms. Women and those in a common law relationship were more likely to report past 12-month suicidal ideation. Regarding the combination of insomnia and past 12-month suicidal ideation, individuals aged 40-64, women, and those who made an annual personal income of less than $20,000 were more strongly associated with reporting both. Individuals endorsing past 12-month suicidal ideation were significantly less

72

likely to report insomnia, and individuals endorsing insomnia were significantly less likely to report past 12-months suicidal ideation. This may suggest that the intensity of one condition may overshadow the impact of the other, reducing the likelihood of reporting. Further exploration is likely warranted.

As expected, the current study found a moderating role of adverse childhood experiences in the relationship between insomnia symptoms and past 12-month suicidal ideation. Specifically, individuals who experience greater than 1.31 types of ACEs demonstrated a stronger relationship between insomnia symptoms and past 12-month suicidal ideation. As this area of study is in its infancy, no additional studies exist that explore the relationship between insomnia, ACEs, and suicide within a community sample. However, in a study utilizing a clinical population, Palagini and colleagues (2021) examined the potential mediating role of insomnia symptoms and suicidal ideation on the relationship between early exposure to stressful events and bipolar disorder. Their findings indicated patients with insomnia symptoms demonstrated more severe symptoms of suicide related behaviour and higher scores related to early life stress. Taken together, it appears that consideration of how insomnia and childhood adversity influence engagement with suicide related behaviours is likely to be an important aspect of providing clinical care. The current study is the first to integrate insomnia, childhood adversity, and suicide related behaviours amongst a community sample of adults within a stringent statistical design.

It was also predicted that sex would moderate the interaction effect between insomnia symptoms and total number of ACEs. This hypothesis was not supported; biological sex did not moderate the interaction between insomnia symptoms and total number of ACEs. This finding was unexpected as previous research has identified women being at higher risk for insomnia (Zhang & Wing, 2006) and having more complex patterns of childhood adversity than males

(Haahr-Pedersen et al., 2020). Additionally, the Gender Paradox of Suicide, as described by Canetto and Sakinofksy (1998), indicates that while men attempt suicide more frequently, women are more likely to engage in nonfatal suicide behaviour such as suicidal ideation. Given the size of the sample in the current study it is possible that, should there be an effect of sex in the capacity as a second moderator, that its effect is very small. Another possible explanation could be that the methods used to capture ACEs, suicidal ideation, and sleep was insufficient. It may be warranted to gather additional details pertaining to these experiences as this may help parse apart the role of sex amongst the relationship between insomnia, ACEs, and suicide risk.

Clinical Implications

The findings of the current study suggest several clinical implications worthy of consideration. Given the role ACEs play in the relationship between insomnia symptoms and suicidal ideation these results indicate that ACEs should be considered when treating individuals who present for clinical care related to insomnia. This finding also highlights the relatively low threshold that an individual would need to meet to see a change in the strength of the relationship between insomnia symptoms and suicide risk, thus highlighting the exceptionally small window of opportunity for detection and the urgency of administrating some form of intervention. As over 61% of Canadians have experienced at least one adversity in childhood (Joshi et al., 2021), it is probable that those who present with sleep concerns will also have had experienced adversity in childhood. Thus, this finding additionally supports the need for increased screening of ACEs, and subsequent screening for post-traumatic stress disorder (PTSD) once a history of trauma has been identified in sleep-troubled individuals seeking treatment. Current recommendations suggest that ACE screenings should be used cautiously and compassionately with a trauma-informed approach within clinical settings so as to not retraumatize individuals

seeking care (Racine et al., 2020). The trauma-informed care approach involves care providers realizing, recognizing, responding, and resisting re-traumatization (four R's; Substance Abuse and Mental Health Services Administration [SAMHSA], 2018). Additionally, trauma-informed care highlights the importance of being empathetic and supportive of the individuals seeking care while recognizing that disclosure of these experiences can be difficult.

Another clinical consideration related to these findings is the understanding of the treatment methods individuals are seeking to alleviate their sleep related distress. In 2019, approximately 3.3 million Canadians reported the use of medical sedatives (Health Canada, 2019). While the specific motivations for the use of such medication remains unclear, a reasonable conclusion is that at least some of these medications are being used in attempt to treat sleep difficulties. The current findings suggest that experiencing childhood adversity may be a contributing factor to why individuals are experiencing sleep problems. As such, if insomnia symptoms are being treated pharmacologically, rather than through a biopsychosocial approach, the root of the problem (i.e., childhood adversity) may not be adequately addressed and therefore the symptoms of insomnia may persist over time.

Currently, clinical best practice guidelines recommend cognitive behavioural therapy for insomnia (CBT-I) as the initial treatment for chronic insomnia, with the potential incorporation of pharmacological therapy on a case-by-case basis (Qaseem et al., 2016). CBT-I consists of a combination of cognitive therapy, behavioural interventions (e.g., sleep restriction, stimulus control), and psychoeducational interventions (e.g., sleep hygiene; Qaseem et al., 2016). CBT-I is highly effective as a treatment method (e.g., Irwin et al., 2006; Morin et al., 2006; Taylor & Pruiksma, 2014) with demonstrated benefits for those with comorbidities (e.g., Ye et al., 2015) and from various age groups including children as young as 5-years-old (e.g., Irwin et al., 2006;

Schlarb et al., 2018). It can be administered by various trained health professionals in a variety of treatment settings in as few as 2 sessions (Edinger & Sampson, 2003) and across various formats (Koffel et al., 2018; Ye et al., 2015) making it a cost-effective and accessible method of treatment. Additionally, early promotion of sleep health and treatment may work to alleviate the intensity of the impact of ACEs, suggesting that CBT-I alone, or in combination with medication, may be a viable simultaneous treatment option for both ACEs and insomnia symptoms especially when utilized soon after exposure to adversity (Brown et al., 2022).

Considerations of how symptoms of trauma could impact the implementation of CBT-I is important. The presentation of sleep disorders in individuals with PTSD symptoms is different than those who suffer from insomnia that is unrelated to traumatic events (Isaac et al., 2022). For instance, individuals who have trauma-related insomnia may be fearful of going to sleep, they may overestimate their sleep latency and sleep onset, or experience more worry and more hypervigilance at night (Isaac et al., 2022; Perlis et al., 2001; Semler & Harvey, 2007). Despite these differences, CBT-I has still been demonstrated as an effective treatment method for improving fear of sleep, and reducing PTSD symptom severity, hypervigilance intensity, and nightmares (Isaac et al., 2022; Kanady et al., 2018).

Taken together, there is a high prevalence of insomnia symptoms and childhood adversity within the Canadian population. From a clinical perspective, it is crucial to employ various screening measures, treat clients through a trauma-informed lens, and provide high-quality, empirically supported treatment such as CBT-I to reduce the impact of these challenging experiences on individuals' overall well-being.

Strengths, Limitations, and Future Research

The present study was the first, to our knowledge, to examine the impact of experiencing adversities in childhood on the relationship between insomnia symptoms and suicidal ideation. Additionally, this study's unique use of moderation analysis to explore the role of ACEs in the relationship between insomnia symptoms and suicidal ideation is a novel contribution to the literature as much of the previous work in these areas has utilized only logistic regression. In identifying the moderating role of ACEs in the relationship between insomnia and suicidal ideation it can be suggested that we should be screening for, and subsequently targeting ACEs in insomnia treatment; a consideration which previously may not have been at the forefront of treatment planning. While much of the available research explores these variables with the use of logistic regression, the analyses utilized in this study are more rigorous in terms of their ability to identify the role of childhood adversities in the relationship between insomnia symptoms and suicidal ideation and highlight the exact point at which ACEs become a significant moderator. This study also utilizes survey information from a large Nationally representative, community-based sample of Canadians with low risk for selection bias and a strong response rate (68.9%) making the results more generalizable to the general population than perhaps would be the case when using predominantly clinical samples.

This study is not without its limitations. The factors investigated are complex and nuanced and the methodology that was utilized characterized these factors in a relatively brief way. It may be beneficial in future work to gather additional information to pertaining to sleep patterns/habits, ACEs, and suicidal ideation or related behaviours to gain better insight into how these factors interact with each other. Doing so could potentially lead to the identification of more effective and efficient treatment for individuals who have experienced this particular constellation of factors.

Additional limitations of the current study include that the collected information was primarily self-report, cross-sectional in nature, and collected over 10 years ago. Therefore, the data may be subject to exaggeration or biases like social desirability and memory recall, which may conceal participants true experiences and thus minimize the genuine strength of the findings. There is also an inability to make causal inferences, however, the results of this study have provided support for furthering this line of research in a more controlled and structured way.

Conclusion

This study identified that the role of ACEs can significantly strengthen the relationship between insomnia and past 12-month suicidal ideation among those with a lifetime history of suicidal ideation. Given the widespread prevalence of childhood adversity, insomnia symptoms, and suicidal ideation, as well as the small threshold of how many ACEs one can experience before significantly impacting the relationship between insomnia symptoms and suicidal ideation, further exploration into the relationship amongst these variables is crucial. Screening procedures for ACEs and suicide related behaviours should be utilized with a trauma-informed approach when individuals reporting insomnia symptoms are seen by health care professionals. Moreover, prevention efforts should be continued in hopes of reducing the number of adversities experienced in childhood and therefore the prevalence of suicide related behaviours later in life. Recent research appears promising in indicating that Canadians born from 1983 to 1992 report significantly less overall abuse, physical abuse, and sexual abuse than older generations (Ligier et al., 2019) suggesting that prevention programs already in place have been working. In addition, as suggested by Brown and colleagues (2022), early promotion of sleep health and

treatment may work to alleviate the intensity of the impact of ACEs that do occur thus providing

additional support for this as a future empirical and clinical area of attention.

Chapter 3: Final Discussion

Summary of Main Findings

While the relationship between insomnia and suicide has been well-established in the literature, much less is known about how additional factors, such as childhood adversities, may influence this relationship. As such, the purpose of the current study was to better understand the potential impact of having experienced childhood adversity on the relationship between insomnia symptoms and past 12-month suicidal ideation among those with a lifetime history of suicidal ideation. This study was intended to build on previous research that has found a relationship between ACEs and insomnia, such as higher ACE scores are associated with increased risk for insomnia in adulthood (e.g., Koskenvuo et al., 2010), as well as ACEs and increased risk for suicide-related behaviours (e.g., Choi et al., 2017; Dube et al., 2001; Thompson et al., 2019). Given the independent relationship between insomnia and suicide risk (e.g., Perlis et al., 2016a; Perlis et al., 2016b; Rossler et al., 2018), it is critical to examine if ACEs strengthen the relationship between insomnia symptoms and risk for suicide. This study utilized a large, community-based sample of 2,687 Canadian adults. Of those individuals, 29% indicated experiencing insomnia symptoms (i.e., difficulty falling asleep or staying asleep most of the time/all of the time) and 78% endorsed experiencing suicidal ideation within the past 12-months. Regarding ACEs, 29.7% did not endorse experiencing any of the adversities that were asked about, 50.7% indicated having been exposed to 1-3 types of adversities, and 19.6% reported exposure to 4 or more types of adversities.

The first objective of this study was to explore the factors associated with insomnia, past 12-month suicidal ideation, and the combination. Those who were more likely to report insomnia symptoms were those 40 years and older, who made less than $29,000, had past 12-month depression, past 12-month anxiety, and at least one ACE. Women and those in a common law

relationship were more likely to report past 12-month suicidal ideation. Regarding the combination of insomnia and past 12-month suicidal ideation, individuals aged 40-64, women, and those who made an annual personal income of less than $20,000 were more strongly associated with reporting both. Individuals endorsing past 12-month suicidal ideation were significantly less likely to report insomnia, and individuals endorsing insomnia were significantly less likely to report past 12-months suicidal ideation. This may suggest that the intensity of one condition may overshadow the impact of the other, reducing the likelihood of reporting.

The second aim of the current study was to explore the potentially moderating role of ACEs on the relationship between insomnia symptoms and past 12-month suicidal ideation. In support of the first hypothesis, this investigation showed that the number of ACEs an individual is exposed to does indeed influence the relationship between insomnia symptoms and suicidal ideation; those who experienced a higher number of childhood adversities demonstrated a stronger relationship between insomnia symptoms and suicidal ideation. More specifically, an individual needs to experience as few as 1.3 types of adversities to see the significant influence of ACEs on the relationship between insomnia symptoms and suicidal ideation. As this study was the first to explore the moderating role of ACEs on the relationship between insomnia symptoms and suicidal ideation, no additional studies exist that explore the relationship between insomnia, ACEs, and suicide within a community sample. However, in a study utilizing a clinical sample of participants, Palagini and colleagues (2021) explored the potential mediating roles of insomnia symptoms and suicidal ideation on the relationship between early exposure to stressful events and bipolar disorder. Their findings suggest that individuals with clinically significant insomnia symptoms showed more severe suicidal behaviours (ideation, plans, and attempts) as

well as higher scores related to early life stress. They argue that this finding indicates strong support for screening of insomnia related symptoms, as well as prevention and early intervention strategies in combination with therapeutic treatment of insomnia as a way to potentially modify clinical features of bipolar disorder. The study presented here was the first to explore the relationship amongst these three variables and did so while utilizing a stringent statistical design. More research is clearly needed to continue to explore the relationship between ACEs, insomnia, and suicide risk to continue developing best practice clinical guidelines for these factors and their potential role in impacting major mental illnesses.

In the current study it was also predicted that sex would moderate the interaction effect between insomnia symptoms and total number of ACEs such that women who report having experienced a greater number of ACEs will have higher rates of insomnia symptoms and higher risk of suicide than men. This hypothesis was not supported; biological sex does not appear to moderate the interaction between insomnia symptoms and total number of ACEs. This finding was unexpected as previous research has identified women being at higher risk for insomnia (Zhang & Wing, 2006) and having more complex patterns of childhood adversity than males (Haahr-Pedersen et al., 2020). Additionally, the Gender Paradox of Suicide, as described by Canetto and Sakinofksy (1998), indicates that while men attempt suicide more frequently women are more likely to engage in nonfatal suicide behaviour such as suicidal ideation. Given the size of the sample in the current study it is possible that, should there be an effect of sex in the capacity as a second moderator, that its effect is very small. Another possible explanation could be the way in which the variables in the current study were operationalized and perhaps the methods used to capture ACEs, suicidal ideation, and insomnia symptoms were insufficient in gathering details related to these experiences.

Clinical Implications

Conditions such as insomnia and suicide related behaviours are widely experienced and can have potentially dire consequences. Similarly, adverse childhood experiences are highly prevalent and have been shown to have substantial consequences related to physical, mental, and emotional health across the lifespan. Research like that conducted here has begun to illuminate the much-understudied relationship amongst these three variables. This section will summarize the clinical implications of the present research.

This investigation found that exposure to as few as 1.3 different types of childhood adversities influences the relationship between insomnia symptoms and suicide. Since ACEs strengthens the relationship between insomnia symptoms and suicide risk, and since previous research (i.e., Joshi et al., 2021) has indicated that a substantial proportion of the population has experienced ACEs, it is possible that those who present to health care providers to address insomnia related concerns may have also experienced childhood adversity. Moreover, this finding also identifies the relatively low threshold that an individual would need to meet to see a greater impact of insomnia symptoms on suicide risk, thus highlighting the exceptionally small window of opportunity for early detection and the urgency to intervene therapeutically to potentially reduce the negative consequences of these experiences. Taken together, these results indicate that ACEs should be considered when assessing individuals who present to clinical care with issues related to sleep in order to ensure these factors are being accounted for throughout ongoing case conceptualization and treatment planning. Additionally, when an individual presents to a health care setting with concerns related to sleep, it is important that screening procedures for ACEs are utilized, with subsequent suicide and trauma-related screeners being implemented should the individual screen positive for childhood adversity.

Of note, researchers have suggested that ACE questionnaires should be administered with a trauma-informed approach to care so as to avoid potential re-traumatization of the client (Racine et al., 2020). Trauma-informed care implies that a program, organization, or system "realizes the widespread impact of trauma and understands potential paths for recovery; recognizes the signs and symptoms of trauma in clients, families, staff, and others involved with the system; and responds by fully integrating knowledge about trauma into policies, procedures, and practices, and seeks to actively resist re-traumatization (Huang et al., 2014, pg. 9). Racine and colleagues (2020) suggest that using the ACE questionnaire in clinical practice requires serious consideration regarding whether the benefits outweigh the potential harms. Taken together, the implementation of screening procedures such as the ACE questionnaire can be informative and helpful, however, it is imperative that when health care providers utilize such measures, they are done in a compassionate and trusting way so as not to unintentionally cause further harm to those with whom we seek to help.

It would be a significant oversight not to recognize the extensive history of prevention efforts that have occurred over the past several decades in the area of childhood adversity and the impact those efforts have had on reducing incidents of child abuse and potential future suicide related behaviours. To achieve the goal of reducing or preventing harm to children, guiding frameworks from national organizations recommend the implementation of strategies involving fostering safe, stable and nurturing relationships within families; promoting parental resilience related to stressors such as depression, anxiety, substance abuse, intimate partner violence, social isolation, financial strain, and parenting difficulties; and encouraging culturally-sensitive norms that support effective parenting practices and healthy expectations regarding child development (Narayan et al., 2021). Recently, there have been encouraging reports that have identified

prevention efforts have been successful in contributing to a decline in child abuse in the USA and Canada over the past few decades (e.g., Finkelhor et al., 2010; Ligier et al., 2019; Shields et al., 2016). In the USA, potential reasons for these changes include better economic conditions, social improvements, increases in the number of social intervention agents as well as changes in norms and practices (Finkelhor & Jones, 2006). In Canada, while demographics, employment rates, and collective values may provide some explanation, Ligier and colleagues (2019) highlight the implementation of preventative measures such as accessible day care and early literacy programs to be crucial. One can conclude that a continuation of such efforts will likely lead to further reductions in ACEs and therefore a reduction in the physical, emotional, and psychological consequences as well as improve the impact on sleep and suicide related behaviours long term. It may also be of benefit to obtain a more comprehensive understanding of parents' positive and adverse childhood experiences. Narayan and colleagues (2020) suggest this may inform the prevention of ACEs in children as the children's risk for experiencing adversity, as well as their capacity for resiliency, may relate to their parents' early life experiences being carried forward into their parenting practices. Further, as argued by Matjasko and colleagues (2022) additional research investments into the etiological factors for adverse childhood experiences, the evaluation of evidence-based strategies for preventing and reducing ACEs, and the implementation of such efforts to public health practice are critical to the prevention of childhood adversity and the promotion of healthy living across the lifespan.

Alongside prevention efforts and increased screening protocols, another potential avenue for intervention that may reduce the intensity or frequency of suicide related behaviours is treating an individual's sleep difficulties (Bishop et al., 2020; Kalmbach et al., 2022). Digital Cognitive Behavioural Therapy for Insomnia (digital CBTI) has been demonstrated to reduce

insomnia symptoms, thus promoting the alleviation and prevention of suicidal ideation (Kalmbach et al., 2022). Clinical guidelines for treatment of insomnia currently suggest the use of multicomponent Cognitive Behavioural Therapy for Insomnia (CBT-I) as the first line treatment method (i.e., CBT-I and pharmacotherapy; American Academy of Sleep Medicine). CBT-I has been shown to be highly effective as a treatment method (e.g., Irwin et al., 2006; Morin et al., 2006; Taylor & Pruiksma, 2014) across multiple age groups (e.g., Irwin et al., 2006) and comorbidities (e.g., Ye et al., 2015). It is a cost-effective method of treatment given that it can be administered by a wide range of trained health professionals in a variety of treatment settings (e.g., physicians, clinical psychologists, nurses etc.) in as few as 2 sessions (Edinger & Sampson, 2003). Additionally, can be administered in multiple formats including individual therapy, group therapy, or virtual therapy (Koffel et al., 2018; Ye et al., 2015). Despite being considered the gold-standard of insomnia treatment, there is a significant dearth of CBT-I providers throughout Canada and the rest of the world (Thomas et al., 2017). The inaccessibility of the services may underscore why approximately 3.3 million Canadians reported medical use of prescription sedatives in 2019 (Health Canada, 2021). Of concern is that if insomnia symptoms are being treated primarily pharmacologically, rather than through a biopsychosocial approach, the root of the problem (i.e., childhood adversity) may not be adequately addressed and therefore the symptoms of insomnia and risk for suicide related behaviour may persist over time. Moreover, the use of sleeping medications over the short- and long-term can have several negative implications thus making it a less-than-ideal option for treatment. For example, short-term effects of using sedatives can include slurred speech, irregular breathing, decreased heart rate and blood pressure, loss of inhibition, impaired judgement, learning, and memory, as well as confusion, disorientation, amnesia, depression and dizziness and in some extreme circumstances

even agitation and hallucinations (Canadian Centre on Substance Use and Addiction, 2022). Long-term use can result in chronic fatigue, vision problems, mood swings, aggressive behaviour, slowed reflexes, breathing problems, liver damage, sleep problems and sexual dysfunction (Canadian Centre on Substance Use and Addiction, 2022). Additionally, long-term use of sedatives can lead to tolerance and thus result in a decrease in the effectiveness of the drug and subsequent increase in dosage to experience the desired effects. Research has indicated that while pharmacotherapy can be effective in the short-term to produce rapid symptomatic relief, the effects on an individual's sleep are not maintained after discontinuing use (Morin et al., 2009), suggesting that in order to maintain any benefit individuals need to remain medicated indefinitely.

Brown and colleagues (2022) describe behavioural sleep disturbances as a key modifiable mechanism in the association between ACEs and various health outcomes. While CBT-I is not intended to treat the experiences of adversity, in conjunction with pharmacotherapy it may serve to lessen the impact of those experiences and serve to reduce the likelihood of suicide related behaviours. Future research should explore the potential impact of pharmacotherapy, CBT-I, and a combination of the two on suicide related behaviours in individuals with adverse childhood experiences and insomnia symptoms.

Strengths and Limitations

This study was the first to examine ACEs as a potential moderator in the relationship between insomnia symptoms and past 12-month suicidal ideation. The information gained from this study suggests that the number of ACEs an individual is exposed to is influential, and therefore, ACEs should be screened for and considered throughout the conceptualization and treatment planning stages of clinical care. Targeting ACEs when treating an individual for sleep

difficulties may help to ease the burden of both challenges and ultimately provide a more complete therapeutic experience. Additionally, this study utilized a novel approach to its analysis, namely moderation analysis, to explore this potential relationship. In doing so, it was possible to identify the specific point at which ACEs became a significant moderator. This information provides a benchmark to utilize in clinical settings for identifying individuals who may need further screening and treatment for insomnia and suicide related behaviours. The second strength was that this study utilized survey information from a large Nationally representative, community-based sample of Canadians with low risk for selection bias and a strong response rate (68.9%). This method of sampling allows the results of the current study to be more generalizable as clinical populations often employ stringent inclusion/exclusion participation criteria.. An additional strength of the current study relates to the use of sex as a moderator variable. While sex was not found to have a significant impact on the relationship between ACEs, insomnia symptoms, and suicidal ideation, the Canadian Institute for Health Research (CIHR) has identified that "accounting for sex and gender in health research has the potential to make health research more rigorous, more reproducible and more applicable to everyone" and therefore strongly encourages the incorporation of these variables into research design.

One notable limitation of the current study was that there was limited data regarding the specific characterization of individuals' insomnia symptoms, as well as a more detailed account of their exposure to ACEs (e.g., age at which experience(s) occurred, relationship to perpetrator(s), time passed since first/last experience, types of adversities experienced etc.) and their suicidal ideation (e.g., frequency/intensity of thoughts, potential additional contributing life events/stressors, additional suicide related behaviours, protective factors). Of note, however, is

that despite the lack of details pertaining to insomnia, ACEs, and suicide related behaviours, a moderating relationship *was* identified. This suggests that the strength of this moderation is likely to be much stronger with a more complex characterization of these variables. As noted previously, when conducting an analysis of sleep difficulties, and insomnia specifically, it can be informative to understand the broader architecture of an individual's sleep, including knowledge about the time the individual typically goes to bed, how long it generally takes to fall asleep, the frequency and duration of nighttime awakenings, their time out of bed, and their sleep efficiency (Morin, 2006). The current study used the available sleep information, which pertained only to difficulty going to sleep or staying asleep. While this approach has been utilized in previous research regarding insomnia symptoms (e.g., Garland et al., 2018), there is ample room for further exploration into individual sleep patterns. Similarly, gathering additional details regarding an individual's exposure to ACEs (e.g., relationship to perpetrator, age at first experience, age at subsequent experiences, time passed since first/last experience, types of ACEs experienced) as well as their experiences with suicide related behaviours (e.g., frequency/intensity of thoughts, potential additional contributing life events/stressors, additional suicide related behaviours, protective factors) may make it possible for future researchers to be able to specifically identify the key components that are driving this relationship and therefore create a more targeted approach to treatment.

As noted by other researchers who have utilized this dataset (e.g., Baiden et al., 2015) another limitation of the current study is the exclusion of Indigenous peoples, members of the armed forces, and institutional populations in the sample. While these populations accounted for less than 3% of the total sample, and therefore were likely to have a minimal impact on the statistical outcomes, these populations include individuals whose voices and experiences should

90

be accounted for. Including these populations in future studies could contribute to a broader understanding of how these populations are impacted by insomnia symptoms and childhood adversities and provide support for the allocation of clinical resources.

Finally, it should be noted that the data used in this study was primarily self-report and retrospective in nature and was collected over 10 years ago. Self-report and retrospective data, especially regarding adverse childhood experiences, limits the ability to make stronger connections between the variables and is potentially subject to various biases (Hardt & Rutter, 2003). However, Hardt and Rutter (2004) argue such bias is not sufficiently great to invalidate retrospective case-control studies of adversities and thus these types of studies maintain a worthwhile place in research. Future studies intending to study the relationship between these factors in more detail should utilize, when possible, objective measures of sleep such as polysomnography and measures with robust psychometric properties such as the Adverse Childhood Experiences questionnaire and Adverse Childhood Experiences-International Questionnaire; Family Background Questionnaire and Family Background Questionnaire-Uganda; Childhood Trauma Questionnaire and Childhood Trauma Questionnaire-Short Form; and ISPCAN Childhood Abuse Screening Tool-Retrospective (Steele et al., 2023). Further, clearly defining the constructs of interest and then asking multiple questions about specific behaviours is crucial to increasing validity (Hardt & Rutter, 2004). While longitudinal data has some challenges relating to the validity of data gathered (Hardt & Rutter, 2004), such a study design could allow for greater understanding of the impact of ACEs on insomnia and suicide risk as individuals could be followed from a young age and appropriate interventions could be provided closer in time to the experience of adversities.

Directions for Future Research

As this study is one of the first to explore the role of ACEs in the relationship between insomnia symptoms and suicidal ideation, multiple avenues for future research exist to continue to deepen the nuanced understanding of this relationship. Future research should employ sleep specific questionnaires to gain a better understanding of individuals' specific sleep architecture as certain aspects of sleep (e.g., total sleep time, wake after sleep onset) may play an additional role in the relationship between sleep, ACEs, and suicidal ideation. Additionally, it would likely be of value to utilize more objective measures of sleep such as polysomnography to help characterize individual sleep patterns.

A more detailed understanding of ACEs and suicide related behaviours would also be of benefit. For example, it may be important to understand the age at which an individual experienced adversity, what type(s) of adversity they experienced, their relationship to the perpetrator, social support, a timeline of their experiences and symptoms, as well as the frequency of their suicidal ideation, any precipitating extraneous events that may have contributed to their willingness to consider suicide, and their engagement in other suicide related behaviours. While this is not an exhaustive list, it does highlight the fact that few details were known about each participant's unique experiences with these challenges. Upon gathering more information, a more detailed understanding of the relationship amongst these variables will be possible thus allowing for more specific and tailored recommendations for assessment and treatment.

Future studies may benefit also benefit from exploration of CBT-I and CBT-I plus sleeping medications to identify the potential impact of these treatment modalities on suicide related behaviours in individuals with a history of adversity who present with concerns related to insomnia. It is possible, given the often-intense nature of ACEs, and the complexity of suicide

related behaviours, that individuals with these experiences need a more complex approach to treatment than those who experience insomnia symptoms alone.

Conclusion

Every year Canadians struggle with the lasting impacts of ACEs, the impact of poor sleep, and thoughts of suicide. This study identified that ACEs can significantly impact the relationship between insomnia and suicidal ideation after experiencing 1.3 types of ACEs. Given the widespread prevalence of childhood adversity, insomnia symptoms, and suicidal ideation, as well as the small threshold of how many types of ACEs someone can experience before significantly impacting the relationship between insomnia symptoms and suicidal ideation, it is imperative to continue to explore how these factors influence each other to more acutely address individual needs. Screening procedures for ACEs and suicide related behaviours should be utilized when individuals reporting insomnia symptoms are seen by health care professionals. Moreover, prevention efforts should be continued in hopes of reducing the number of adversities experienced in childhood and therefore the prevalence of suicide related behaviours later in life. Overall, the findings of the current study contribute to the literature exploring adverse childhood experiences, insomnia symptoms, and suicidal ideation and have done so using a stringent statistical analysis. The findings presented here support the value of further exploration into this relationship and contribute to the growing evidence supporting the positive impact that treating insomnia has in reducing risk for suicide. In addition to prevention efforts, therapeutic interventions like CBT-I may be an accessible, efficacious, and cost-effective modality to help ease the burden of poor sleep and thus potentially reduce the long-lasting impacts of childhood adversities and the risk of engaging in suicide related behaviours. This area of research is relatively new and will likely benefit from future work that parses apart the complexity of each

individual factor to further understand their interactions. While work of this nature does not erase

the unfortunate experiences that were endured throughout childhood, it may serve to ease the

burden of those experiences in later life.

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